

**ICCAT GBYP 16/2019-A
TAGGING PROGRAMME 2019**

Atlantic-Wide Research Programme for Bluefin Tuna
(GBYP PHASE 9)

***Tagging of Atlantic bluefin tunas with ICCAT tags in
Skagerrak in 2019***



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FINAL REPORT

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1. Executive Summary

Atlantic bluefin tuna have recently returned to the Skagerrak-Kattegat area between Denmark and Sweden during their summer feeding migrations, where they have been extremely rare for over five decades. In an effort to understand the factors that affect their distribution and ecology, we conducted a tagging study that would enable us to gain a better understanding of their migratory behaviour and shed some light on the proximate causes leading to it. We deployed a variety of electronic and conventional tags on 50 large (> 224 cm curved fork length) Atlantic bluefin tuna captured by volunteer rod-reel anglers in Skagerrak (Denmark) between August 24 and September 9, 2019. Specifically, we deployed 15 pop-up satellite archival tags provided by ICCAT. Additionally, sampling in the form of a fin clip for genetic analysis and a muscle biopsy and blood sample to explore the physiological status of each tagged individual. These tagging and sampling operations will extend the results obtained from a similar electronic tagging conducted in the same area in 2017 and 2018.

2. Introduction

Atlantic bluefin tuna have been a rare sight (if not completely absent) from Danish and Swedish waters since the 1960s, until approximately 2014 when infrequent sightings were reported. The number of observations of the species have since been on the rise, and numbered in the hundreds this year.

In 2017, the first Atlantic bluefin tuna were tagged with electronic tags in Denmark and Sweden. This was the first time bluefin tuna were tagged in Scandinavian waters since the late 1950s and early 1960s, when Bluefin tuna were tagged with conventional tags in Norwegian waters (Hamre, 1963; Mather *et al.*, 1995).

For the third year in a row, tunas have been tagged in Skagerrak, in waters near Denmark and Sweden at the end of August and beginning of September 2019 (project known as Scandinavian Bluefin Marathon). Part of this work was carried out under a contract signed with GBYP ICCAT program, which provided both conventional tags and 15 PSAT satellite tags. This project relied heavily on the participation and dedication of experienced big game anglers who volunteered their time to safely catch and tag bluefin tunas by rod and reel. The tunas were then tagged with a pop up satellite archival tag or an acoustic tag as well as a floytag from the ICCAT series, and sampled. Here, we provide a brief summary of the project, including an overview of the planning, contact with anglers and the overall results of the tagging operation and related sampling.

2.1 Project objectives

The overall objective of the project was to tag and sample bluefin tuna in Danish waters to: 1) explore the detailed migration routes used by bluefin tuna that undergo a feeding migration into Skagerrak and Kattegat, 2) identify the population of origin of bluefin tuna migrating into Skagerrak and Kattegat, 3) explore relationships between a catch-and-release experience, migratory behaviour and physiological status, and 4) investigate long-term and larger-scale movements, and how these might be affected by fishing and ecosystem conditions. The method to obtain this information was to deploy several pop-up satellite archival tags (PSAT), 10-year acoustic tags, conventional ICCAT tags and to sample (fin clip, muscle biopsy and blood sample) bluefin tuna in waters near Denmark and Sweden in 2019.

3. Methods

Briefly:

- a) 75 boats and more than 550 experienced anglers fished for 7 days over a 17-day period. All the tunas were caught using rod and reel.
- b) All tunas were brought onboard the tagging boat to be tagged and sampled. The tunas were also measured, and the hook was removed safely whenever possible. All the tags were deployed following the ICCAT GBYP protocols.
- c) In total, 46 adult bluefin tunas were tagged and sampled, all were tagged with a floytag from the ICCAT tagging series, 15 of those were also tagged with an ICCAT provided miniPAT PSAT.

3.1 Planning and organisation of tagging operations

Coordination of fishing and project operation: Kim Aarestrup and Kim Birnie-Gauvin;

Tagging coordination and planning by Kim Aarestrup and Kim Birnie-Gauvin, respectively;

Onboard tagging operation by Kim Aarestrup and Kim Birnie-Gauvin;

Assistance in tagging operation from Brian MacKenzie and Hans-Ole Olesen;

Data collection by Kim Birnie-Gauvin.

3.2 Selection of anglers

All fishing operations were similar to the 2017 and 2018 projects (Birnie-Gauvin *et al.*, 2018; MacKenzie *et al.*, 2018), but with updates based on previous experience. In brief, we reached out to sport fishing communities in Denmark and nearby countries (e.g. Danish Angler Association (Dansk Sportsfiskerforbund) and Swedish Angler Association (Sportfiskarna)) as well as participants from previous years. Because all the fish that should be released for tagging studies must be captured, tagged and released in good condition, there were very strict requirements for the teams. To be selected, fishing teams had to have an appropriate boat (including VHF, AIS and safety equipment), powerful gear (minimum 80 lbs reels, 130 lbs main line, 200 lbs leader, circle hooks and a specified hook for gaffing the tuna), and documented experience with big game fishing of species similar to in mass and behaviour to bluefin tuna. We further requested a minimum of 1-week participation during the project.

In addition to Danish teams, 2 Swedish and 3 German teams participated. In total, 75 teams were found qualified to participate. Each team was provided with a flag and unique number to be placed on the boat. All the information was handed to the fishing authorities to enable control of participating boats. Additionally, a small group of highly experienced anglers were selected to perform a 'gear check' on all boats to ensure the quality and standards of the gear, as stipulated in the project description.

3.3 Timing and location of fishing and tagging operations

The tagging operation took place between 24 August 2019 and 9 September 2019. We had a total of 7 fishing days (weather-dependent). The fishing area was approximately 15 to 20 nautical miles north of Skagen, Denmark (**Figure 1**).

3.4 Fishing operations

The fishing was done with rod and reel, typically using balloons and drifting. Baits were largely mackerel with some garfish. Some teams opted to chum in addition. The fishing area was restricted to app. 6 nautical miles from a predefined position where the tagging boat was placed (so the tagging boat could reach any fishing position within 20 minutes). Each boat had 2-6 crew members at any given moment. When a tuna was gaffed by the anglers, it was swum 5-10m from the boat at app. 2 knots to facilitate recovery of the tuna. The tuna was then transferred with a rope to the tagging boat where tagging and sampling was performed.

3.5 Tagging and sampling operations

Once a tuna was transferred to the tagging boat, the operations went as follows:

- 1) The tuna were 'swum' behind the boat and their conditions were evaluated by the tagging team (movement, colours, ventilation, tail beats etc.);
- 2) The tuna were then brought on-board the tagging boat using a winch system; they were pulled onto a wet black mat tailored specifically for the tagging of large pelagic fish;
- 3) As soon as the tuna's mouth was out of water, it was continuously ventilated with fresh seawater using a large pump; the tuna's eyes were covered with a wet dark microfiber towel;
- 4) The tuna were tagged, sampled (fin clip, blood sample and muscle biopsy) and the hook was removed (**Figure 2**);
- 5) The tuna was measured (CFL, curved fork length) and then released back into the water. Generally, all tagging, sampling and release was done within 2 minutes. Curved fork lengths were converted to straight fork lengths (Parrack *et al.*, 1979), and the estimated straight fork lengths were used to estimate whole weight using a l-w relationship (Rodriguez-Marin *et al.*, 2015) ($W = 0.0000350801 * SFL^{2.8785}$, where W is weight in kg and SFT is straight fork length in cm) and employed in the 2017 ICCAT bluefin tuna stock assessment (ICCAT, 2017).

4. Results

4.1 Numbers and sizes of tunas caught and tagged

A total of 50 adult bluefin tunas were tagged with conventional ICCAT tags. Of those fish, a total of 15 were tagged with ICCAT-provided Wildlife Computers miniPAT tags. All PSAT tags were set to pop after a 12-month deployment. All tags were mounted externally.

The tunas ranged from 224 to 262 cm in length (CFL, **Figure 3**), with mean length of 247 ± 10 cm. This length range, after conversion to straight fork length, corresponds to an estimated mass range of approximately 179-281 kg. Given the fork length-at-age curve (Cort, 1991) used in stock assessments (ICCAT, 2017), these tunas were estimated to be ca. 11-16 years. The 15 PSAT tagged tuna's ranged from 231 to 262 cm

4.2 Samples collected

Fin clips (< 0.5 cm in size) were taken from all 50 tagged tunas for genetic assignment to population of origin. In addition, muscle biopsies (< 0.5 cm in size) and blood samples (<1mL) were obtained from most tagged tunas.

5. Overall summary and conclusions

The project successfully engaged the Danish, Swedish and German big game fishing community to participate in a tagging operation for bluefin tuna in Skagerrak and Kattegat. Scandinavian Bluefin Marathon 2019 successfully deployed 3 types of tags (PSAT, 10-year acoustic and conventional tags), and the results of these taggings in the next 1+ year will contribute to new knowledge on bluefin migratory behaviour (both short and long-term).

6. Acknowledgements

This work was carried out under the provision of the ICCAT Atlantic Wide Research Programme for Bluefin Tuna (GBYP), funded by the European Union, by several ICCAT CPCs, the ICCAT Secretariat and by other entities (see: <http://www.iccat.int/GBYP/en/Budget.htm>). We wish to thank our skippers, Hans-Ole Olesen, Claus Møller Sørensen, Sune Andersen and Bertel Kristensen, for their time and dedication to the project. We also wish to thank all the volunteer anglers, without whom this project would not have been possible. The contents of this paper do not necessarily reflect the point of view of ICCAT or of the other funders, which have not responsibility about them, neither do they necessarily reflect the views of the funders and in no ways anticipate the Commission's future policy in this area."

7. References

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Figure 1. Location of fishing and tagging operations (24 August to 9 September 2019) in Skagerrak, between Denmark and Sweden.

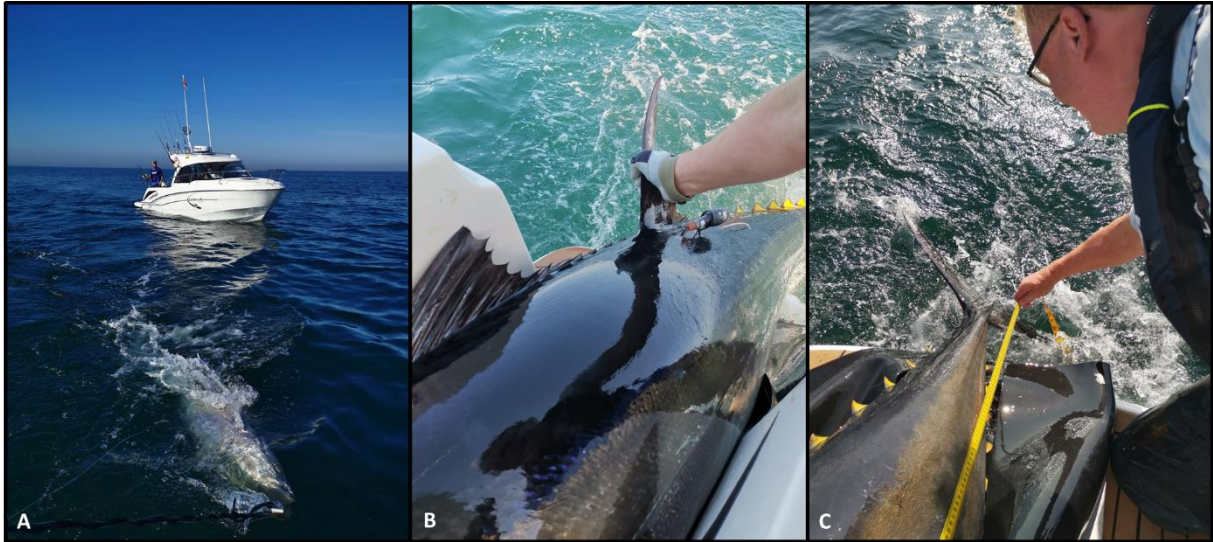


Figure 2. Methods. A) gaffed Atlantic bluefin tuna passed from the anglers' boat to the tagging boat is being swum to evaluate its condition. B) bluefin tuna onboard the tagging boat is tagged with a PSAT tag and a conventional ICCAT tag. C) bluefin tuna onboard the tagging boat is measured. Photos: Kim Birnie-Gauvin ©.

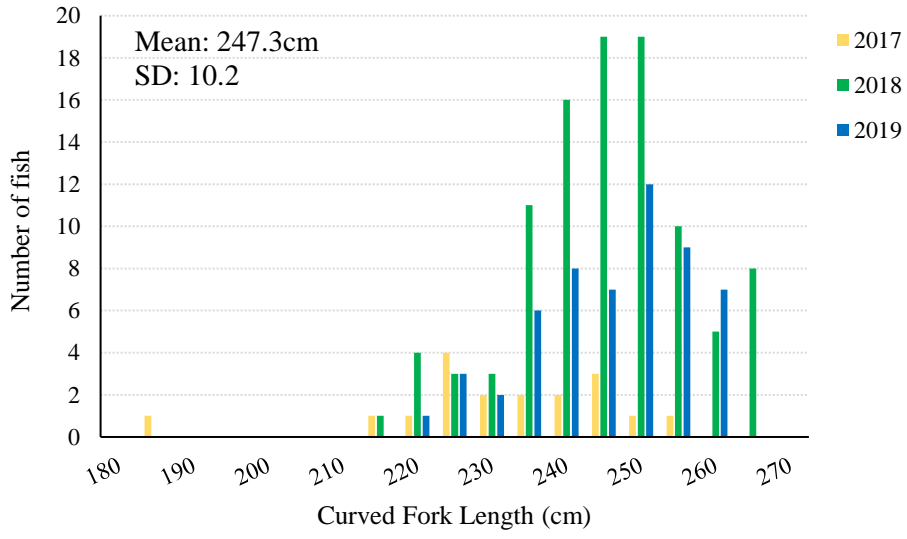


Figure 3. Frequency distributions of measured curved fork lengths for 50 adult Atlantic bluefin tunas tagged in Skagerrak in August-September 2019, compared to those tagged in 2017 and 2018.

Table 1. Tagged Bluefin tuna in Skagerrak 2019 with information on date, type of tag, tag ID's, release site and person tagging.

Date	Tag ID	Tag type	Conventio	Latitude	Longitude	Length	Vial	Tagger
24/08/2019	18P1845	ICCAT	80039	58.07889	10.93083	262	T01	KA
24/08/2019	18P1659	ICCAT	80030	58.05111	10.93806	250	T02	KA
24/08/2019	18P1504	ICCAT	80040	58.03611	11.02861	246	T03	KA
25/08/2019	18P1889	ICCAT	80031	58.08433	10.90287	246	T04	KA
25/08/2019	18P1893	ICCAT	80038	57.96778	10.78667	235	T05	KA
25/08/2019	18P1890	ICCAT	80041	58.08386	10.93904	243	T06	KA
25/08/2019	18P1891	ICCAT	80046	58.05722	10.81056	262	T07	KA
25/08/2019	18P1514	ICCAT	80032	58.14278	10.85611	231	T08	KA
25/08/2019	18P1843	ICCAT	80044	58.1005	10.94168	241	T09	KA
25/08/2019	18P1892	ICCAT	80034	58.08872	10.91675	243	T10	KA
25/08/2019	18P1522	ICCAT	80043	58.01694	11.03	252	T11	KA
25/08/2019	18P1886	ICCAT	80047	58.10694	10.84056	261	T12	KA
25/08/2019	18P1954	ICCAT	80026	58.10466	10.92332	261	T13	KA
25/08/2019	18P1559	ICCAT	80042	58.09149	10.94298	255	T14	KA
25/08/2019	18P1560	ICCAT	80048	58.08247	10.95608	255	T15	KA
25/08/2019	9078-1300	Acoustic	80027	58.12278	10.84944	253	T16	KA
25/08/2019	9081-1300	Acoustic	80028	57.99667	10.83639	262	T17	KA
25/08/2019	9083-1300	Acoustic	80049	58.00946	10.87697	256	T19	KA
26/08/2019	19P0329-1	Wildlife	80029	58.13528	10.84472	261	T21	KA
26/08/2019	19P0383-1	Wildlife	80020	58.125	10.96444	228	T23	KA
26/08/2019	19P0465-1	Wildlife	80036	58.24417	10.86972	231	T24	KA
26/08/2019	9082-1300	Acoustic	80050	58.05861	10.96444	252	T25	KA
26/08/2019	179486-35	X-tag	79990	58.04611	10.7875	254	T26	KA
26/08/2019	179482-35	X-tag	80009	58.15222	10.86556	254	T27	KA
26/08/2019	179485-35	X-tag	80014	58.05722	10.69611	250	T28	KA
27/08/2019	179483-35	X-tag	80006	58.24361	10.79889	238	T29	KA
27/08/2019	179484-35	X-tag	80002	58.01056	10.77278	237	T30	KA
27/08/2019	179487-35	X-tag	80001	58.21111	10.91056	243	T31	KA
27/08/2019	179489-35	X-tag	80021	58.21056	10.81167	235	T32	KA
28/08/2019	179488-35	X-tag	80022	58.03556	10.73444	246	T33	KA
28/08/2019	179490-35	X-tag	80010	58.18861	10.75361	243	T34	KA
28/08/2019	179491-35	X-tag	80018	58.24361	10.59111	238	T35	KA
28/08/2019	179492-35	X-tag	80015	58.09639	10.84306	240	T36	KA
28/08/2019	6193-1326	Acoustic	80013	57.92472	10.94278	225	T37	KA
28/08/2019	6192-1326	Acoustic	80017	58.05694	10.88861	239	T39	KA
01/09/2019	6190-1326	Acoustic	80007	58.0625	10.9125	252	T40	KA
01/09/2019	6191-1326	Acoustic	80023	58.02222	11.00472	258	T41	KA
08/09/2019	6182-1326	Acoustic	80012	58.10361	11.00222	228	T43	KA
08/09/2019	6184-1326	Acoustic	80016	58.19722	11.13694	257	T44	KA
08/09/2019	6188-1326	Acoustic	79985	58.07944	11.12	244	T45	KA
09/09/2019	6183-1326	Acoustic	79988	58.0025	10.89194	246	T42	KA
09/09/2019	179493-35	X-tag	79996	58.17194	11.01083	257	T46	KA
09/09/2019	6186-1326	Acoustic	79979	58.15778	11.08389	240	NA	KA
09/09/2019	6185-1326	Acoustic	79976	58.16861	10.94306	255	T47	KA
09/09/2019	6187-1326	Acoustic	79987	58.13528	10.02472	224	T48	KA
09/09/2019	6189-1326	Acoustic	80000	58.07556	11.09583	245	T49	KA

Table 2. Electronic tags deployed within ICCAT GBYP Project 16/2019-A

Tag Serial No.	Argos No. decimal	Conventional Tag No.	Deployment Date	Deployment Latitude	Deployment Longitude	Specimen length CFL (cm)
18P1504	180997	BYP80040	24/08/2019	58.036111	11.028611	246
18P1514	180998	BYP80032	25/08/2019	58.142778	10.856111	231
18P1522	180999	BYP80043	25/08/2019	58.016944	11.030000	252
18P1559	181000	BYP80042	25/08/2019	58.091487	10.942978	255
18P1560	181001	BYP80048	25/08/2019	58.082469	10.956079	255
18P1659	181002	BYP80030	24/08/2019	58.051111	10.938056	250
18P1843	181003	BYP80044	25/08/2019	58.100499	10.941678	241
18P1845	181004	BYP80039	24/08/2019	58.078889	10.930833	262
18P1886	181005	BYP80047	25/08/2019	58.106944	10.840556	261
18P1889	181006	BYP80031	25/08/2019	58.084329	10.902870	246
18P1890	181007	BYP80041	25/08/2019	58.083862	10.939035	243
18P1891	181008	BYP80046	25/08/2019	58.057222	10.810556	262
18P1892	181009	BYP80034	25/08/2019	58.088721	10.916746	243
18P1893	181010	BYP80038	25/08/2019	57.967778	10.786667	235
18P1954	181011	BYP80026	25/08/2019	58.104664	10.923315	261