TAGGING PROGRAMME 2015 – ICCAT/GBYP 05, OBJECTIVE A AS MODIFIED BY THE GBYP STEERING COMMITTEE ELECTRONIC TAGGING OF ADULT BLUEFIN TUNAS BY PURSE-SEINERS IN THE EASTERN MEDITERRANEAN"

Final Report

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Summary

Abstract

The scientific tagging campaign was carried out in the Eastern Mediterranean, mostly the Gulf of Antalya, with a partnership between the University of Istanbul, Faculty of Fishery, and Consorzio Unimar, Italy.

Tagging campaign was carried out using electronic tags in order to provide additional data to better understand the behaviour of Bluefin tuna.

An additional tagging campaign, , recommended by the ICCAT GBYP Steering Committee, was carried out in the "Tonnara" of Carloforte (Sardinia, Italy) in order to deploy some tags not deployed in the first part of the campaign.

Keywords

Bluefin tuna, *Thunnus thynnus*, Mediterranean, Eastern Mediterranean Sea, Sardinian Sea, tagging, purse seine, fixed traps

1. Background and objectives

The main objectives of the ICCAT Atlantic-Wide Bluefin Tuna Research Programme (GBYP) are to improve: (a) the understanding of key biological and ecological processes, (b) the current assessment methodology, (c) the management procedures, and (d) advice.

Key tasks are to reduce uncertainty in stock assessment and to provide robust management advice. This requires improved knowledge of key biological processes and parameters. However, currently almost all the data used in stock assessments are obtained from the fisheries-dependent data. It is therefore important to obtain data from alternative sources, such as tagging studies, in order to verify the assumptions made when conducting the assessments.

The specific objectives of the tagging activity in the medium term (according to the ICCAT/GBYP Tagging Design) are:

a. validation of the current stock status definitions for populations of BFT in the Atlantic and Mediterranean Sea;
b. estimation of biological parameters such as growth, natural mortality rates (M) of BFT populations by age or age-groups;
c. estimation of tagging reporting rates for conventional tags, by major fishery and area, also using the observer programs currently deployed in the Mediterranean fisheries (ICCAT ROP-BFT);
d. evaluation of habitat utilization and large-scale movement patterns (spatio-temporal) of both juveniles and spawners;
e. e) estimation of the retention rate of various tag types, due to contrasting experiences in various oceans;
f. f) estimation of the feasibility of tagging BFT in traps and purse-seiners by divers getting at the same time reliable size estimates.

The ICCAT GBYP Steering Committee in 2015 recommended to concentrate the efforts for Phase 5 toward electronic tagging in order to provide additional data to improve the understanding of Bluefin tuna behavior.

2. Methodology required

This report refers to the activities carried out in the Eastern Mediterranean Sea according to the ToRs of the Call for Tenders.

The methodology provided for the electronic tagging of adult Bluefin tunas by purse-seiners in the Eastern Mediterranean Sea – included, among others, the following specific tasks:

a. deployment of 40 miniPATs on adult Bluefin tunas;
b. the time-frame for tagging shall be mid-May 2015 to mid-July 2015;
c. purse-seiners shall be the type of vessel to be used for tagging; the total number of vessels by area shall be sufficient for reaching the final objective, with a minimum of one vessel;
d. adult tunas shall be tagged by divers directly underwater, fish can be kept in the seine or moved into a cage; each fish shall be tagged by an expert diver, possibly following the same methodology reported in SCRS/2014/189. Tagging shall be recorded with underwater stereo-cameras, with the purposes of estimating the size of each individually tagged fish; sequence of tags, pictures and laser estimates shall be properly recorded for future uses and controls. Number of each tag and length estimates shall be recorded on the ICCAT form;
e. carring out biological sampling during the tagging activities; biological samples must be collected from the same fish school, as much as possible. Sampling shall be conducted according to the protocols adopted by the Contractor(s) in charge of the biological and genetic sampling and analyses; the samples shall be shipped to the laboratory in charge.
f. the hiring of a Coordinator for tagging activities with specific experience in electronic tagging of tunas. The Coordinator shall be responsible for directly managing all the field activities and the scientific team;
g. the hiring of a tagging team.

3. Materials and methods

The team participating to the field activities was composed of a partnership between Turkish and Italian scientists. The Turkish partner was the Faculty of Fisheries – University of Istanbul, with the tagging coordinator (Prof. Saadet Karakulak) and a tagging team member (Taner Yildiz). Related to the same partner there was also a Subcontractor, Akua Grup, which was in charge of the necessary logistic support, namely the fishing boat (or boats), fishing crew, and the divers for supporting the field activities. The Italian partner was Consorzio Unimar with the same team that carried out the tagging in the South Tyrrhenian Sea in 2013 (Adriano Mariani, Marco Dell'Aquila, and Massimiliano Valastro)

3.1 Preliminary meeting

In order to share and agree the field activities, adapting the experiences of the past tagging activities of 2013 to the partially new situations, a series of informal meetings and exchange of information were held among the participants.

It was also decided to organize in Izmir a preparatory meeting to discuss about all the practical aspects and possibly identify all risks and the way for minimizing them. The meeting was held on May 15, 2015 with all the participants to the campaign (Figure 1).

During this meeting, the Italian Team reported about the method provided for the GBYP 2015 satellite tagging campaign in the Eastern Mediterranean, which was built upon the previous method successfully tested by the team of Unimar during the conventional tagging campaign, carried out in 2013 in the central Tyrrhenian Sea.

The field organization was agreed, particularly for the starting date. According to the fishermen, the best choice was to perform the work at the very beginning of the fishing campaign (although in such circumstances, the hazard to recapture some of the tagged tunas, appeared clearly too high, this which was repeatedly told by our team to the Turkish fishermen). This was also not in line with the GBYP instructions.

The other possibility (to carry out the tagging after the fishing campaign, as suggested by the scientific team and the GBYP coordination) would have resulted in greater costs for them, and the non – availability of the divers team, according to what was reported by the Turkish fishermen.

Therefore, taking into account these constrains, the scientific team agreed to be ready before the official beginning of the campaign.

3.2 Geographic area

The area of the scientific tagging campaign was the Eastern Mediterranean mainly the Gulf of Antalya where Akua Grup fleet was going to operate.

The fishing operations were focused mainly on the western slope of the Antalya basin, where the underwater topography shows a rapid ascent in the proximity of the Anaximander ridge. The area is characterized by a major mesoscale current instability generated from the western Cyprus gyre and the main northern Levantine current path. This specific area is not among the known spawning areas for Bluefin tuna and therefore it is likely that this great concentration of tuna was there due to the high variability of physical factors able to boost positively the food chain. Anyway, the ecology of Bluefin tuna in this part of the Levantine Sea is still unclear.

3.3 Fishing activity in the area

20 purse seiners whose length ranged between 32 and 62 m, were present in the North Levantine Sea during the tagging activity. The fishing strategy, generally consisted in detecting the fish school mostly by sonars, surrounding it with the purse seine and closing the net with groups of 7-8 co-operating purse seiners to search the school and to catch it (Figure 2).

3.4 Vessel

The scientific crew attended BFT fishing operation on a purse seine vessel (Cinar İbrahim). The vessel was 50 m in length, 623 gross tonnages, and powered by 3770 HP engines. This boat was equipped with cutting edge electronic systems like sonar, echo sounder and a particular sensor that used a software to visualize the composition of the fish school biomass.

3.5 Tagging

UNIMAR received the following technical equipment which was selected and to be used according to the best opportunities on field (Figure 3):

- 40 electronic miniPATs tags + 1 miniPAT applicator;
- 50 conventional spaghetti tags;

3.6 Spearguns

The equipment used included three “arbalete” spear guns (Figure 4), respectively 120, 95, 90cm all equipped with a single or coupled power band . The shaft head was properly milled to host the 3mm spring steel applicator pin. As in the 2013 campaign, videos of the firing phases were recorded using a GoPro video camera installed on the side of the spear gun using a specific mounting bracket.

Just before the beginning of the tagging campaign, several ballistic trials were carried out in order to test the spear gun efficiency. With the best ballistic compound, a 2,5mm thick plastic bin, was pierced by accurate shots even at a distance of 3m., with a spear shaft fully rigged with a fake mini Pat tag.

In order to guarantee the best hold of the dart and avoid to wound the fish too much, it was decided to stop the dart penetration just some centimetres from the fish skin, using a rubber stop, locked on the shaft, through a thickness.

The hold of the dart was tested on board a few days before the tagging operations, on a dead tuna brought on board during the early fishing stages. The dart was implanted with the manual applicator on the back of a fish of about 130 kg, in to a depth of 6 cm and despite the attempt to pull it off with force, it was necessary to use a knife to detach the dart from the fish back

3.7 Recording system

The videos of the tagging were recorded by a GoPro 3 Hero Black edition video camera (video camera + underwater case) installed on the side of the speargun using a specific mounting bracket (Figure 5). The video camera was set up with the following parameters:

- video resolution 1440p
- PAL system 52 frame per second

4. Detailed activities

The scientific crew was based on the fishing boat “Cinar İbrahim”. This boat participated to the campaign as a support boat, for the organization, search and spotting of the tunas, but without fishing net on board.

All the scientific team members were ready at the Gazipasa Port, Alanya, south of Turkey, on May 24, and boarded on May 25, 2015. Table 1 show the list of the activities by day.

Fishing activities were carried by more than one fishing boat belonging to the same group (other groups were also fishing in the same area in the meantime). Searching was not carried out (or not mainly) through direct visual spotting of tunas (very few tuna schools were spotted at the surface), but through the detection of schools by sonar, with two or three boats moving ahead parallel to cover a wider sea area.

During the night between May 25 and 26, 2015, a first school was caught.

Fishermen however decided to continue fishing activity, waiting for a more convenient time under more favourable moment for them to carry out the tagging. Probably they didn't want to stop because of the very intense fishing activity going on in the surrounding area.

5 days have passed and the group of fishermen belonging to Turkish subcontractor made other catches, without the possibility for the scientific team to carry out the tagging.

In the afternoon of the fifth day a tuna school of a reported size of about 150 fish was caught, and made available for the tagging (Table 3). However, we estimated it was not safe to start the operations so close to the sunset, and asked them to move the fish into a cage, to carry out the tagging the day after under more favourable and safe conditions. In this case it was also possible to avoid stopping two fishing boats which were necessary for keeping the net in suitable conditions, and avoiding as well the possibilities for the tunas to have some accident and mortality inside the net during the night.

Tagging operations started at the early morning of May 31, 2015. In Figure 6 the position of the tagging operations and the movements during fishing campaign are shown.

5. Results

5.1 Catch and tagging operations

The cage had a size of 25 m diameter and an average depth of 10 m.

During the first diving we discovered that the number of fish was about 40 (the exact number of fish to be tagged), on the contrary of what was initially reported.

The tagging operations began in perfect weather and sea conditions. The first dive performed at 8.30 a.m., proved the quiet behaviour of the school. After a short briefing, it was decided to proceed with the tagging operation. Guided by the need of a very conservative and "precautionary" approach, in order to avoid any possible risk of frenzying reactions of the fish, it was decided to perform the tagging with a single operator with the longest and most powerful spear gun through slow and silent free diving descent.

Probably because of the few fishes in the cage, the operational scenario appeared immediately complex (Figure 7 show the situation in the cage during the tagging operation: the cage was very large and deep, leaving to the fish a very great space were they could swim; considering the small number of fish, it was very difficult to approach the fish to the right distance for the tag). Although initially the swimming of the tunas appeared calm and regular, the operator could hardly ever have a good shot at less than 2m from the fish back. Despite the ballistic tests proved the wooden arbalete 120cm, powered by a single power band, to be the most suitable for accurate and powerful long distance shots, during the initial stages of the tagging operation, it was necessary to increase the power of the spear gun, coupling the single power band, with another circular one, to ensure a complete penetration of the dart trough the fish skin (Figure 8).

Thanks to the optimization of the set, it was possible to place the first tags with reasonable accuracy . Unfortunately, after about the deployment of the first 6-7 tags, a growing number of misfire shots shown a drastic change in the fish behaviour, which once lost their initial curiosity, in a clear defensive attitude began to swim very fast and compact, crossing the operator at distances and angles incompatible with a good shot.

Thanks perhaps to the several breaks made between shots, at the end of the first cycle of operations lasted about 5 hours, 17 tags were successfully deployed. At this stage, the objective difficulty to continue with only one diver, forced us to modify the strategy.

The tagging proceeded with the aid of two additional scuba divers and the deployment of other 14 tags. Obviously in this context, with increasingly nervous and fast swimming fish, the risk of double

tagging the same fish was very high, so once recorded the second episodes of double tagging, it was decided to stop the tagging operations.

Because of the general conditions, it was decided not to continue the campaign; fishermen were still completely absorbed by the intense surrounding fishing activity, and there were not the operative conditions to continue the work in a satisfactory way.

At the end of the activities 30 pop-up tags were applied on 28 large fishes (two fishes were double-tagged) (Table 4).

5.2 Trials of tune size estimates method.

At the end of tagging activities, after tunas were released, some trials were carried out with a fish dead during fishing operations. The sample was hanged horizontally at 4 meters depth, and many videos were taken with the camera mounted on the spear gun, simulating different shooting distance from the fish, using the spear shaft and its line as reference. Images were also taken rotating the spear gun to get different angles in order to "mime" the different possible approaches to the fish during tagging activity (Table 6; Figure 10).

A better estimate of tuna size will be determined using the analysis of images coming from the video-camera mounted on the spear guns, using an algorithm that compares images of tunas with a series of images of a graduated pole, taken from a known distance (SCRS/2014/189). The videos will be very useful to tune the calculation of size estimates, being known the length of the tuna sample; the same algorithm will be improved using the size collected by the tuna sample.

5.3 Biological sampling

A total of 4 bluefin tunas, dead during different fishing operations, were also sampled for the biological sampling, according to the requested protocols. . The samples will be provided to the Consortium headed by AZTI.

5.4 Methods of video analysis

Video analysis methods were set up for the 2013 tagging campaign and they were reported in details in the final report. Further trials, however, were carried out and reported in this report in order to improve the method. Trials were carried out on dead tunas of known sizes, in the Eastern Mediterranean campaign as well as in the Sardinian campaign.

6. Amended activities in Sardinian traps.

After the tagging campaign in the Levantine Sea, 9 pop-up tags were not deployed (1 tag was defective , therefore unusable) (Table 2, Table 5).

Following the recommendations of the GBYP Steering Committee, in agreement with GBYP Coordinator, and with the Consortium in charge of GBYP tagging in Sardinian traps, it was agreed to deploy the remaining tags on bluefin tunas in Sardinian traps. An amendment to the contract with ICCAT allowed this operation.

After some contacts with the responsible of tagging activities in Sardinia (Piero Addis, COMBIOMA) for setting the organization, the tagging team (composed of Dr. Mariani, Dr. Dell'Aquila and Dr. Valastro) arrived in Portoscuso – Sardinia - on June 29th, 2015.

The team was operative on June 30th, 2015, waiting for the tunas to enter into the last section of the trap ("death chamber"). After some time it was not possible to finalize this passage, therefore tagging was postponed by one day.

On 1st July, our team together with the COMBIOMA team, reached the last portion of the trap on a small vessel, were in a large pool ("death chamber"), a small group (50-70 fishes) of medium sized tunas were gathered for tagging purpose. The trap portion measured about 20m long, 10m wide and 15 m depth.

The approach adopted by our team was the same as for the Turkish tagging campaign, and included for the trial a new experimental spear gun, which was deemed too powerful for the relative small size of the fish (Figure 9).

The two divers on duty, alternate their silent freediving, easily implanting all available tags. As it happened in Turkey, just at the end of the tagging operation, some difficulties occurred due to the small number of fish gathered in the trap, which once aware of the tagging, made the operators' task more complicated, increasing their speed and movements. This episode clearly shows the need to operate in an optimal space (quantity of water) with a redundant number of fish, at least 300 % the number of tags to deploy, both electronic and conventional.

After the end of the tagging operations, the tuna school was released into the wild.

At the end of tagging activities, after tunas were released, some trials were carried out with a fish dead during fishing operations (Table 6, Figure 11). The objectives was the same of the Turkish trial.

The spear gun used , was the reliable 120cm powered by two circular power bands. The gun was always coupled by a GoPro video camera put on a special bracket.

In order to prevent possible post release infections , every dart was properly treated with a water proof disinfectant spray.

The Sardinian tuna trap, presented a completely different operational scenario that our team faced since the first open water tagging campaign in 2013. It confirms that the ductility of the methodology adopted so far, is suitable for the various situations encountered on the field. In the next future, it could probably turn useful invest some resources for testing different darts and applicators.

7. Conclusions and recommendations for future improvements

At the end of the tagging campaigns it is convenient to underline some focal points, useful for future improvements.

From the point of view of the methods, the methodology adopted showed its ductility. Keeping always as the first reference the need of adopting a conservative approach, in order to avoid risks of mortality, the best method is to keep the fish quiet and in a wide space as much as possible. The calmness behaviour of the fish allows as well to operate in the proper way, which is essential above all when tagging with pop-up tags.

This need requires also having the availability of a number of fish, which shell be much higher than the number of tags, otherwise it will be increasingly difficult to have fish which can be approached by the diver.

After 3 field campaigns (South Tyrrhenian 2013, Eastern Mediterranean and Sardinia 2015) we tested many different settings of the spearguns and shafts, identifying, for each situation and also depending on the size of the samples, the best equipment.

According to our experience, the use of different kinds of darts should be further studied and analysed. Unless the dart is deep inserted by hand into and through the rays of the dorsal fin, some doubts remain about the holds of dart, once inserted into the flesh, also according to the different size of the tunas. Once a detailed analysis of the data obtained from the many tags which popped-off so far is finished, it will be possible to better understand the reason for the surfacing, either fishing or premature detachment. Unless, as it is quite unlikely, all the tags surfaced because the tunas were fished, it will be very important to carry out parallel trials with different types of darts.

Final remarks should be about the available time for the preparation of the fishing campaign, which was very tight. When the time is so reduced, as it was this year, everything becomes increasingly difficult, and possible unpredictable problems can arise much easier thereby undermining the results.

Having more available time means to have the chance to prepare better the field activities and to discuss about operational choices.

Finally, a better planning of the field activities, particularly about the need to deploy the tags at the end of the fishing season, will certainly reduce the difficulties we encountered this year with the fishermen. For sure, the tagging activity shall not be in parallel with any current fishing activity for Bluefin tuna. This will certainly imply much higher costs due to the need of hiring a professional vessel and a tug vessel with a cage, along with the necessary crew and divers, but possibly will result in a much better cost-benefit balance, particularly taking into account the cost of the electronic tags.

Table 1 – Tagging activity by day, Eastern Mediterranean sea.

N	date	Activity*	N° of fish	Size range (FL cm)	N.	Death	Weather condition	Note
1	25/05/2015	sighting				0	calm	
2	26/05/2015	sighting				0	calm	
3	27/05/2015	sighting				0	calm	
4	28/05/2015	sighting				0	calm	
5	29/05/2015	sighting				0	calm	
6	30/05/2015	sighting catch	150			0	calm	
7	31/05/2015	tagging	40	200-300	30**	0	calm	

*Activity of boat "Cinar İbrahim".

**One tag had the corrosible attachment link broken (Tag 14P0510).

Table 2 – Tagging activity by day, Sardinian Sea.

N	date	Activity*	N° of fish	Size range (FL cm)	N.	Death	Weather condition	Note
1	30/06/2015					0	calm	
2	01/07/2015	tagging	50-70	100-150	9	0	calm	

Table 3 – Eastern Mediterranean sea, catching ad releasing coordinates

	Date	Time	Lat N°	Long E°
Catching	30/05/2015	16:30	36.453483	31.657083
Releasing	31/05/2015	15:30	36.429367	31.507733

Table 4 – Eastern Mediterranean Sea: list of the deployed tags

S/N	Area	Date of deployment	FL (cm)	RWT (kg)	notes
10P0551	Eastern Mediterranean Sea	31/05/2015	300	481	
14P0209	Eastern Mediterranean Sea	31/05/2015	250	279	
14P0291	Eastern Mediterranean Sea	31/05/2015	260	313	
14P0314	Eastern Mediterranean Sea	31/05/2015	230	217	
14P0464	Eastern Mediterranean Sea	31/05/2015	270	351	
14P0468	Eastern Mediterranean Sea	31/05/2015	255	296	
14P0471	Eastern Mediterranean Sea	31/05/2015	270	351	
14P0476	Eastern Mediterranean Sea	31/05/2015	295	458	
14P0477	Eastern Mediterranean Sea	31/05/2015	305	506	
14P0488	Eastern Mediterranean Sea	31/05/2015	305	506	
14P0489	Eastern Mediterranean Sea	31/05/2015	250	279	
14P0490	Eastern Mediterranean Sea	31/05/2015	255	296	
14P0494	Eastern Mediterranean Sea	31/05/2015	300	481	
14P0502	Eastern Mediterranean Sea	31/05/2015	230	217	
14P0510	Eastern Mediterranean Sea	31/05/2015	240	246	broken
14P0512	Eastern Mediterranean Sea	31/05/2015	265	332	
14P0521	Eastern Mediterranean Sea	31/05/2015	290	435	
14P0542	Eastern Mediterranean Sea	31/05/2015	285	413	
14P0552	Eastern Mediterranean Sea	31/05/2015	230	217	
14P0553	Eastern Mediterranean Sea	31/05/2015	270	351	
14P0556	Eastern Mediterranean Sea	31/05/2015	290	435	
14P0559	Eastern Mediterranean Sea	31/05/2015	295	458	
14P0565	Eastern Mediterranean Sea	31/05/2015	245	262	
14P0568	Eastern Mediterranean Sea	31/05/2015	255	296	
14P0570	Eastern Mediterranean Sea	31/05/2015	300	481	
14P0572	Eastern Mediterranean Sea	31/05/2015	250	279	
14P0573	Eastern Mediterranean Sea	31/05/2015	295	458	
14P0575	Eastern Mediterranean Sea	31/05/2015	280	391	
14P0576	Eastern Mediterranean Sea	31/05/2015	270	351	
14P0579	Eastern Mediterranean Sea	31/05/2015	265	332	
14P0589	Eastern Mediterranean Sea	31/05/2015	240	246	

Table 5 – Sardinian Sea: list of the deployed tags

S/N	Area	Date of deployment	FL (cm)	RWT (kg)	notes
12P0204	Sardinian Sea	01/07/2015	130	39	
12P0205	Sardinian Sea	01/07/2015	130	39	
12P0206	Sardinian Sea	01/07/2015	120	31	
12P0207	Sardinian Sea	01/07/2015	115	27	
12P0209	Sardinian Sea	01/07/2015	140	49	
14P0214	Sardinian Sea	01/07/2015	115	27	
14P0518	Sardinian Sea	01/07/2015	115	27	
14P0534	Sardinian Sea	01/07/2015	145	54	
14P0563	Sardinian Sea	01/07/2015	115	27	

Table 6 – List of the images captured during the trials with the dead fish.

	Eastern Mediterranean Sea			Sardinian Sea		
FL (cm)	242			113		
RWT (kg)	247			26,1		
	Reference angle			Reference angle		
Reference distance (cm)	45° 	90° 	135° 	45° 	90° 	135° 
100	X	X	X	X	X	X
150				X	X	X
200	X	X	X	X	X	X
250				X	X	X
300	X	X	X	X	X	X

Figure 1 - Preliminary meeting in Izmir

Figure 2 - Fishing vessel during fishing operations in the Eastern Mediterranean Sea-

Figure 3 - Conventional tags and miniPats applied on the shaft.

Figure 4 - Speargun used during the trial (wooden).

Figure 5 - Video camera with mounting bracket.

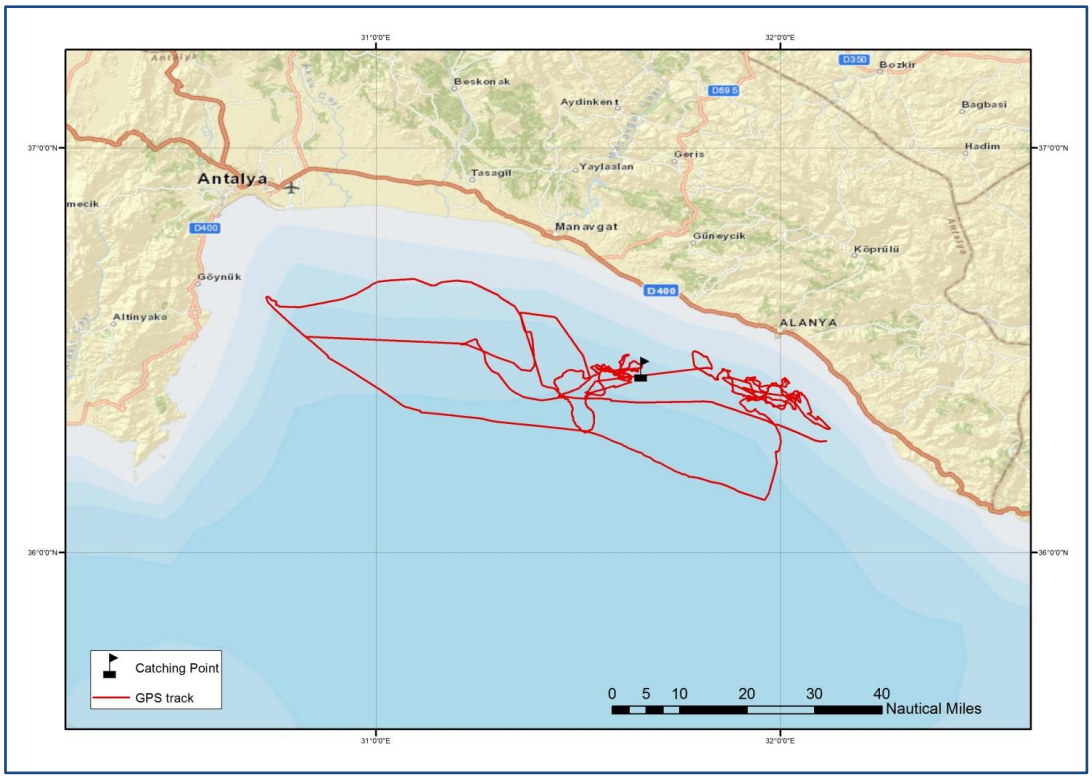

Figure 6 - Position and movements of the purse seiner during the tagging campaign in Eastern Mediterranean Sea.

Figure 7 – Free diver during a tag operation in Eastern Mediterranean Sea.

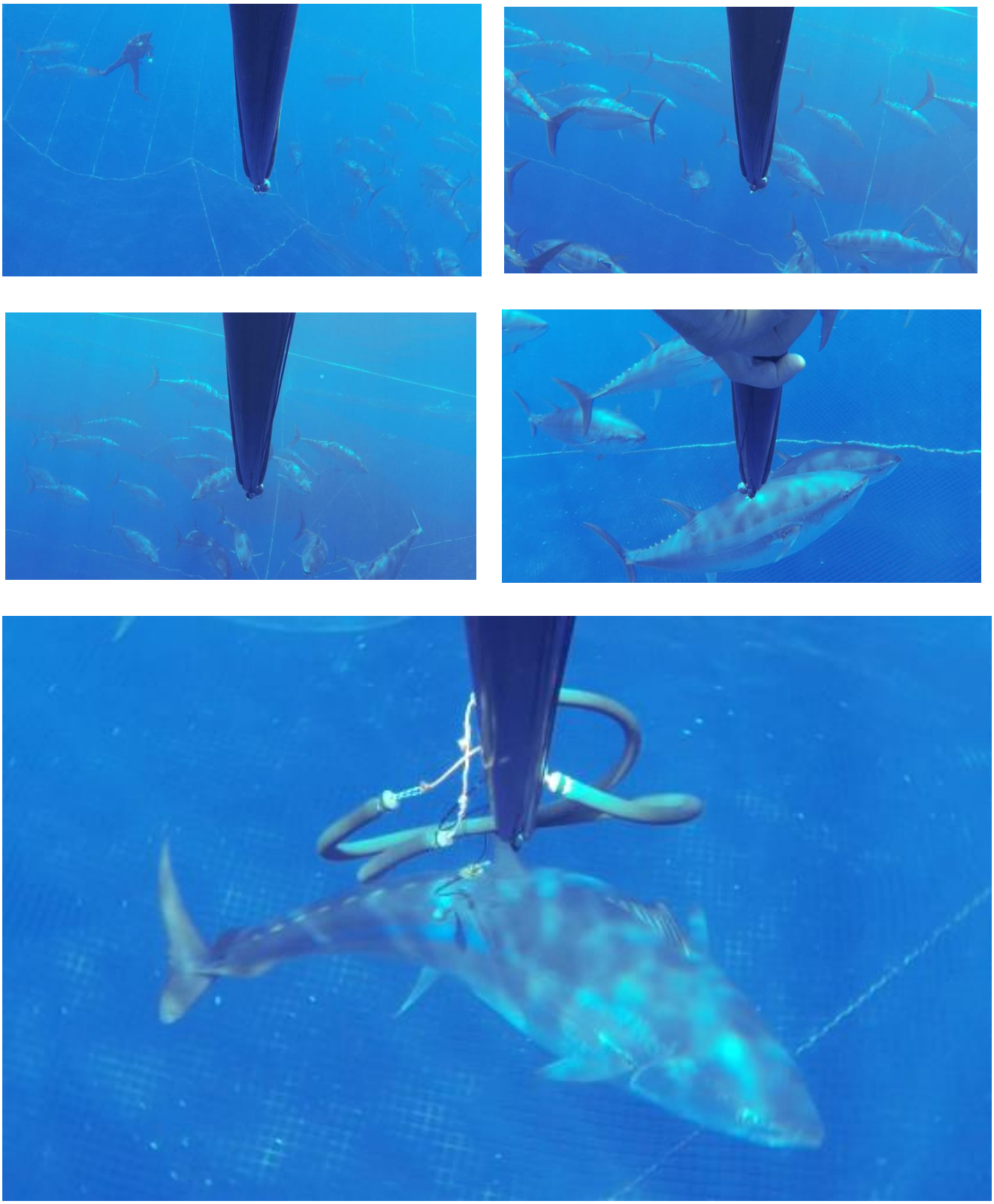

Figure 8 - Example of tagging (Eastern Mediterranean Sea).

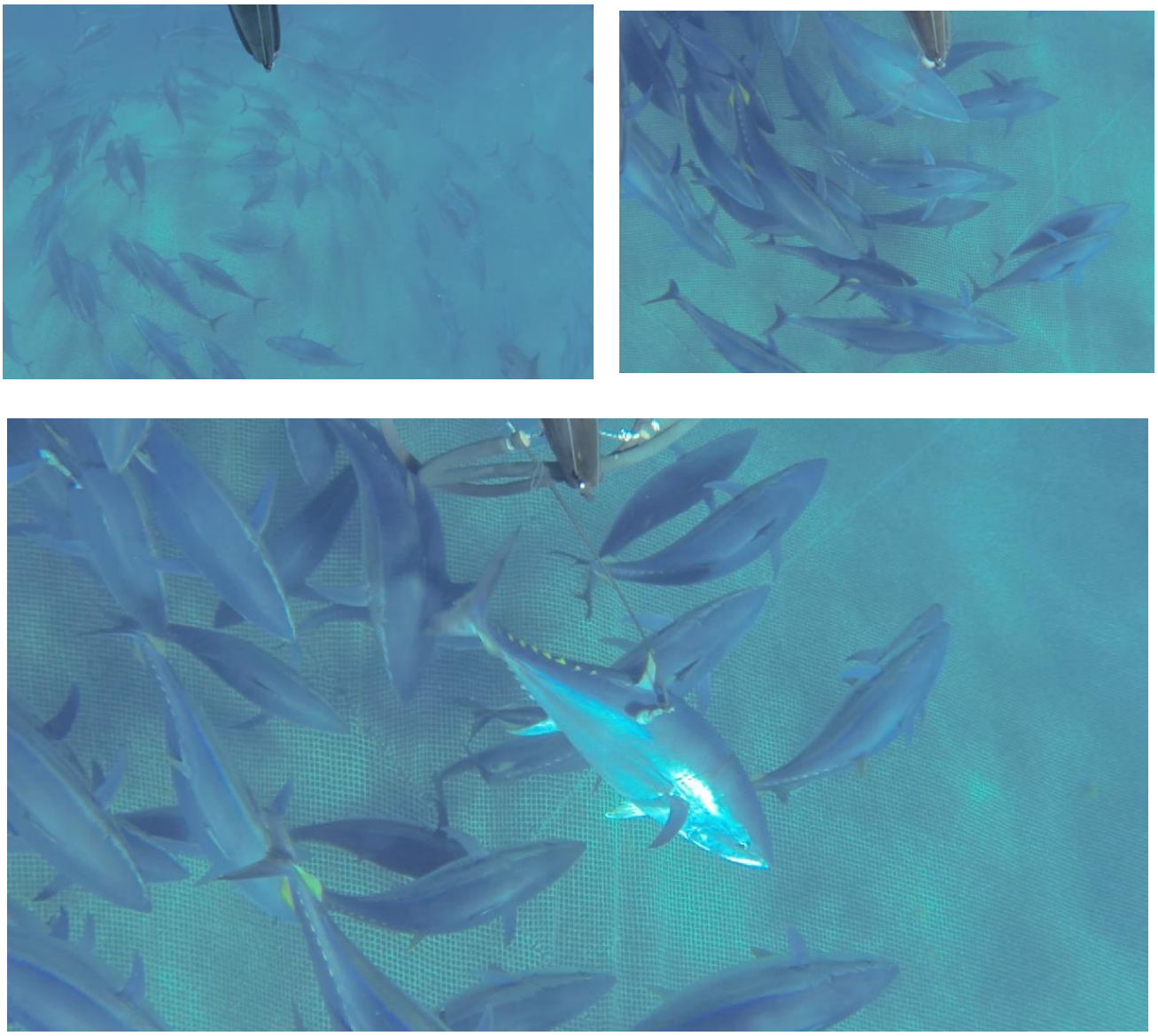

Figure 9 - Example of tagging (Sardinian Sea).

Figure 10 - Trials with the fish dead during the fishing activities (Eastern Mediterranean Sea).

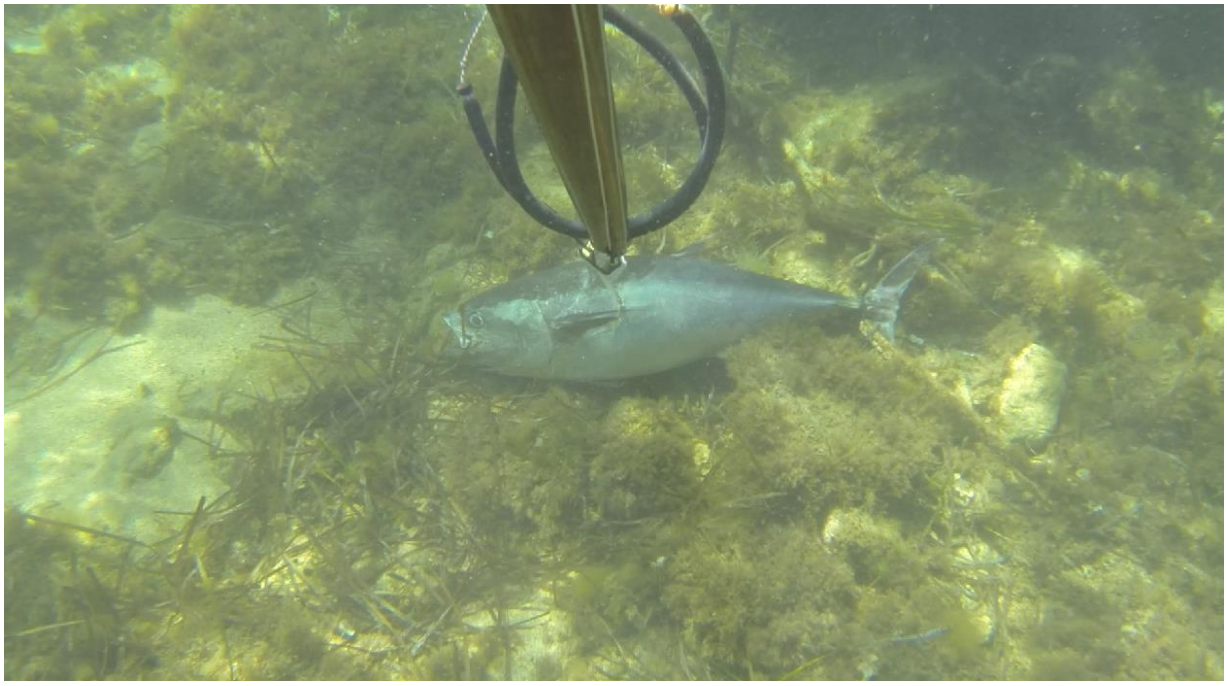

Figure 11 - Trials with the fish dead during the fishing activities (Sardinian Sea).