

Atlantic-Wide Research Programme for Bluefin Tuna (Phase 11)

(ICCAT GBYP Award SG21-00644 of ICCAT GBYP circular 0471/2021)

Tagging of Adult Bluefin Tunas in Skagerrak 2021

Final report (Deliverable 5)

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Executive Summary

Atlantic bluefin tunas have recently returned to the Skagerrak-Kattegat-Sound area during their summer feeding migrations, where they have been extremely rare for over five decades. In an effort to understand the factors affecting their distribution and ecology, a tagging study was developed to enable the improved understanding of the migratory behaviour of these fish visiting the NE Atlantic. The study will over time accumulate substantial individual behavior data to shed light on the proximate causes leading to a north easterly expansion of distribution range similar to that before the 1960'ies. In 2021 we deployed a variety of electronic and conventional tags on 36 large (> 210 cm curved fork length) Atlantic bluefin tuna captured by volunteer rod-reel anglers in Skagerrak between August 21 and September 5, 2021. Specifically, we deployed 17 pop-up satellite archival tags (9 of which were provided by ICCAT). Additionally, sampling fin clippings was done for each tagged individual for genetic analysis and muscle biopsy to explore the physiological status. These tagging and sampling operations will extend the results obtained from a similar electronic tagging conducted in the same area in 2017 - 2020.

Introduction

Atlantic bluefin tuna have been very rare (if not completely absent) in Scandinavian waters since the 1960s, until approximately 2014 when infrequent sightings were reported. The number of observations of the species have since increased, and numbered in the hundreds this year. In 2017, the first Atlantic bluefin tuna were tagged with electronic tags in both 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 fourth year, tunas were tagged in Skagerrak between Denmark and Sweden at the end of August and beginning of September 2021. Part of this work was carried out under a MoU with ICCAT GBYP Phase 11 program, which provided both conventional tags and pop-up satellite (PSAT) tags. Under the CIRCULAR # 0471/2020 9 Wildlife Computers miniPAT pop-up satellite tags were provided to SLU by ICCAT GBYP through the SG21-00644 Memorandum of Understanding. This project relied heavily on the participation and dedication of experienced big game anglers who volunteered their time to safely catch bluefin tunas by rod and reel. The tunas were then tagged by SLU with a pop-up satellite tag or an acoustic tag as well as with a conventional floytag from the ICCAT series, and sampled for genetic analysis and tissue. 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.

The overall objective of the project is to tag and sample bluefin tuna in Scandinavian 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 is to deploy several PSAT tags, 10-year acoustic tags, conventional ICCAT tags and to sample (fin clip, muscle biopsy) bluefin tuna in waters near Sweden and Denmark.

Legislative preparation

Tagging was carried out under an exemption from the moratorium on directing fishing on bluefin tuna in Sweden given to SLU by the Swedish Agency for Marine and Water Management (Dnr. 1648-21)

Tagging was carried out under an animal welfare permit issued by the national ethical council (Dnr 5.8.18.-09486/2020)

Contracts developed and signed with participating voluntary angling teams

Any accidental deaths of BFT were to be reported through the Research Mortality Allowance, ICCAT GBYP Circular G-0777/2020

Methods

In brief:

- a) In Skagerrak and Kattegat, experienced Big Game anglers (In total 47 boats involving more than 500 experienced anglers) fished for up to 11 days over the period from 21st August to 5th September. All the tunas were caught using rod and reel.
- b) All ABFT were brought onboard the tagging boat to be tagged and sampled. Whilst onboard, fish were also measured, sampled and the hook was removed whenever possible. All fish were revitalized from the capture experience by towing head-first after the tagging boat at 2-3 knots prior to release after the tagging procedure. All tags were deployed following ICCAT GBYP protocols.
- c) In total, 36 ABFT were tagged and sampled, all were tagged with a conventional tag from the ICCAT tagging series as well as an acoustic tag. A subset of 17 were also given a PSAT, of which 9 were provided by ICCAT GBYP. Tags deployed and metrics of all tagged ABT can be seen in Table 1 and 2.

All the tags were deployed following the ICCAT GBYP protocols.

Planning and organization of tagging operations

Tagging was carried out under an Animal Welfare License issued by the animal welfare council (Dnr 5.8.18.-09486/2020) as required under Swedish law.

Research leader: Tomas Brodin Coordination of fishing and project operation: Andreas Sundelöf and Gustav Hellström Tagging coordination and planning: Andreas Sundelöf and Gustav Hellström Responsible for animal welfare permits: Gustav Hellström Onboard tagging operation: Andreas Sundelöf and Gustav Hellström Assistance in tagging operation: Tomas Brodin, Johan Leander, Sam Shry, Daniel Palm and Hege Sande Data collation: Andreas Sundelöf, Gustav Hellström, Tomas Brodin

Selection of anglers

All fishing operations were similar to the 2017 and 2020 projects (Birnie-Gauvin et al., 2018; MacKenzie et al., 2018, Sundelöf et al. 2019, Aarestrup et al. 2020, Aarestrup et al. 2021), but with updates based on previous experience. In brief, we reached out to commercial and angling communities in Scandinavia 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. In total, 47 teams where 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. To be able to handle fish in scientific experiments the teams were provided a course in fish handling and fish welfare.

Timing and location of fishing and tagging operations

The tagging operation took place between 21st of August and 5 September 2021. During this period the conditions were good enough to fish for 11 of the days. The tagging operation is strongly weather-dependent and can only be performed when sea state is calm. Hence the number of realized tagging days are usually dispersed over several weeks. The fishing area was approximately 15 to 20 nautical miles SW of Lysekil in central Skagerrak (Figure 1).

Fishing operations

The fishing was done with rod and reel, typically using balloons and drifting. Baits were largely mackerel. Some teams opted to chum in addition. The fishing area was restricted to app. 5-7 nautical miles (depending on daily availability of fishing teams and weather conditions) from a predefined position where the tagging boat was placed. This position was chosen in order for the tagging boat to quickly reach any fishing boat within less than 30 minutes. Each boat had 3-8 crew members at any given moment. When a tuna was gaffed by the anglers, it was swum 5-10 m from the boat at app. 2 knots to facilitate recovery of the tuna. The tuna was then transferred with a flying gaff on a leash to the tagging boat where tagging and sampling was performed.

Tagging and sampling operations

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

- 1. The tuna was 'swum' behind the boat and its condition was evaluated by the tagging team;
- 2. The tuna was then brought on-board the tagging boat using a winch system; it was pulled onto a wet black mat tailored specifically for the tagging of large pelagic fish;

- 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 was tagged, sampled (fin clip, blood sample and muscle biopsy) and the hook was removed (Figure 2);
- 5. The tuna's condition was continuously evaluated by the tagging team (movement, colours, fins, finlets, ventilation, tail beats)
- 6. The tuna was again 'swum' behind the tagging boat to assess swimming strength before being released.
- 7. The tuna was measured (CFL, curved fork length, half girth) and then released back into the water. Generally, tagging, sampling and release was done in 2-3 minutes.

Results

A total of 36 large adult bluefin tunas were tagged with conventional ICCAT tags in 2021. All of them were also tagged with an acoustic tag (either Vemco or Thelma) and 17 were tagged with Wildlife Computers miniPAT tags of which 9 were provided by ICCAT GBYP (Table 1). All PSAT tags were set to pop after a 12-month deployment. All tags were mounted externally. The tunas tagged in 2021 ranged from 210 to 279 cm in length (CFL, Figure 3 and Table 2), with a median length of 251 cm. Fin clips (< 1 cm in size) were taken from all 36 tagged tunas for genetic assignment to population of origin. In addition, muscle biopsies (< 0.5 cm in size) were sampled from the majority of the tagged tunas. Fin clips for analysis of origin were collected from additional fish, such as commercial bycatches landed in Sweden.

During the fishing and tagging operation 3 tunas accidentally died and were duly reported to ICCAT and processed to collect otoliths, DNA, tissue samples and stomach contents.

Table 1. Number of tags of different types deployed by Sweden in 2021							
Tag type	#						
Conventional	36						
Acoustic	36						
Wildlife Computers miniPAT	17 (9 by GBYP 8 by SLU)						

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Overall summary and conclusions

The project successfully engaged big game fishing communities around Skagerrak to participate in a tagging operation for bluefin tuna in this recently reestablished foraging area. The tagging operation is part of a collaboration with DTU in Denmark and together we tagged 169 large adult bBluefin tunas in 2021 and has accumulated more than 400 tagged beluefin tunas, of which more than 300 have been tagged with different types of electronic tags including acoustic transmitters and Pop-up satellite tags.

Acknowledgements

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necessarily reflect ICCAT's point of view or that of any of the other sponsors, who carry no responsibility. In addition, it does not indicate the Commission's future policy in this area.

We appreciate the effort of all the voluntarily participating anglers, without whom the tagging operations would not be possible. We also direct our gratitude to our skippers, Nicklas Sandberg and Thomas Kjelleberg, for their skills and devotion to the project.

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Figure 1. Location of tagging operations. Tagging positions 2017-2020. Yellow dots - ICCAT PSAT, blue dots – acoustic, purple dots –Wildlife PSAT. Grey dots indicate acoustic loggers deployed by the project.



Figure 2. Methods. Left: all vessels monitored by AIS. Middle: Tagging, measurements and sampling performed onboard. Right: Tuna swum behind boat before release.



Figure 3. CFL of all fish tagged by SLU and DTU in 2017-2021

Date	Tagging Lat (Declat)	Taging Lon (Declon)	Provider	Tag Serial ID	Argos PTT	Acoustic ID	Acoustic Serial	Conventional	Tagger	CFL
2021-08-21	57.9867	11.0350	GBYP	20P2950	215271	61148	1391243	32101	AS	224
2021-08-21	58.0383	11.0767	GBYP	20P2952	215272	61149	1391244	32102	GH	252
2021-08-21	58.0283	11.0667	GBYP	20P2953	215273	61150	1391245	32103	AS	250
2021-08-21	57.9933	11.0283	GBYP	20P2958	215274	61151	1391246	32104	GH	235
2021-08-21	58.1117	10.9683	GBYP	20P2960	215275	61152	1391247	32105	AS	259
2021-08-21	58.0900	11.0617	GBYP	20P2961	215276	61153	1391248	32106	GH	242
2021-08-22	58.1133	11.0100	GBYP	20P2962	215277	61154	1391249	32107	AS	279
2021-08-22	58.1700	10.9717	GBYP	20P2964	215278	61155	1391250	32108	GH	254
2021-08-22	58.0933	10.9733	GBYP	20P2965	215279	61156	1391251	32109	AS	250
2021-08-22	58.1133	10.9183	SLU			61159	1391254	32111	AS	258
2021-08-22	58.1283	10.9217	SLU			61158	1391253	32110	GH	249
2021-08-22	58.1550	10.8583	SLU			61157	1391252	32113	AS	260
2021-08-22	58.1383	10.9017	SLU			61160	1391255	32112	GH	241
2021-08-23	58.0433	10.9267	SLU			61164	1391259	32118	GH	265
2021-08-23	58.0150	10.8833	SLU			61162	1391257	32116	GH	239
2021-08-23	58.1100	10.9217	SLU			61165	1391260	32114	GH	224
2021-08-23	58.0200	10.8783	SLU			61161	1391256	32115	AS	245

Table 2. All tags that were deployed. Tags provided by ICCAT in **bold**.

2021-08-23	58.0900	10.8800	SLU			61163	1391258	32117	AS	241
2021-08-23	58.1350	10.9250	SLU			61166	1391261	32119	AS	259
2021-08-23	58.0183	10.8900	SLU			60430	1395695	32121	AS	238
2021-08-23	58.1100	10.9117	SLU			61167	1391262	32120	GH	251
2021-08-23	58.0383	10.8800	SLU			60431	1395696	32122	GH	252
2021-08-23	58.1583	10.9067	SLU			60432	1395697	32123	AS	260
2021-08-23	58.1267	10.8983	SLU			60433	1395698	32124	GH	265
2021-08-29	58.0367	11.0817	SLU	21P0860	224535	2780	2128	32134	AS	224
2021-08-30	57.9650	10.8250	SLU	21P0803	221960	2781	2128	32138	GH	254
2021-08-30	57.9617	10.8133	SLU	21P0805	221961	2782	2128	32139	AS	252
2021-08-31	58.0483	10.9817	SLU	21P0807	221962	2783	2128	32140	GH	252
2021-09-01	58.0550	10.9017	SLU	21P0863	224537	2884	2128	29563	AS	248
2021-09-01	58.0383	10.8950	SLU	21P0862	224536	2786	2128	32141	GH	245
2021-09-01	58.0367	11.1267	SLU	21P0809	221964	2785	2128	32142	AS	251
2021-09-01	57.9500	11.0100	SLU	21P0808	224535	2886	2128	32143	GH	246
2021-09-02	58.3217	11.0767	SLU			60436	1395701	32145	AS	264
2021-09-04	58.0633	10.8367	SLU			60438	1395703	32147	AS	259
2021-09-04	58.0133	10.8617	SLU			60437	1395702	32146	GH	210
2021-09-05	58.0333	11.0083	SLU			2885	2128	32148	GH	264