Chapter 7.5

Status of Blue Crab, *Callinectes sapidus*, population in Maryland's Coastal Bays

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Abstract
The Maryland Department of Natural Resources (DNR) has conducted the Coastal Bays Fisheries Investigations (CBFI) Trawl and Beach Seine Surveys in Maryland's Coastal Bays since 1972, sampling with a standardized protocol since 1989. Although these gears target finfish, bycatch of crustaceans, mollusks, sponges and macroalgae are common. Geometric mean indices for blue crab developed from both the Trawl ($p = 0.20$) and Beach Seine ($p = 0.37$) Survey data varied without trend between 1997-2013. Both indices showed a time series high value in 2010 and low value in 2013. 2010 had a warm, wet spring, which provides prime conditions for coastal spawners that use the Maryland Coastal Bays as a nursery, such as blue crabs. In contrast, 2013 had a record-breaking cold winter, late spring, and a coast-wide severe late-spring storm, and subsequent late seagrass growth. Therefore, in 2013, conditions were poor for coastal spawners, and the Blue Crab indices reflect those environmental conditions.

The commercial harvest varied without trend in the time period 1997-2006 ($p = 0.14$) with a mean harvest of 1.24 million pounds per year and has varied without trend since 2007 ($p = 0.71$) with a mean harvest of 1.56 million pounds per year, ranging from 0.5 million pounds to 2.37 million pounds in 2010, the time series high since 1991. Additionally, there has been no trend in commercial harvest over the entire 1997-2013 time series ($p = 0.054$).

Data from the Trawl survey showed a strong seasonal trend in abundance, with a peak in June and dropping throughout the summer and fall. The Beach Seine Survey is only conducted in June and September, but showed the same relative difference in abundance between the two months. The Trawl Survey data also showed a significant difference in abundance among the four Coastal Bays, which appears to be related to mean depth and bottom dissolved oxygen, as there is are significant correlations with both factors ($p < 0.0001$)

Mean size of crabs caught in the CBFI Trawl Survey shows an increasing trend, both over the extended time period (1989-2013, $p<0.001$) and since 1997 ($p = 0.001$). A comparison study of Blue Crab mean length frequencies by gear type conducted in 2012-2013 to investigate if SAV beds in Maryland's Coastal Bays serve as critical habitat for fisheries resources, including crabs, showed significant differences ($p< 0.0001$). The mean length for Blue Crabs collected in the submerged aquatic vegetation, SAV, beds was the smallest (41.8mm) followed by beach seine (53.6 mm) and trawl (62.7 mm). The data suggest that the SAV beds provide habitat for small crabs measuring less than 40 mm in length. While small crabs were found in habitat without concentrated seagrass, this habitat appears to be most desirable for juvenile Blue Crabs.

The stability of the indices developed from the fishery-independent surveys, the stability of the commercial harvest, and the slight increase in mean size all suggest that the state of Blue Crabs in the Maryland Coastal Bays appears stable. The inter-annual variability of the abundance indicators reflects the biology of Blue Crabs as a coastal spawner, with population levels reflecting large-scale environmental factors.

Introduction

The Blue Crab, *Callinectes sapidus*, is a valuable resource to the Coastal Bays ecosystem and the commercial and recreational efforts it supports. As a coastal spawner, Blue Crabs in the Coastal Bays are simply a subset of a larger population that is subject to environmental factors operating at larger scales than this relatively small area. Therefore, DNR does not actively manage Blue Crabs in the Coastal Bays.

This report presents the state of the Blue Crab in the Coastal Bays as indicated by three factors – (1) fishery-independent indices of abundance, (2) commercial harvest and (3) mean size.

Abundance

DNR has conducted the Coastal Bays Fisheries Investigations (CBFI) Trawl and Beach Seine Surveys in Maryland's Coastal Bays since 1972, sampling with a standardized protocol since 1989 (Doctor et al., 2013). Although these gears target finfish, bycatch of crustaceans, mollusks, sponges, and macroalgae are common. Shore beach seine sampling is conducted at 19 fixed sites beginning in the second weeks of June and September to sample the shallow regions of the Coastal Bays frequented by juvenile fishes (Figure 7.5.1). Trawl sampling is conducted at 20 fixed sites with depths greater than 1.1 m (3.5 ft) from April through October (Figure 7.5.1). Physical and chemical data are documented at each sampling location. In both surveys, Blue Crabs are measured for carapace width, sexed and maturity status is determined. A subsample of the first 50 Blue Crabs at each site is measured and the rest are counted.

The distribution of crab catch from both surveys showed a strong right skew with less than 10% zero catches, so the geometric mean was developed as in index of relative abundance. Both the Beach Seine ($p = 0.37$) and Trawl Survey ($p = 0.20$) indices varied without trend between 1997-2013 (Figure 7.5.2 and 7.5.3).

Both indices showed a time series high value in 2010 and low value in 2013. 2010 had a warm, wet spring, which provides prime conditions for coastal spawners that use the Maryland Coastal Bays as a nursery, such as Blue Crabs. It should be noted that the Maryland Striped Bass Juvenile Index was also very high in that year (Durell and Weedon, 2011). In contrast, 2013 had a record-breaking cold winter, late spring, and a coast-wide severe late-spring storm, and subsequent late seagrass growth. Therefore conditions were poor for coastal spawners.

Data from the trawl survey showed a strong seasonal trend in abundance, with a peak in June and dropping throughout the summer and fall (Figure 7.5.4). The beach seine survey is only conducted in June and September, but showed the same relative difference in abundance between the two months.

The trawl survey data showed a significant difference in abundance among the four Coastal Bays, which appears to be related to mean depth and bottom dissolved oxygen, as there are significant correlations with both factors ($p<0.0001$).

Table 7.5.1 Mean Crab Count vs. environmental factors, from 1997-2013 data from the Maryland Department of Natural Resources, Coastal Bays Fisheries Investigations (CBFI) Trawl Survey

Bay	Mean Crab Count	Mean Site Depth	Bottom DO	Bottom Temperature	Salinity
Isle of Wight Bay	77	5.7	6.3	21.9	26.5
Chincoteague Bay	56	6.6	6.5	22.4	28.9
Assawoman Bay	38	7.4	6.5	21.8	27
Sinepuxent Bay	18	8.0	6.9	20.9	29.7

Commercial Harvest

Reported commercial harvest is the only fishery-dependent index available. Blue Crab recreational surveys have been conducted through Old Dominion University in 2001, 2002, 2005 and 2011, but all surveys were conducted only in the Chesapeake Bay, so do not provide information about Coastal Bays Blue Crab abundance.

The commercial harvest varied without trend in the time period 1997-2006 ($p = 0.14$) with a mean harvest of 1.24 million pounds per year (Figure 7.5.5). Harvest has varied without trend since 2007 ($p = 0.71$) with a mean harvest of 1.56 million pounds per year, ranging from 0.5 million pounds to 2.37 million pounds in 2010, the time series high since 1991. Additionally, there has been no trend over the entire 1997-2013 time series ($p = 0.054$).

Size

Mean size of crabs caught in the CBFI Trawl Survey shows an increasing trend, both over the extended time period (1989-2013, $p<0.001$) and since 1997 ($p = 0.001$, Figure 7.5.6).

A comparison study of Blue Crab mean length frequencies by gear type was conducted in 2012-2013 to investigate if SAV beds in Maryland's Coastal Bays serve as critical habitat for fisheries resources, including Blue Crabs. DNR expanded the CBFI to include stratified random sampling of SAV beds that had been present for at least five years as mapped in aerial surveys by the Virginia Institute of Marine Sciences Results showed mean lengths to be significantly different by gear type ($p < 0.0001$). The mean length for Blue Crabs collected in the seagrass beds was smallest (41.8 mm), followed by beach seine (53.6 mm) and trawl (62.7 mm). While small crabs were found in habitat without concentrated seagrass, this habitat appears to be most desirable for juvenile Blue Crabs.

Status of *Hematodinium perezi* in Maryland Coastal Bays

Histological assays of crab hemolymph from 2005 -2010 indicate the parasite continues to persist in crabs in the Coastal Bays ecosystem with seasonal variation (Figure 7.5.7, Messick unpublished data).

Molecular assays have been developed to detect the parasite in hemolymph, water and sediments. In May, July, and September 2006, and January 2007, crabs in Ocean City were sampled for *Hematodinium perezi* using a DNA-based assay (Nagle et al. 2009) to detect the genome of the parasite, *H. perezi*. Parasite DNA was present in July (37%), September (30%) and January (22%) (E.J. Schott and G.A. Messick, unpublished data). The polymerase chain reaction (PCR)-based prevalence was higher than prevalence as determined by histology, which agrees with Nagel *et al*. (2009). It is notable that even by PCR, *H. perezi* was not detected in May of 2006. Areas where the parasite was found in sediment and water tend to cluster along the Delmarva shoreline in areas like Johnson's Bay and Newport Bay (J.S. Pitula, unpublished data). This is interesting since these are areas closest to potential nutrient runoff. Approximately 10% of water and sediment samples from Maryland Coastal Bays ecosystem test positive for *H. perezi* using molecular assays (J.S. Pitula, unpublished). There may be hydrodynamic effects that influence infections. Recent molecular assays indicate that the parasite is found briefly in sediments and water in spring, followed by absence, then a strong presence during the summer. Summer detections may be consistent with sporulation from diseased crabs, but the spring detection may represent a free-living stage in the life cycle of the parasite (J.S. Pitula, unpublished).

Summary

The stability of the Blue Crab indices developed from the fishery-independent surveys, the stability of the commercial harvest of blue crabs in the Coastal Bays, and the slight increase in mean size all suggest that the state of Blue Crabs in the Maryland Coastal Bays is stable. The inter-annual variability of the abundance indicators appears to reflect large-scale environmental factors, typical of the biology of coastal spawners.

Figure 7.5.1 Sampling sites for the Maryland Department of Natural Resources Fisheries Service has conducted the Coastal Bays Fisheries Investigations (CBFI) Trawl and Beach Seine Survey.

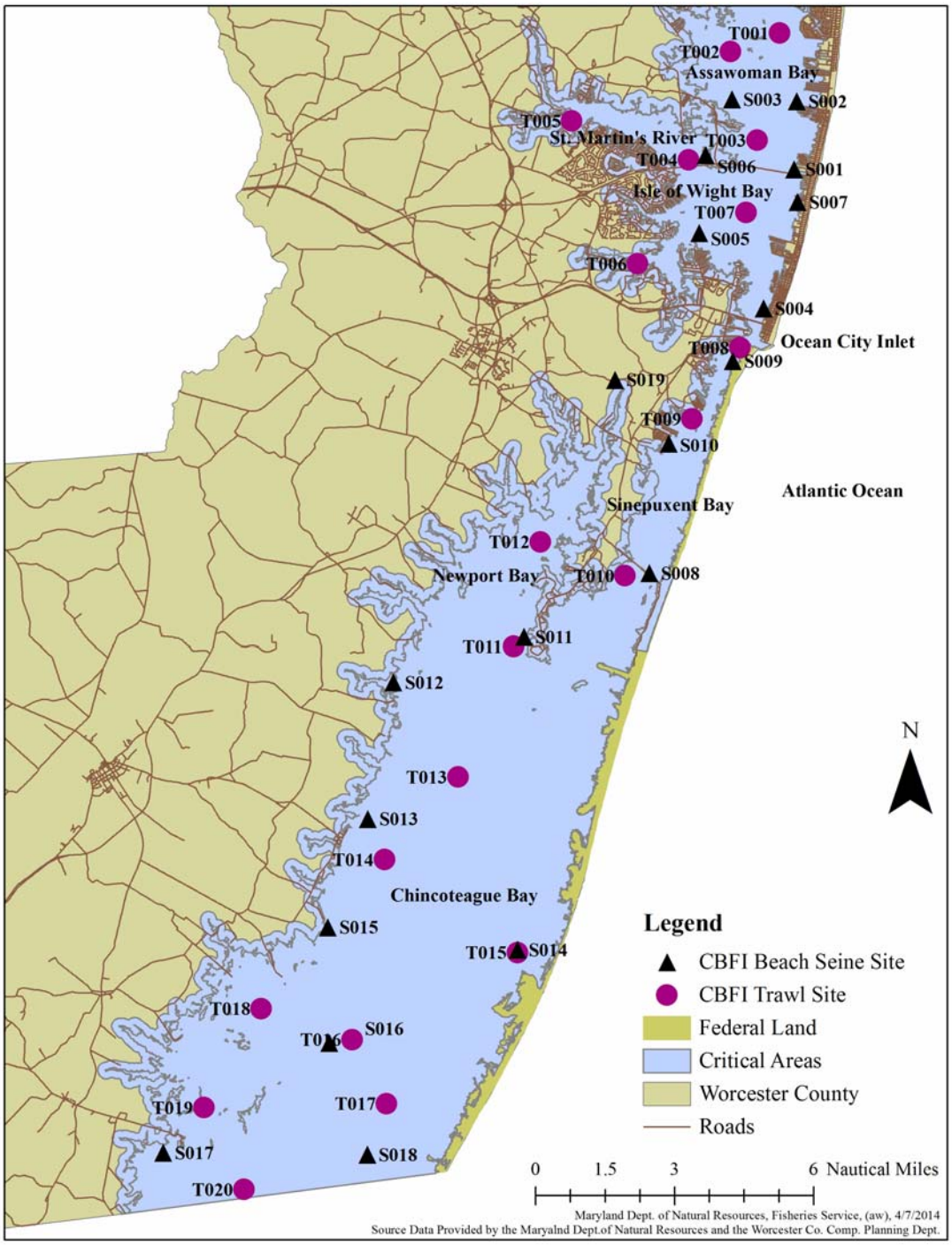


Figure 7.5.2 Annual Time Series of Geometric Mean Index of Abundance with 95% confidence interval, developed from Maryland Department of Natural Resources Fisheries Service Coastal Bays Fisheries Investigations Beach Seine Survey data.

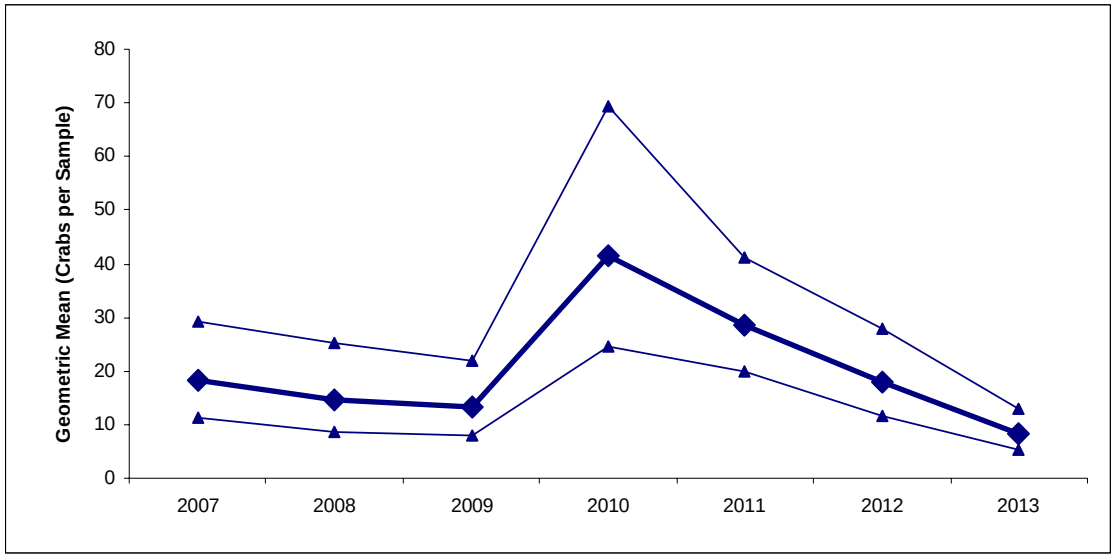


Figure 7.5.3 Annual Time Series of Geometric Mean Index of Abundance with 95% confidence interval, developed from Maryland Department of Natural Resources Fisheries Service Coastal Bays Fisheries Investigations Trawl Survey data.

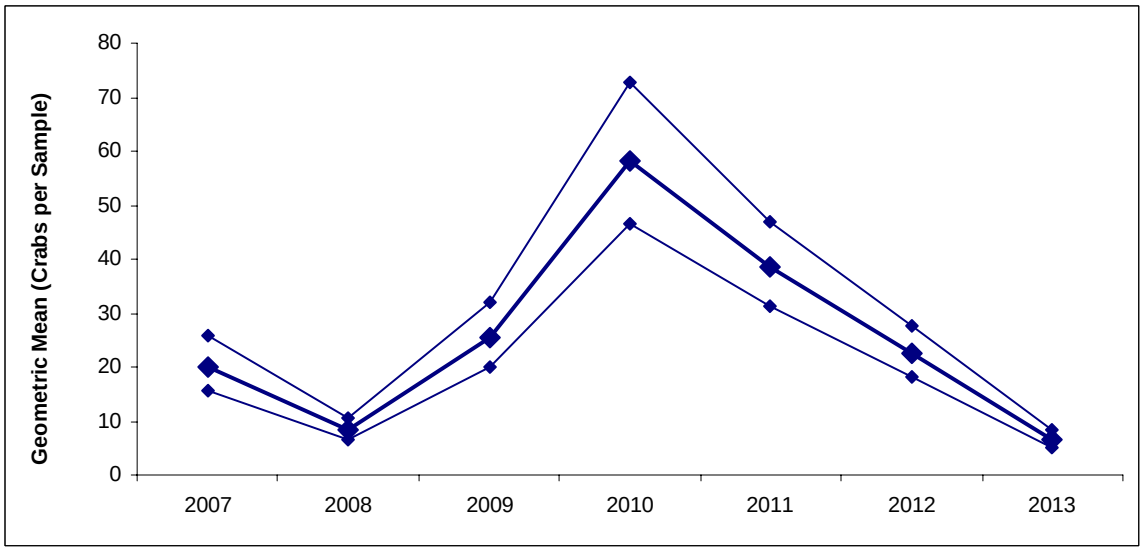


Figure 7.5.4 Monthly Mean Crabs per Sample with 95% confidence interval (2007-2013), developed from Maryland Department of Natural Resources Fisheries Service Coastal Bays Fisheries Investigations Trawl Survey data.

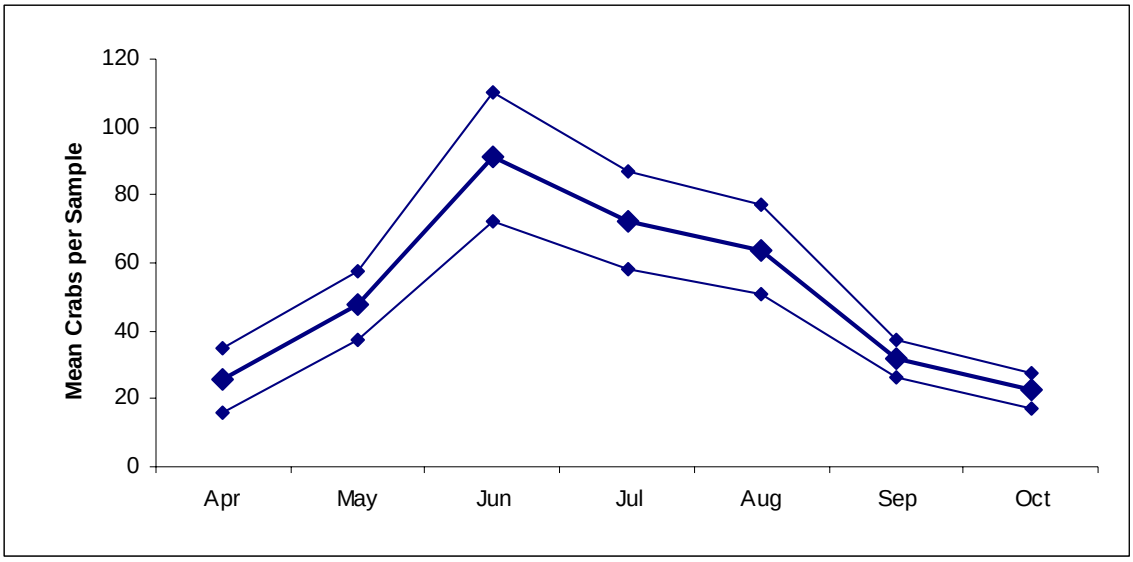


Figure 7.5.5 Annual harvest of Blue Crab Commercial Harvest in Maryland's Coastal Bays (1997-2013).

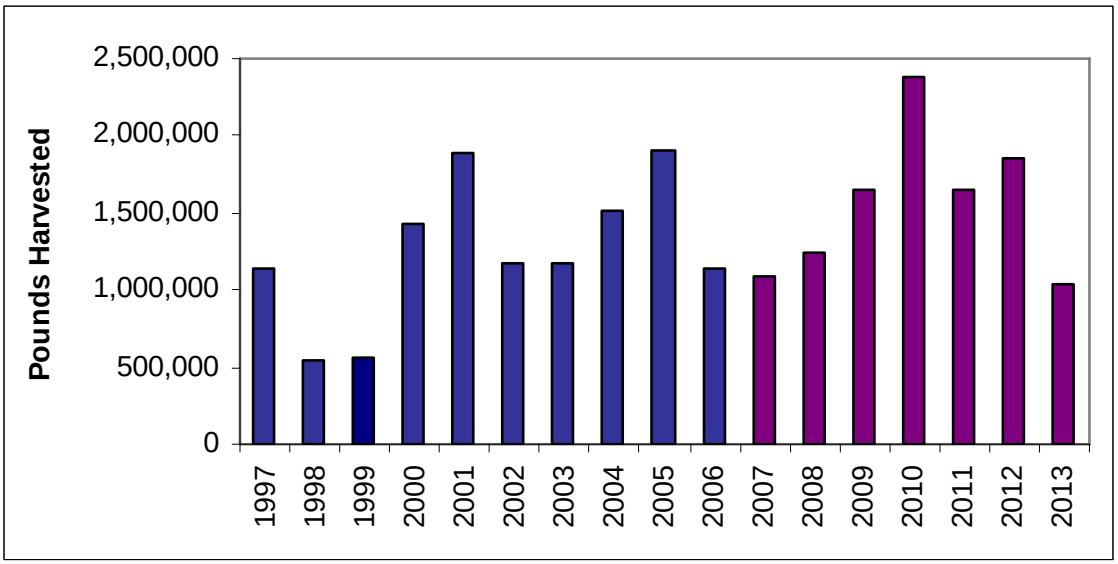


Figure 7.5.6 Time Series of Mean Carapace Width with 95% confidence interval (1997-2013), developed from Maryland Department of Natural Resources Fisheries Service Coastal Bays Fisheries Investigations Trawl Survey data.

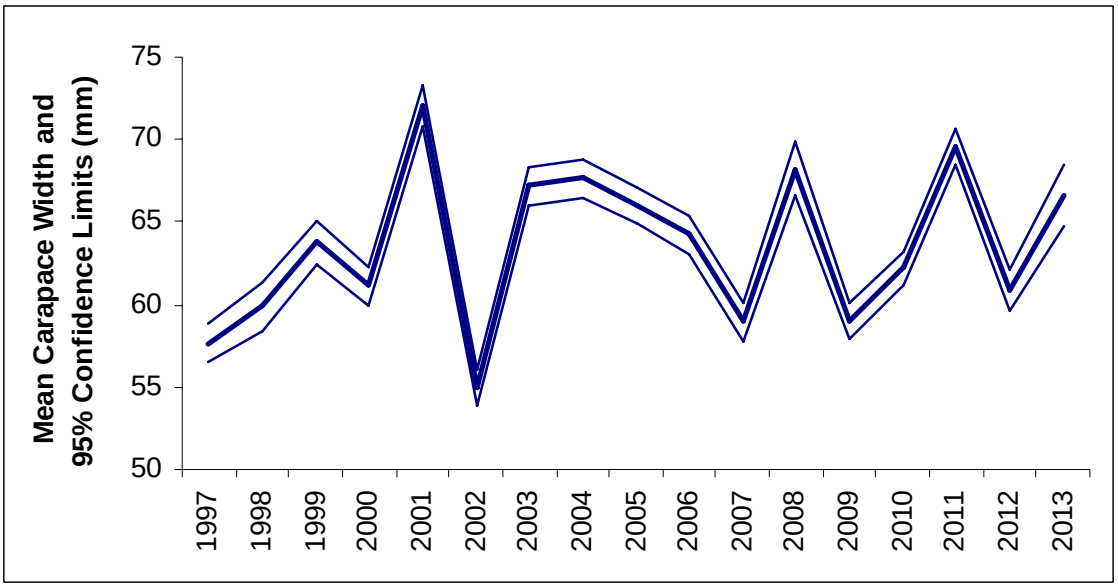
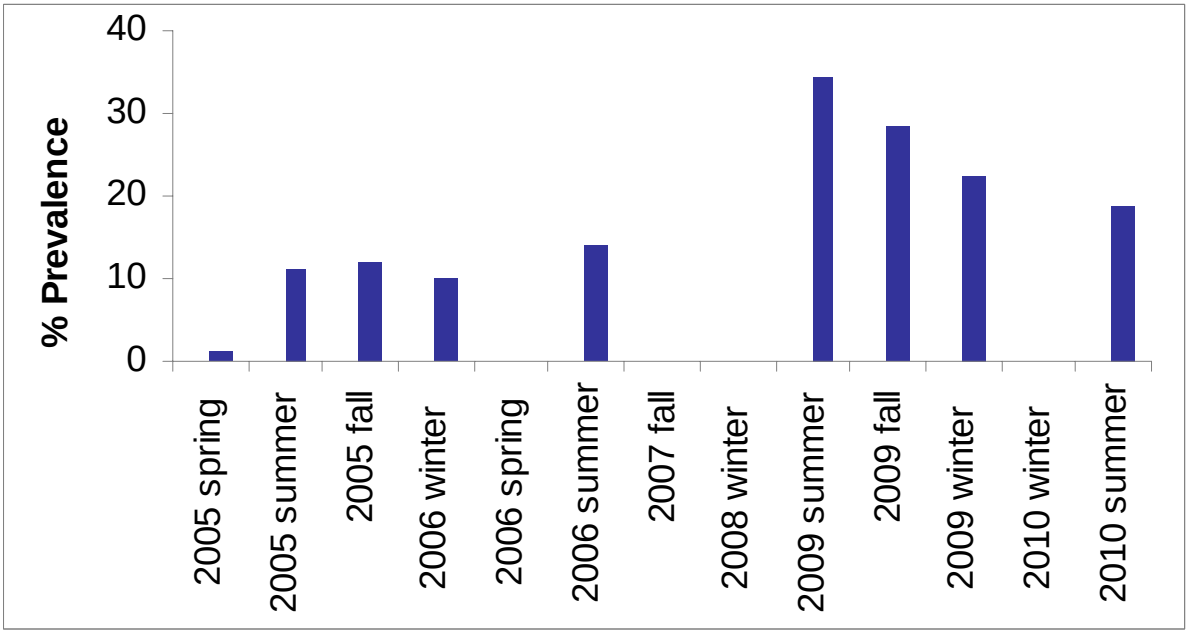


Figure 7.5.7 Time Series of percent prevalence of *Hematodinium perezi* developed from Maryland Department of Natural Resources Fisheries Service Coastal Bays Fisheries Investigations Trawl Survey data.



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