Life history parameters of the sandbar shark, *Carcharhinus plumbeus*, in the Northwest Atlantic.

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DRAFT

Introduction

The sandbar shark, *Carcharhinus plumbeus,* is a common large coastal shark that inhabits temperate and subtropical waters world wide and attains lengths greater than 2 meters (Compagno 1984). In the western North Atlantic the species inhabits near-shore waters out to the edge of the continental shelf from Cape Cod to Brazil (Bigelow 1948; Springer 1960; Garrick 1982). Tagging studies suggest that this region is composed of two unit stocks. One stock is found from Cape Cod south to the Northern Yucatan peninsula and another from Trinidad to Brazil (Springer 1960; Kohler et al. 1998). Genetic studies conducted on specimens from Virginia waters and the Gulf of Mexico further support the existence of a single stock that utilizes the area of Cape Cod to the Northern Yucatan Penninsula (Heist et al. 1995).

Published data were examined to determine life history parameters for the sandbar shark in the Northwest Atlantic for use in stock assessment models.

Materials and Methods

Published data were examined for estimates of life history parameters for the sandbar shark. Age and growth estimates were obtained through vertebral centra analyses and tag-recapture methods. Data used in this review were obtained through fishery-independent and fishery-dependent surveys.

Age and growth

Age and growth of the sandbar shark has been studied extensively in the Northwest Atlantic. Multiple studies have utilized vertebral centra for determining age at size for the sandbar shark in the Northwest Atlantic. Casey et al.(1985) and Sminkey and Musick (1995) estimated age and growth parameters for sandbar sharks from vertebral centra analyses. Casey and Natanson (1992) utilized tag recapture methods as another means of estimating life history parameters.

Size at maturity

Sminkey and Musick (1996) utilized reproductive and size at 100% maturity in their demographic analyses of the sandbar shark. Sharks examined were obtained through the fishery-independent Virginia Institute of Marine Science shark longline survey and from fishery-dependent surveys.

Reproduction

Multiple studies have reported values for litter sizes in sandbar sharks (Springer 1960; Clark and von Schmidt 1965; Sminkey and Musick 1996; Cortés 2000). These studies also examined the reproductive periodicity of the sandbar shark.

Results

Age and growth

Previous studies of the age and growth of the sandbar shark from the northwest Atlantic have yielded mixed results (Table 1). Lawler (1976) produced unrealistic values for maximum length (267 cm TL) and only produced von Bertalanaffy growth parameters for female sandbar sharks due to a limited sample size of males. Casey et al. (1985) provided a more comprehensive study of the age and growth of the sandbar shark that consisted of a large sample size and included age validation studies, but also produced unrealistic maximum length estimates (303 cm Fork Length). Empirical maximum reported lengths are 234 cm TL (175 PCL) and 226 cm TL (169 cm PCL) for females and males respectively (Cortés 2000). This study did lack a representative sample from larger size classes, which is an inherent problem in conducting an age and growth study on long-lived species. The oldest male to be aged was 15 years old and the oldest female to be aged was 21 years old. Casey and Natanson (1992) provided new growth parameters based on tagging experiments and proposed age at maturity to be to 30 years and maximum size to be 186 cm FL.

Sminkey and Musick (1995) reexamined age and growth of the sandbar shark from samples obtained a decade apart, 1980-1981 and 1991-1992. The sample set from 1991-1992 was the most robust sample size and had the greatest size range of any study conducted on sandbar sharks to date. Sminkey and Musick (1995) produced theoretical estimates for maximum size that were in close agreement with empirical values (Table 1). Minimum and maximum ages assigned to sharks in this study were 1 and 25 years respectively. Estimated values from this work were corroborated by Grubbs et al. (in press).

Size at maturity

Maturity in both males and females was reached between 15 and 16 years of age at a length of approximately 135 cm PCL (Springer 1960; Casey et al. 1985; Sminkey and Musick 1995). Sminkey and Musick (1995) reported the smallest mature male examined in their study was 129 cm pre-caudal length (PCL) and the largest immature male was 136 cm PCL. Sminkey and Musick (1995) also reported the smallest mature female examined was 126 cm PCL and the largest immature female was 140 cm PCL.

Fecundity

In the Northwest Atlantic pups were approximately 47 cm Fork Length (FL) at birth (Springer 1960; Castro 1993; Sminkey and Musick 1995; Cortés 2000). Litter sizes in the NWA population averaged 8.4 pups per litter and ranged from four to 12 pups (Springer 1960; Clark and von Schmidt 1965; Sminkey and Musick 1996; Cortés 2000). Due to the advanced development of the pups, a long gestation period is required. Gestation is approximately 9-12 months (Springer 1960; Clark and von Schmidt 1965;

Lawler 1976). The lack of large yolky ova in late term females suggests at least a one year resting period following parturition (Musick 1995; Branstetter and Burgess 1996).

Discussion

Although multiple studies have examined the age and growth of the sandbar shark in the Northwest Atlantic, estimates life history parameters put forth by Sminkey and Musick (1995; 1996) appear to be the most accurate. Theses findings have been supported through tag-recapture data of the Virginia Institute of Marine Science Shark longline survey (Grubbs et al.; in press). Whenever possible mark-recapture techniques and age-at-length studies should be combined to provide more sound estimates of life-history parameters.

Table 1. Von Bertalanffy parameters for the sandbar shark from previously published data. Growth parameters were estimated from analyses of vertebral centra and tag recapture information. (All lengths can be converted to fork length through the following relationship: FL=1.1*Pre-caudal length +1)

		Male	Female	Combined
Casey et al.1985	L_∞	233 cm (PCL)	270 cm (PCL)	
	K	0.0501	0.04	
	t_0	-4.5	-4.9	
	Age at maturity (yrs)	13	12	
	Size at Maturity	139 cm (PCL)	184 cm (PCL)	
Casey and Pratt 1992	L_∞			168 cm (PCL)
	K			0.046
	t_0			-6.45
	Age at maturity (yrs)			30
	Size at Maturity			
Sminkey and Musick 1995 (1980-1981 samples)	L_∞	184 cm (PCL)	197 cm (PCL)	199 cm (PCL)
	K	0.059	0.059	0.057
	t_0	-5.4	-4.8	-4.9
	Age at maturity (yrs)	15-16	15-16	15-16
	Size at Maturity	135	136	136

Sminkey and Musick 1995 (1990-1991 samples)	L_∞	166 cm (PCL)	165 cm (PCL)	164 cm (PCL)
	K	0.087	0.086	0.089
	t_0	-3.8	-3.9	-3.8
	Age at maturity (yrs)	15-16	15-16	15-16
	Size at Maturity	135	136	136

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