RELATIVE ABUNDANCE OF BONNETHEADS AND ATLANTIC SHARPNOSE SHARKS IN TWO FLORIDA GULF ESTUARIES, 1995 TO 2004

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Introduction

The Center for Shark Research (CSR) at Mote Marine Laboratory has been conducting routine surveys of sharks along the Florida Gulf coast since 1991. In 1995-97, the CSR conducted a NMFS/MARFIN-funded project on shark nurseries to assess Florida's coastal areas as nurseries specifically for the blacktip shark (*Carcharhinus limbatus*). These areas of study encompass two major estuaries along the Florida Gulf coast. As a by product of this study, the CSR also quantified relative abundance of small shark species including bonnetheads (*Sphyrna tiburo*) and Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*), determined bycatch mortality and associated fishes in gill net fishing gear, and conducted basic biological studies in shark distribution, feeding, growth and reproduction in the Florida Gulf. Building upon the CSR's MARFIN study, research funded primarily through NMFS Highly Migratory Species (HMS) Division continued the CSR shark nursery studies in the Gulf of Mexico through 2004, which allowed a relatively continuous sampling of small shark species in these nurseries in all years except 1998.

This paper examines the results of relative abundance surveys for bonnetheads (*Sphyrna tiburo*) and Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) in two Florida Gulf estuaries monitored by the CSR since 1995. Trends in abundance of these species from 1995-2004 were analyzed to provide a standardized index of recruitment in the eastern Gulf of Mexico. The analyses were focused on two estuaries along the Florida Gulf coast: 1) Yankeetown, a relatively pristine area of open Gulf near the Withlacoochee River, south of Cedar Key and north of Crystal River and 2) Pine Island Sound, a semi-enclosed estuary in the Charlotte Harbor system that is moderately populated and industrialized (Figure 1).

Field Methods

Monthly, random stratified, fishery-independent sampling by gill net was conducted in the two Florida Gulf estuaries, from March through October from 1995 to 1997 for Yankeetown area, and in 1995 and 1997 for the Charlotte Harbor area (with sampling in summer months only during 1999-2004) in all years except 1998. In each area, two geographically fixed 10 km^2 grids were regularly sampled based upon previous exploratory surveys that revealed subareas with relatively high CPUE of these two species (Figure 2 and 3). For quantitative assessment of relative abundance, standardized sets were conducted each month in five of the ten 1x1 blocks for each grid (Figure 4).

Sets were made using 0.52 mm monofilament, 11.8 cm stretch mesh, 366x3 m weighted gill nets, used due to their relatively high selectivity for small species of elasmobranchs and relatively low bycatch of other species. The net was allowed to soak for at least one hour before being retrieved. All sharks caught were identified, sexed, measured, categorized by stage of maturity (immature or mature), weighed and live sharks were tagged and released. For both species, maturity was assessed from information obtained from the literature (Parsons 1983, 1993, Carlson and Parsons 1997) and by examining the claspers on male sharks (Gelsleichter et al. 2002). Physical data including depth, tide, salinity, temperature, dissolved oxygen, bottom type, and weather were collected for each set to characterize the study areas.

Data Analysis

Analyses for this paper were separated by the stage of maturity of the sharks. The numbers of immature and mature sharks for both species caught on each set were converted to CPUE. CPUE was calculated by dividing the number of animals caught by the soak time of the net (the time from the first float entering the water to the time that the last float came out of the water). CPUE data were standardized using the natural logarithm of the CPUE + 1 before being analyzed. Standardized catch rates from both stage of maturity were calculated using a General Linear Model (GLM) with month, year, area, grid and block (nested with grid) as factors. The GLM also included an interaction term between year and area to investigate if the estuaries had a different pattern of catch rates. Only the summer months (June, July and August) were including in these analyses.

Results

A total of 447 quantitative gill net sets were conducted between the two areas every summer from 1995 to 2004. To assess overall trends in catch rate, the GLM was applied to data collected from June through August (the months sampled most consistently). During the entire study, which encompassed other areas not including in these analyses, a total of 8,257 sharks were captured comprising 13 species of 4 families (Table 1).

<u>Bonnethead Analysis</u>

Mature bonnetheads:

This analysis indicated that there were significant differences in catch rates between all factors tested except month and area for the mature bonnethead sharks (Table 2). The lack of significance interaction for area indicated that the two areas did not have different patterns of annual catch rates. Regression analysis of the percentage of annual catch rates for the mature bonnetheads indicated that the slope of the catch time series for Yankeetown was significantly different from zero (slope = 0.066, R^2 = 0.4602) and slightly different from zero in Charlotte Harbor (slope = 0.0544, R^2 = 0.2715) (Figure 5).

Immature bonnetheads:

There were significant differences in catch rates between all factors tested except month for the immature bonnethead sharks (Table 2). The significant interaction term indicated that Yankeetown and Charlotte Harbor had different patterns of annual catch rates in immature sharks. Regression analysis of the percentage of annual catch rates for the immature bonnethead sharks indicated that the slope of the catch time series for Charlotte Harbor was different from zero (slope = 0.0586, R^2 = 0.375), but it was not significantly different from zero in Yankeetown (slope = 0.0073, R^2 = 0.0115) (Figure 6).

<u>Atlantic Sharpnose Analysis</u>

Mature sharpnose sharks:

There were significant differences in catch rates between all factors tested except month and grid (Table 3). Both areas had different patterns of annual catch rates. Regression analysis of the percentage of annual catch rates indicated that the slope of the catch series for Yankeetown was significantly different from zero (slope = 0.0593, R^2 = 0.6201); however, the slope of the catch series for Charlotte Harbor was not significantly different from zero (slope = 0.0016, R^2 = 0.1042) (Figure 7).

Immature sharpnose sharks:

There were significant differences in catch rates between all factors tested except month and year (Table 3). Both areas had different of annual catch rates. Regression analysis of the percentage of annual catch rates indicated that the slope of the catch series for Yankeetown were different from zero but not significantly different (slope = 0.011, R^2 = 0.3303), the same occurred for Charlotte Harbor (slope = 0.0066, R^2 = 0.0676) (Figure 8)

Discussion

Results of our studies indicate that there has been an increase in number of mature bonnetheads in both areas between 1995 and 2004. There has been also a slight increase in the number of immature bonnethead sharks for the Charlotte Harbor area, but there is no clear evidence of decline or increase in the number of immature sharks in the Yankeetown area. There appears to be increase in the number of mature and immature Atlantic sharpnose sharks between 1995 and 2004 for the Yankeetown area; however, the low number of catch rates for the Charlotte Harbor area for both maturity stage groups made it difficult to make solid conclusions about the status of this population. Interestingly, of the 336 the Atlantic sharpnose sharks captured in our surveys, only 7 individuals were females.

The results of our surveys were affected by periodic, and sometimes severe, blooms of red tide (*Karenia brevis*, a dinoflagellate toxic to fish). Elasmobranchs appear to be highly sensitive to the toxin associated with these blooms and can respond by evacuating affected areas. A severe red tide was documented in the Charlotte Harbor area in 2001 although blooms were present at varying levels during all the years of the study. Additionally, pulses of fresh waters as a result of the episodic opening of dams following