Biological Surveys to Assess The Relative Abundance and Distribution of Coastal Sharks and Teleosts of the Mexican Gulf of Mexico; 1997, 1998, 2001, and 2002

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ABSTRACT

In efforts to maintain viable shark populations, the National Marine Fisheries Service (NMFS, an agency of NOAA) developed the 1993 Fisheries Management Plan (FMP) for Sharks of the Atlantic Ocean (NOAA 1993). This plan stresses the need for monitoring and assessment of shark populations to determine the efficacy of FMP measures. NMFS Mississippi Laboratories (MSL) instituted field surveys (beginning 1995), with support from the NMFS Highly Migratory Species Division, to assess distribution and relative abundance of coastal sharks in the western North Atlantic Ocean and Gulf of Mexico. In order to assess the extent of shared shark and teleost populations between Mexico and the U. S. within the western North Atlantic Ocean and the Gulf of Mexico, NMFS and the Instituto Nacional de la Pesca (INP) of Mexico instituted a cooperative bottom longline research initiative that operates under auspices of MEXUS-Gulf. The first of a series of cooperative projects was conducted during summer of 1997, with subsequent projects during 1998, 2001 and 2002 [Grace 1997, 1998, 2001 and 2002]. Scientists representing INP, NMFS and several Mexican and U. S. based institutions and universities participated. Gear, survey design and project objectives for the Mexico based effort was consistent with NMFS U. S. based surveys. One hundred and sixty five bottom longline stations were completed during 51 survey days. Captures include 97 sharks, 57 other elasmobranches and 248 teleosts. The MEXUS-Gulf bottom longline surveys have been successful for developing a useful fisheries independent data base.

KEY WORDS: Longline, MEXUS-Gulf, Survey

Estudios Biológicos para Evaluar la Abundancia Relativa y Distribución de Tiburones Costeros y Teleósteos del Golfo de México, 1997, 1998, 2001 Y 2002

En un esfuerzo para mantener viables las poblaciones de tiburón en aguas de los Estado Unidos, el Servicio Nacional de Pesquerías Marinas de los Estados Unidos (the National Marine Fisheries Service, NMFS) implemento a partir de 1993 un Plan de Manejo Pesquero para los Tiburones del Océano Atlántico. Para evaluar la eficacia del plan, el Laboratorio de la NMFS en Mississippi condujo una serie de cruceros de prospección (1995 - 2002), para evaluar la distribución y abundancia relativa de tiburones costeros en la costa occidental de los E.U. del Océano Atlántico Norte y del Golfo de México. Para extender la cobertura de los estudios para varias especies del tiburón, la NMFS y el Instituto Nacional del la Pesca (INP) iniciaron una serie de cruceros de investigación conjuntos (1997, 1998, 2001 y 2002) dentro de las aguas territoriales mexicanas del Golfo de México. El objetivo fundamental del proyecto del Golfo de Mexico fue desarrollar una base de datos de pesquerías independiente para el manejo de las diferentes especies de tiburón (tiburones costeros grandes y pequeños) y teleósteos de importancia comercial (huachinangos y meros). Los objetivos secundarios incluyeron estudios de marcado y muestreo biológico para el conocimiento de las historias de vida de las principales especies.. En cuatro cruceros conjuntos de investigación se realizaron 165 estaciones de palangre de fondo durante 51 días del estudio. Las capturas incluyeron 97 tiburones (11 especies), 57 de otros elasmobranquios (3 especies) y 248 teleósteos.

PALABRAS CLAVES: MEXUS- Golfo de México, estudios biológico,

INTRODUCTION

Use of longline gear to survey fish populations has historical precedents for fisheries surveys. However, some longline surveys lacked sound statistical survey designs or surveys were directed toward a particular species of interest or problem, therefore, there are limitations for the usefulness of historical longline data for current fisheries management purposes. In order to compare fish population trends it is advantageous for biological surveys to be designed and conducted in a uniform manor. This is especially true when trying to assess several different species occupying dissimilar habitats along broad geographical areas. In response to the need for developing a fisheries independent data base that would be useful for determining the efficacy of the 1993 Shark FMP, NMFS MSL instituted bottom longline studies designed to satisfy 5 important assessment principles: stock wide survey, synopticity, well-defined sampling universe, controlling biases and useful precision (Grace and Henwood 1997). During 1999 survey objectives were

expanded to include teleosts of U. S. management interests (e.g., red snapper, *Lutjanus campechanus*).

MATERIALS AND METHODS

The timing for the longline surveys was based on research vessel availability, and even though it is known that shark and finfish catch rates by species may vary seasonally no adjustment for seasonal variations was possible. Type and configuration of fishing gear was based on gear used during NMFS MSL surveys. Monofilament bottom longline gear was selected for the longline projects because it is the preferred gear of the commercial fishing sector, and because comparison of monofilament longline gear versus rope or "Yankee gear" (Branstetter and Musick 1994) indicated that monofilament gear is significantly more efficient. A hydraulic longline reel was used for setting and retrieving the mainline. Radar reflecting buoys were used to mark longline locations. The mainline was weighted (10 kg weights) at the start buoy, midset and end buoy; additional weights were added (between start and midset, between midset and end) for sites in areas of strong currents. Longline gear components included; 1.0 nautical mile of 426 kg (1,000 lb) test monofilament mainline, #3/0 J hooks (1997 and 1998) or #15/0 circle hooks (2001 and 2002) baited with Atlantic mackerel (*Scomber scombrus*. 1997 and 1998 surveys) or Atlantic bonito *(Sarda sarda*, 2001 and 2002 surveys), 3.66 m (12 ft) gangions (leaders) of 332 kg (730 lb) test monofilament. Longline gear (100 hooks) was fished for one hour determined as the time duration between deployment of the last longline set buoy to retrieval of the first buoy to begin haulback. Longline gear was retrieved in the direction of the longline set.

Survey vessels used to conduct the bottom longline surveys were the NOAA Ship OREGON II (51.5 m length) and the Mexican RV ONJUKU (35.0 m length). With minor modifications, these survey vessels proved effective for conducting bottom longline operations. Survey data recorded to characterize gear and catch included gear specifics, environmental and biological data. Biological data for sharks and teleosts included identifications (genus and species), length (mm), weight (kg), sex and mortality. Sea surface to sea bottom environmental profiles were collected at each survey site with a CTD.

SURVEY DESIGN

All longline sites during all surveys were selected at random. The first coordinate for random longline site locations was a randomly selected latitude or longitude (dependent on the perpendicular direction of bathymetric contours), with the second coordinate a random distance from the minimum survey depth of 9 m (5 fm). Sampling density for each survey was a function of available sea days. Longline sites were occupied in the most time efficient manner possible and were not designated day or night sites prior to the survey. Longline locations were allocated

within contiguous 60 n. mile sampling zones to assure allocation throughout survey areas without gaps in coverage.

During 1997 statistical zones were allocated three longline sites with additional longline sites randomly selected or selected midpoint between extreme distances. During 1998, 2001 and 2002 allocation of randomly selected surveys sites was by proportional allocation within 60 n. mile sampling zones based on continental shelf area; sampling zones in areas with a broad continental shelf were allocated more survey sites than sampling zones with a narrow continental shelf. The depth range for longline sites during 1997 and 1998 was 9 m (5 fm) - 55 m (30 fm); during 2001 and 2002 the depth range was 9 m - 366 m (200 fm). During 2001 and 2002, in addition to the randomly selected sites designated by proportional allocation, 2 longline sites were selected at random (not by proportional allocation) between 183 m (100 fm) - 366 m (200 fm). The survey area for the 2001 and 2002 was defined by delineating survey zones along areas of highest catch rates for sharks and teleosts during the 1998 survey. Most bottom longline sets were conducted parallel to depth contours unless survey conditions (i.e. oceanic currents, sea surface conditions) necessitated a different orientation.

RESULTS

During 51 sea days, 165 bottom longline sets were completed (Figure 1 and Table 1). Shark captures constituted 24.1% of the total catch, other elasmobranchs were 14.2% and teleosts were 61.7% (Table 2).

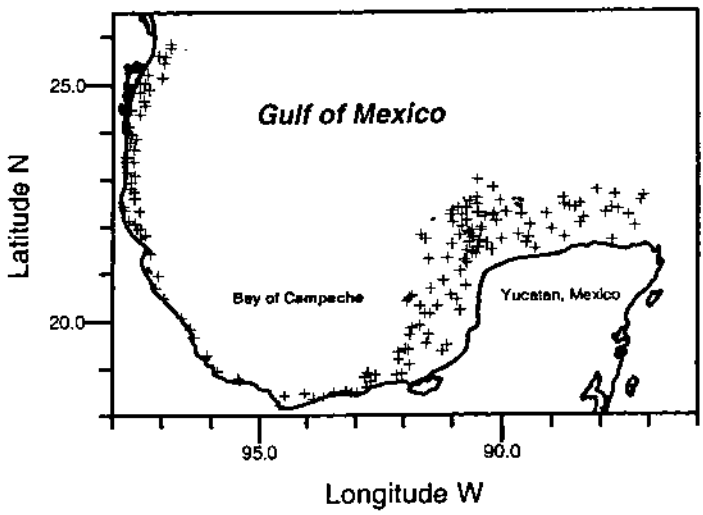

Figure 1. Bottom longline locations for MEXUS- Gulf bottom longline surveys, 1997, 1998, 2001, and 2002.

Table 1. Survey descriptions, MEXUS - Gulf bottom longline surveys, 1997, 1998, 2001 and 2002.

Survey and date	Location	Depth range (m)	Effort (# sets)	Random station selection description
OT-97-04 (227), 8/9 – 8/24/97	U.S. - Mexico boundary to Cabo Rojo, Mexico	9 m - 55 m	25	Longline sites allocated within samplings zones, #3/0 J hooks.
OT-98-02 (231), 7/24 – 8/21/98	Entire Mexican Gulf of Mexico coast	9 m - 55 m	110	Longline sites selected by proportional allocation; #3/0 J hooks.
ONJUKU 6/1 – 6/20/01	Eastern Bay of Campeche	9 m – 366 m	38	Longline sites selected by proportional allocation; #15/0 circle hooks.
ONJUKU 6/28 – 7/5/02	Eastern Bay of Campeche	9 m – 366 m	29	Longline sites selected by proportional allocation; #15/0 circle hooks.

Twelve shark species were captured (97 captures, Table 2) with the most frequently captured shark the Atlantic sharpnose shark (62 captures) followed by the blacknose shark (10 captures). Sixty-eight sharks were tagged and released. Mortality for shark captures was 12.0%. Three species of other elasmobranchs (rays) were captured with the southern stingray the most frequently captured (53 captures).

Twenty-six teleost species were captured (248 captures, Table 2). The most frequently captured teleost was the red grouper (129 captures) followed by the hardhead catfish (24 captures) and the mutton snapper (13 captures). Mortality for teleosts was 2.0 %.

DISCUSSION AND CONCLUSION

Seasonality may be the primary factor that contributes most to potential sources of survey bias concerning catch per unit effort (CPUE) for sharks. NMFS tag return information indicates for some sharks (i.e., blacktip sharks) there is a spring shark migration north from the Mexican Gulf of Mexico to the U. S. Gulf of Mexico, with a return migration to Mexico during fall [Kohler 2002]. If there is a substantial U.S. - Mexico Gulf of Mexico shark migration then it is possible the summer time frame for the MEXUS-Gulf surveys may reflect a reduced relative abundance for sharks as compared with relative abundance during fall or winter. Though a migration event may be plausible for some sharks, species like the Atlantic sharpnose shark (the most frequently captured during the surveys) and the blacknose shark are not documented to be long-distance migrators. Conducting future surveys during other seasons is a possibility provided research vessel sea days are available.

Table 2. Elasmobranch and teleosts captures for MEXUS-Gulf bottom longline surveys, 1997, 1998, 2001 and 2002.

Genus and species, common name	# Captured	Mean Length, TL	Size Range, TL
Carcharhinus acronotus, blacknose shark	10	881 mm	785 – 980 mm
Carcharhinus falciformis, silky shark	5	924 mm	805 – 1235 mm
Carcharhinus leucas, bull shark	1	2500 mm	
Carcharhinus limbatus, blacktip shark	4	825 mm	730 – 872 mm
Carcharhinus plumbeus, sandbar shark	1	1400 mm	
Carcharhinus isodon, finetooth shark	1	1168 mm	
Rhizoprionodon terraenovae, Atlantic sharpnose shark	82	878 mm	603 – 1025 mm
Galeocerdo cuvier, tiger shark	1	870 mm	
Mustelus canis, smooth dogfish	5	991 mm	700 – 1200 mm
Sphyrna lewini, scalloped hammerhead	3	1343 mm	1012 – 2000 mm
Sphyrna tiburo, bonnethead	3	938 mm	900 – 1000 mm
Ginglymostoma cirratum, nurse shark	1	2500 mm	
Dasyatis sp., stingrays not identified to species	3	1017 mm	800 – 1250 mm, disk width measurement
Dasyatis americana, southern stingray	53	848 mm	485 – 2000 mm, disk width measurement
Aetobatis narinari, spotted eagle ray	1	1520 mm	disk width measurement
Synodus foetens, inshore lizardfish	1	383 mm	
Arius felis, hardhead catfish	24	312 mm	282 – 371 mm
Bagre marinus, gafftopsail catfish	8	472 mm	361 – 555 mm
Gymnothorax funebris, green moray	5	1039 mm	864 – 1450mm
Gymnothorax moringa, spotted moray	9	940 mm	470 – 1509 mm

Table 2 continued.

Genus and species, common name	# Captured	Mean Length, TL	Size Range TL
Gymnothorax nigromarginatus, blackedge moray	2	718 mm	670 – 765 mm
Gymnothorax saxicola, honeycomb moray	2	610 mm	580 – 640 mm
Ophichthus rex, king snake eel	10	1205 mm	1000 – 1750 mm
Prionotus tribulus, bighead searobin	2	296 mm	288 – 305 mm
Diplectrum formosum, sand perch	2	250 mm	230 – 270 mm
Epinephelus nigritus, Warsaw grouper	1	844 mm	
Epinephelus adscensionis, rock hind	1	365 mm	
Epinephelus flavolimbatus, yellowedge grouper	9	685 mm	500 – 965 mm
Epinephelus guttatus, red hind	2	389 mm	373 – 405 mm
Epinephelus morio, red grouper	129	495 mm	285 – 880 mm
Mycteroperca bonaci, black grouper	6	912 mm	530 – 1203 mm
Mycteroperca venosa, yellowfin grouper	1	660 mm	
Remora remora, remora	1	700 mm	fork length measurement
Rachycentron canadum, cobia	3	1022 mm	735 – 1260 mm
Etelis oculatus, queen snapper	1	750 mm	
Lutjanus analis, mutton snapper	13	727 mm	608 – 848 mm
Lutjanus campechanus, red snapper	5	628 mm	487 – 840 mm
Lutjanus cyanopterus, cubera snapper	2	1096 mm	1080 – 1111 mm
Lutjanus griseus, gray snapper	3	508 mm	410 – 595 mm
Menticirrhus americanus, southern kingfish	1	326 mm	
Calamus calamus, saucereye porgy	2	618 mm	602 – 635 mm
Calamus nodosus, knobbed porgy	1	677 mm	
Trichiuridae, snake mackerel not identified to species	1	600 mm	
Batrachoididae, toadfish not identified to species	1	400 mm	

The MEXUS-Gulf surveys were not designed to assess a specific shark or teleost species. The emphasis for the surveys has been to provide data useful for developing a fisheries independent time series and to provide tagging and biological sampling opportunities. Due to high catch variability between surveys and relatively low catch rates for the multi-species complex encountered by the longline gear it would be difficult to establish any meaningful conclusions concerning relative abundance or distribution by species. However, as the time series continues to develop through future surveys the subsequent data should help define important biological profiles for several species.

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