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Atlantic-Wide Research Programme for Bluefin Tuna (Phase 14)

(ICCAT GBYP Award)

## Tagging of Adult Bluefin Tunas in Skagerrak 2024

### 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 2024 we deployed a variety of electronic and conventional tags on 12 large (> 238 cm curved fork length) Atlantic bluefin tuna captured by volunteer rod-reel anglers in Skagerrak between August 16 and September 8. Specifically, we deployed 12 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 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 - 2023.

## 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). Tagging work has continued since then and knowledge on the return of large bluefin tuna in Scandinavian waters is accumulating from these efforts (Aarestrup et al. 2022, Keno et al. 2024, Nielsen et al. 2024). For the seventh year, tunas were tagged between Denmark and Sweden at the end of August and in September 2024. Part of this work was carried out under a MoU with ICCAT, which provided both conventional tags and 6 Wildlife Computers miniPAT pop-up satellite tags. 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. 2024-002165)

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 (close to 50 boats involving more than 500 experienced anglers) fished for 9 days over the period from 16th August to 8th 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, 12 ABFT were tagged and sampled. All were tagged with a conventional tag from the ICCAT tagging series as well as a PSAT and an acoustic tag. A subset of 6 were tagged with PSATs 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 international and national permits: Andreas Sundelöf and Tomas Brodin

Coordination of fishing and project operation: Gustav Hellström

Tagging coordination and planning: Gustav Hellström, Andreas Sundelöf, Petter Lundberg

Responsible for animal welfare permits: Gustav Hellström

Onboard tagging operation: Gustav Hellström, Andreas Sundelöf and Petter Lundberg

Assistance in tagging operation: Tomas Brodin and Hege Sande

Data collation: Gustav Hellström, Tomas Brodin, Andreas Sundelöf and Petter Lundberg

### *Selection of anglers*

All fishing operations were similar to the 2017-2023 projects (Birnie-Gauvin et al. 2018; MacKenzie et al. 2018, Sundelöf et al. 2019, Sundelöf et al. 2021, Aarestrup et al. 2020, Brodin et al. 2023), 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. Almost 50 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 16th of August and 8<sup>th</sup> of September 2024. During this period the conditions were good enough to fish for 9 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 located SW of Lysekil in central Skagerrak (Figure 1).

### *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 towed 5-10 m from the boat at a speed of at least 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 12 large adult bluefin tunas were tagged with conventional ICCAT tags in 2024. All of them were also tagged with an acoustic tag (Innovasea) and with Wildlife Computers miniPAT tags of which 6 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 2024 ranged from 238 to 276 cm in length, with a median length of 250 cm. Fin clips (< 1 cm in size) were taken from all 12 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.

No tuna died during the 2024 fishing and tagging operation.

Table 1. Number of tags of different types deployed by Sweden in 2024

Tag type	#
Conventional	12
Acoustic	12
Wildlife Computers miniPAT	12 (6 GBYP, 6 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 100 large adult bluefin tunas were tagged in total in the Skagerrak-Kattegat-Sound region during 2024. The second scientifically peer-reviewed results from the project were published during 2024 (Nielsen et al. 2024) presenting a method to determine the sex of Bluefin tuna using DNA-samples.

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several ICCAT CPCs, the ICCAT Secretariat, and other 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.

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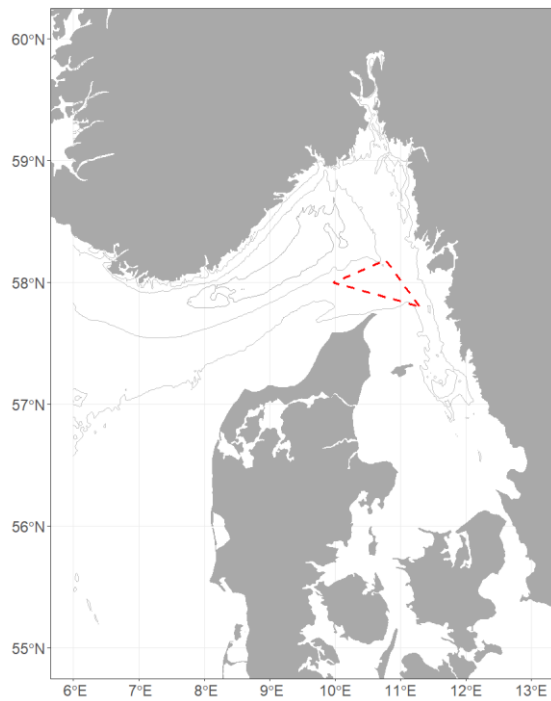


Figure 1. Location of tagging operations 2023.



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