

Atlantic-Wide Research Programme for Bluefin Tuna (Phase 12)

(ICCAT GBYP Award of ICCAT GBYP circular #0433/2022)

Tagging of Adult Bluefin Tunas in Skagerrak 2022

Final report

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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 2022 we deployed a variety of electronic and conventional tags on 48 large (> 219 cm curved fork length) Atlantic bluefin tuna captured by volunteer rod-reel anglers in Skagerrak between August 22 and September 2, 2022. Specifically, we deployed 18 pop-up satellite archival tags (6 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 - 2021.

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 fifth year, tunas were tagged in Skagerrak between Denmark and Sweden at the end of August and beginning of September 2022. Part of this work was carried out under a MoU with ICCAT GBYP Phase 12 program, which provided both conventional tags and pop-up satellite (PSAT) tags. Under the CIRCULAR #0433/2022 6 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 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. 2182-2022)

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 570 experienced anglers) fished for up to 10 days over the period from 22st August to 2nd 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, 48 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 18 were also given a PSAT, of which 6 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, Petter Lundberg and Hege Sande

Data collation: Andreas Sundelöf, Gustav Hellström, Tomas Brodin

Selection of anglers

All fishing operations were similar to the 2017-2021 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 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 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. 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 22nd of August and 2nd September 2021. During this period the conditions were good enough to fish for 10 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. 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 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;

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 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 (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 38 large adult bluefin tunas were tagged with conventional ICCAT tags in 2022. All of them were also tagged with an acoustic tag (either Innovasea or Thelma) and 18 were tagged with Wildlife Computers miniPAT tags of which 9 were provided by ICCAT GBYP (Table 1). PSAT tags were in general set to follow ICCAT standard programming and to pop after a 12-month deployment. 2 PSATs were programmed to pop after 24 months. All tags were mounted externally. The tunas tagged in 2022 ranged from 219 to 282 cm in length (CFL, Figure 3 and Table 2), with a median length of 253 cm. Fin clips (< 1 cm in size) were taken from all 48 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	48
Acoustic	48
Wildlife Computers miniPAT	18 (6 by GBYP 12 by 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 around 200 large adult bluefin tunas were tagged in total in 2022. The first scientifically peer-reviewed results from the project were published during 2022 (Aarestrup et al. 2022) documenting skipped spawning and both easterly and westerly migration routes returning from Scandinavian waters to the Mediterranean for spawning.

Acknowledgements

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entities (see <https://www.iccat.int/gbyp/en/overview.asp>). The content of this paper does not 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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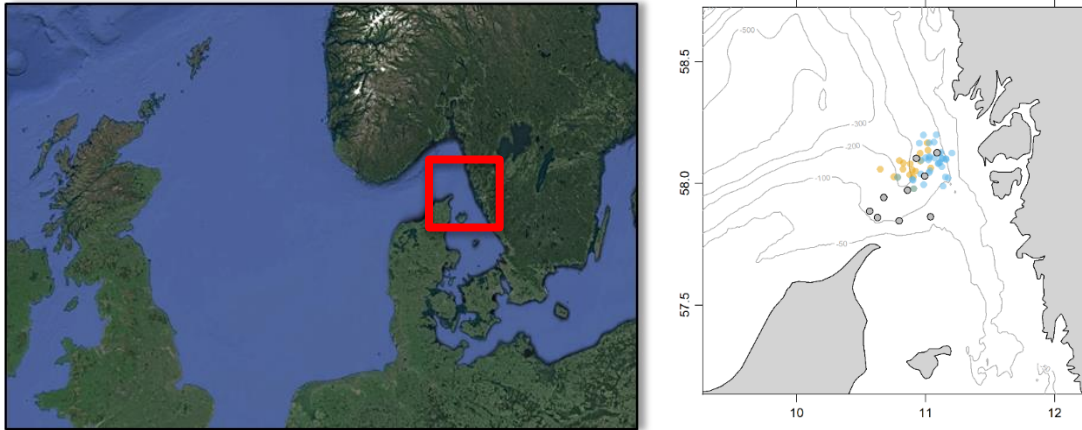


Figure 1. Location of tagging operations. Tagging positions 2017-2020. Yellow dots - ICCAT PSAT, blue dots– acoustic, purple dots –Wildlife PSAT. Grey dots indicate acoustic loggers deployed by the project.



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

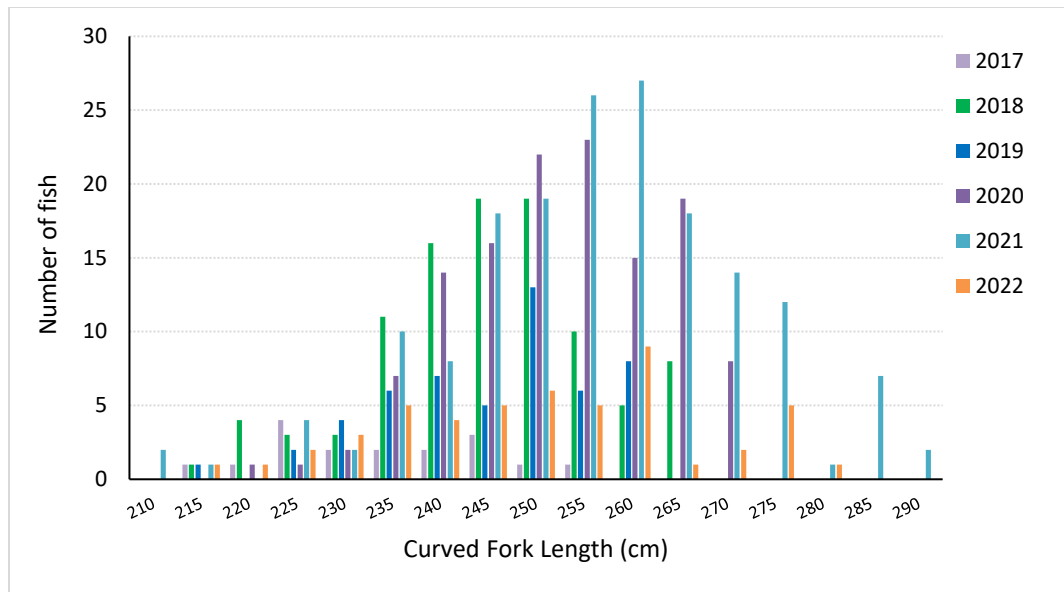


Figure 3. CFL of all fish tagged by SLU and DTU in 2017-2022 (SLU only for 2022)

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

Date	Tagging Lat (Declat)	Tagging Lon (Declon)	Provider	Tag Serial ID	Argos PTT	Acoustic ID	Acoustic Serial	Conventional	Tagger	CFL
20220822	58.123	11.008	ICCAT	21P2288		60445		32159	AS	219
20220822	58.020	11.030	ICCAT	22P0022		60439		32152	GH	232
20220822	58.048	11.003	ICCAT	21P2246		60440		32153	AS	264
20220822	58.125	10.962	ICCAT	22P0028		60441		32154	GH	253
20220823	58.121	10.906	ICCAT	22P0023		60442		32076	AS	245
20220823	58.115	10.894	ICCAT	22P0030		60443		32077	GH	256
20220823	58.103	10.883	SLU	22P0184		60444		32078	AS	282
20220823	58.127	10.933	SLU	22P0151		60449		32079	GH	254
20220823	58.074	10.959	SLU	22P0121		60452		32080	AS	239
20220823	58.099	10.860	SLU	22P0181		60446		32081	GH	274
20220823	58.106	10.862	SLU	22P0186		64048		32100	AS	239
20220823	58.155	10.928	SLU	22P0150		60447		32082	GH	263
20220823	58.080	10.930				60435		32083	AS	262
20220824	58.147	10.851	SLU	22P0088		60453		32098	AS	246
20220825	58.092	11.156	SLU	22P0183		41580		32084	GH	263
20220826	58.157	10.548	SLU	22P0185		41577		32085	AS	280

20220826	58.128	10.615	SLU	22P0146	41575	32086	GH	242
20220826	58.157	10.523	SLU	22P0149	41573	32087	AS	255
20220826	58.157	10.555	SLU	22P0129	41571	32088	GH	240
20220826	58.156	10.576			41581	32089	AS	261
20220826	58.164	10.544			41574	32090	GH	229
20220826	58.157	10.513			41578	32091	AS	251
20220826	58.148	10.597			41576	32092	GH	257
20220826	58.155	10.546			41582	32093	AS	262
20220826	58.163	10.550			41572	32094	GH	246
20220827	58.077	10.663			41579	32096	AS	276
20220827	58.123	10.586			60459	32097	GH	256
20220827	58.159	10.574			60458	32149	AS	249
20220827	58.179	10.572			60465	32155	GH	262
20220830	58.125	10.623			60560	32156	AS	252
20220830	58.145	10.618			60450	32157	GH	276
20220830	58.188	10.565			60466	32158	AS	274
20220830	58.200	10.658			60469	32159	AS	240
20220830	58.043	10.592			60462	32160	GH	231
20220830	58.145	16.067			60461	32161	GH	242
20220830	58.172	10.552			60468	32162	AS	262
20220831	58.073	10.635			60463	32163	GH	260
20220831	58.053	10.662			41539	32175	AS	236
20220901	58.025	10.873			41540	32164	GH	263
20220901	58.053	10.913			41542	32165	AS	250
20220901	58.058	10.890			41541	32166	GH	250
20220901	58.059	10.888			41545	32167	AS	268
20220901	58.028	10.985			60455	32169	GH	244
20220902	58.072	10.807			41536	32169	AS	233
20220902	58.088	10.860			60456	32170	GH	255
20220902	58.107	10.815			41537	32171	AS	222
20220902	58.123	10.845			60467	32172	GH	229
20220902	58.158	10.950			60457	32173	AS	276