

THE ATLANTIC-WIDE RESEARCH PROGRAMME FOR BLUEFIN TUNA (GBYP
Phase 11)

Electronic tagging in Canada and North Carolina in 2021

Final Report

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Introduction

The Stanford TAG-A-Giant (TAG) program has been a leader in electronic tagging of northern bluefin tuna for over 25 years. Our team has used the data collected through this program to enhance our understanding of the spatial distribution of Atlantic bluefin tuna (*Thunnus thynnus*; ABT) with the goal of improving assessment models. A primary aim is to use these long-term spatial datasets to better quantify parameters necessary for effective management such as seasonal movement patterns and natural and fisheries mortality. By combining satellite tag data with multi-year acoustic records we can validate model assumptions and improve the accuracy of our mortality estimates. Additionally, genetic analysis of fin clips collected during the tagging can be used to validate stock-of-origin assignments based on visitation to a spawning ground.

In June 2021 ICCAT GBYP program launched a Call for Expressions of Interest to collaborate with GBYP Phase 11 E-tagging activities (ICCAT GBYP Circular # 0471/2020). TAG and Stanford University answered this Call presenting two bids, one for developing tagging activities in Canadian waters in autumn 2021 and the other to carry out a tagging campaign in the Canary Islands during the first semester of 2022. Both proposals were awarded, assigning to these campaigns a total of 25 ICCAT GBYP electronic tags (20 pop-up satellite tags and 5 internal archival tags).

Regarding the proposal for tagging activities in Canadian waters, we proposed to continue deploying satellite tags on ABT to investigate their spawning ground preference and to improve our previously developed survivorship model. This research also continued our Canadian and US time series with deployments in the western Atlantic that span over 25 years enabling evaluation of the effects of climate change on ABT distribution and abundance in the North Atlantic.

Consequently, the first MOU was signed in 2021 between ICCAT GBYP, TAG and Stanford University, in relation to the Canada tagging campaign, whose objective was to deploy electronic and conventional tags on large, mature ABT in Canadian waters. Along the deployment of these electronic and conventional tags, biological samples were also to be obtained from all individuals tagged during these tagging campaigns. Specifically, this 2021 MOU for Canada waters campaign awarded 8 WC PATs and 3 Lotek PSATs to TAG.

Ultimately a total of 13 ICCAT GBYP satellite tags were deployed in Canada 2021 campaign by TAG (12 WC PATs, 1 Lotek PSAT). These tags constituted 8 WC PATs and 1 Lotek PSAT from the 2021 MOU, and 2 WC PATs which were added, substituting 2 of the 3 Lotek tags, after the original agreement was made. The remaining 2 WC PATs that were deployed were initially awarded by GBYP to Stanford University under a MOU to carry out a campaign in Canary Islands in 2020, which was unfulfilled due to COVID-19 travel restrictions.

In addition, during the Canada 2021 tagging campaign, 11 experimental Lotek PSATs were received by TAG for deployment. Of the 11 tags received, 7 were deployed in Canada under the ownership of the Block lab, 1 was deployed under the ownership of ICCAT GBYP (L330-3454) according to the 2021 MOU, and the remaining 3, also owned by ICCAT GBYP, were shipped to Ireland to be finally deployed in Celtic Seas under another of the MOUs signed by

ICCAT GBYP under GBYP Phase 11 in relation to E-tagging activities, specifically with the Irish Marine Institute.

Moreover, this report includes also the 2021 North Carolina tagging campaign, despite the fact that it is was not formally included under the aforementioned MOU signed in relation to Canada 2021 campaign, under which 3 WC PATs deployed from the unfulfilled 2020 Canary Island MOU, and 2 Lotek archival tags deployed were from the current 2021 Canary Island MOU allocation.

Results: 2021 tagging campaigns in Canadian waters and North Carolina

Table 1: All electronic tags deployed under reported MOU.

MOU	Tag Number	PTT	Status	Tag Type	Manufacturer
Unfulfilled 2020 Canary	19P1626	199918	Deployed North Carolina March 2021	PAT	Wildlife
Unfulfilled 2020 Canary	19P1627	199919	Deployed North Carolina March 2021	PAT	Wildlife
Unfulfilled 2020 Canary	19P1629	199921	Deployed North Carolina March 2021	PAT	Wildlife
Unfulfilled 2020 Canary	21P0164	220506	Deployed Canada 2021	PAT	Wildlife
Unfulfilled 2020 Canary	21P0638	222303	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0344	220546	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0348	220548	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0366	220558	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0400	220561	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0405	220562	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0408	220564	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0418	220568	Deployed Canada 2021	PAT	Wildlife
Canada 2021	21P0424	220573	Deployed Canada 2021	PAT	Wildlife
Canary 2021	21P0427	220574	Deployed Canada 2021	PAT	Wildlife
Canary 2021	21P0429	220576	Deployed Canada 2021	PAT	Wildlife
Canada 2021	L330-3454	225500	Deployed Canada 2021	PSAT	Lotek
Canary 2021	L231-1052		Deployed North Carolina December 2021	Internal	Lotek
Canary 2021	L231-1057		Deployed North Carolina December 2021	Internal	Lotek

Table 2: Metadata pertaining to all ICCAT satellite tags deployed during the Canada 2021 tagging campaign. (BB-Dr. Barbara Block, RS-Robert Schallert, PC-Perry Comolli)

Event ID	Tag Number	PTT	Tag Type	Date	Latitude	Longitude	CFL (cm)	Tagger	Pop Date	Rec Date	Status
512101100	21P0424	220573	PAT	9/16/2021	45.9917	-61.6012	265	RS	10/2/2021	10/5/2021	White shark Mortality
512101400	21P0418	220568	PAT	9/17/2021	45.9856	-61.6213	260	RS			Deployed
512101500	21P0405	220562	PAT	9/17/2021	45.9878	-61.6233	284	RS			Deployed
512101600	21P0408	220564	PAT	9/17/2021	45.9987	-61.6139	263	PC			Deployed
512101900	21P0366	220558	PAT	9/17/2021	45.9912	-61.6162	279	RS	1/7/2022		Premature Release
512102100	21P0400	220561	PAT	9/17/2021	45.9925	-61.6141	288	RS			Deployed
512102900	21P0348	220548	PAT	9/18/2021	45.826	-61.6143	278	RS			Deployed
512103200	21P0344	220546	PAT	9/22/2021	45.9683	-61.6267	275	RS			Deployed
512103900	21P0427	220574	PAT	9/29/2021	45.919	-61.6619	261	BB			Deployed
512104200	21P0429	220576	PAT	9/29/2021	45.9241	-61.6529	266	BB	10/3/2021	10/4/2021	Mortality
512105000	L330-3454	225500	PSATFLEX	9/30/2021	45.9229	-61.6427	255	BB			Deployed
512105200	21P0638	222303	PAT	10/1/2021	45.921	-61.6606	276	BB/RS			Deployed
512105700	21P0164	220506	PAT	10/1/2021	45.9249	-61.6425	268	BB/RS	10/4/2021	10/5/2021	Mortality

The annual tagging campaign conducted by the TAG program for the past 14 years in the Gulf of St. Lawrence, based out of Port Hood, Nova Scotia has been vital to the understanding of the migration of ABT. Both historically recognized stocks, the western (spawning in the Gulf of Mexico) and the eastern (spawning in the Mediterranean Sea), mix in the Gulf of St. Lawrence during the late summer and early fall (August-November), utilizing the vast biomass of herring and mackerel found in the gulf during these months as critical forage for their long migration back to their respective spawning grounds. With a long-term focus on tagging in this region, the TAG program (with help from ICCAT GBYP and the Canadian Department of Fisheries and Oceans) is continuing to shed light on how these migration trends, and spatial usage of the Gulf of St. Lawrence by these two important stocks has changed over time. The continuity of this large, long-term data set is critical to providing important insight and useful data incorporation into the fishery management of ABT throughout the entirety of the north Atlantic.

The Canada 2021 tagging campaign was conducted out of Murphy's Pond, Port Hood, Nova Scotia. Tagging operations were conducted using two commercial vessels, F/V Bay Queen IV and F/V Nicole Brandy, the former being the vessel where all tagging operations took place, the latter being used as a support vessel for fishing operations. Fishing was conducted using rod and reel setups with a single dead/live-baited (w/ *Clupea harengus/Sarda sarda*) circle hook. Fishing primarily took place on the herring spawning grounds immediately behind Henry's Island (approx. 45.98°, -61.61°) and near Fisherman's Bank (approx. 45.92°, -61.66°). The lead taggers for this campaign were Dr. Barbara Block and Robert Schallert, with deck assistance from technician Perry Comolli, graduate student Chloe Mikles, and technician Ted Reimer. A total of 13 ICCAT satellite tags (12 WC PAT, 1 Lotek PSAT) were deployed on ABT during the Canada 2021 campaign (Mean CFL = 271cm, Min CFL = 255cm, Max CFL = 288cm).

Three of the PAT tags deployed during this campaign released prematurely and were recovered by the field team. All 3 of the recovered tags have been sent back to WC and ICCAT will receive trade-in values on later purchases. 1 additional PAT tag prematurely released in the Slope Sea region 112 days after deployment and is currently transmitting data.

PAT 21P0424, based off recovered tag data, is hypothesized to be a mortality caused from interaction with a white shark shortly after tagging. PATs 21P0429 and 21P0164, based off recovered tag data, are hypothesized to be tagging mortalities. Additionally, PAT 21P0366, prematurely released 112 days after deployment, and is currently transmitting data.

Table 3: Metadata pertaining to all ICCAT satellite and archival tags deployed during the North Carolina 2021 tagging campaigns. (RS-Robert Schallert)

Event ID	Tag Number	PTT	Tag Type	Date	Latitude	Longitude	CFL (cm)	Tagger	Pop Date	Rec Date	Status
512100300	19P1627	199919	PAT	3/11/2021	35.5960	-74.7582	230	RS			Deployed
512100200	19P1626	199918	PAT	3/11/2021	35.5611	-74.7975	197	RS			Deployed
512100100	19P1629	199921	PAT	3/11/2021	35.5748	-74.7545	250	RS	4/10/2021		ICCAT Issue No Data
512106700	L231-1057		Lotek archival	12/14/2021	34.8312	-76.2439	185	RS			Deployed
512106800	L231-1052		Lotek archival	12/14/2021	34.8441	-76.245	149	RS			Deployed

Tagging in North Carolina is particularly valuable as it is a critical foraging ground for ABT across a range of year classes and mixed stocks of origin. From our tagging data (beginning in 1996) we are able to understand that North Carolina is a mixing ground hotspot—fish tagged in this region travel to spawn in the Gulf of Mexico, Mediterranean Sea, and the Slope Sea. Tags deployed in this location have enabled many successful yearlong and multiyear tracks and have demonstrated strong linkages between fish in these waters and the Mediterranean population. Continuation of tagging in this region ensures over two-and-a-half decades of continuity in the time series of electronic tagging in the western Atlantic, and a greater understanding of links between foraging and spawning grounds.

The North Carolina 2021 tagging campaign was split between two fishing hotspots: The Outer Banks north of Cape Hatteras in March, and in the Cape Lookout region in December. Tagging operations in March were conducted out of Pirate’s Cove Marina, Manteo, NC aboard the F/V Sushi, a recreational charter fishing vessel. Fishing operations were conducted using rod and reel setups, w/ trolled ballyhoo (*Hemiramphus brasiliensis*) dead baits and lure combo. Fishing primarily took place along the interior edge of the Gulf Stream, localized around various local seamounts and temperature breaks. A total of 3 satellite tags (3 WC PATs) were deployed on ABT during this portion of the North Carolina 2021 campaign (Mean CFL = 226cm, Min CFL = 197cm, Max CFL = 250cm). Tagging in December occurred out of Morehead City, NC, aboard the F/V Weldor’s Ark, a privately-operated recreational fishing vessel. Fishing operations were conducted using rod and reel setups drifting dead baits, which were either Atlantic menhaden (*Brevoortia tyrannus*) or bluefish (*Pomatomus saltatrix*). Fishing primarily took place northeast of the Cape

Lookout Shoals, within 5 miles of shore and localized around natural rocky and artificial reefs. Robert Schallert was the lead tagger during both of these tagging operations, which included the training of and deck assistance by graduate student Chloe Mikles. A total of 2 Lotek archival tags were deployed on ABT during this trip (Mean CFL = 167cm, Min CFL = 149cm, Max CFL = 185cm).

Conclusion

The 2021 MOU has enabled the TAG program, in collaboration with the Canadian Department of Fisheries and Oceans, to maintain the continuity of this important western Atlantic tagging dataset that contributes management-relevant information into the ICCAT GBYP. The improved natural mortality estimates, stock-specific movement patterns, and insights into regional mixing dynamics have all been valuable to ABT management, especially for the development of the multi-stock M3 mixing model supporting the new Management Strategy Evaluation process. Future campaigns supported by ICCAT GBYP will continue to add critical spatial use and migration information from these important regions utilized by ABT.

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