

# Tagging of Atlantic bluefin tuna (*Thunnus thynnus*) with pop-up satellite archival tags (PSAT) in Norway during 2023

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## **Executive summary**

Atlantic bluefin tunas (BFT) have reoccurred in increasing numbers along the coast of Norway during the last decade. To study the behavior, migration and general ecology of BFT returning to their historical productive feeding grounds in Norwegian waters, the Institute of Marine Research in Norway continued its tagging program of BFT along the coast of Norway in collaboration with the International Commission for the Conservation of Atlantic Tunas (ICCAT) between the 6<sup>th</sup> of September and 22<sup>nd</sup> of October 2023. Like in previous years, the major aims were to collect genetic samples of BFT and tag these with both pop-up satellite archival tags (PSATs) and conventional tags as far north as possible. Tagging was performed on-board a specially designed tagging vessel with an aluminum ramp to pull the fish on board. In total, eleven BFT ranging from 231 cm to 292 cm (CFL) in length were tagged with PSATs and conventional tags, and genetic samples were collected. Nine BFT were caught from research vessels, and two individuals were transferred from collaborating recreational fishing boats to the tagging vessel. All fish were caught using rod-and-line and spreader bars as lures. The results of this project contribute to the understanding of the behavior, migration and ecology of this highly migratory species at its historical feeding grounds far north in the northeast Atlantic Ocean.

## 1. Introduction

Atlantic bluefin tunas (BFT) have returned to Norwegian waters in large numbers during the last decade (Nøttestad et al., 2020). To study the behavior, migration and ecology of BFT in Norwegian waters, the Institute of Marine Research (IMR) in Norway conducted electronic tagging programs as part of the Grand Bluefin Year Programme (GBYP) in 2018, 2020, 2021 and 2022 (Ferter et al., 2019; Ferter et al., 2020; Ferter et al., 2021; Ferter et al., 2022).

Like in previous years, the International Commission for the Conservation of Atlantic Tunas (ICCAT) provided pop-up satellite tags (PSATs) to be deployed in the Mediterranean and North Atlantic Ocean targeting eastern stock individuals as part of ongoing CPCs national electronic tagging programs (ICCAT GBYP CIRCULAR # G-0869/2023). Through a Memorandum of Understanding (MoU), IMR agreed to deploy eight PSATs provided by ICCAT as part of the GBYP 2023 Phase 13 e-tagging activities. In addition, IMR had three self-financed PSATs available, and the results of these additional tags will be shared with ICCAT GBYP. Although both fishing and tagging were planned to be mainly performed from a research vessel owned by IMR, this study greatly benefited from collaboration with recreational BFT fishers in terms of knowledge sharing and helping to catch BFT for electronic tagging.

To study the behavior of individuals feeding at the northernmost distribution limit of the species, the aim of this project was to extend previous tagging campaigns by collecting genetic samples of BFT and tag these fish with PSATs and conventional tags during their feeding period as far north as possible in Norwegian waters.

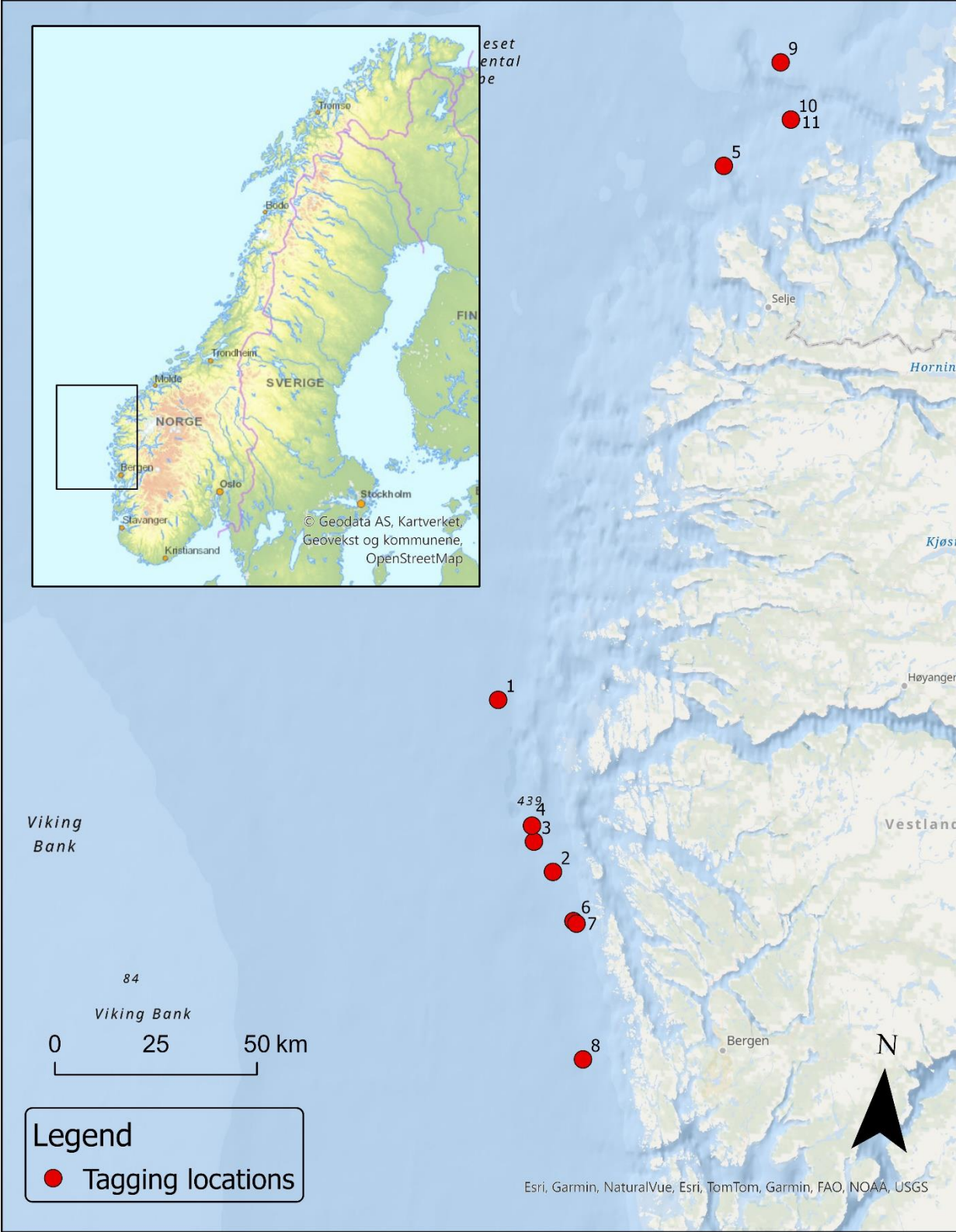
## 2. Materials and Methods

All procedures followed the handling and tagging protocols in 2021 (Ferter et al., 2021).

### *Study area and period*

The field study was conducted north of 60°N between Bergen and Ålesund in western Norway between the 6<sup>th</sup> of September and 22<sup>nd</sup> of October 2023 (Figure 1). This area was chosen because of many observations of feeding BFT during the study period, and because most of both recreational and commercial catches were taken within this area during this year's season. Moreover, like in previous years, the aim of this study was to deploy the PSATs as far north as possible in Norwegian waters. A total number of 10 effective fishing days were conducted from

IMR's tagging vessel. All experimental procedures were approved by the Norwegian Food Safety Authority (FOTS ID 29603) and the Norwegian Directorate of Fisheries.



**Figure 1:** Map of the study area. The red dots indicate the tagging and release locations of the eleven tagged BFT in this study. Numbers next to the dots indicate fish ID.

### *Fishing equipment and methods*

Nine of the fish were caught from research-associated vessels, and two from collaborating recreational fishing boats (table 1) using fishing rods in the 130 lbs range, and reels of at least size 80. All fish were fought stand-up using a fighting belt (Black Magic XL wide Equalizer gimbal and harness system). Spreader bars with multicoloured squids and 400 lb. leader and >450 lb. swivels were used as fishing method on all fishing days. To keep fighting time to a minimum, the boat was used to overtake the fish as fast as possible after the first initial run. This made it possible to pull up the head of the fish from straight above, hampering the swimming of the fish and cutting angling duration to a minimum.

### *Tagging protocol*

Once the BFT was close to the boat, a large, barbless hook with a rope was placed between the tip of the tongue and the lower jaw of the BFT. The fish was then towed behind the boat (in 2 - 3 knots) for up to 10 minutes. Afterwards, the fish was pulled into the boat on a 108-cm wide, custom-built aluminum ramp and placed on a 6 cm thick foam mattress which was covered with a smooth tarpaulin. The eyes of the fish were then covered with a towel to minimize stress, and a hose with high-volume but low-pressure continuous seawater supply was placed into the mouth of the fish to irrigate the gills. The fish were tagged with one PSAT (MiniPat-348, Wildlife Computers, 365 days deployment duration, constant pressure release after three days) fitted with two monofilament anchors (one of them fitted to the base of the PSAT and the other one as a loop) and titanium darts next to the second dorsal fin (Wilson et al., 2015). In addition, a conventional spaghetti tag was placed close to the second dorsal fin following the instructions in the ICCAT-GBYP tagging manual (Cort et al., 2010). During tagging, the curved fork length (CFL) of the fish was measured and a fin clip was taken for genetic analysis. The fin clip was stored in > 99.0 % ethanol at 4°C. The genetic samples were sent to AZTI for further analysis, and to be included in the GBYP tissue bank. After tagging, the fish was released on a thin rope which was pulled through the same hole as the large, barbless hook, and towed behind the boat (in 2 - 3 knots) for a short time until the fish showed strong swimming activity.

## **3. Results**

A total number of eleven BFT were tagged with both PSATs and conventional spaghetti tags during the 10 fishing days (table 1). All fish were tagged north of 60°N (figure 1, table 1). The size of the fish ranged from 231 cm to 292 cm (CFL). Nine fish were caught from the research-

associated vessels and two fish (IDs 3 and 9) were transferred from a recreational fishing boat to the research vessel. Fighting time ranged between 15 to 90 minutes (mean = 30 minutes).

**Table 1:** Overview of the eleven BFT tagged along the coast of Norway in 2023.

Date	ID	Boat	Release time	Release position	CFL [cm]	Angling duration [min]	PSAT ID	Conventional
10/9/2023	1	Tagging boat	19:45	61.13, 4.21	273	20	23P0493	BYP032070
17/9/2023	2	Tagging boat	12:27	60.76, 4.52	251	18	22P1248*	BYP032058
17/9/2023	3	Recreational boat	15:45	60.82, 4.42	231	40	22P1255*	n/a
18/9/2023	4	Tagging boat	17:45	60.86, 4.41	264	20	22P1279*	BYP032060
1/10/2023	5	Tagging boat	18:00	62.35, 5.10	266	40	22P1282*	BYP032061
5/10/2023	6	Directorate of Fisheries	12:00	60.66, 4.63	260	20	22P1280*	BYP032067
5/10/2023	7	Tagging boat	14:10	60.65, 4.64	239	15	22P1283*	BYP032056
9/10/2023	8	Tagging boat	16:55	60.35, 4.71	240	20	22P1284*	BYP032063
22/10/2023	9	Recreational boat	15:00	62.59, 5.34	279	90	23P0297*	BYP032069
22/10/2023	10	Tagging boat	17:00	62.46, 5.41	251	15	23P0495	BYP032054
22/10/2023	11	Tagging boat	17:45	62.46, 5.41	292	30	23P0494	BYP032064

\* ICCAT GBYP PSAT

To date, nine of the tags have not reported indicating that they are still attached to the fish, and that these fish survived. However, IDs 6 and 11 died immediately after tagging as indicated by constant pressure recordings for three days.

#### 4. Discussion and concluding remarks

The 2023 tagging campaign was a continuation of previous electronic tagging of BFT in Norwegian waters (Ferter et al., 2020; Ferter et al., 2021; Ferter et al., 2022). The number of tagged fish was as high as in 2022, and in total 36 fish have been tagged with PSATs in Norwegian waters since 2020. Apart from two post-release mortalities, all 2023-tags are still attached to the BFT, strongly indicating that the improved tagging protocol, i.e. on-board tagging with double anchoring, is an effective method. This is backed up by the fact that several of the tags from previous tagging projects stayed on for an entire year of deployment. As all fish in this year's study were tagged north of 60°N, the results of this study will further increase our knowledge on the behavior and migration of BFT at the northernmost border of its distribution range, and fill important knowledge gaps (Nøttestad et al., 2017; Horton et al., 2020; Nøttestad et al., 2020).

Pulling the fish on board for tagging makes it possible to place the tag accurately as desired. Results from all tagging years demonstrate high retention rates of the tag and high survival rates (see also Stokesbury et al., 2011). Towing the fish on a thin rope after tagging until the fish showed strong swimming activity was a further improvement compared to previous tagging campaigns. However, in 2023, we experience higher post-release mortality (2 out of 11 tagged fish) compared to previous years, which might be linked to later tagging in the

season. At that point, the BFT had fed on high-caloric prey for several weeks in Norwegian waters, which significantly increased their weight and presumably fat content. This may potentially have made them less resilient to stress later in the season compared to earlier in the season.

Overall, the experiences and knowledge gained from this year's study have laid the foundation for future successful electronic tagging studies of BFT in Norwegian waters. Further tagging efforts are required to further improve our understanding of the large-scale and long-term migration pattern and behavior of BFT in its northernmost distribution area.

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