Tagging of Atlantic Bluefin Tuna for Evaluation of Habitat Utilization of Gulf of Mexico Spawning Grounds Using Telemetry Data

April 30, 2012

Prepared by
the Fish Technical Working Group of the
Mississippi Canyon 252 Trustees

Comments and questions should be addressed to:
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Approval of this work plan is for the purposes of obtaining data for the Natural Resource Damage Assessment (NRDA). Each party reserves the right to produce its own independent interpretation and analysis of any data collected pursuant to this work plan.

The trustees have developed a preliminary conceptual model of the MC252 Deepwater Horizon release, potential pathways and routes of exposure, and potential receptors. This preliminary model has informed the trustees' decision to pursue the studies outlined in the work plan. By signing this work plan and agreeing to fund the work outlined, BP is not endorsing the model articulated in the work plan.

All materials associated with the collection or analysis of samples under these protocols or pursuant to any approved work plan, including any remains of samples and including remains of extracts created during or remaining after analytical testing, must be preserved and disposed of in accordance with the preservation and disposal requirements set forth in Pretrial Orders ("PTOs") # 1, # 30, #35, # 37, #39 and #43 and any other applicable Court Orders governing tangible items that are or may be issued in MDL No. 2179 IN RE: Oil Spill by the Oil Rig "DEEPWATER HORIZON" (E.D. LA 2010). Destructive analytical testing of oil, dispersant or sediment samples may only be conducted in accordance with PTO # 37, paragraph 11, and PTO # 39, paragraph 11. Circumstances and procedures governing preservation and disposal of sample materials by the trustees must be set forth in a written protocol that is approved by the state or federal agency whose employees or contractors are in possession or control of such materials and must comply with the provisions of PTOs # 1, # 30, # 35, 37, #39 and #43.

This work plan will be implemented consistent with existing trustee regulations and policies. All applicable state, federal and Canadian permits must be obtained prior to conducting work.

At the time of signature, all tagging activities in Canada have been completed.

APPROVED:

Jessica White for Lisa DiPinto 5/16/2012

NOAA Trustee Representative: Date

FOR KOLAND GUIDRY 6/5/12

Louisiana Trustee Representative: Date

5/18/2012

BP Representative: Date

Introduction

This work plan provides for tagging of Atlantic bluefin tuna during the 2011 tagging season. The plan was developed cooperatively by the trustees and BP Exploration and Production, Inc. as part of the ongoing natural resource damage assessment (NRDA) for the Deepwater Horizon/Mississippi Canyon 252 (MC 252) oil spill. This tagging study is a continuation of an electronic tag deployment program implemented prior to the MC 252 spill, which continued cooperatively in 2010 as part of the Natural Resource Damage Assessment (NRDA). The goal of this work is to tag Atlantic bluefin tuna in Canada, and collect telemetry data that will improve the understanding of Atlantic bluefin tuna habitat utilization in the Gulf of Mexico (GOM), thereby facilitating assessment of potential injury to Atlantic bluefin tuna as a result of the MC 252 oil spill.

Approach and Rationale

Atlantic bluefin tuna (*Thunnus thynnus*) are among the world's most imperiled commercial pelagic fishes. The western population that spawns in the Gulf of Mexico [GOM] has been depleted by over 70% since 1970, and the adult biomass is estimated to be as low as 15% of the target sustainable population level (ICCAT 2010). A new population assessment which incorporates mixing of western and eastern populations indicates that the GOM breeding stock is reduced by as much as ~67% from initial 1950 biomass (Taylor et al., in press). These steep declines are a result of industrial overfishing driven by the high demand for bluefin tuna as a premier sushi fish. Bluefin tuna fisheries generate hundreds of millions of dollars annually in the Atlantic alone. The species has been considered for both international and U.S. endangered species listing in the past year (CITES 2010, NOAA 2011), but has not yet been listed. Atlantic bluefin tuna were, however, recently listed as Endangered by the International Union for Conservation of Nature (IUCN, Collette et al. 2011).

The Gulf of Mexico region is considered a critical spawning habitat for Atlantic bluefin tuna (NOAA 2009, Block et al. 2005). Three scientific technologies - genetic assessments, electronic tagging, and analyses of isotopes in bluefin tuna ear bones - have confirmed that Gulf of Mexico-spawning bluefin tuna form a discrete western Atlantic population unit (Block et al. 2001, 2005, Carlsson et al. 2007, Boustany et al. 2008, Rooker et al. 2008). In recognition of the depleted state of the population and the importance of the GOM, ICCAT has prohibited directed bluefin tuna fishing in the GOM since 1982, and NOAA created a Habitat Area of Particular Concern there in 2009 (NFMS 2009). Continuing bycatch issues that surfaced in the past decade primarily involving catch by pelagic longliners in the northern Gulf of Mexico (Block et al. 2005, Teo et al. 2007, Teo and Block 2010) have led to the mandatory use of weak hooks (designed to release giant bluefin) on pelagic longlines set in the Gulf as of May 2011.

In cooperation with BP, tagging of Atlantic bluefin tuna was conducted in 2010 and was continued in 2011 with this work plan, as part of the ongoing NRDA. The MC252 oil spill occurred within the only known spawning ground of the western Atlantic population

during the presumed peak of bluefin tuna spawning (April-May, Teo and Block 2010). Habitat utilization of bluefin tuna has been studied in the GOM since 1999 through the use of electronic tags (Block et al. 2005, 2011, Teo et al. 2007a,b, Teo and Block 2010) and thus an extensive pre-spill telemetry dataset for bluefin tuna spawning in the GOM exists. Telemetry has recorded bluefin tuna movements and behavior, as well as oceanographic conditions, within the habitat utilized by the tagged tuna. Data are used to construct models for GOM habitat utilization, including spawning habitat selection. This scientific foundation will enable assessments of potential changes in behavior or spatiotemporal distribution of bluefin tuna in relation to GOM habitat factors, and therefore could be useful in assessing potential effects associated with the MC252 spill.

In 2010, cooperative NRDA funding supported bluefin tagging on the Gulf of St. Lawrence (GSL) foraging grounds to assess whether the fish would use the GOM in a manner similar to prior years within the electronic tagging data set. This prior deployment yielded over 5200 days of data and 11 full tracks within the GOM. Continued tagging on the foraging grounds will provide an additional year of data. The 2011 work plan will continue the tagging work, deploying additional satellite and acoustic tags in Canada to increase the sample size of tracks, and enhance our capacity to examine long-term survivorship, and to examine habitat use of spawning size bluefin tuna in the GOM following the MC252 spill.

Goal:

The goal of this work plan is to deploy electronic tags on Atlantic bluefin tuna in the GSL foraging ground and collect telemetry data that will improve the understanding of Atlantic bluefin tuna habitat utilization in the GOM, thereby facilitating assessment of potential injury to Atlantic bluefin tuna as a result of the MC 252 oil spill.

Field Effort:

Electronic tagging will take place on the GSL foraging ground between Nova Scotia and Prince Edward Island, Canada in late September and October of 2011. Forty pop-up archival tags and 21 acoustic tags will be available for bluefin tuna in a three week field season, to be deployed on a total of 56 tunas (5 tunas will be double-tagged with Mk10 PATs and mini-PATs). We intend to use the same methods and standard operating procedures (SOPs) employed in 2010. A combination of Mk10 PAT pop up satellite archival tags and mini-PATs (Wildlife Computers) will be used, as well as 21 Vemco coded acoustic tags (V16-4h). To conduct this scientific work on fish as large as 1000 lbs, procedures approved by the Institutional Animal Care and Use Committee (IACUC) of Stanford University for these programs form the basis for the SOP provided below. The work is conducted based on methodologies developed over the past 10 years on the northern foraging grounds.

In compliance with permitting requirements of the Canadian government, commercial rod and reel vessels will be chartered to conduct the tagging in the GSL. In the GSL, it is

imperative to charter commercial vessels as "catcher" vessels that will transfer fish to the designated tag surgery vessel to increase the likelihood of encountering bluefin tuna during the period of tagging. Weather is a challenge in this region, and of the 21 days planned for the expedition, it is anticipated that at most 15 days may be spent on the water. A permit has been obtained, in collaboration with Dr. Mike Stokesbury of Acadia University, for the activities under this Plan.

Duration of tag retention is critical for obtaining tracks on the GOM spawning grounds. Prior work has shown a fish must retain a pop-up archival tag for 230 days and be over 260 cm to record spawning tracks. Tags will be programmed to remain on the fish until June-July 2012 to capture data from the entire GOM spawning period. The number of fish to be tagged with pop-up archival tags (~35 individuals) was chosen based on past retention rates indicating ~50% (~18) of the fish will record data within the GOM. The number of tags targeted was chosen based upon the time available to the existing research team, the funding needed to implement the field work and consideration of general statistical guidelines related to the intended potential future uses of the resulting data for injury assessments. Existing data include 42 GOM tracks into the breeding grounds for the years 1999-2009, three tracks in 2010, and 11 tracks in 2011. The expected additional 18 tracks in 2012 , in combination with existing data, is expected to enable large sample size statistical comparisons of bluefin tuna behaviors pre- and post-spill. The following satellite telemetry tag data will be collected:

- Date of entry to the GOM (crossing to the west of 80°W);
- Horizontal distribution in the GOM;
- Period of residency within the GOM;
- Percentage of time spent in defined depth bins;
- Individual satellite telemetry data and associated temperature and depth information from the tags

A detailed description of data processing will be specified in a separate work plan.

Timeline:

Deploy tags in Canada's Gulf of St. Lawrence	September - October 2011
Receive data from deployed satellite tags and upload to the GulfTOPP database	June - July 2012

Project Management and Reporting:

Dr. Barbara Block (Stanford University) is designated as Project Officer on all contracts originating with this work plan and will be responsible for ensuring dissemination of, and compliance with, all health and safety requirements, assigning tasks, verifying the completion of field trips, and consolidating and delivering all data.

Data Management, Trustee Oversight, and Sharing:

NOAA and BP have agreed in principle to sharing of the Atlantic bluefin tuna data for evaluations of potential injury through the GulfTOPP database. A separate database sharing and management agreement to carry out the intended cooperative efforts to maintain access to the data and associated system will need to be developed in a future work plan.

Tagging Cruises Shipboard Data

All profile, acoustic, and other electronic data (including photographs) will be saved to an on-board computer, and all data shall be migrated to a dedicated hard drive. The data will be controlled and managed by the trustees under project protocols, including Chain-of-Custody (COC) tracking of the hard drive. Data is generally organized by sampling station and all electronic data files will be filed into this structure by the NOAA NRDA data manager with the assistance of the operator/data logger. The hard drive will be duplicated in full following the cruise, and duplicates of the hard drive will be provided to (1) the Louisiana Oil Spill Coordinator's Office (LOSCO) on behalf of the State of Louisiana, and to (2) Cardno ENTRIX on behalf of BP. The original hard drive shall be kept in a secure facility in trustee custody.

Copies of all documentation produced onboard, including COCs, field notes, sampling logs, sampling forms, photos, photo logs, ship logs, and GPS tracking shall be transferred to the NOAA NRDA Sample Intake Team following NRDA data management protocols. An identical copy of all documentation will be provided to LOSCO, on behalf of the State of Louisiana, and to BP/Cardno ENTRIX at the end of the cruise.

Tag Output Data

Data from all Wildlife Computers tags are delivered through the Argos satellite system as tags are released from the tuna and come to the surface. This happens automatically when a tag reaches its programmed release date, although tags occasionally report ahead of their scheduled date.

Coded acoustic tags report to the VR3 underwater receiver lines maintained by the Ocean Tracking Network (OTN) program, located in the Strait of Belle Isle, the Cabot Strait, and in three locations on the continental shelf southeast of Nova Scotia. The acoustic tags are being deployed as part of a separate, non-NRDA project, and work in conjunction with receiver arrays located in the North Atlantic. The information obtained from the acoustic tags may assist in evaluating mortality of a satellite-tagged animal if the satellite tag pops up prematurely.

All data resulting from the 2011 satellite tag deployment will be uploaded to the GulfTOPP database. The GulfTOPP database provides a secure repository for visualizing and accessing telemetry data from the Gulf, along with all depth and temperature time-

series data and relevant oceanographic datasets. From this data position information, behavioral and oceanographic reconstructions can be obtained.

The GulfTOPP data management system consists of hardware and software specifically developed to deal with proprietary and platform-specific (i.e., tag-specific) software, data accumulation, quality verification, decoding operations and generation of derived data products, while incorporating multi-level security, timely data flow and consistency across multiple platforms. To support sustainable data delivery, the system combines two decentralized, autonomous relational database management systems (RDBMS) into a single federated database system via network connections and shared protocols. Although both constituent databases utilize the same open-source RDBMS, PostgreSQL, each system has its own distinct table schema specifically designed to manage conspecific data, partially distinct data dictionary components, and client interfaces. While network access reliably delivers relational database table information, distribution of the large time-series data files is accomplished using native Apache web server functionality and OPeNDAP's client-server architecture and network protocol.

All raw electronic tag data received will be saved either to a dedicated hard drive or alternate storage media as otherwise agreed. The data will be controlled and managed by the trustees under project protocols, including Chain-of-Custody tracking of the hard drive. The hard drive will be duplicated in full following completion of the 2011-2012 data acquisition season, and duplicates of the hard drive will be provided to (1) the Louisiana Oil Spill Coordinator's Office (LOSCO) on behalf of the State of Louisiana, and to (2) Cardno ENTRIX on behalf of BP. The original hard drive will be kept in a secure facility in trustee custody.

As noted above, a separate database sharing and management agreement to carry out the intended cooperative efforts to share and maintain access to the processed usable data through the GULFTOPP system or an alternative system will need to be developed in a future work plan.

Budget:

The total cost for this scope of work is $476,296. The Parties acknowledge that this budget is an estimate, and that actual costs may prove to be higher. BP's commitment to fund the costs of this work includes any additional reasonable costs within the scope of this approved work plan that may arise. The trustees will make a good faith effort to notify BP in advance of any such increased costs.

A. Salary and Fringe		
Research Associate	11.25 mos.	
Programmer	5.0 mos.	
GIS Technician	5.0 mos.	
Subtotal A.		**$132,600**

B. Equipment/Supplies		
PAT tags	20 @ $3,500	$59,500[1,2]
mini-PAT tags	20 @ $4,500	$90,000[2]
Acoustic Tags	21 @ $360 (in kind donation)	
Tethering materials & tagging supplies		$ 8,500
Misc. Supplies/shipping		$ 1,500
Subtotal B.		**$159,500**
C. Travel		
Airfare	(2 researchers US, 1 Local)	$ 2,500
Lodging	(2 cottages for 3 wks @ $690/wk/cottage)	$ 4,140
Van Rental	(3 weeks)	$ 1,500
Food	(3 researchers for 3 weeks)	$ 1,500
Subtotal C.		**$ 9,640**
D. Other Costs		
Charter vessels (45 charter days @ $1,200/day)		$54,000
Charter vessel fuel (35 charter days @ $300/day)		$10,500
Argos Satellite Time		$ 8,000
Field Assistant		$ 8,500
Subtotal D.		**$81,000**
E. Overhead		
[redacted] on Salaries, supplies & Argos (Stanford University subgrant)		[redacted]
10% on Travel and charter vessel costs (The Ocean Foundation reimbursement)		[redacted]
Subtotal E.		[redacted]
F. Total Project Costs		**$476,296**

Durable Equipment - All durable equipment (such as cameras, GPS, etc.) purchased by BP for this study will be returned to BP or their designated representatives at the conclusion of its use for this study. Radio/satellite tags that are recovered or are not deployed will be returned to BP or its designated contractor at the end of this study, unless otherwise agreed.

References:

[1] The cost of 3 PATs leftover from the 2010 NRDA-funded tagging is deducted.
[2] PAT and mini-PAT tags will be purchased directly through NOAA, thus are not included in Overhead calculations.

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Appendix I: Field Protocol

Bluefin Tuna Tagging Standard Operating Procedures
(in accordance with Stanford-approved APLAC protocol #10786)

Hopkins Marine Station of Stanford University
Pacific Grove, CA

Standard Operating Procedures are intended to provide detailed and explicit instructions for the research staff in the collection of data, and should be fully reviewed by staff so that:

- They are versed on objectives, methods, procedures, and details before proceeding.
- Data are collected systematically and consistently.
- Each staff member understands and adheres to the requirements.

Events may arise that require revisions to the procedures documented.

Revisions to procedures should be documented in writing, with a detailed explanation of why the revision was necessary. Revisions to the plan will be conducted only after the approval of the Principal Investigator and/or Co-Principal Investigators.

Materials:

Titanium lip-hook
Surgical mat (two-inch foam covered with vinyl)
Tape measure (min length 3 m)
Eye cover
Tagging stick and titanium tag applicator
Pop-up archival tag (Wildlife Computers MK10 or mini-PAT) with titanium dart
Ethanol
Betadine

Procedure:

A. Fish Capture and Handling

1. Bluefin are caught on rod and reel with heavy line and circle hooks. Heavy line minimizes the fight time, and fish can be reeled in quickly to minimize fatigue of the fish. Circle hooks are less likely to be swallowed and can be rapidly removed without causing injury to the fish.
2. Captured fish will be brought onboard the tagging vessel for tagging by slipping a specially designed titanium lip-hook through the lower jaw, and pulling the fish through the transom door onto a vinyl mat, which reduces skin abrasions.

3. Once the tuna is on deck, a deck hose is inserted in the fish's mouth to direct a steady stream of saltwater over both gills alternatively to supply oxygen to the fish, and a wet cloth is placed over the eyes to keep the fish calm. The animals are measured from the nose to the fork of the tail, and age is calculated using a length-weight regression. A small fin clip is taken for genetic analyses using sterile scissors.

B. Satellite Tagging

1. Tagged fish will be selected carefully to maximize the potential for obtaining GOM tracks. Only fish deemed to be in good physical condition (i.e., with no visible injuries) will be tagged. Only bluefin 250 cm and above will be tagged. If captured fish do not meet these criteria they will be released without a satellite tag.

2. The pop-up archival tag is quickly placed with a tagging stick and titanium tag applicator into the dorsal musculature. The penetration depth for the tag's titanium dart is 8cm. The darts will be soaked in 100% ethanol, followed by betadine. After tagging, the surgical mat is turned around, and the tuna is released head-first out the transom door to flush water over its gills and reduce the chance for disorientation. The fish is out of the water for less than 1 minute to minimize post-release mortality.