

1-1-2007

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## NSUWorks Citation

David W. Kerstetter, Fabio H.V. Hazin, J. C. Pacheco, and John E. Graves. 2007. Joint United States-Brazil Billfish Research in the Western South Atlantic. Collective Volume of Scientific Papers – International Commission for the Conservation of Atlantic Tunas (ICCAT), (5) : 1612 -1615. [https://nsuworks.nova.edu/occ\\_facreports/57](https://nsuworks.nova.edu/occ_facreports/57).

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## JOINT UNITED STATES-BRAZIL BILLFISH RESEARCH IN THE WESTERN SOUTH ATLANTIC

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### SUMMARY

*A joint research project between Brazilian and U.S. scientists was initiated in 2004 to investigate the interaction of istiophorid billfishes with pelagic longline fisheries in the western equatorial South Atlantic Ocean. This project incorporates two general themes (1) an investigation into several aspects of pelagic longline operations by comparing catch results between circle and "J" style hooks, time-of-capture with hook time recorders, and by direct monitoring of pelagic longline gear behavior; and (2) an additional evaluation of billfish trophic ecology using a combination of satellite tag technology and traditional analyses (e.g., gut contents and ageing). Data obtained from this research will provide additional data for the evaluation of habitat-based stock assessment modeling efforts for billfish and other pelagic fish species.*

### RESUME

*Un projet de recherche conjoint entre les scientifiques du Brésil et des Etats-Unis a été lancé en 2004 dans le but de déterminer l'interaction des istiophoridés avec les pêcheries palangrières pélagiques dans l'océan Atlantique Sud équatorial occidental. Ce projet incorpore deux thèmes généraux : (1) une recherche sur plusieurs aspects des opérations palangrières pélagiques en comparant les résultats de capture des hameçons circulaires et des hameçons de type J, en déterminant le moment de la capture avec des capteurs temporels d'hameçons et en réalisant un suivi direct du comportement de l'engin de palangre pélagique ; et (2) une évaluation additionnelle de l'écologie trophique des istiophoridés en utilisant une combinaison de technologie de marquage par satellite et d'analyse traditionnelle (p.ex. contenus stomacaux et détermination de l'âge). Les données obtenues de cette recherche fourniront des données supplémentaires pour l'analyse des efforts de modélisation des évaluations de stocks basées sur l'habitat des istiophoridés et d'autres espèces de poissons pélagiques.*

### RESUMEN

*En 2004 se inició un proyecto de investigación conjunta entre los científicos brasileños y estadounidenses para investigar la interacción de los istiofóridos con las pesquerías de palangre pelágico en el océano Atlántico Sur ecuatorial occidental. Este proyecto incorpora dos temas generales: (1) una investigación sobre varios aspectos de las operaciones de palangre pelágico mediante la comparación de los resultados de las capturas de los anzuelos circulares y los anzuelos en forma de J, mediante la determinación del momento de la captura con registradores de tiempo de los anzuelos y mediante el seguimiento directo del comportamiento del arte de palangre pelágico y (2) una evaluación adicional de la ecología trófica de los marlines utilizando una combinación de tecnología de marcas satélite y análisis tradicionales (por ejemplo, contenido estomacal y determinación de la edad). Los datos obtenidos de esta investigación proporcionarán datos adicionales para el análisis de los esfuerzos de modelación de la evaluación de stock basada en el hábitat para los marlines y otras especies de peces pelágicos.*

### KEYWORDS

*Western equatorial Atlantic Ocean, istiophorid billfish, satellite tags, hook comparisons*

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## **1. Introduction**

The available evidence of istiophorid billfish abundance in the Atlantic Ocean through ICCAT catch rates strongly suggests a seasonal expansion and contraction of their range, which is supported through the available conventional tag recovery data (Jones and Prince, 1998). Specifically, the wintering grounds for the majority of white marlin *Tetrapturus albidus* and blue marlin *Makaira nigricans* appear to be in the equatorial waters of the western Atlantic. This range also intersects with the range of the growing international pelagic longline fleet for swordfish *Xiphias gladius* and large *Thunnus* sp. tunas. However, little experimental work with this fishery had been conducted regarding such bycatch and whether the associated mortality of these bycatch species could be mitigated through the use of alternative fishing technology such as circle hooks.

The United States-Brazil Joint Atlantic Billfish Research Program (JABRP) was begun in 2004 with funding from the U.S. National Marine Fisheries Service (NMFS) and the Secretaria Especial de Aquicultura e Pesca, da Presidência da República (SEAP-PR). The two general themes of the JABRP were to conduct: (1) an investigation into several aspects of pelagic longline operations, including reducing bycatch mortality, by comparing catch results between circle and “J” style hooks, as well as analyses of time-of-capture with hook time recorders, and by direct monitoring of pelagic longline gear behavior, and (2) an additional evaluation of billfish trophic ecology using a combination of satellite tag technology and traditional analyses (e.g., gut contents). In addition to the four listed co-authors, this program also includes billfish researchers from the Instituto de Pesca, Secretaria da Agricultura e Abastecimento (Brazil), the University of Miami (USA), the NMFS Southeast Fisheries Science Center Miami Laboratory (USA), Nova Southeastern University (USA), and the Universidade Federal Rural de Pernambuco (Brazil)

## **2. Research areas**

### ***2.1 Nature of pelagic longline interactions***

Research activities investigating the nature of interactions between billfishes and pelagic longline gear began in March 2006. This work is being conducted aboard Brazilian-flagged commercial pelagic longline vessels home-ported in Natal (RN), Brazil. The main component of the research under this goal was a detailed comparison of catch rates between size 18/0 circle hooks and size 9/0 J-style or tuna-style hooks, including data on hook location and mortality at haulback (see Kerstetter and Graves, 2006a). Many sets also included deployments of electronic hook-time recorders to determine time of hooking as well as electronic temperature-depth recorders to determine both the effective fishing depths of the longline gear and to elucidate the temperature profile of the fishing areas in the equatorial fishing grounds of the fleet.

A report of the first three trips is found in SCRS/2006/150. Preliminary results indicate significantly higher catch rates on circle hooks for yellowfin tuna and swordfish, as well as significant rates of external hooking locations for bigeye tuna, yellowfin tuna, swordfish, and sailfish. Work will continue for at least the remainder of 2006.

### ***2.2 Molecular genetic analyses***

The development of more precise molecular markers with the increasing use of direct sequencing has allowed analyses of stock structure at better resolution than past studies. For this work, small muscle tissue samples are being taken from pelagic longline vessel billfish bycatch, along with geographic location, sex, estimated weight, and length. Samples are currently stored in a stable DMSO/EDTA buffer solution in Brazil pending an export permit from IBAMA, the Brazilian natural resources agency. This sampling will also continue for at least the remainder of 2006.

### ***2.3 Billfish tagging***

Deployments of pop-up satellite tags (PSATs) are occurring as part of two separate projects. The first project will address post-release survival of sailfish from equatorial pelagic longline gear using similar methods described in Kerstetter and Graves (2006b). A total of ten PSATs (Microwave Telemetry, Inc. model PTT-100 HR; 10-day durations) will be deployed on sailfish caught incidental to normal longline operations (identical materials and methods are described in SCRS/2006/149). The second project will deploy six additional PSATs (Wildlife Computers models PAT-4 (2) and Mk-10 (4); 30-day and 60-day durations) on blue and white marlin caught in the western South Atlantic recreational rod-and-reel and commercial pelagic longline fisheries.

To date, one sailfish has been tagged for the first project from a commercial longline vessel. Two blue marlin have also been tagged as part of the second project. One was tagged in May 2006 from a recreational fishing vessel in Canavieiras, Brazil, and the other from a pelagic longline vessel later the same month. Data from these tags have not yet been analyzed. Additional tagging activities will continue for the remainder of 2006 or until all of the tags have been deployed.

All live billfish are also being tagged with conventional tags donated by the NMFS Cooperative Tagging Program (CTC; Miami, FL, USA). The cooperative research has tagged and released 16 blue marlin, 12 sailfish, and 10 white marlin with CTC tags. Tagging will continue through the duration of the pelagic longline activities.

#### ***2.4 Billfish age and growth studies***

The determination of age and growth of billfish has been problematic, especially since the prohibition of billfish landings by the U.S. pelagic longline fleet in 1988. To address small sample sizes and the potential for differential growth rates between the North and South Atlantic, the program is facilitating collection of samples from Brazil. Samples of anal spines, gonads, and tissue samples will be collected from all billfish dead at haulback in the commercial pelagic longline fishery. Blue marlin samples will be analyzed in Brazil, while white marlin samples will be analyzed in the United States. So far, about 300 specimens from each species have been sampled.

### **3. Summary**

The work under the JABRP is largely in progress, although some data is already being provided to such venues as the SCRS. It is anticipated that additional progress will be achieved during the next year. However, additional cooperative work will only serve to continue to foster the communication between the Brazilian and United States billfish research community.

### **4. Acknowledgements**

We are grateful to NMFS and SEAP/ PR for their valuable support of this cooperative research program. We would also like to thank the longline vessel captains who have participated in this research. The CTC conventional tags deployed during this study were graciously provided by E.D. Prince (NMFS Southeast Fisheries Science Center).

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**Table 1.** Matrix of research participants and specific research themes in the Joint Atlantic Billfish Research Program during 2006.

<b>Research Institution</b>	<b>Pelagic Longline Gear Interactions</b>	<b>Molecular Genetic Analyses</b>	<b>Billfish Tagging Studies</b>	<b>Billfish Age and Growth</b>
Rosenstiel School of Marine and Atmospheric Science University of Miami (Florida, USA)	X		X	X
Virginia Institute of Marine Science College of William and Mary (Virginia, USA)	X	X	X	
Departamento de Pesca Universidade Federal Rural -- Pernambuco (Brazil)	X		X	X
Highly Migratory Species Biology Branch NMFS Southeast Fisheries Science Center (Florida, USA)		X		X
Instituto de Pesca de São Paulo Secretaria da Agricultura e Abastecimento (Brazil)			X	
Guy Harvey Research Institute Nova Southeastern University (Florida, USA)		X		