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WHALE SHARKS ASSOCIATED WITH FISH SCHOOLS OFF SOUTH TEXAS

Twelve sightings of *Rhincodon typus* were made during aerial surveys of outer continental shelf waters adjacent to the coast of south Texas. Surveys were conducted in August and November 1979 and in June and August of 1980 at altitudes of 91 m and 228 m in a study area extending from 26° 02' N to 27° 02' N and from the coast offshore to 94° 56' W, an area 111 x 222 km. Three-day replicate surveys were flown in the area during each study period. The surveys in November and June were spread over several days because of unfavorable weather conditions. The 1979 surveys were flown in a Cessna 337 Skymaster and the 1980 surveys in a Beechcraft AT-11 with a glass observation dome in the nose of the aircraft. Both planes were equipped with Barnes PRT-55 infrared radiometers for measuring surface seawater temperatures and TDL-711 Loran-C Navigation systems.

Seven *Rhincodon* were seen during August 1979 (Table 1) in a small part of the study area about 100 km east of South Padre Island. All were in water 600-1800 m deep, over the lower continental slope. The surface water temperature in the entire survey tract was 28° — 30° C; all whale shark sightings were in water with surface temperatures of 29° C.

All seven whale sharks were found while investigating aggregations of fishes and birds. The aggregations were first sighted as disturbances of the surface water visible at distances of 1 km or more. The disturbances resulted from the activity of fast-swimming fishes, each about 0.3-0.5 m in length, moving in schools and apparently feeding on smaller prey. We were not able to identify the fishes, but their size, speed, and schooling habits suggested mackerel or small tuna. Sharks, 1-5 m long, of lamnid or car-

charinid body form, were visible beneath the fish schools. Most of the associations had sea birds gathered above them. The most common birds were Black Terns (*Chlidonias niger*), Sooty Terns (*Sterna fuscata*), and Cory's Shearwaters (*Calonectris diomedea*). Our sightings included 150-200 Cory's Shearwaters, more than have been reported previously from the state of Texas and adjacent waters (Webster 1976, 1977, 1978, 1979). The first whale shark observed was associated with an aggregation including 5 bird species, a school of 50-60 dolphins (probably *Stenella plagiodon*), and a pod of 10-15 short-finned pilot whales (*Globicephala macrorhynchus*), as well as fish and smaller sharks. The whale shark was hanging vertically, tail down, near the surface disturbance. The characteristic pattern for whale sharks of pale spots and lines on the dorsal surface was clearly visible, as was the characteristic shape, with broad, blunt head and terminal mouth. The other six *Rhincodon* seen in August 1979 were in horizontal position in, under, or adjacent to six of the approximately 30 aggregations observed. They ranged in size from 8-15 m. At least two other sightings of possible whale sharks were made, but only those close enough to the surface to be seen well are included in Table 1.

Whale sharks were not observed during November 1979, but they were recorded again in June and August 1980. The schools of large fishes were not seen in June; however, two *Rhincodon* were seen. The first was in 60 m water, much shallower than the previous sightings. The second was in water of 500+m within 8 km north of the area where the August 1979 sightings were concentrated, and was accompanied by a 3 m shark; a Cory's Shearwater flew above them.

Three whale sharks were seen in August 1980, two with fish aggregations similar to those of the previous year. Only

Table 1. Locations of whale sharks off South Texas, August 1979-August 1980.

Dates	Number Seen	Position	Approximate depth (m) ¹
20 August 1979	1	26°29'N, 96°13'W	660
21 August 1979	2	26°27'N, 96°14'W	600
21 August 1979	1	26°28'N, 96°14'W	640
22 August 1979	1-3 ²	26°18'N, 96°04'W	880
22 August 1979	1	26°29'N, 95°44'W	1400
22 August 1979	1	26°29'N, 95°27'W	1600
22 June 1980	1	26°14'N, 96°31.8'W	62
26 June 1980	1	26°34.0'N, 96°15.6'W	510
21 August 1980	1	26°47.2'N, 95°42.9'W	1320
22 August 1980	1	26°2.8'N, 96°44.0'W	50
22 August 1980	1	26°03.0'N, 95°20.9'W	1650

¹taken from NOAA nautical chart 11300 (formerly C & GS 1119).

²One definite, two more possible, but too deep to see clearly.

seven such fish aggregations were seen in August 1980. They were composed of larger fishes (0.5-1.5 m) that appeared to be tuna and 1-3 m sharks. Very few birds were associated with these aggregations, but this may be related to the passage of Hurricane Allen through the area less than 2 weeks previously. The third *Rhincodon* seen in August 1980 was in 50 m water within 200 m of a group of 20-25 dolphins, but no concentrations of fishes were noted in the area.

Gudger (1941) related a variety of observations of whale sharks feeding on baitfish schools, usually in association with predatory fishes, including jacks (*Caranx* sp.) and unspecified bonito and tunas. He concluded that schooling baitfishes are the primary food of whale sharks. Springer (1957) described *Rhincodon* in the northern Gulf of Mexico hanging vertically, head up, in the center of baitfish schools. They raised their heads out of the water, opened their mouths as they sank back, and drew in quantities of water and fish. Springer watched small blackfin tuna (*Thunnus atlanticus*) jump into the mouths of the whale sharks, apparently in pursuit of the baitfishes. Only one of the whale sharks in this study was seen in a vertical atti-

tude and none were seen to raise their heads out of the water, inferring they were feeding in one of the more conventional ways described by Gudger.

These observations indicate that *Rhincodon* regularly occur off the Texas coast, at least in summer. *Rhincodon* regularly appear in Cuban waters in winter and feed with "bonito" on schools of "sardines" (references in Gudger 1941). It is possible that whale sharks migrate seasonally from Cuban waters into the northern and western Gulf of Mexico and back. The observed association of whale sharks, pilot whales, dolphins, marine birds, and large fishes illustrates the patchiness of resources in pelagic environments and the ability of the larger vertebrates to find and exploit resource concentrations.

These observations were made during surveys of marine mammals, birds, and turtles of outer continental shelf areas. The Bureau of Land Management, New Orleans OCS Office, in cooperation with the U.S. Fish and Wildlife Service, provided funding (MOU-AA551-MU9-19) for the surveys. The survey planes were chartered from Aero Marine Inc. of Groton, Connecticut.

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