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

2005 Report

Prepared by:
**Angel Bolinger, Steve Doctor, Allison Luettel,
Mike Luisi, and Gary Tyler**

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Prepared By: ______________________________
Mike Luisi, Principal Investigator & Manager Atlantic Program Date

Approved By: ______________________________
Tom O'Connell, Assistant Director, Estuarine & Marine Division Date

Approved By: ______________________________
George L. Herlth, Jr., Appointing Authority Date

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Preface

Recent analyses of Coastal Bay Fisheries Investigations Trawl and Beach Seine Survey data have revealed some seasonal and temporal biases in the data collection (1972-1988) which significantly effect the analyses of the overall time series dataset (1972-2005). These biases were a result of 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 will highlight the differing results of analyses of the historical (1972-2005) v. the standardized (1989-2005) data and will be the last report to include data prior to 1989 in the 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, and 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.

Along 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 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 monthly at 20 fixed sites throughout Maryland's Coastal Bays from April through October (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.

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 covered (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 (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 19 fixed sites in depths less than 1.1 m (3.5 ft.) along the shoreline. Most seine samples involved quarter-circle hauls covering about 117 m^2 (1,257 ft^2). However, some sites necessitated varying this routine to fit the available area and depth. GPS coordinates were taken at the beginning and ending of the seine to determine area covered.

Water Quality and Physical Characteristics

For the two above methods of fish sampling, physical and chemical data were documented at each sampling location. Chemical parameters included: salinity, temperature, and dissolved oxygen (DO). Physical parameters included: wind direction and speed, water depth, tide state, and weather condition. Data were recorded into a field book.

Salinity, water temperature, and dissolved oxygen were taken at each site with a Yellow Springs Instrument (YSI) 30 at 30 cm below the surface. A weight was used to keep the probe at the proper depth and as vertical as possible. Chemical data were taken 30 cm from the surface for each seine site due to the shallow depth.

Both beginning and ending depths for each trawl were using a marked pole and recorded. At seine sites, depth was estimated by the biologists pulling the seine.
Wind speed and direction were estimated by a biologist. Criteria used to estimate wind speed included wave size and appearance. Wind direction was determined by the direction of the waves and by checking the weather forecast for that day.

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 (mm) using a wooden measuring board with a 90 degree right angle. A meter stick was used for species over 500 mm. Total length (TL) measurements were taken for most fishes (Table 1). At each site, a sub-sample of the first 20 fish of each species of commercial or recreational interest were measured, and the rest were counted. Species not of commercial or recreational interest were only counted. Counts of large numbers of fishes not of commercial or recreational importance or invertebrates such as comb jellies or grass shrimp were sometimes estimated.

Blue crabs were measured for carapace width, sexed, and maturity status was determined (Table 1). Sex and maturity categories included: male, immature female, mature female (sook), and mature female with eggs. A sub-sample 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.

Small quantities (generally $\leq$ 10) of invertebrates were occasionally counted. Slightly larger quantities of invertebrates were sometimes visually estimated. Unknown species were placed in Ziploc bags on ice or kept in a bucket of water and taken to the office for identification.

Data Analysis

Statistical analyses were conducted on species that historically (1972–2005) 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 (1972-2005). 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 was added to all catches in order to transform zero catches, because the log of zero does not exist (Ricker 1975.) Significance was determined at $\alpha = 0.05$. Time series trends were compared to regression analyses of transformed catch data from 1989-2005 to determine if protocol standardization (1989) may have had an influence in the overall time series trend.

The Geometric Mean (GM) was calculated to develop species specific annual trawl and beach seine indices of relative abundance (1972-2005). 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 anitlog [$\log_e$-mean(x+1)] and anitlog [$\log_e$-mean(x+1) ± standard error * (t value: $\alpha = 0.05$, n-1)], respectively. A geometric grand mean was calculated for the overall time series (1972-2005) and standardized time series (1989-2005) and were used as a point estimates for comparison to the annual estimate of relative abundance.

A chi-squared analysis was used to compare species specific seasonal trawl relative abundance. Historical (1972-2004) and standardized (1989-2004) trends were compared to annual (2005) trends in order to determine any significant difference in seasonal abundance. Significance was determined at ά = 0.05. Monthly abundance indices were determined by first calculating the sum-CPUE by month for the time series (historical, standardized, or annual) using the raw (untransformed) catch data. Monthly percent-CPUE were calculated [(monthly sum CPUE)/(total CPUE) * 100)] and used to represent the expected (historical or standardized) and observed (annual) values in the analysis. An online chi-squared calculator (http://schnoodles.com/cgi-bin/web_chi.cgi) was used to perform the test and it was accessed on March 5, 2007.

Results and Discussion:

Species: Atlantic Croaker (*Micropogonias undulatus*)

Atlantic croaker were collected in 42 of 140 trawls (30%) and in zero of 38 beach seines. A total of 72 juvenile Atlantic croakers were collected in trawl samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Atlantic croaker ranked 15th out of 72 species in overall finfish abundance. The trawl CPUE was 4.1 fish/hectare.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed no significant trend (P=0.3481, Figure 2). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0001, Figure 3).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both below the historical grand mean (Figures 4 and 5, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicate a significant difference (P=0.001, df=6, Figure 6).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0281 and 0.0048, Figures 7 and 8, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both below the standardized grand mean (Figures 9 and 10, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicate a significant difference (P=0.001, df=6, Figure 6).

Discussion

Although regression analysis resulted in a declining trend in the historical beach seine catch data, sampling bias in pre-standardized data may have influenced the result. However, analyses of the standardized trawl and beach seine data also indicated similar declines in relative abundance. Significant changes in relative abundance may reflect a combination of environmental conditions and/or fishing pressure. The below average index in 2005 translates to a poor year for recruitment, however, since Atlantic croaker spawn offshore, environmental conditions and ocean currents may also be a factor. It is not immediately apparent why the relative monthly abundance distributions are different.

Management

In the mid-Atlantic, Atlantic croaker were managed by the State of Maryland in cooperation with ASMFC. Maryland's 2005 recreational Atlantic croaker regulations were comprised of a 25 fish creel and a 9 inch minimum size limit. Commercial restrictions included a 9 inch minimum size and a season closure from January 1 to March 15, 2005.

Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Atlantic Menhaden (*Brevoortia tyrannus*)

Atlantic menhaden were captured in 15 of 140 trawls (10.7%) and in 22 of 38 beach seines (57.9%). A total of 10,367 Atlantic menhaden were collected in trawl (57 fish) and beach seine (10,310 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Atlantic menhaden ranked 2nd out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 3.2 fish/hectare and 271.3 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0001 and 0.0001, Figures 11 and 12, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was below the historical grand mean, while the beach seine index was equal to the historical grand mean (Figures 13 and 14, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicate a significant difference (P=0.001, df=6, Figure 15).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0066 and 0.0185, Figures 16 and 17, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl index was equal to the standardized grand mean, while the beach seine index was above the standardized grand mean (Figures 18 and 19, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling was restricted to June and September. Results indicate a significant difference (P=0.001, df=6, Figure 15).

Discussion

Although regression analyses resulted in a declining trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analysis of the standardized trawl data also indicates a decreasing trend in relative abundance. Analysis of standardized beach seine data indicates a trend, however, the 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 and/or fishing pressure.

Juvenile Atlantic menhaden 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. Although the 2005 beach seine index was above the standardized grand mean, it may have been influenced by a large number (n=3,000) collected at one site (S007) in September.

Peak catches occurred in June which was expected based on known life history information (Figure 15, Murdy *et al* 1997, Able and Fahay 1998).

Management

In the mid-Atlantic, Atlantic menhaden were managed by the State of Maryland in cooperation with ASMFC. There were no recreational or commercial creel, size limits, or harvest limits for this species in 2005. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Atlantic Silverside (*Menidia menidia*)

Atlantic silversides were captured in 17 of 140 trawls (12.1%) and in 36 of 38 beach seines (94.7%). A total of 2,844 Atlantic silversides were collected in trawl (79 fish) and beach seine (2,765 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Atlantic silversides ranked 3rd out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 4.5 fish/hectare and 72.8 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed no significant trend (P=0.0869, Figure 20). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0001, Figure 21).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 22 and 23, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 (Figure 24, P=0.001, df=6).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed no significant trend (P=0.0896, Figure 25). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0003, Figure 26).

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 27 and 28, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 24).

Discussion

Although regression analysis resulted in a declining trend in the historical beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analysis of the standardized beach seine data also indicated a similar decline 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.

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 data. Since 1989, the relative abundance estimates seldom varied from the historical and standardized grand means.

Management

No management plan exists for Atlantic silverside. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Bay Anchovy (*Anchoa hepsetus*)

Bay anchovies were captured in 75 of 140 trawls (53.6%) and in 22 of 38 beach seines (57.9%). A total of 2,838 bay anchovies were collected in trawl (2,312 fish) and beach seine (526 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Bay anchovies ranked 4th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 131.7 fish/hectare and 13.8 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0001 and 0.0001, Figures 29 and 30, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 31 and 32, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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=0.01, df=6, Figure 33).

Standardized Data (1989-2005)

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

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl index was below the standardized mean, while the beach seine index equal to the standardized grand mean (Figures 36 and 37, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 (Figure 33, P=0.001, df=6).

Discussion

Although regression analyses resulted in a declining trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analyses of the standardized trawl and beach seine data also indicated similar declines 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.

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 varied from the historical and standardized grand means.

Management

No management plan exists for bay anchovy. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Black Sea Bass (*Centropristis striata)*

Black sea bass were collected in 11 of 140 trawls (7.9%) and 3 of 38 beach seines (7.9%). A total of 16 juvenile black sea bass were collected in trawl (11 fish) and beach seine (5 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Black sea bass ranked 34th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.6 fish/hectare and 0.1 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed no trend (P=0.2178, Figure 38). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0201, Figure 39).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was below the historical grand mean, while the beach seine index was equal to the historical grand mean (Figures 40 and 41, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 42).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated no significant trends (P=0.6843 and 0.6089, Figures 43 and 44, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was below the standardized grand mean, while the beach seine index was equal to the standardized grand mean (Figures 45 and 46, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 42).

Discussion

Although regression analysis resulted in a declining trend in the historical beach seine catch data, sampling biases in the pre-standardized data may have influenced the result. Analyses of the standardized trawl and beach seine data indicated no significant declines 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.

Black sea bass were caught in both near shore and open water locations. However, since black seabass are structure oriented neither index accurately represents the relative abundance.

Management

In the mid-Atlantic, black sea bass were managed by the State of Maryland in cooperation with ASMFC, and the Mid-Atlantic Fishery Management Council (MAFMC). Maryland's 2005 recreational black sea bass regulations were comprised of a 25 fish creel and a 12 inch minimum size limit. Commercial restrictions included an 11 inch minimum size and required landing permit which contained an Individual Fishing Quota (IFQ) 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: Bluefish (*Pomatomus saltatrix*)

Bluefish were collected in 3 of 140 trawls (2.1%) and in 7 of 38 beach seines (18.4%). A total of 19 juvenile bluefish were collected in trawl (4 fish) and beach seine (15 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Bluefish ranked 31st out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.2 fish/hectare and 0.4 fish /haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0001, Figure 47). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.1202, Figures 48).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals

(CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both below the historical grand mean (Figures 49 and 50, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 51).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated no significant trends (P=0.1421 and 0.7074, Figures 52 and 53, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was equal to the standardized grand mean, while the beach seine index was below the standardized grand mean (Figures 54 and 55, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling is restricted to June and September. Results indicated a significant difference (P=0.001, df=5, Figure 51).

Discussion

Although regression analysis resulted in a declining trend in the historical trawl catch data, sampling biases in the pre-standardized data may have influenced the result. Analyses of the standardized trawl and beach seine data indicated no significant declines in relative abundance.

Bluefish were caught in both near shore and open water locations. However, neither index represents an accurate picture of changes in relative abundance because few individuals were caught. Since 1989, the relative abundance estimates seldom varied from the standardized grand means, unlike the historical grand mean.

Management

In the mid-Atlantic, bluefish were managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2005 recreational bluefish regulations were comprised of a 10 fish creel and an 8 inch minimum size limit. Commercial restrictions included an 8 inch minimum size and no seasonal closures. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Hogchoker (*Trinectes maculatus)*

Hogchokers were collected in 23 of 140 trawls (16.4%) and 3 of 38 beach seines (7.9%). A total of 84 hogchoker were collected in trawl (58 fish) and beach seine (26 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Hogchoker ranked 13th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 3.3 fish/hectare and 0.7 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0001, Figure 56). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.6613, Figure 57).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 58 and 59, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 60).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0111, Figure 61). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.518, Figure 62).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 63 and 64, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling is restricted to June and September. Results indicated a significant difference (P=0.01, df=6, Figure 60).

Discussion

Although regression analysis resulted in a declining trend in the historical trawl catch data, sampling biases in the pre-standardized data may have influenced the result. However, analysis of the standardized trawl data also indicated a similar decline in relative abundance although it has been steady for the past 10 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.

Hogchokers 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 estimates seldom varied from the historical and standardized grand means.

Management

No management plan exists for hogchoker. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Mummichog (*Fundulus heteroclitus*)

Mummichogs were collected in 4 of 140 trawls (2.9%) and in 21 of 38 beach seines (55.3%). A total of 639 mummichogs were collected in trawl (18 fish) and beach seine (621 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Mummichogs ranked 8th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 1.0 fish/hectare and 16.3 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (P=0.7331 and 0.0543, Figures 65 and 66, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 67 and 68, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling is restricted to June and September. Results indicated a significant difference (P=0.001, df=5, Figure 69).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed no significant trend (P=0.3766, Figure 70). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0467, Figure 71).

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 72 and 73, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 69).

Discussion

Although regression analyses resulted in no significant trend in the historical trawl or beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. Analysis of the standardized trawl data indicated no trend in relative abundance; however, analysis of the standardized beach seine data resulted in an overall increasing trend. 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.

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 varied from the historical and standardized grand means.

Management

No management plan exists for mummichog. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Northern Searobin (*Prionotus carolinus*)

Northern searobin were collected in 21 of 140 trawls (15.0%) and zero of 38 beach seines (0%). A total of 62 juvenile northern searobin were collected in trawl (62 fish) and beach seine (0 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Northern searobin ranked 17th out of 72 species in overall finfish abundance. The trawl CPUE was 3.5 fish/hectare.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (Figures 74 and 75, P=0.0081 and 0.0058, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was equal to the historical grand mean, while the beach seine index was below the historical grand mean (Figures 76 and 77, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 (Figure 78, P=0.20, df=6).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (Figures 79 and 80, P=0.0001 and 0.0002, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was equal to the historical grand mean, while the beach seine index was below the historical grand mean (Figures 81 and 82, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 (Figure 78, P=0.20, df=6).

Discussion

Although regression analyses resulted in an indiscernible overall trend (decreasing from 1972 – 1984 and increasing from 1988 – 2005) in the historical trawl and a decreasing trend in the beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. Analysis of the standardized trawl data indicated an increasing trend in relative abundance while standardized beach seine data resulted in a declining trend. 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 searobins 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 estimates occasionally varied from the standardized trawl grand mean.

Management

No management plan exists for northern searobin. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Pigfish (*Orthopristis chrysoptera*)

Pigfish were collected in 3 of 140 trawls (2.1%) and in 4 of 38 beach seines (10.54%). A total of 39 juvenile pigfish were collected in trawl (6 fish) and beach seine (33 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Pigfish ranked 23rd out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.3 fish/hectare and 0.9 fish /haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (Figures 83 and 84, P=0.0084 and 0.0001, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 85 and 86, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 (Figure 87, P=0.001, df=5).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (Figures 88 and 89, P =0.7343 and 0.8427, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 90 and 91, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 (Figure 87, P=0.001, df=5).

Discussion

Although regression analyses resulted in an increasing trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. Analyses of the standardized trawl and beach seine data indicated no trend in relative abundance. Zero pigfish were captured in the trawl and beach seine before 1981 and 1992, respectively. This occurrence can explain the differing historical and standardized regression results. 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. It is unclear why pigfish began showing up in trawl and seine collections in the early 1990's.

Pigfish 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 varied from the historical and standardized grand means.

Management

No management plan exists for pigfish. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Silver Perch (*Bairdiella chrysoura*)

Silver perch were collected in 50 of 140 trawls (35.7%) and in 15 of 38 beach seines (39.5%). A total of 1,065 silver perch were collected in trawl (585 fish) and beach seine (480 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Silver perch ranked 6^{th} out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 33.3 fish/hectare and 12.6 fish/haul, respectively.

<u>*Historical Data (1972-2005)*</u>

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0001 and 0.0001, Figures 92 and 93, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was above the historical grand mean, while the beach seine index was equal to the historical grand mean (Figures 94 and 95, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 96).

<u>*Standardized Data (1989-2005)*</u>

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0001, Figure 97). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.6846, Figure 98).

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl index was above the standardized grand mean, while the beach seine index was equal to the standardized grand mean (Figures 99 and 100, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 96).

Discussion

Although regression analyses resulted in an increasing trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analysis of the standardized trawl data indicated an increasing trend in relative abundance while standardized beach seine data resulted in no trend. 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.

Silver perch 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 varied from the historical and standardized grand means.

Management

No management plan exists for silver perch. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Smallmouth Flounder (*Etropus microstomus)*

Smallmouth Flounder were collected in 18 of 140 trawls (12.8%) and 1 of 38 beach seines (2.6%). A total of 53 smallmouth flounder were collected in trawl (52 fish) and beach seine (1 fish) samples conducted on Maryland’s Coastal Bays in 2005 (Table 2). Smallmouth flounder ranked 20th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 3.0 fish/hectare and 0.03 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0003, Figure 101). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.9441, Figure 102).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 103 and 104, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 105).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0001 and 0.0315, Figures 106 and 107, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 108 and 109, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling is restricted to June and September. Results indicated a significant difference (P=0.001, df=6, Figure 105).

Discussion

Although regression analysis resulted in an increasing trend in the historical trawl catch data, sampling biases in the pre-standardized data may have influenced the result. However, analysis of the standardized trawl data also indicated an overall increase in relative abundance while standardized beach seine data resulted in a declining trend. 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.

Smallmouth 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 relative abundance estimates seldom varied from the historical and standardized grand means.

Management

No management plan exists for smallmouth flounder. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Spot (*Leiostomus xanthurus)*

Spot were collected in 94 of 140 trawls (67.1%) and 33 of 38 beach seines (86.8%). A total of 11,394 spot were collected in trawl (7,995 fish) and beach seine (3,399 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Spot ranked 1st out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 455.3 fish/hectare and 89.4 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated significant trends (P=0.0001 and 0.0001, Figures 110 and 111, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 112 and 113, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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=1.0, df=6, Figure 114).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] indicated no significant trend (P=0.696 and 0.1305, respectively, Figures 115 and 116).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was above the standardized grand mean, while the beach seine index was equal to the standardized grand mean (Figures 117 and 118, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. Beach seine data were excluded from this analysis because sampling is restricted to June and September. Results indicated no significant difference (P=0.10, df=6, Figure 114).

Discussion

Although regression analyses resulted in a decreasing trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. Analyses of the standardized trawl and beach seine data indicated no trend in relative abundance.

Spot 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 frequently varied from the historical and standardized grand means.

Management

In the mid-Atlantic, spot were managed by the State of Maryland in cooperation with ASMFC. There were no recreational or commercial creel, size limits, or harvest limits for this species in 2005. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Striped Killifish (*Fundulus majalis*)

Striped killifish were collected in zero of 140 trawls and in 18 of 38 beach seines (47%). A total of 253 striped killifish were collected in beach seine samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Striped killifish ranked 9th out of 72 species in overall finfish abundance. The beach seine CPUE was 6.7 fish/haul.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (P=0.1204 and 0.7509, Figures 119 and 120, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was below the historical grand mean, while the beach seine index was equal to the historical grand mean (Figures 121 and 122, respectively).

Chi-squared analysis could not be performed to determine if there was a significant difference between the historical (1972-2004) and 2005 monthly relative trawl abundance indices. No striped killifish were collected during the 2005 CBFI Trawl Survey (Figure 123).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (P=0.2576 and 0.2166, Figures 124 and 125, respectively).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was below the standardized grand mean, while the beach seine index was equal to the standardized grand mean (Figures 126 and 127, respectively).

Chi-squared analysis could not be performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 monthly relative trawl abundance indices. No striped killifish were collected during the 2005 CBFI Trawl Survey (Figure 123).

Discussion

Although regression analyses resulted in no trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analyses of the standardized trawl and beach seine data also indicated no trend in relative abundance.

Striped killifish were caught only 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 frequently varied from the historical and standardized grand means.

Management

No management plan exists for striped killifish. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Summer Flounder (*Paralichthys dentatus)*

Summer Flounder were collected in 42 of 140 trawls (30.0%) and 5 of 38 beach seines (13.2%). A total of 95 juvenile summer flounder were collected in trawl (85 fish) and beach seine (10 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Summer Flounder ranked 12th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 4.8 fish/hectare and 0.3 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Trawl catch data [$\log_e(x+1)$] showed no trend (P=0.2066, Figure 128). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0003, Figure 129).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both below the historical grand mean (Figures 130 and 131, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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=0.025, df=6, Figure 132).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed no significant trends (P=0.9844 and 0.1812, Figures 133 and 134, respectively.

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both below the standardized grand mean (Figures 135 and 136, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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=0.025, df=6, Figure 134).

Discussion

Although regression analysis resulted in a decreasing trend in the historical beach seine catch data, sampling biases in the pre-standardized data may have influenced the result. Analyses of the standardized trawl and beach seine data indicated no trend in relative abundance.

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 relative abundance estimates frequently varied from the historical and standardized grand means.

The comparison of catch distribution by month shows a lower peak in abundance in June than July, which was not typical.

Management

In the mid-Atlantic, summer flounder were managed by the State of Maryland in cooperation with ASMFC and the MAFMC. Maryland's 2005 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. 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: Weakfish (*Cynoscion regalis)*

Weakfish were collected in 56 of 140 trawls (40%) and 3 of 38 beach seines (7.9%). A total of 1,799 juvenile weakfish were collected in trawl (1,789 fish) and beach seine (10 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Weakfish ranked 5th out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 101.9 fish/hectare and 0.3 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0001 and 0.0007, Figures 137 and 138, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was above the historical grand mean, while the beach seine index was equal to the historical grand mean (Figures 139 and 140, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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=1.0, df=6, Figure 141).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (Figure 142, P=0.0001). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.11, Figure 143).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl index was above the standardized grand mean, while the beach seine index was equal to the standardized grand mean (Figures 144 and 145, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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=1.0, df=6, Figure 141).

Discussion

Although regression analyses resulted in an increasing trend in the historical trawl catch data and a decreasing trend in the historical beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analysis of the standardized trawl data also indicated an increase in relative abundance while standardized beach seine data resulted in no trend. Significant 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. The weakfish/striped bass interaction may become pivotal in advancing multi-species management of fish stocks in the future.

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 estimates frequently varied from the historical and standardized grand means.

Management

In the mid-Atlantic, weakfish were managed by the State of Maryland in cooperation with ASMFC. Maryland's 2005 recreational weakfish regulations were comprised of an 8 fish creel and a 13 inch minimum size limit. Commercial regulations in 2005 restricted fisherman to a 12 inch minimum size and included a complicated 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: White Mullet *(Mugil curema)*

White mullet were collected in 1 of 140 trawls (0.7%) and in 11 of 38 beach seines (28.9%). A total of 51 white mullet were collected in 140 trawl (1 fish) and 38 beach seine (50 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). White mullet ranked 21st out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.1 fish/hectare and 1.3 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0011 and 0.0001, Figures 146 and 147, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 148 and 149, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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 (Figure 150, P=0.001, df=3).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed a significant trend (P=0.0018, Figure 151). Regression of beach seine catch data [$\log_e(x+1)$] indicated no significant trend in relative abundance (P=0.0658, Figure 152).

GM indices of relative abundance were calculated and compared with the standardized 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% CI of the GM indices of relative abundance were compared. The 2005 trawl index was equal to the standardized grand mean, while the beach seine index was below the standardized grand mean (Figures 153 and 154, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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=3, Figure 150)

Discussion

Although regression analyses resulted in an increasing trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. However, analysis of the standardized trawl data also indicated an increasing trend in relative abundance while standardized beach seine data resulted in no trend. 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 relative abundance estimates frequently varied from the historical and standardized grand means.

Management

No management plan exists for white mullet. There were no recreational or commercial creel, size limits, or harvest limits for this species. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Species: Winter Flounder (*Pseudopleuronectes americanus*)

Winter Flounder were collected in 18 of 140 trawls (12.9%) and 10 of 38 beach seines (26.3%). A total of 201 juvenile winter flounder were collected in trawl (59 fish) and beach seine (142 fish) samples conducted on Maryland's Coastal Bays in 2005 (Table 2). Winter Flounder ranked 10^{th} out of 72 species in overall finfish abundance. The trawl and beach seine CPUEs were 3.4 fish/hectare and 3.7 fish/haul, respectively.

Historical Data (1972-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the historical time series. Both trawl and beach seine catch data [$\log_e(x+1)$] showed significant trends (P=0.0472 and 0.0011, Figures 155 and 156, respectively).

GM indices of relative abundance were calculated and compared with the historical time series grand mean. The point estimate of the historical time series grand mean was used as an indicator of central tendency of abundance, against which the 95% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the historical grand mean (Figures 157 and 158, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the historical (1972-2004) and 2005 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=1.0, df=5, Figure 159).

Standardized Data (1989-2005)

Regression analysis was performed in order to determine if there was a trend in the annual relative abundance over the standardized time series. Trawl catch data [$\log_e(x+1)$] showed no trend (P=0.3447, Figure 160). Regression of beach seine catch data [$\log_e(x+1)$] indicated a significant trend in relative abundance (P=0.0002, Figure 161).

GM indices of relative abundance were calculated and compared with the standardized 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% confidence intervals (CIs) of the GM indices of relative abundance were compared. The 2005 trawl and beach seine indices were both equal to the standardized grand mean (Figures 162 and 163, respectively).

Chi-squared analysis was performed to determine if there was a significant difference between the standardized (1989-2004) and 2005 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 160).

Discussion

Although regression analyses resulted in an increasing trend in the historical trawl and beach seine catch data, sampling biases in the pre-standardized data may have influenced these results. Analysis of the standardized trawl data indicated no trend in relative abundance; however, similar to the historical pattern, analysis of the standardized beach seine data results also indicated an increasing trend. 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 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 occasionally varied from the historical and standardized grand means.

Management

In the mid-Atlantic, winter flounder were managed by the State of Maryland in cooperation with ASMFC. There were no recreational or commercial creel, size limits, or harvest limits for this species in 2005. Monitoring will continue in the CBFI Trawl and Beach Seine Survey.

Water Quality and Physical Characteristics

Analysis of the 2005 CBFI Trawl Survey water quality data showed an increase in the overall water temperature of the bays from April through July, with a high temperature of 34°C recorded in Assawoman Bay on July 20, 2005 (Table 3 and Figure 164). July was followed by cooler water temperatures from August to October. Overall, Sinepuxent Bay had the lowest average water temperature 20.4ºC, while St. Martins River had the highest 23.8ºC. The lower water temperatures observed in Sinepuxent Bay were more than likely a result of its close proximity to the Ocean City Inlet (Atlantic Ocean), combined with its channel depth (>8 ft.) and relatively small surface area. Conversely, St. Martins River is located farther from the inlet and has a lower average channel depth (<5 ft.). High water temperatures in St. Martins River may also be the result of input from storm water runoff from its highly developed watershed (Ocean Pines community) and warmer freshwater tributaries.

Generally, DO levels in the coastal bays decreased from April to August (Table 3 and Figure 165). The lowest recorded level of 2.1 mg/L was collected on September 28, 2005 in Chincoteague Bay. Typically, as water temperatures increase, DO levels drop as a result of temperatures effect on waters solubility properties. Analysis of the 2005 CBFI Trawl Survey water quality data showed similar DO/water temperature trends throughout the bays (Figures 166-171). In Isle of Wight Bay, an exception to this trend was observed. As water temperatures increased from May to June, the average DO level also increased from 5.5 mg/L to 7 mg/L, respectively (Figure 168). Similar results were also recorded in St. Martins River in July (Figure 167). This occurrence was likely a result of weather conditions (sunlight=photosynthesis, wind=aeration) and time/location at which samples were taken.

Overall, the variation in salinity recorded throughout the bays was large from April to July (16.5–30.2 ppt) becoming less variable from August to October (23.1–32.5 ppt) (Table 3 and Figure 172). St. Martins River had the lowest average salinity (23.25 ppt), while Sinepuxent Bay had the highest (29 ppt). It was expected that Sinepuxent Bay would have the highest average salinity due to its close proximity to the Ocean City Inlet. On the other hand, St. Martins River is located much farther from the inlet and receives significant freshwater inputs from its headwater tributaries.

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Table 1. Measurement types for fishes and invertebrates captured during the 2005 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 length
Turtles	Carapace length

Table 2. List of species collected in Maryland's Coastal Bays Trawl (T) and Seine (S) Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and 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)**	**CPUE (S)**
Finfish Species						
Spot	*Leiostomus xanthurus*	11394	7995	3399	455.3	89.4
Atlantic Menhaden	*Brevoortia tyrannus*	10367	57	10310	3.2	271.3
Atlantic Silverside	*Menidia menidia*	2844	79	2765	4.5	72.8
Bay Anchovy	*Anchoa mitchilli*	2838	2312	526	131.7	13.8
Weakfish	*Cynoscion regalis*	1799	1789	10	101.9	0.3
Silver Perch	*Bairdiella chrysoura*	1065	585	480	33.3	12.6
Golden Shiner	*Notemigonus crysoleucas*	655	0	655	0	17.2
Mummichog	*Fundulus heteroclitus*	639	18	621	1.0	16.3
Striped Killifish	*Fundulus majalis*	253	0	253	0.0	6.7
Winter Flounder	*Pseudopleuronectes americanus*	201	59	142	3.4	3.7
Pumpkinseed Sunfish	*Lepomis gibbosus*	130	0	130	0	3.4
Summer Flounder	*Paralichthys dentatus*	95	85	10	4.8	0.3
Hogchoker	*Trinectes maculatus*	84	58	26	3.3	0.7
Brown Bullhead	*Ameiurus nebulosus*	74	0	74	0	1.9
Atlantic Croaker	*Micropogonias undulatus*	72	72	0	4.1	0
Atlantic Needlefish	*Strongylura marina*	65	0	65	0	1.7
Northern Searobin	*Prionotus carolinus*	62	62	0	3.5	0
Northern Pipefish	*Syngnathus fuscus*	56	43	13	2.4	0.3
Oyster Toadfish	*Opsanus tau*	55	29	26	1.7	0.7
Smallmouth Flounder	*Etropus microstomus*	53	52	1	3.0	<0.1
White Mullet	*Mugil curema*	51	1	50	0.1	1.3
Rainwater Killifish	*Lucania parva*	50	1	49	0.1	1.3
Pigfish	*Orthopristis chrysoptera*	39	6	33	0.3	0.9
Northern Kingfish	*Menticirrhus saxatilis*	34	32	2	1.8	0.1
Naked Goby	*Gobiosoma bosc*	32	18	14	1.0	0.4
Pinfish	*Lagodon rhomboides*	31	1	30	0.1	0.8

Table 2 (con't). List of species collected in Maryland's Coastal Bays Trawl (T) and Seine (S) Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and 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)**	**CPUE (S)**
Sheepshead Minnow	*Cyprinodon variegatus*	29	0	29	0	0.8
Bluegill	*Lepomis macrochirus*	28	0	28	0	0.7
American Eel	*Anguilla rostrata*	27	11	16	0.6	0.4
Spotted Hake	*Urophycis regia*	21	21	0	1.2	0
Bluefish	*Pomatomus saltatrix*	19	4	15	0.2	0.4
Windowpane Flounder	*Scophthalmus aquosus Dorosoma*	17	17	0	1.0	0
Gizzard Shad	*cepedianum*	16	0	16	0	0.4
Black Sea Bass	*Centropristis striata*	16	11	5	0.6	0.1
Clearnose Skate	*Raja eglanteria*	16	16	0	0.9	0
Banded Killifish	*Fundulus diaphanus Microgobius*	12	0	12	0	0.3
Green Goby	*thalassinus*	12	11	1	0.6	<0.1
Black Drum	*Pogonias cromis*	11	5	6	0.3	0.2
Striped Mullet	*Mugil cephalus*	10	0	10	0	0.3
Northern Puffer	*Sphoeroides maculatus*	10	8	2	0.5	0.1
Striped Burrfish	*Chilomycterus schoepfii*	10	10	0	0.6	0
Tautog	*Tautoga onitis*	9	2	7	0.1	0.2
Striped Cusk Eel	*Ophidion marginatum*	9	9	0	0.5	0
Dusky Pipefish	*Syngnathus floridae*	8	8	0	0.5	0
Carp	*Cyprinus carpio*	7	0	7	0	0.2
Striped Anchovy	*Anchoa hepsetus*	7	2	5	0.1	0.1
Striped Blenny	*Chasmodes bosquianus*	6	1	5	0.1	0.1
Spotted Seatrout	*Cynoscion nebulosus*	6	1	5	0.1	0.1
Black Crappie	*Pomoxis nigromaculatus*	4	0	4	0	0.1
Atlantic Herring	*Clupea harengus*	4	3	1	0.2	<0.1
Blackcheek Tonguefish	*Symphurus plagiusa*	4	4	0	0.2	0
Lined Seahorse	*Hippocampus erectus*	4	4	0	0.2	0
Fourspine Stickleback	*Apeltes quadracus*	4	4	0	0.2	0

Table 2 (con't). List of species collected in Maryland's Coastal Bays Trawl (T) and Seine (S) Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and 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)**	**CPUE (S)**
Spotfin Killifish	*Fundulus luciae*	3	0	3	0	0.1
Skilletfish	*Gobiesox strumosus*	3	0	3	0	0.1
Striped Bass	*Morone saxatilis*	3	0	3	0	0.1
Southern Stingray	*Dasyatis americana*	3	1	2	0.1	0.1
Smooth Butterfly Ray	*Gymnura micrura*	3	3	0	0.2	0
Bluespotted Sunfish	*Enneacanthus gloriosus*	2	0	2	0	0.1
Halfbeak	*Hyporhamphus unifasciatus*	2	0	2	0	0.1
Spotfin Mojarra	*Eucinostomus argenteus*	2	1	1	0.1	<0.1
Threespine Stickleback	*Gasterosteus aculeatus*	2	2	0	0.1	0
Red Snapper	*Lutjanus campechanus*	1	0	1	0	<0.1
Feather Blenny	*Hypsoblennius hentz*	1	0	1	0.0	<0.1
Spotfin Butterflyfish	*Chaetodon ocellatus*	1	0	1	0.0	<0.1
Mosquitofish	*Gambusia affinis*	1	0	1	0.0	<0.1
Cownose Ray	*Rhinoptera bonasus*	1	0	1	0.0	<0.1
Hickory Shad	*Alosa mediocris*	1	0	1	0.0	<0.1
White Perch	*Morone americana*	1	0	1	0.0	<0.1
Gray Snapper	*Lutjanus griseus*	1	1	0	0.1	0
Silver Hake	*Merluccius bilinearis*	1	1	0	0.1	0
Northern Stargazer	*Astroscopus guttatus*	1	1	0	0.1	0
	Total Finfish	**47,867**	**25,842**	**22,025**		
Crustacean Species						
Blue Crab	*Callinectes sapidus*	8645	6770	1875	385.6	49.3
Grass Shrimps	*Palaemonetes spp.*	4185	1839	2346	104.7	61.7
Sand Shrimp	*Crangon septemspinosa*	1742	1736	6	98.9	0.2
Brown Shrimp	*Farfantepenaeus aztecus*	162	162	0	9.2	0
Mantis Shrimp	*Squilla empusa*	61	61	0	3.4	0
Lady Crab	*Ovalipes ocellatus*	39	39	0	2.2	0

Table 2 (con't). List of species collected in Maryland's Coastal Bays Trawl (T) and Seine (S) Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and 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)**	**CPUE (S)**
Nine-Spined Spider Crab	Libinia emarginata	24	24	0	1.4	0
Long-Clawed Hermit Crab	*Pagurus longicarpus*	17	14	3	0.8	0.1
Say Mud Crab	*Dyspanopeus sayi*	15	14	1	0.8	<0.1
Flatclaw Hermit Crab	*Pagurus pollicaris*	9	9	0	0.5	0
Rock Crab	*Cancer irroratus*	5	5	0	0.3	0
Green Crab	*Carcinus maenas*	2	0	2	0.0	0.1
Big-Clawed Snapping Shrimp	*Alpheus heterochaelis*	2	2	0	0.1	0
	Total Crustaceans	**14,908**	**10,675**	**4,233**		
Mollusk Species						
Blue Mussel	*Mytilus edulis*	1300	1300	0	74.1	0
Solitary Glassy-Bubble	*Haminoea solitaria*	290	290	0	16.5	0
Snail	*Nassarius vibex*	35	13	22	0.7	0.6
Bruised Nassa (mud snail)	*Crepidula fornicata*	12	12	0	0.7	0
Atlantic Slipper Shell						
Longfin Squid	*Loligo pealeii*	9	9	0	0.5	0
Thick-lipped Oyster Drill	*Eupleura caudata*	5	3	2	0.2	0.1
Hard Shell Clam	*Mercenaria mercenaria*	3	3	0	0.2	0
Atlantic Oyster Drill	*Urosalpinx cinerea*	2	2	0	0.1	0
Blood Ark	*Anadara ovalis*	2	2	0	0.1	0
Dwarf Surfclam	*Mulinia lateralis*	2	2	0	0.1	0
Stout Razor Clam	*Tagelus plebeius*	1	1	0	0.1	0
Shark Eye	*Neverita duplicata*	1	1	0	0.1	0
Convex Slipper Shell	*Crepidula convexa*	1	1	0	0.1	0
Marsh Periwinkle	*Littorina irrorata*	1	1	0	0.1	0
	Total Mollusks	**1,655**	**1,631**	**24**		

Table 2 (con't). List of species collected in Maryland's Coastal Bays Trawl (T) and Seine (S) Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and 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)	CPUE (S)
Other Species						
Comb Jelly	*Beroe spp.*	8092	7061	1031	402.1	27.1
Sea Squirt	*Mogula manhattensis*	4235	3235	1000	184.2	26.3
Sea Nettle	*Chrysaora quinquecirrha*	259	179	80	10.2	2.1
Common Sea Cucumber	*Sclerodactyla briareus*	140	138	2	7.9	0.1
Forbes Asterias Star	*Asterias forbesi*	66	66	0	3.8	0
Horseshoe Crab	*Limulus polyphemus*	22	19	3	1.1	0.1
Diamondback Terrapin	*Malaclemys terrapin terrapin*	6	0	6	0	0.2
Boring (Sulphur) Sponge	*Cliona celata*	6	6	0	0.3	0
Moon Jelly	*Aurelia aurita*	2	1	1	0.1	<0.1
	Total Other	**12,815**	**10,695**	**2,120**		

Table 3. Coastal Bays Fisheries Investigations 2005 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	April	May	June	July	August	September	October
Assawoman Bay (Sites: T001, T002, and T003)							
Temp (°C)	14.07 (13.7-14.8)	19.4 (18.8-19.8)	26.3 (25.9-26.9)	31.5 (30.2-34.0)	27.1 (26.1-27.8)	26.0 (25.8-26.20)	16.1 (15.9-16.2)
DO (mg/L)	9.37 (9.2-9.5)	6.7 (5.6-7.9)	6.7 (6.1-7.0)	5.7 (5.5-6.14)	4.1 (3.3-4.9)	5.2 (5.1-5.3)	6.3 (6.2-6.3)
Salinity (ppt)	21.7 (21.0-22.6)	24.8 (23.2-26.4)	20.4 (18.7-23.0)	22.3 (20.2-24.3)	27.0 (25.5-29.2)	28.9 (28.4-29.9)	29.5 (28.9-30.3)
Saint Martins River (Sites: T004 and T005)							
Temp (°C)	16.2 (14.1-18.3)	21.3 (19.8-22.7)	28.3 (26.8-29.8)	31.7 (31.2-32.2)	27.5 (26.7-28.3)	25.1 (24.6-25.6)	16.5 (16.4-16.6)
DO (mg/L)	9.25 (9.2-9.3)	6.7 (6.2-7.3)	5.4 (4.6-6.1)	6.5 (6.5-6.6)	6.4 (5.7-7.1)	5.5 (5.1-6.0)	6.6 (5.6-7.5)
Salinity (ppt)	20.01 (18.0-22.1)	22.5 (20.1-24.8)	19.9 (16.5-23.3)	20.8 (19.1-22.5)	25.8 (23.3-28.3)	26.4 (24.0-28.7)	27.4 (25.4-29.4)
Isle Of Wight Bay (Sites: T006 and T007)							
Temp (°C)	15.8 (13.9-17.6)	20.7 (18.7-22.7)	28.9 (27.1-30.6)	30.6 (29.2-31.9)	26.3 (25.4-27.2)	25.0 (24.3-25.7)	17.9 (17.1-18.6)
DO (mg/L)	9.25 (9.1-9.4)	5.5 (4.0-6.9)	7.0 (6.7-7.3)	6.2 (5.6-6.8)	4.8 (4.1-5.6)	4.9 (4.9-4.9)	6.1 (5.9-6.3)
Salinity (ppt)	20.7 (17.6-23.8)	25.2 (22.6-27.8)	22.6 (19.9-25.2)	23.5 (21.2-25.7)	28.1 (26.9-29.2)	29.0 (27.2-30.7)	28.6 (26.5-30.7)
Sinepuxent Bay (Sites: T008, T009, and T010)							
Temp (°C)	13.6 (12.8-15.3)	18.5 (17.7-19.7)	22.6 (19.4-25.6)	26.7 (22.9-28.6)	24.8 (23.1-27.2)	24.0 (21.0-26.3)	12.8 (12.7-12.9)
DO (mg/L)	9.27 (9.2-9.3)	6.9 (6.7-7.0)	5.8 (4.5-6.4)	4.9 (4.5-5.3)	5.7 (4.64-6.6)	5.5 (5.3-5.9)	7.2 (6.8-7.6)
Salinity (ppt)	26.87 (26.6-27.1)	29.3 (28.8-29.6)	28.8 (27.7-29.3)	27.0 (25.1-30.2)	29.7 (28.7-30.3)	31.0 (30.9-31.2)	30.5 (30.3-30.7)

Table 3 (con't): Coastal Bays Fisheries Investigations 2005 water quality data collected during trawl sampling. Mean values are reported with the range in parentheses.

Parameter	April	May	June	July	August	September	October
			Newport Bay (Sites: T011 and T012)				
Temp (°C)	17.2 (16.2-18.2)	19.9 (19.4-20.3)	26.8 (26.8-26.8)	28.4 (28.4-28.4)	27.3 (27.1-27.4)	26.2 (25.4-26.9)	17.7 (17.6-17.8)
DO (mg/L)	7.4 (6.9-7.9)	6.62 (5.86-6.62)	4.6 (4.2-5.0)	4.2 (3.8-4.6)	5.0 (4.6-5.0)	5.2 (5.0-5.4)	6.1 (5.7-6.6)
Salinity (ppt)	26.05 (25.1-27.0)	25.1 (23.6-26.5)	22.9 (20.8-25.0)	20.7 (17.9-23.5)	24.6 (23.1-26.0)	26.5 (24.4-28.5)	27.0 (23.8-30.1)
			Chincoteague Bay (Sites: T013, T014, T015, T016, T017, T018, T019 and T020)				
Temp (°C)	15.4 (14.2-16.7)	19.1 (18.8-19.7)	23.1 (21.8-24.4)	29.6 (27.7-30.3)	26.2 (25.7-26.9)	23.3 (22.3-24.4)	17.5 (17.1-18.3)
DO (mg/L)	8.1 (7.4-9.0)	6.1 (5.5-6.8)	6.4 (5.9-7.1)	4.6 (4.2-4.9)	5.5 (5.1-6.0)	4.8 (2.1-7.2)	5.7 (5.0-6.8)
Salinity (ppt)	25.0 (23.5-27.7)	25.6 (23.9-27.0)	26.6 (25.6-28.3)	26.3 (24.3-29.7)	28.3 (26.2-30.5)	30.7 (28.7-32.5)	30.4 (30.0-30.8)

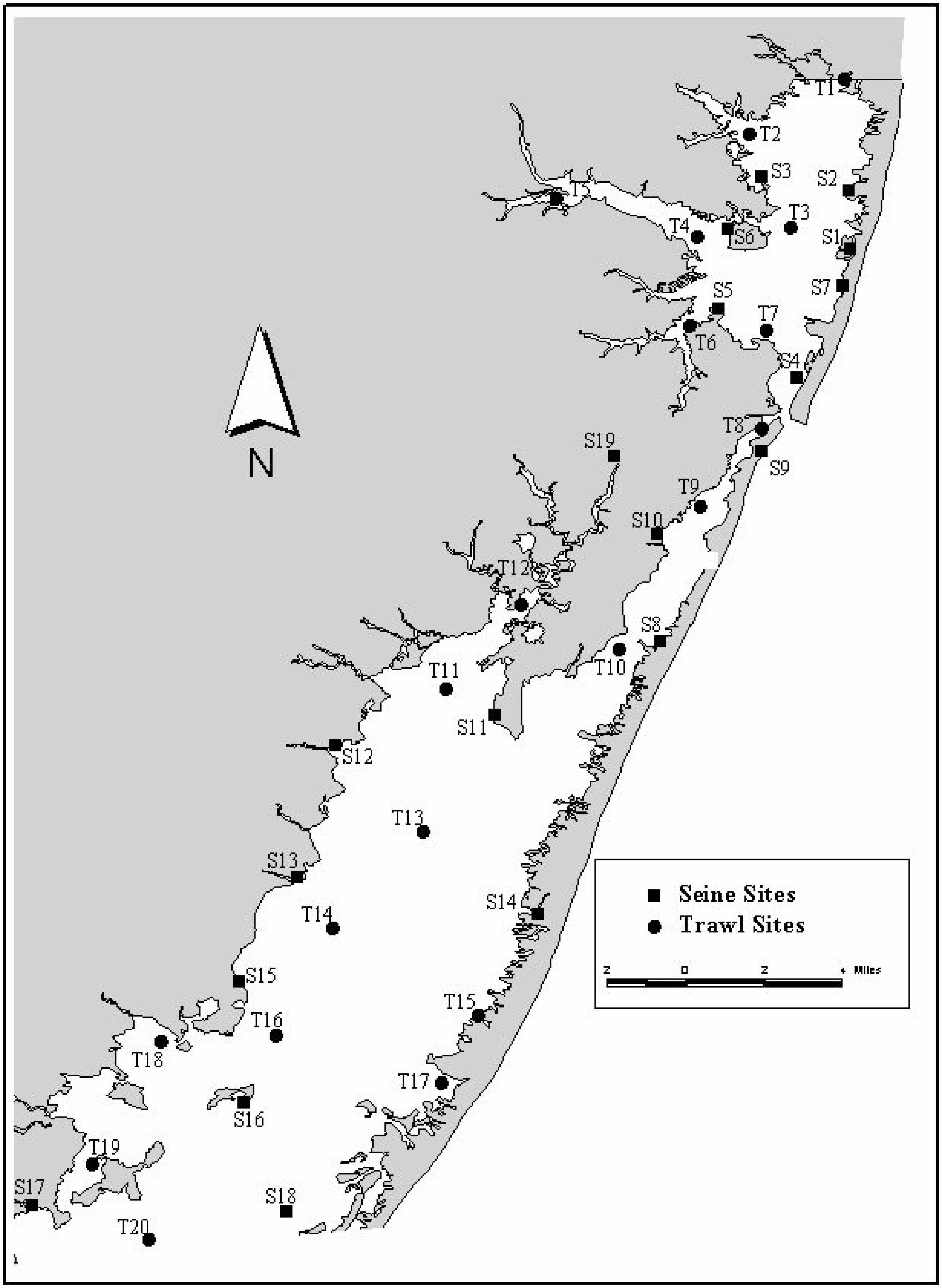

Figure 1. Site locations for the 2005 Coastal Bays Fishery Investigations Trawl and Beach Seine Survey.

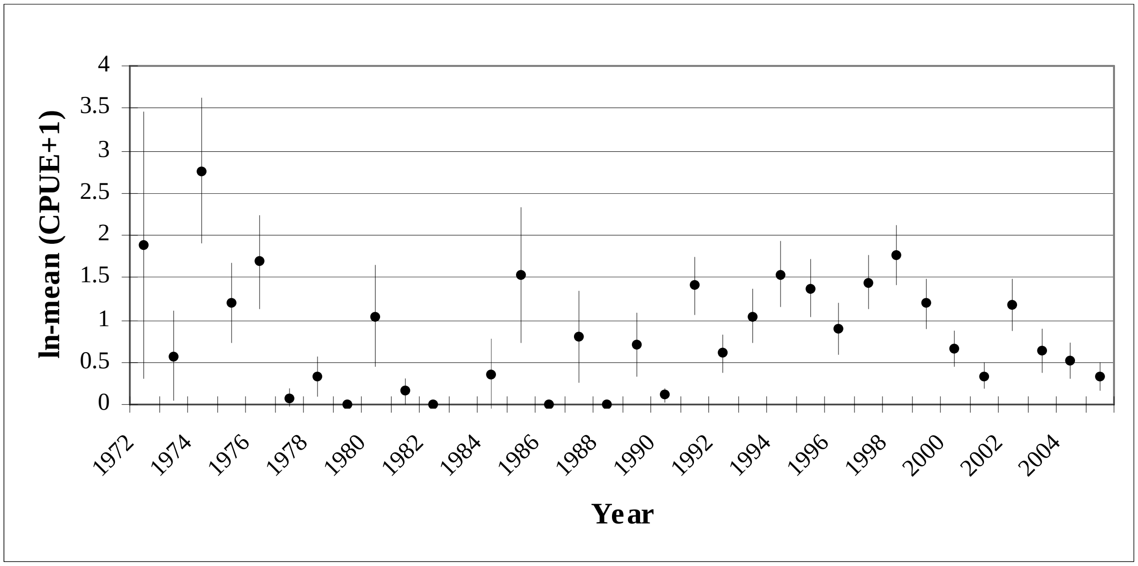

Figure 2. Atlantic croaker trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

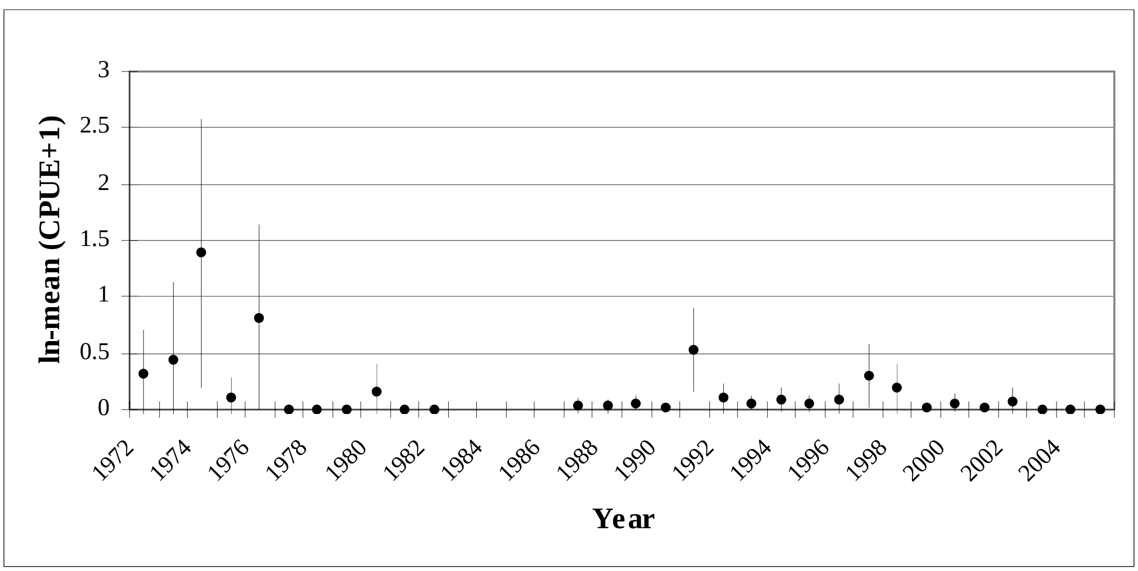

Figure 3. Atlantic croaker beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

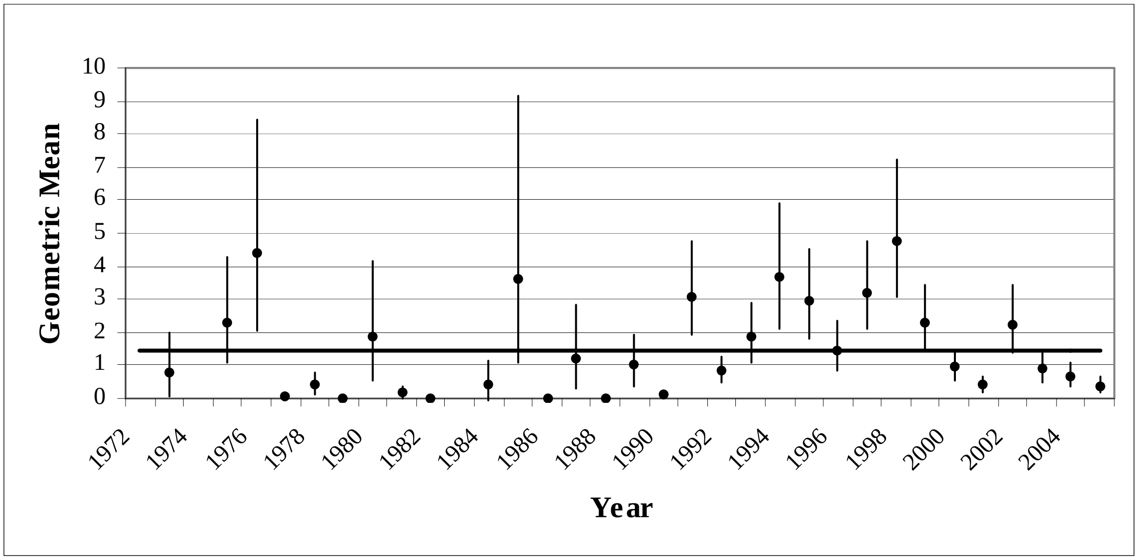

Figure 4. Atlantic croaker trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1974, and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1974: n=43, 1983: n=3). Solid line represents the time series grand mean.

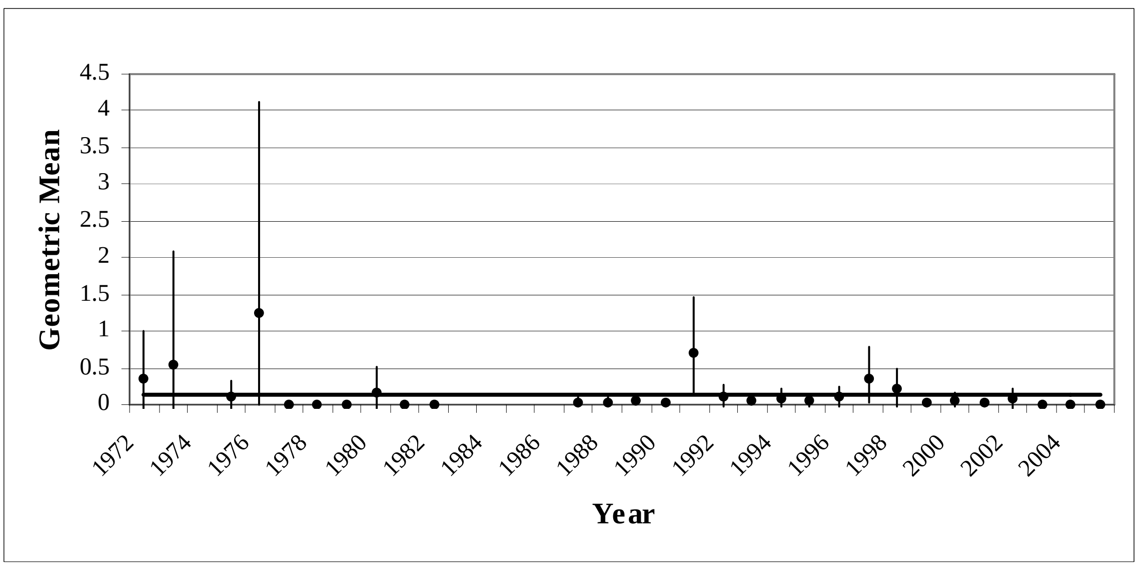

Figure 5. Atlantic croaker beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1974 and 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1974: n=14, 1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

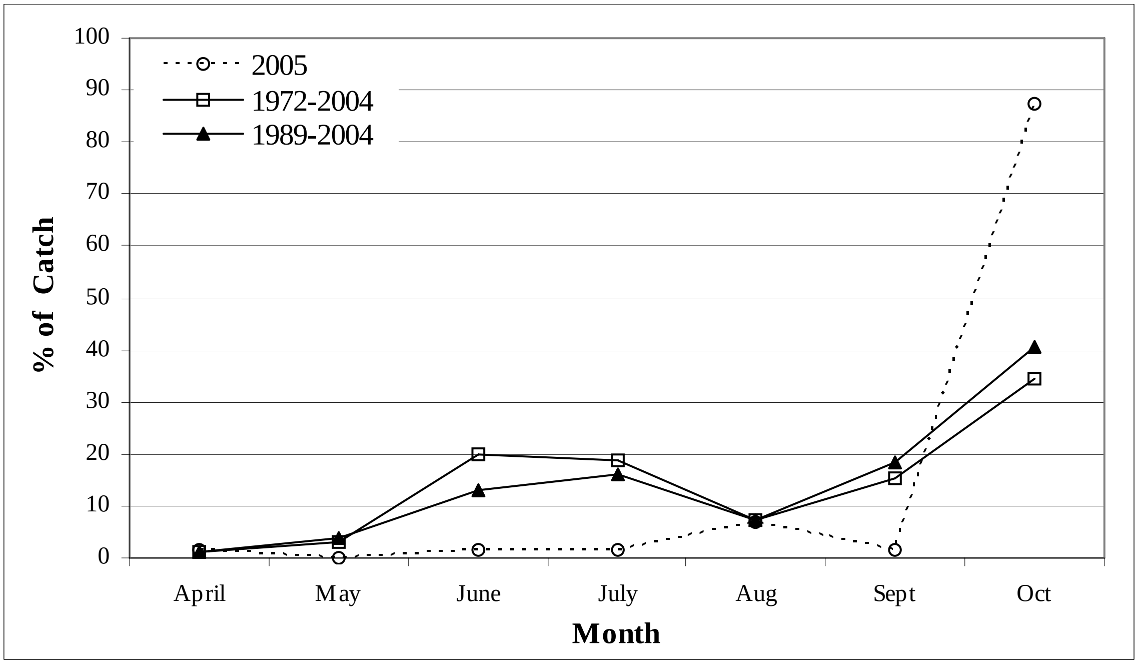

Figure 6. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal Atlantic croaker trawl percent catch by month.

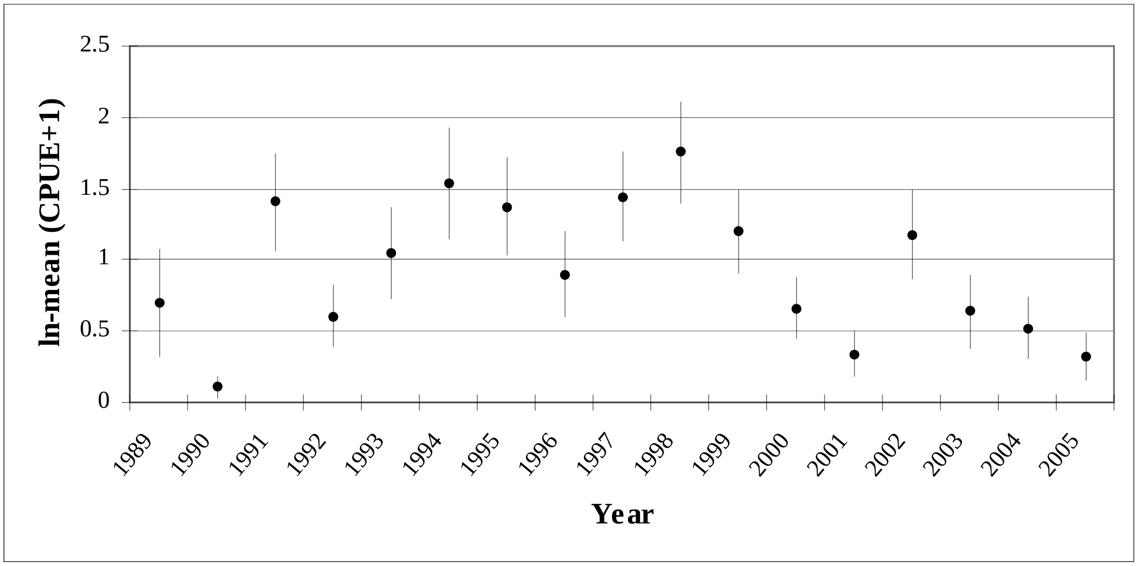

Figure 7. Atlantic croaker trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

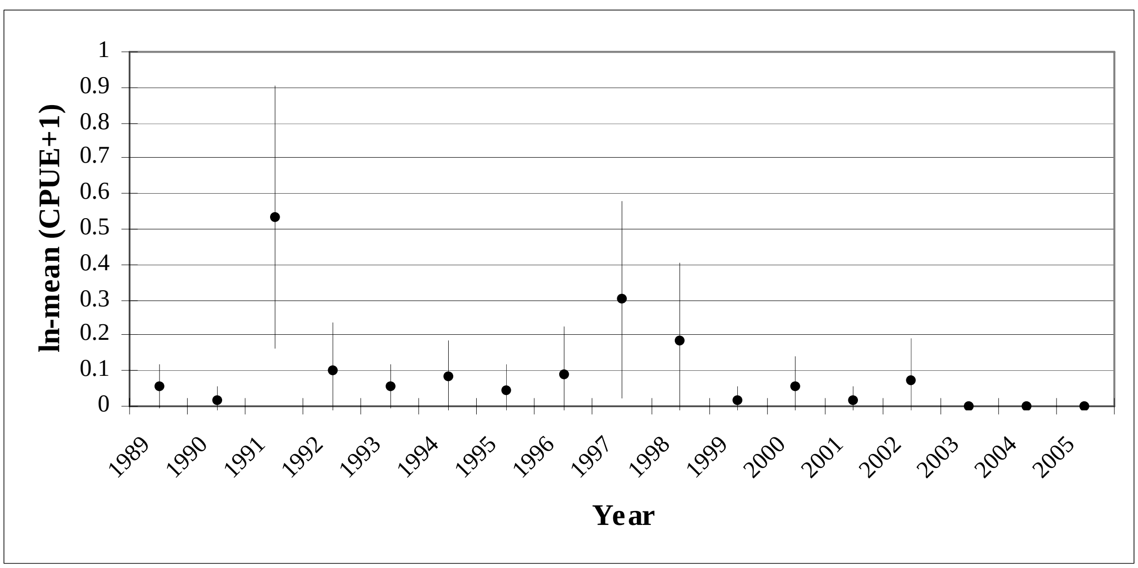

Figure 8. Atlantic croaker beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

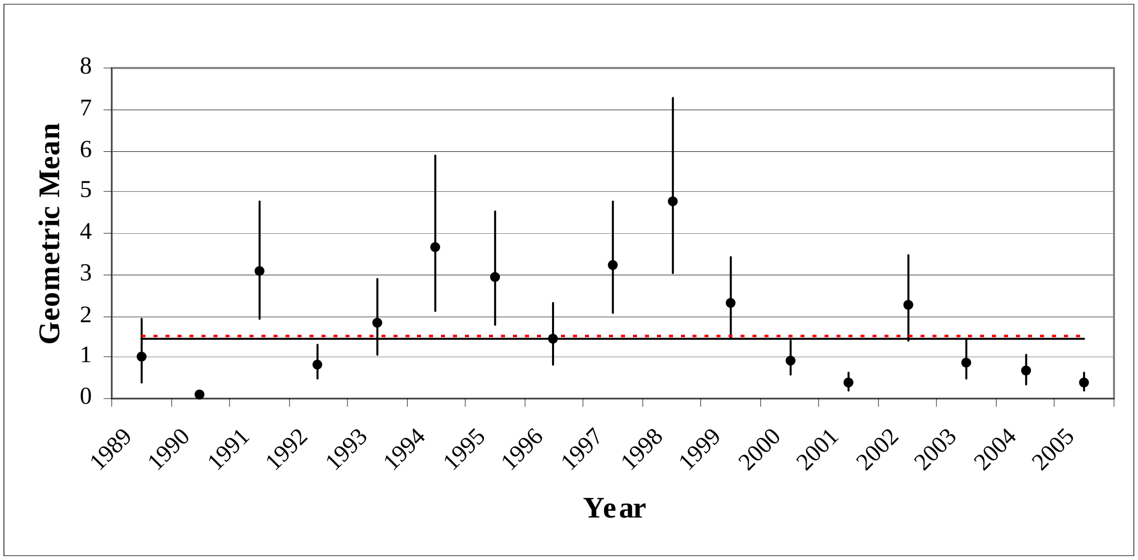

Figure 9. Atlantic croaker trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

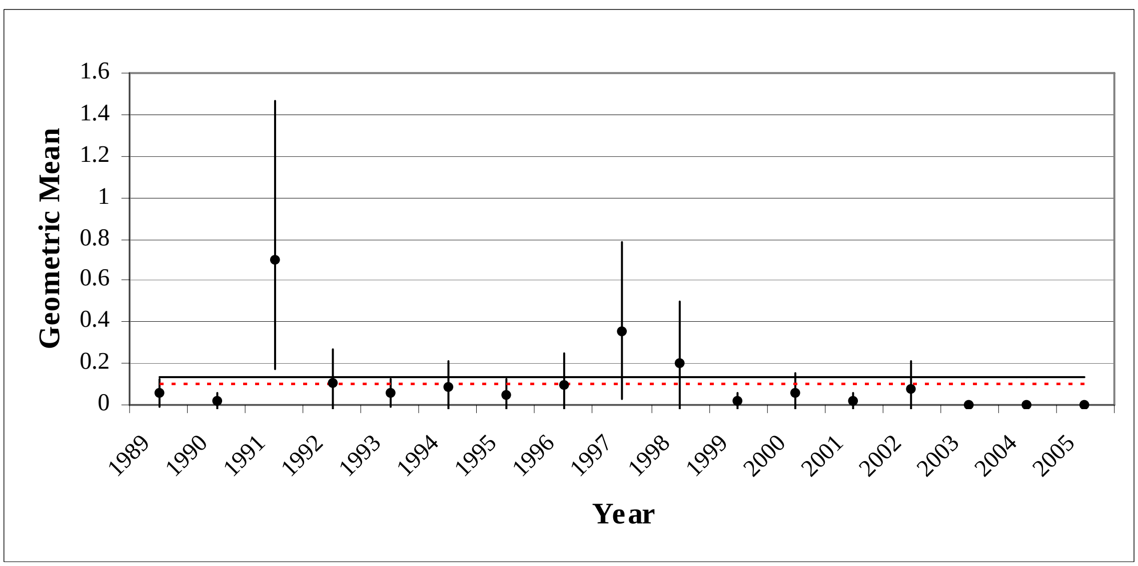

Figure 10. Atlantic croaker beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

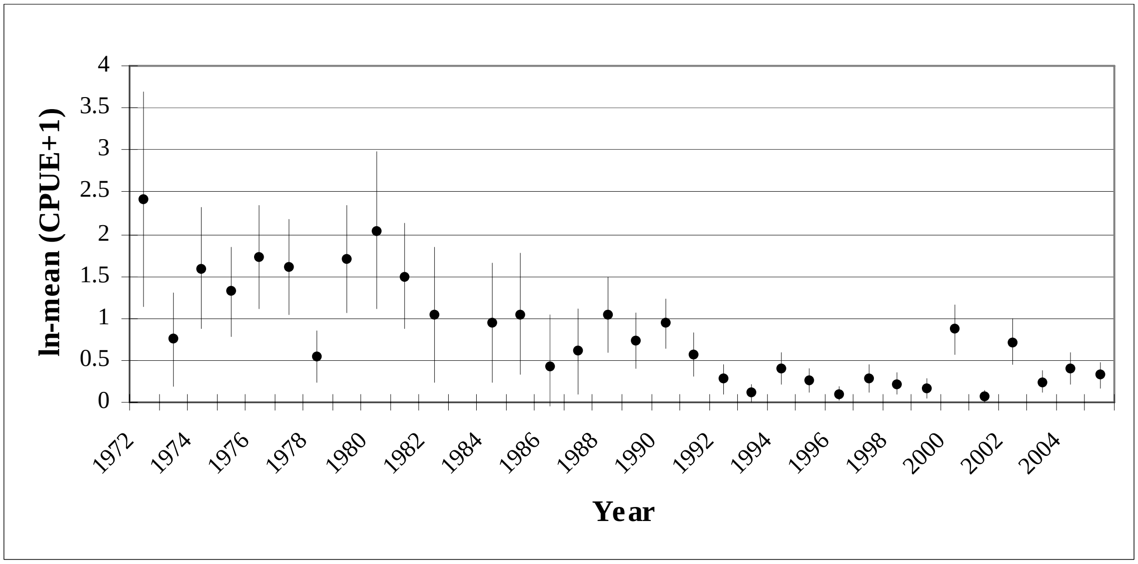

Figure 11. Atlantic menhaden trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

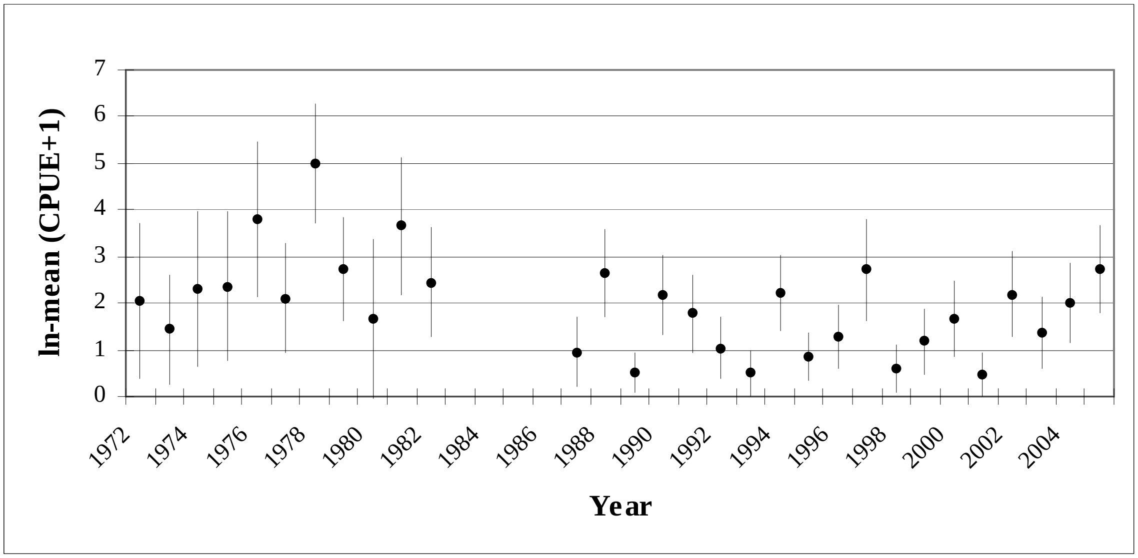

Figure 12. Atlantic menhaden beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983 - 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

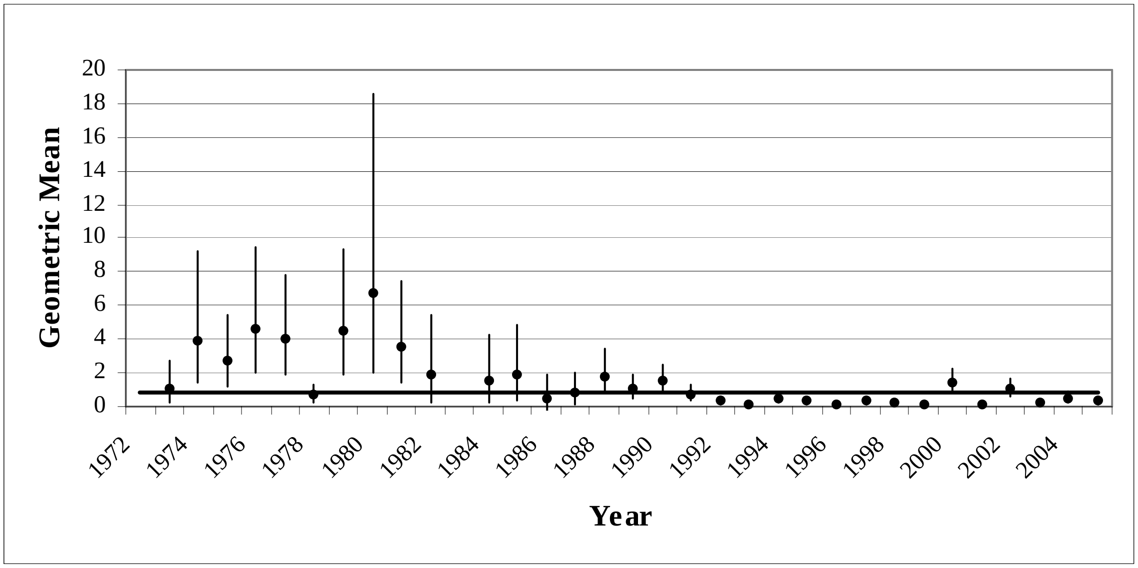

Figure 13. Atlantic menhaden trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972 and1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3). Solid line represents the time series grand mean.

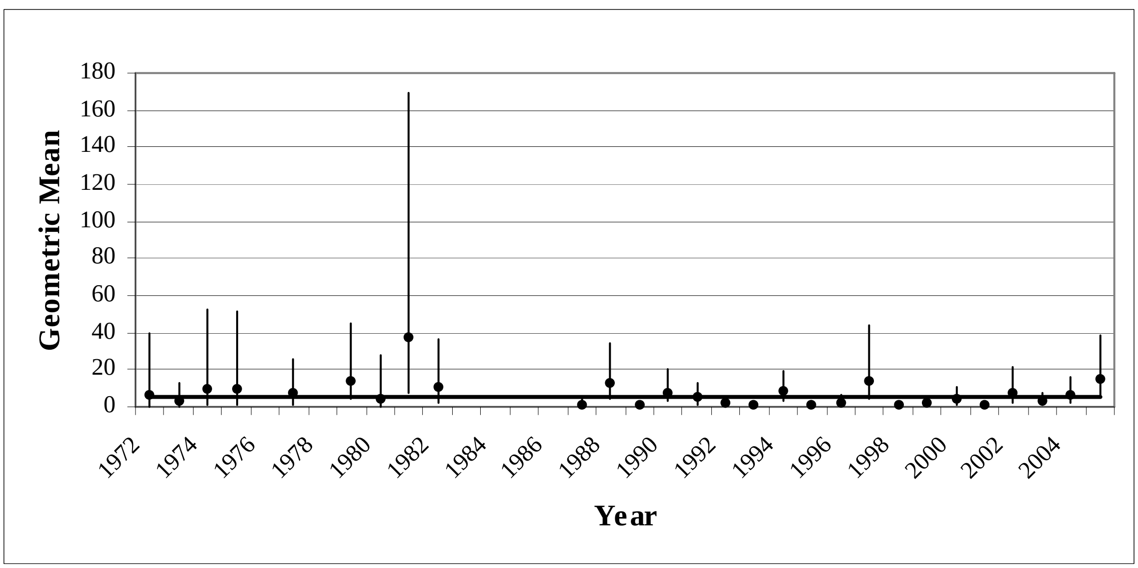

Figure 14. Atlantic menhaden beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1976, 1978, and 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1976: n=16, 1978: n=20, 1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

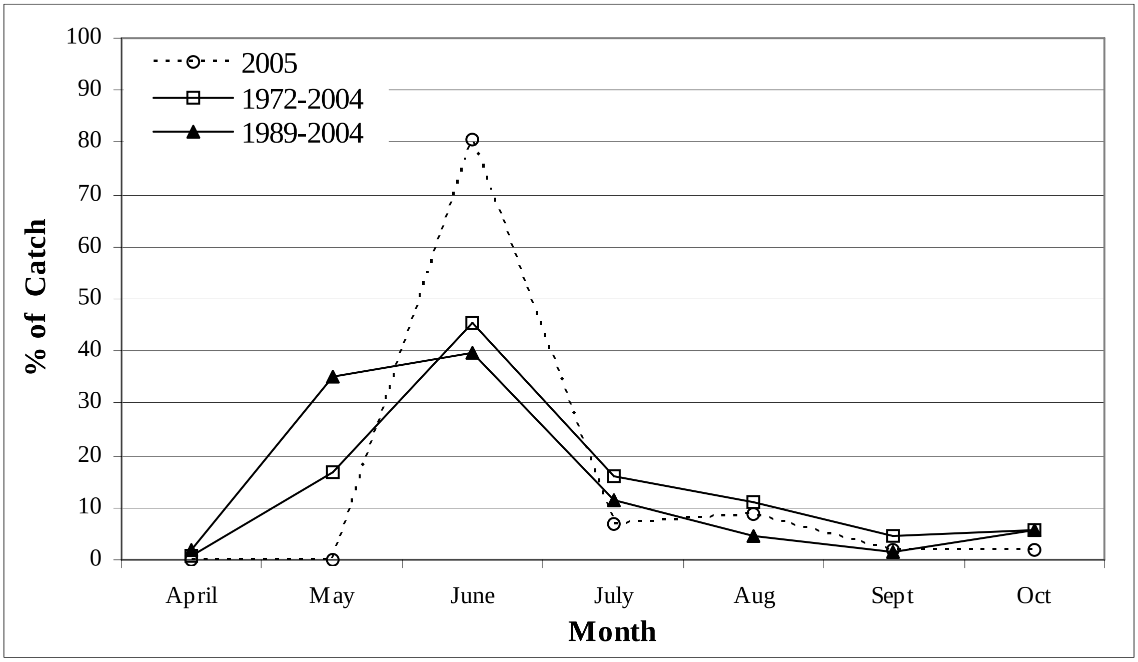

Figure 15. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal Atlantic menhaden trawl percent catch by month.

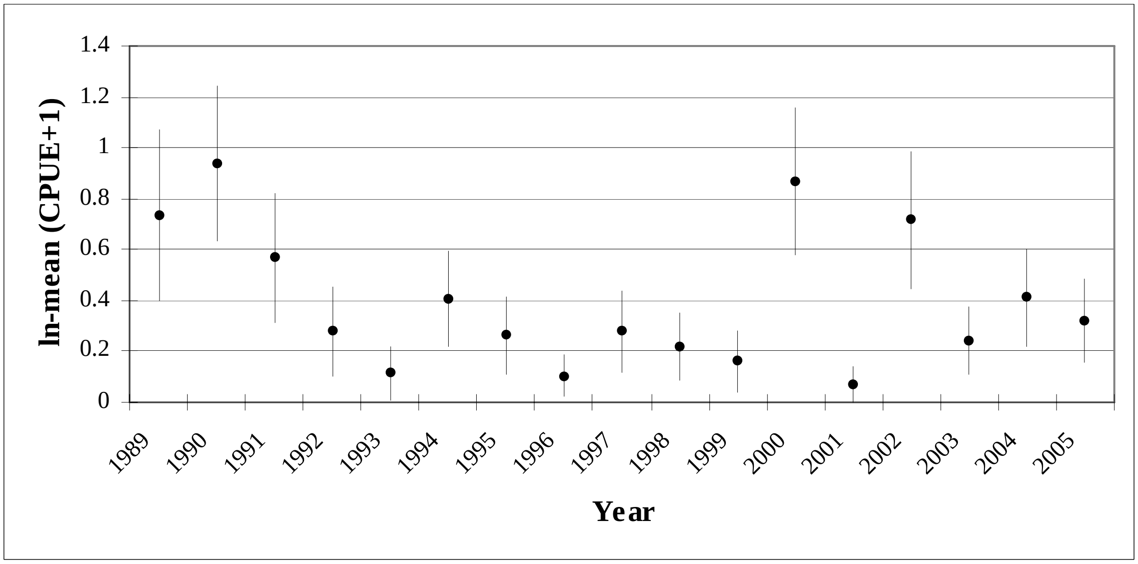

Figure 16. Atlantic menhaden trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

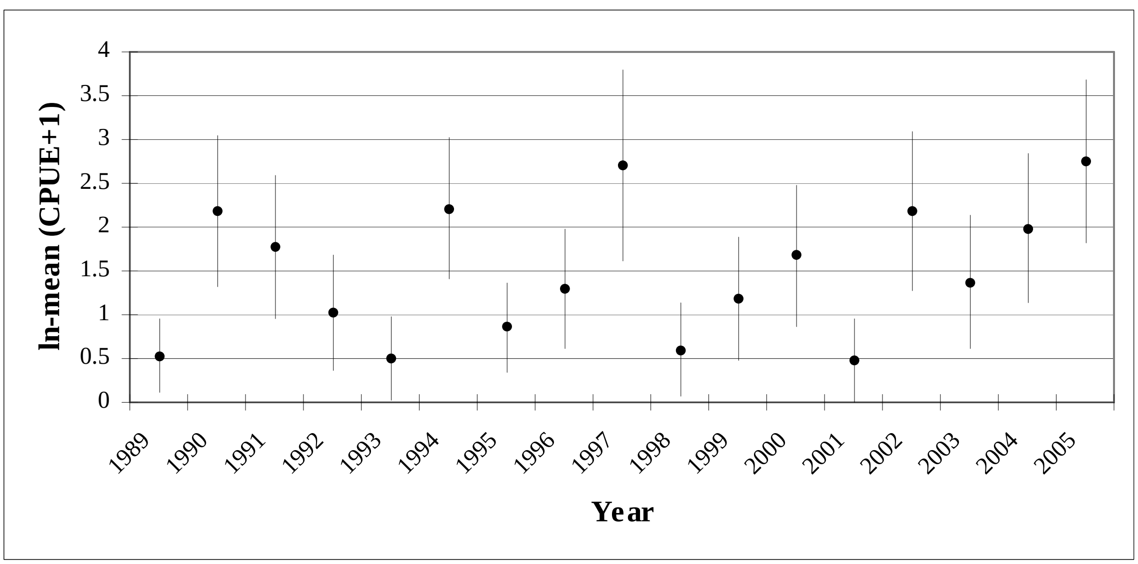

Figure 17. Atlantic menhaden beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

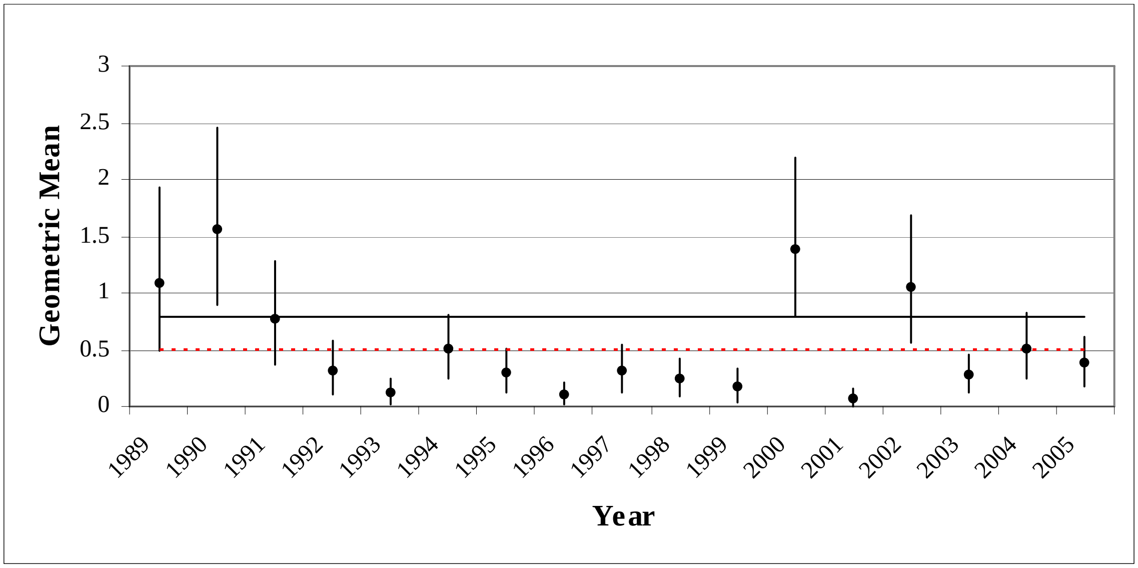

Figure 18. Atlantic menhaden trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

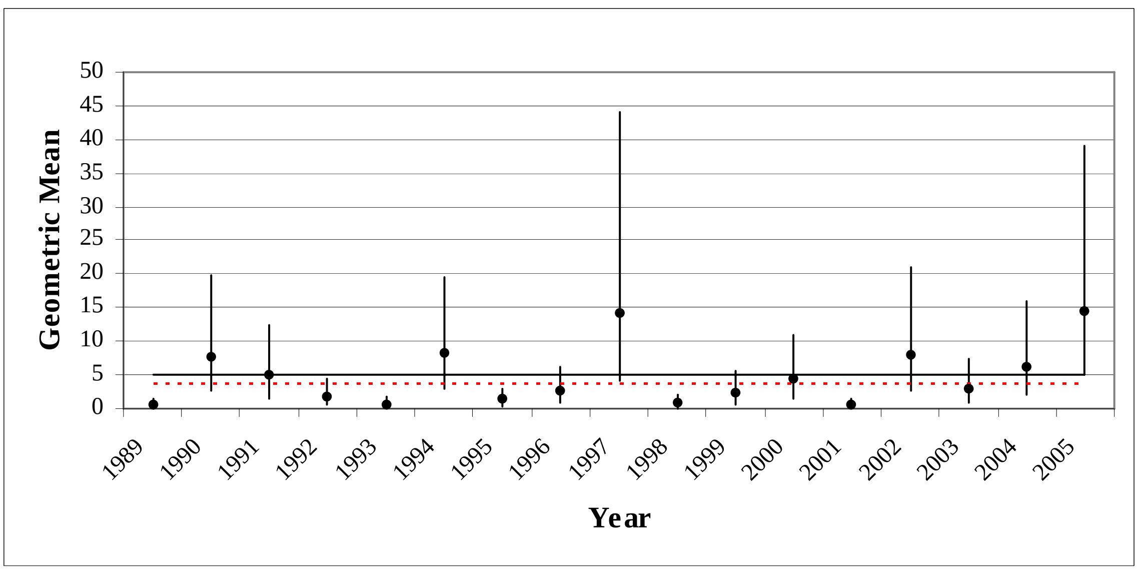

Figure 19. Atlantic menhaden beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

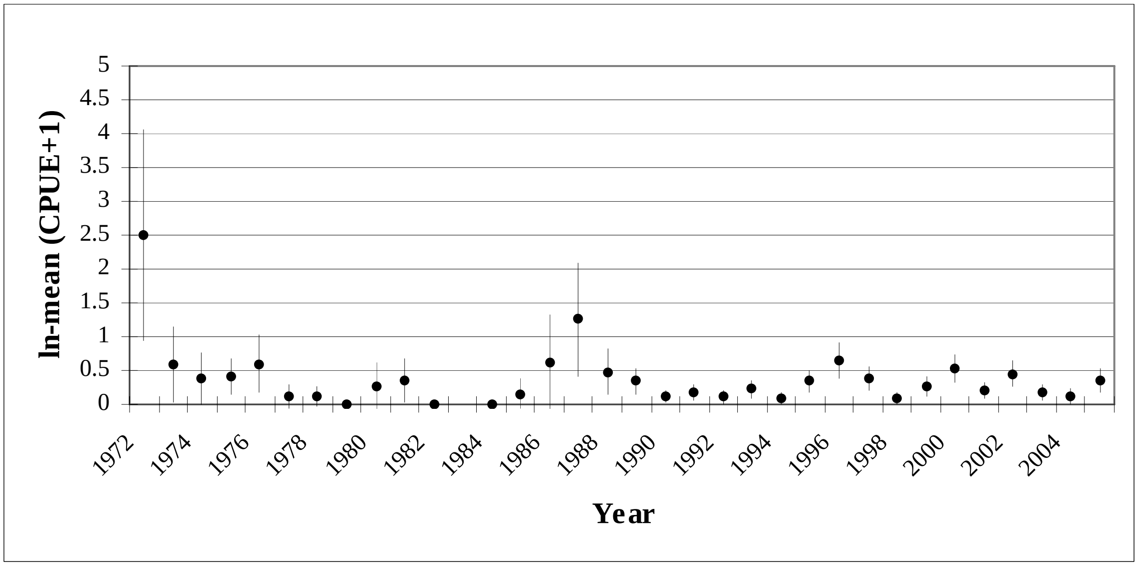

Figure 20. Atlantic silverside trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

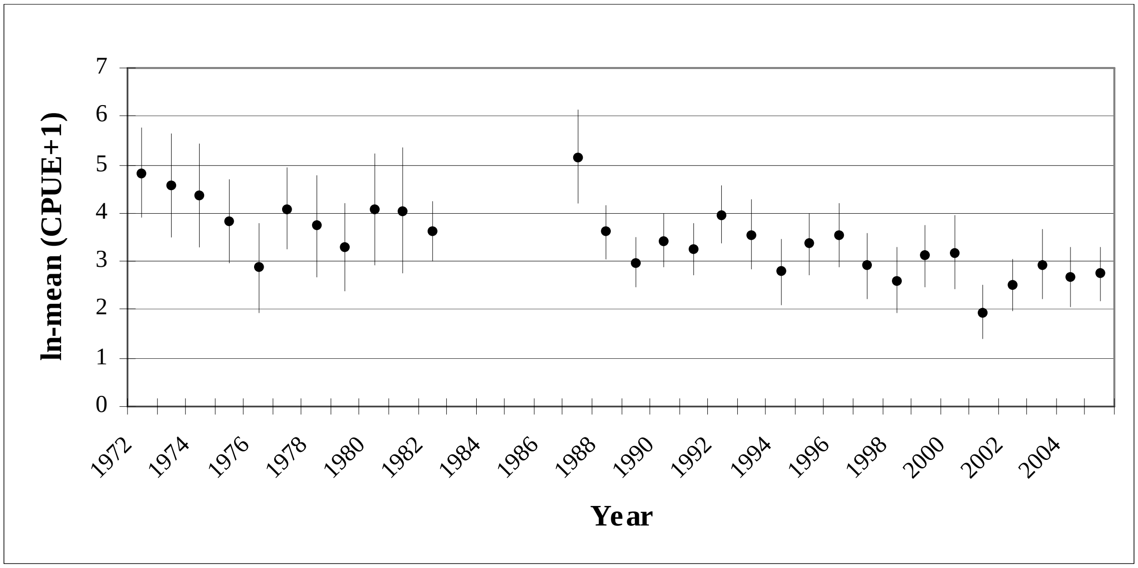

Figure 21. Atlantic silverside beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

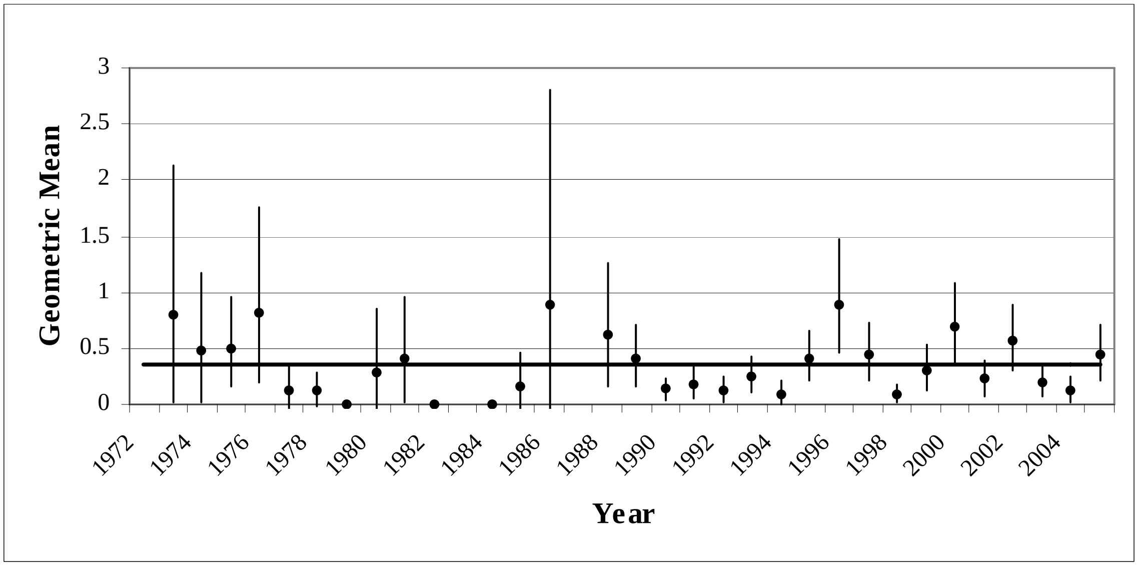

Figure 22. Atlantic silverside trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1983, and 1987 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3, 1987: n=34). Solid line represents the time series grand mean.

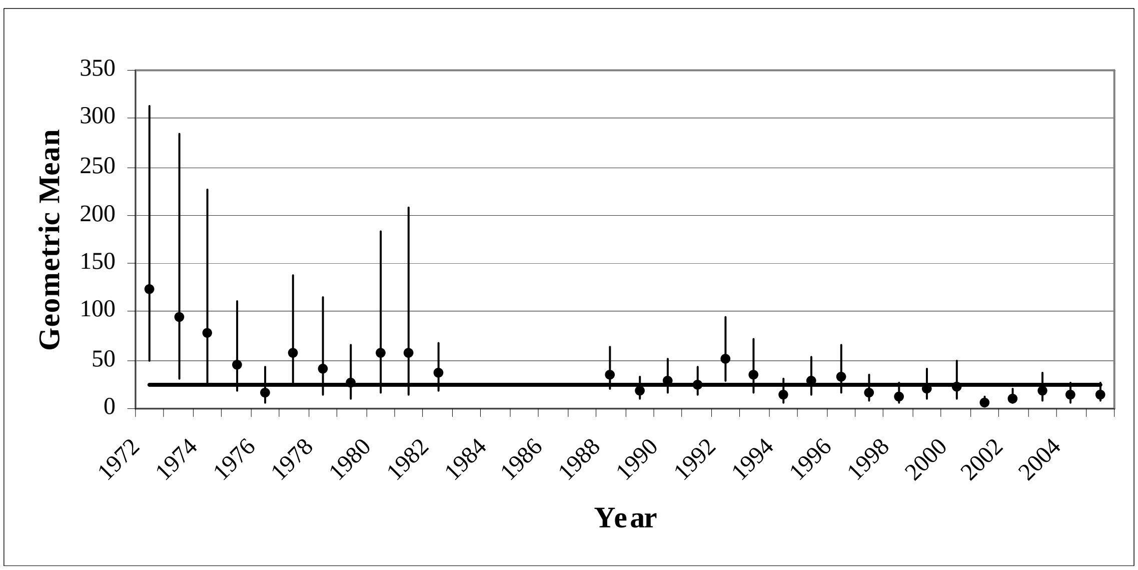

Figure 23. Atlantic silverside beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1987 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4, 1987: n=21). Solid line represents the time series grand mean.

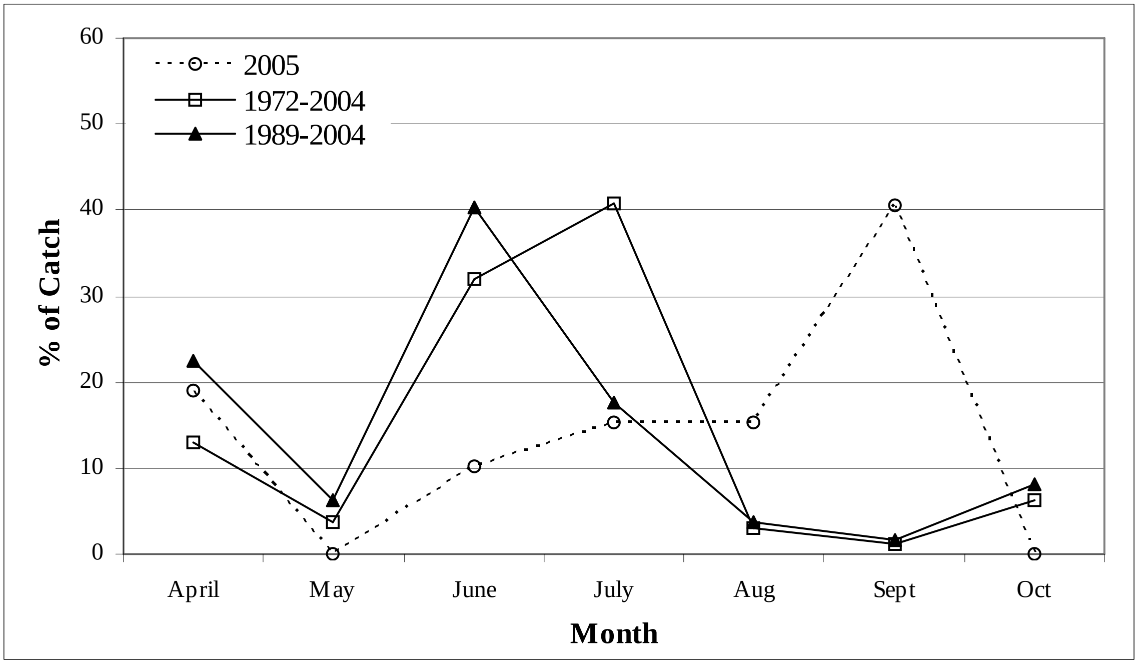

Figure 24. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal Atlantic silverside trawl percent catch by month.

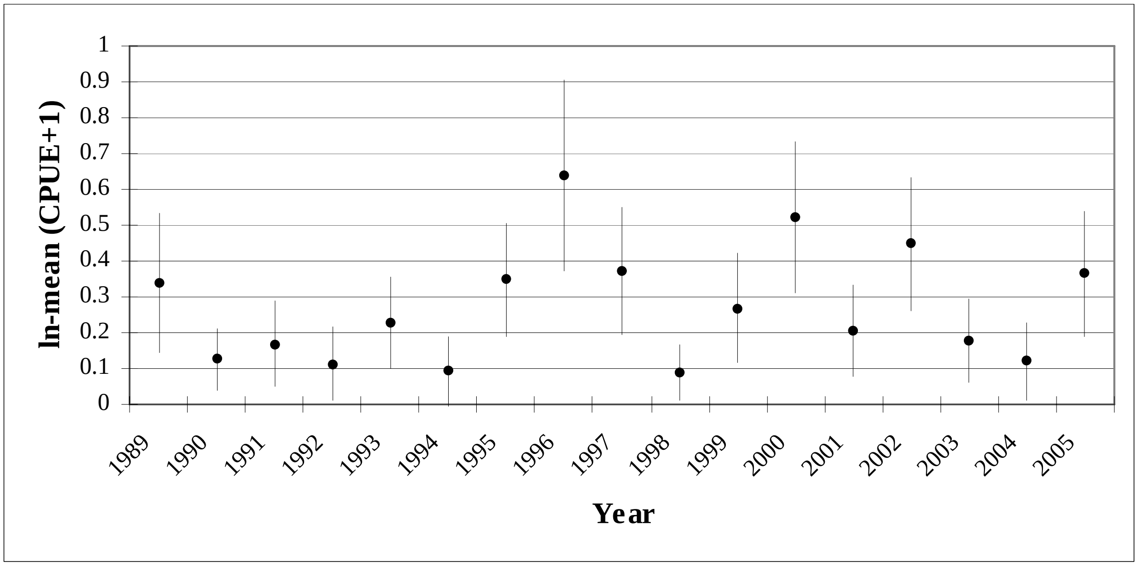

Figure 25. Atlantic silverside trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

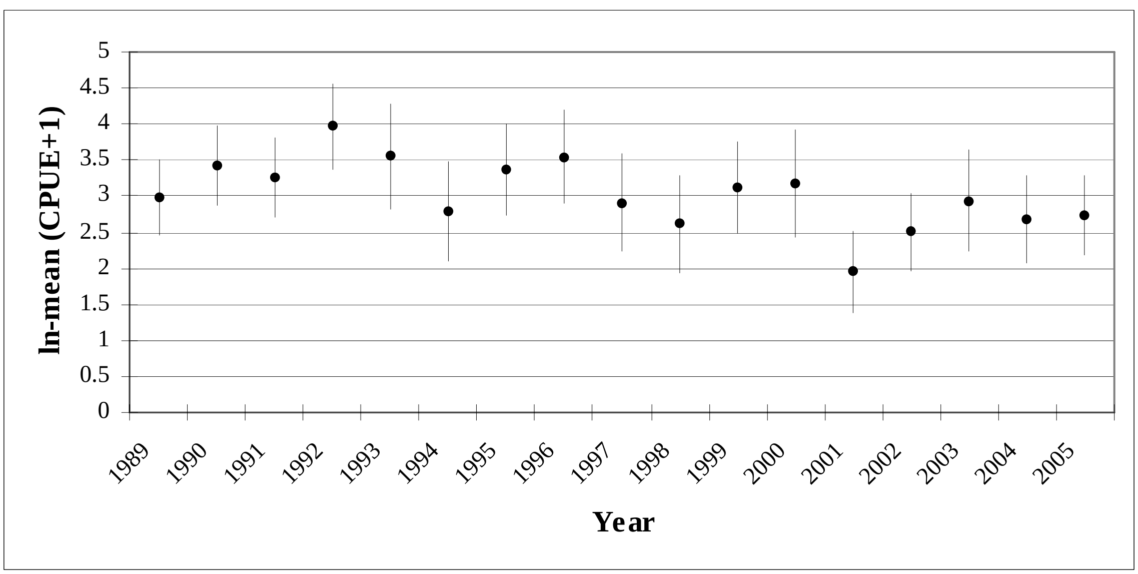

Figure 26. Atlantic silverside beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

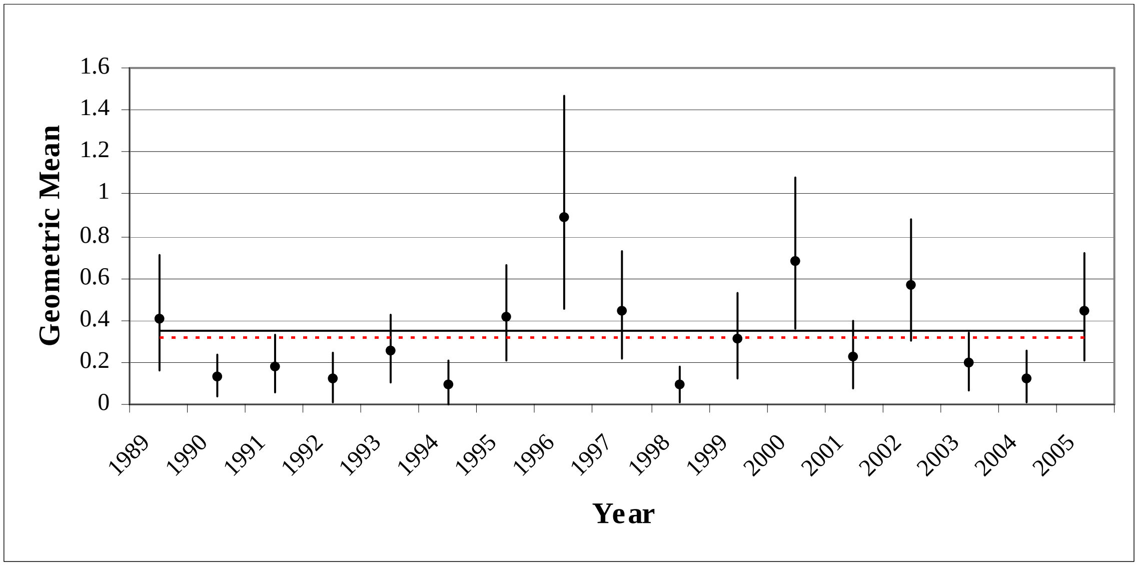

Figure 27. Atlantic silverside trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

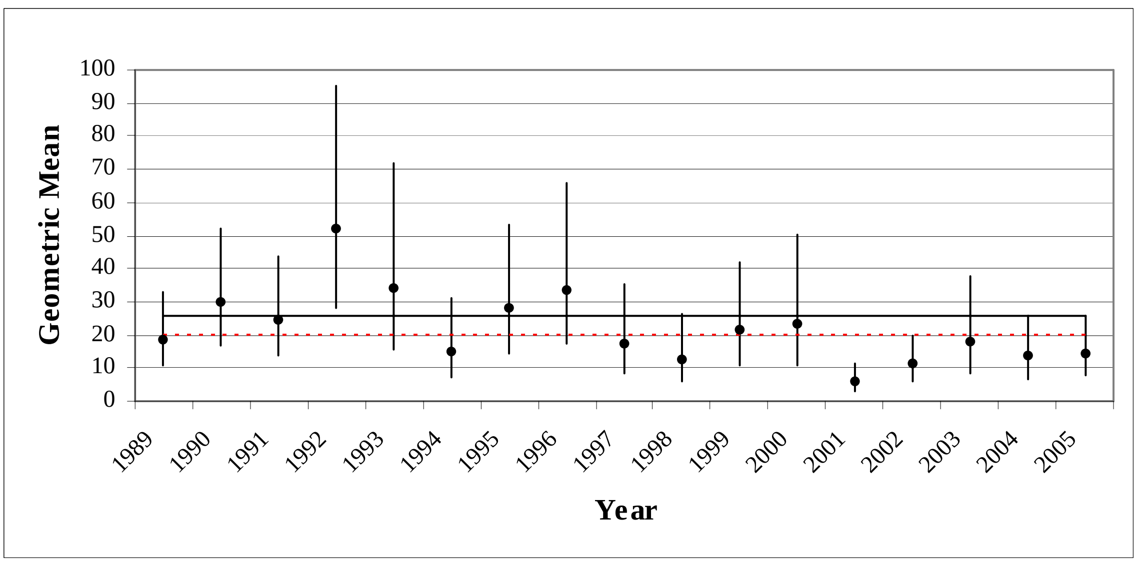

Figure 28. Atlantic silverside beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

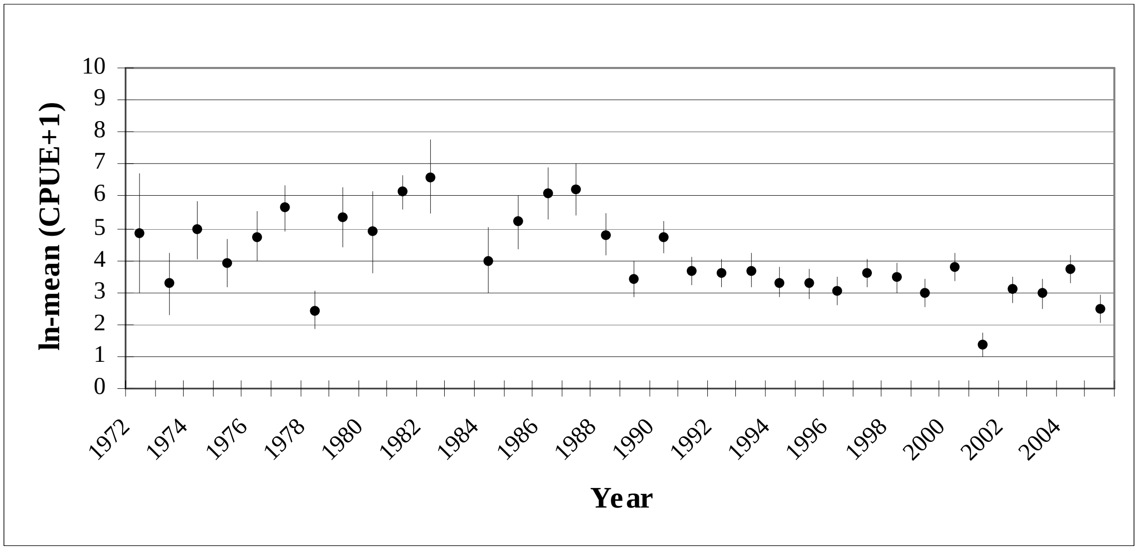

Figure 29. Bay anchovy trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

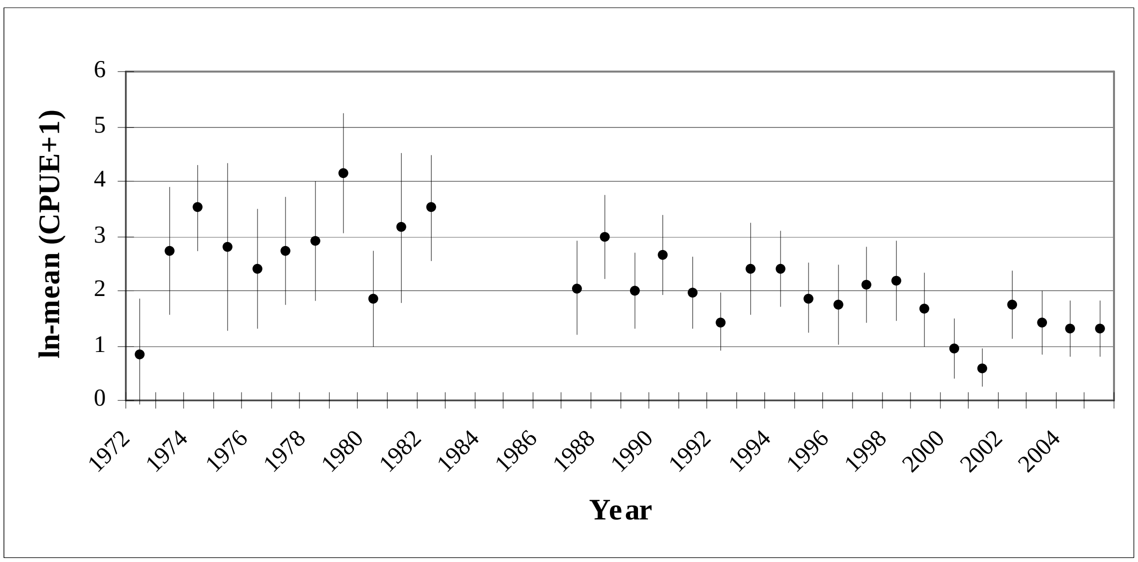

Figure 30. Bay anchovy beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

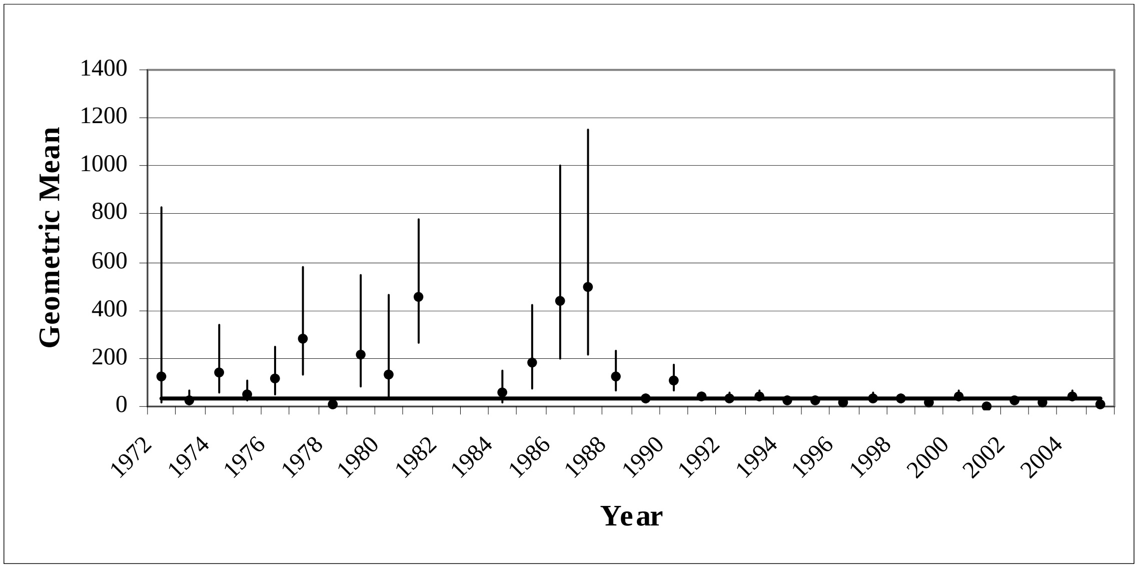

Figure 31. Bay anchovy trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1982 and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1982: n=18, 1983: n=3). Solid line represents the time series grand mean.

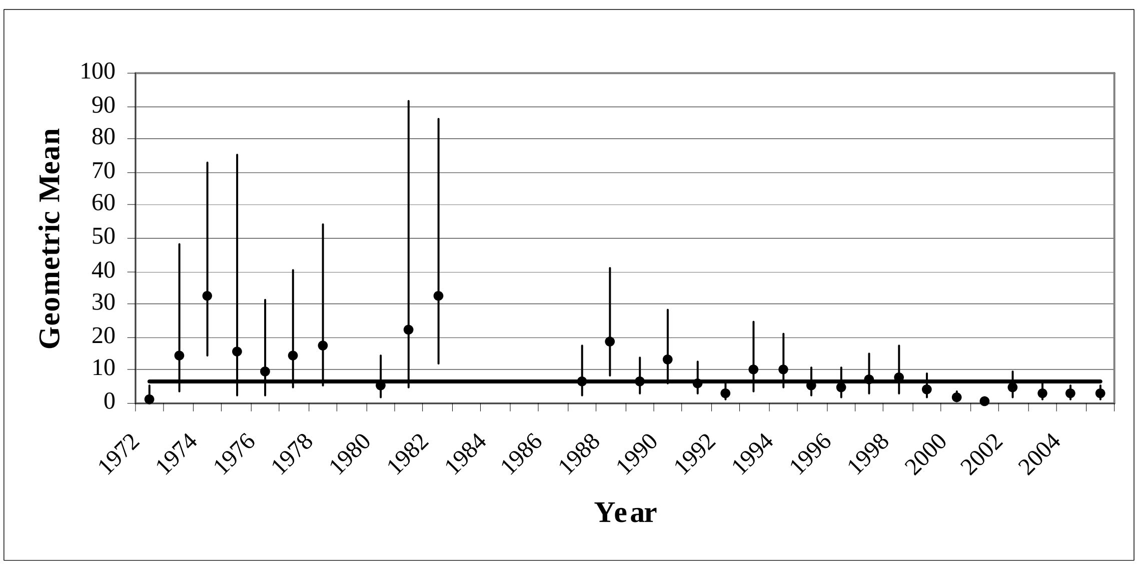

Figure 32. Bay anchovy beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1979 and 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1979: n=21, 1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

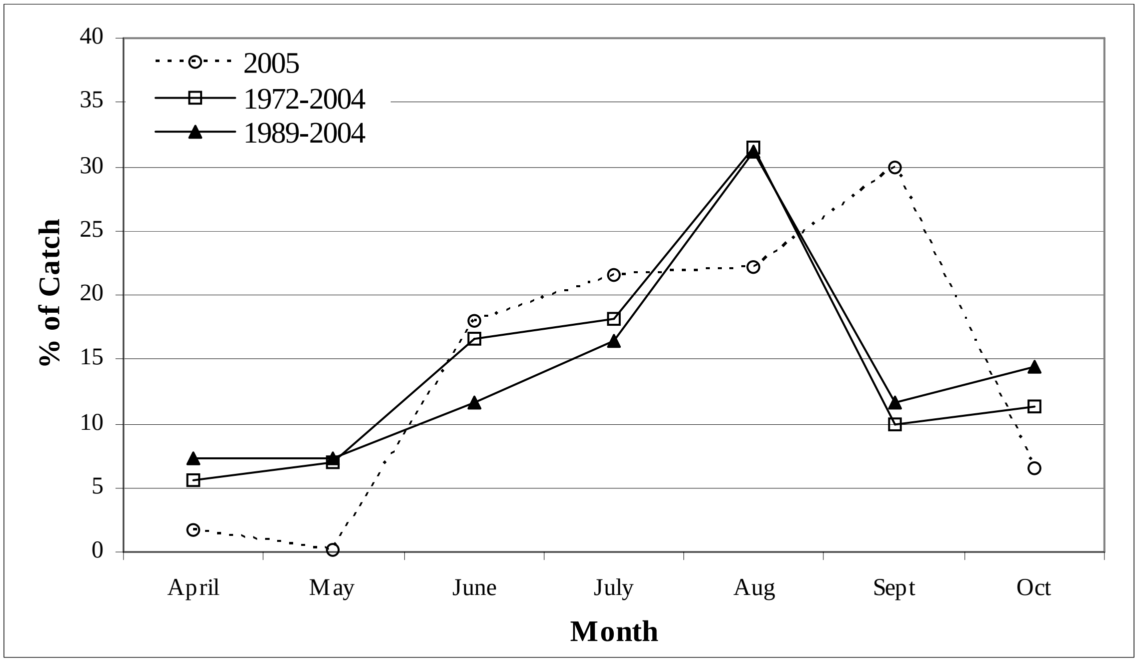

Figure 33. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal bay anchovy trawl percent catch by month.

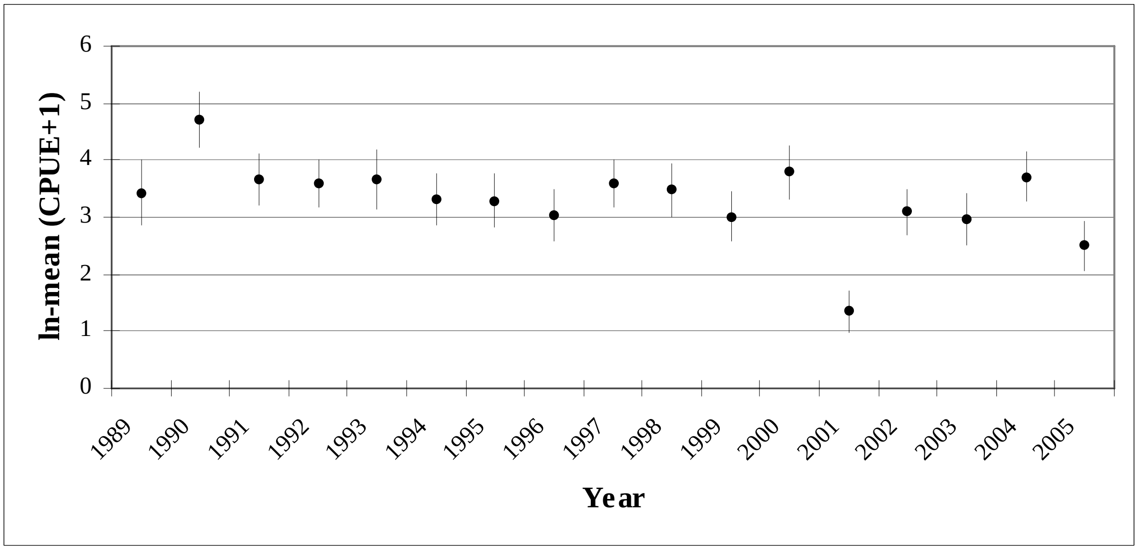

Figure 34. Bay anchovy trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

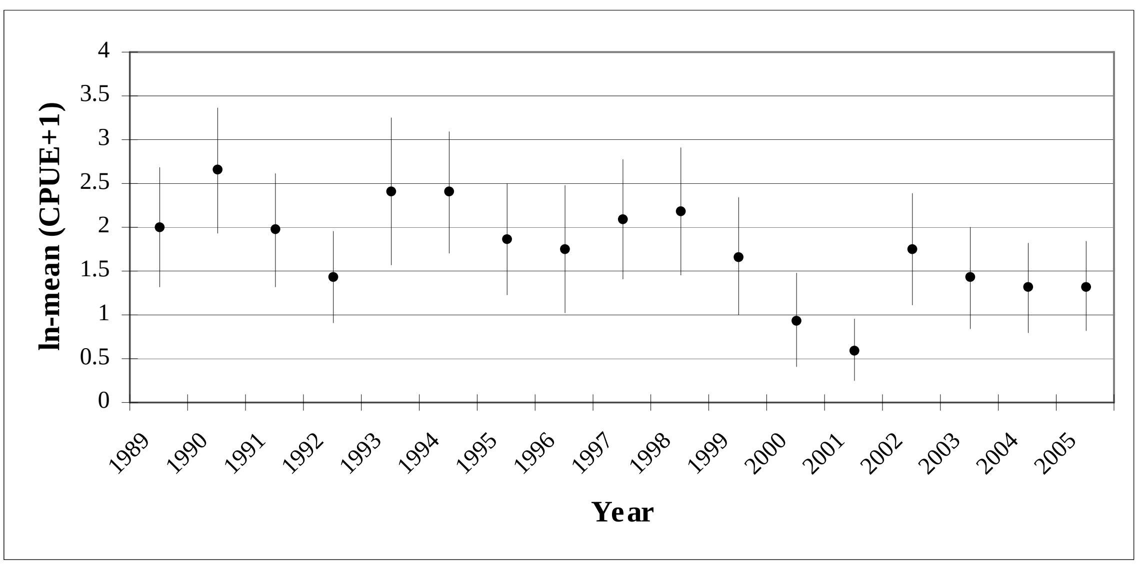

Figure 35. Bay anchovy beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

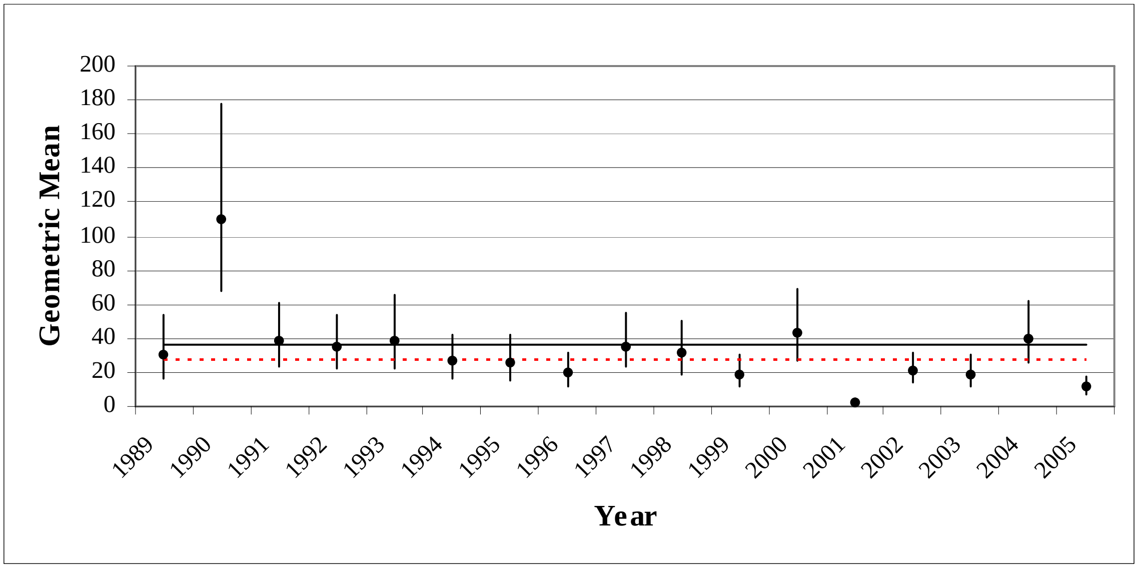

Figure 36. Bay anchovy trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

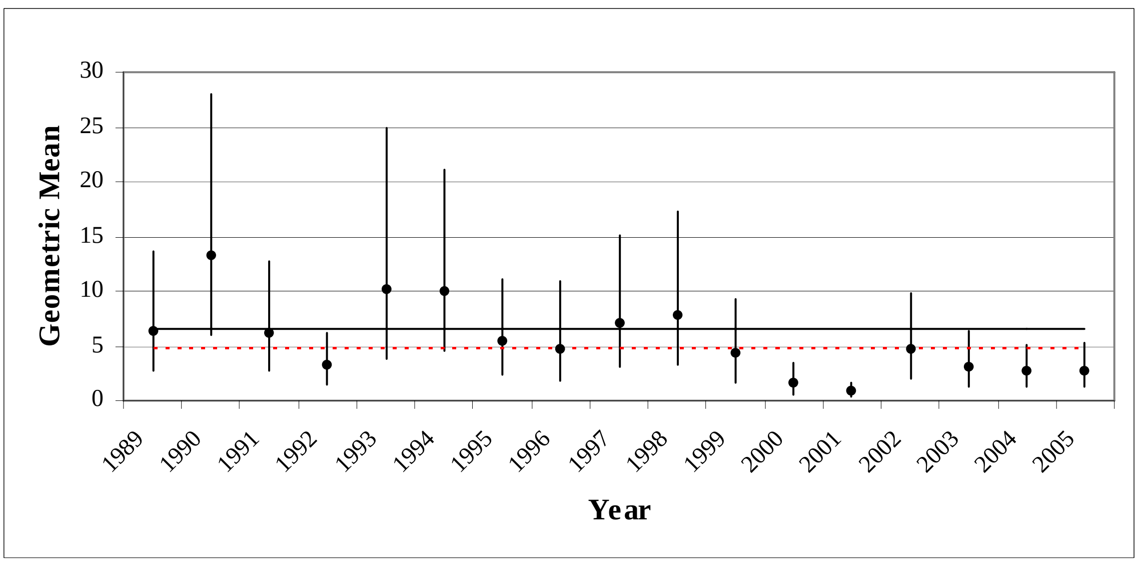

Figure 37. Bay anchovy beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

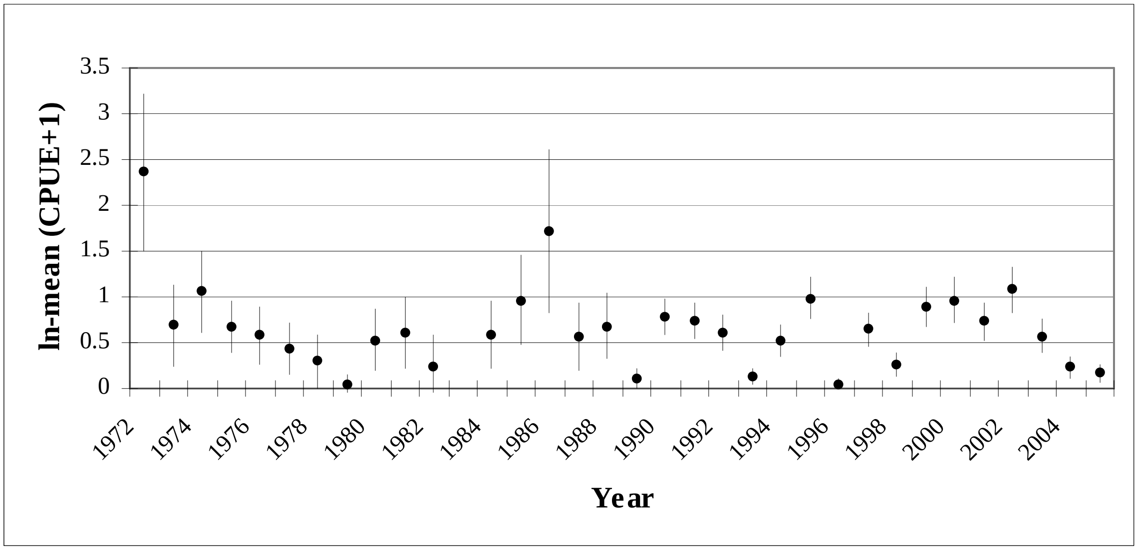

Figure 38. Black sea bass trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

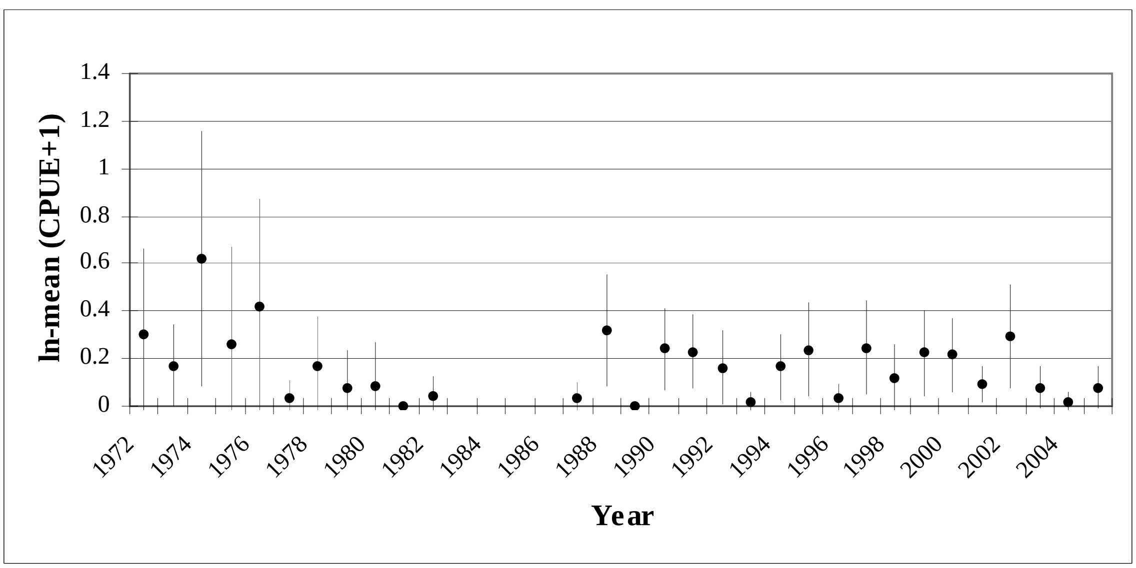

Figure 39. Black sea bass beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

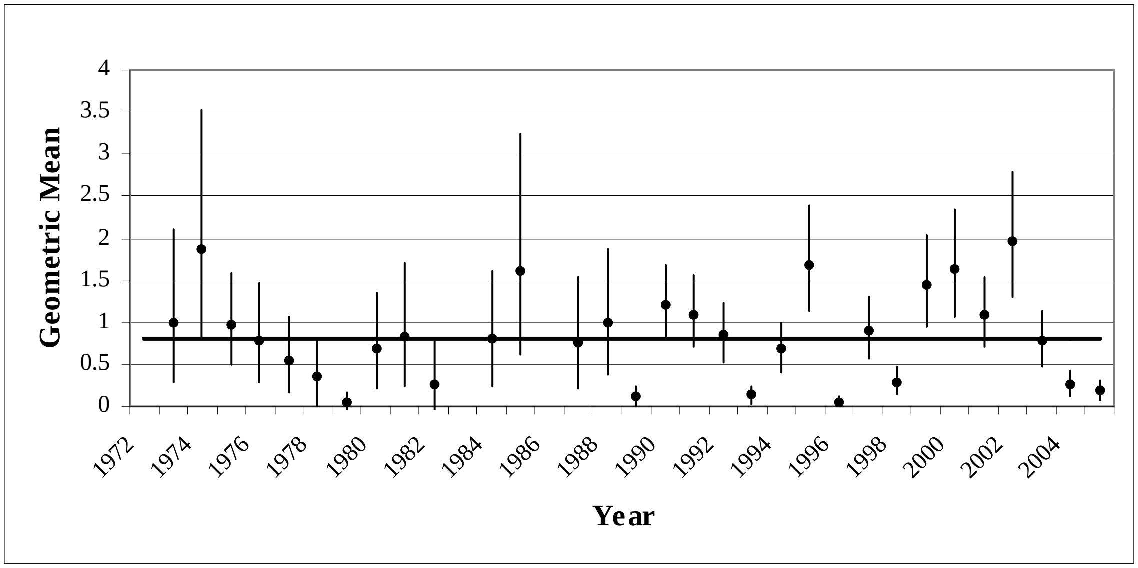

Figure 40. Black sea bass trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1983, and 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3, 1986: n=22). Solid line represents the time series grand mean.

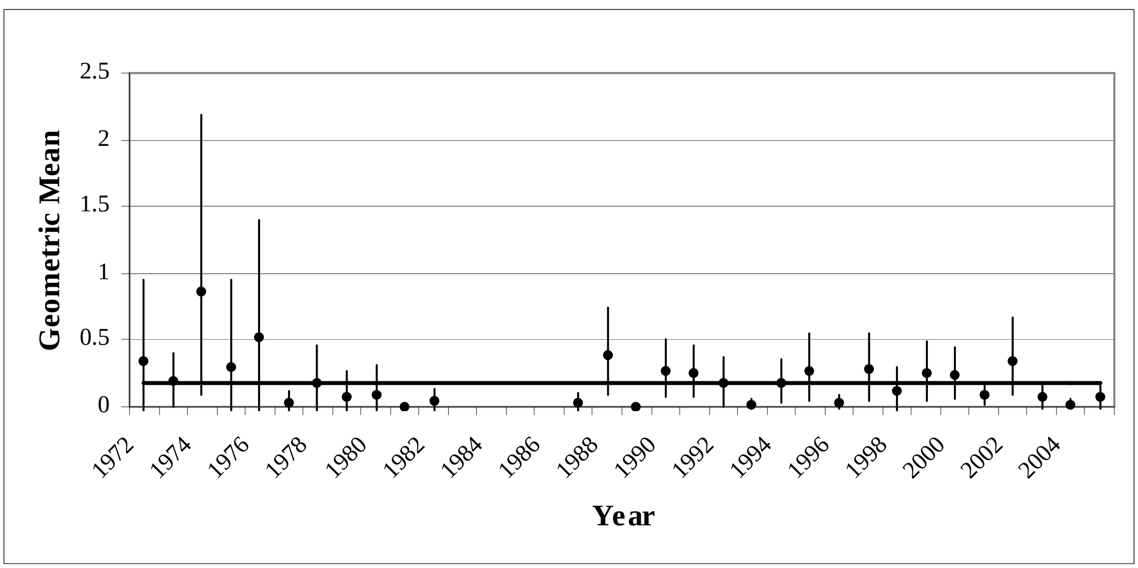

Figure 41. Black sea bass beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

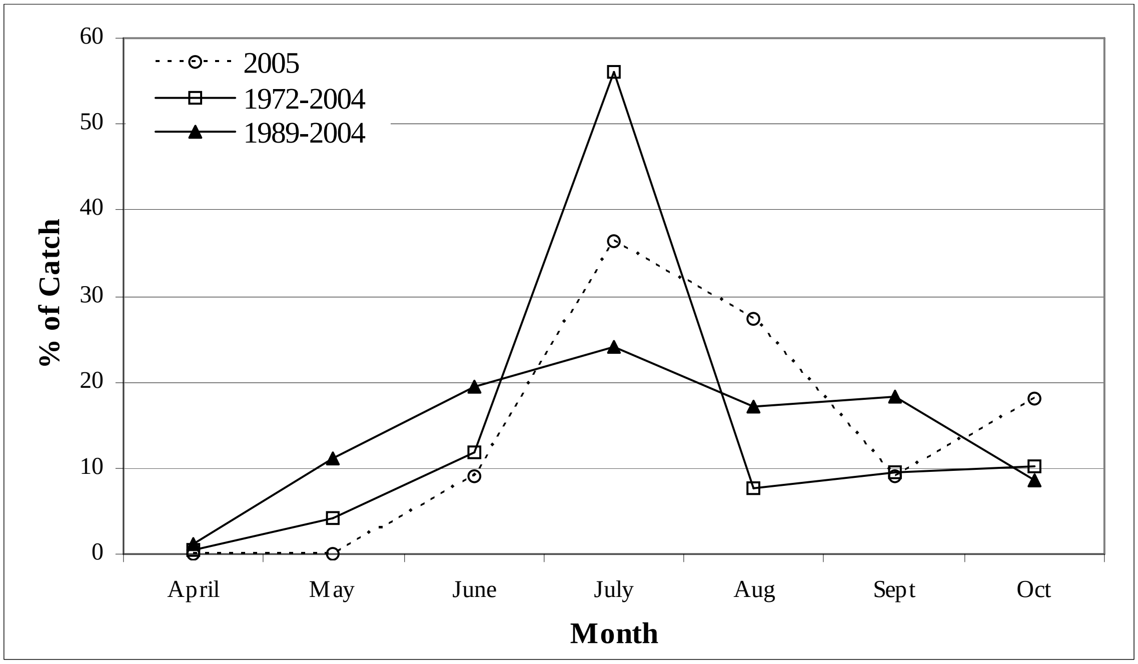

Figure 42. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal black sea bass trawl percent catch by month.

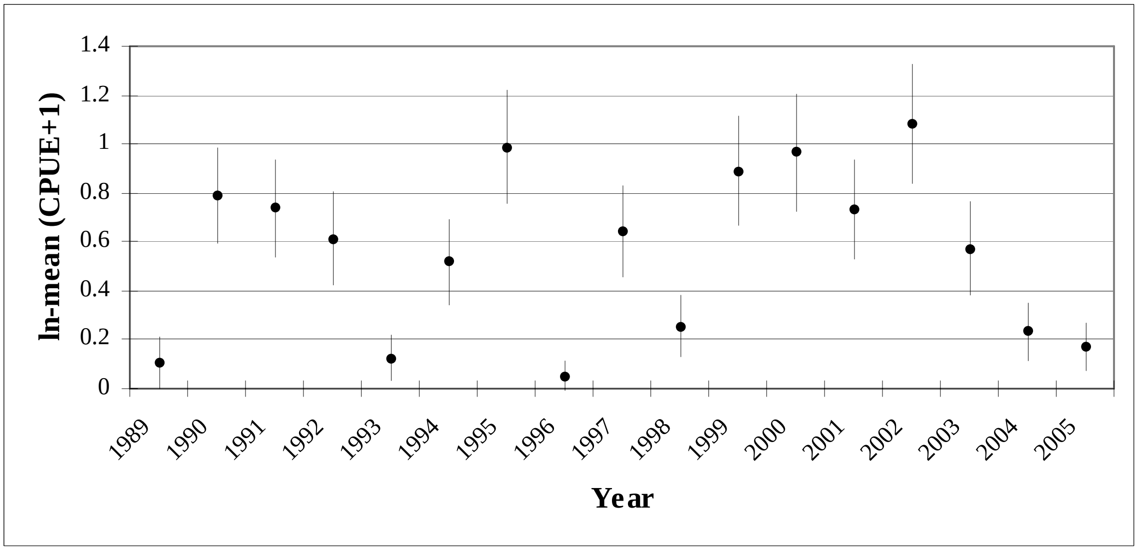

Figure 43. Black sea bass trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

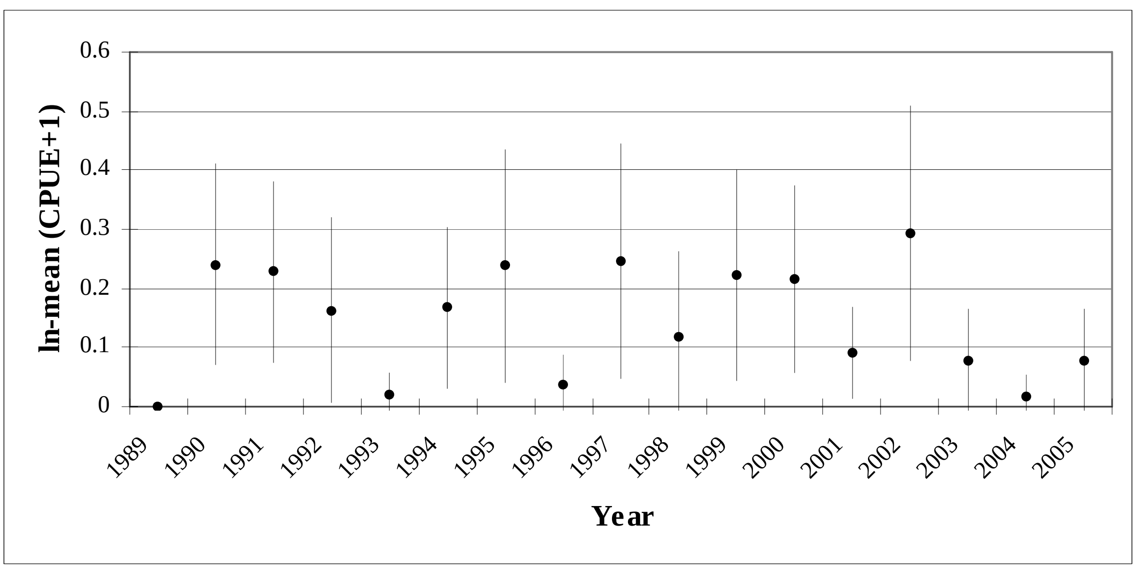

Figure 44. Black sea bass beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

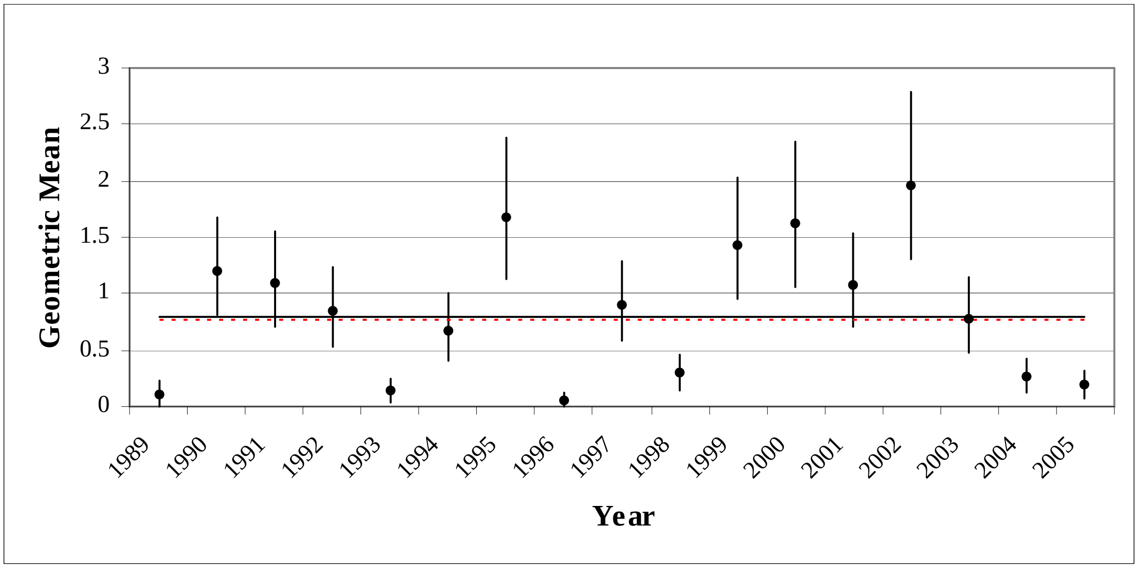

Figure 45. Black sea bass trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

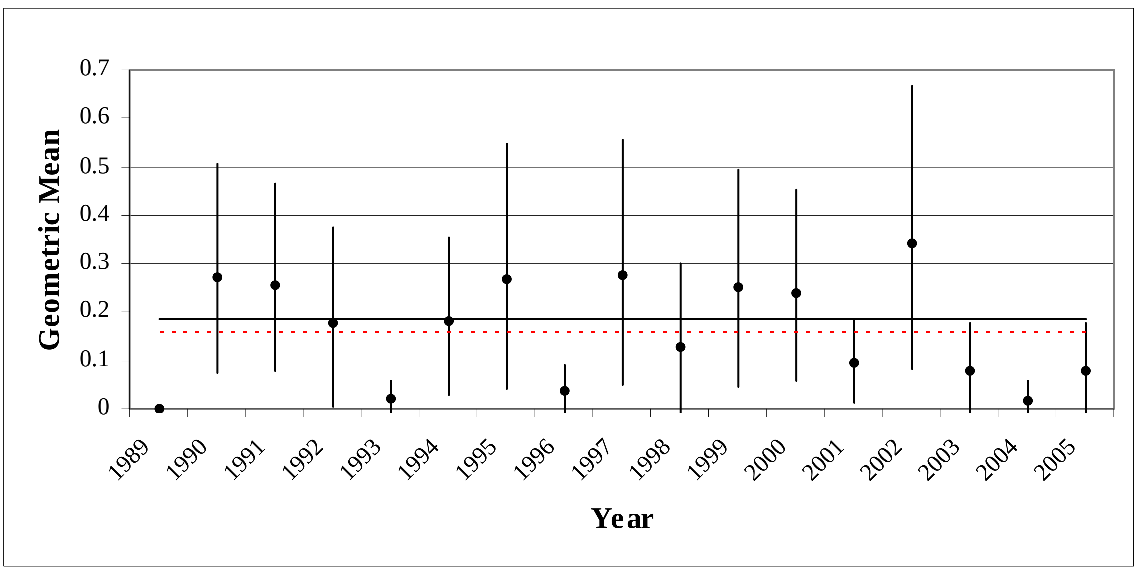

Figure 46. Black sea bass beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

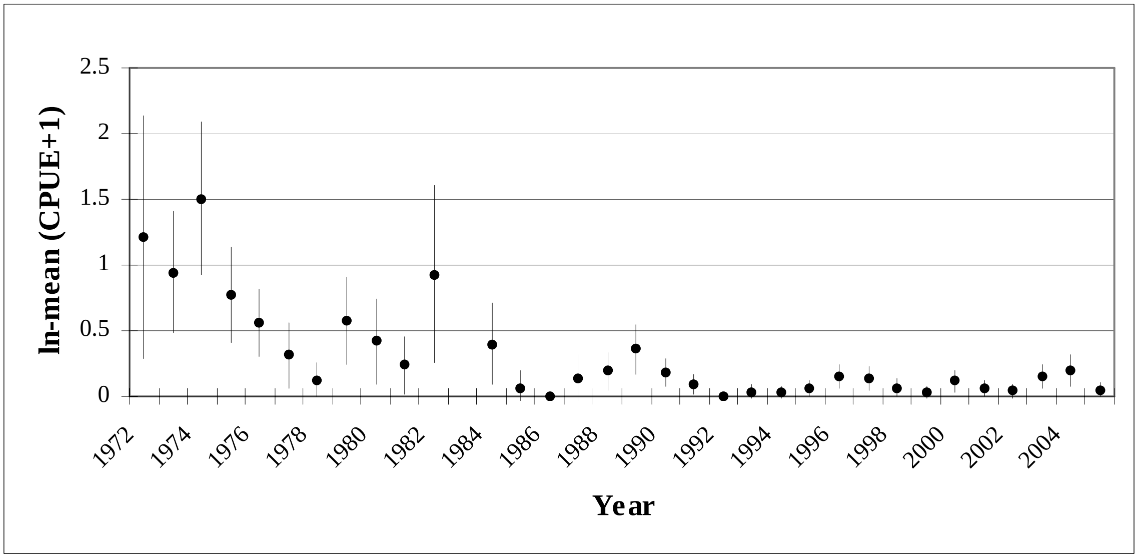

Figure 47. Bluefish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

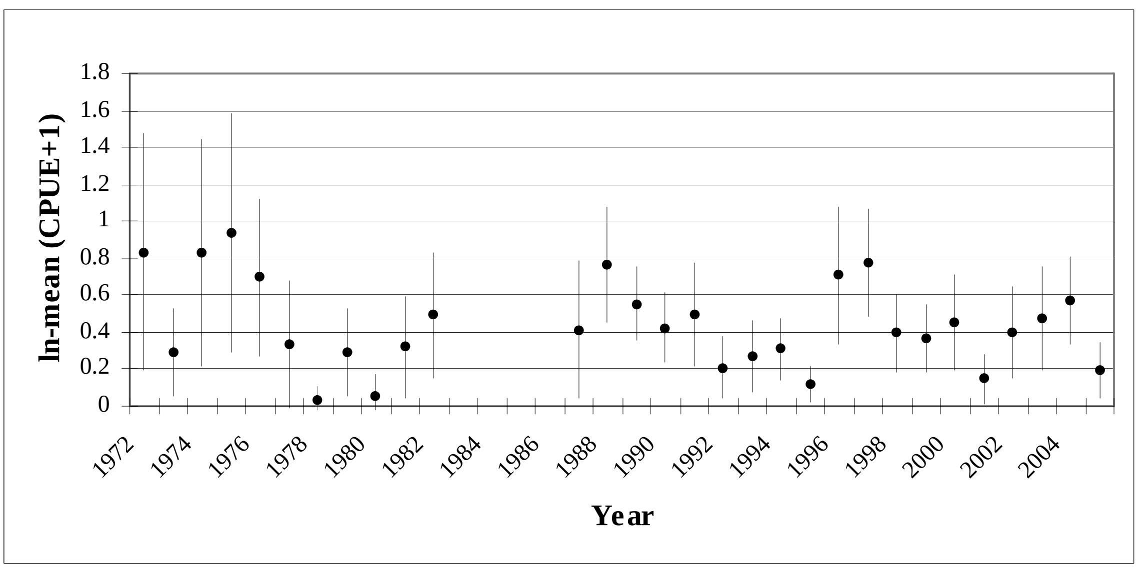

Figure 48. Bluefish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

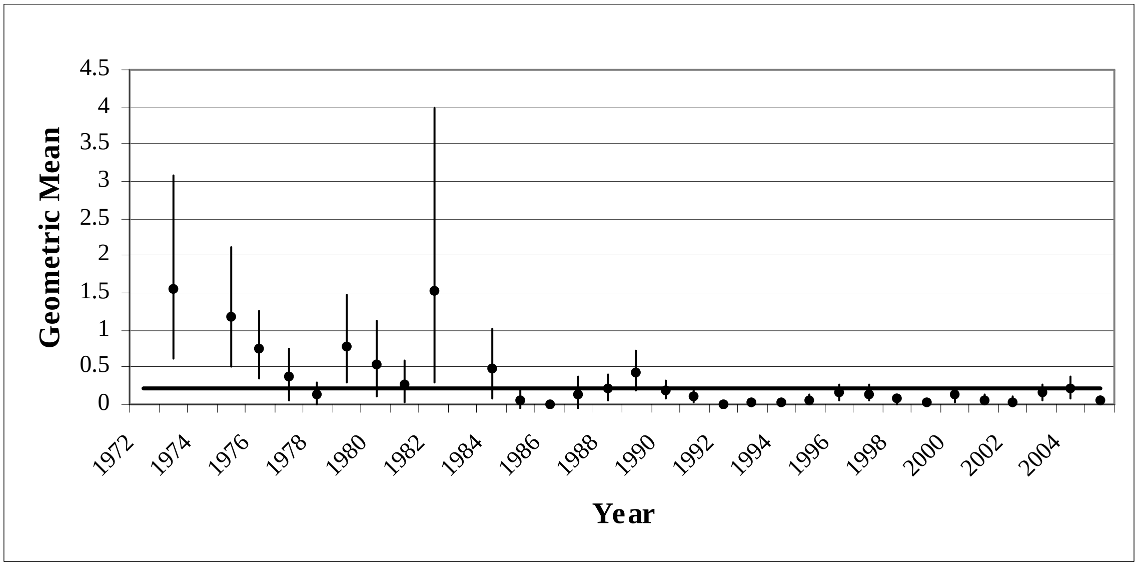

Figure 49. Bluefish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1974, and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1974: n=43, 1983: n=3). Solid line represents the time series grand mean.

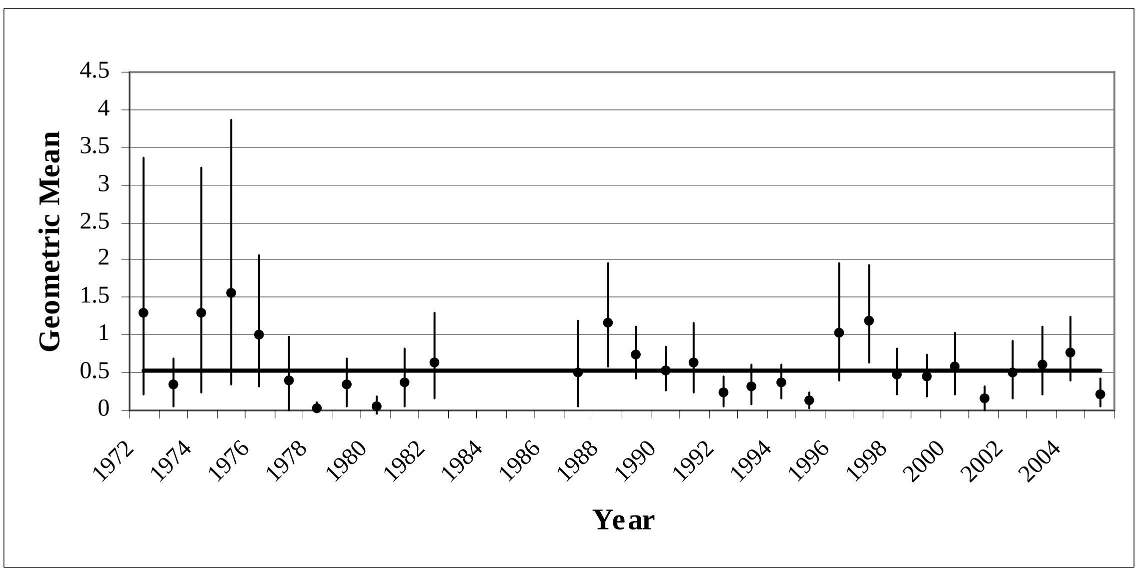

Figure 50. Bluefish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

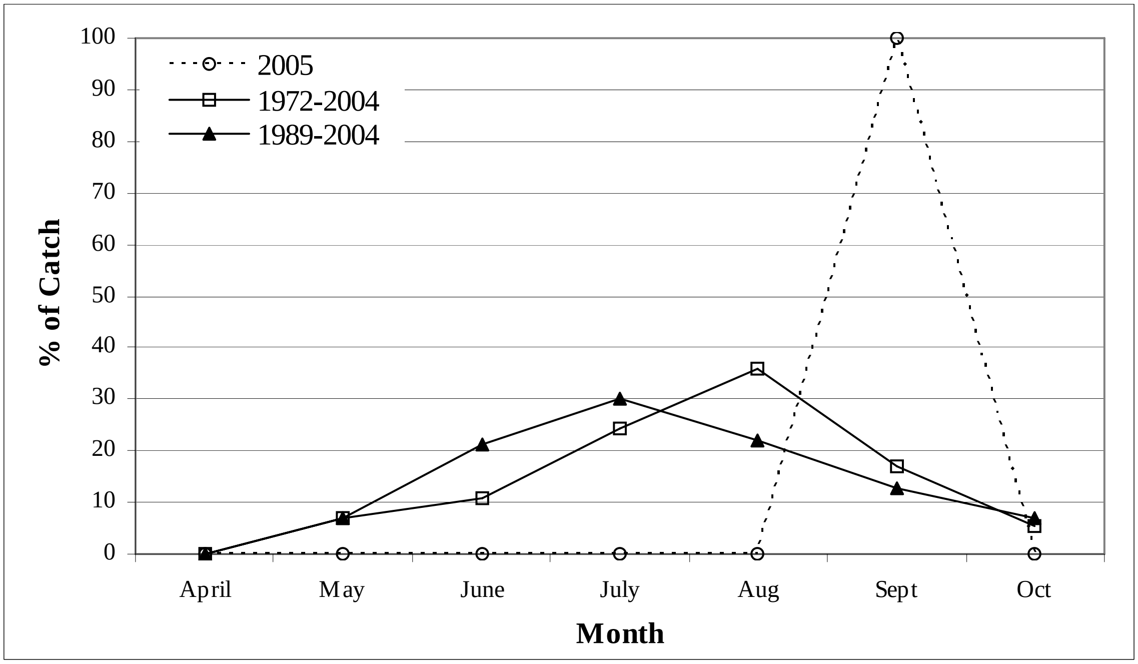

Figure 51. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal bluefish trawl percent catch by month.

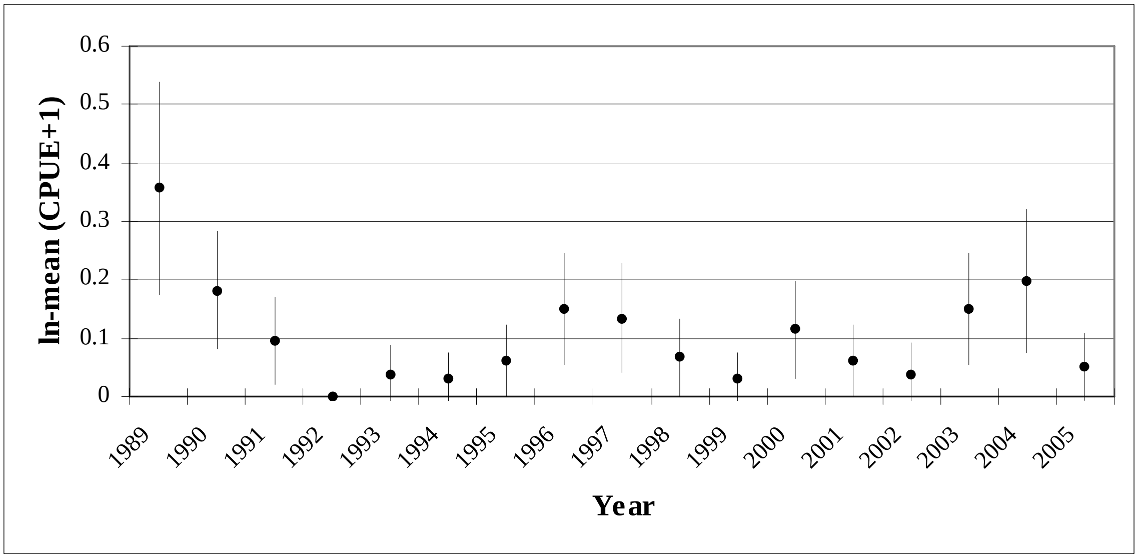

Figure 52. Bluefish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

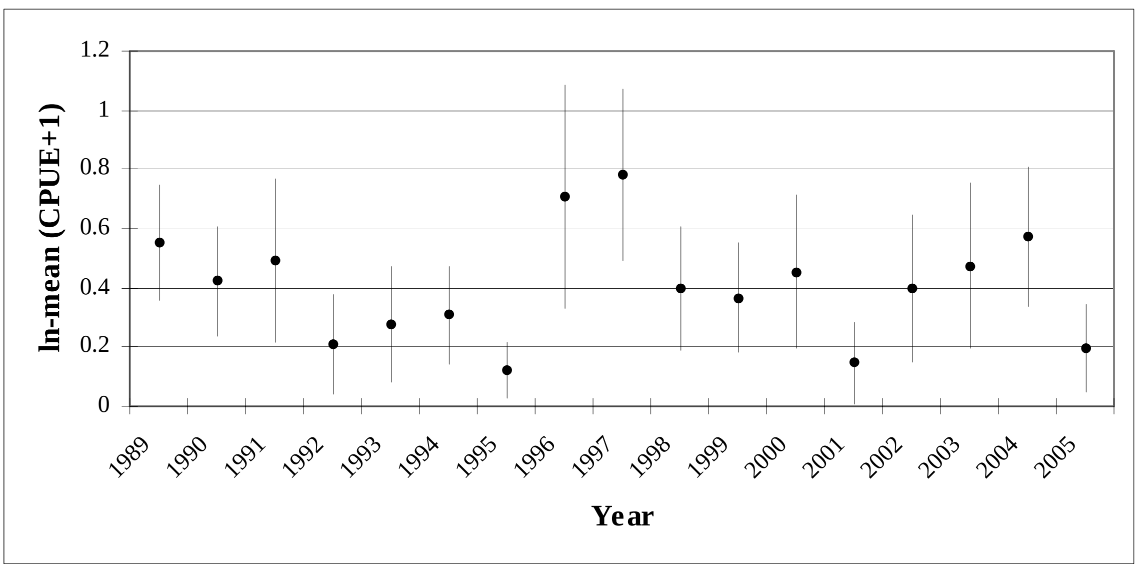

Figure 53. Bluefish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

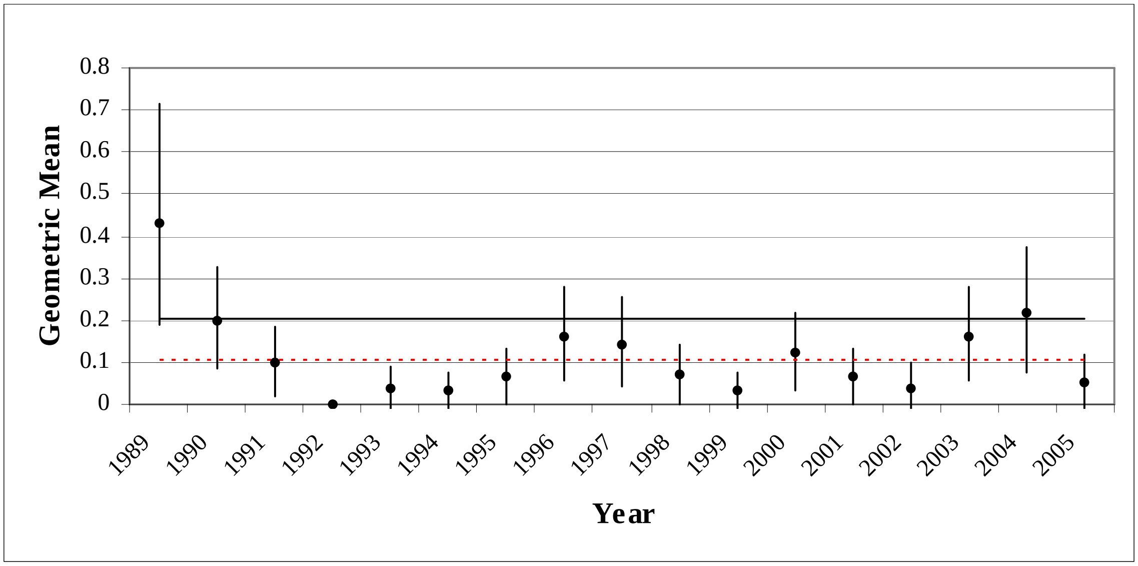

Figure 54. Bluefish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

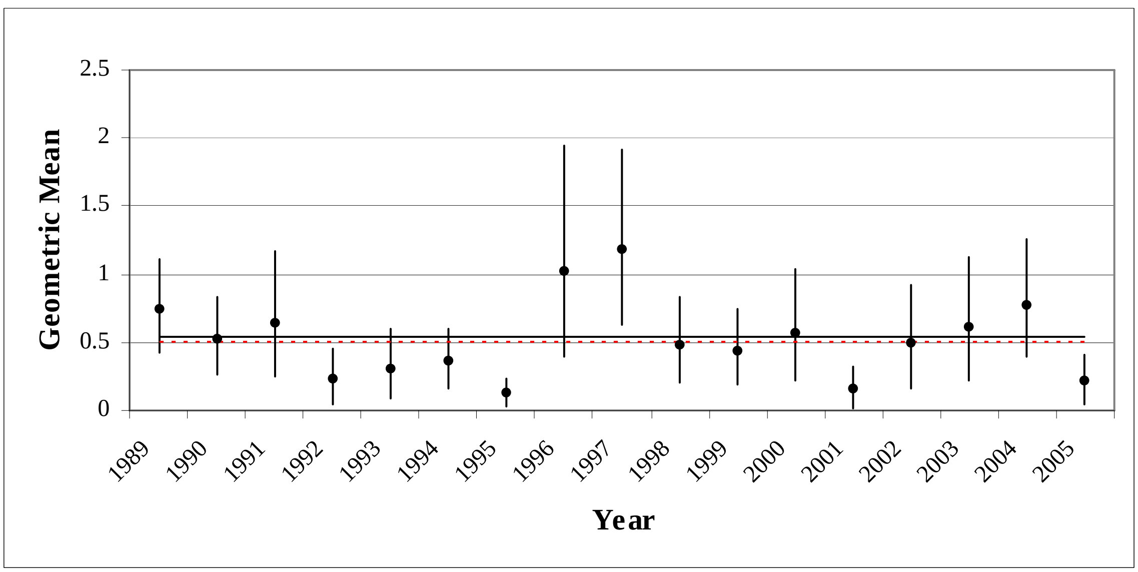

Figure 55. Bluefish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

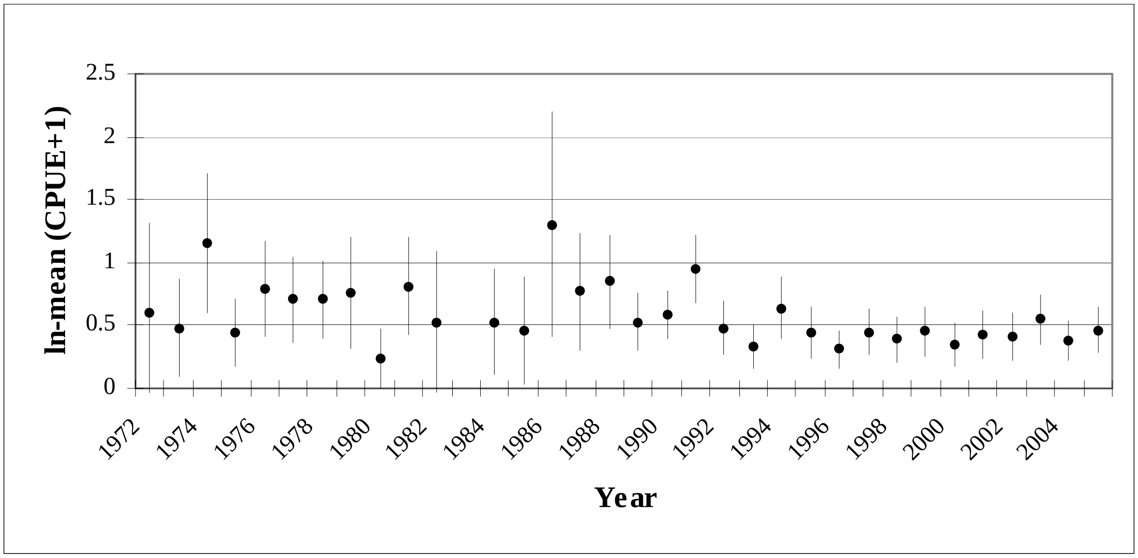

Figure 56. Hogchoker trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

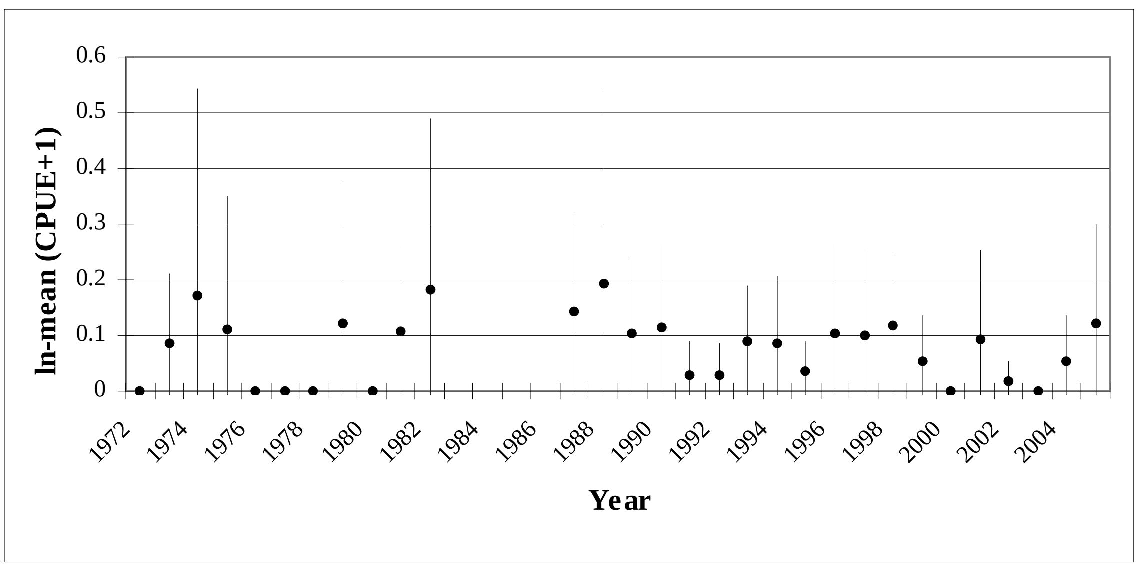

Figure 57. Hogchoker beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

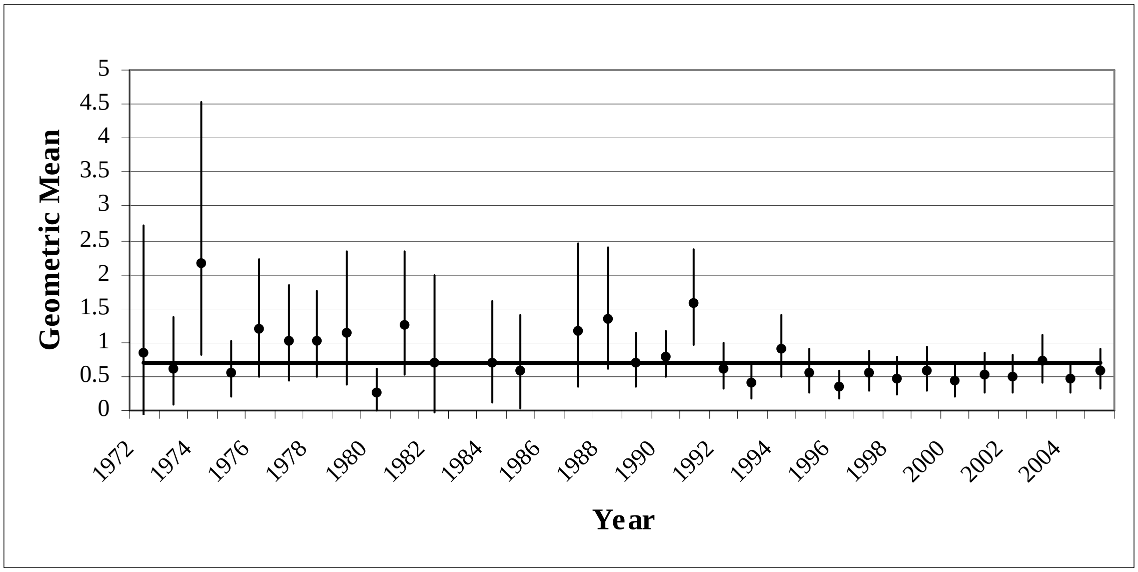

Figure 58. Hogchoker trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 and 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3, 1986: n=22). Solid line represents the time series grand mean.

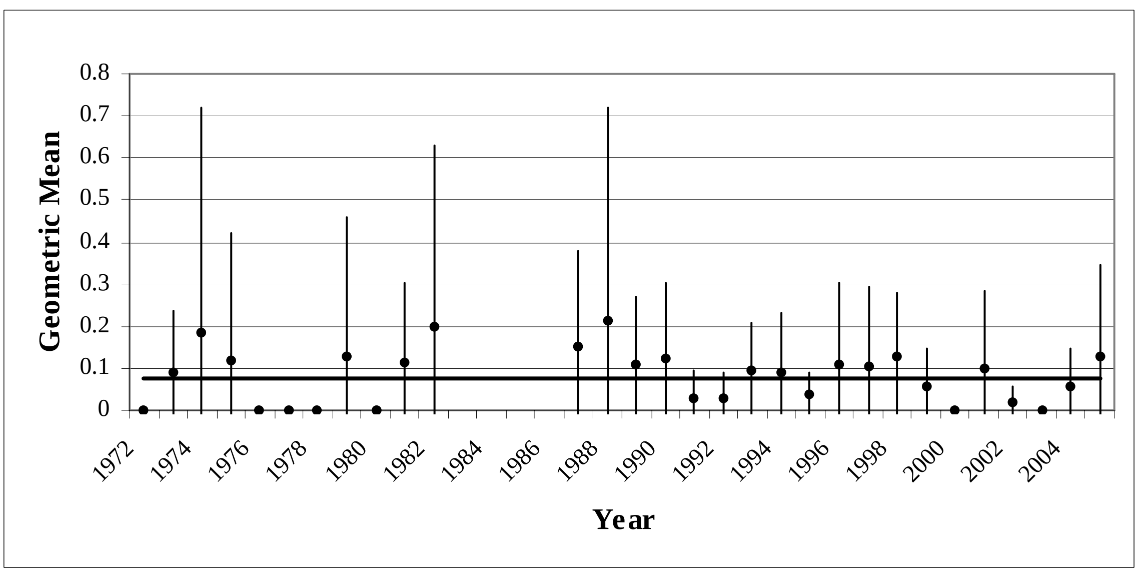

Figure 59. Hogchoker beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

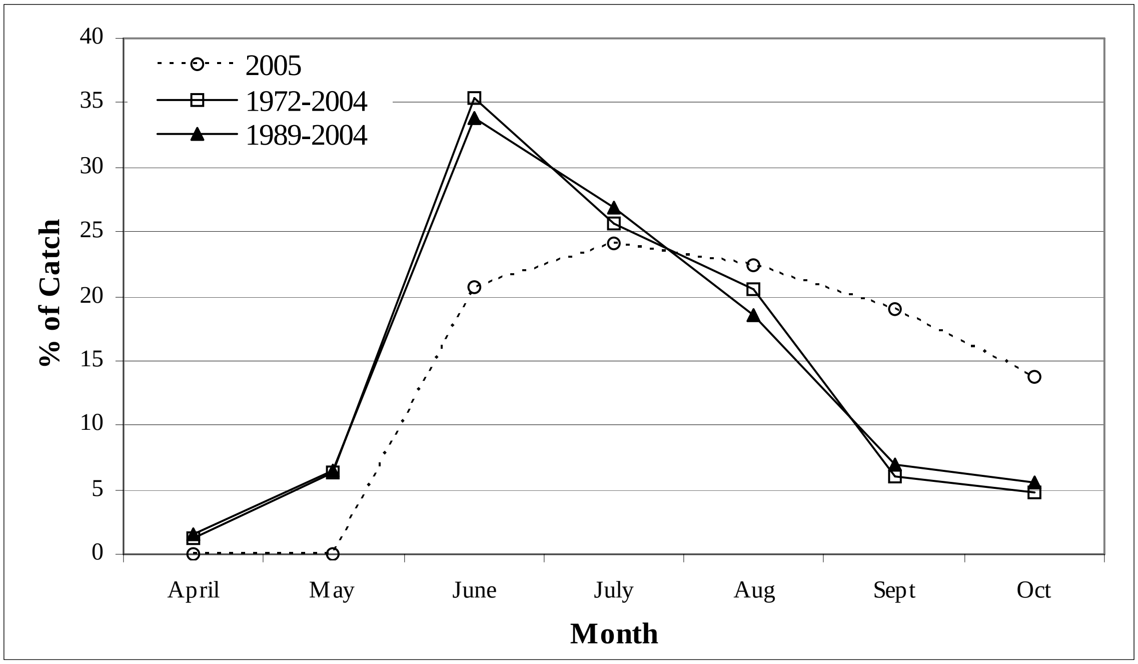

Figure 60. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal hogchoker trawl percent catch by month.

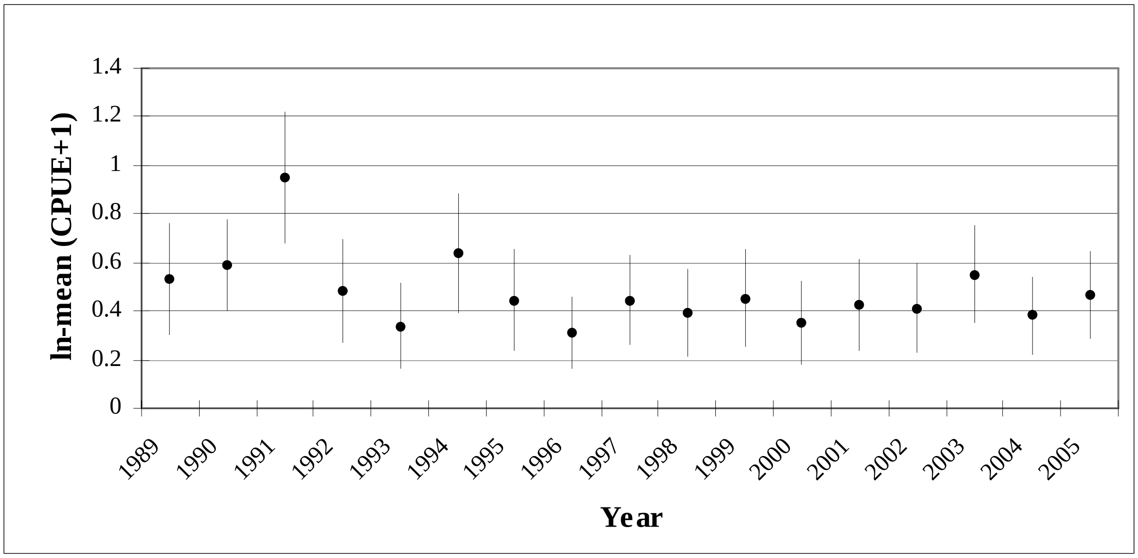

Figure 61. Hogchoker trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

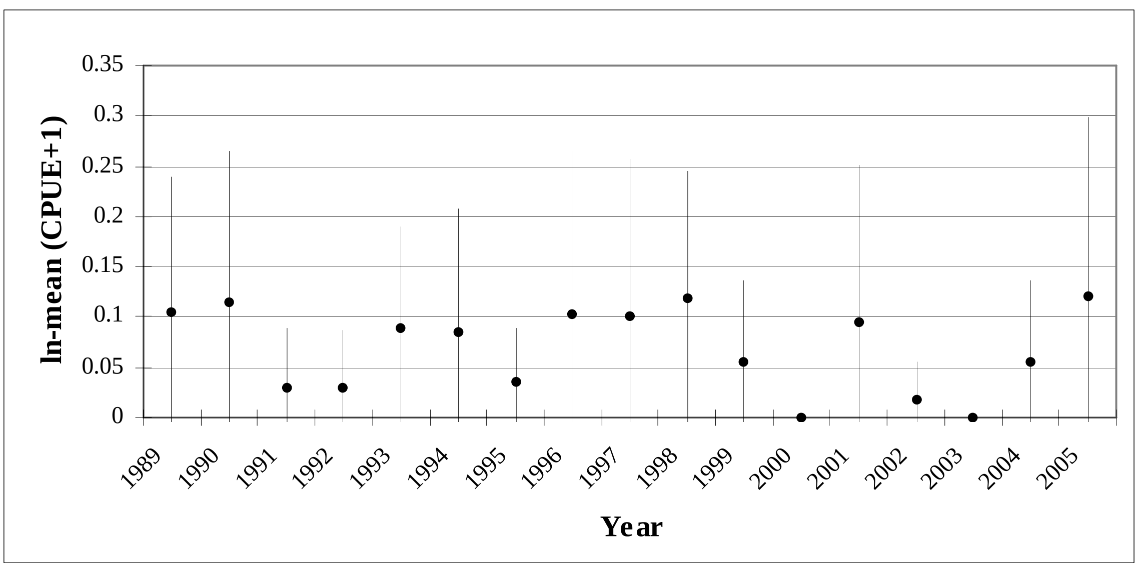

Figure 62. Hogchoker beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

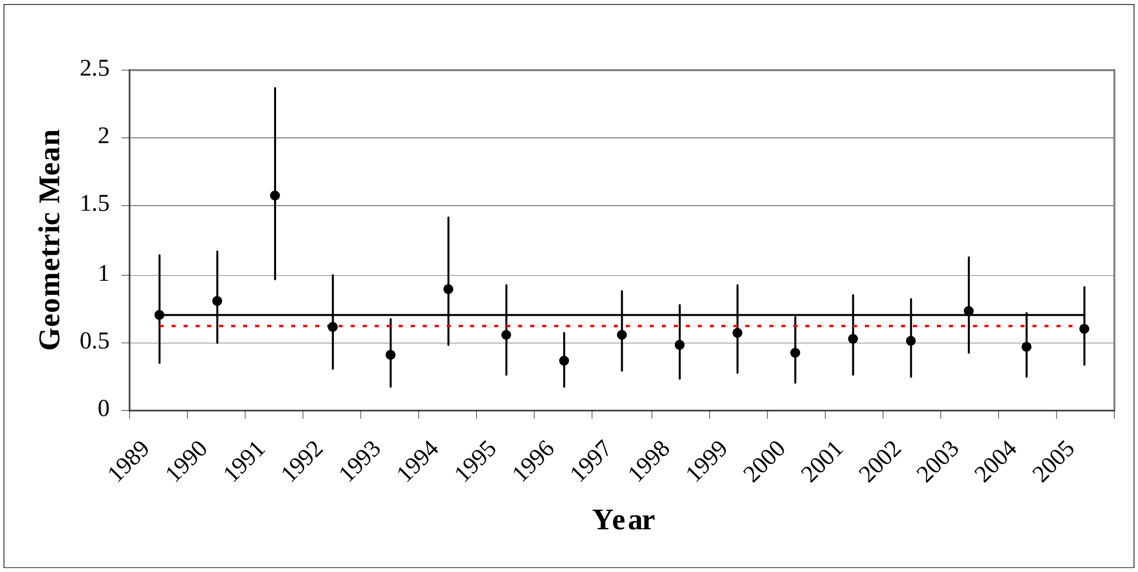

Figure 63. Hogchoker trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

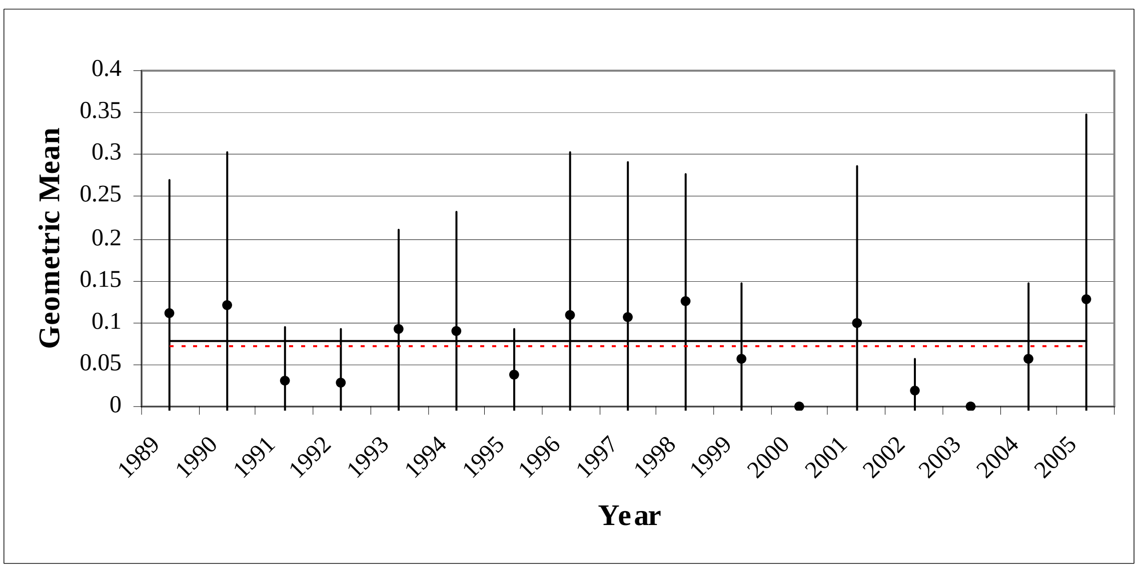

Figure 64. Hogchoker beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

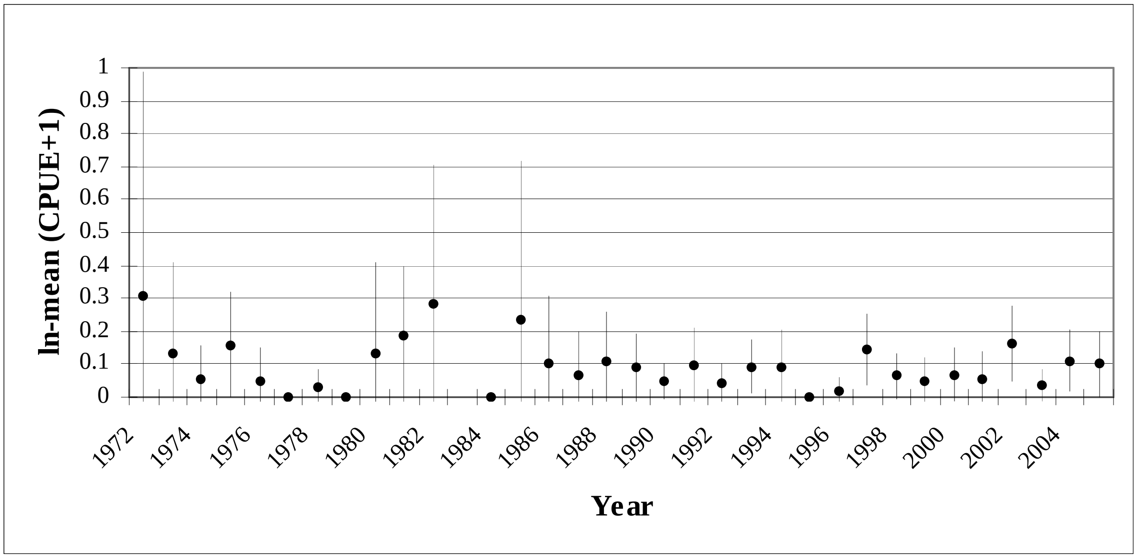

Figure 65. Mummichog trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

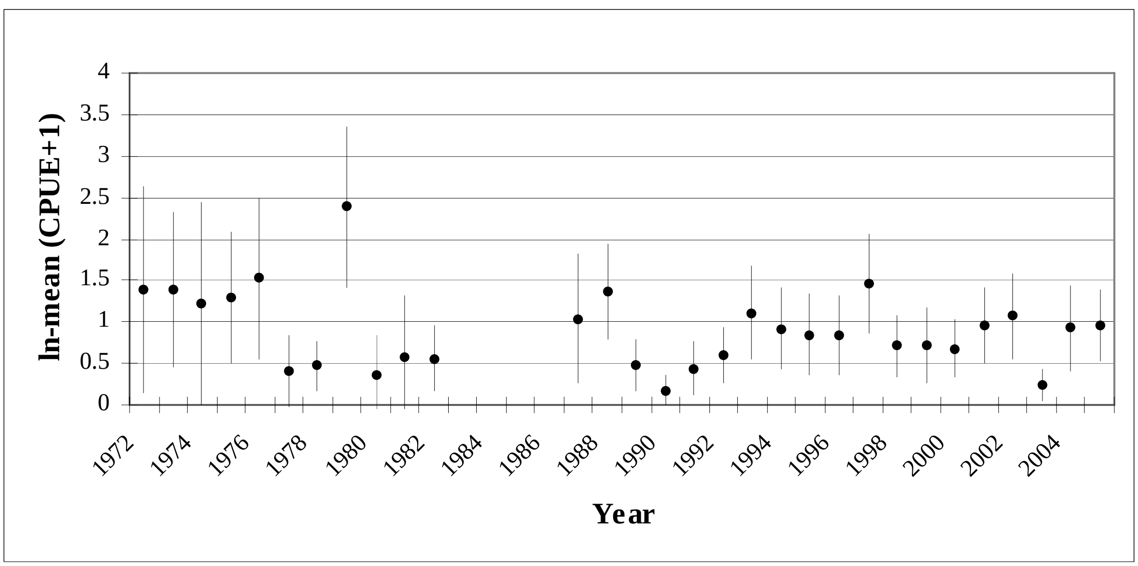

Figure 66. Mummichog beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

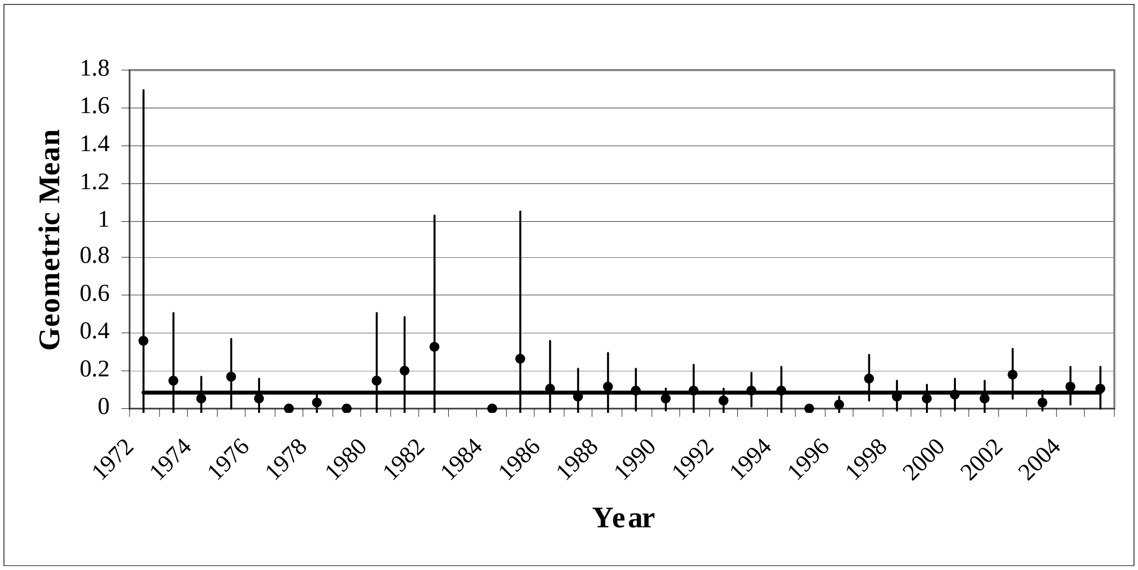

Figure 67. Mummichog trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3). Solid line represents the time series grand mean.

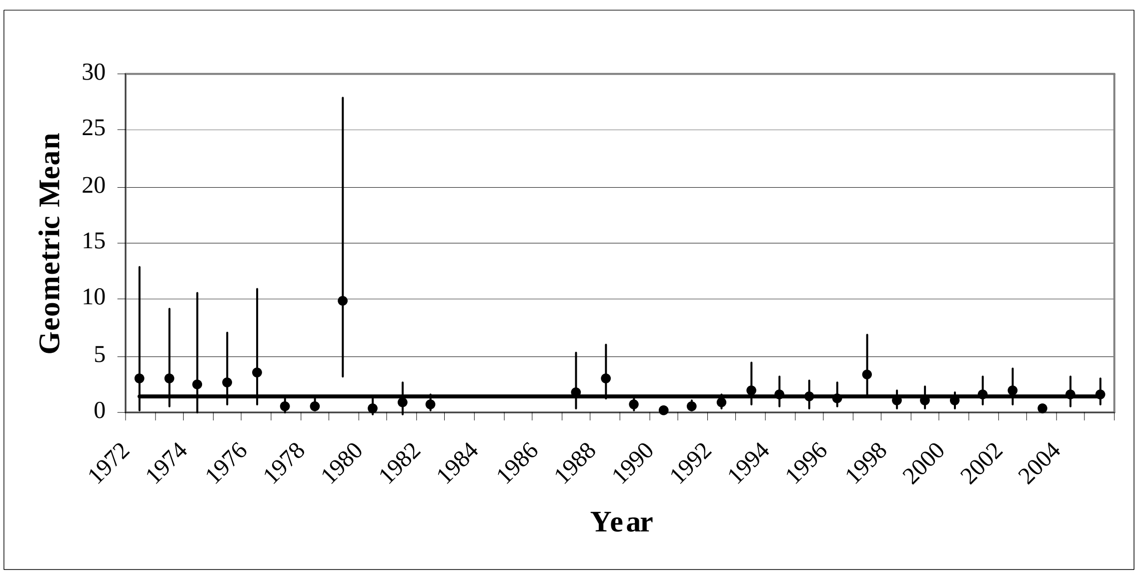

Figure 68. Mummichog beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

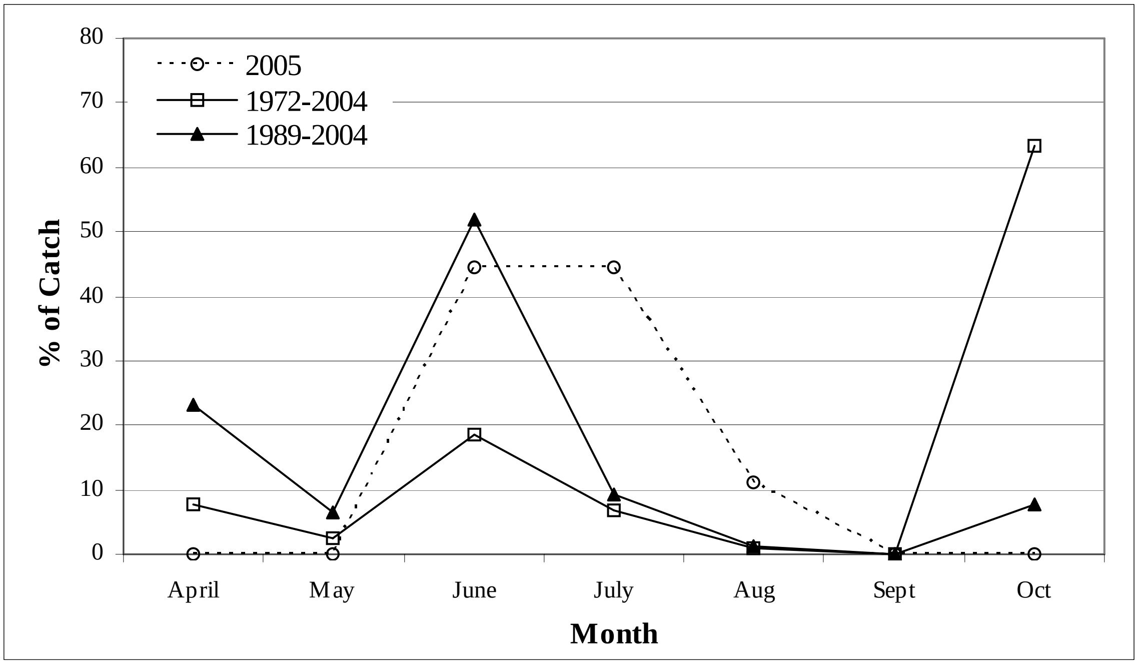

Figure 69. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal mummichog trawl percent catch by month.

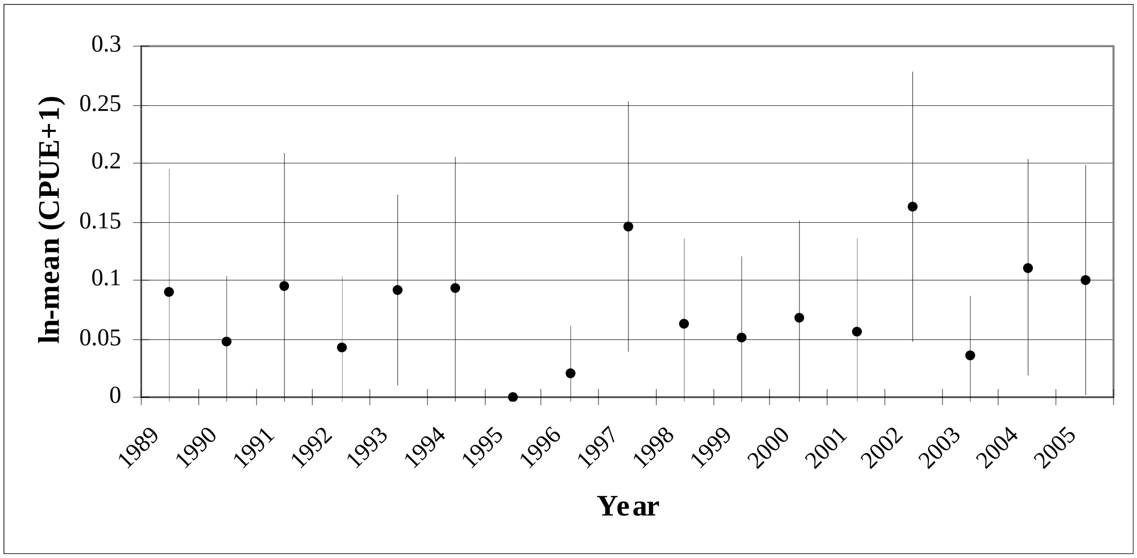

Figure 70. Mummichog trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

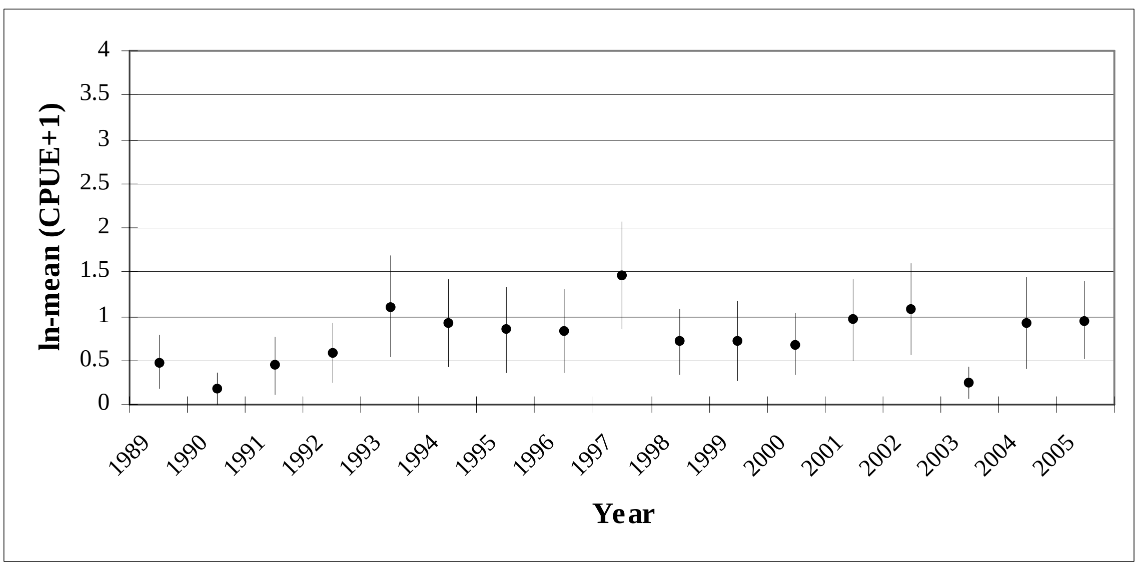

Figure 71. Mummichog beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

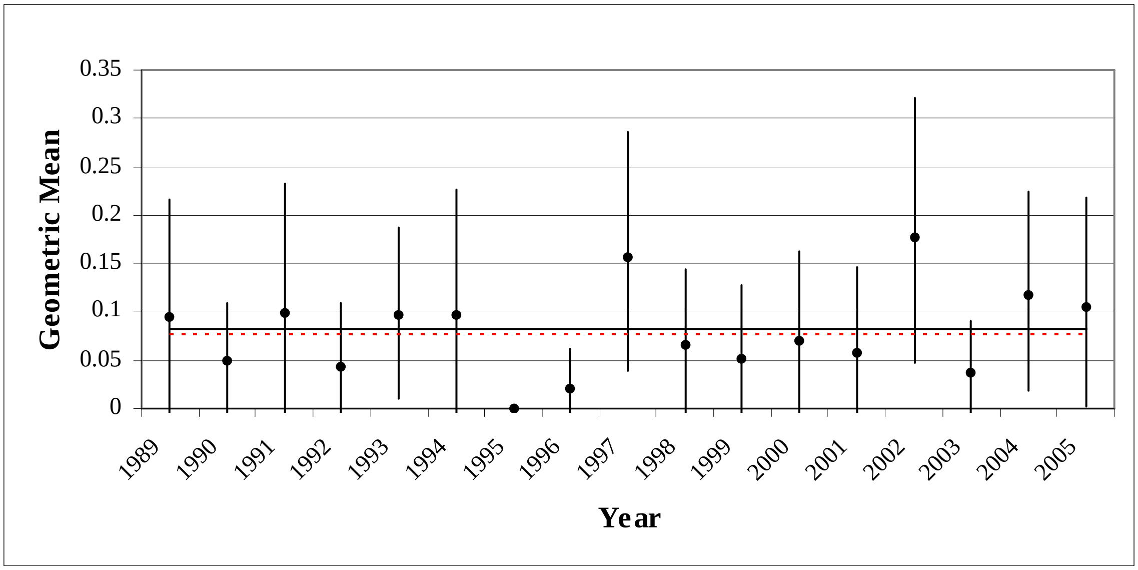

Figure 72. Mummichog trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

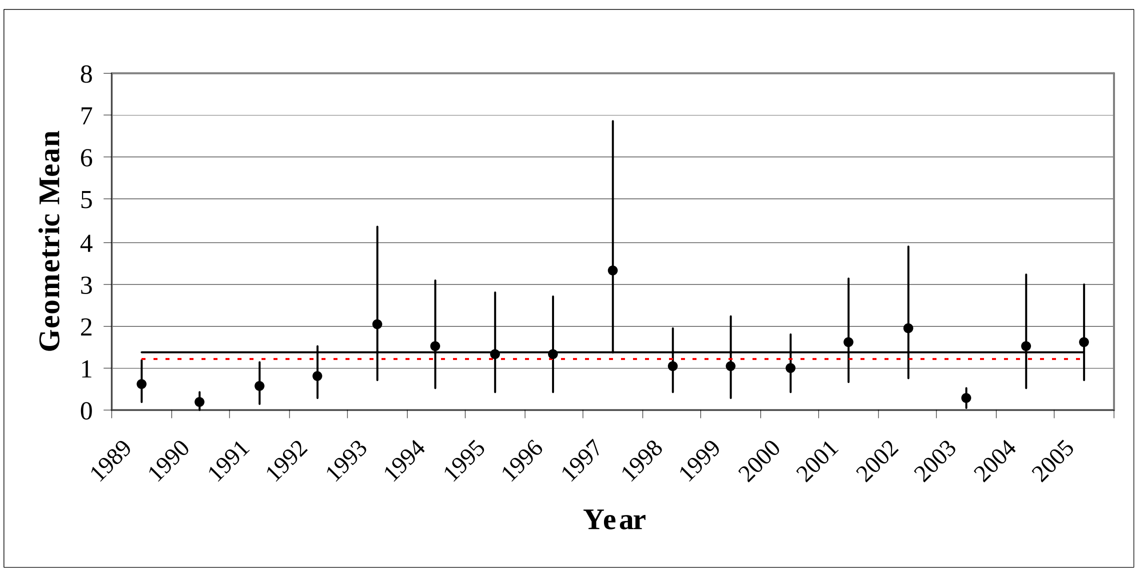

Figure 73. Mummichog beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

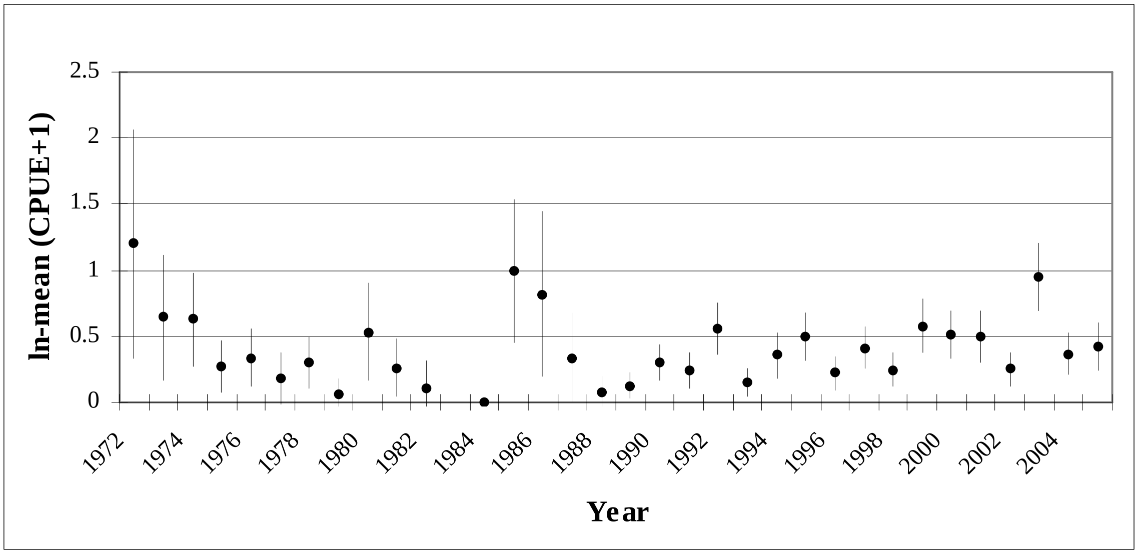

Figure 74. Northern sea robin trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

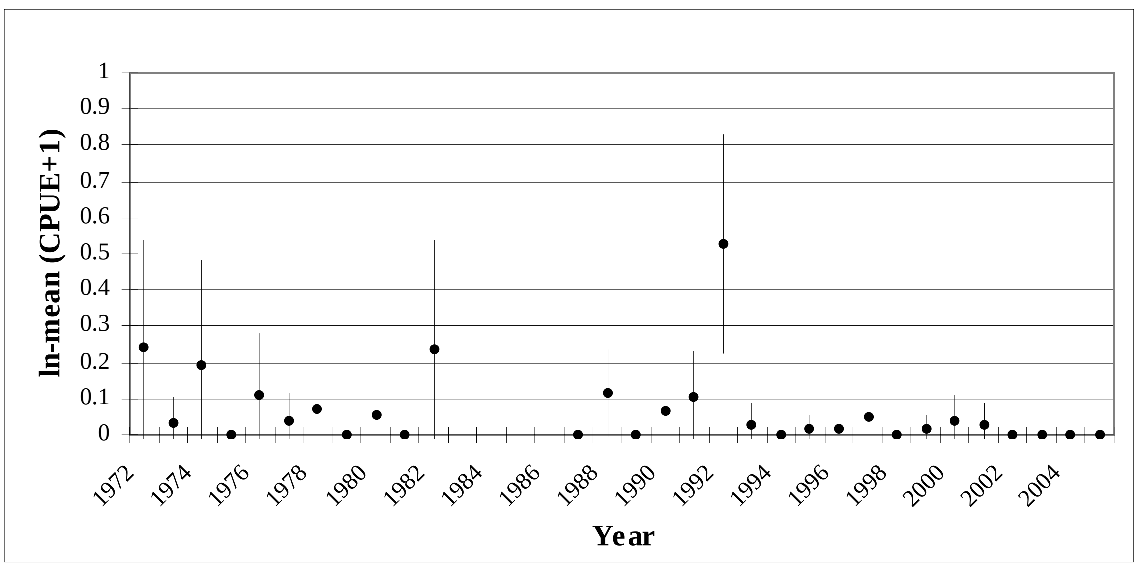

Figure 75. Northern sea robin beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

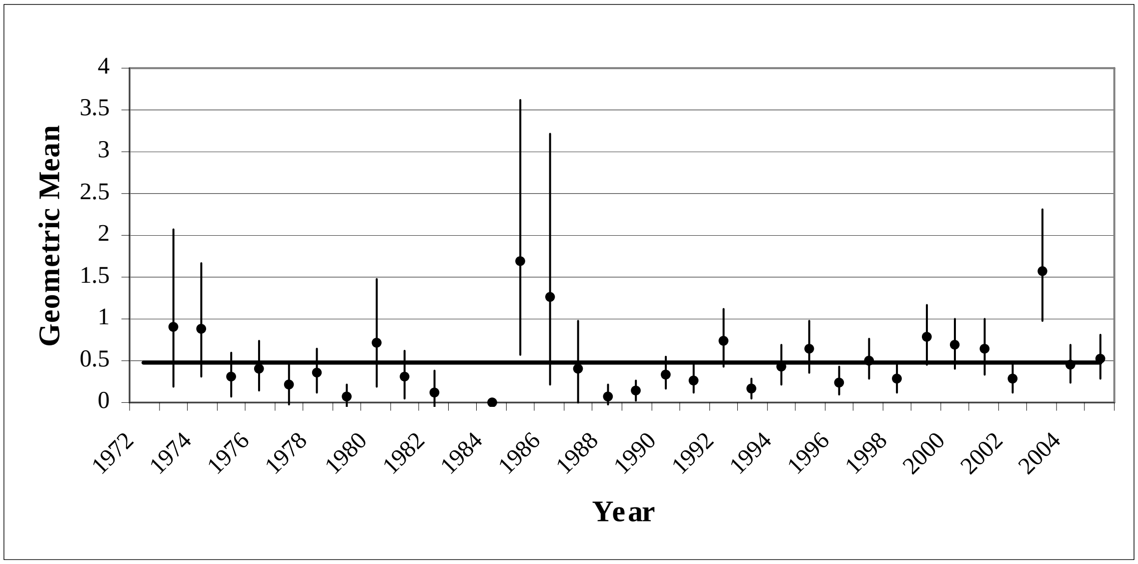

Figure 76. Northern sea robin trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972 and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3). Solid line represents the time series grand mean.

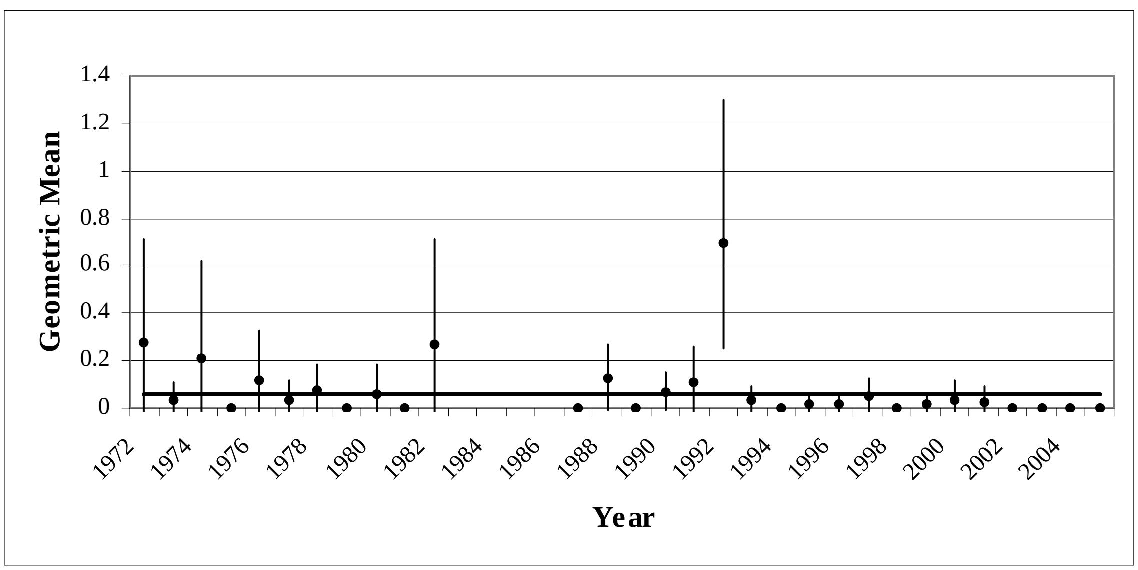

Figure 77. Northern sea robin beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

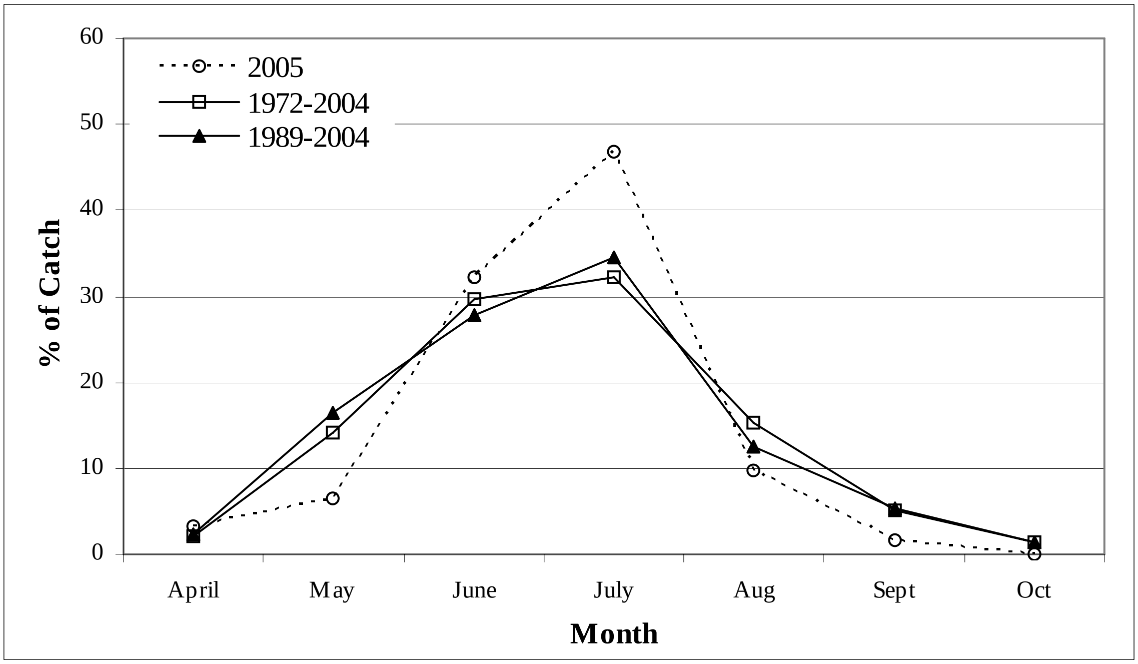

Figure 78. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal northern sea robin trawl percent catch by month.

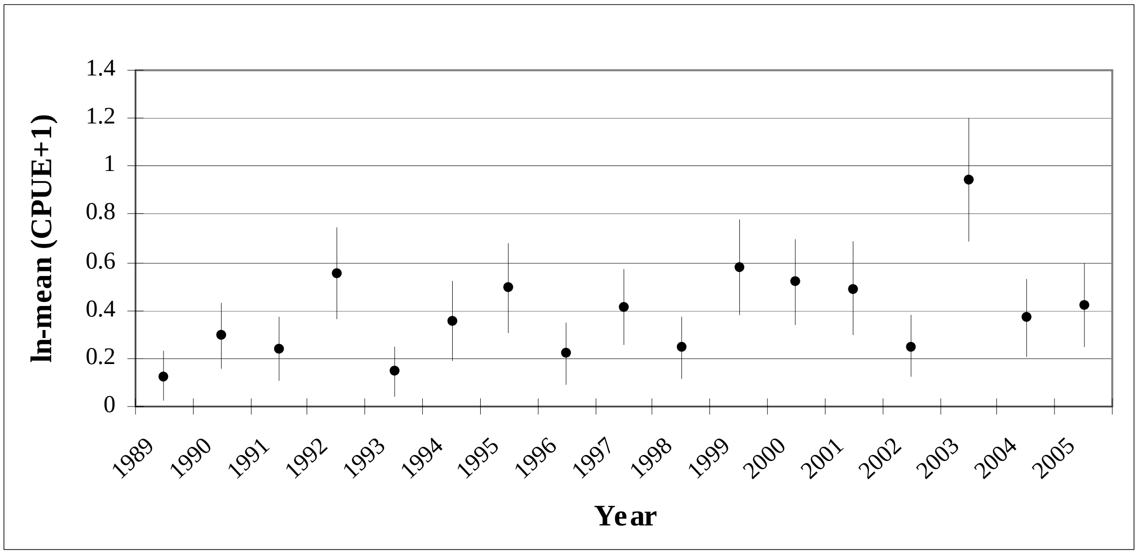

Figure 79. Northern sea robin trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

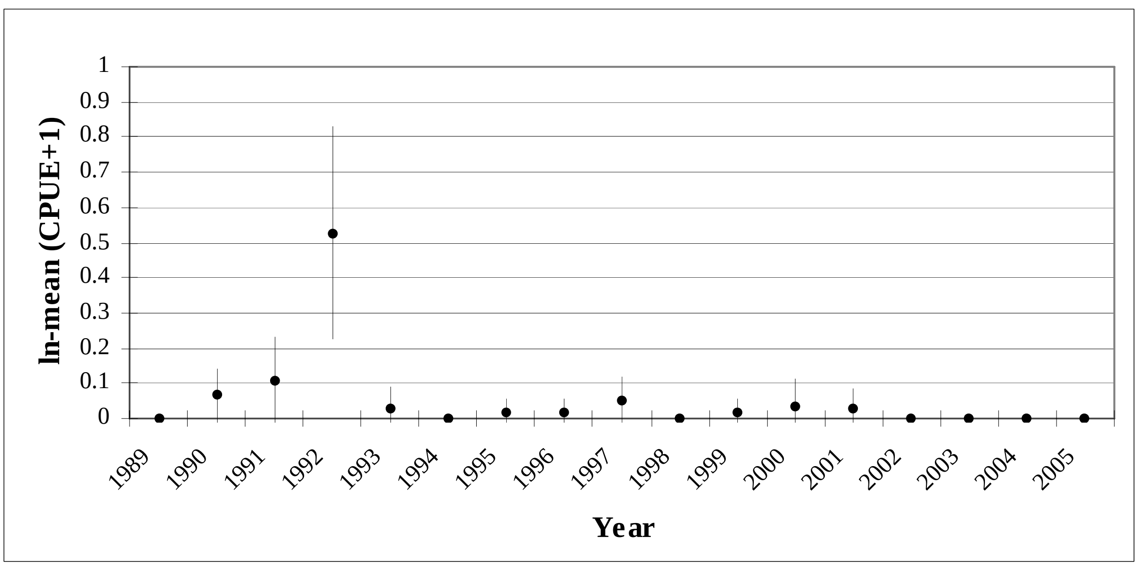

Figure 80. Northern sea robin beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

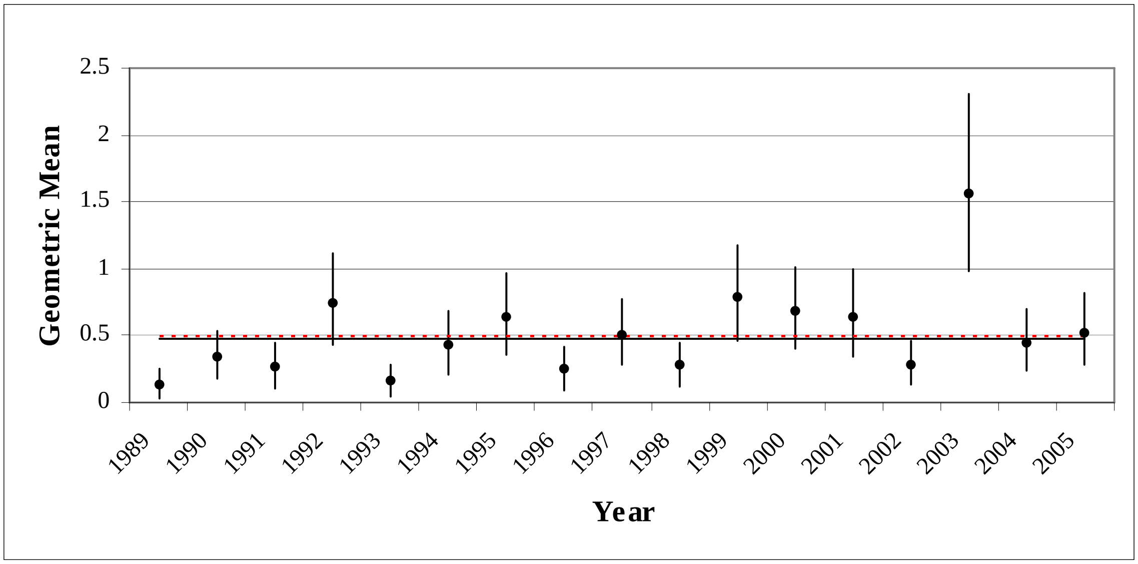

Figure 81. Northern sea robin trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

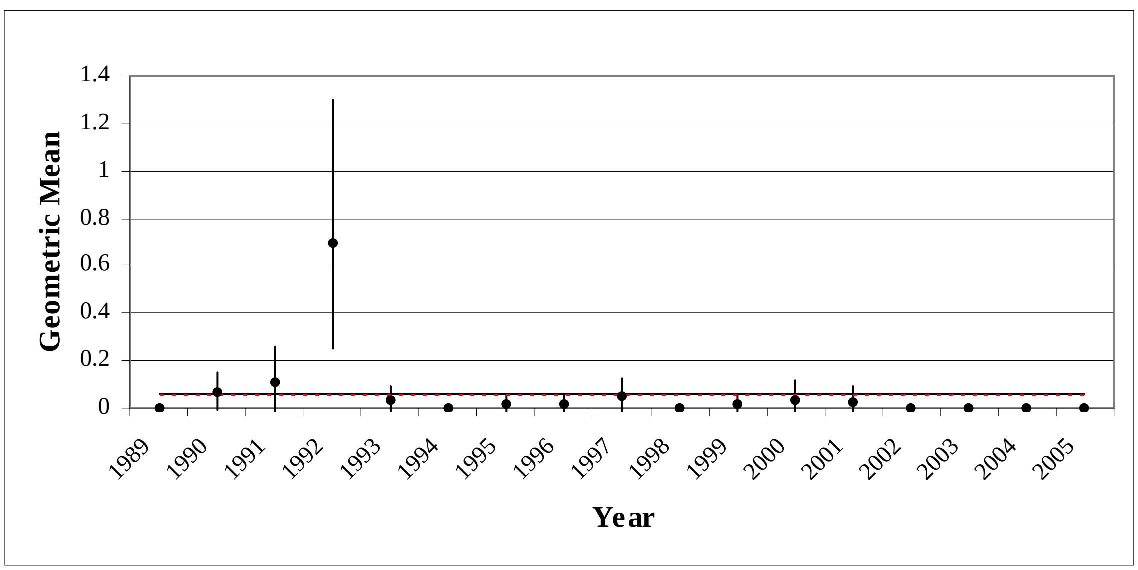

Figure 82. Northern sea robin beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

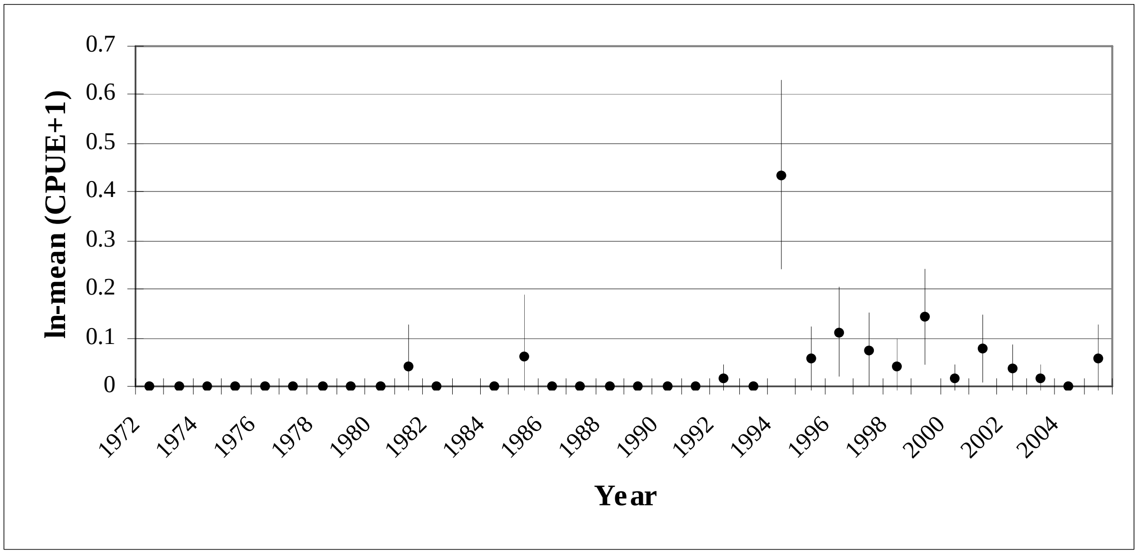

Figure 83. Pigfish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

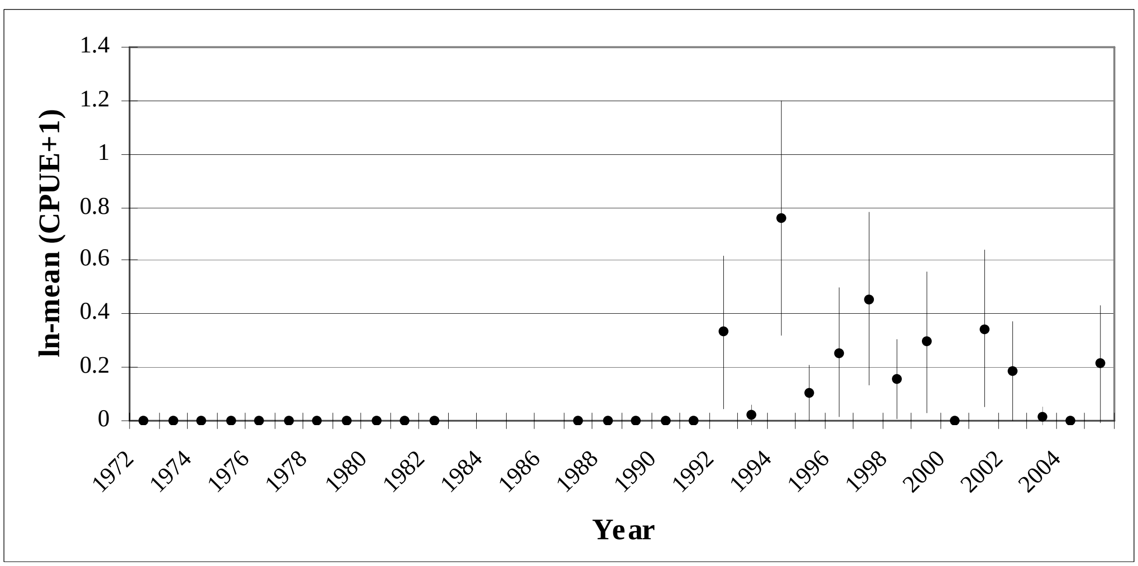

Figure 84. Pigfish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

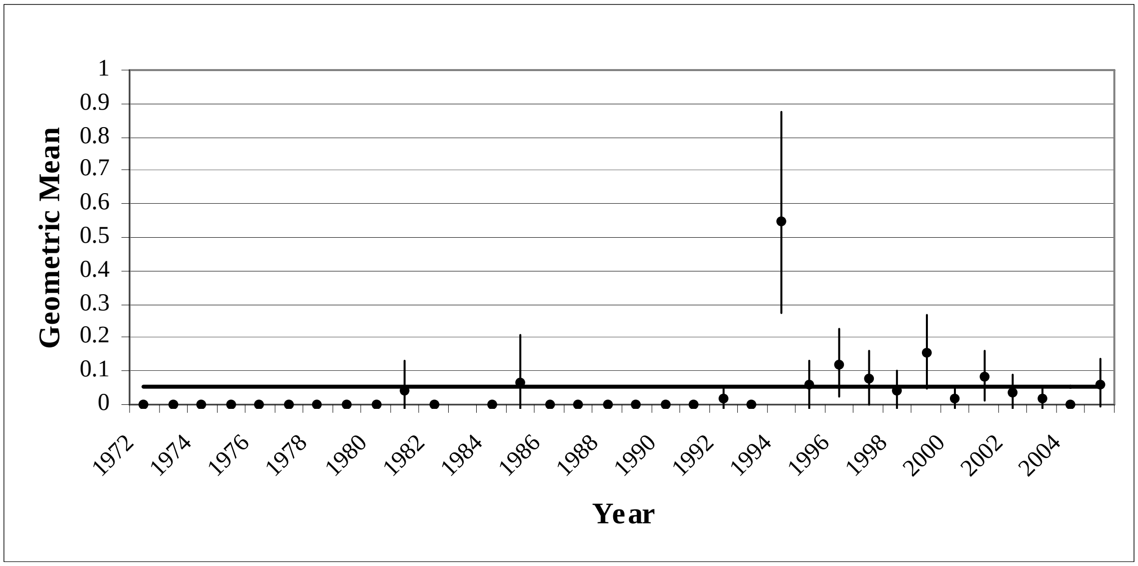

Figure 85. Pigfish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3). Solid line represents the time series grand mean.

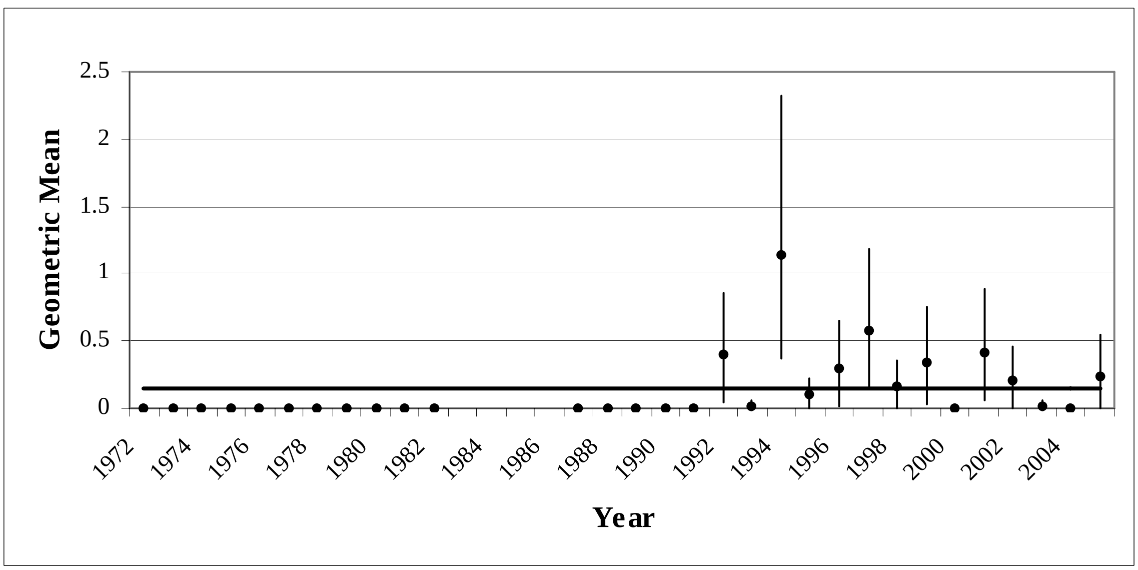

Figure 86. Pigfish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

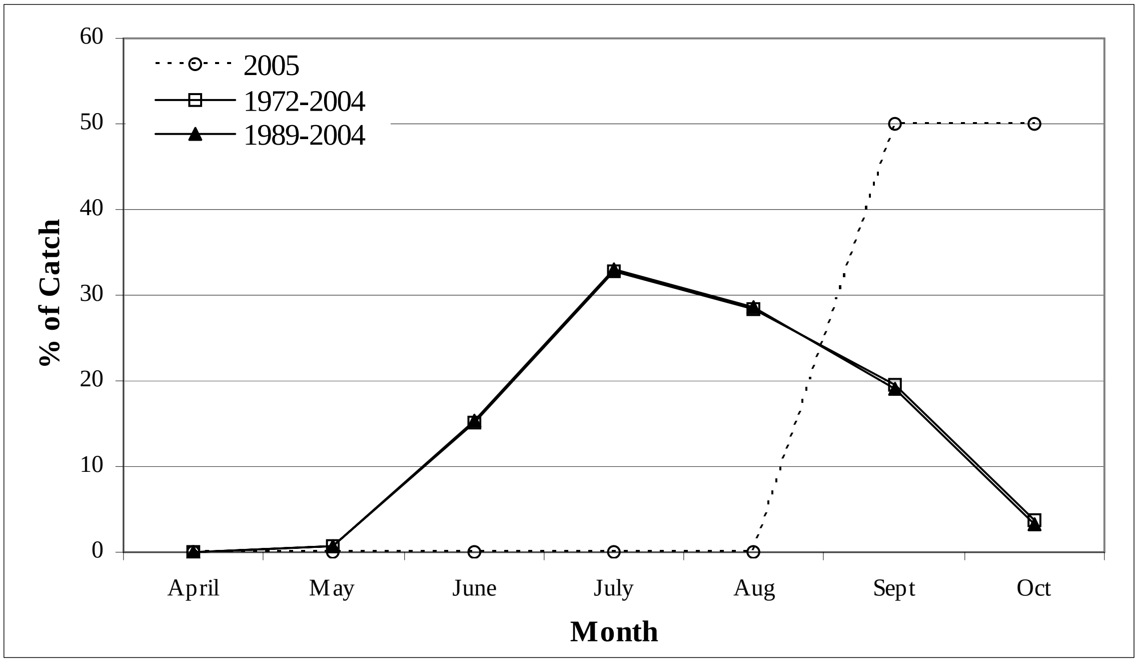

Figure 87. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal pigfish trawl percent catch by month.

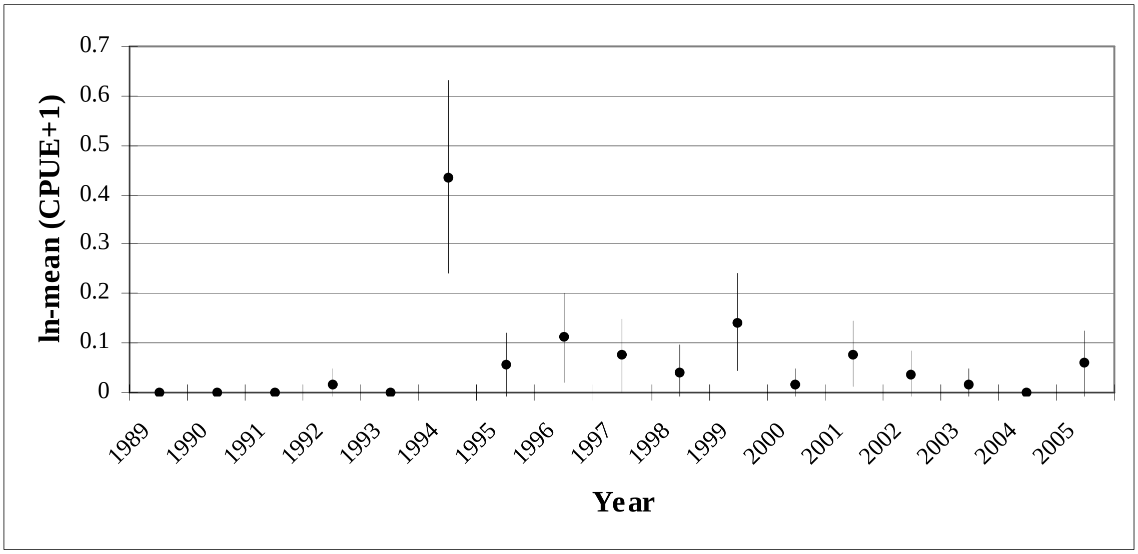

Figure 88. Pigfish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

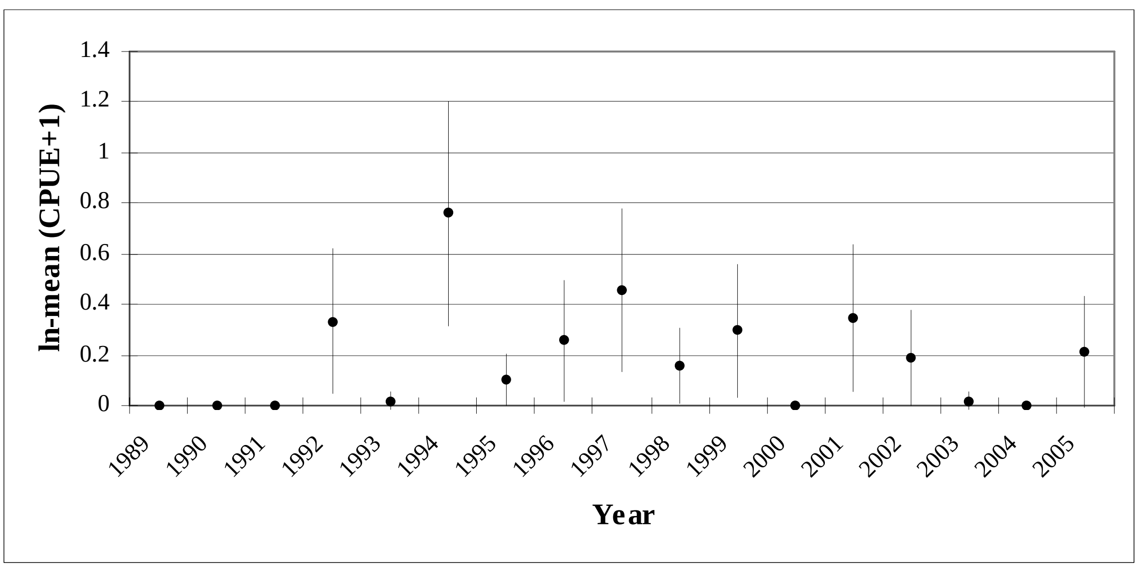

Figure 89. Pigfish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

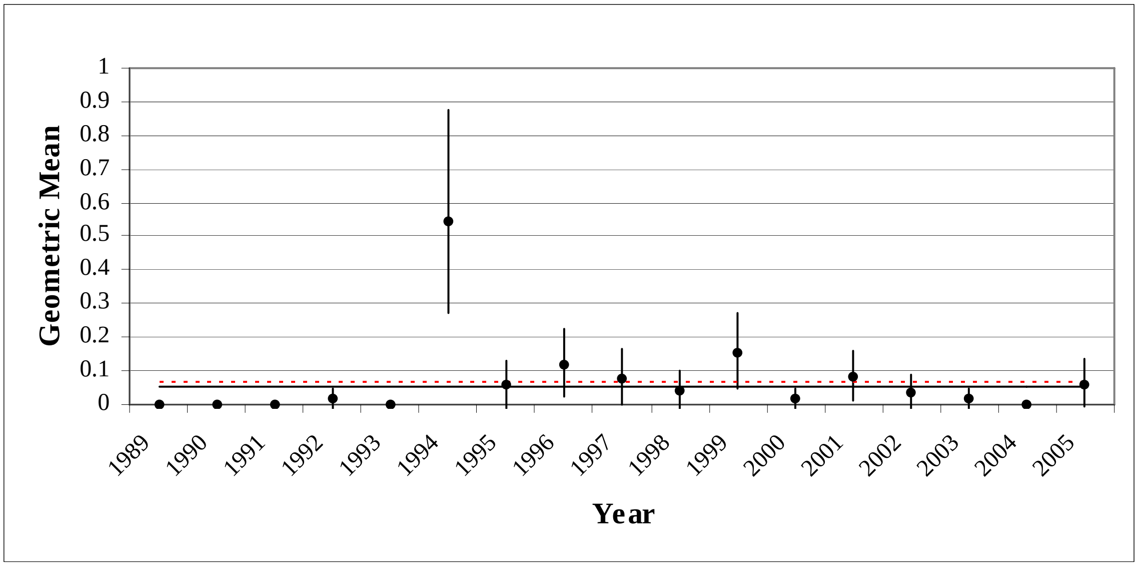

Figure 90. Pigfish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

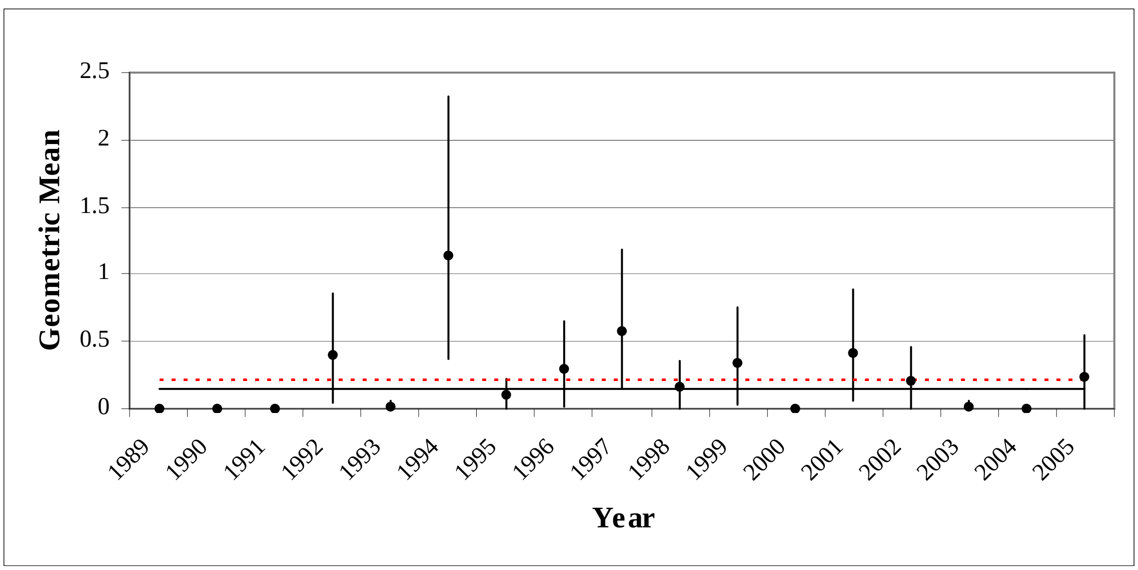

Figure 91. Pigfish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

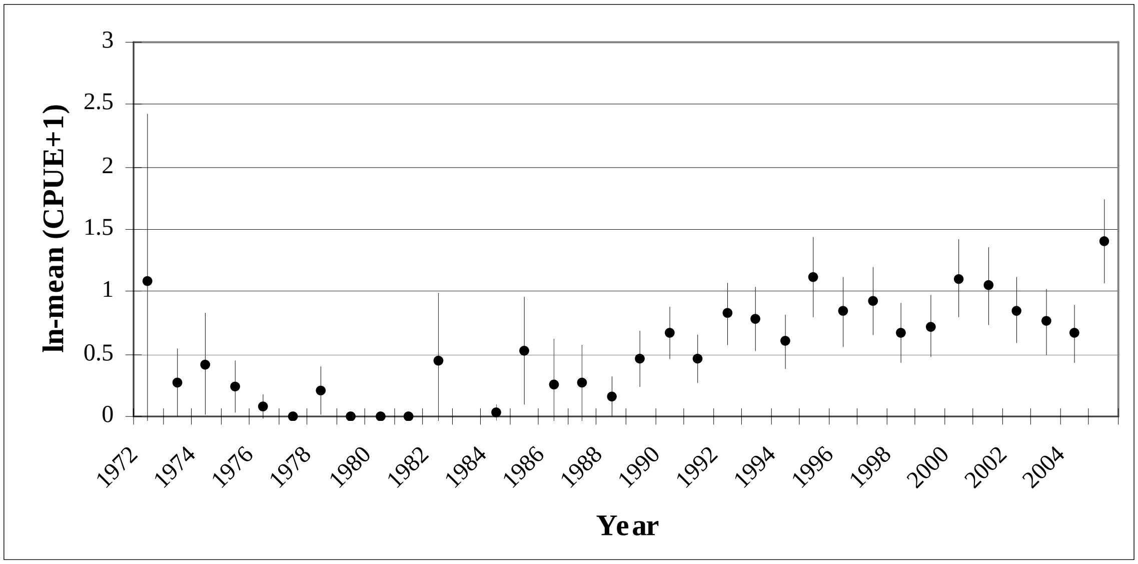

Figure 92. Silver perch trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

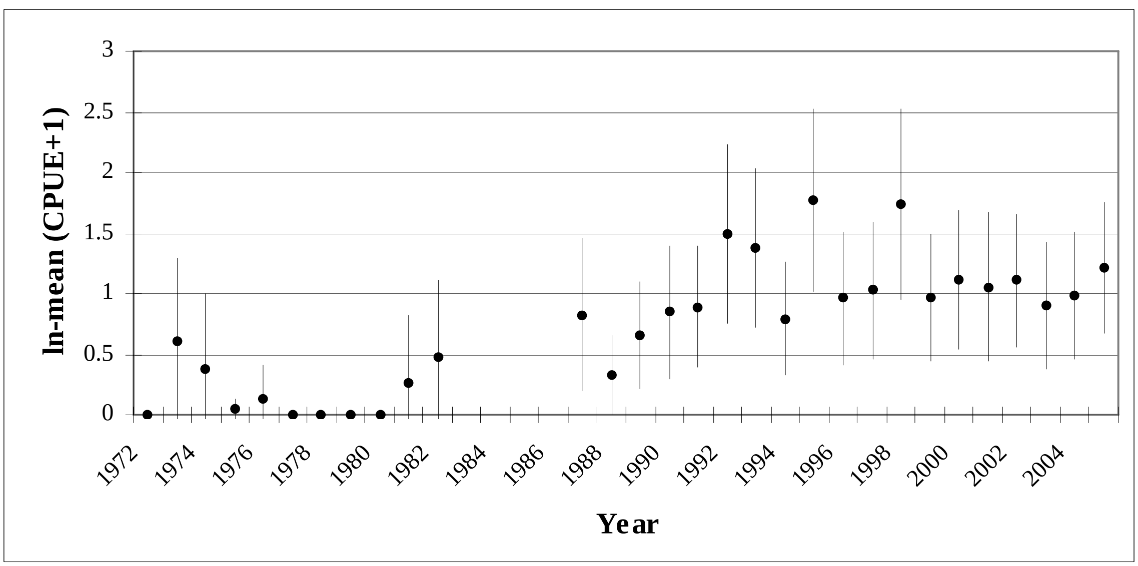

Figure 93. Silver perch beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

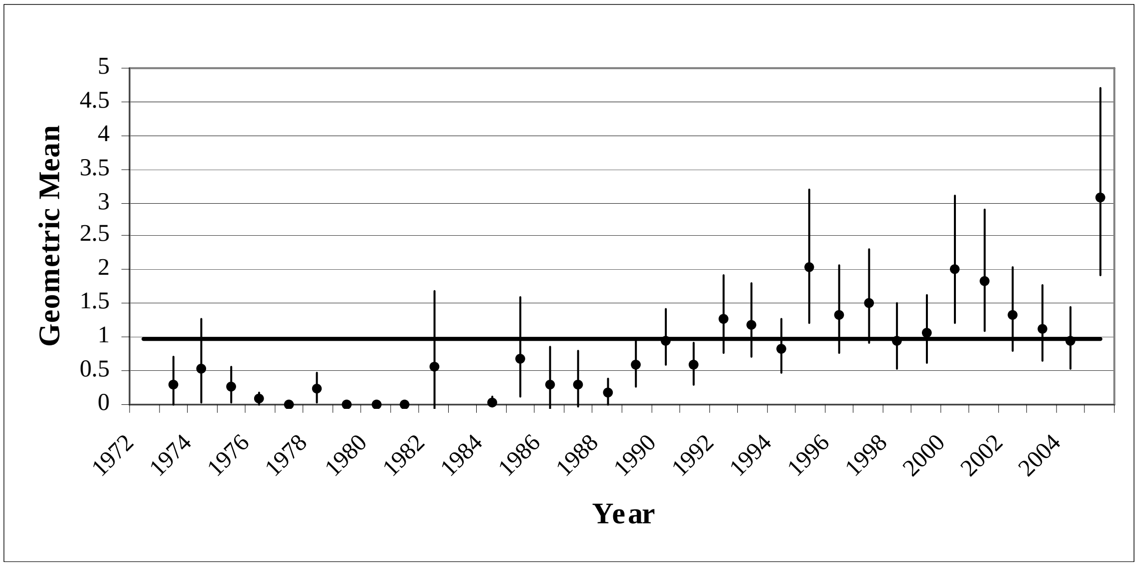

Figure 94. Silver perch trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972 and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3). Solid line represents the time series grand mean.

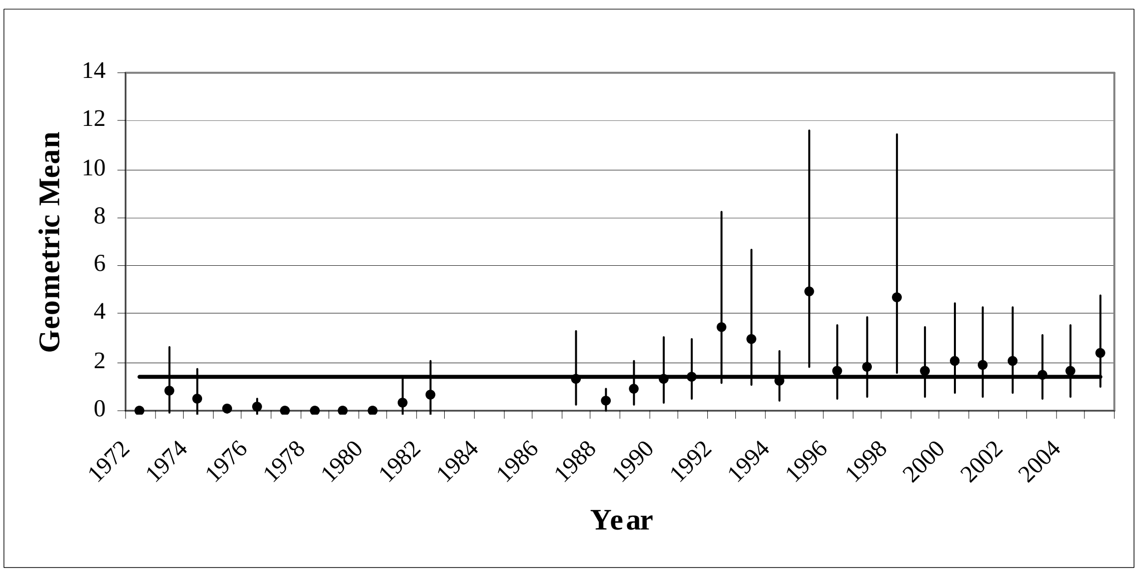

Figure 95. Silver perch beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

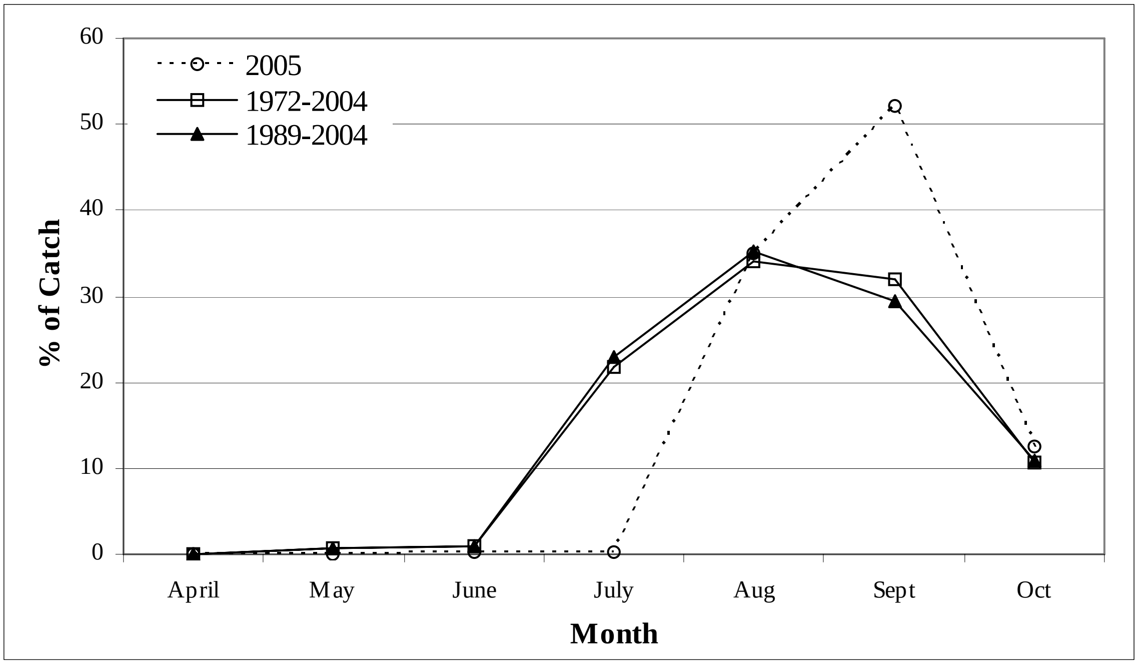

Figure 96. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal silver perch trawl percent catch by month.

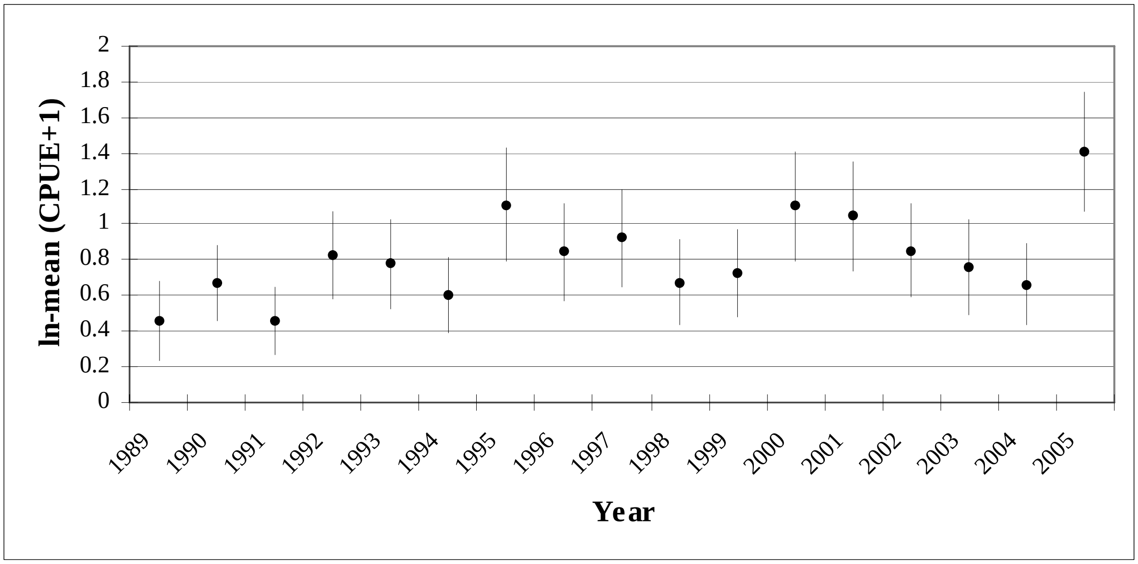

Figure 97. Silver perch trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

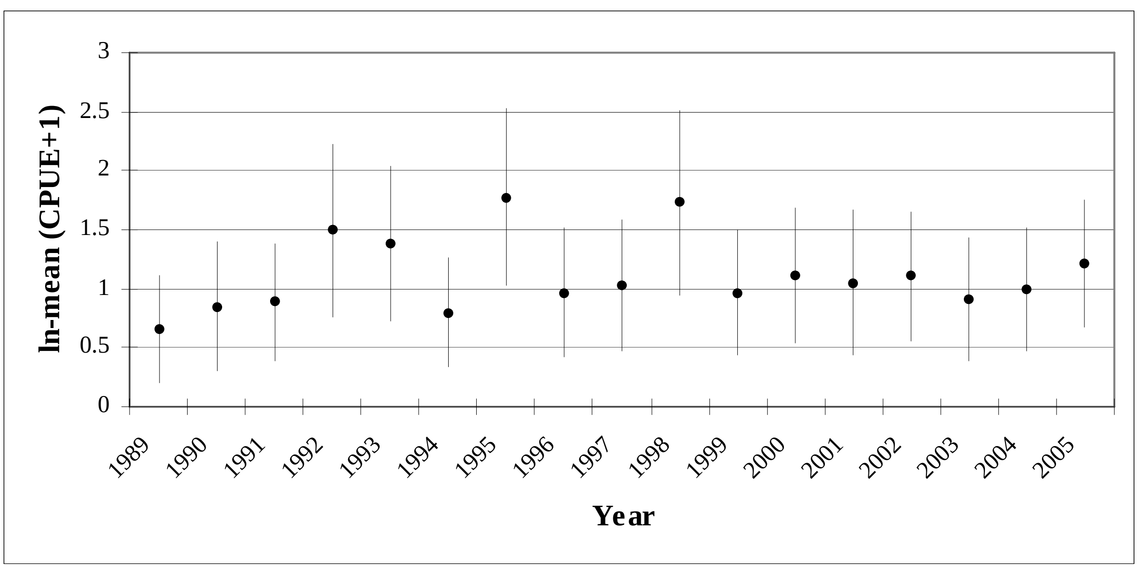

Figure 98. Silver perch beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

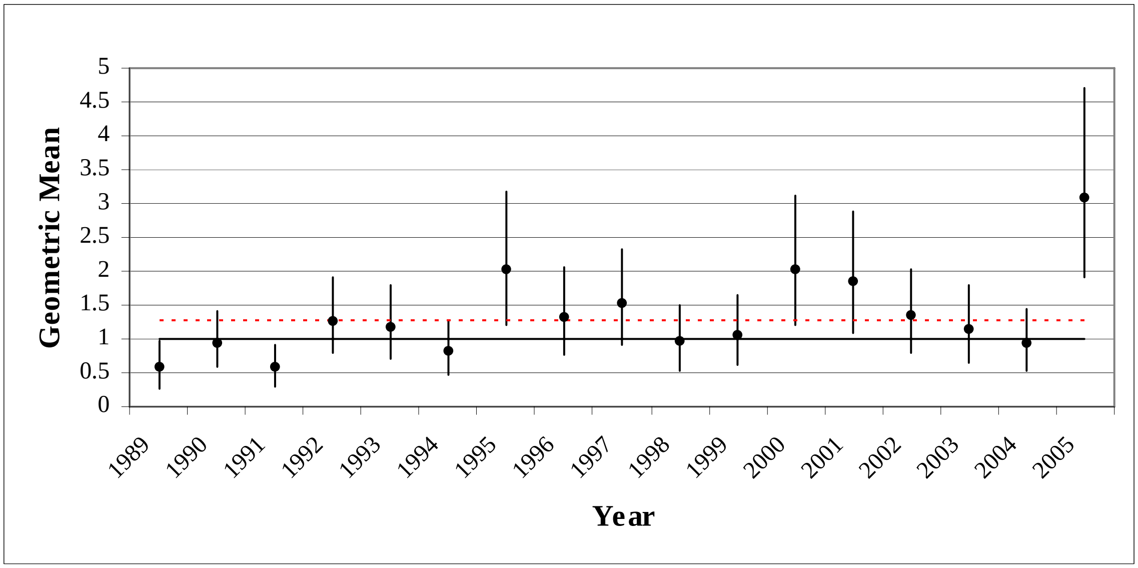

Figure 99. Silver perch trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

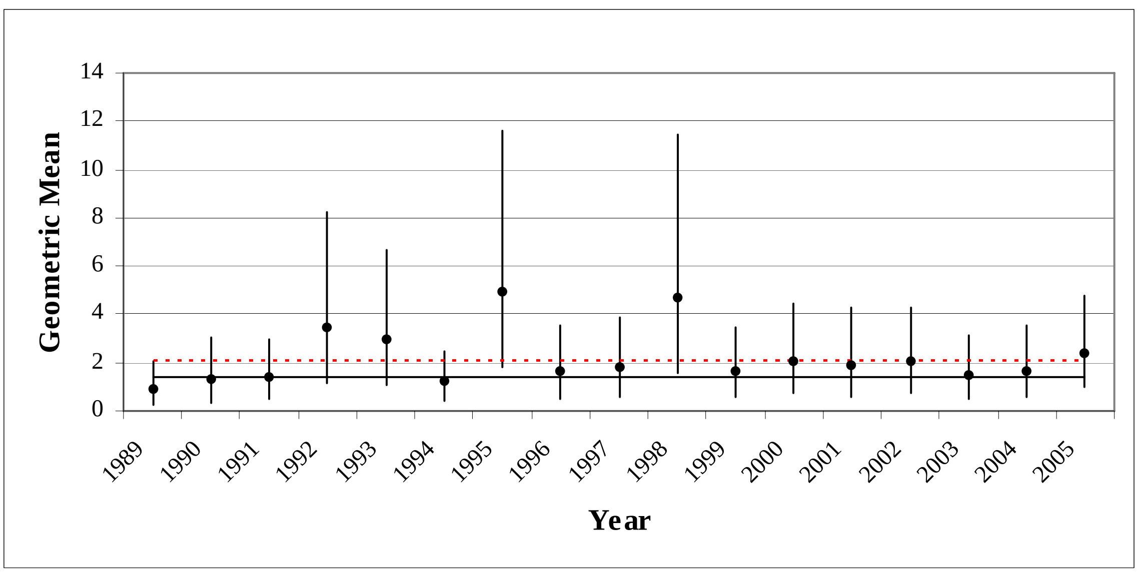

Figure 100. Silver perch beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

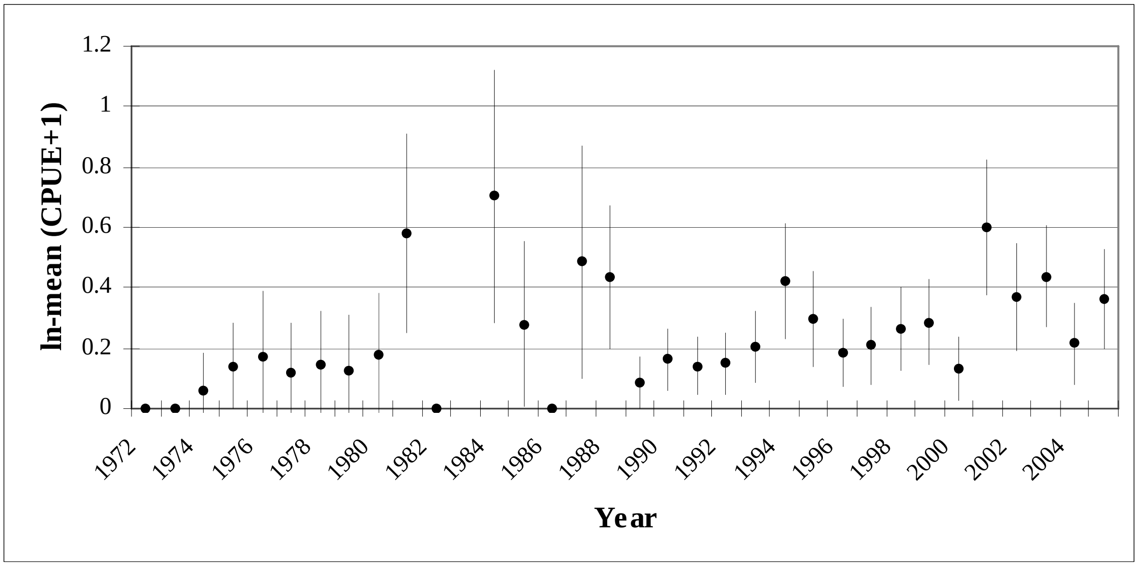

Figure 101. Smallmouth flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

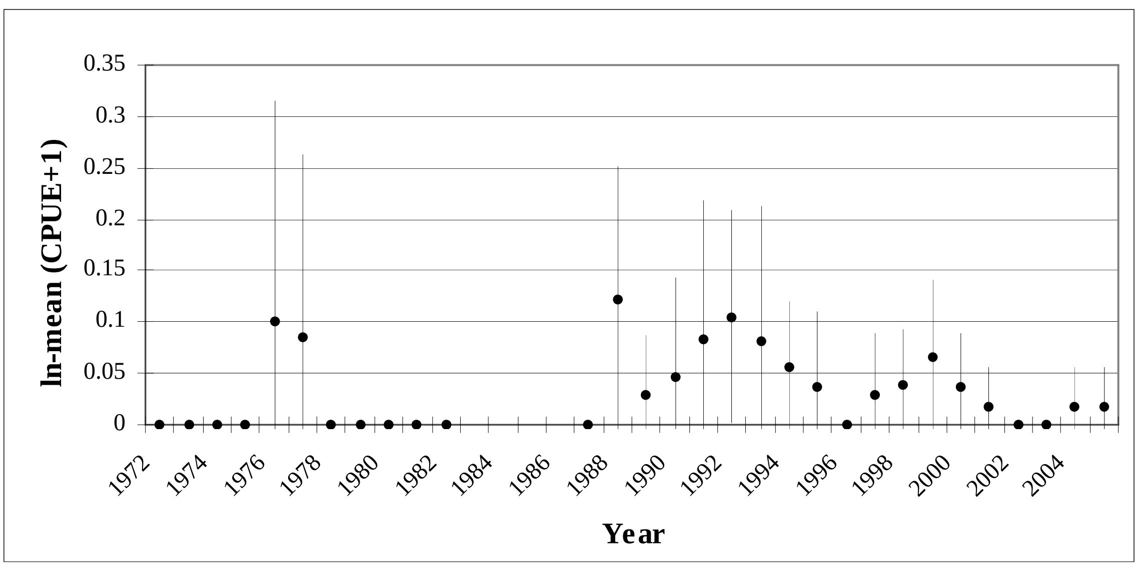

Figure 102. Smallmouth flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

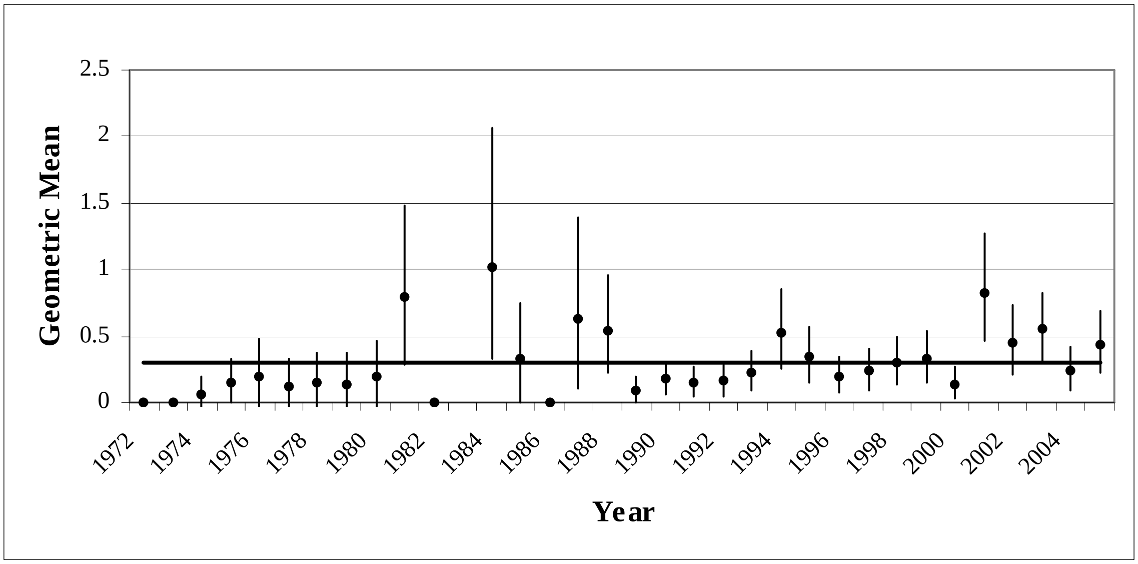

Figure 103. Smallmouth flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3). Solid line represents the time series grand mean.

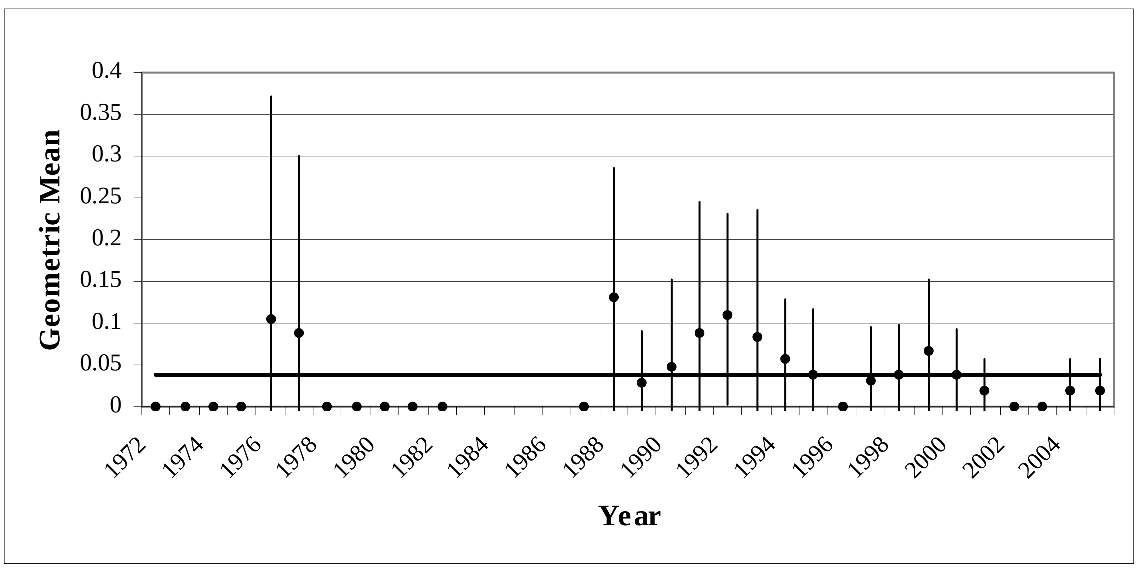

Figure 104. Smallmouth flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

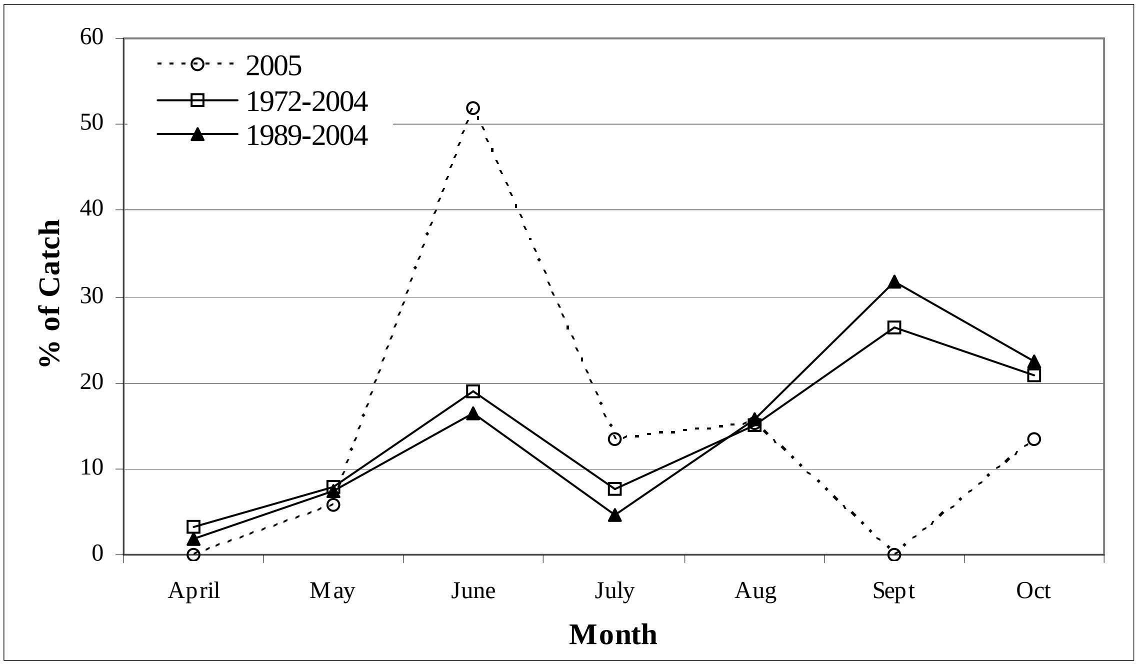

Figure 105. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal smallmouth flounder trawl percent catch by month.

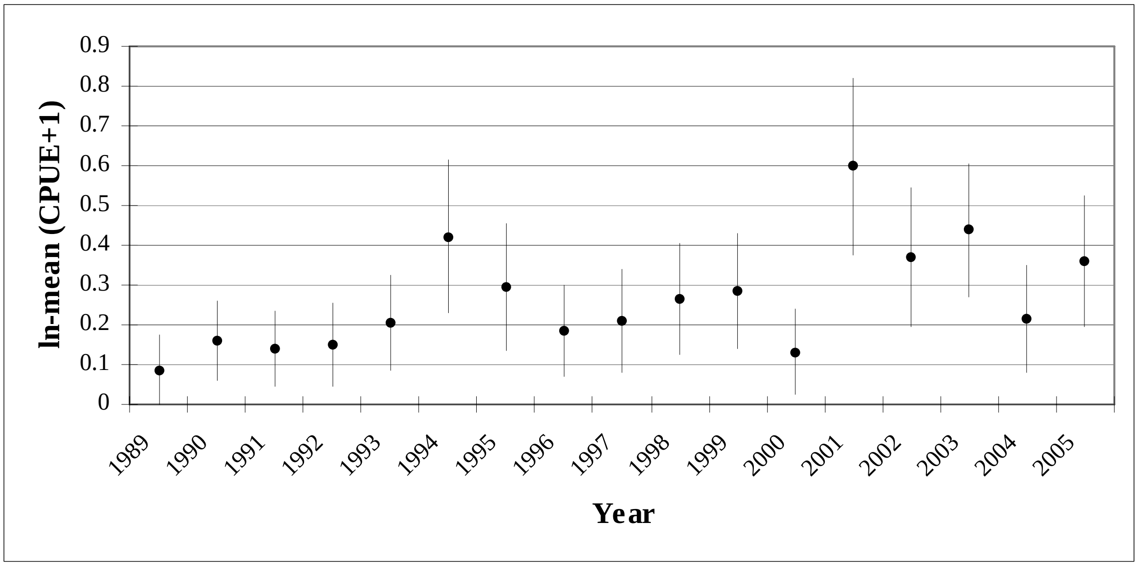

Figure 106. Smallmouth flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

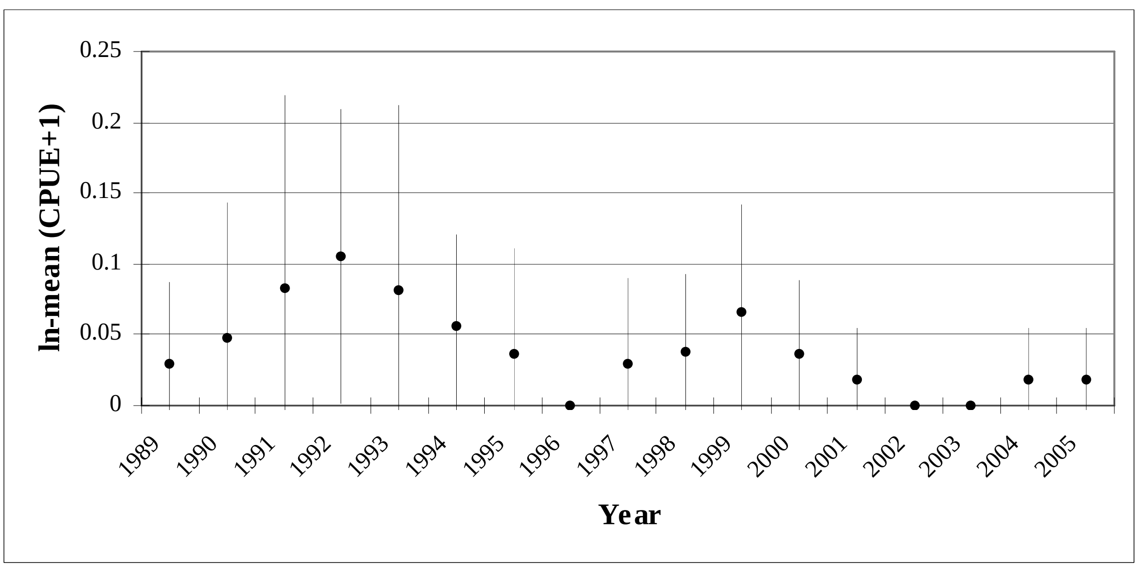

Figure 107. Smallmouth flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

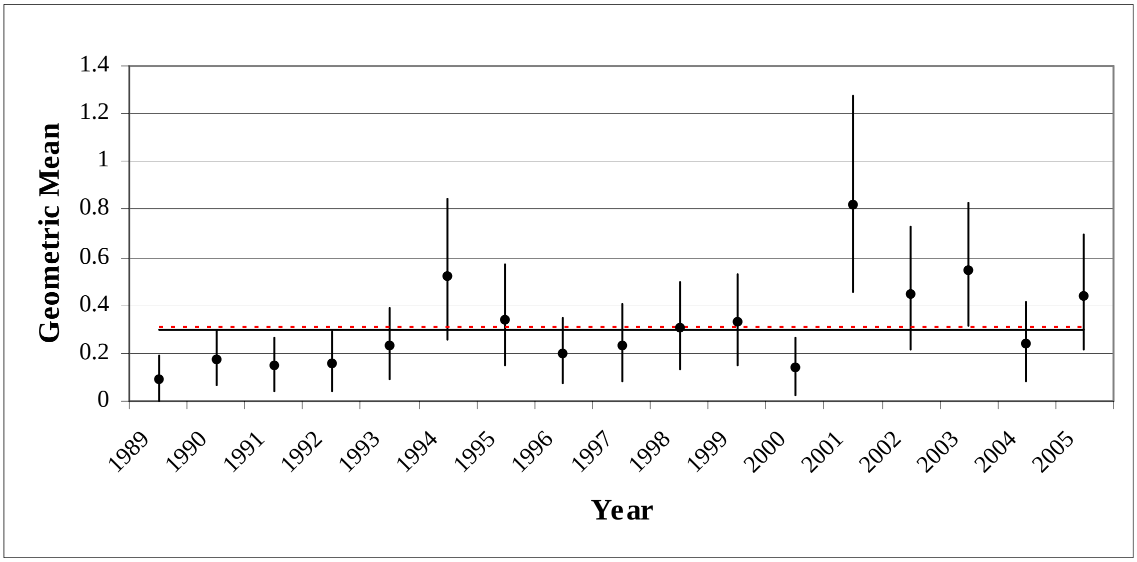

Figure 108. Smallmouth flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

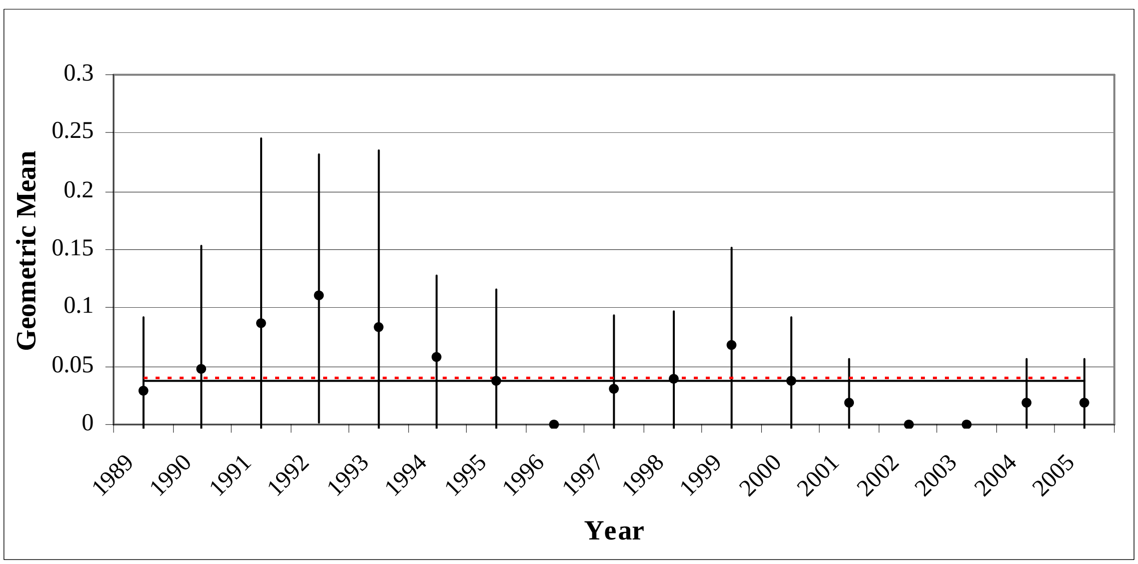

Figure 109. Smallmouth flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

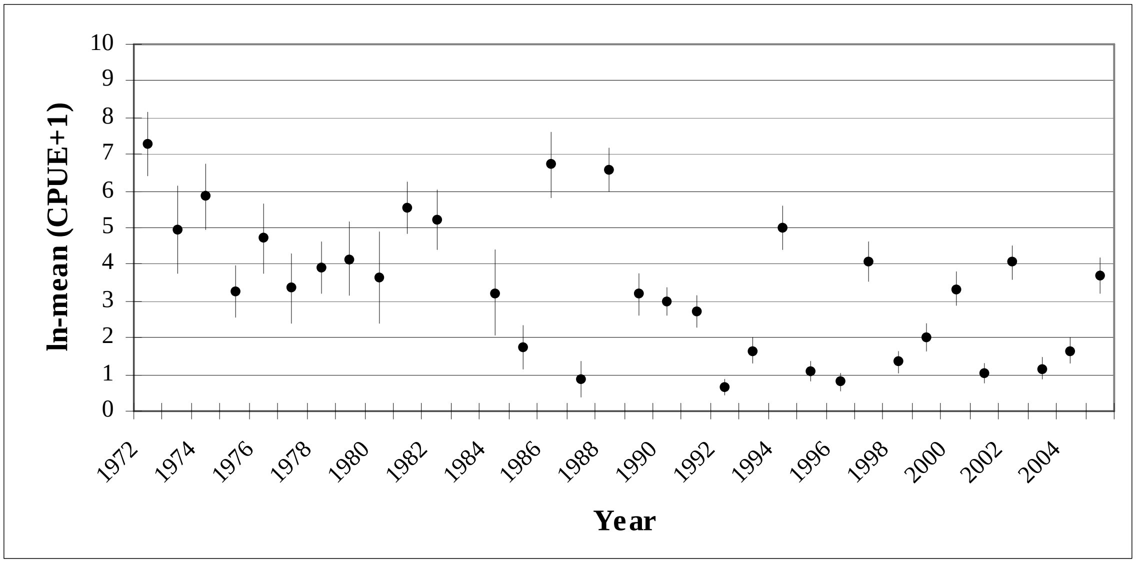

Figure 110. Spot trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

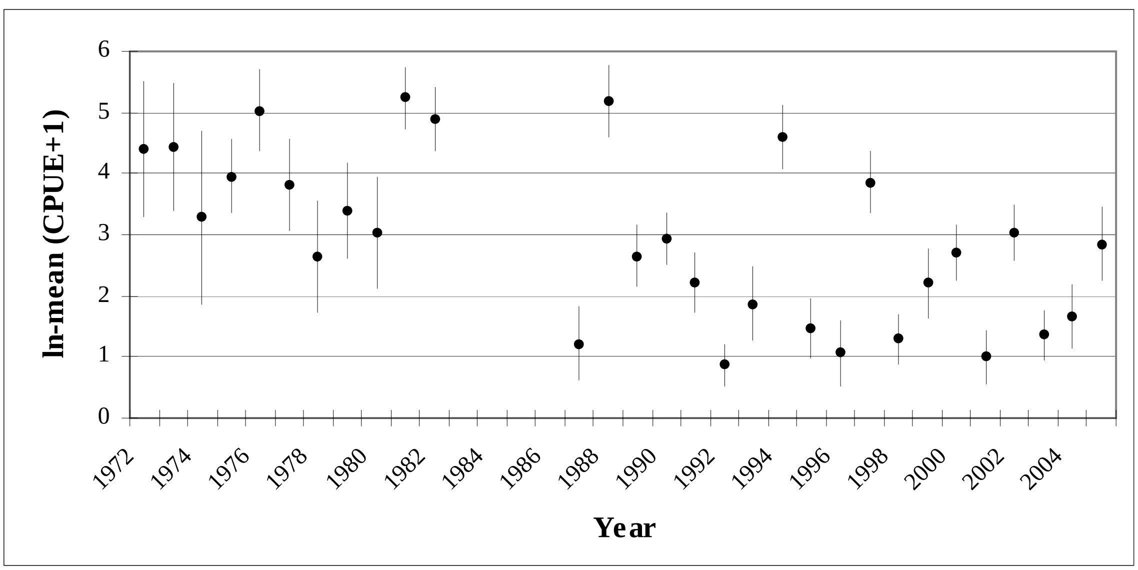

Figure 111. Spot beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

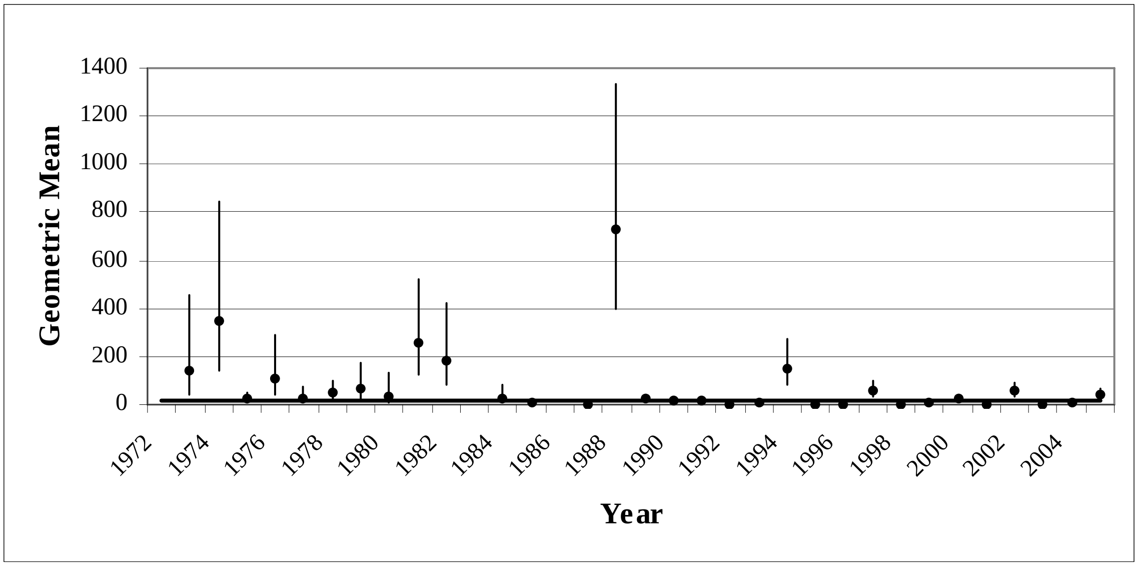

Figure 112. Spot trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1983, and 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3, 1986: n=22). Solid line represents the time series grand mean.

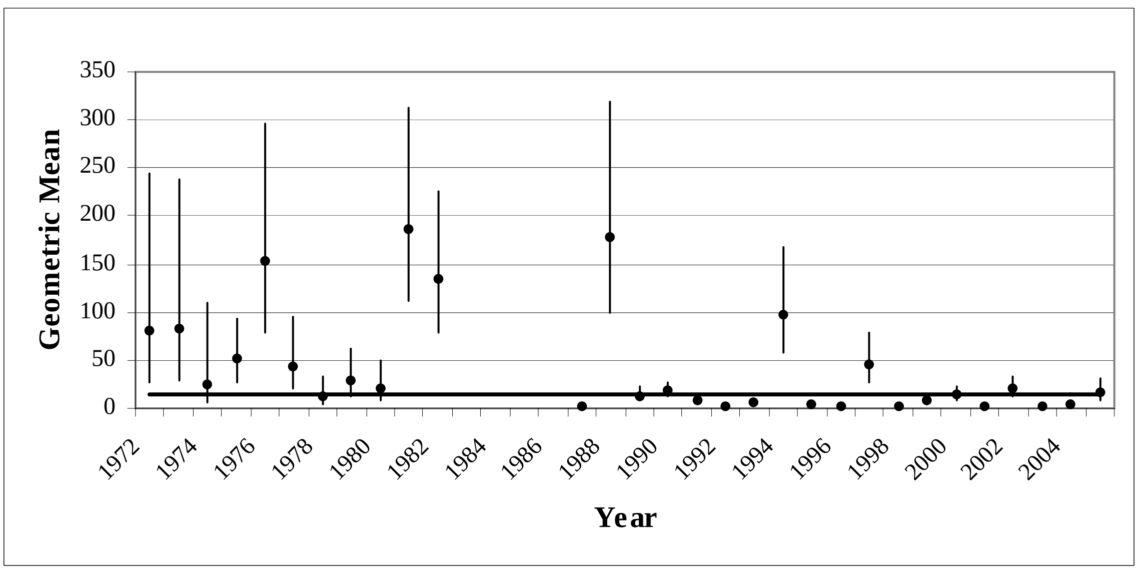

Figure 113. Spot beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

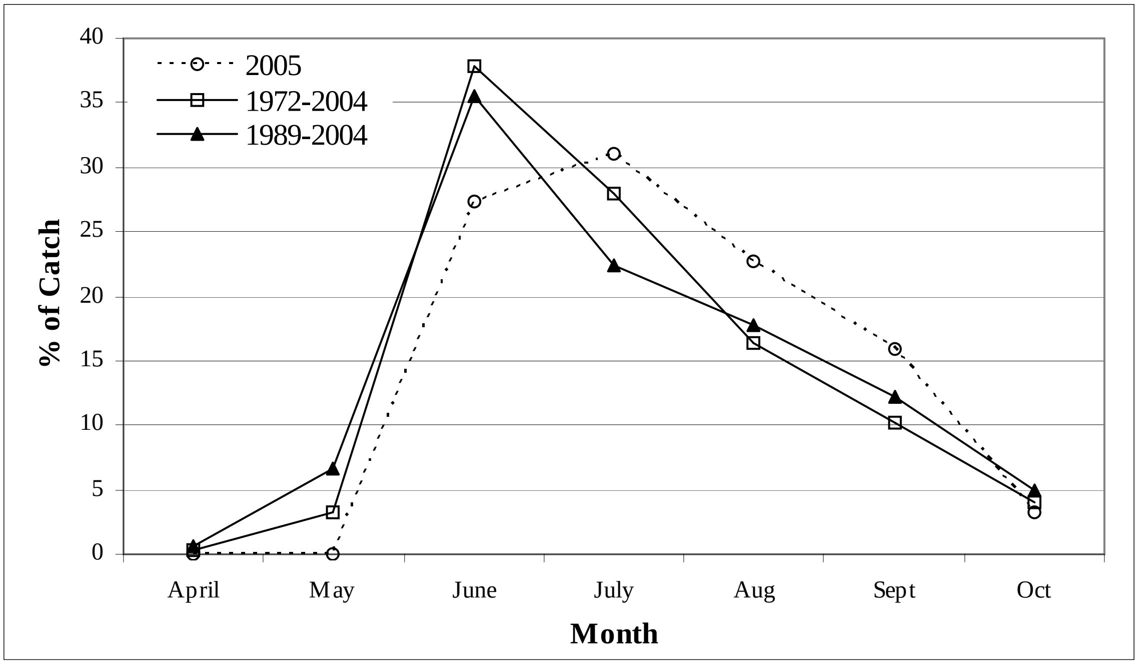

Figure 114. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal spot trawl percent catch by month.

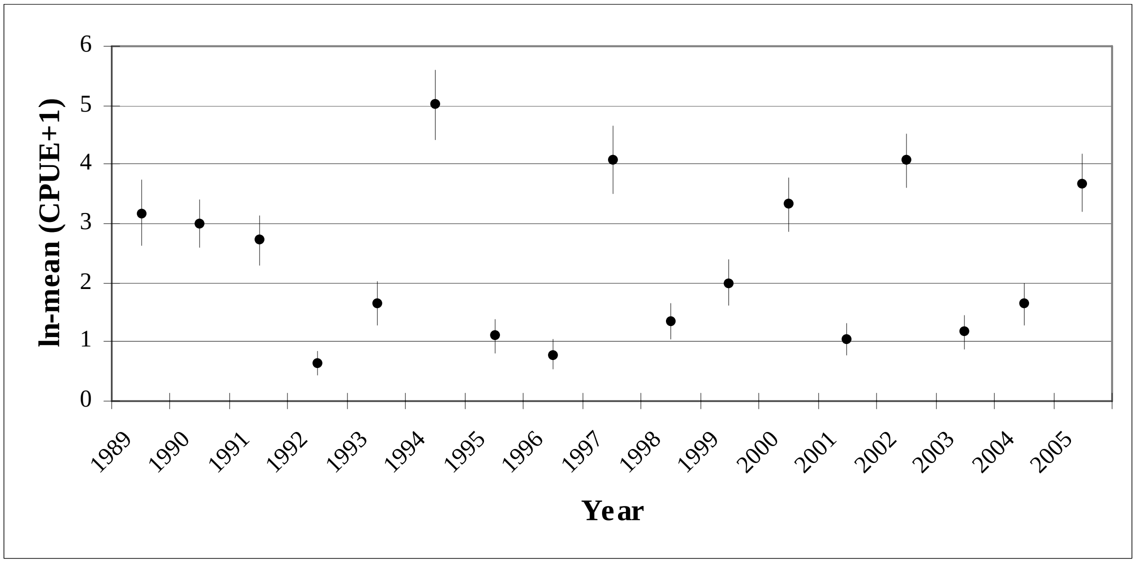

Figure 115. Spot trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

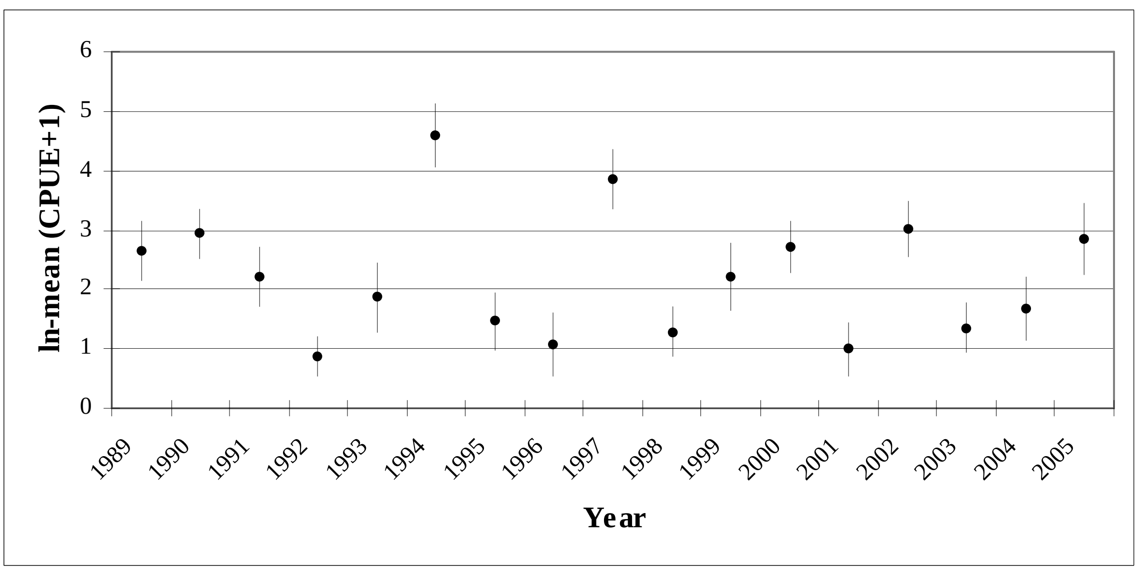

Figure 116. Spot beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

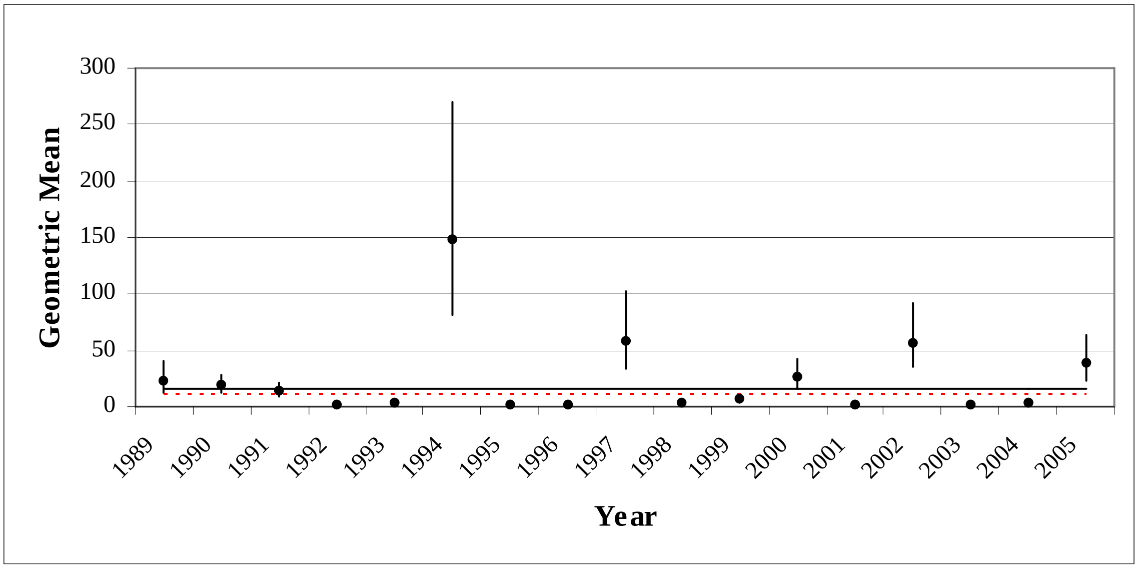

Figure 117. Spot trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

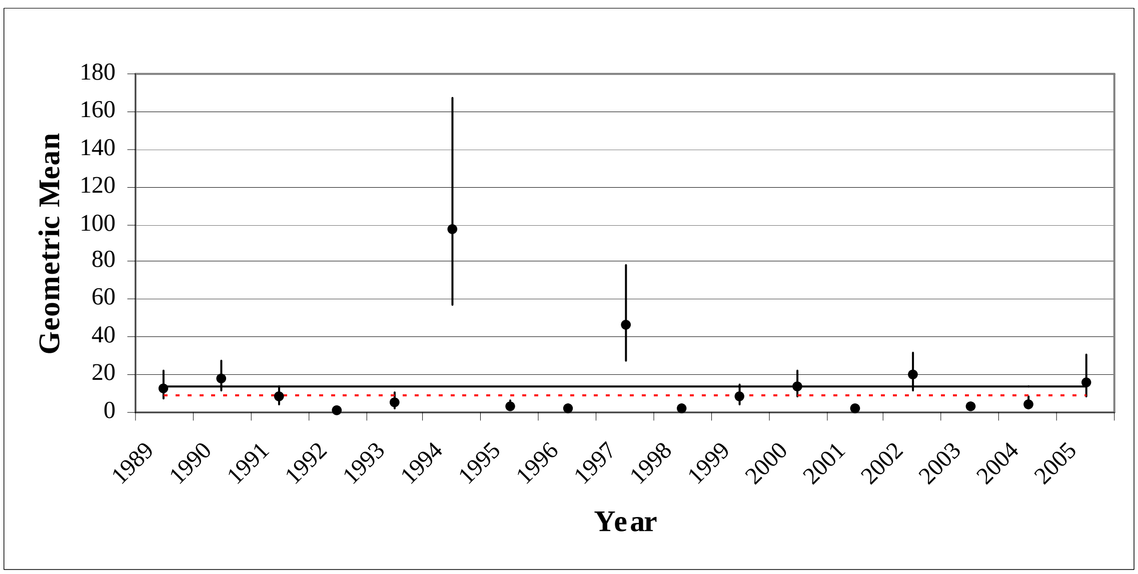

Figure 118. Spot beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

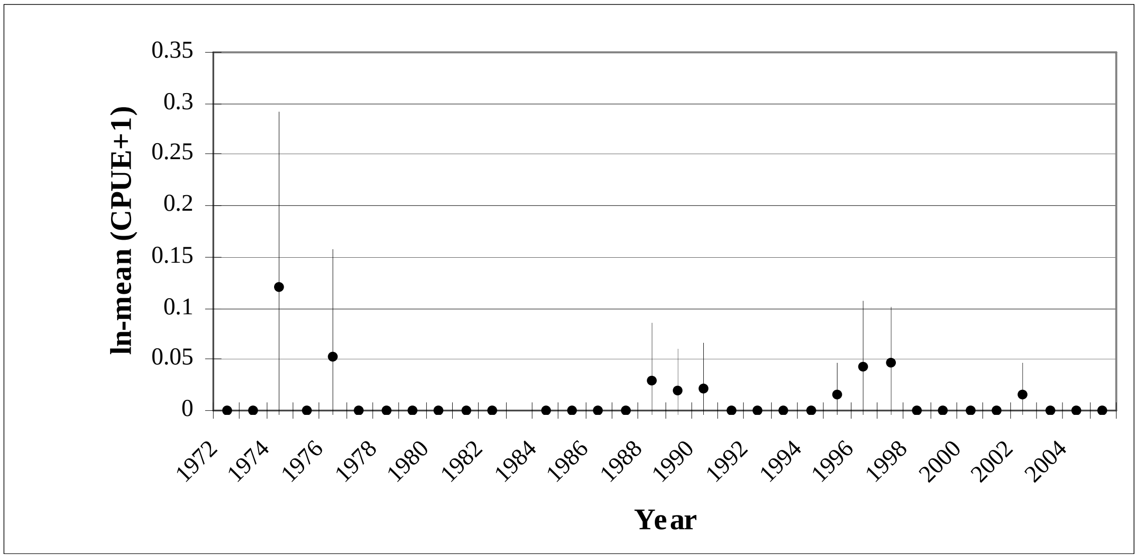

Figure 119. Striped killifish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

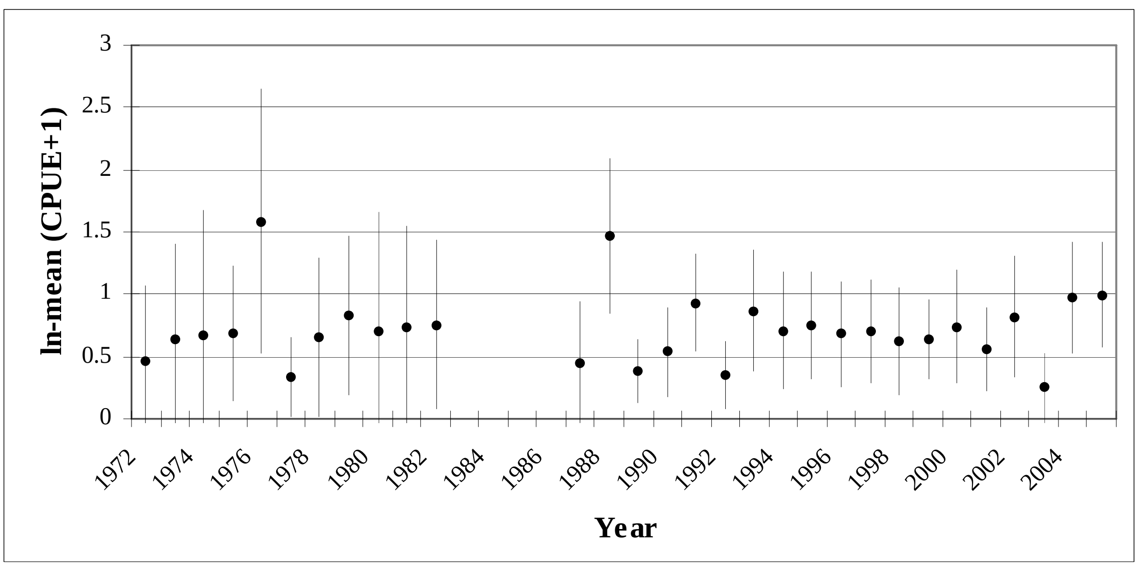

Figure 120. Striped killifish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

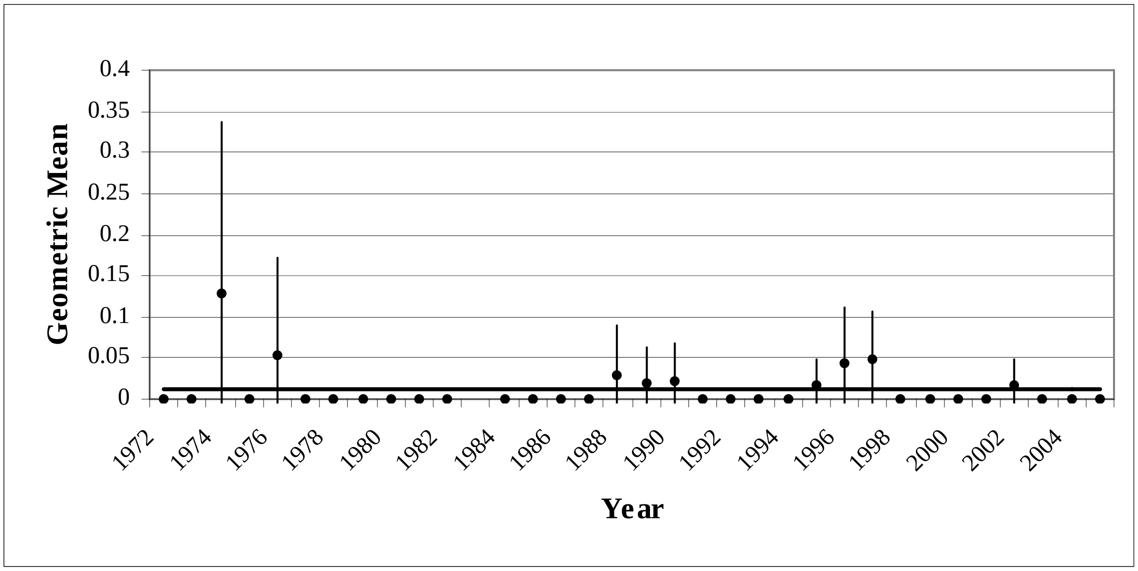

Figure 121. Striped killifish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3). Solid line represents the time series grand mean.

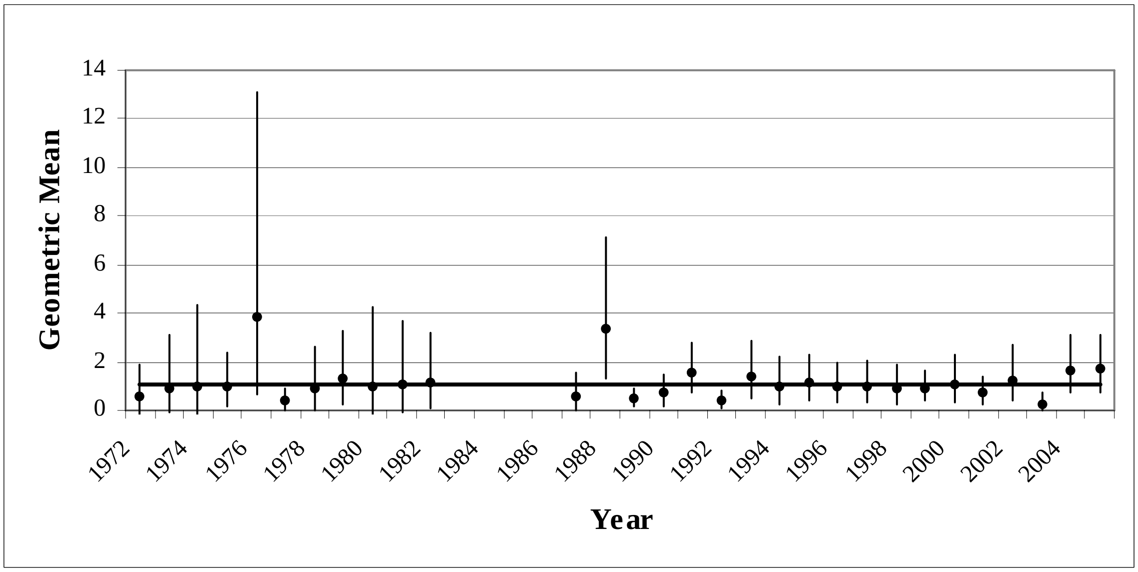

Figure 122. Striped killifish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

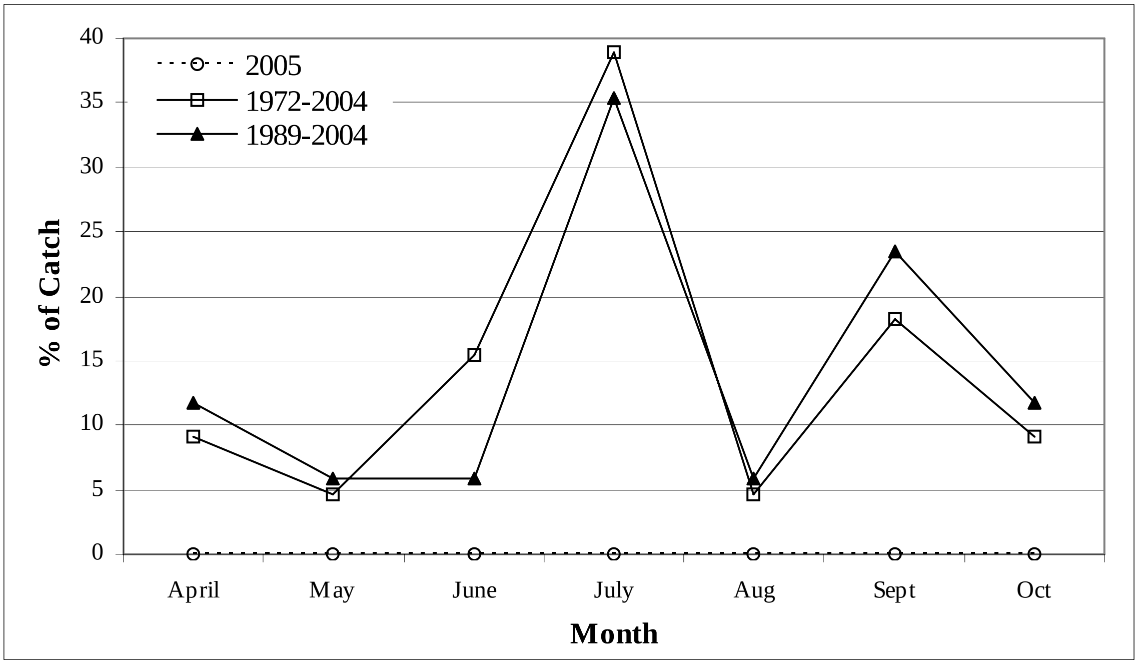

Figure 123. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal striped killifish trawl percent catch by month.

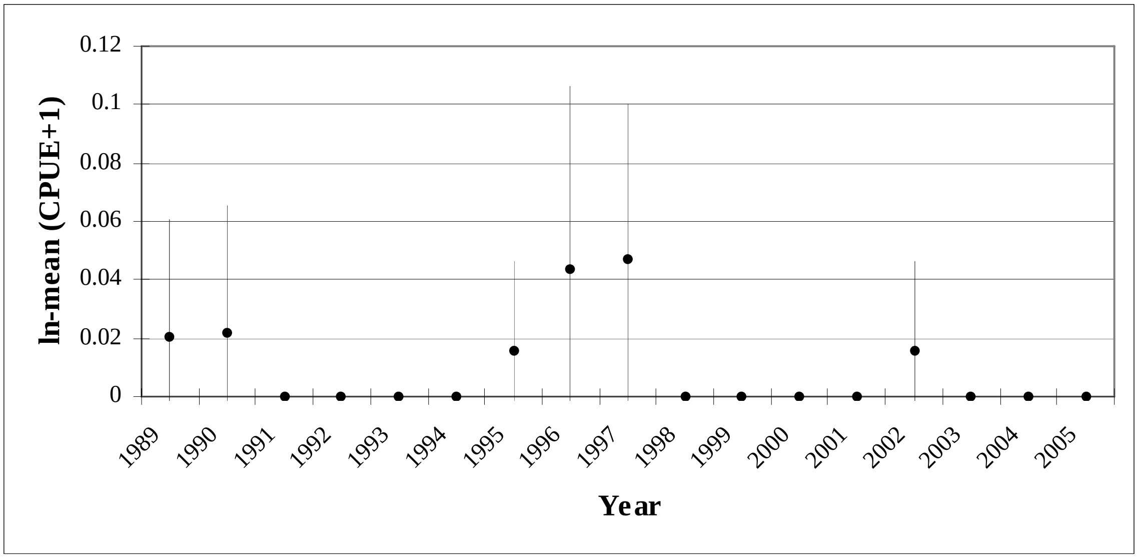

Figure 124. Striped killifish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

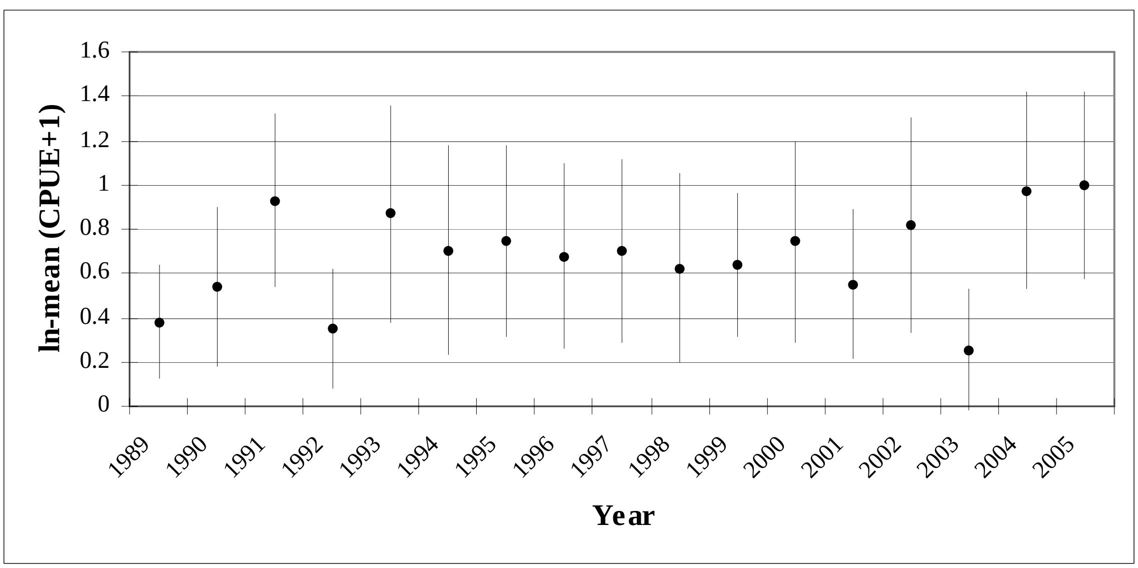

Figure 125. Striped killifish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

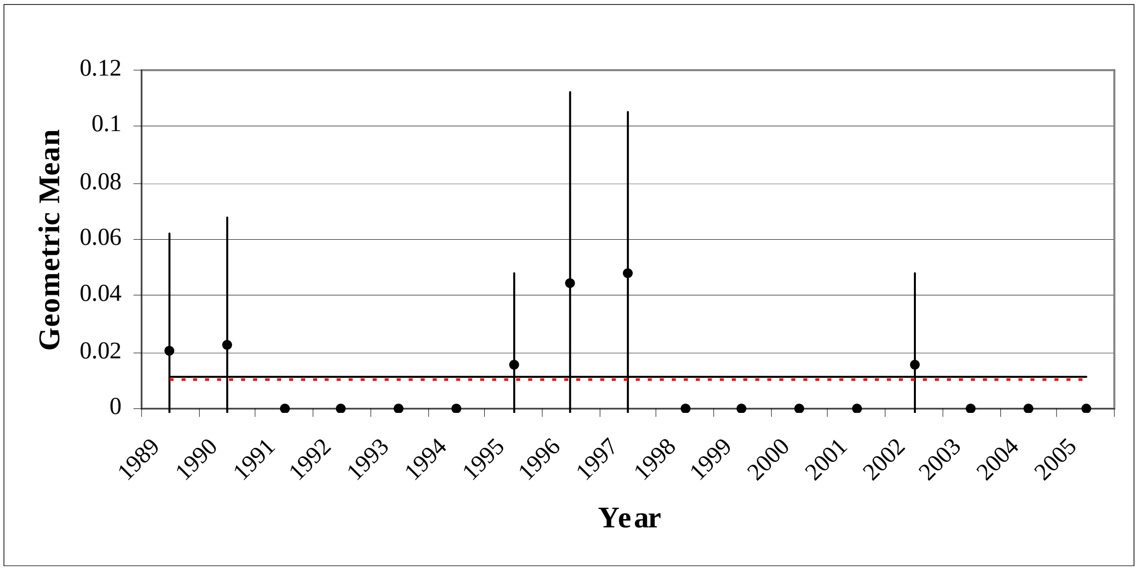

Figure 126. Striped killifish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

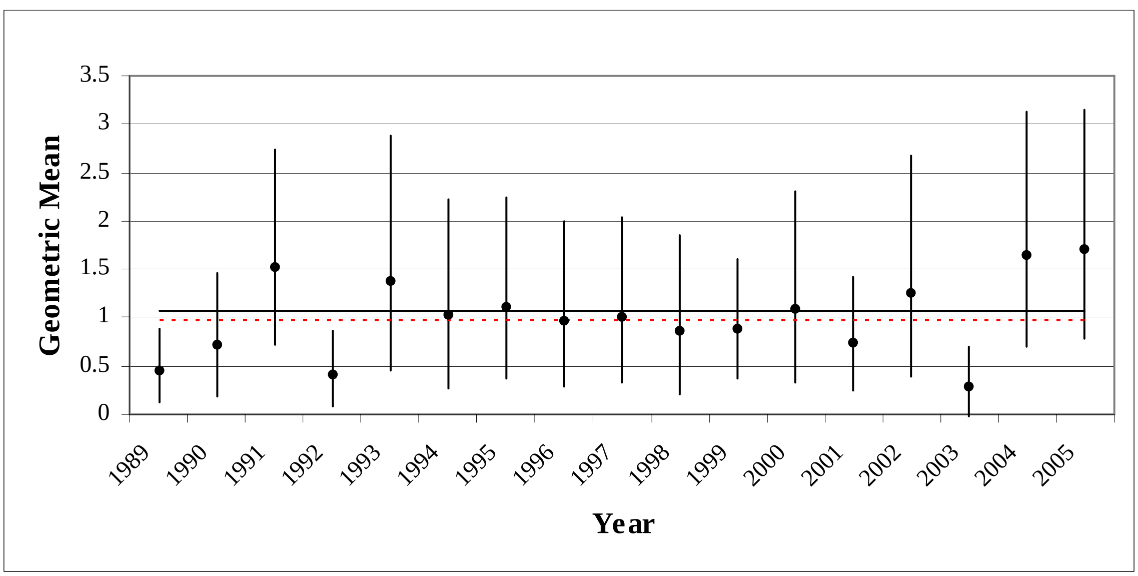

Figure 127. Striped killifish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

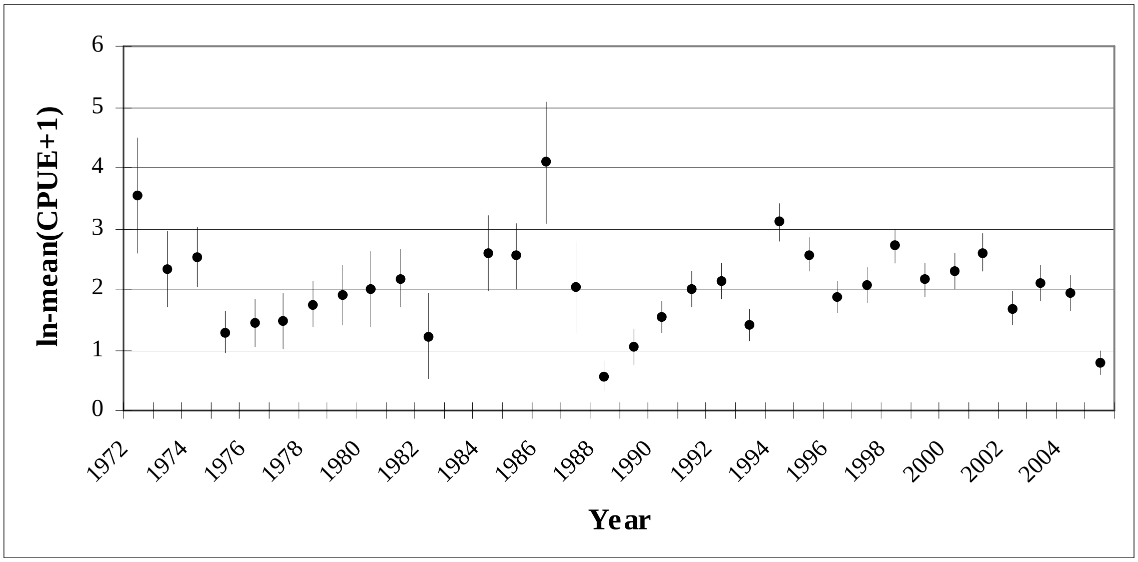

Figure 128. Summer flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

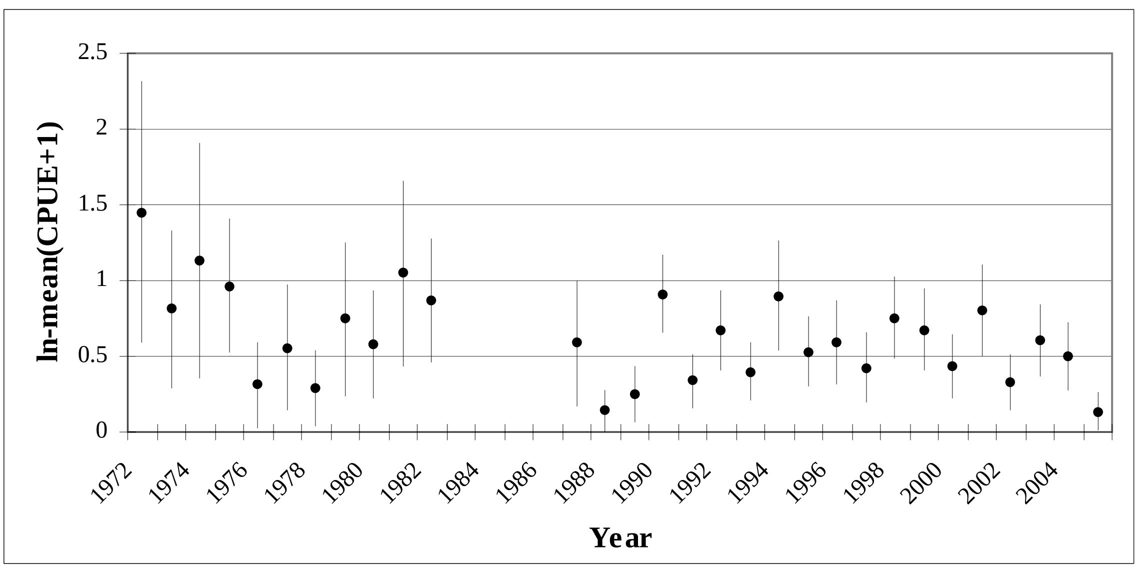

Figure 129. Summer flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

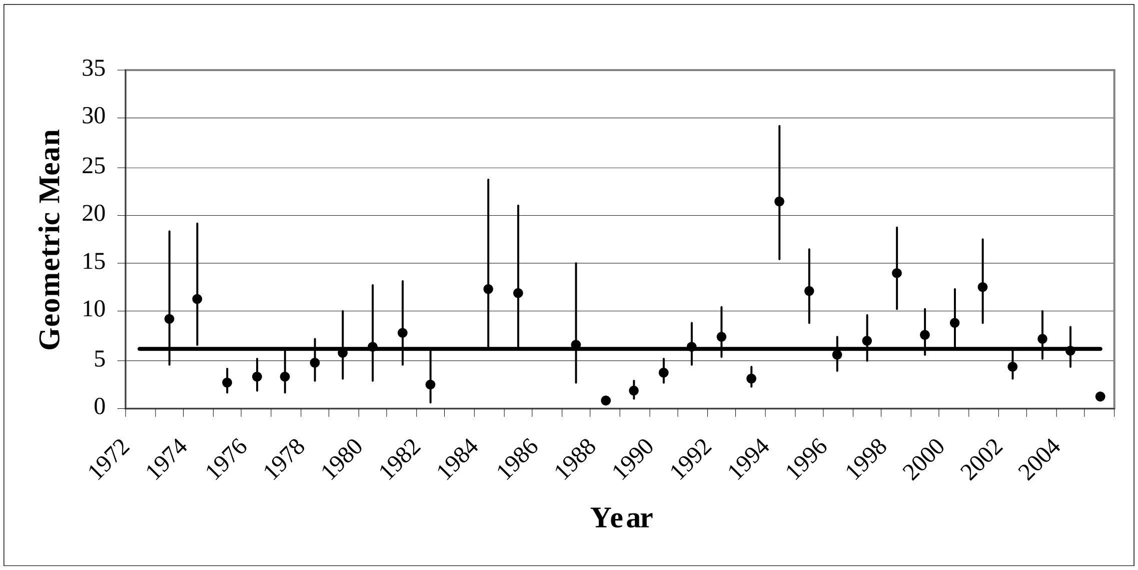

Figure 130. Summer flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1972, 1983, and 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1972: n=12, 1983: n=3, 1986: n=22). Solid line represents the time series grand mean.

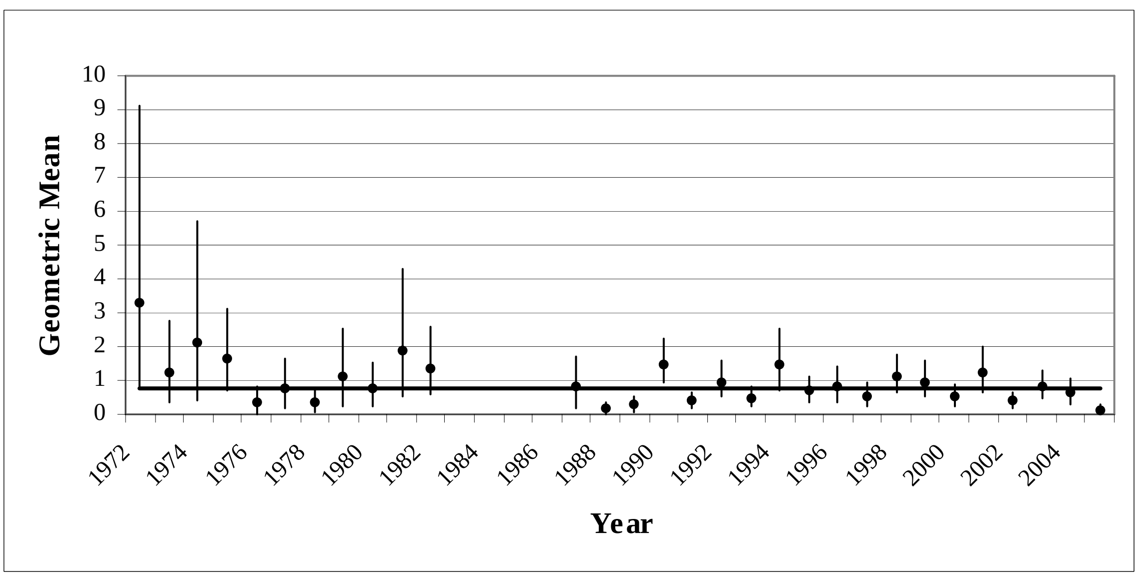

Figure 131. Summer flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

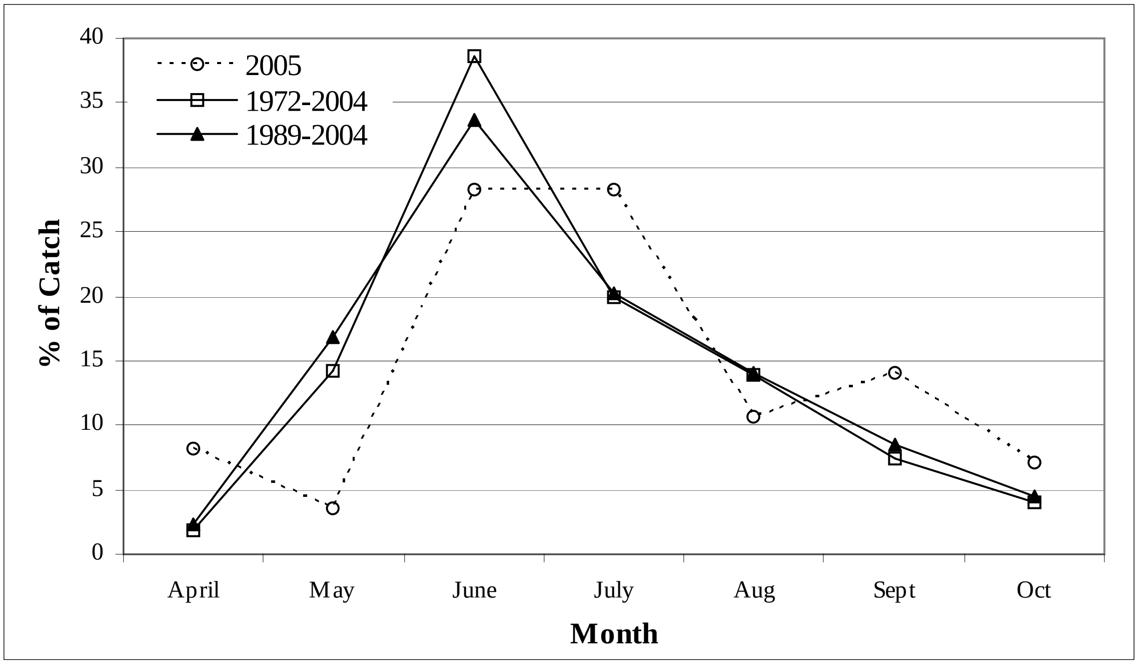

Figure 132. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal summer flounder trawl percent catch by month.

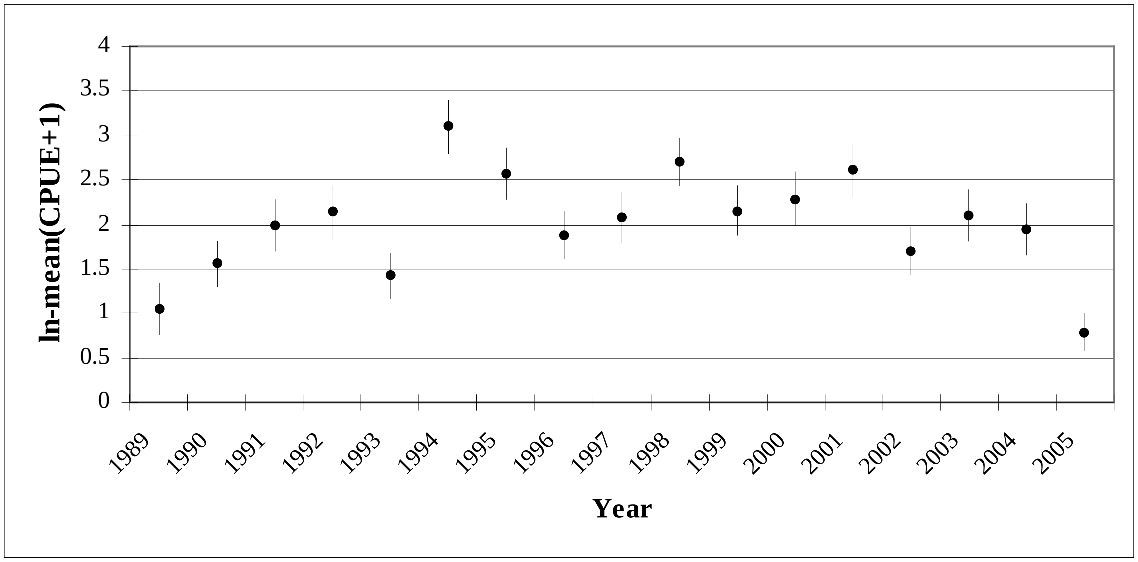

Figure 133. Summer flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

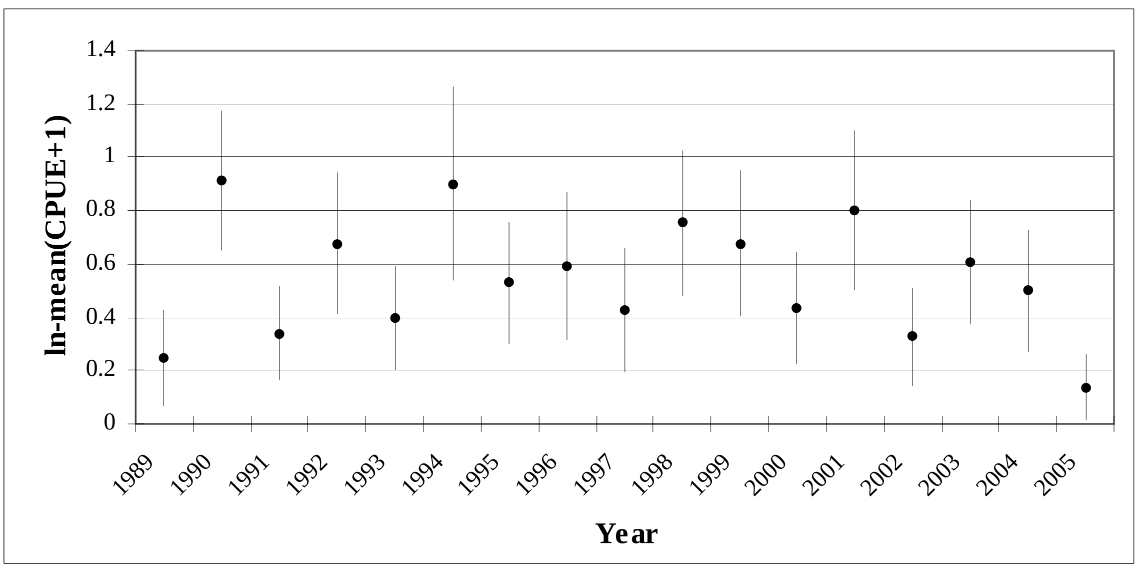

Figure 134. Summer flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

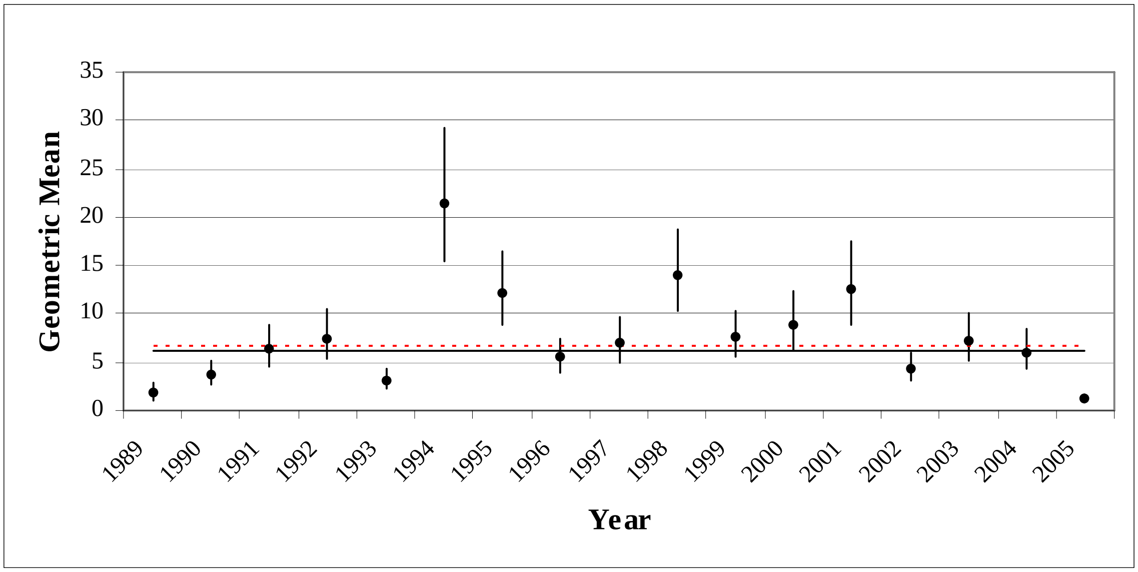

Figure 135. Summer flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

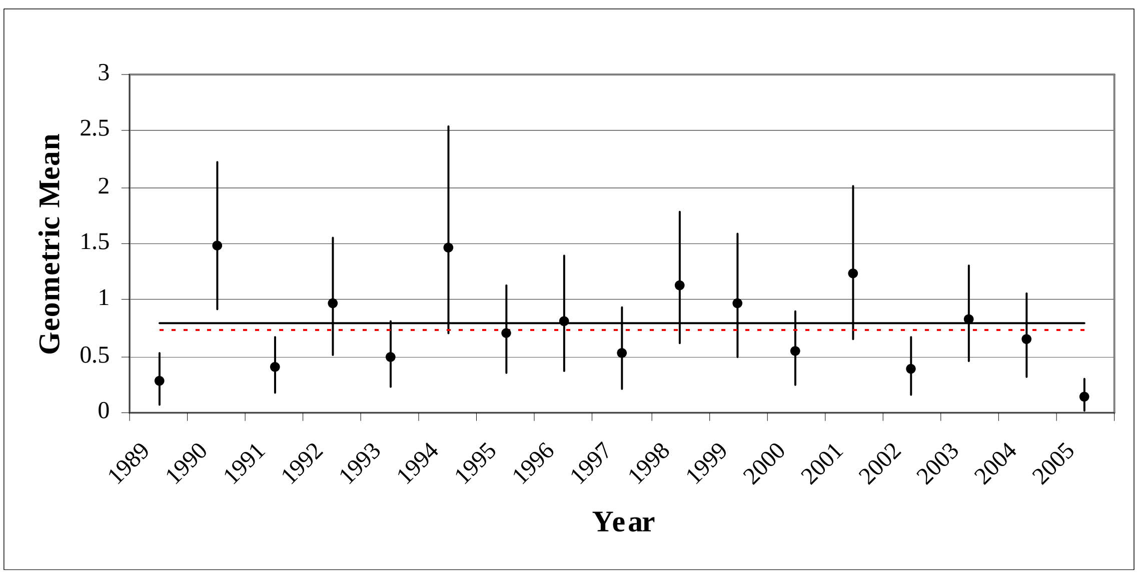

Figure 136. Summer flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

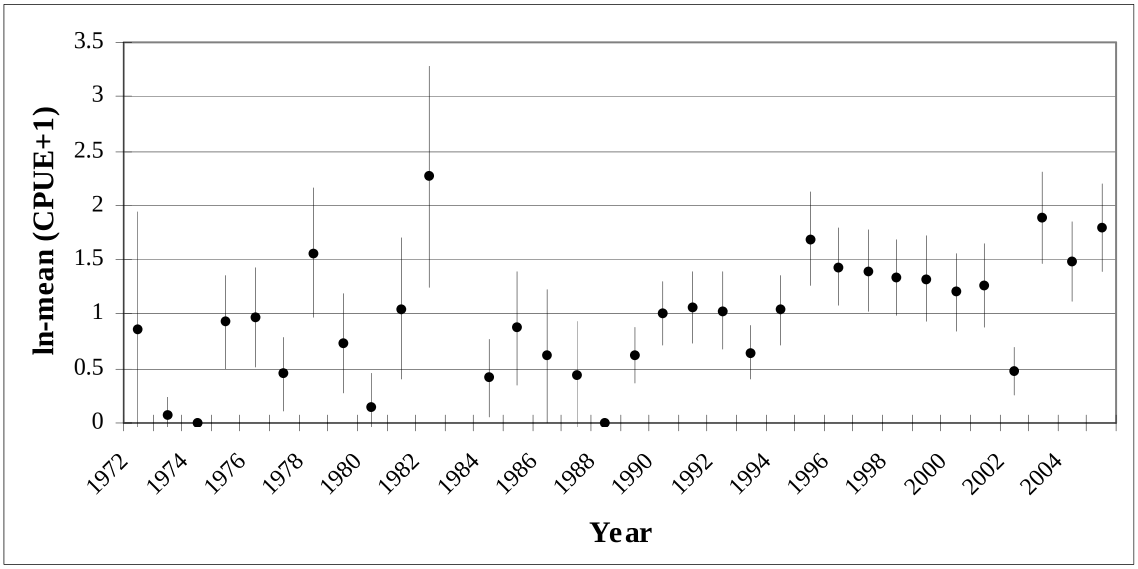

Figure 137. Weakfish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

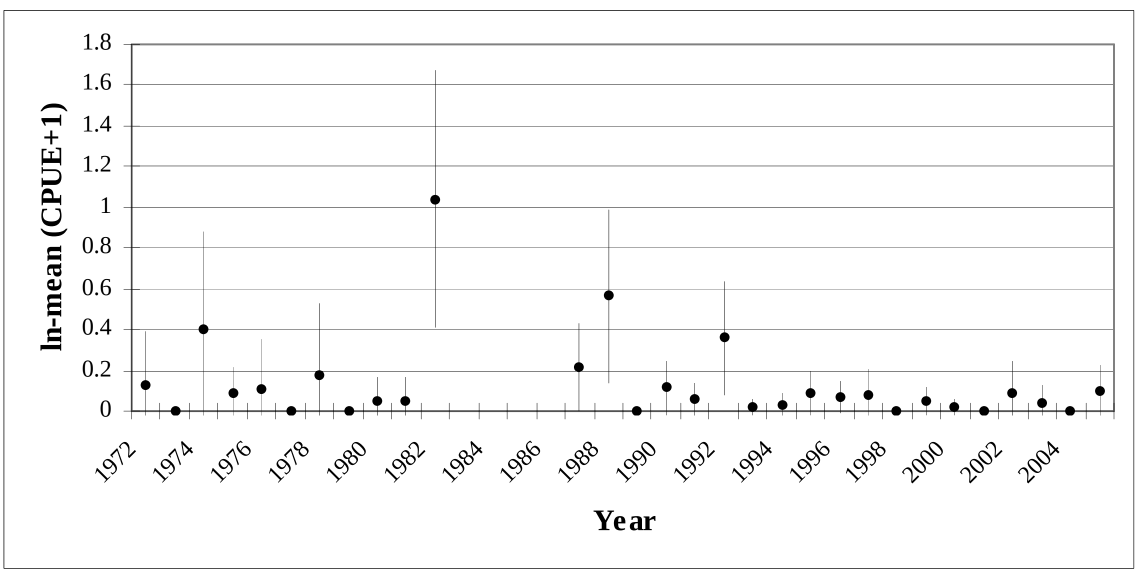

Figure 138. Weakfish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

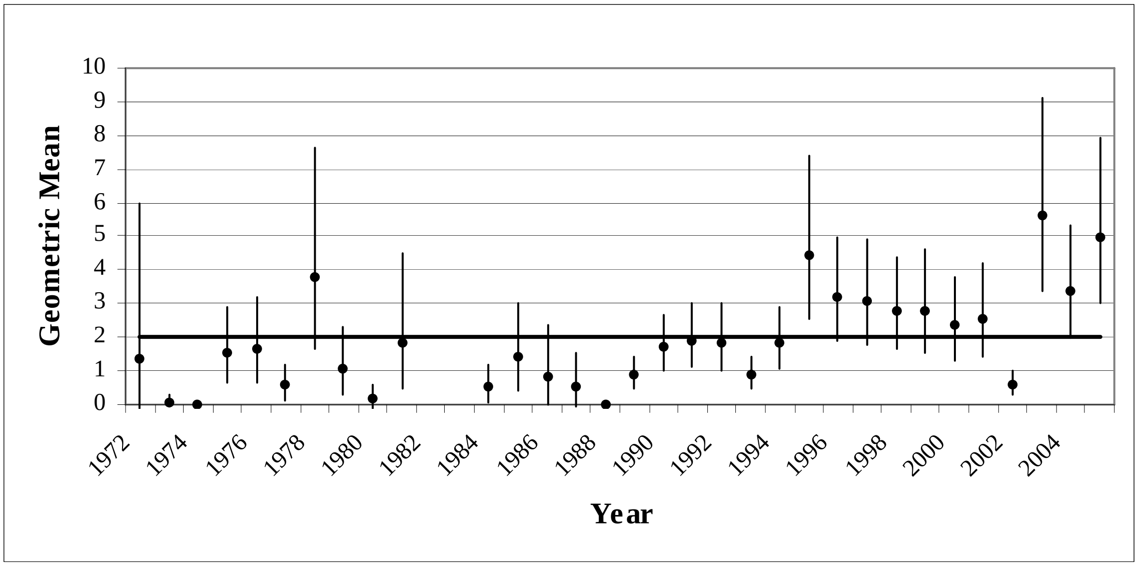

Figure 139. Weakfish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1982 and 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1982: n=18, 1983: n=3). Solid line represents the time series grand mean.

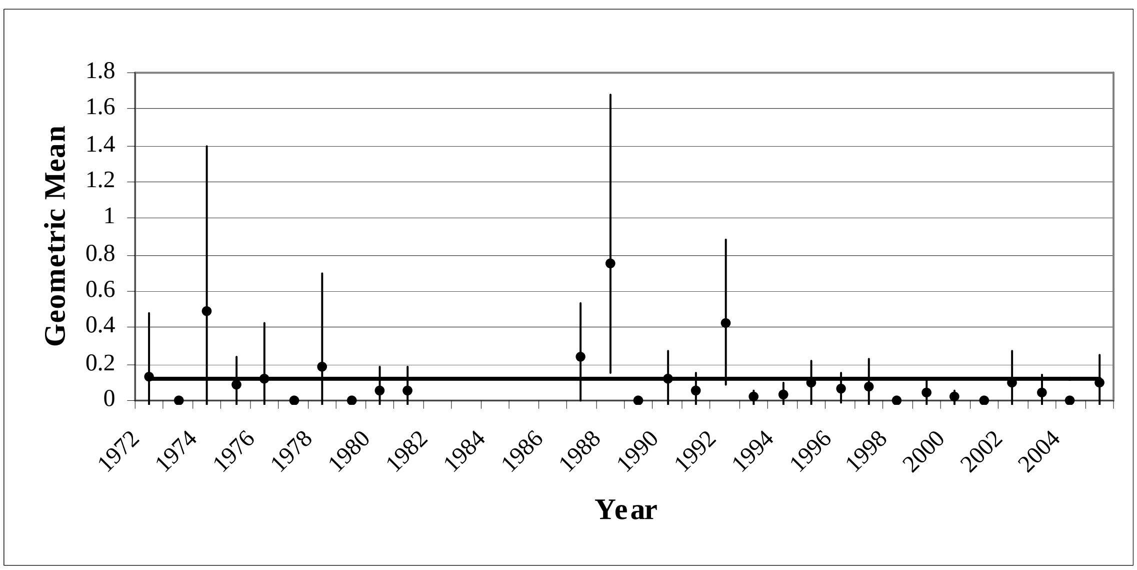

Figure 140. Weakfish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1982-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1982: n=17, 1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

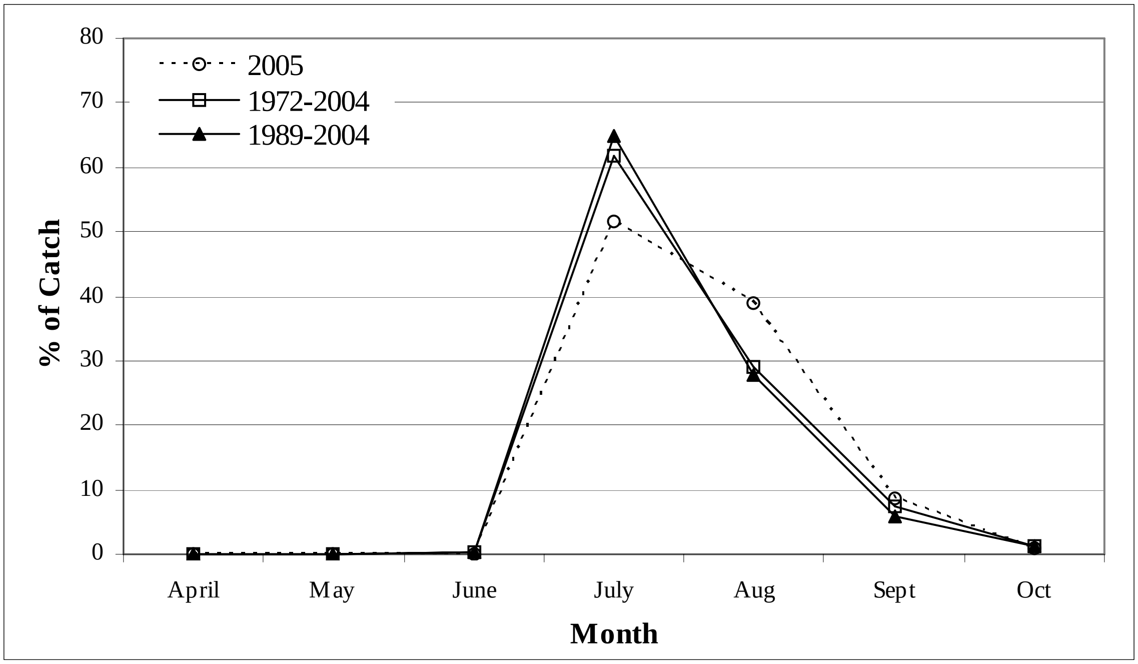

Figure 141. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal weakfish trawl percent catch by month.

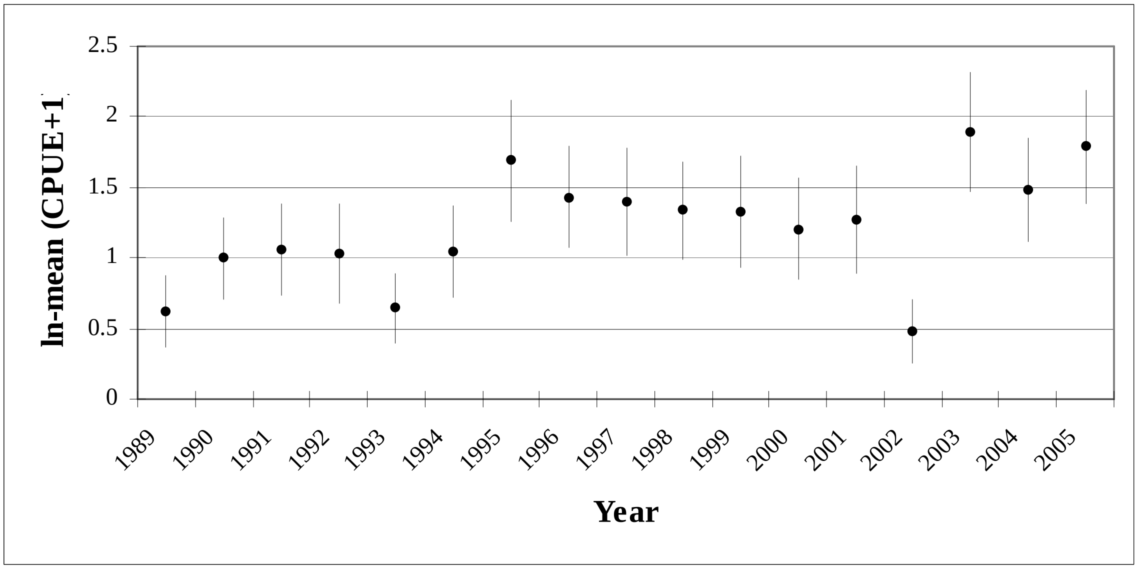

Figure 142. Weakfish trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

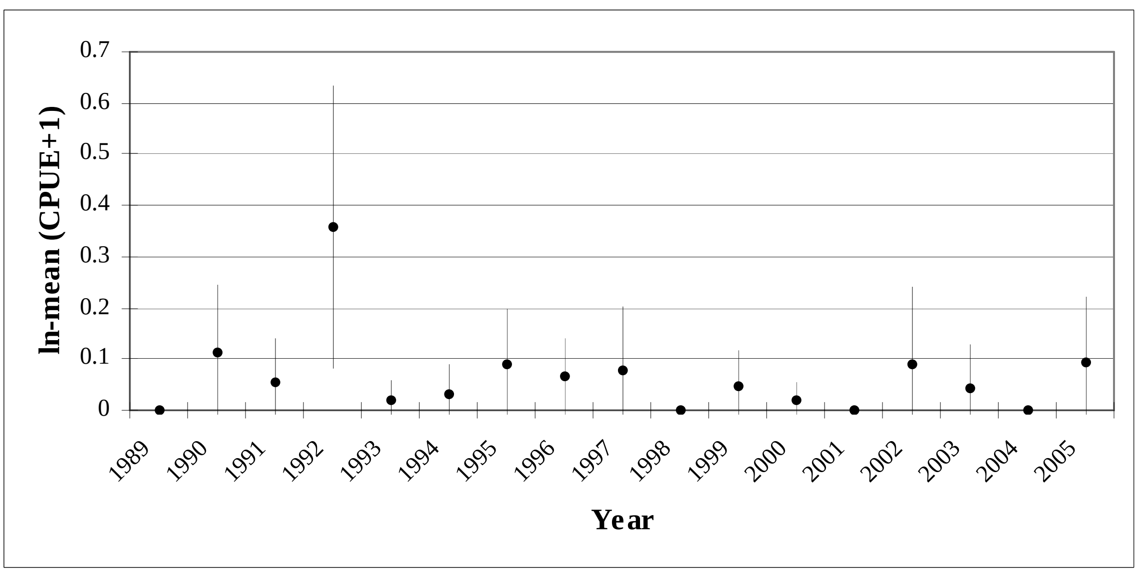

Figure 143. Weakfish beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

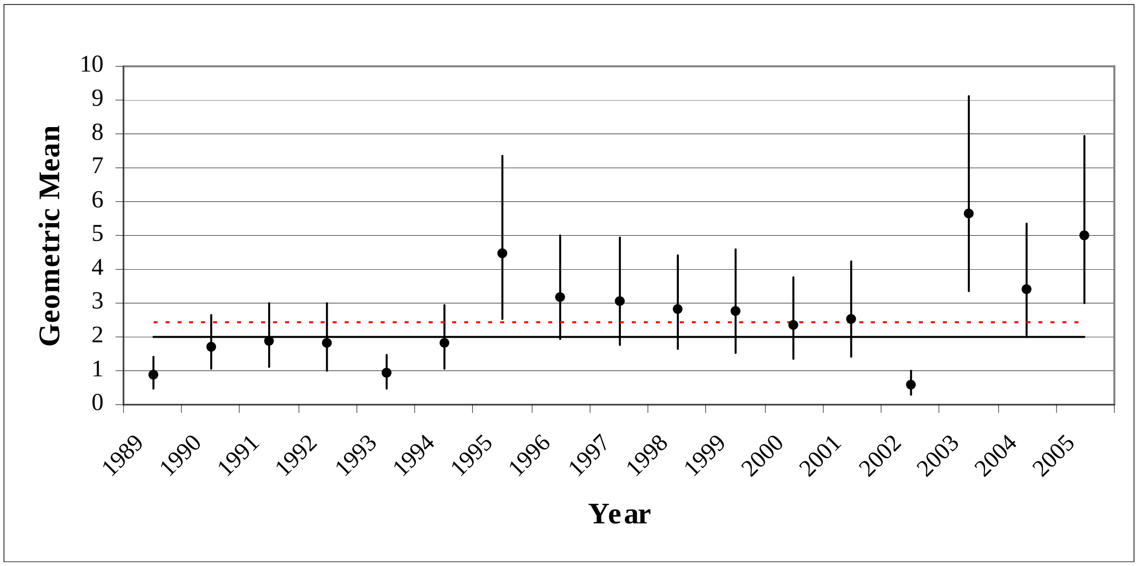

Figure 144. Weakfish trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

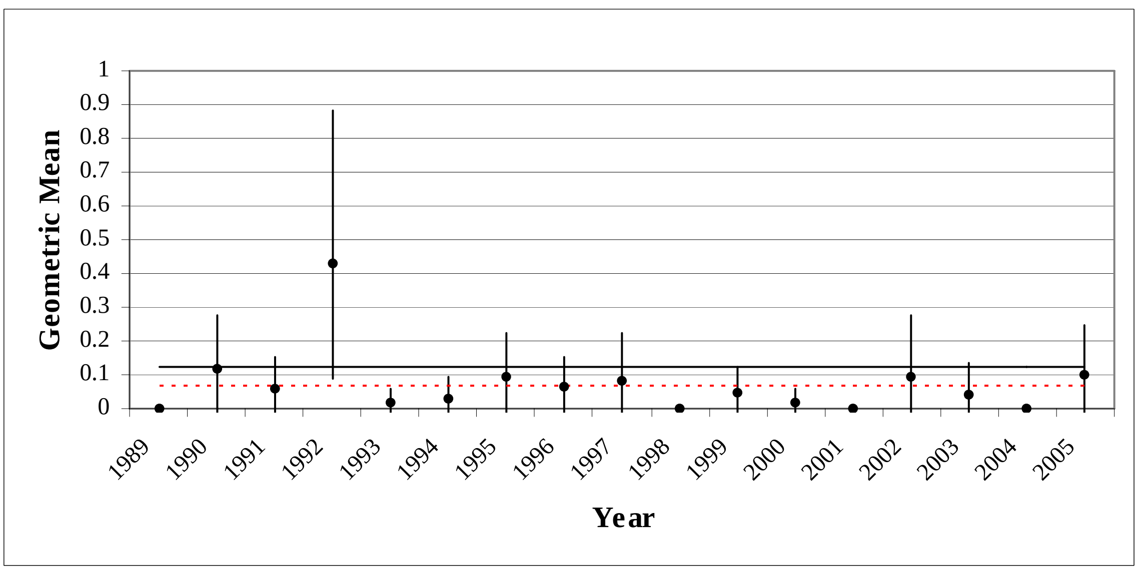

Figure 145. Weakfish beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

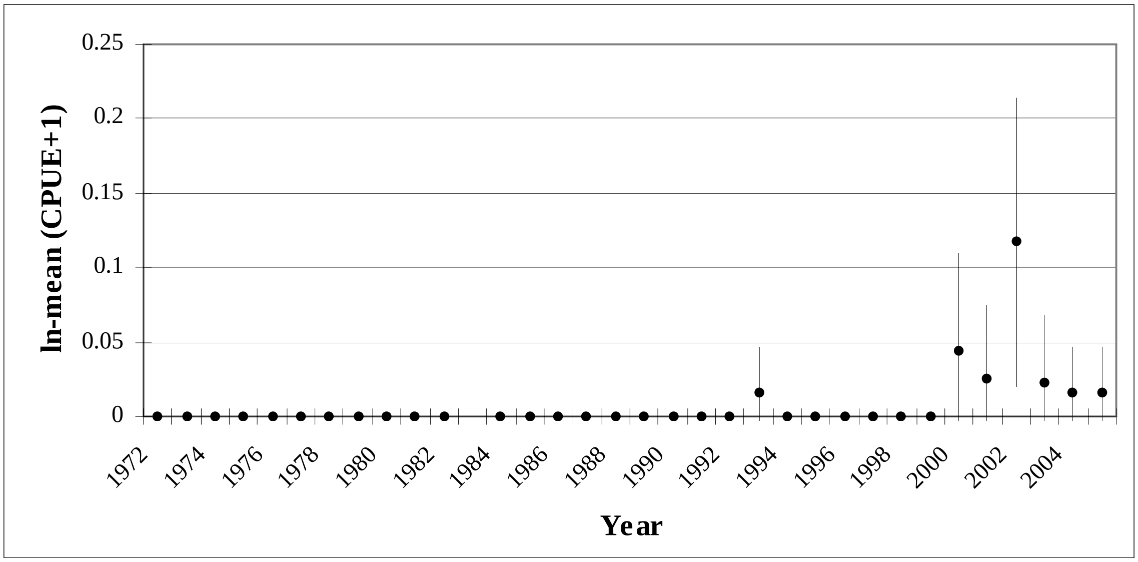

Figure 146. White mullet trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

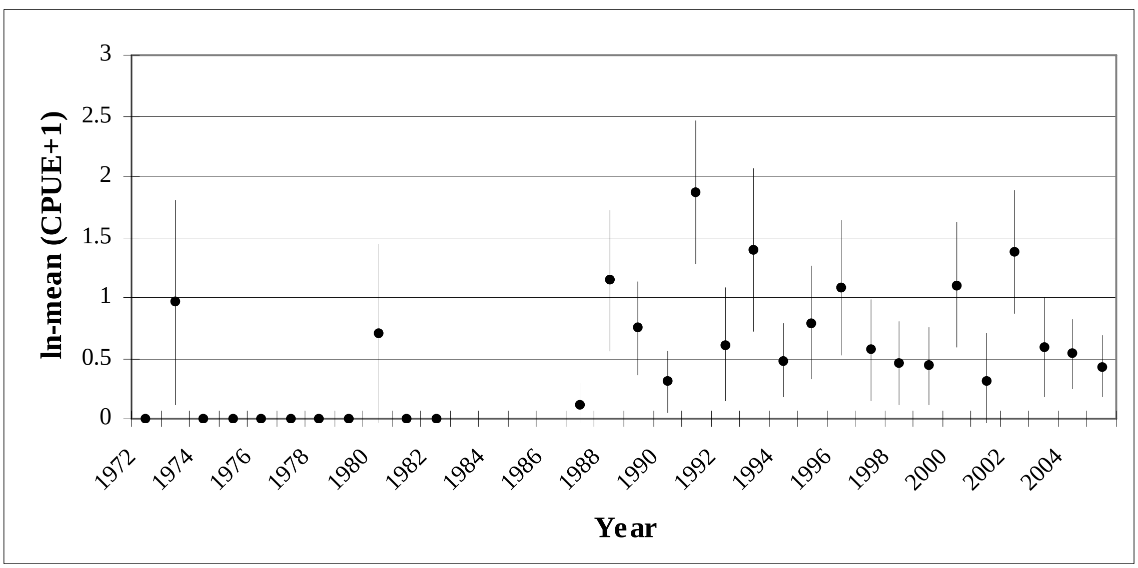

Figure 147. White mullet beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

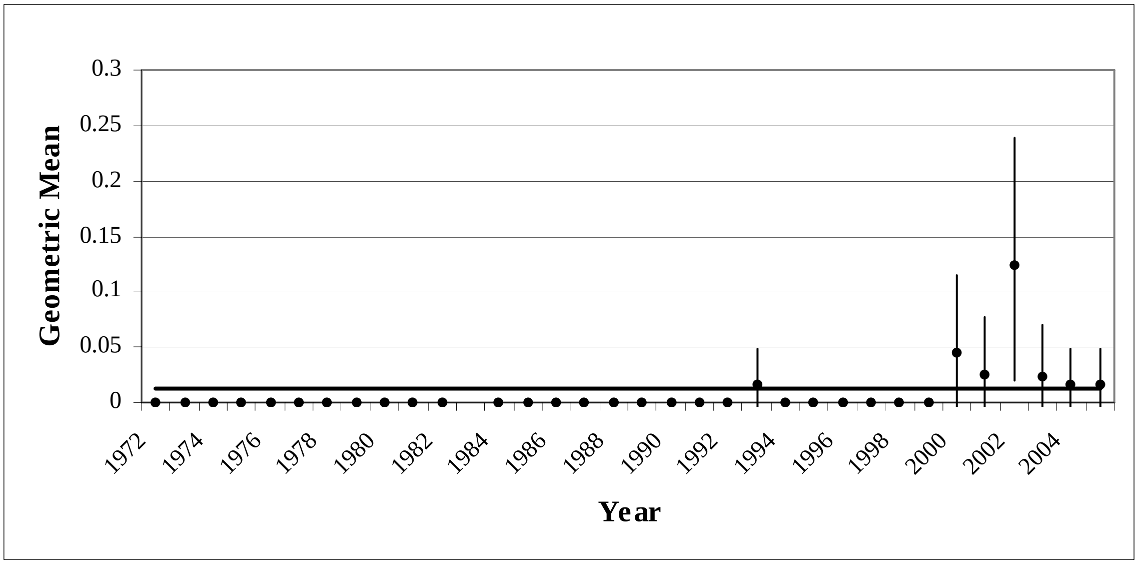

Figure 148. White mullet trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3). Solid line represents the time series grand mean.

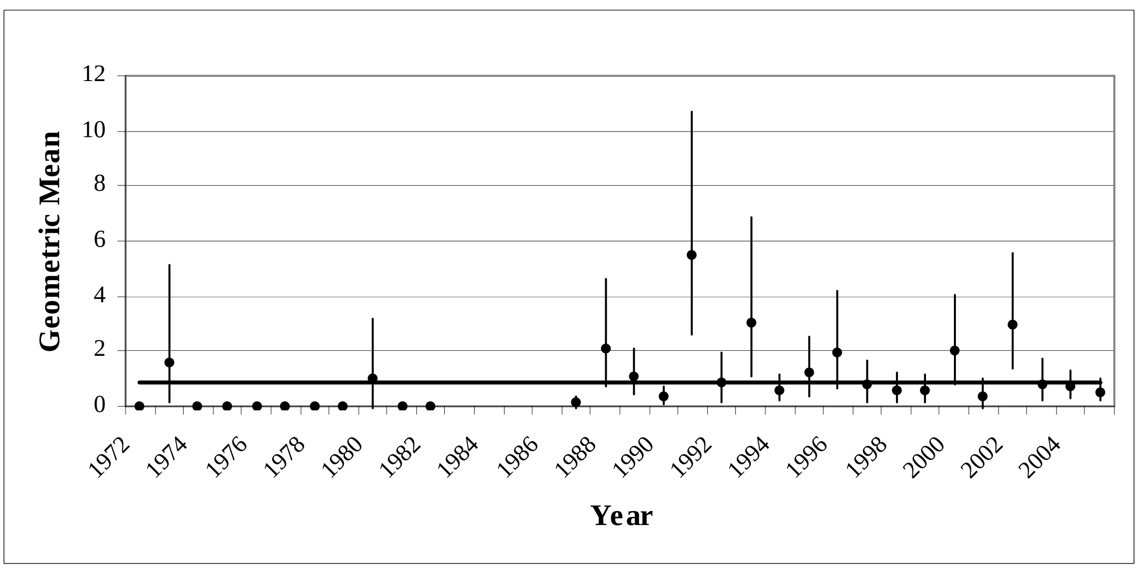

Figure 149. White mullet beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

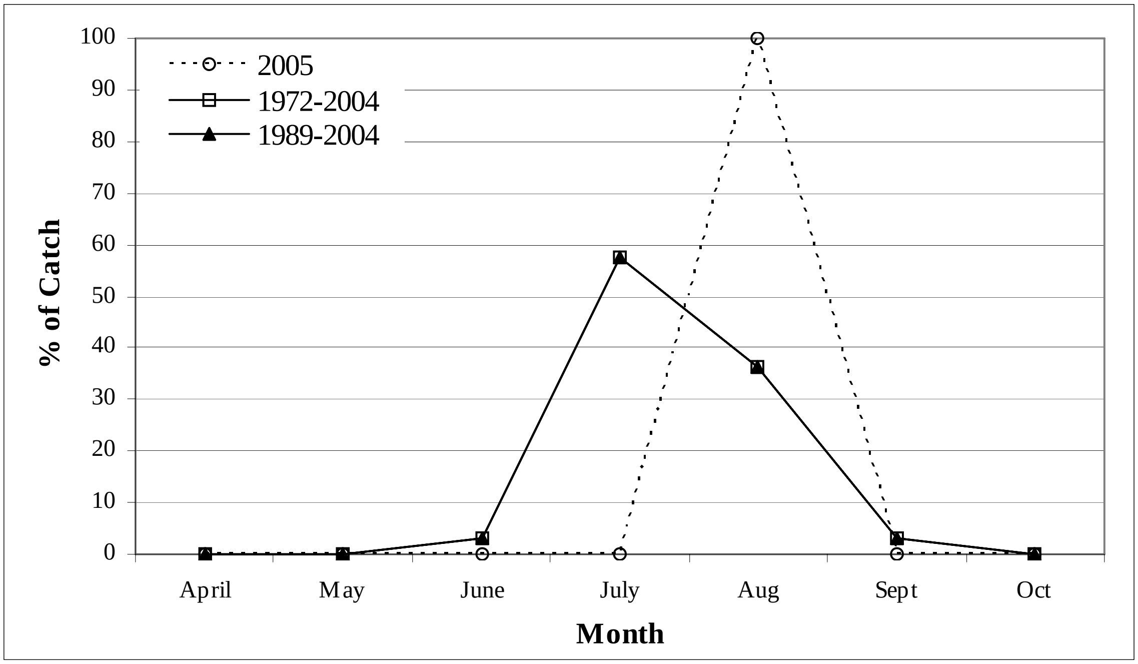

Figure 150. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal white mullet trawl percent catch by month.

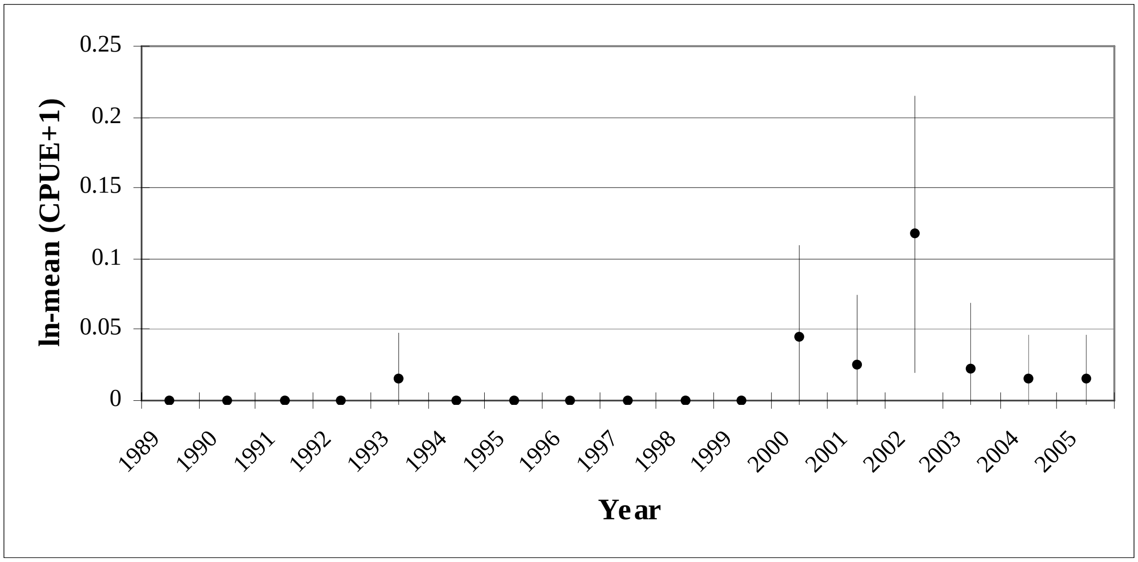

Figure 151. White mullet trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

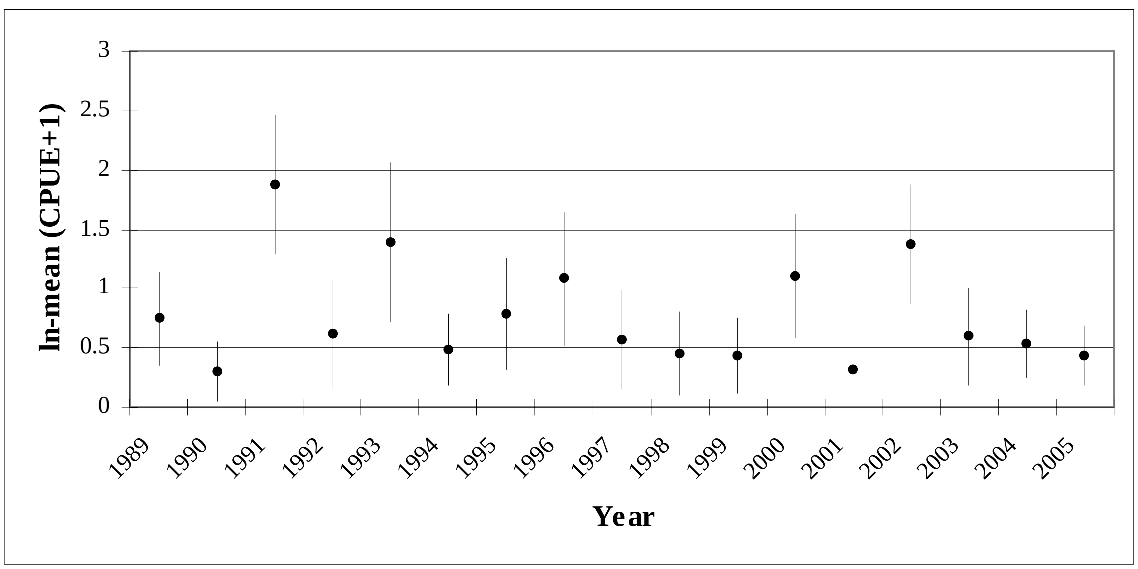

Figure 152. White mullet beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

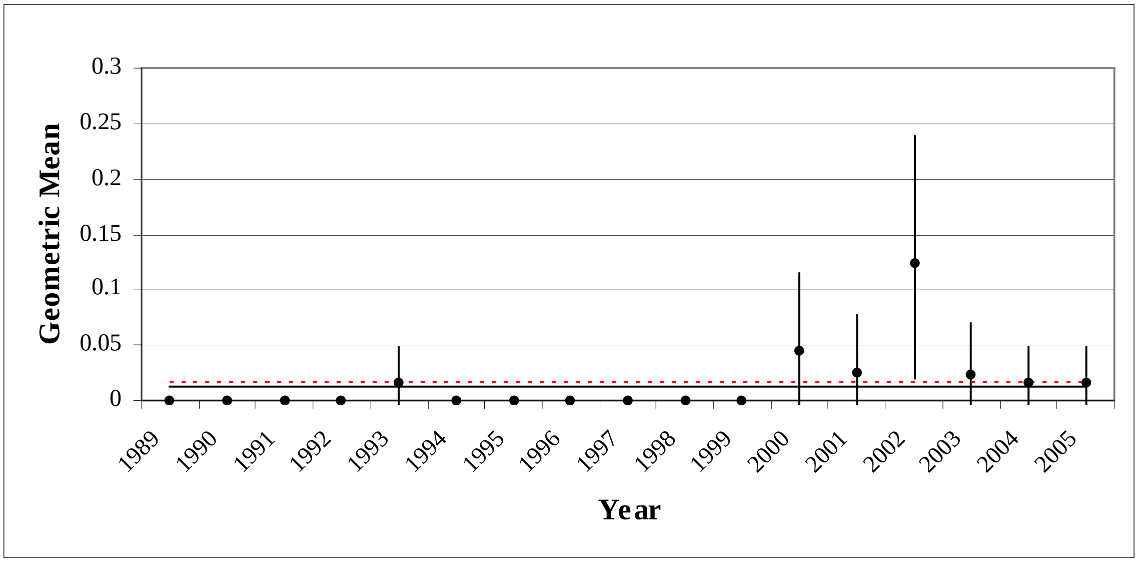

Figure 153. White mullet trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

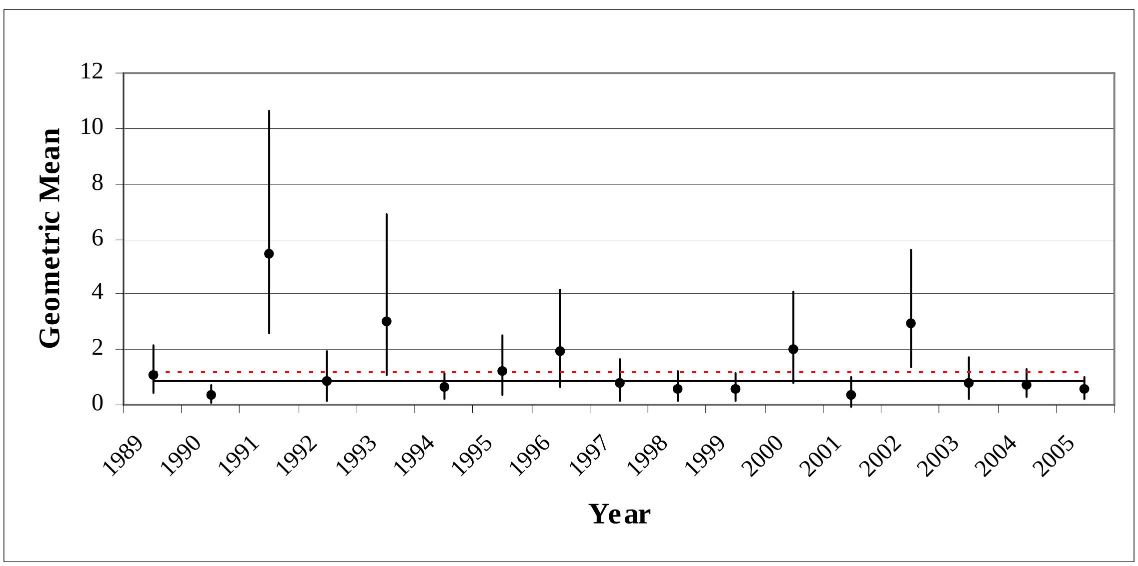

Figure 154. White mullet beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

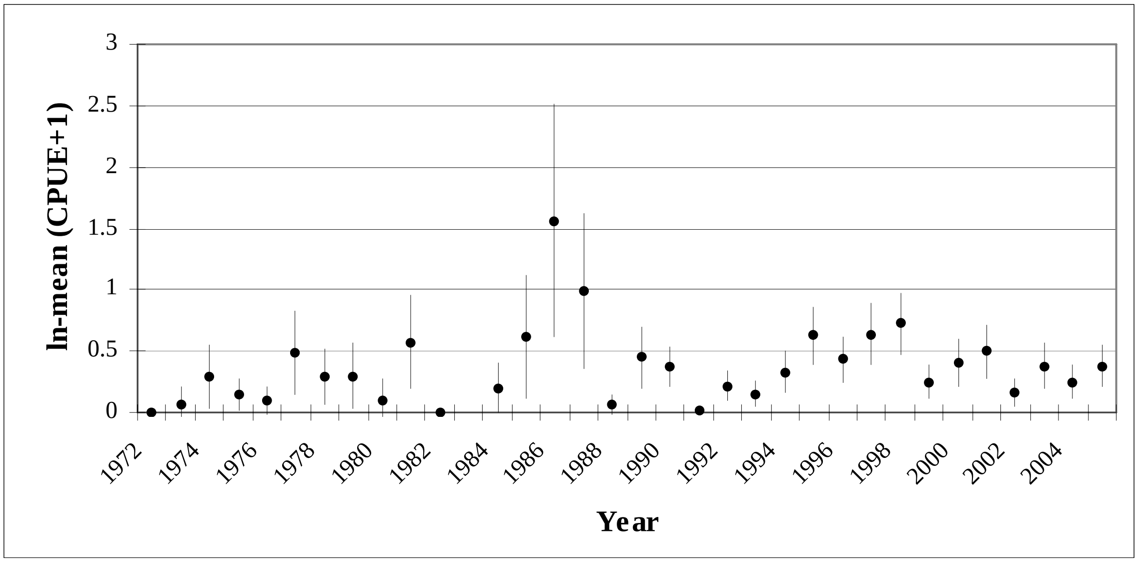

Figure 155. Winter flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3).

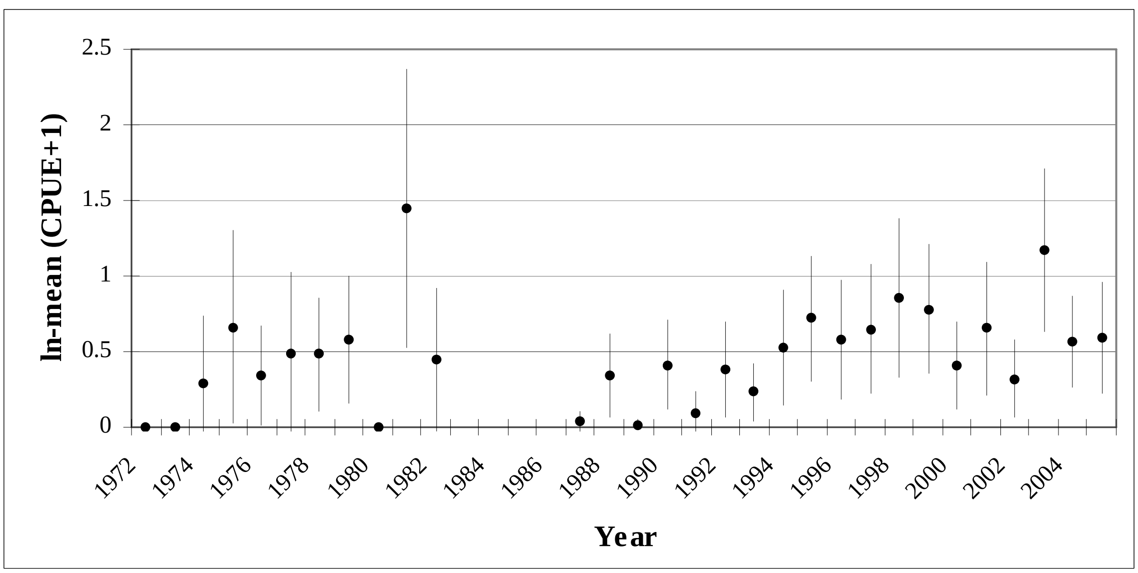

Figure 156. Winter flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1972-2005). Beach seine data collected from 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4).

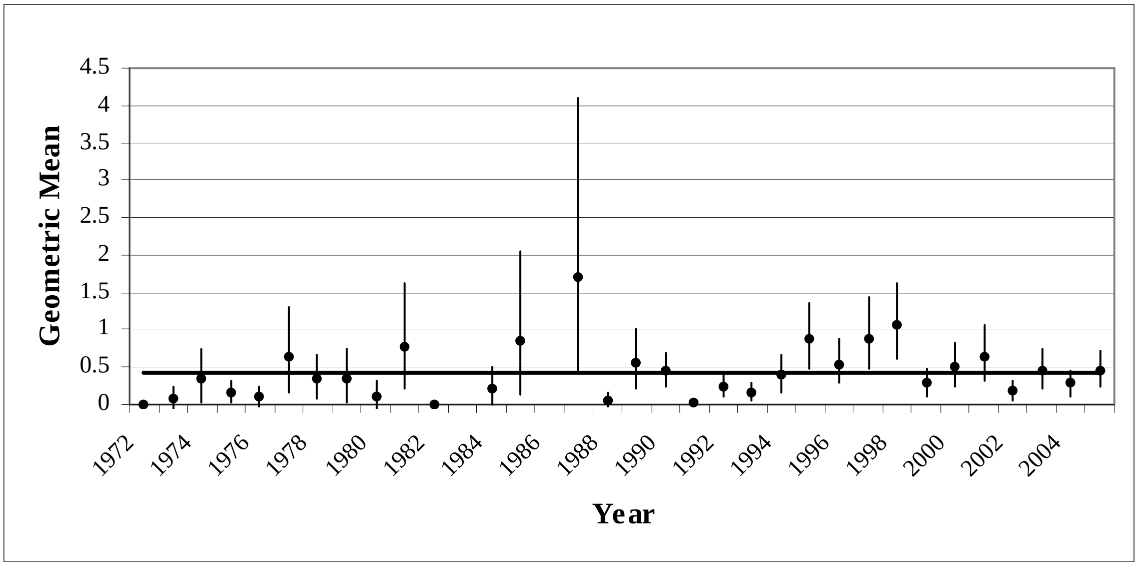

Figure 157. Winter flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Trawl data collected in 1983 and 1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1983: n=3, 1986: n=22). Solid line represents the time series grand mean.

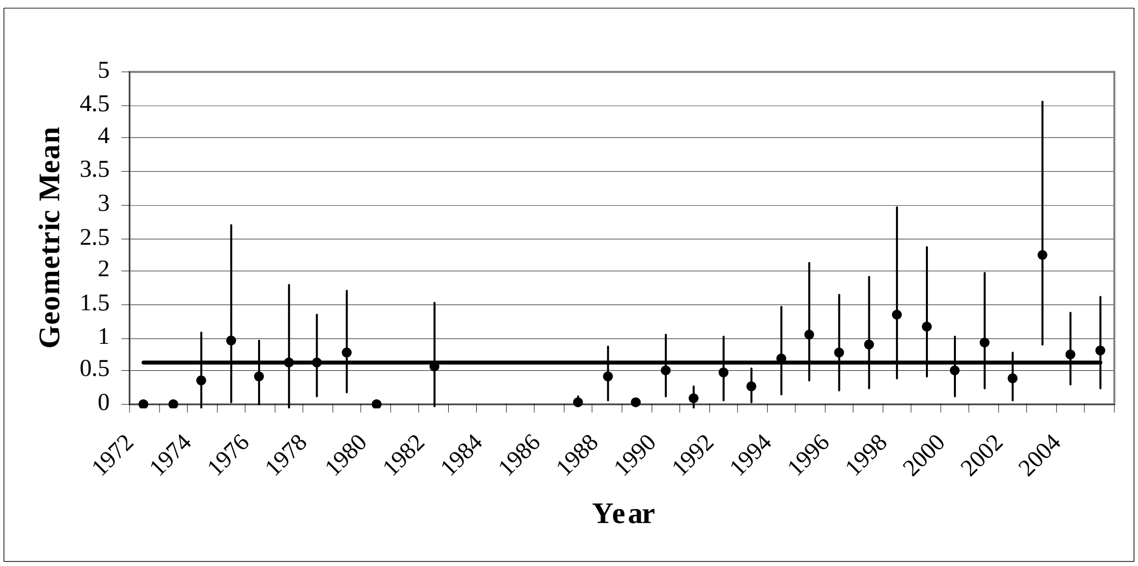

Figure 158. Winter flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1972-2005). Beach seine data collected from 1981 and 1983-1986 were omitted from the graph due to limited sample size causing excessive confidence interval range (1981: n=13, 1983: n=6, 1984: n=2, 1985: n=1, 1986: n=4). Solid line represents the time series grand mean.

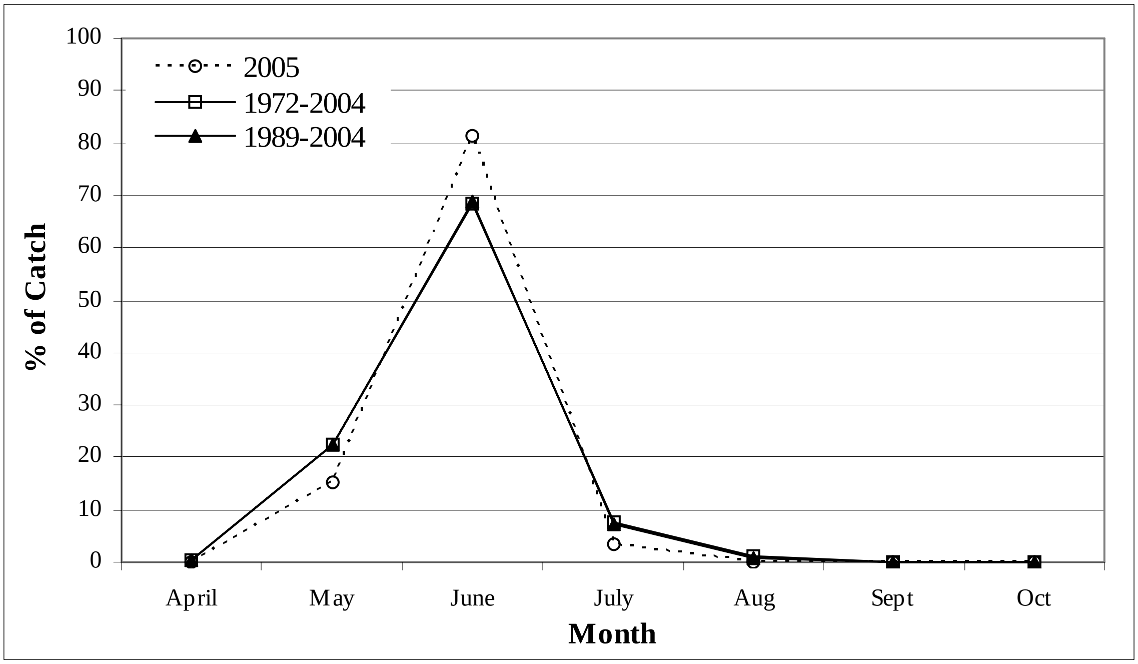

Figure 159. Comparison of historical (1972-2004), standardized (1989-2004) and 2005 seasonal winter flounder trawl percent catch by month.

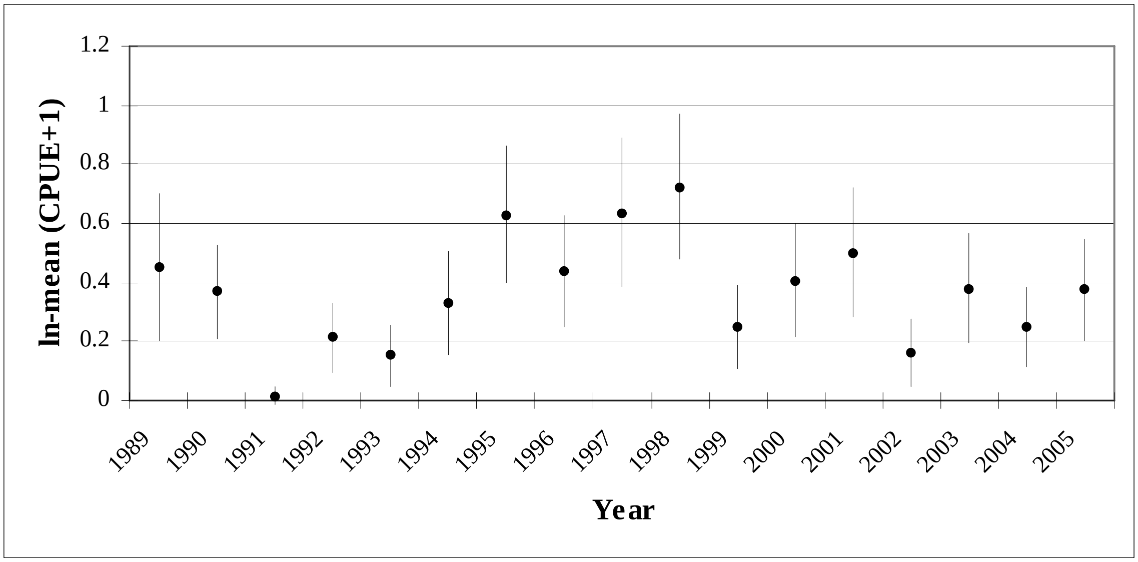

Figure 160. Winter flounder trawl relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

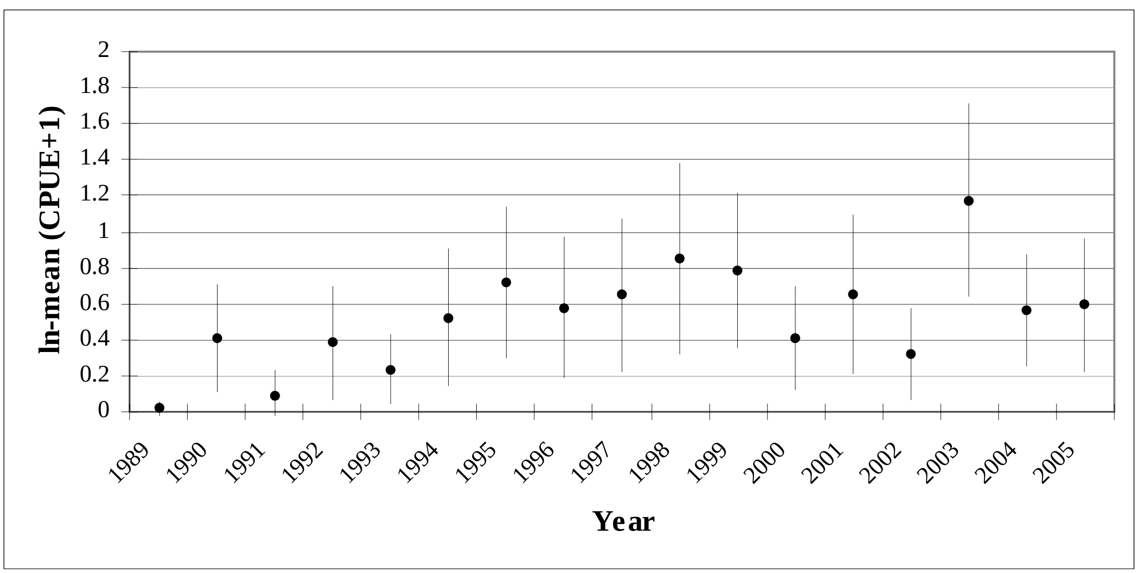

Figure 161. Winter flounder beach seine relative abundance (ln-mean CPUE+1) with 95% confidence intervals (1989-2005). Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

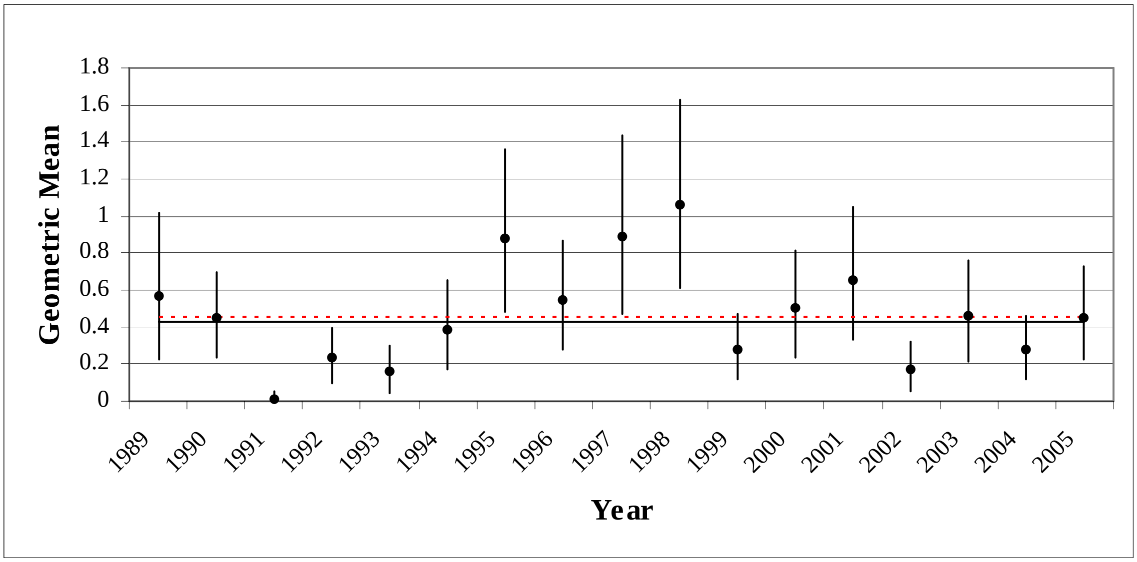

Figure 162. Winter flounder trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=140/year).

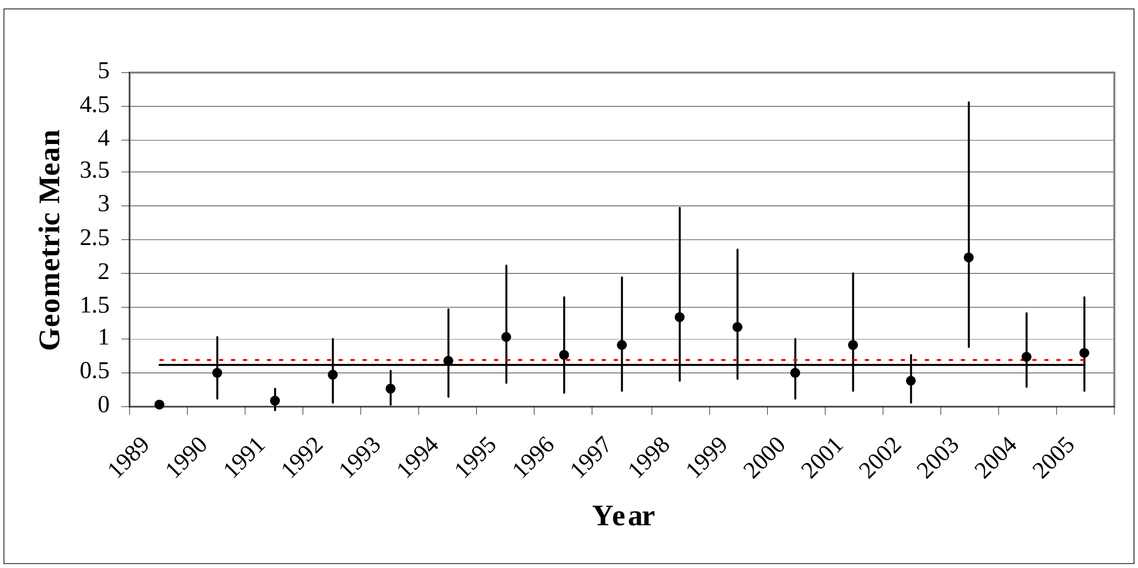

Figure 163. Winter flounder beach seine index of relative abundance (geometric mean) with 95% confidence intervals (1989-2005). Solid line represents the 1972-2005 time series grand mean and the dashed line represents the 1989-2005 time series grand mean. Protocols of the Coastal Bays Fishery Investigation Trawl and Beach Seine Survey were standardized in 1989 (n=38/year).

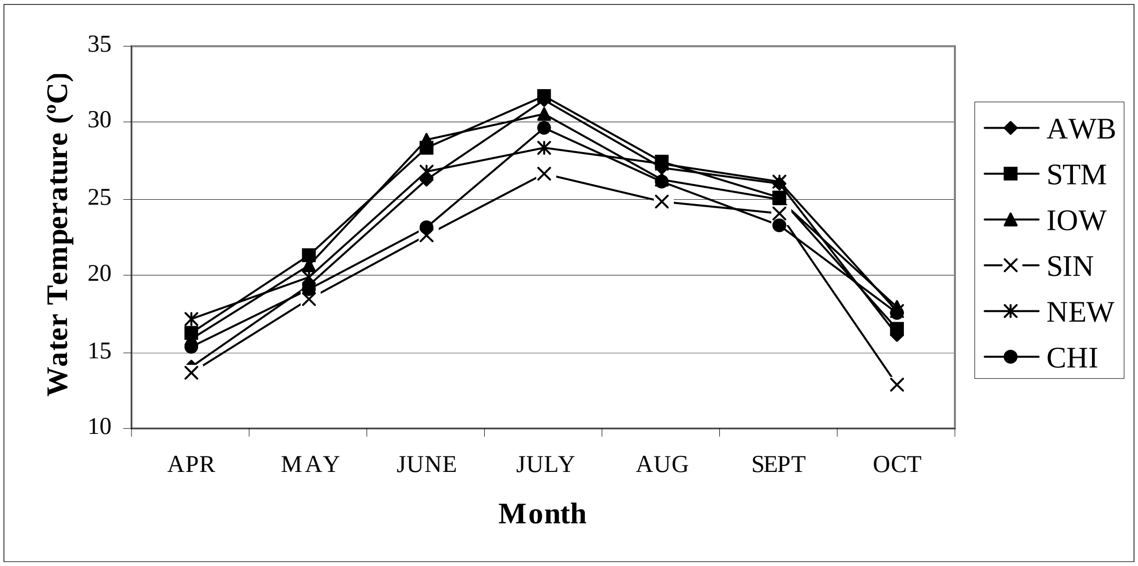

Figure 164. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

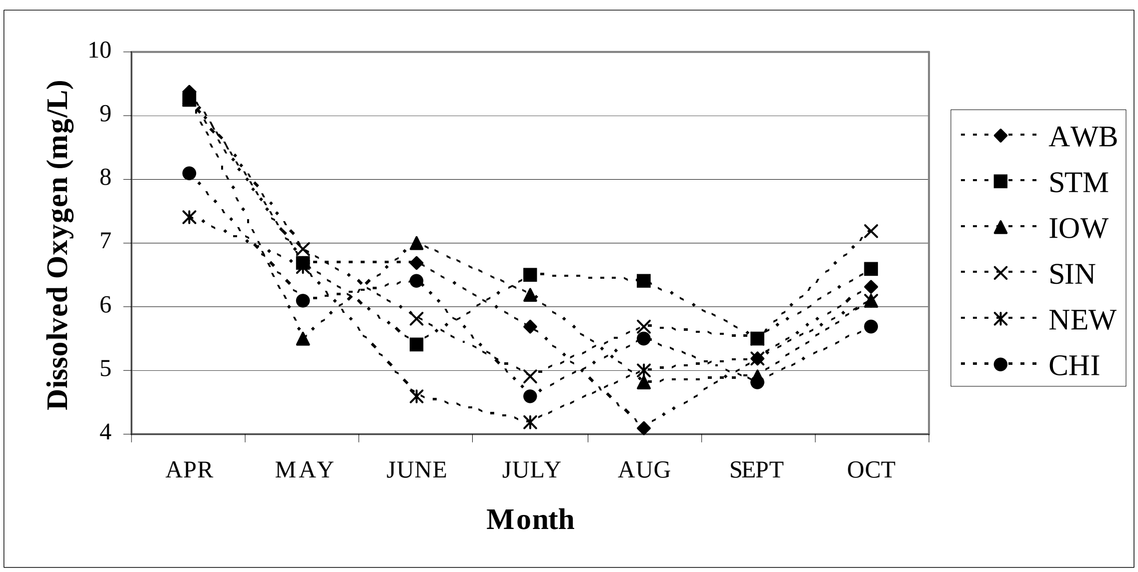

Figure 165. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean dissolved oxygen (mg/L) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

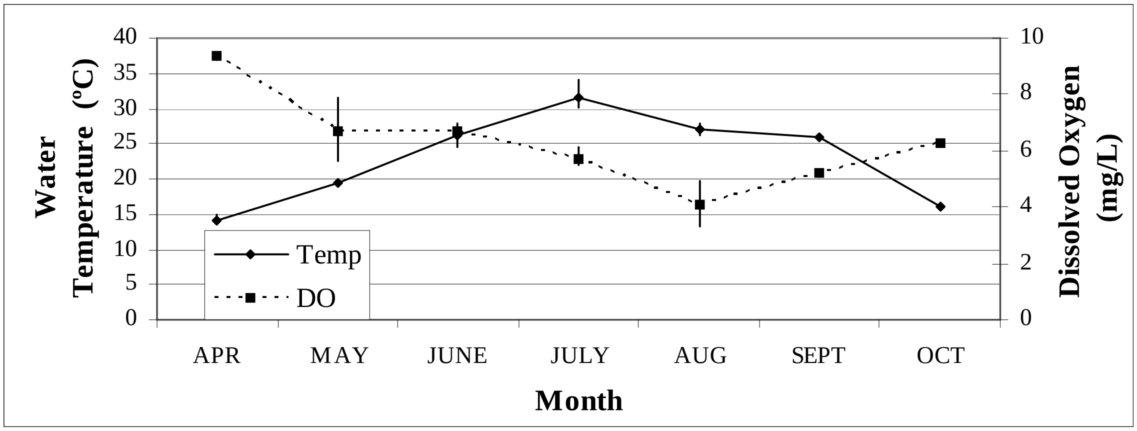

Figure 166. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in Assawoman Bay. Error bars represent the range of values collected.

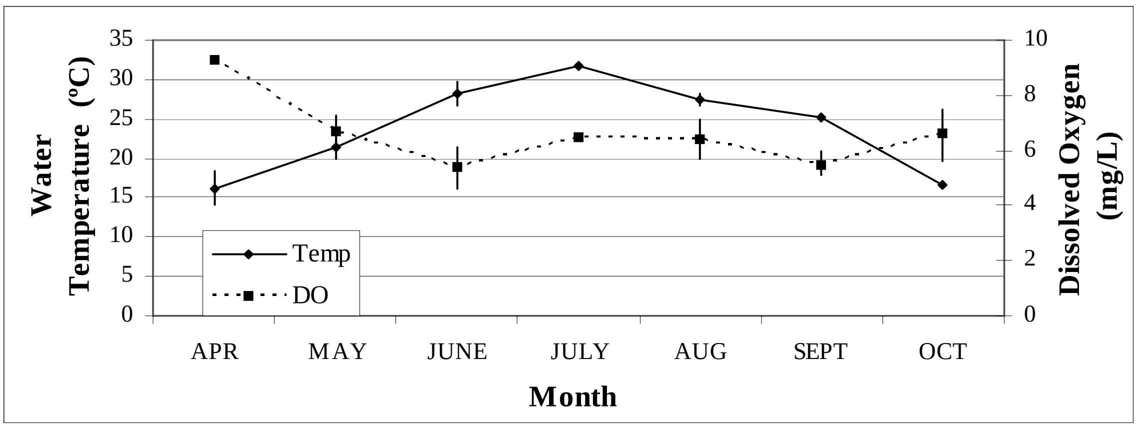

Figure 167. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in St Martins River. Error bars represent the range of values collected.

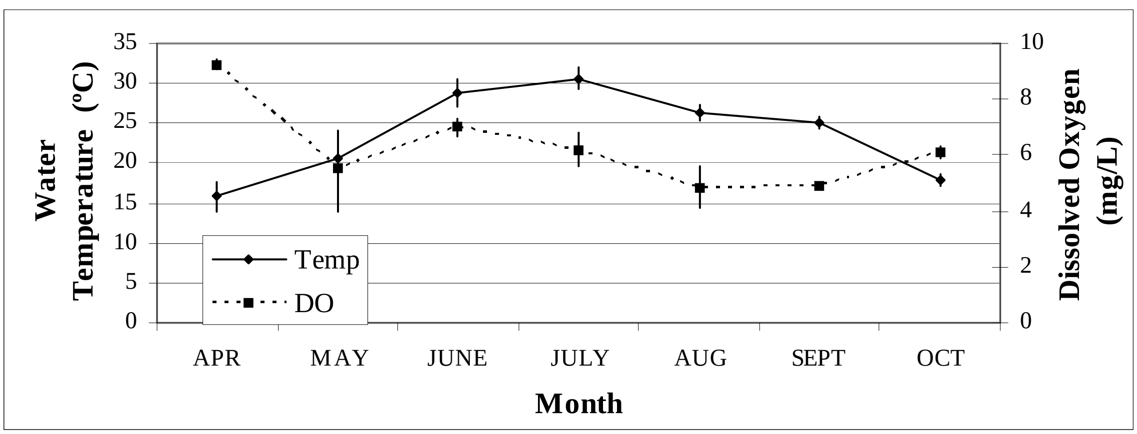

Figure 168. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in Isle of Wight Bay. Error bars represent the range of values collected.

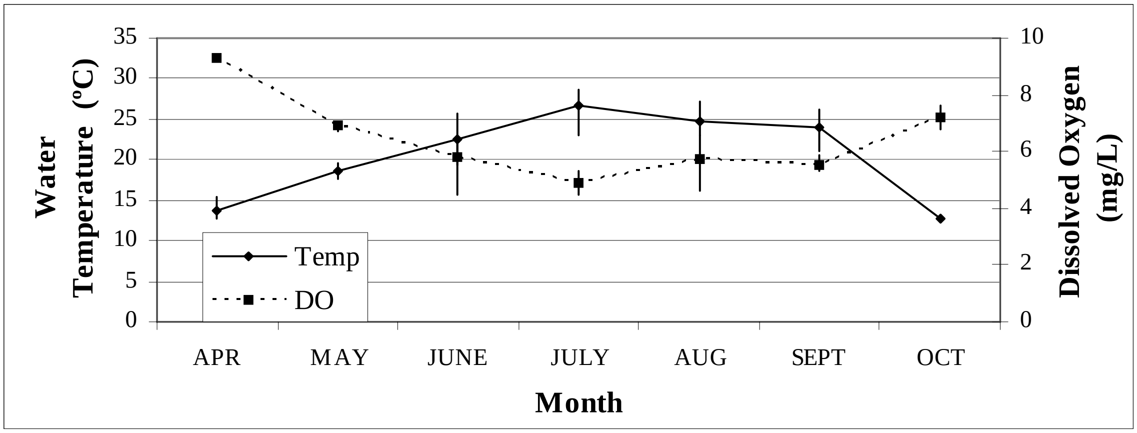

Figure 169. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in Sinepuxent Bay. Error bars represent the range of values collected.

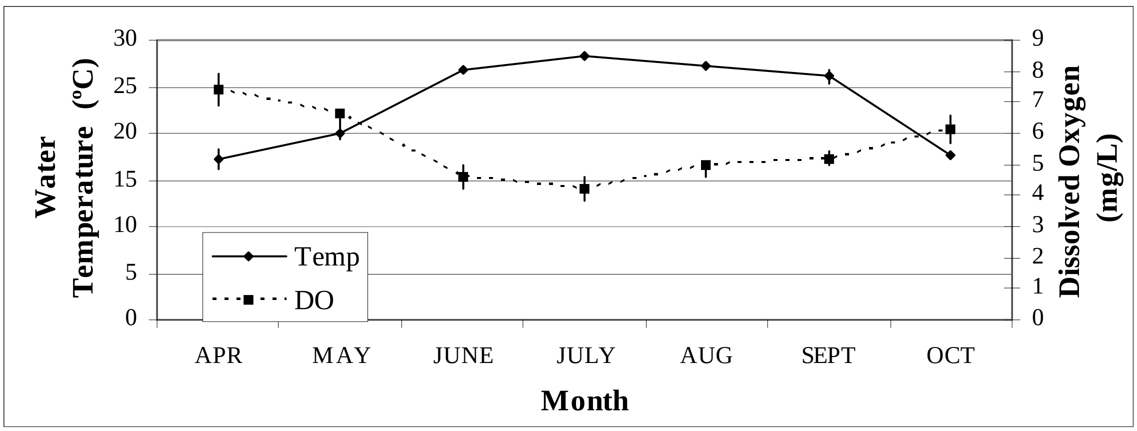

Figure 170. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in Newport Bay. Error bars represent the range of values collected.

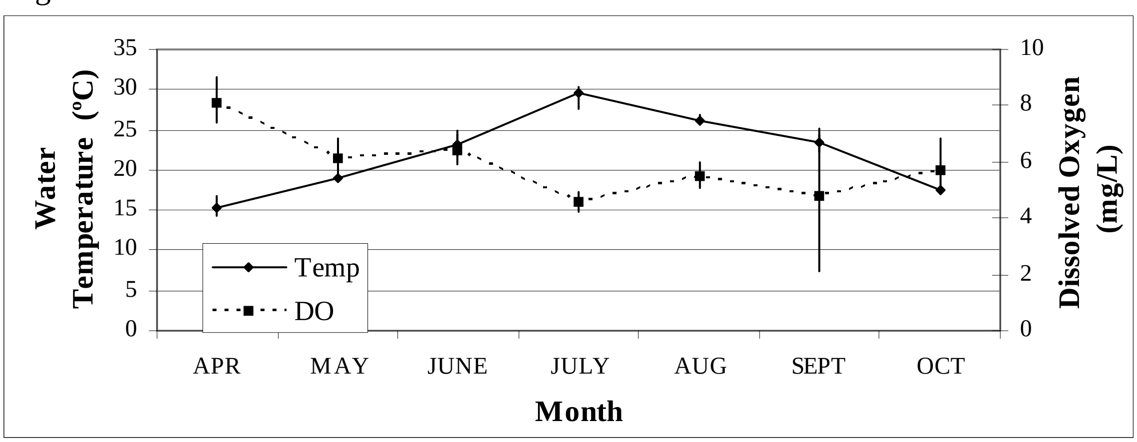

Figure 171. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean water temperature (°C) and dissolved oxygen (mg/L) in Chincoteague Bay. Error bars represent the range of values collected.

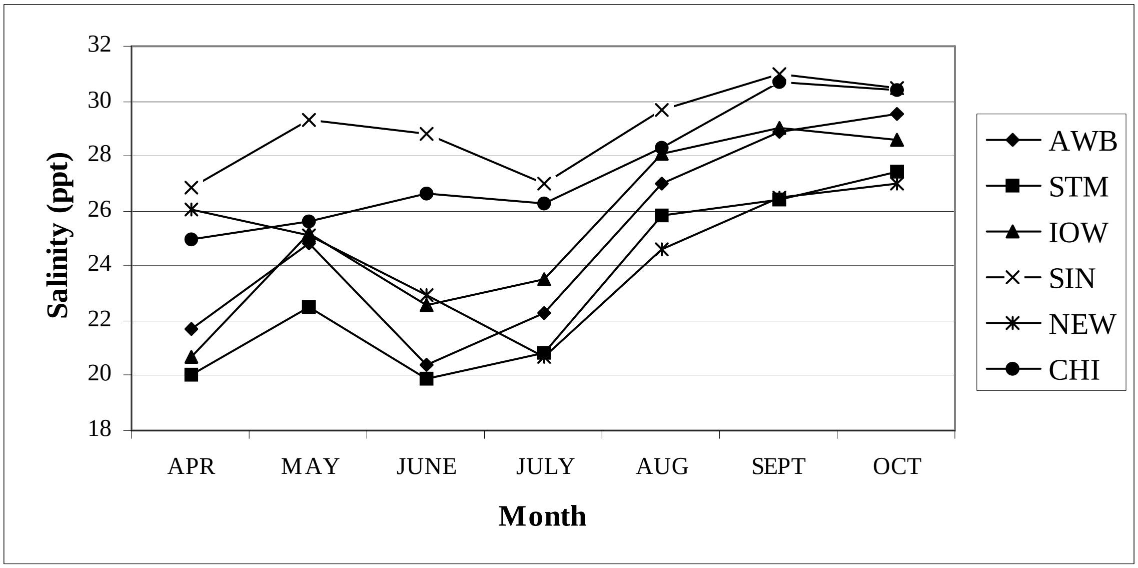

Figure 172. 2005 Coastal Bays Fisheries Investigations Trawl Survey mean salinity (ppt) by month for Assawoman Bay (AWB), St. Martins River (STM), Isle of Wight Bay (IOW), Sinepuxent Bay (SIN), Newport Bay (NEW), and Chincoteague Bay (CHI).

Chapter 2

Offshore Trawl Survey

Introduction:

In an effort to obtain information on adult gamefishes in the near-shore Atlantic waters catches onboard cooperating commercial trawlers operating out of Ocean City, Maryland were sampled. Those length and relative abundance data have been used to supplement the Coastal Bays Fisheries Investigation Trawl and Beach Seine Survey. In addition, those data were used to meet Atlantic States Marine Fisheries Commission (ASMFC) data requirements and were included in compliance reports for summer flounder (*Paralichthys dentatus*), weakfish (*Cynoscion regalis*), and horseshoe crabs (*Limulus polyphemus*).

In 2005, the Maryland Department of Natural Resources (MD DNR) collaborated with the University of Maryland Eastern Shore (UMES) on an offshore trawl survey, focusing on the migration of summer flounder in the vicinity of Ocean City Inlet and coastal bays. Routine offshore sampling efforts were combined with the UMES tagging study. This allowed us the opportunity to achieve our offshore sampling goals while assisting in another study.

Methods:

Time

An attempt was made, when weather cooperated, to sample monthly from April through December. Seven days of trawl sampling occurred between April 28, 2005 and June 22, 2005.

Gear and Location

Sampling was conducted on commercial trawlers that targeted summer flounder and other mid-Atlantic species such as weakfish (*Cynoscion regalis*), croaker (*Micropogonias undulatus*), and striped bass (*Morone saxatilis*). The net was a standard summer flounder trawl net with a 15.2 centimeter (cm, 6 inches) cod end. Trawls lasted one hour or less to minimize stress on the fish.

Sampling location was chosen by the captain to maximize the capture of summer flounder. Trawls were conducted between one and three miles east of Ocean City, MD and within one mile north and south of the Ocean City Inlet (Figure 1). Trawl coordinates were not recorded. The depth range was between 9.1 meters (m, 30 feet) and 18.3 m (60 feet). Tow duration was one hour or less for all trawls.

Sample Processing

A sample of each haul was collected by randomly scooping the catch into a 1000 Liter (L) tub, and then estimating the volume of the sample to the whole catch. All fishes were measured for Total Length (TL) in millimeters (mm, Table 1). Wing span was measured for skates and rays, horseshoe crabs were measured for prosomal width, and other species of crabs were measured for carapace width. Whelks were measured for length. Data was recorded on a standardized data sheet.

Data analysis

Staff biologists entered the data into a Microsoft Excel spreadsheet. Data on length and abundance was analyzed using Excel. Total catch was estimated by multiplying the number of fish in the sample by the inverse of the percentage of catch the sample represented. When sufficient in quantity, length frequency graphs were produced for individual species.

Results and Discussion:

The predominant species encountered in these trawls were summer flounder, horseshoe crabs, little skate (*Leucoraja erinacea*), and clearnose skate (*Raja eglanteria*)). Atlantic sturgeon (*Acipenser oxyrinchus*), weakfish, smooth dogfish (*Mustelus canis*), spiny dogfish shark (*Squalus acanthias*), black sea bass (*Centropristis striata*), Atlantic croaker (*Micropogonias undulates)*, butterfish (*Peprilus triacanthus*), winter flounder (*Pseudopleuronectes americanus*), northern kingfish (*Menticirrhus saxatilis)*), southern stingray (*Dasyatis americana*), smooth butterfly ray (*Gymnura micrura*), cownose ray (*Rhinoptera bonasus*), and assorted crab species were caught in very low numbers, which precluded detailed analysis of these species (Table 2). A complete list of encountered species can be found in Table 2.

A total of 462 summer flounder were measured. Mean total length was 342 mm. The 2005 summer flounder length frequency showed a large 2004 year class returning as age one fish (Figure 2). The 2004 annual CBFI trawl index was above average with the 9th highest index of 33 years.

Due to the coast-wide moratorium on harvesting Atlantic sturgeon, the catches of 26 of them on five dates between 5/23 and 6/22 was interesting. The mean length of captured Atlantic sturgeon was 1219 mm with the largest one measuring 1829 mm and the smallest was 670 mm. One fish had been tagged twice, and the recapture information was provided to the U. S. Fish and Wildlife Service (USFWS). USFWS return information indicated that it had been previously tagged on 9/15/03 in Long Island Sound, CT. and on 3/21/05 in the James River, VA.

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Table 1. Measurement types for fishes and invertebrates captured during the 2005 offshore trawls.

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 length
Turtles	Carapace length

Table 2. List of species collected during Maryland's Offshore Trawl Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of total abundance.

Common Name	Scientific Name	Total Number
Finfish Species		
Clearnose Skate	*Raja eglanteria*	29544
Little Skate	*Leucoraja erinacea*	5309
Southern Stingray	*Dasyatis americana*	634
Summer Flounder	*Paralichthys dentatus*	584
Windowpane Flounder	*Scophthalmus aquosus*	420
Atlantic Croaker	*Micropogonias undulatus*	245
Butterfish	*Peprilus triacanthus*	225
Weakfish	*Cynoscion regalis*	309
Spotted Hake	*Urophycis regia*	155
Smooth Dogfish	*Mustelus canis*	150
Northern Kingfish	*Menticirrhus saxatilis*	140
Spiny Dogfish	*Squalus acanthias*	130
Northern Puffer	*Sphoeroides maculatus*	95
Northern Stargazer	*Astroscopus guttatus*	57
Scup	*Stenotomus chrysops*	55
Pigfish	*Orthopristis chrysoptera*	50
Atlantic Angel Shark	*Squatina dumeril*	40
Black Sea Bass	*Centropristis striata*	40
Silver Hake	*Merluccius bilinearis*	35
Monkfish	*Lophius americanus*	30
Atlantic Sturgeon	*Acipenser oxyrinchus*	28
Striped Searobin	*Prionotus evolans*	25
Northern Searobin	*Prionotus carolinus*	20
Smallmouth Flounder	*Etropus microstomus*	20
Atlantic Herring	*Clupea harengus*	15
Smooth Butterfly Ray	*Gymnura micrura*	15
Cownose Ray	*Rhinoptera bonasus*	8
Black Drum	*Pogonias cromis*	1
Winter Flounder	*Pseudopleuronectes americanus*	2
	Total Finfish	**38,381**
Crustacean Species		
Nine-Spined Spider Crab	*Libinia emarginata*	917
Atlantic Rock Crab	*Cancer irroratus*	859
Blue Crab	*Callinectes sapidus*	175
Long-Clawed Hermit Crab	*Pagurus longicarpus*	12
	Total Crustaceans	**1,963**

Table 2 (con't). List of species collected during Maryland's Offshore Trawl Surveys from April through October, 2005. Species are grouped (Finfish, Crustaceans, Mollusks, Other) and listed by order of total abundance.

Common Name	**Scientific Name**	**Total Number**
Mollusk Species		
Channeled Whelk	*Busycotypus canaliculatus*	2185
Knobby Whelk	*Busycon carica*	1375
Longfin Squid	*Loligo pealeii*	122
Sea Scallop	*Placopecten magellanicus*	50
	Total Mollusks	**3,732**
Other Species		
Horseshoe Crab	*Limulus polyphemus*	6393
Sea Star	*Asterias forbesi*	515
	Total Other	**6,908**

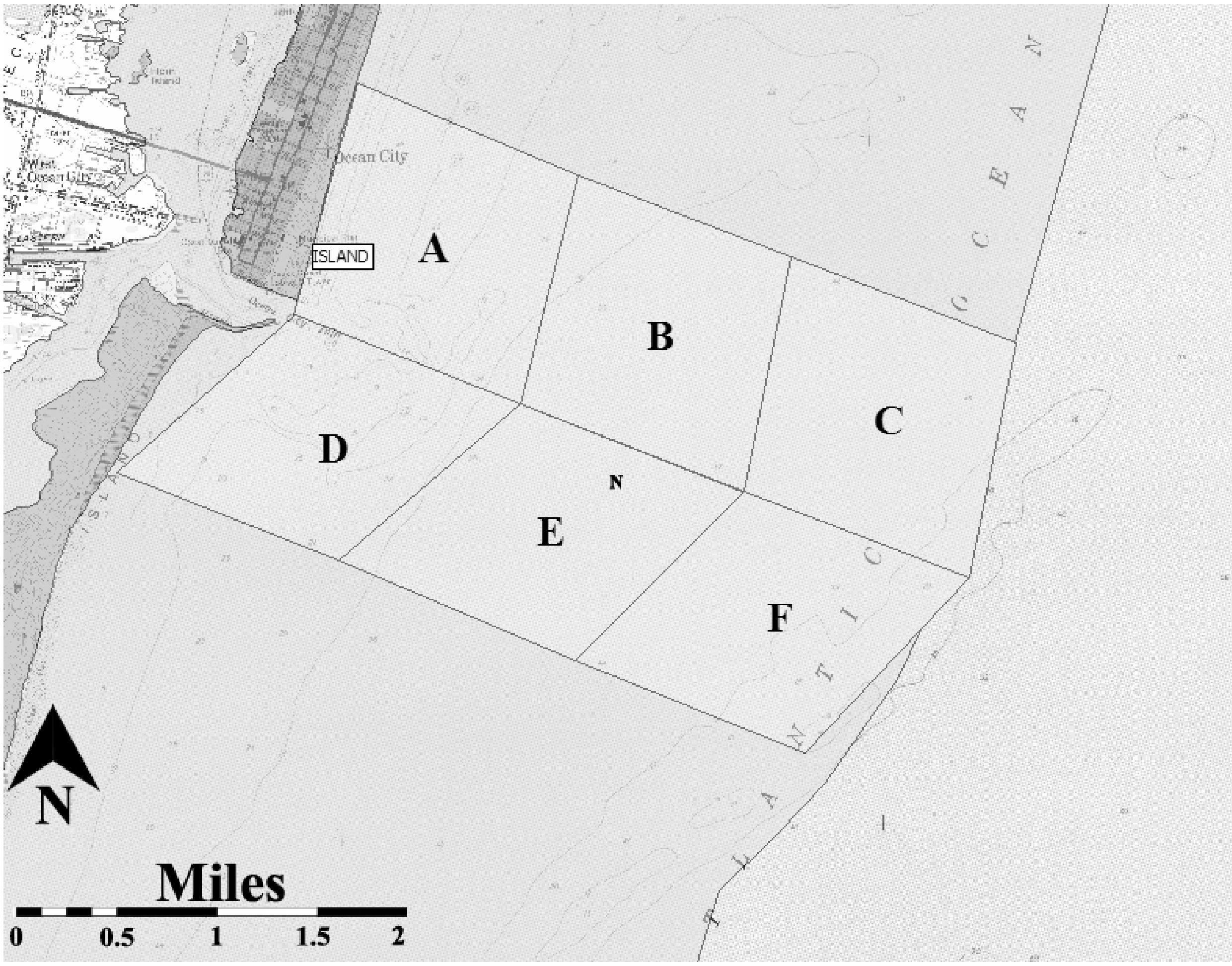

Figure 1. Map of 2005 offshore trawl locations.

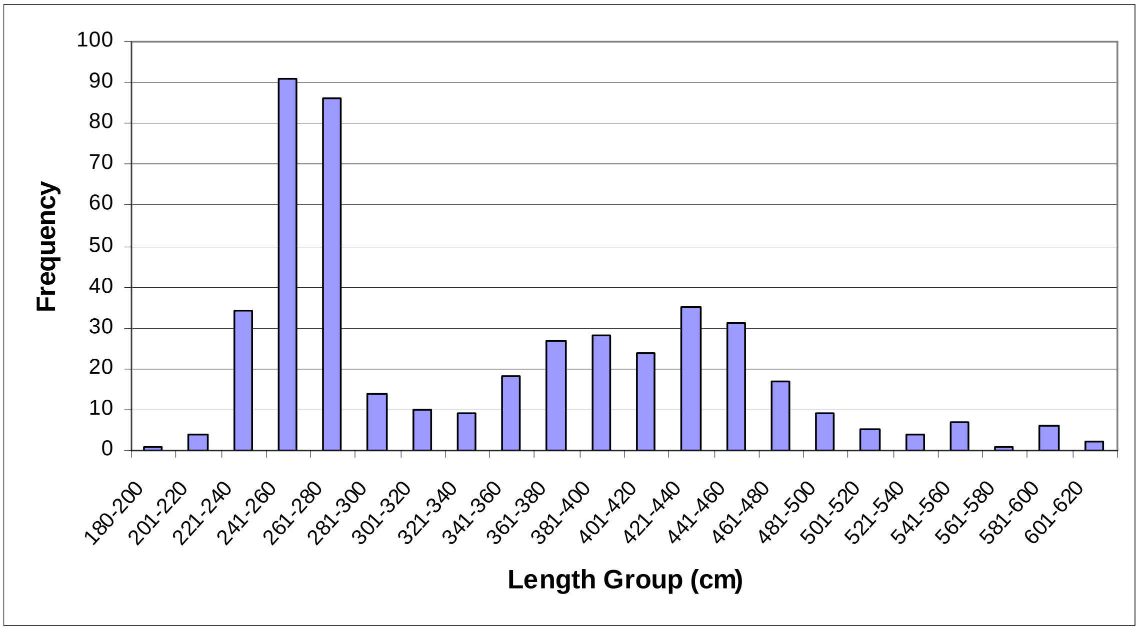

Figure 2. Length frequency of summer flounder collected during Maryland's 2005 Offshore Trawl Survey (n=462).

Chapter 3

Seafood Dealer Catch Monitoring

Introduction:

Data have been collected by this project for several years to be used in the coastal stock assessment for weakfish (*Cynoscion regalis*). The weakfish stock assessment committee needs information on age and size of fish commercially harvested along the coast, as well as the age and size composition of the population as a whole. The collection of those data from commercially harvested fish satisfies this need, as well as meets data collection compliance requirements of Atlantic States Marine Fisheries Commission (ASMFC).

Methods:

In 2005 weakfish were obtained from a local fish dealer and sampled for length, weight, and age. Between November 15-28, 2005, 189 weakfish were purchased for samples. One hundred and fifteen of the fish were caught by trawl, and sixty-four were caught by gill net. All the fish were caught in the fall. 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.

Results and Discussion:

The fish ranged in age from one to four years with a mean age of 2.5 years. Average age for males was 2.4 years and average age for females was 2.6 years. The mean length and weight of all the sampled fish was 395 mm (range 300–550 mm) and 634 g (range 280-1650 g). In Maryland, the minimum length for commercially caught weakfish is 304.8 mm.

Mean lengths and weights by gear and sex are represented in tables 1 and 2. A wider range of fish sizes was caught in the trawl sample when compared to the gill net sample. In both gear type samples, the females average weight and length was greater than for the males.

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Table 1. Commercial bottom trawl caught weakfish average length and weight (with range), n=115.

Gender (n)	Weight	Length
Male (46)	566 (300-1350)	372 (300-514)
Female (59)	710 (280-1650)	404 (305-550)

Table 2. Commercial gill net caught weakfish average length and weight (with range), n=64.

Gender (n)	Weight	Length
Male (13)	586 (400-780)	392 (350-426)
Female (51)	630 (400-1000)	406 (355-465)

Chapter 4

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 estimates which resulted in an increase in the minimum size and a creel reduction in Maryland. 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 (MD DNR) Fisheries Service for the following:

- to fulfill the Atlantic States Marine Fisheries Commission (ASMFC) reporting requirements in conjunction with other recreational Summer Flounder (SF) harvest data;
- serve 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 in Maryland;
- promote public participation in fisheries management and data collection.

In addition, 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 (NMFS) annually used these data for estimating the size structure of undersized fish. Until the state of Connecticut started a similar program, the MVASFS was the only source of discard data for summer flounder along the Atlantic coast.

Methods:

Data Collection

The survey was promoted by outdoor columnists (Candus Thomson, Gene Mueller, Bill Burton) writing for large local newspapers (Baltimore Sun, Washington Times, Annapolis Capital) as well as several smaller newspapers catering to the maritime industry. Local sport fishing organizations (Coastal Conservation Association (CCA), Maryland Saltwater Sportfishermen's Association (MSSA), Pasadena Sportfishing Group (PSG)), tackle shops, and marinas also promoted voluntary participation. A brief description of the survey with contact information was included with fishing license sales from May through December 2005. Additional promotional techniques included: a press release encouraging participation (Figure 1), presentations to local sportfishing groups, advertisements off the MD DNR website home page (Figure 2), website content on the CCA website, and distribution of survey materials (instruction sheets (Figure 3), paper forms (Figure 4), postage paid return envelopes, survey business cards (Figure 5), summary of previous years results) at two winter fishing shows (Timonium Bass Expo, PSG Flea Market).

The survey operated from April through the end of October. Recreational anglers and charter boat captains (includes partyboats AKA headboats) were asked to count the total number of fish caught, measure only the first 20 summer flounder to the nearest ¼ of an inch, 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 summer flounder where zero fish were caught. All survey information was required to be submitted online or mailed by November 1st of the current year (Figure 3). Anglers were reminded not to submit the same information twice or using both methods. Survey forms received in the mail were entered into the online survey so that all data were stored in one place.

Statistical Analyses

After November 15, 2005 the data were 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 several different ways because of the options available for separating the data. To calculate the general Atlantic CPUE, the following calculations were performed in this order:

Angler Hours per Trip = number of anglers * number of hours fished
Total Angler Hours = ∑ Angler Hours per Trip
CPUE = ∑SF/Total Angler Hours

Since all legal fish may not have been kept, CPUE was 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 party boat, *Bay Bee*, submitted length and effort data from its twice daily flounder fishing trips from April through May. The MVASFS 2002-2005 Atlantic data were reviewed to determine if *Bay Bee* data created bias in the survey results (Appendix 1). For each year, a Kolmogorov-Smirnov (KS) chi-square test was performed to determine if there was a significant difference in the length data developed from the *Bay Bee* and the measurements from all other recreational anglers. Atlantic CPUE was calculated with and without *Bay Bee* data.

Total length data were used in a preliminary study to determine if drastic cuts in the 2007 Total Allowable Landings (TAL) would require Maryland to change minimum size and creel limits (Appendix 2). These data were used since the 2006 survey was incomplete at the time the SF Management Board was meeting in November 2006. Methods used to develop SF size limit options were described by Barker et al. in (2004) MD DNR Fisheries Service Technical Memo 45 (Appendix 3).

Results and Discussion:

Sixty five individuals submitted data from 496 trips targeting summer flounder. This was the least number of trips taken in the history of the survey (Table 1). Relaxation of creel and minimum size requirements may have influenced angler perception that participation was not as important. There were 42 instances of no catch trips (zero summer flounder caught), which was about 50% lower than 2004. The decrease in no catch trips may be related to the decline in participation or anglers may not be reporting those trips.

The total number of measured SF caught in 2005 (7204 SF) decreased from 2004 (16800), but was greater than 2003 (5494 SF, Table 1). Although the total number of SF caught declined, more fish were measured and kept unlike 2004 (502) and was similar to other years in the survey (Table 1). The decline in total number of fish caught may be related to lower participation. More fish being measured and kept may be reflective of the reduction in the minimum size from 16 inches down to 15.5 inches combined with a higher creel limit of four fish instead of 3 fish. The average length of measured SF was 13.4 inches, which has not fluctuated much in the history of the survey (Table 1, Figure 6). This trend may be reflective of the relatively similar year class strengths (SAW, 2006).

A KS chi-square test was performed to determine if there was a significant difference in the length frequencies developed from *Bay Bee* data and those from recreational anglers'. Results from the KS test indicated no differences between *Bay Bee* length data and that from recreational anglers (P = 0.994, Appendix 1). 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 declined from 2004, the CPUE for measured, kept fish was constant and increased for legal fish (regardless of fate). These results were expected since the minimum size was decreased and the creel increased (Table 1). Results from testing *Bay Bee* data against that submitted by recreational anglers showed that no bias exists for effort (Table 1, Appendix 1).

Results from testing *Bay Bee* effort data against that submitted by recreational anglers were reported by Barker and Bolinger (2005). A four year CPUE comparison ensured that *Bay Bee* effort data were not driving the over all CPUE (Table 1). Although the absolute difference seems to be about 15% in any given year (which would generally be considered significant), there is no bias (no consistent pattern of whether the *Bay Bee* CPUE is greater or smaller), and the overall percent difference is fairly small (6%). Barker concluded that there was no reason to perform formal statistical tests on these numbers (Appendix 1).

Total length data were used in a preliminary study to determine if drastic cuts in the 2007 Total Allowable Landings (TAL) would require Maryland to change minimum size and creel limits. These data were used since the 2006 survey was incomplete at the time the Summer Flounder Management Board was meeting in November 2006 (Appendix 2).

References

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 The Maryland Volunteer Angler Summer Flounder (SF) Survey Data for the Atlantic Coastal Bays 2002 – 2005.

Year	2002	2003	2004	2005
Regulations Creel @ Minimum Size (inches)	8 @ 17	8 @ 17	3 @ 16	4 @ 15.5
Number of Individuals Submitting Surveys	107	102	103	65
Total Number of Trips	723	597	658	496
Total Number of Trips without catches	97	95	86	42
Total Number SF Caught	7982	5494	16800	7204
Total Number SF Measured	5212	4063	6421	4549
Measured and Kept	663	653	502	619
Measured and Released	4549	3401	5759	3898
Unknown Fate	0	9	160	32
Mean Length (inches) of Measured SF	13.7	13.4	13.5	13.4
% of Measured SF ≥ Minimum Size	14%	15%	8%	13%
Total Angler Hours (A-Hr)	25860	18785	17771	15451
CPUE (Fish/A-Hr)	0.35	0.31	1	0.47
CPUE (Measured Kept SF/A-Hr)	0.03	0.04	0.06	0.06
CPUE (Measured Legal SF/A-Hr)	0.04	0.04	0.03	0.05
CPUE *Bay Bee*	0.33	0.31	1.03	0.46
CPUE without *Bay Bee*	0.41	0.34	0.87	0.51

DNR ENCOURAGES ANGLERS TO PARTICIPATE IN THE SUMMER FLOUNDER VOLUNTEER ANGLER SURVEY

ANNAPOLIS - The Maryland Department of Natural Resource (DNR) Fisheries Service is encouraging anglers to participate in the Summer Flounder Volunteer Angler Survey. The data collected is used to help manage the fishery.

"Recreational anglers of summer flounder have continued to enjoy the benefits of the rapidly rebuilding flounder stock along the Atlantic seaboard," said Howard King, Director of DNR's Fisheries Service. "This is due in large part to the anglers that take an interest in the management of this natural resource by filling out the survey and I'd like to personally thank them for their time."

Anglers who participate in the Summer Flounder Volunteer Angler Survey will help guide the Department's management approach for both the Chesapeake Bay and Atlantic Coast populations. The results of the survey will also be used to augment and enhance existing data from the National Marine Fisheries Services' Marine Recreational Fisheries Statistics Survey.

In addition, as an Atlantic States Marine Fisheries Commission member, Maryland is required to participate in a monitoring program that will provide information on the size composition of the harvest in the summer flounder recreational fishery. The survey data is the only source of information on recreationally caught and released undersized fish available to Maryland and Virginia fisheries managers.

To participate in this important survey, visit URL http://www.dnr.maryland.gov/fisheries/survey/sfsurveyintro.shtml or contact DNR at 1-877-620-8DNR, ext. 8311. A packet with forms and postage paid envelopes is available to anglers that do not wish to participate through the Internet.

The Maryland Department of Natural Resources (DNR) is the state agency responsible for providing natural and living resource-related services to citizens and visitors. DNR manages more than 446,000 acres of public lands and 17,000 miles of waterways, along with Maryland's forests, fisheries and wildlife for maximum environmental, economic and quality of life benefits. A national leader in land conservation, DNR-managed parks and natural, historic and cultural resources attract 11 million visitors annually. DNR is the lead agency in Maryland's effort to restore the Chesapeake Bay, the state's number one environmental priority. Learn more at www.dnr.maryland.gov

Figure 1. Press release issued in May 2005 promoting the MVASFS.

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 Angel Bolinger at 1-877-620-8DNR ext. 8311 or via email at abolinger@dnr.state.md.us. Participate online at URL: http://www.dnr.state.md.us/fisheries/survey/sfsurveyintro.shtml.

Figure 2. MVASFS promotional message printed with Maryland fishing license sales from May - December 2005.

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 at http://www.dnr.state.md.us/fisheries/survey/sfsurveyintro.shtml or through the mail.
  Mailing to: Maryland Department of Natural Resources
  Fisheries Service
  Attention: Volunteer Angler Summer Flounder Survey
  Tawes State Office Building, B-2
  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 Angel Bolinger via e-mail abolinger@dnr.state.md.us, or call 410-643-4601 ext. 108.

Figure 3. Instructions provided with paper forms for the 2005 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, 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 4. Copy of the MVASFS paper form.

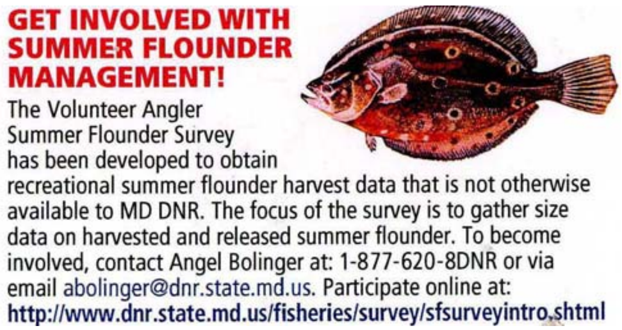

Figure 5. Scan of the Maryland Volunteer Angler Summer Flounder Survey business card, which were distributed at fishing shows, presentations, and Maryland Sport Fishing Tournament citation centers.

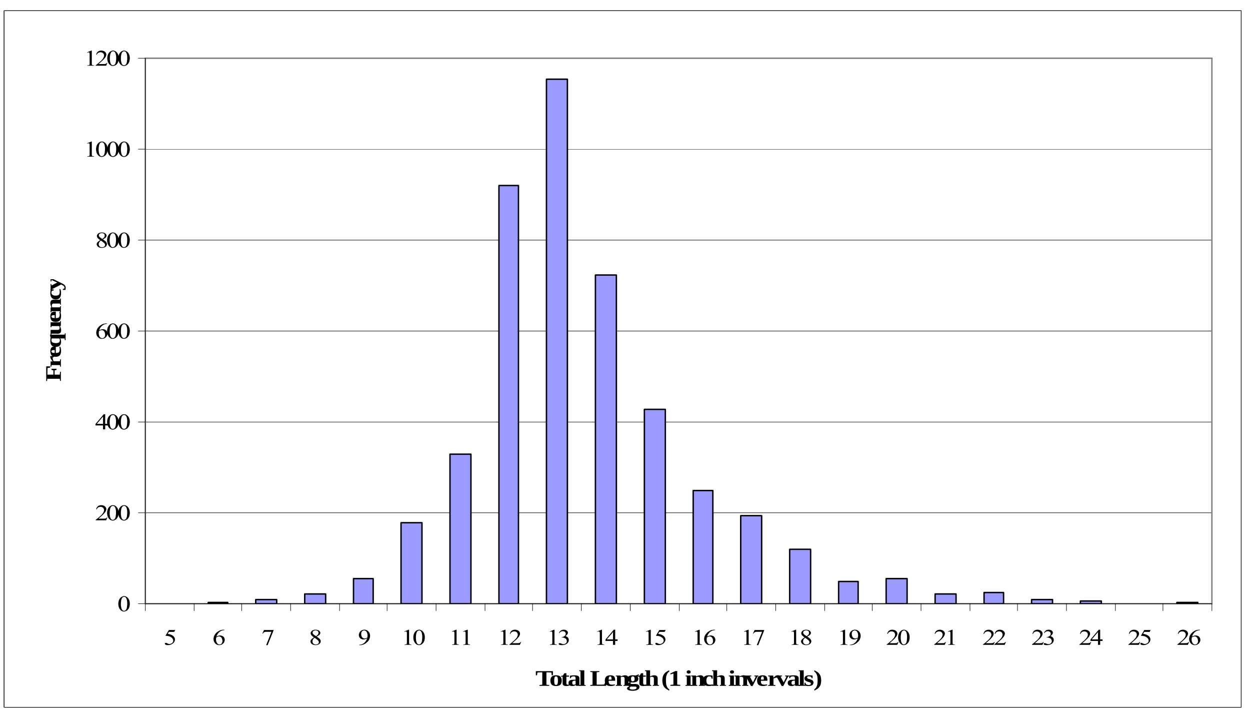

Figure 6. Length frequency of kept and released 2005 Atlantic Coast measured data collected from the Maryland Volunteer Angler Summer Flounder Survey, n=4,549.

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Appendix 1.

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

Prepared by
Linda Barker and Angel Bolinger
Maryland Department of Natural Resources
Fisheries Service

November 29, 2005

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).

An examination of the 2002 – 2005 MVASFS data revealed that most submissions for the Atlantic region were from *Bay Bee* party boat captain, Bobby Gowar (or his substitute). Captain Gowar provided a large portion of the surveys (77% in 2005, 63% in 2004, 71% in 2003, and 62% in 2002) because he submitted data from his twice daily fishing trips from April through October. In order to determine if *Bay Bee* data biased the analyses, a Kolmogorov-Smirnov (KS) chi square test and Catch Per Unit of Effort (CPUE) comparisons were performed.

Methods

A KS chi-square test was performed to determine if there was a significant difference in the length frequency developed from *Bay Bee* data and those from recreational anglers' (Bolinger *et al* 2007). The KS comparison was performed using the website located at URL: http://www.physics.csbsju.edu, accessed on November 22, 2005.

A similar concern existed that *Bay Bee* data influenced the 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:

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

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

$$\text{CPUE} = \sum \text{SF}/\text{Total Angler Hours} \qquad \text{Eqn3}$$

MD DNR Fisheries Service statistician, Linda Barker, looked at the following questions and answers pertaining to CPUE's calculated on the above referenced data.

- What was the mean of the two CPUE's?
  (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*
- What was the mean of the absolute difference?
  |Annual Percent Difference|
- Was there a bias over time (*Bay Bee* CPUE consistently larger or smaller)?

Results and Discussion

The 2002 through 2005 MVASFS length measurements were reviewed to determine if *Bay Bee* data created bias in the length frequency distributions. These results from the KS test indicated no differences between *Bay Bee* length data and that from recreational anglers (2005 P = 0.674, 2004 P = 0.971, 2003 P = 0.460, and 2002 P=0.905). Therefore, including *Bay Bee* measurements with those submitted from recreational anglers should result in an overall length frequency without bias.

A four year CPUE comparison ensured that *Bay Bee* effort data were not driving the over all CPUE (Table 1). Although the absolute difference seems to be about 15% in any given year (which would generally be considered significant), there was no bias (no consistent pattern of whether the *Bay Bee* CPUE was greater or smaller), and the overall percent difference was fairly small (6%). Barker concluded that there was no reason to perform formal statistical tests on these numbers.

Recommendations

Based on these results, MD DNR statistician, Linda Barker, made the following recommendations:

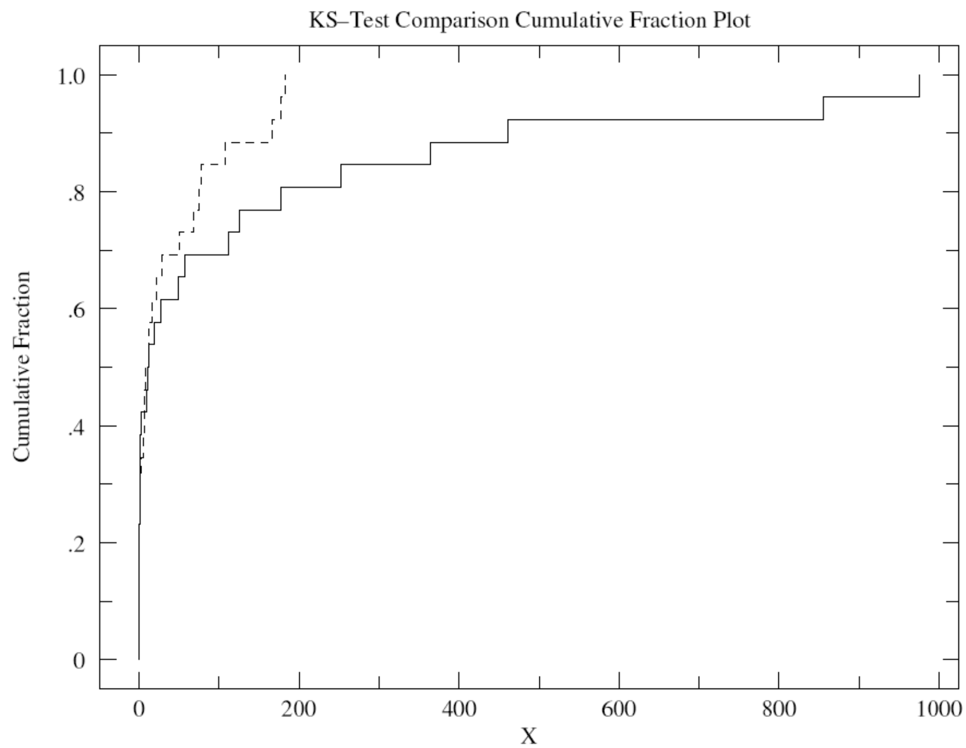
- Annually review those data to ensure that *Bay Bee* percentage contribution to length frequency and effort data remain relatively constant.
- Annually review those data to ensure that *Bay Bee* lengths do not create bias in the frequency.
- Omit *Bay Bee* data from effort calculations for technical reports and management decisions, since effort values developed from a more heterogeneous data set are more defensible. Inclusion of *Bay Bee* data was acceptable for non-technical public presentations of survey results.

References

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. 2005 Coastal Bays Fisheries Investigation. Maryland Department of Natural Resources. Fisheries Service. Annapolis, MD.

Table 1. 2002 – 2005 Maryland Volunteer Angler Summer Flounder Survey (MVASFS) Catch Per Unit of Effort (CPUE), Mean, and Percent Difference by Year and Category for its Atlantic Coast.				
Year	***Bay Bee*** **CPUE**	**Without** ***Bay Bee*** **CPUE**	**Mean**	**% Difference (Absolute)**
2005	0.46	0.51	0.48	-11 (11)
2004	1.03	0.87	0.95	17 (17)
2003	0.31	0.34	0.32	-10 (10)
2002	0.33	0.41	0.37	-21 (21)
Mean				15



2005 Maryland Volunteer Angler Summer Flounder Survey (MVASFS) Kolmogorov-Smirnov (KS) Comparison Percentile Plot from http://www.physics.csbsju.edu Accessed on November 22, 2005, n=4,549.

Appendix 2.

2007 Summer Flounder Coast-wide Total Allowable Landings (TAL) Scenarios and the Effects of these Varying TALs on Maryland's Summer Flounder Fisheries.

The coast-wide TAL for summer flounder is divided by a commercial / recreational split of 60% / 40%, respectively. Each respective quota is then sub-divided by state according to a previously established percentage.

State	Commercial Allocation (%)[1]	Recreational Allocation (%)[2]
Maine (ME)	0.04756	---
New Hampshire (NH)	0.00046	---
Massachusetts (MA)	6.82046	5.5
Rhode Island (RI)	15.68298	5.7
Connecticut (CT)	2.25708	3.7
New York (NY)	7.64699	17.6
New Jersey (NJ)	16.72499	39.1
Deleware (DE)	0.01779	3.1
Maryland (MD)	**2.03910**	**2.9**
Varginia (VA)	21.31676	16.7
North Carolina (NC)	27.44584	5.6
Total	100	99.9

[1] *Commercial percentages were taken from a letter to the summer flounder monitoring committee dated (July 10, 2006).*

[2] *Recreational percentages were taken from Addendum XVIII to the Summer Flounder, Scup & Black Sea Bass Fishery Management Plan (February 2006).*

Proposed cuts to the 2007 TAL along the coast will have impacts to both the commercial and recreational fishing communities. The following table represents multiple TAL scenarios and the impact each will have on Maryland's commercial and recreational fisheries.

Year	TAL (Coast)	Comm. Quota (60% TAL)	Rec. Quota (40% TAL)	MD Comm. Allocation (2.04%)	MD Rec. Allocation (2.9%)	MD Rec. Target	% Reduction from 2006
	M Lbs.	M Lbs.	M Lbs.	Lbs.	Lbs.	# Fish	
2005	30.3	17.9	11.98	364,999	347,420	141,000	-
2006	23.6	13.94	9.29	284,251	269,410	109,000	-
2007	19.9 [a]	11.94	7.96	**243,469**	230,840	**92,336**	**15**
Options	14.156 [b]	8.494	5.662	**173,193**	164,210	**65,684**	**40**
	13.89 [c]	8.334	5.556	**169,939**	161,124	**64,450**	**41**
	12.983 [d]	7.79	5.193	**158,842**	150,603	**60,241**	**45**
	5.2 [e]	3.120	2.080	**63,620**	60,320	**24,128**	**88**

[a] *Original Proposed TAL for 2007. (50% probability of reaching the target F = 0.276.)*

[b] *Using a revised fishing rate (F = 0.15) this TAL will have a 50% probability of reaching the target biomass by 2010.*

[c] *Monitoring Committee recommendation (July 18, 2006)*

[d] *Using a revised fishing rate (F = 0.15) this TAL will have a 75% probability of reaching the target biomass by 2010.*

[e] *Original NMFS TAL for reaching the target biomass by 2010.*

The recreational target is reported as numbers of fish. This target is calculated using the recreational allocation (lbs.) divided by approximately 2.5. I assume that this constant is a predetermined constant representing the average weight of recreationally harvested fish along the coast. Analysis of the 2005 and 2006 quotas and targets reported by the states led me to this conclusion.

2005 Coastal Rec. Quotas and Targets					2006 Coastal Rec. Quotas and Targets			
State	Rec. Quota (Lbs)	Rec. Target (# fish)	*Quota / Target*		State	Rec. Quota (Lbs)	Rec. Target (# fish)	*Quota / Target*
MA	658,900	263,000	*2.51*		MA	510,950	203,000	*2.52*
RI	682,860	271,000	*2.52*		RI	529,530	209,000	*2.53*
CT	443,260	179,000	*2.48*		CT	343,730	138,000	*2.49*
NY	2,108,480	845,000	*2.50*		NY	1,635,040	650,000	*2.52*
NJ	4,684,180	1,873,000	*2.50*		NJ	3,632,390	1,443,000	*2.52*
DE	371,380	150,000	*2.48*		DE	287,990	116,000	*2.48*
MD	347,420	141,000	*2.46*		MD	269,410	109,000	*2.47*
VA	2,000,660	800,000	*2.50*		VA	1,551,430	616,000	*2.52*
NC	670,880	845,000	*2.49*		NC	520,240	207,000	*2.51*

Curious to what the predicted length of a 2.5 lb flounder would be, I used a Length-weight regression analysis conducted by NEFSC using Fall/Winter/Spring Bottom Trawl Survey Data collected from 1992-1999 to determine this length. Length-weight regression analysis results in the establishment of parameters (a=y-intercept, b=slope) that can be used to predict fish weight for an associated length. Using the parameters determined for summer flounder, the following table represents predicted weights at associated lengths. *(An 18.5 – 19.0 inch fish is predicted to weigh approximately 2.5 lbs.)*

Formula/Parameters: $\ln W = \ln a + b (\ln L)$; $\ln a = -12.2841$; $b = 3.2156$ *(Fall Survey #'s; M&F Comb.)*

Length (inches)	Weight (lbs.)
15.0	1.235712
15.5	1.373121
16.0	1.52071
16.5	1.678879
17.0	1.848032
17.5	2.028576
18.0	2.220917
18.5	**2.425467**
19.0	**2.642641**
19.5	2.872853
20.0	3.116521
20.5	3.374067
21.0	3.645914
21.5	3.932486

The following table represents the 2007 summer flounder minimum size and creel measures that will have to be considered in order to achieve the recreational quota.

	2007 Summer Flounder Recreational Minimum Size (inches)				
Creel	15	16	17	18	19
1	55,541	36,856	24,165	16,396	10,279
2	70,333	46,081	30,612	21,036	12,296
3	79,328	50,625	34,978	22,715	13,181
4	84,693	53,608	38,278	23,069	13,575
5	88,215	56,591	38,684	23,069	13,575
6	91,737	58,657	38,684	23,069	13,575
7	93,092	59,024	38,684	23,069	13,575
8	93,092	59,024	38,684	23,069	13,575

All values are projected using the 2005 MD Volunteer Angler Survey data. Projections are likely to change when 2006 data become available, however, changes may be biologically insignificant.

Currently, Maryland's recreational summer flounder season is managed using the following minimum size and creel limits:

Chesapeake Bay: 15" @ 2 fish

Atlantic and Coastal Bays: 15.5" @ 4 fish

Appendix 3.

DEVELOPMENT OF SUMMER FLOUNDER SIZE LIMIT OPTIONS FOR MARYLAND'S 2004 FISHING SEASON

BY

LINDA BARKER

ALEXEI SHAROV

STEVE DOCTOR

Maryland Department of Natural Resources

Fisheries Service

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INTRODUCTION

Maryland's annual summer flounder recreational landings have exceeded the Atlantic States Marine Fisheries Commission's (ASMFC) target harvest several times over the last decade. The most recent year in which the target was exceeded was 2001. In 2002 Maryland increased the minimum size from 16.5 to 17.0 inches and closed the fishery from July 25 - August 12. The estimated 2002 catch of 68,891 flounder was only 56% of the target of 122,000 fish. Maryland maintained the 17.0-inch minimum size limit but eliminated the season closure in 2003. The 2003 estimated catch of 40,240 was only 33% of the target.

This report describes the methods used to determine the minimum size/creel limit combinations that should allow Maryland recreational anglers to land the target harvest of 131,000 fish in 2004. It also presents a process for estimating size and creel limits based on Maryland's Summer Flounder Volunteer Angler Survey (MVAS) data, estimates of the annual change in stock size based on the 2003 National Marine Fisheries Service's Northeast Fisheries Science Center (NEFSC) Stock Assessment Report and the Marine Recreational Fisheries Statistics Survey (MRFSS) estimates of the recreational harvest for the most recent three-year period.

METHODS AND RESULTS

The predicted recreational harvest for 2004 was estimated for several size and creel limit combinations assuming there will be no significant change in the length frequency of summer flounder in Maryland waters from 2003 to 2004 and fishing effort will remain constant over time (equivalent to 2003). The analysis was based on length frequency data collected in the MVAS, an estimate of stock growth from 2003 to 2004 based on NEFSC data and MRFSS recreational harvest data.

Development of representative length frequency

In 2002, Maryland instituted a volunteer angler survey for summer flounder. The MVAS provides catch per trip and length information from Maryland's Atlantic coastal bays and Chesapeake Bay. Anglers record all of their targeted summer flounder trip information including: location, time spent fishing, number of fish caught, number kept, and lengths of all fish caught. Data from 1229 survey trips in 2002 and 2003 were used in the analysis. A total of 7318 summer flounder were measured during this period. These data are essential for managing the fishery because they supply information on the length structure of released fish, which is not available from the MRFSS.

The MVAS length frequency data indicates that Chesapeake Bay fish were slightly larger as a group than Atlantic coastal bay fish (Figure 1), and the length frequency of the catches in 2002 and 2003 were similar (Figure 2). Although Chesapeake Bay fish were larger than coastal bay fish, they comprised only 11% of the total reported MVAS catch across both years. Therefore, the MVAS data were combined to create an overall LF curve for 2002-2003 Maryland Atlantic coastal bay and Chesapeake Bay summer flounder (Figure 3). (Note that Maryland DNR pound net survey data were examined to determine if there were large differences in the population length frequency by year or if there was a trend over time. These data were taken from stations in the lower Chesapeake Bay. Examination of the yearly length frequency plots did not indicate that there were large annual differences or a trend in the LF over time.)

Projected 2004 harvest

Projected 2004 landings for several size and creel limit combinations were calculated using 2001-2003 MRFSS harvest data adjusted for season closures in 2001 and 2002, MVAS data, and information contained in the 2003 NEFSC Stock Assessment Report.

Adjustments to reported harvests.

The first step in predicting the 2004 harvest was to adjust historical landings to account for the effects of in-season fishery closures. In 2001, the fishery was closed from July 25 to August 6. Based on a Weibull cumulative function fitted to the MRFSS data for 1994-1998[1], 15.77% of the annual harvest was caught on average from July 25 to August 6. Therefore, the reported harvest for 2001 was increased by 15.77%. The 2002 reported harvest was increased by 21.48% to account for the July 26-August 12, 2002 closure. The average harvest for the period 2001 – 2003 was then calculated based on the adjusted harvest numbers for 2001 and 2002, and the actual 2003 harvest.

The MRFSS reported 2003 harvest was 40,240 fish. The 2002 harvest (68,891), when adjusted for the season closure, was 83,689 fish. The 2001 harvest (139,392), when adjusted for the season closure, was 161,374 fish. Therefore, the average adjusted harvest for 2001-2003 assuming no closed season was 95,101 fish at a 17.0-inch minimum size and a creel limit of 8 fish.

Adjustments for population growth from 2003 to 2004

The next step in predicting the 2004 harvest was to adjust stock size to account for the expected increase in the summer flounder stock from 2003 to 2004. This was accomplished using information from the 2003 NEFSC Stock Assessment Report (NEFSC website (Table 9, www.nefsc.noaa.gov/nefsc/publications/crd/crd0309/t97.htm, accessed 12/8/03)).

The stock size in numbers per age for 2004 was calculated as follows:

$$N_{2004} = N_{2003} * e^{(-(M + (PR*F)))}$$

where

N_{2003} = number of fish at age from VPA assessment;
M = natural mortality, assumed to be 0.20;
PR = partial fishing mortality at a given age as taken from the VPA assessment;
F = target fishing mortality rate (0.25).

The 2002 coastwide mean lengths of 1- and 2-year-old summer flounder were 14 and 16.5 inches, respectively. Assuming that harvest directly reflects abundance, and that the stock is fished at the target fishing mortality rate, the 2004 harvest of 1+- and 2+-year-old fish would increase by 6.4% and 14.9%, respectively (Table 1). For minimum sizes in the 15.5-16.0 inches range, the age of entry to the fishery would be about 1.5 years and the harvest would increase by 10.7% (an average % increase for 1+ and 2+ populations). For minimum sizes of 16.5-17.0 inches, the age of entry to the fishery would be 2 years and the projected harvest would increase by 14.9%. Therefore, in this analysis, calculations for minimum sizes of 15.5 and 16.0 inches were based on a 10.7 % exploited population growth and calculations for minimum sizes of 16.5 and 17.0 inches were based on a 14.9 % population growth.

Predicted 2004 harvest for various size limits at an 8 fish creel and no closed season

The predicted number of flounder that would be harvested in 2004 at a given size limit less than 17.0 inches, an 8 fish creel and no closed season (PH) was calculated as follows:

$$PH = AH * [(P_1)/(P_2)] * S$$

where

AH = adjusted average 2001-03 harvest at a 17.0-inch minimum size, 8 fish creel and no season closure (95,101 fish);
P_1 = % of fish measured in the MVAS above a given size limit in 2002-2003 (Fig 2);
P_2 = % of fish measured in the MVAS 17.0 inches and larger in 2002-2003 (Fig 2);
S = change in relative stock size between 2003 and 2004.

Table 2 indicates that the 2004 Maryland summer flounder harvest at size limits of 17.0 and 16.5 inches, with an eight fish creel and no closed season would be below the 2004 ASMFC target of 131,000 fish. Table 2 also indicates that reductions in either the creel limit or the season length at 16.0 and 15.5 inch minimum size limits are needed to achieve a harvest that is at or below the 2004 ASMFC target.

Projected 2004 harvest with changing creel limits

The 2002-2003 MVAS data were analyzed to determine the effect of creel limits on the harvest for size limits between 15.5 and 17.0 inches (Table 3). The total number of fish caught per angler for different creels (FPA) was estimated as:

Number of fish = Number of anglers * FPA

For example, for anglers that caught only two fish greater than minimum size of 17 inches:

565 Anglers * 2 FPA = 1130 Fish

The reduction in harvest (in numbers of fish) due to reduced creel limits was then calculated as the sum of the difference between creel limit and FPA for all creel categories greater than the creel limit in question, multiplied by the number of anglers for corresponding creel categories. For example, the loss of harvest for a minimum size of 16.5 inches and a creel limit of 6 fish (Table 3) was calculated as follows:

Reduction in harvest: (8-6)*20 + (7-6)*16 = 56 fish

Finally, percent reduction for creel limits less than 8 fish were calculated by dividing by the loss of harvest (in numbers of fish) by the total harvest for that minimum size limit with an 8 fish creel limit (Table 4). For example, percent in harvest reduction for a minimum size of 16.5 inches and a creel limit of 6 fish was calculated as follows:

Percent reduction in harvest: 56 lost / 4305 total = 1.3 %

Estimates of 2004 harvest for different minimum sizes and creel limits were calculated by multiplying the estimated 2004 harvest for a creel limit of 8 fish (Table 2) by the percent of harvest reduction due to reduced creel limits (Table 4).

These results, based on calculations performed with conservative assumptions, indicate that the 2004 ASMFC target of 131,000 fish will not be achieved by the current Maryland limits of 17.0 inch minimum size and 8 fish creel limit. However, several other combinations of creel limit and minimum size can achieve the target harvest (Table 5).

Figure 1. Cumulative length frequencies of Maryland summer flounder in Atlantic coastal bays (2002- 2003) and Chesapeake Bay (2002- 2003), based on Maryland Volunteer Angler Survey data.

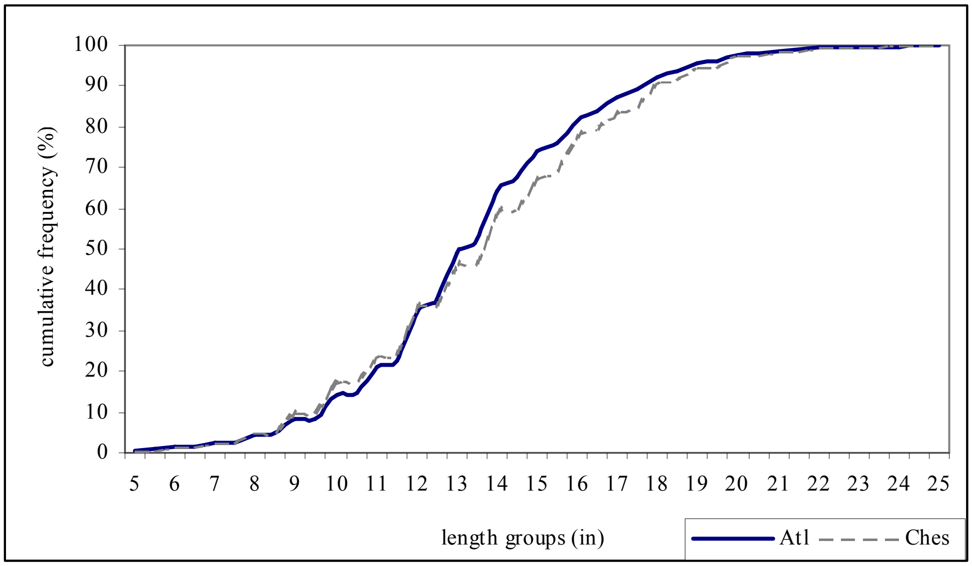


Figure 2. Cumulative length frequencies of Maryland summer flounder in Atlantic coastal bays and Chesapeake Bay, 2002-2003, based on Maryland Volunteer Angler Survey data.

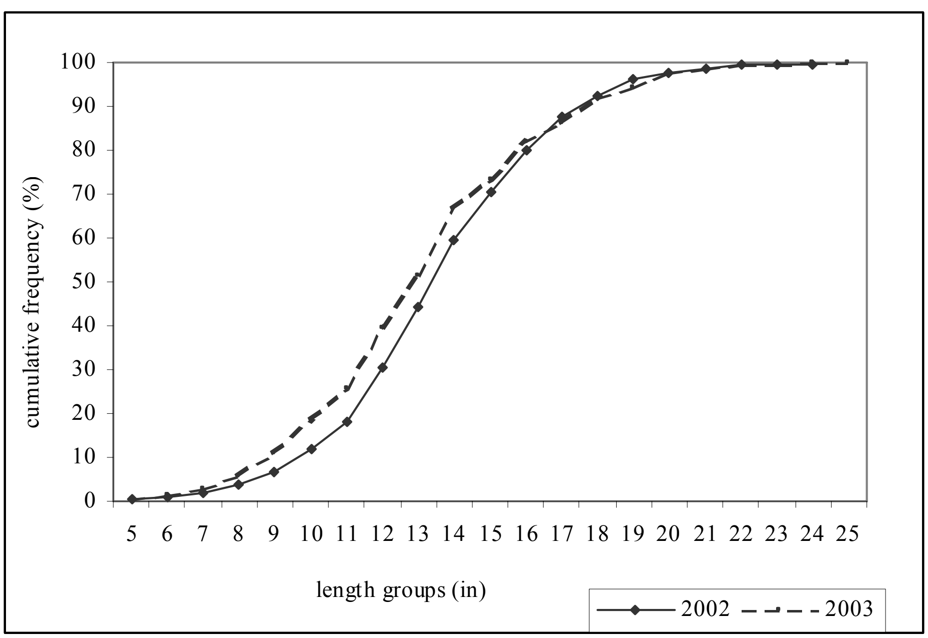
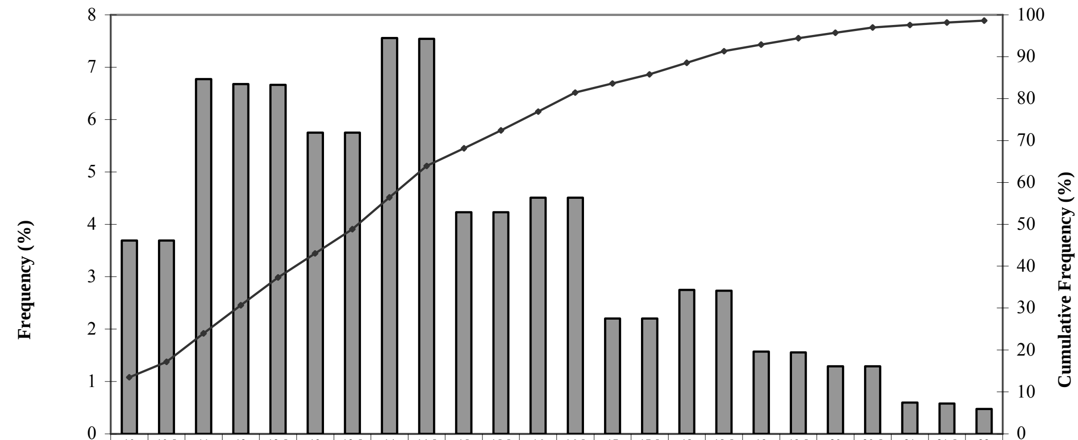


Figure 3. Length frequency of Maryland summer flounder in Atlantic coastal bays and Chesapeake Bay based on 2002-2003 Maryland Volunteer Angler Survey data.



	10	10.5	11	12	12.5	13	13.5	14	14.5	15	15.5	16
frequency	3.6932	3.6932	6.7735	6.6792	6.6635	5.752	5.752	7.5593	7.5436	4.2276	4.2276	4.5105
cum.freq.	13.52	17.21	23.98	30.66	37.33	43.08	48.83	56.39	63.93	68.16	72.39	76.90

	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22
frequency	4.5105	2.2002	2.2002	2.7503	2.7346	1.5716	1.5559	1.2887	1.2887	0.5972	0.5815	0.4715
cum.freq.	81.41	83.61	85.81	88.56	91.29	92.87	94.42	95.71	97.00	97.60	98.18	98.65

Length Groups (in)

frequency — cum.freq.

Table 1. Summer flounder population growth in numbers (as 1000s). Based on Table 9, www.nefsc.noaa.gov/nefsc/publications/crd/crd0309/t97.htm, accessed 12/8/03.

AGE	PR	2003 N	2004 N
0	0.01	35,368	35,368
1	0.17	30,964	28,885
2	0.76	19,077	24,296
3	1	15,375	12,916
4	1	5,974	9,804
5	1	4,694	3,809
6	1	2,435	2,993
7+	1	642	1,553
Total N for age 1+		**79161**	**84,255**
% Growth			**6.4**
Total N for age 2+		**48197**	**55371**
% Growth			**14.9**

Table 2. Projected 2004 Maryland recreational catch of summer flounder for different minimum sizes, with no season closure and 8-fish creel.
Based on average reported catch of 2001-2003, adjusted for season closure.

Minimum Size Limit	2001 Reported Harvest	2002 Reported Harvest	2003 Reported Harvest	2001-2003 Avg. Adj. Harvest	% exploited population growth	Predicted 2004 Harvest
17.0	139,392	68,891	40,240	95,101	14.9	109,271
16.5					14.9	123,939
16.0					10.7	148,376
15.5					10.7	177,346

Table 3. Number of fish caught per creel, or Fish Per Angler (FPA), based on MVAS 2002-2003 data.

FPA	17.0		16.5		16.0		15.5	
	Anglers	Fish	Anglers	Fish	Anglers	Fish	Anglers	Fish
1	1510	1510	1480	1480	1338	1338	1340	1340
2	565	1130	589	1178	850	1700	865	1730
3	174	522	280	840	287	861	282	846
4	62	248	90	360	170	680	146	584
5	0	0	23	115	184	920	219	1095
6	10	60	10	60	67	402	87	522
7	36	252	16	112	0	0	20	140
8	31	248	20	160	26	208	39	312
		3970		**4305**		**6109**		**6569**

Table 4. Percent of harvest reduction due to reduced creel limits for four minimum size limits based on MVAS 2002-2003 data[1].

Creel	Minimum size (in)			
	17.0	**16.5**	**16.0**	**15.5**
1	39.8	41.7	52.2	54.4
2	17.7	17.9	26.2	29.1
3	9.8	7.7	14.2	17.0
4	6.3	3.9	6.9	9.3
5	4.4	2.4	2.4	3.7
6	2.5	1.3	0.9	1.5
7	0.8	0.5	0.4	0.6
8	0	0.0	0.0	0.0

1 Harvest reductions from seasonal closures were taken from a Weibull curved based on state-specific 1994-1998 MRFSS data. The 1994-1998 time period is the standard time used by the technical committee to calculate seasonal reductions.

Table 5. Estimated 2004 recreational harvest of summer flounder in Maryland for different minimum sizes and creel limits[2].

Creel	Minimum size (in)			
	17.0	16.5	16.0	15.5
1	65,781	72,256	70,924	80,870
2	89,930	101,754	109,502	125,738
3	98,562	114,395	127,307	147,197
4	102,387	119,105	138,138	160,852
5	104,463	120,964	144,815	170,784
6	106,539	122,327	147,041	174,685
7	108,397	123,319	147,783	176,281
8	109,271	123,939	148,376	177,346

2 Estimates of the predicted harvest were also calculated for the four size limits under consideration using the most conservative exploited population growth rate estimate (6.4%). This change did not effect the maximum allowable creel limit for a given size minimum size.