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Post-Release Survival of Sailfish (Istiophorus platypterus) Captured on Commercial Pelagic Longline Gear in the Southern Gulf of Mexico

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POST-RELEASE SURVIVAL OF SAILFISH *(ISTIOPHORUS PLATYPTERUS)* CAPTURED ON COMMERCIAL PELAGIC LONGLINE GEAR IN THE SOUTHERN GULF OF MEXICO

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SUMMARY

To estimate post-release survival of sailfish caught incidentally to regular commercial pelagic longline fishing operations in the southern Gulf of Mexico targeting mixed swordfish and tunas, ten pop-up satellite archival tags were deployed for ten days on incidentally captured animals. All ten tags transmitted following the full deployment period, transmitting 25-82% of the archived data. Repeated, short-duration movements at depth and horizontal displacement data from were consistent with survival of those nine of the ten animals for the ten-day deployment period. The results of this study indicate that sailfish can survive the trauma resulting from interaction with pelagic longline gear and that management measures promoting the release of sailfish from the pelagic longline fishery will reduce fishing mortality on the Atlantic sailfish stocks.

RESUME

Afin d'estimer la survie après la remise à l'eau des voiliers capturés accidentellement pour réglementer les opérations de pêche commerciales à la palangre pélagique dans le Sud du Golfe du Mexique ciblant l'espadon et les thonidés combinés, dix marques-archives pop-up reliées par satellite ont été déployées pendant dix jours sur des spécimens capturés accidentellement. Pendant toute la période de déploiement, les dix marques ont toutes transmis 25-82% des données archivées. Au cours de la période de déploiement de dix jours, les données des déplacements répétés, de courte durée en profondeur et des déplacements horizontaux ont concordé avec la survie de neuf des dix spécimens. Les résultats de cette étude indiquent que les voiliers peuvent survivre le traumatisme consécutif à l'interaction avec l'engin de palangre pélagique et que les mesures de gestion favorisant la remise à l'eau des voiliers capturés par la pêcherie palangrière pélagique réduira la mortalité par pêche des stocks de voiliers de l'Atlantique.

RESUMEN

Para estimar la supervivencia tras la liberación del pez vela capturado de forma incidental en las operaciones de pesca comerciales con palangre pelágico, en el Golfo de México meridional, y que dirigen su actividad a los túnidos y al pez espada, se colocaron diez marcas archivo pop-up vía satélite durante diez días en ejemplares capturados de forma incidental. Las diez marcas transmitieron lo siguiente durante todo el periodo, transmitiendo 25-82% de los datos archivados. Los movimientos repetidos y de corta duración en sentido vertical y los datos de desplazamientos horizontales coincidieron con la supervivencia de nueve de estos diez ejemplares para el periodo de despliegue de diez días. Los resultados de este estudio indican que el pez vela puede sobrevivir al trauma de la interacción con el palangre pelágico y que las medidas de ordenación que fomentan la liberación del pez vela de la pesquería de palangre pelágico reducirán la mortalidad por pesca en los stocks de pez vela del Atlántico.

KEYWORDS

Pelagic longline, post-release survival, sailfish, Istiophorus platypterus

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1. Introduction

Pelagic longline fishing gear is used throughout the world to commercially harvest broadbill swordfish *Xiphias gladius* and various tuna species. Incidental to these target species, pelagic longline gear also catches a variety of other animals, including istiophorid billfishes. Within the western Atlantic Ocean, it is estimated that of the the pelagic longline fishery is responsible for approximately one-third of the sailfish fishing mortality, with local gillnet, artisanal, and recreational fisheries comprising the other two thirds (ICCAT, 2001).

The current status of several highly migratory species stocks under the purview of the International Commission for the Conservation of Atlantic Tunas (ICCAT), is either fully exploited or over-exploited, including the western and eastern Atlantic stocks of sailfish. The present assessment methodology used for billfish species primarily utilizes long time-series of pelagic longline catch data combined with data from recreational and other commercial fisheries. The last formal assessment of the western Atlantic sailfish stock, which also included spearfish, occurred in 2001. The results of that assessment were considered unsatisfactory, however, but based on catch-per-unit-effort (CPUE) data, the ICCAT Standing Committee for Research and Statistics (SCRS) recommended maintaining international catches at the current level for the western stock. Based on other CPUE data in conjunction with local abundance indices, the SCRS also noted that the eastern Atlantic stock may be in decline.

Management measures requiring the release of live istiophorid billfishes have been suggested as one means to reduce fishing mortality on billfishes without sacrificing target catches (Kerstetter *et al.*, 2003; Kerstetter and Graves, 2006). Jackson and Farber (1998) reported that about 32% of sailfish caught in the Venezuelan longline fishery were alive at the time of gear retrieval, and data from the U.S. observer program in the Gulf of Mexico report that 48% of sailfish were released alive from U.S. commercial pelagic longline gear in that area between 1985 and 1990 (Farber and Lee, 1991). In the United States, the National Marine Fisheries Service (NMFS) has required the release of live sailfish from the commercial longline fishery for several years, although the fate of the released fish is unknown. The SCRS called for further work on the estimation of post-release survival for all billfishes at its 2005 meeting (ICCAT, 2005).

An increasing amount of information now exists about the post-release survival of billfish. Both blue marlin (Graves et al., 2002) and white marlin (Horodysky and Graves, 2005) caught in recreational fisheries have been shown to have high rates of post-release survival, especially when caught with circle hooks. Blue marlin (Kerstetter *et al.*, 2003) and white marlin (Kerstetter and Graves, 2006) captured on pelagic longline gear also demonstrate relatively higher rates of post-release survival, albeit lower than recreational fisheries. Little is known, however, about post-release survival of sailfish. In general, recovery rates of sailfish tagged with conventional streamer tags by commercial and recreational fishermen have been quite low (<2% for all billfish species: Jones and Prince, 1998; Ortiz et al., 1998). While this observation is consistent with high post-release mortality, low recovery rates could also result from tag shedding and non-reporting of recovered tags (Bayley and Prince, 1994; Jones and Prince, 1998). Acoustic tracking of sailfish (Jolley and Irby, 1979) has shown post-release survival of recreationally-caught sailfish for periods ranging from approximately 3-28 hours, but these studies were limited by vessel time and environmental conditions, and may not have evidenced delayed mortality from capture-related injuries that can occur several days following release. Pop-up satellite archival tags (PSATs), which are programmed to record data for a set period of time, then independently release from the animal, float to the surface, and transmit the stored data through the Argos satellite system, provide a useful tool for the analysis of post-release survival. In this study we deployed ten PSATs on sailfish captured on pelagic longline gear in the western Atlantic Ocean to evaluate short-term mortality resulting from gear interaction.

2. Materials and methods

2.1 Tag Model

The Microwave Telemetry, Inc. (Columbia, MD, USA) model PTT-100 HR satellite tag was used in this work (see Kerstetter and Graves, 2006 for tag and rigging details). The PTT-100 HR model tags sampled temperature, pressure (depth), and light level approximately every two minutes. All tags were pre-programmed to release from the fish after ten days, and the tags were activated prior to attachment to the animal by removing a small magnet from the side of the tag. This model also included emergency release software that automatically detached the tag if the pressure sensor indicated depths approaching the crush limit of the tag casing (ca. 2000 m).

2.2 Tagging procedures

Tags were either activated prior to haulback or during haulback immediately following the tagging of a fish in preparation for another animal. The captain of the vessel identified incoming sailfish on the line during the morning haulback of the gear and fish were evaluated as live or dead based on movement (or lack thereof) alongside the vessel. All sailfish evaluated as alive were tagged, regardless of physical condition (i.e., no "high-grading" of animals). The PSAT tagging procedures used were identical to the ones described in Kerstetter and Graves (2006). A conventional streamer tag was also attached to all sailfish in this study.

Sailfish were released as soon as possible after tagging by the standard commercial protocol of cutting the leader near the hook unless the hook was readily accessible for manual removal. No animals were resuscitated after tagging. Prior to release, hook type and location were noted and fish lengths and weights were estimated. Each tagging procedure, from positive species identification to actual release from the gear, lasted less than five minutes. All other pertinent data, including the time of day, vessel location, and sea surface water temperature were recorded immediately after tagging.

2.3 Data analysis

Survival of tagged animals was inferred from three types of environmental data provided by the tag: water temperature changes, depth changes, and ambient light intensity. Frequent short-scale (< ½ hour) variations in both depth and temperature were used as indicators of a live sailfish. The survival of individual animals were also supported by the net horizontal displacement, calculated as the distance from the location of the vessel at the time the sailfish was released to that of the first good transmission from the free-floating PSAT to the ARGOS satellite system. All distances were calculated with PROGRAM INVERSE (NGS, 1975; modified by M. Ortiz, NMFS SEFSC, Miami, FL).

The 95% confidence intervals associated with these estimates were calculated using the RELEASE MORTALITY version 1.1.0 software developed by Goodyear (2002). These confidence intervals were based on 10,000 simulations with assumed underlying post-release mortality rates derived from the transmitted data with no error sources (e.g., no premature releases or tag-induced mortality). For the purpose of these simulations, natural mortality was also assumed to be zero because of the relatively short duration of the tagging deployment period. Unless otherwise noted, all statistical analyses for this study were conducted using SAS version 9.0 (SAS Institute, Cary, NC, USA).

3. Results

All tagging operations in this study occurred opportunistically aboard the commercial pelagic longline fishing vessel F/V *Kristin Lee* (16.5 m length) during trips in November 2005 (n = 1 PSAT) and May 2006 (n = 9 PSATs). Sailfish tagging occurred in the southern Gulf of Mexico (GOM), approximately 95 km south-southwest of Key West, Florida, an area traditionally fished by the U.S. coastal pelagic longline fleet. The vessel used 10 fathom (fa; 18.3 m) buoy line lengths and both size 16/0 non-offset and size 18/0 10°-offset circle hooks. Bait was usually frozen squid (*Illex* sp.), but occasionally included frozen Atlantic mackerel (*Scomber scombrus*).

The first ten sailfish deemed to be alive at haulback were tagged, regardless of physical condition. During the two fishing trips used in this study, 11 of 18 sailfish (61.1%) were alive at the time of haulback. Estimated weights of fish released alive ranged from 15.9-29.5 kg. Four animals were foul-hooked, and another was entangled in the leader itself. Only the first sailfish tagged had swallowed the hook such that it was not visible upon examination alongside the vessel. The other nine fish were tagged within a five-day period, within the same general geographic area, and additional information on each animal is found in **Table 1.**

Nine of them survived the full duration of the 10-day deployment period. The first sailfish tagged in this work (hooked internally) showed some vertical movements during the first 12 hours, and then rested along the seafloor for approximately two days before undergoing vertical movements while showing no light level, even during times of daylight. Based on previous research (Kerstetter *et al.*, 2004), we conclude that this tag (and part of the sailfish) were probably eaten by a scavenging animal. The other nine fish all showed similar, short-scale (< 15 minutes) vertical movements with underlying diurnal patterns. Although the majority of time was spent within 50 m of the surface, several animals demonstrated frequent movements to over 100 m. Minimum straight-line distances over the ten-day deployment period varied widely between individuals, ranging from 97.3 to 554.9 km.

These data result in a post-release survival rate of 90%. Assuming an underlying true post-release mortality rate of 10%, the results of the Goodyear (2002) simulations indicate a 95% C.I. range of mortality of 0-30% for released animals after ten days. To date, none of the conventional tags applied to these animals has been reported or returned to the NMFS Cooperative Tagging Center.

4. Discussion

The importance of sailfish to local economies through recreational fishing and tourism is difficult to overstate. There are nearly year-round U.S. recreational fisheries for sailfish in the Florida Straits and southern Gulf of Mexico (NMFS, 1998), and similar fisheries are increasing throughout the Caribbean Sea as more countries develop tourist-based infrastructures. Ditton and Stoll (1998) estimated that over 230,000 anglers in the United States alone target billfish for a combined 2,137,000 days annually. Billfish anglers are also among the highest-spending saltwater anglers, with an estimated $180 million in expenditures by billfish tournament anglers in 1989 alone (Fisher and Ditton, 1992).

In recent years, ICCAT has rarely discussed sailfish specifically during the annual commission meeting, in part because of their lack of commercial importance relative to the tunas and swordfish, but also because of the lack of concern noted by the SCRS about the status of the two stocks. Although ICCAT has promoted the release of live blue marlin and white marlin caught by pelagic longline gear (ICCAT, 1997), and encouraged the use of monofilament leaders to promote live release of billfish (ICCAT, 1996), it has not acted specifically regarding sailfish. In the United States, commercial fishermen have been prohibited by regulation from landing or possessing Atlantic sailfish since the approval of the first NMFS fishery management plan for Atlantic billfish in 1988 (NMFS, 1988).

Although a low sample size, the results of this study provide a missing element to ICCAT stock assessments for sailfish: an experimentally-generated estimate of post-release mortality for the pelagic longline fishing. In addition, these results demonstrate relatively high survival of sailfish released from pelagic longline gear in the warm waters of the southern Gulf of Mexico/Florida Straits and suggest that releasing sailfish currently retained by pelagic longline fisheries of other nations would have positive benefits to the Atlantic stocks.

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Table 1. Summary information for ten sailfish (*Istiophorus platypterus*) tagged with PTT-100 HR-model pop-up satellite archival tags and released from commercial pelagic longline gear in the southern Gulf of Mexico and Florida Straits, November 2005 and May 2006. "D/NV" refers to the hook that was deep and not visible at the time of release. "Y" = yes; "N" = no; L = live (for duration of 10-day tag deployment period); D = dead; and "MSLD" = minimum straight-line distance (distance between the location at release and the location where the tag began transmitting data).

Tag Number	Hook Type	Hook Location	Hook Removed?	Estimated Weight (lbs/kg)	Fate?	MSLD (nmi/km)	MSLD per day (nmi/km)
FL-05-01	18/0 OS	NV	N	55/24.9	D	28.3/52.5	2.8/5.2
FL-06-01	16/0 NOS	Corner	Y	50/22.7	L	241.9/448.0	24.2/44.8
FL-06-02	18/0 OS	Foul (under jaw)	Y	65/29.5	L	202.7/375.5	20.3/37.5
FL-06-03	16/0 NOS	Foul (operculum)	N	35/15.9	L	81.0/150.1	8.1/15.0
FL-06-04	18/0 OS	Foul (under jaw)	Y	35/15.9	L	101.8/188.6	10.2/18.9
FL-06-05	16/0 NOS	Corner	N	35/15.9	L	179.5/332.4	17.9/33.2
FL-06-06	16/0 NOS	Foul (eye socket)	N	35/15.9	L	299.6/554.9	29.9/55.5
FL-06-07	16/0 NOS	Entangled	n/a	35/15.9	L	52.5/97.3	5.2/9.7
FL-06-08	18/0 OS	Lower Jaw	Y	40/18.1	L	104.5/193.5	10.4/19.3
FL-06-09	18/0 OS	Corner	Y	35/15.9	L	241.3/447.0	24.1/44.7