15. Large Pelagics (coastal sharks, pelagic sharks, and highly migratory species)

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Background and Estimation Approaches

Bluefin tuna Virtual Population Analysis (VPA) estimates of stock size and biomass were obtained from a recent ICCAT (International Commission for the Convservation of Atlantic Tunas) stock assessment (ICCAT 2003). For bluefin tuna we assumed that 50% of the age 3+ VPA biomass occupies the New England region during July-October. This approach produced a biomass of 9,067 mt during July-October and an annual average biomass of 3,022 for the entire region (Table 15.1). Combining subjective information about the distribution of bluefin tuna during their residency period from the Mid-Atlantic region to the Gulf of Maine with some information in the literature (Chase 2002), we assumed that 45% of the regional contingent was found in both the Gulf of Maine and Georges Bank ecoregions and 10% in the SNE region. Biomass in the 4 ecoregions was the product of the regional proportions and the average annual biomass (Table 15.1).

Since no stock abundance information is available for yellowfin, bigeye, albacore, swordfish, and white-blue marlin, we developed a ratio method with Japanese longline ICCAT data (1978-1988, 5,640 sets) for the United States Exclusive Economic Zone (US EEZ) (Hoey *et al.* 2002). We used the ratio between catch rates for these species and bluefin tuna from Hoey *et al.* (2002) to produce a raising factor to scale tuna-billfish numbers during 1996-2000 to bluefin tuna numbers for the same period. We used ICCAT SCRS reports for each species to obtain mean weight data, and this was used to estimate biomass during each year. An assumption concerning the relative proportion of each stock in the 4 ecoregions was also made with distribution maps available in the ICCATR SCRS reports for each species. Average biomass for the 1996-2000 period was calculated for bluefin tuna, yellowfin tuna, bigeye tuna, albacore tuna, swordfish, and a white-blue marlin aggregate group.

Annual production for bluefin and bigeye tuna was calculated from VPA results for these species obtained from ICCAT SCRS Reports. Production data for these two species were used to calculate P:B ratios (bluefin tuna = 0.316, bigeye = 0.558). Production for albacore was calculated from the P:B ratio for bluefin tuna and yellowfin by using the P:B ratio for bigeye tuna. We assumed that swordfish and white-blue marlin are less productive, so a P:B ratio of 0.2 was used for these species. Consumption was calculated by assuming that the daily ration for the tunas was the same as for bluefin tuna (3%) and multiplying this value by the biomass during 1996-2000. Swordfish and white-blue marlin were assumed to have a daily ration of 1% body weight (BW). Landings for these species were obtained from ICCAT SCRS Reports, and it was assumed that only 10% of the average landings during 1996-2000 occurred on the continental shelf for albacore, yellowfin, bigeye, swordfish, and white-blue marlin (5% for yellowfin tuna) (Table 15.2). United States Bluefin tuna landings were averaged for 1996-2000 and scaled to account for residency time (Table 15.2). Data for all the tuna and billfish were summed for each ecoregion for biomass, production, consumption, and landings and converted to g m^{-2} (Table 15.3).

To estimate blue shark abundance, we used the ratio between blue shark and bluefin tuna catch rates from Hoey *et al.* (2002) to produce a raising factor to scale blue shark numbers during 1996-2000 to bluefin tuna numbers for the same period. This exercise produced a ratio of 1.5. Next a weighted average mean weight (drawn) was calculated from recreational mean weight data (24.59 kg) collected during MRFSS interviews and a factor of 1.96 round:drawn ratio was used to convert to round weight (48.19 kg) (Cortez 2002). Biomass in the region was estimated by assuming that 50% of the stock (Kohler 1988) is found in the SNE-GOM area during May-October. This yielded a calculated biomass of 7,950 mt for the six month period and an annual average of 3,975 mt (Table 15.4). We further assumed that the biomass was equally distributed (Kohler 1988) over the SNE-GOM ecoregions, with 1,325 mt in each region (Table 15.4).

For the other sharks (hammerhead, shortfin mako, thresher, dusky, porbeagle, sandbar, and other) we used the ratio between the catch rates of these sharks and blue shark from Hoey *et al.* (2002) to produce a raising factor to scale numbers during 1996-2000 to blue shark numbers for the same period. Next a weighted average mean weight (drawn) was calculated from recreational mean weight data collected during MRFSS interviews for blue, mako, thresher, and porbeagle shark. The average weight for mako shark was used for sandbar and dusky, while the average weight for blue shark was used for hammerhead shark because no information for these species was available. A factor of 1.96 round:drawn ratio was used to convert to round weight for each species (Cortez 2002). We further assumed that the biomass was unequally distributed over the MA-GOM ecoregions on a seasonal basis.

Production and Consumption

Consumption by sharks in the four regions was estimated from daily ration estimates for blue (0.056) and mako (0.010) shark available from the literature (Stillwell and Kohler 1982; Kohler 1988). An average of these two values (0.008) was used to estimate consumption for the other shark species. Production for all sharks was estimated by assuming a P:B ratio of 0.1. This ratio was used with average biomass to calculate production for each species. Recreational and commercial landings of sharks were averaged during 1996-2000, scaled down to account for the percentage landed in the region, and scaled to an annual basis since sharks are only present during about half the year. Data for biomass, production, consumption, and landings were further scaled to g m^{-2} for each ecoregion and combined into a pelagic group (thresher, mako, blue, porbeagle, and hammerhead) and a coastal group (dusky, sandbar, other) (Table 15.5).

References

Chase, B.C. 2002. Differences in diet of Atlantic bluefin tuna (Thunnus thynnus) at five seasonal feeding grounds on the New England continental shelf. Fisheries Bulletin. 100:168-180.

Cortes, E. 2002. Catches and catch rates of pelagic sharks from the Northwestern Atlantic, Gulf of Mexico, and Caribbean. Collected Volumes Scientific Papers. ICCAT. 54(4): 1164-1181.

Hoey, J.J, E. Pritchard, C. Brown, and M. Showell. 2002. Pelagic shark abundance indices based on fishery-dependent and fishery-independent data from the western North Atlantic. Collected Volumes Scientific Papers. ICCAT. 54(4): 1199-1211.

ICCAT. 2003. Report of the 2002 Atlantic bluefin tuna stock assessment session. Col. Vol. Sci. Pap. ICCAT. 55(4):1289-1415.

Kohler, N.F. 1988. Aspects of the feeding ecology of the blue shark, Prionace glauca in the Western North Atlantic. PhD. Dissertation, University of Rhode Island. UMI Ann Arbor, MI. 163 pp.

Stillwell, C.E., and N.E. Kohler. 1982, Food, feeding habits, and estimates of daily ration of the shortfin mako (Isurus oxyrinchus) in the Northwest Atlantic. Canadian Journal of Fisheries and Aquatic Sciences. 39:407-414.

Table 15.1. Bluefin tuna biomass, average biomass, and regional average biomass during 1996-2000 (mt).

Bluefin tuna biomass in NE region Jul–Oct	9067 (4 month residency)
Annual average biomass	3022

Region	% Annual average biomass	Biomass
GOM	0.45	1359.9
GB	0.45	1359.9
SNE	0.1	302.2
MA	0	0

Table 15.2. Average landings adjusted for seasonality for tuna, billfish and sharks during 1996-2000.

Species	Average Landings 1996-2000 (mt)
Bluefin tuna	316.65
Bigeye	10.20
Yellowfin	92.60
Albacore	14.40
Swordfish	0.58
White-blue marlin	1.28
Blue shark	56.96
Shortfin mako	82.57
Thresher	47.45
Porbeagle	2.18
Dusky	104.64
Sandbar	698.33
Hammerhead	NA
Other	NA

Table 15.3. Average biomass (B), consumption (C), production (P), and landings (L) in g m^{-2} for tuna and billfish by ecoregion during 1996-2000.

Tuna, billfish	g m^{-2} yr^{-1}			
area	B	C	P	L
GOM	0.018341	0.07219	0.012875	0.001801
GB	0.035163	0.137283	0.024003	0.003406
SNE	0.009904	0.041785	0.005782	0.001071
MA	0.008747	0.042862	0.004366	0.001268

Table 15.4. Blue shark biomass, average biomass, and regional average biomass during 1996-2000.

Blue shark biomass in NE region May–Oct	7950 (6 month residency)
Annual average biomass	3975

Region	% Annual average biomass	Biomass
GOM	0.3333	1324.868
GB	0.3333	1324.868
SNE	0.3333	1324.868
MA	0	0

Table 15.5. Average biomass (B), consumption (C), production (P), and landings (L) in g m^{-2} for pelagic and coastal sharks by ecoregion during 1996-2000.

Pelagic sharks		g m^{-2} yr^{-1}		
Area	B	C	P	L
GOM	0.013014	0.013513	0.001301	0.00023
GB	0.024358	0.025903	0.002436	0.000794
SNE	0.019873	0.022623	0.001987	0.001153
MA	0.010237	0.012939	0.001024	0.001044

Coastal sharks		g m^{-2} yr^{-1}		
Area	B	C	P	L
GOM	0	0	0	0
GB	0	0	0	0
SNE	0.015858	0.023153	0.001586	0.005451
MA	0.016986	0.024799	0.001699	0.005838