

# **Tagging of Atlantic bluefin tuna (*Thunnus thynnus*) with pop-up satellite archival tags (PSAT) in Norway during 2021**

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## **Executive summary**

Atlantic bluefin tunas (BFT) have reoccurred in increasing numbers along the coast of Norway during the last years. To study the behavior, migration and general ecology of BFT returning to their historical 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 11<sup>th</sup> of August and 6<sup>th</sup> of October 2021. Like in the 2020 tagging project, 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, nine BFT ranging from 244 cm to 292 cm (CFL) in length were tagged with PSATs and conventional tags, and genetic samples were collected. Six BFT were caught from the tagging vessel, and three 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 and 2020 (Ferter et al., 2019; Ferter et al., 2020).

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 # 471/2021). Through a Memorandum of Understanding (MoU), IMR agreed to deploy five PSATs provided by ICCAT as part of the GBYP 2021 Phase 11 e-tagging activities. In addition, IMR had 10 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.

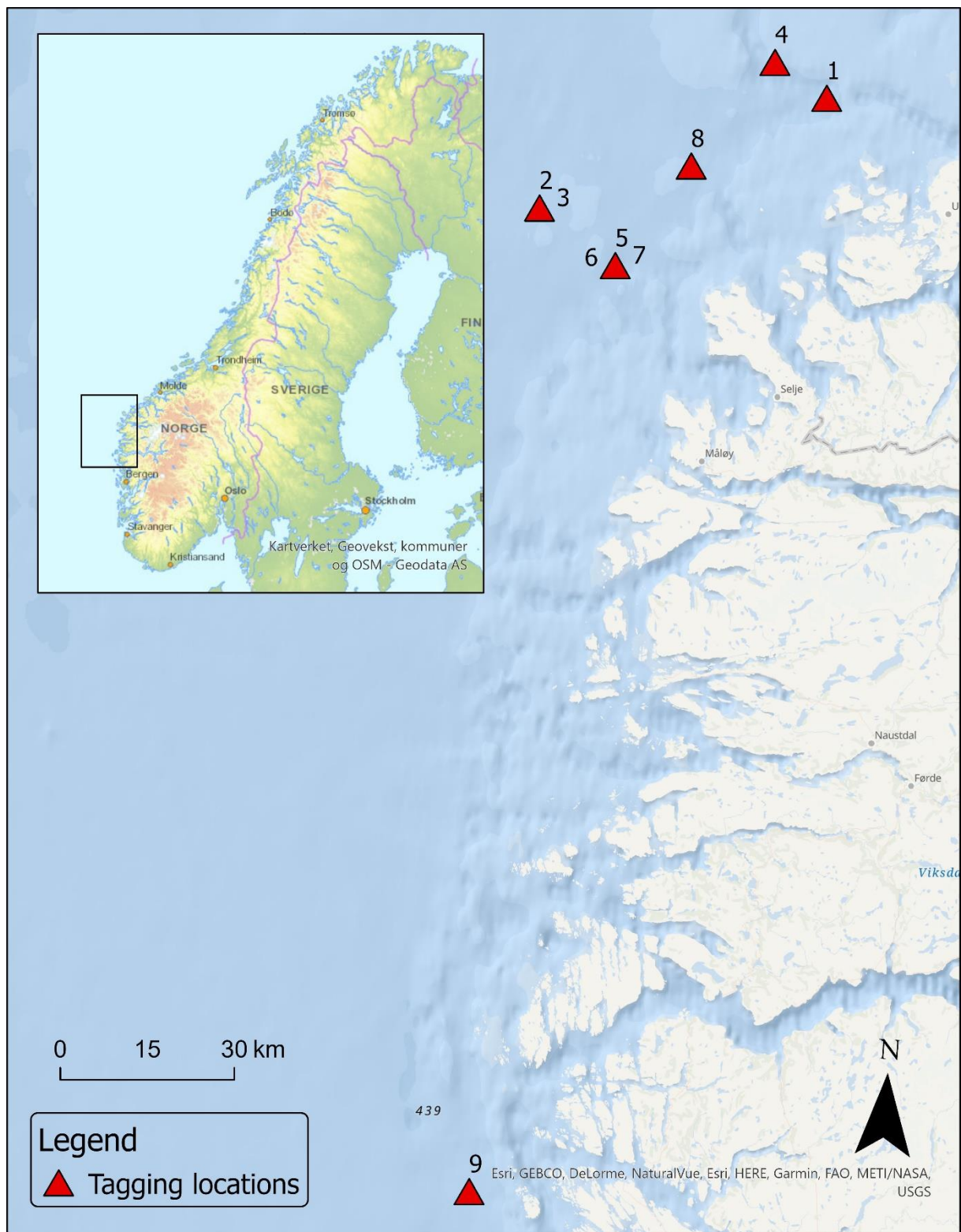
To study the behavior of individuals feeding at the northernmost distribution limit of the species, the aim of this project was to extend previous tagging campaigns by collecting genetic samples of BFT and tag these fish with PSATs and conventional tags during their feeding period as far north as possible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

## 2. Materials and Methods

All procedures followed the handling and tagging protocols in 2020 (Ferter et al., 2020).

### *Study area and period*

The field study was conducted north of 60°N between Bergen and Ålesund in western Norway between the 11<sup>th</sup> of August and 6<sup>th</sup> of October 2021 (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 2020, the aim of this study was to deploy the PSATs as far north as possible in Norwegian waters. A total number of 20 effective fishing days were conducted from IMR's tagging vessel. All experimental procedures were approved by the Norwegian Food Safety Authority (FOTS ID 24304) and the Norwegian Directorate of Fisheries.



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

### *Fishing equipment and methods*

Six of the fish were caught from the research vessel, and three from collaborating recreational fishing boats (table 1) using fishing rods in the 130 lbs range, and reels of at least size 80. Eight fish were fought stand-up using a fighting belt (Black Magic XL wide Equalizer gimbal and harness system), and one from a rod holder mounted to the boat (ID 4). Spreader bars 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 were 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 (except for ID 1). Afterwards, the fish was pulled into the boat 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. 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 immediately back into the water without any further treatments, based on experience from 2020 (Ferber et al., 2020).

## **3. Results**

A total number of nine BFT were tagged with both PSATs and conventional spaghetti tags during the 20 fishing days (table 1). All fish were tagged north of 60°N (figure 1, table 1). The size of the fish ranged from 244 cm to 292 cm (CFL). Six fish were caught from the research

vessel and three fish (IDs 4, 7 and 8) were transferred from a recreational fishing boat to the research vessel. In all cases, the fighting time was below one hour.

**Table 1:** Overview of the five BFT tagged along the coast of Norway in 2021.

Date	ID	Boat	Release time	Release position	CFL [cm]	Angling duration [min]	PSAT ID	Conventional
30.08.2021	1	Tagging boat	16:40	62° 30.670N 5° 27.499E	253	15	20P2966*	BYP031128
16.09.2021	2	Tagging boat	14:15	62° 18.848N 4° 31.502E	242	20	20P2993*	BYP031144
16.09.2021	3	Tagging boat	17:10	62° 18.848N 4° 31.502E	290	50	20P2985*	BYP031509
16.09.2021	4	Recreational boat	20:30	62° 33.726N 5° 16.712E	270	60	20P2988*	BYP031160
29.09.2021	5	Tagging boat	14:15	62° 13.991N 4° 47.325E	243	20	20P2968*	BYP031174
29.09.2021	6	Tagging boat	15:56	62° 13.991N 4° 47.325E	292	25	21P0041	BYP031172
29.09.2021	7	Recreational boat	17:25	62° 13.991N 4° 47.325E	275	50	21P0055	BYP031166
30.09.2021	8	Recreational boat	19:50	62° 23.658N 5° 01.183E	244	40	21P0051	BYP031167
06.10.2021	9	Tagging boat	12:25	60° 47.341N 4° 30.987E	275	18	21P0049	BYP031175

\* ICCAT GBYP PSAT

To date, eight of the nine tags have not reported, indicating that they are still attached to the fish, and that the fish survived. One tag was released due to constant pressure shortly after deployment (ID 1), indicating post-release mortality. This tag (20P2966) was physically recovered.

#### 4. Discussion and concluding remarks

The 2021 tagging campaign was a continuation of the 2020 electronic tagging of BFT in Norwegian waters (Fertner et al., 2020). However, the number of tagged fish was almost doubled from five fish tagged in 2020 to nine fish tagged in 2021. All tags are still attached to the BFT which survived the tagging, 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 3 out of 5 tags from the 2020 tagging project stayed on for an entire year of deployment (unpublished data). 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 both 2020 and 2021 demonstrate high retention rates of the tag. However, pulling the fish on board also poses extra stress on the fish, and the one post-release mortality observed in this study may be attributed to the on-board handling as the fish was in very good condition otherwise. This individual was the only one which was pulled directly on board after a relatively short fight (15 min). After this mortality event, all fish were towed behind the boat (in 2 - 3 knots) before they were pulled on board and all these fish survived, leading to an overall

very high survival rate, as demonstrated in other studies (Stokesbury et al., 2011; Horton et al., 2020). Thus, no changes to the protocol are suggested for future tagging studies.

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 migration pattern and behavior of BFT in its northernmost distribution area.

## **5. Acknowledgements**

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