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Atlantic-Wide Research Programme for Bluefin Tuna (Phase 13)

(ICCAT GBYP Award of ICCAT GBYP circular #0869/2023)

Tagging of Adult Bluefin Tunas in Skagerrak 2023

Final draft (Deliverable 2)

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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 an 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's. In 2023 we deployed a variety of electronic and conventional tags on 41 large (> 229 cm curved fork length) Atlantic bluefin tuna captured by volunteer rod-reel anglers in Skagerrak between August 19 and September 3, and in Öresund between 23 and 27 September. Specifically, we deployed 20 pop-up satellite archival tags (8 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 as well as the level of contaminants in the fish. These tagging and sampling operations will extend the results obtained from similar electronic tagging conducted in the same area in 2017 - 2022.

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 thousands 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 sixth year, tunas were tagged between Denmark and Sweden at the end of August and in September 2023. Part of this work was carried out under a MoU with ICCAT GBYP Phase 13 program, which provided both conventional tags and pop-up satellite (PSAT) tags. Under the CIRCULAR #0869/2023, 8 Wildlife Computers miniPAT pop-up satellite tags were provided to SLU by ICCAT GBYP through a 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 and 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 event, migratory behaviour, survival and physiological status, and 4) map spatiotemporal survival dynamics and 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 PSAT tags, 10-year acoustic tags, conventional ICCAT tags and to retrieve DNA and tissue samples from bluefin tuna in waters near Sweden and Denmark.

Legislative preparation

Tagging was carried out under an exemption from the moratorium on targeted fishing on bluefin tuna in Sweden given to SLU by the Swedish Agency for Marine and Water Management (Dnr. 1922-2023)

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 regarding rule of conduct and animal ethics education.

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 570 experienced anglers) fished for up to 10 days over the period from 22st August to 2nd September. In Öresund, a subset of the same group of anglers fished between 23-27 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. All fish were revitalized from the capture event 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, 41 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 20 were also given a PSAT, of which 8 were provided by ICCAT GBYP. The tags deployed and the metrics of all tagged ABT can be seen in Table 1 and 2.

Planning and organization of tagging operations

Research leader: Tomas Brodin

Coordination of fishing and project operation: Gustav Hellström

Tagging coordination and planning: Gustav Hellström

Responsible for animal welfare permits: Gustav Hellström

Onboard tagging operation: Gustav Hellström and Petter Lundberg

Assistance in tagging operation: Tomas Brodin and Hege Sande

Data collation: Gustav Hellström, Tomas Brodin and Petter Lundberg

Selection of anglers

All fishing operations were similar to the 2017-2022 projects (Birnie-Gauvin et al. 2018; MacKenzie et al. 2018, Sundelöf et al. 2019, Sundelöf et al. 2021, Aarestrup et al. 2020, Aarestrup et al. 2021), but with updates based on previous experience. In brief, we reached out to commercial fishermen and big-game recreational anglers in Scandinavia, with focus on project 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 participating fishing 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 size and behaviour to bluefin tuna. In total, 47 teams were found qualified to participate. All the information was handed to the fisheries regulation authorities to enable control of participating boats. Additionally, a small group of very 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 19th of August and 27th September 2023. During this period the conditions were good enough to fish for 12 of the days. The tagging operation is strongly weather-dependent and can only be performed when the sea is calm enough to ensure safety for the participating fishing teams. Hence the number of realized tagging days are usually dispersed over several weeks. The Skagerrak fishing area was approximately 15 to 20 nautical miles SW of Lysekil in central Skagerrak (Figure 1), and the Öresund fishing area was just outside of the city of Helsingborg.

Fishing operations

The fishing was done using passive angling by drifting the with the boat, typically using live baitfish (mackerel) which were kept at preferred depth using balloons as floats. Some teams opted to chum in addition. The fishing area was restricted to approx. 4-7 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 15 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 approx. 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;

3. As soon as the tuna was out of water and on the tagging boat, 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 put back into the water, and again 'swum' behind the tagging boat to assess swimming strength before being released by removing the gaff.
7. The tuna was measured (curved fork length and half girth) and then released back into the water. Generally, tagging, sampling and release was completed in 2-3 minutes.

Results

A total of 40 large adult bluefin tunas were tagged with conventional ICCAT tags in 2023. All of them were also tagged with an acoustic tag (Innovasea) and 20 were tagged with Wildlife Computers miniPAT tags of which 8 were provided by ICCAT GBYP (Table 1). PSAT tags were set to follow ICCAT standard programming and to pop after a 12-month deployment. All tags were mounted externally using Domeier anchors. The tunas tagged in 2023 ranged from 229 to 291 cm in length (CFL, Figure 3, Table 1), with a median length of 264 cm. Fin clips (< 1 cm in size) were taken from all 41 tagged tunas for genetic assignment to population of origin and for sexing. 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 1 tuna 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 2023

Tag type	#
Conventional	40
Acoustic	41
Wildlife Computers miniPAT	20 (8 GBYP, 12 SLU)

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 almost 200 large adult bluefin tunas were tagged in total in the Skagerrak-Kattegat-Sound region during 2023. The first scientifically peer-reviewed results from the project were published during 2022 (Aarestrup et al. 2022) documenting skipped spawning, as well as both easterly and westerly migration routes returning from Scandinavian waters to the Mediterranean for spawning.

Acknowledgements

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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 skipper, Nicklas Sandberg for his skills and devotion to the project.

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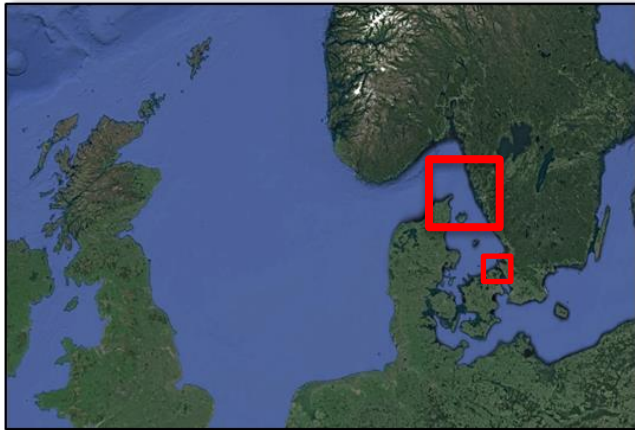


Figure 1. Location of tagging operations 2023.

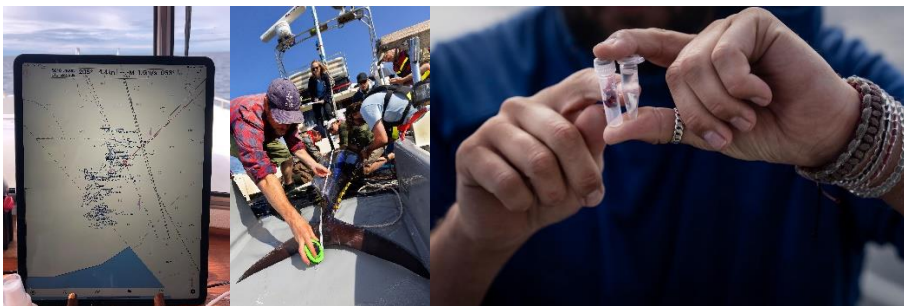


Figure 2. Methods. Left: all vessels monitored by AIS. Middle: Tagging, measurements and sampling performed onboard. Right: Fin clip and muscle biopsy samples.

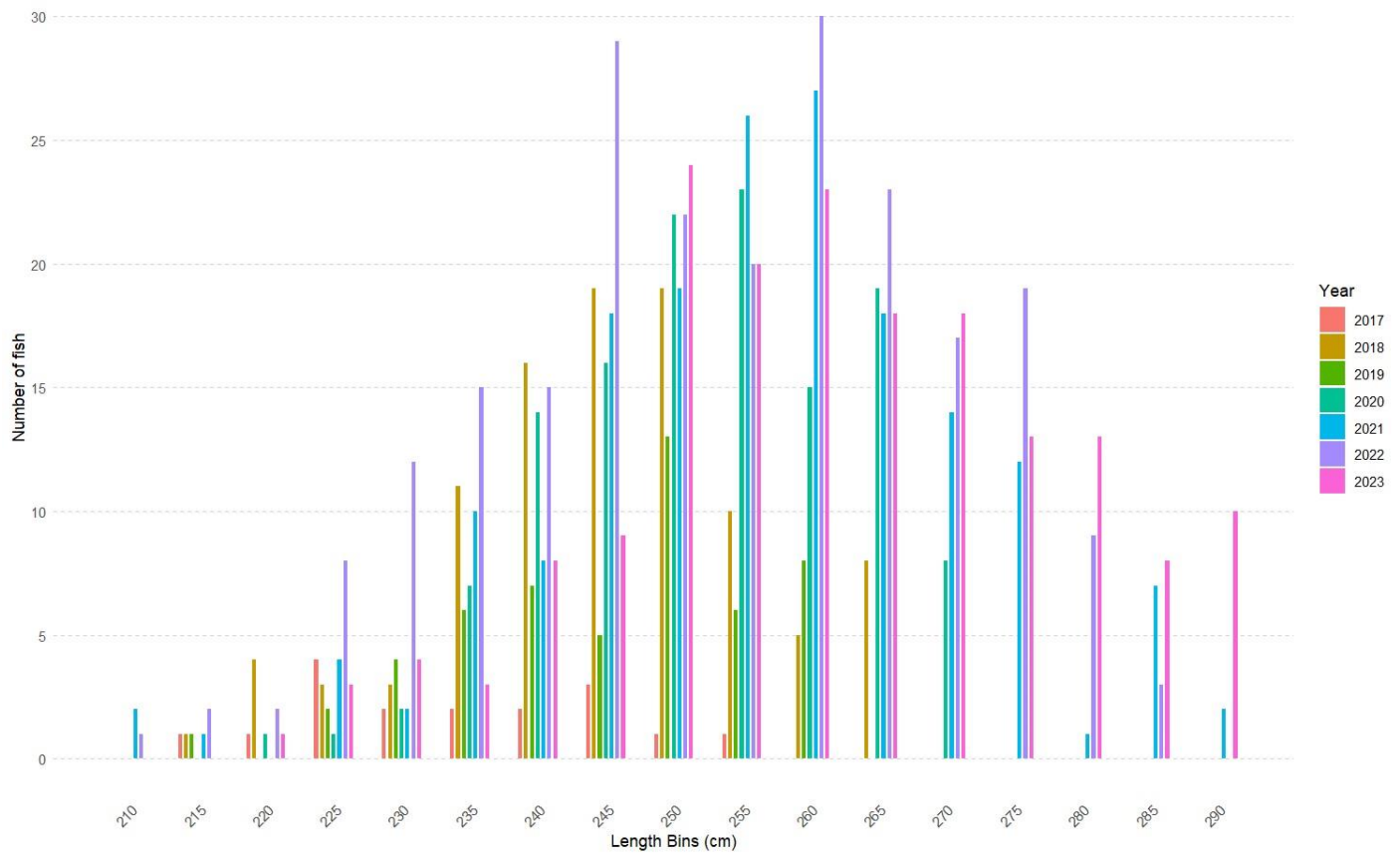


Figure 3. CFL of all fish tagged by SLU and DTU in 2017-2023

Table 1. Data on all tags that were deployed in 2023.

Date	Declat	Declong	Provider	PSAT Serial nr.	Argos PTT	Acoustic Serial nr.	Acoustic ID	Conventional	Tagger	CFL
20230819	58.098	10.873	SLU VFM	23P0147	243260	1534283	41570	032174	GH	274
20230819	58.110	10.850	SLU VFM	23P0148	243261	1534280	41587	032201	GH	238
20230819	58.093	10.885	SLU VFM	23P0214	243272	1534282	41569	032202	GH	236
20230819	58.100	10.865	SLU VFM	23P0162	243264	1534281	41568	032203	GH	280
20230820	58.050	11.007	SLU VFM	23P0163	243265	1534279	14566	032204	GH	286
20230822	57.730	11.410	SLU VFM	23P1291	252391	1534275	41562	032206	GH	240
20230822	57.685	11.372				1534274	41561		PL	261
20230822	57.677	11.372	SLU VFM	23P1262	252388	1534278	41565	032095	PL	256
20230822	57.655	11.365	SLU VFM	23P0166	243266	1534277	41564	032205	PL	248
20230822	57.667	11.343	SLU VFM	23P1311	252395	1534276	41563	032207	GH	259
20230826	58.113	10.815	SLU VFM	23P1292	252392	1534260	41547	032208	GH	250
20230828	58.122	10.718	SLU VFM	23P1263	252389	1534262	41549	032187	GH	235
20230828	58.135	10.678	SLU VFM	23P1309	252394	1570454	41322	032188	GH	240

20230828	58.092	10.700				1570452	41320	032209	PL	246
20230828	58.137	10.733				1570450	41318	032210	PL	264
20230828	58.152	10.712				1570456	41324	032211	GH	264
20230830	58.130	10.635				1534267	41554	032212	GH	247
20230830	58.128	10.677				1534268	41555	032213	PL	276
20230830	58.153	10.682				1534261	41548	032214	GH	229
20230830	58.105	10.652				1534266	41553	032215	PL	234
20230830	58.150	10.662				1534272	41559	032216	GH	249
20230831	58.108	10.690				1534265	41552	032217	GH	260
20230923	56.080	12.625	ICCAT	22P1258	244321	1534263	41550	032219	GH	284
20230923	56.060	12.648	ICCAT	23P0786	250428	1534271	41558	032218	GH	266
20230923	56.087	12.628	ICCAT	23P0813	250437	1534269	41556	032220	GH	273
20230923	56.092	12.618	ICCAT	23P0811	250435	1534264	41551	032221	GH	290
20230923	56.093	12.608	ICCAT	23P0800	250434	1534270	41557	032222	GH	291
20230923	56.068	12.653	ICCAT	23P0787	250429	1534273	41560	032180	GH	257
20230924	56.055	12.653	ICCAT	23P0812	250436	1570475	41343	032195	GH	286
20230924	56.065	12.648	ICCAT	23P0773	250427	1570477	41345	032198	GH	290
20230924	56.045	12.630				1570479	41347	032179	GH	282
20230925	56.108	12.585				1570481	41349	032192	GH	269
20230925	56.128	12.473				1570483	41351	032196	GH	280
20230925	56.122	12.563				1570485	41353	032200	GH	263
20230926	56.123	12.582				1570484	41352	032185	GH	277
20230927	56.198	12.508				1570482	41350	032190	PL	258
20230927	56.228	12.477				1570476	41344	032193	PL	254
20230927	56.205	12.477				1570480	41348	032176	PL	286
20230927	56.192	12.498				1570478	41346	032199	PL	280
20230927	56.172	12.528				1570474	41342	032194	PL	290
20230927	56.242	12.462				1570463	41331	032197	PL	279