Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area, concluded under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

Accord sur la Conservation des Cétacés de la Mer Noire, de la Méditerranée et de la zone Atlantique adjacente, conclu sous l'égide de la Convention sur la Conservation des Espèces Migratrices appartenant à la Faune Sauvage (CMS)

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FINAL REPORT:
TUNISIAN DOLPHIN PROJECT
POPULATION SIZE AND HABITAT USE FOR BOTTLENOSE AND COMMON DOLPHINS

Delegates are kindly invited to bring their own documents to the Meeting.
This document will be available only in electronic format during the Meeting.

Accord sur la Conservation des Cétacés de la Mer Noire, de la Méditerranée et de la zone Atlantique adjacente

ACCOBAMS

Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area

The Tunisian Dolphin Project (TDP), *Final Report*

TDP Tunisian Dolphin Project

In association with

UN environment United Nations Environment Programme

MAP

SPA/RAC

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ATUTAX Association Tunisienne de Taxonomie الجمعية التونسية لتصنيف الكائنات الحية

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Ibrahem Ben Amer (M.Sc. marine Biology), expert and consultant

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1. Summary

The Tunisian Dolphin Project (TDP) is a research initiative that started in 2009 mainly to monitor and assess the status of the local bottlenose dolphin (*Tursiops truncatus*) population that forge in the Channel and Lake of Bizerte. The first stages of the project were financed by SPA/RAC and has started on a very small scale (Aissi 2010). In 2015, the project expanded and developed with the main aim of establishing a long-term monitoring programme for coastal dolphin species occurring in the same area with the aims of; *assessing the* status of the population and estimate its size; monitor the impact of anthropogenic activities taking place in the area such as fisheries which is operating intensively in the area.

In 2015, and under the support of the Specially Protected Areas Regional Activity Centre (SPA/RAC), the TPD started a mark-recapture survey to compile data that will eventually lead to the population estimate (MoU N° 43 RAC/SPA_2015). The project also monitored the state of interaction with the local fisheries and looked for possible impacts of other anthropogenic activities in the region (UNEP/MAP-RAC/SPA, 2015). In 2016 and all the way to September 2017, and under the collaborate support of ACCOBAMS and SPA/RAC, the team expanded the survey area to include the entire northern Tunisian coast. The team continued building the photo-identification catalogue and monitoring the interaction with the local fisheries.

The study resulted in total marking of 59 individuals of bottlenose dolphins (*Tursipos truncatus*) in which they were identified and catalogued using standard methods of photo-Identification (43 individuals in 2015, 13 in 2016, and 3 in 2017). no fieldwork was carried out during 2018 due to administrative and logistic reasons which are explained in more details in this report.

The study also concluded that the Bay of Bizerte area might be qualified as an important feeding ground for bottlenose dolphin since the area is known for its richness (from the fresh water interring the bay from the lake and channel) and since most of the dolphin's sightings made were associated with feeding behavior.

The survey team has also kept records of other marine species of interest which were encountered during the survey such as birds, pelagic fish and jellyfish. The team managed to record the presence of important bird species such as Scopoli's

shearwater (*Calonectris diomedea*), Audouin's gull (*Ichthyaetus audouinii*), Little Tern (*Sternula albifrons*) and others.

There were few obstacles encountered during the survey's time but unfavorable weather conditions was the main issue that hindered the survey from covering the entire Tunisian Northern Coast in that period.

2. Introduction

The bottlenose dolphin (*Tursiops truncatus*, Montagu, 1821) is by far one of the most studied species of the known 85 cetaceans around the world (Wells and Scott, 1999). Nowadays, studies as far back as the 1970's can be found conducted in various parts of the world (Würsig and Würsig, 1977; Hammond and Thompson, 1991; Williams *et. al.* 1993; Notarbartolo de Sciara *et. al.,* 1993). The species is worldwide distributed and can be found in both hemispheres in tropical and temperate waters not exceeding 40˚ latitudes (Leatherwood and Reeves, 1983). However, in the North Atlantic the species is found beyond these boundaries and in higher latitudes, as is the case in the North Sea (Wilson *et. al.,* 1999), Norway and Iceland (Wells and Scott, 1999). The species is also known to inhabit both coastal and offshore habitats with the majority of the world population tending to be an inshore dwelling species (Jefferson *et. al.,* 1993). In the Mediterranean Sea, the species is mainly found in the coastal neretic waters and considered the most common species of cetaceans within the basin (Notarbartolo di Sciara and Demma, 1994). In several cases (e.g. Cañadas 2002; Forcada *et. al.,* 2004; Kerem *et. al.,* 2012), it is documented in areas as deep as 500m exceeding the costal continental shelf habitat .

The Species is listed in the Annex II (endangered or threatened species) of the Protocol Concerning Specially Protected Areas and Biological diversity (SPA BD). It's also considered among the species to be monitored to assess the Good Environmental Status (GES) of the Mediterranean Sea within the Ecosystem Approach (EcAp) and Marine Strategy Framework Directive (MSFD) processes.

Moreover, the status of this coastal dolphin is classified as **Vulnerable** by the International Union for the Conservation of Nature (IUCN) in the Mediterranean due to several anthropogenic factors (Bearzi and Fortuna, 2006; Reeves and Notarbartolo di Sciara, 2006). These includes; bycatch (Bearzi, 2004), prey depletion (Díaz López & Shirai, 2007), habitat degradation, noise, pollution, urbanization of the coastline, and direct killing (culling and hunting) in previous times (Notarbartolo di Sciara, 2006). These human based impacts may be some of the reasons behind the patchy distribution of the species across the basin (Bearzi *et. al.,* 2008).

In the North African / Middle Eastern coast of the Mediterranean, little research has been conducted along the >5000 km coast. A few studies were conducted in the following countries (following the alphabetical order): Algeria (Boutiba *et. al.,* 1996), Egypt (UNEP/MAP-RAC/SPA, 2016), Israel (Kerem *et. al.,* 2012), Libya (Ben Amer *et.*

al., 2014), Morocco (Zahri *et. al.,* 2004) and Tunisia (Ben Naceur *et. al.,* 2004; Aïssi et al., 2012; Ben Messaoud *et al*., 2012; Aïssi *et al.,* 2015). However, these studies are mostly short term and opportunistic rather than a long-term monitoring program which is advised by relevant regional organizations such as ACCOBAMS (ACCOBAMS resolutions No 2.11) and SPA/RAC (through the EcAp agreed Common Indicators).

In Tunisia, there were few studies concentrating on the species itself (e.g. Aïssi *et al.,* 2012; Benmasoud *et. al.,* 2013; Ben Naceur *et. al.,* 2003). These studies were mostly short-termed and not linked to get a wider picture of the species. A good approach is to adapt a long term programme that will be run annually with robust results (ACCOBAMS Resolutions No 2.11).
Hence, and in 2015, the milestone of such a programme was established in the Northern Tunisia to investigate and study the population(s) of bottlenose and common dolphins in that area. The initiative was titled the Tunisian Dolphin Project (TDP).

3. The Northern Tunisian Coast (Study area)

In General, the northern coast of Tunisia can be divided into two forms from an oceanic point of view; the golf of Tunis and the gulf of Bizerte are mostly shallow in depth with sedimentary bottoms (sand and mud), rich with marine biodiversity and heavily impacted by commercial and artisanal fisheries (The gulf of Tunis is one of the important fishing grounds in the country, Azouz 1973; Zarrad *et al.,* 2001 and *et al.,* 2003).
The other form can be found mostly in the western part of northern Tunisia all the way to the Algerian borders, it comprises of cliff-like coastline with sandy coves, rocky ridged bottom and a steep cont. shelf (IOC *et al.,* 2003; Azouz and Ben Othman 1975). This subregion contains some important fishing grounds for several commercial species of fish, sponges and red coral (Canestrin and Canestrini 1883).
The study area of the project was set in the coastal region between the two SPAMI sites of Zembra archipelagos in the northeast (37.124 N, 10.804 E) and Galite in the northwest (37.526 N, 8.933 E). The area encompasses a 297km of coastline and an estimated area of 4,000km^2 (Figure 1). Since the two targeted species are mainly of costal delphinid, the survey mostly covered shallow waters and rarely crossed the 200m isobaths. Cetacean species are known to occur in the area especially delphinid species (Karaa *et al.,* 2012; Aissi 2010).

4. Materials and Methods

The survey was conducted using a Mark-Recapture special model known as Photo-Identification. It is a method mainly associated with marine megafauna but has also been used with terrestrial animals as well (Powell and Gale, 2015).

The main concept of the method is to mark a proportion of individuals within the population randomly and recapture the marks in a second event. The ratio between marked and unmarked individuals in both seasons is used to estimate the abundance of that population. However, certain assumptions must be met in order for the method to be valid (Nicholas, 1992; Kenneth, 2000).

There are several models used in estimating abundance, each with its own assumptions and criteria. Most of these assumptions are based on the closure of the population to loss or gain of individuals (e.g. mortalities, reproduction or migration), please refer to: Seber 1982; Hammond 1986 and Stevick 2001 for more information.

In the case of bottlenose dolphin, certain natural marks (such as scars, notches and skin lesions) in the dorsal fin and saddle area are captured directly using cameras and a suitable zoom extension (Wursig and Jefferson, 1990; Rosel, 2011). These photos are taken in sequence in certain estimated period of time and in random for all the individuals encountered. (Figure 2). The photos are then processed manually or using computer software (such as: DARWIN, or FIN BASE) and a catalogue of fin images (right and lift) for each individual is built up (Karczmarski and Cockcroft, 1998; Wursig and Wursig, 1977, Read *et al.,* 2003, Wilson *et al.,* 1999). The resulted compiled re-sightings (Capture) of previously 'Marked' individuals can then be used in models to estimate several parameters related to the life history of the population such as; abundance estimation, mortality rate, site and group fidelity (Wursig and Wursig, 1977, Read *et al.,* 2003, Wilson *et al.,* 1999).

5. Survey Protocol

The Survey was carried out in the field from several small fishing vessels (4 - 5 meters long) with external engines. The selected survey line in each trip was set randomly to reduce bias with the aim to cover as much of the survey area as possible. In each trip, there were two observers on the boat, each responsible for the view area from the bow (front) to the beam adjacent (side). When a cue is sighted (dolphins' splash, surfacing or breach), time, GPS location, heading of the group, number of individuals and

behavior were recorded on a dedicated form (or vocally using a Dictaphone) before moving closer to the group. The boat will move closer to the cue location (taking in consideration the guidelines of approaching cetaceans to not disturb the pod, ACCOBAMS and SPA/RAC 2004), further information is noted regarding the behavior change, confirmation of the individuals' number and the structure of the group (calves and adults). After that, pictures were taken randomly of as much individuals as possible in the pod taking in consideration the balance between 'boat-shy' and 'boat-lover' individuals. The pictures were taken using one or two digital LCR cameras with suitable lens attached (Canon EOS 50D with Sigma 70-300mm f/4.0-5.6 lens, and later on the project Canon EOS 7D Mark II with Canon EF 70-200mm f/2.8L IS II USM lens) .

Most of the pictures were taken for the dorsal fin and saddle area of the dolphins in groups or individually. The research team also took note of ecological variables such as sea state, wave height and wind pattern. Afterward, the team will follow the pod for some time to make sure that sufficient number of pictures is taken and to note any change in the behavior of the pod.

Along with collecting data on cetaceans, the team also recorded other data such as the presence of birds (species and number of individuals), pelagic fish and other fauna, marine debris, fishing activities and gear.

At the end of the day, the data is then transferred into a laptop in which the images are processed for the photo-id analysis. The pictures were processed using photoshop software and individuals were named with codes that follows the area of capture, date, track number, sighting number and the sequence of the photo. For instance, BIZ1206150104023 suggest that the picture was taken in the Bay of Bizerte vicinity, on the 12th June 2015 on the first track of that day, on the forth sighting with a sequence number of 23. (Table 1and Figure 3 shows the numbering of individuals and some examples of from the catalogue).

6. Fieldwork Seasons' Breakdown

In July 2015 and through a funding scheme by SPA/RAC (MoU Nº43 SPA/RAC_2015), a survey was designed and established to target the local bottlenose dolphin population that dwell in the Bay of Bizerte area (37.318°N, 9.915°E) (Figure 1). This survey concluded to 44 captures of marked individuals of bottlenose dolphins resident in the area and use the bay mainly. The results of this stage of the study were communicated during several ACOBAMS and SPA/RAC events (e.g. ACCOBAMS

Sixth Meeting of Parties) and in the European Cetacean Society Conference held in Madeira in March 2016 (poster and abstract No. CO05), (please refer to Figure in the appendix).

In summer 2016, the survey continued on a larger scale and expanded to cover the entire Northern Tunisian coast (Figure 1) with a funding scheme by ACCOBAMS and SPA/RAC (MoU 11/2016/FAC) and with co-funding by OceanCare. The newly funded project targeted both the bottlenose and common dolphins (*Delphinus delphis*) species dwelling in the Northern Tunisia. Although there were little encounters of the latter species, the survey managed to expand its cover and to add up to 13 new marked individuals of bottlenose dolphin to the original catalogue and to further look into the interaction with fisheries on a wider scale.

In summer 2017 season, the study continued on a very smaller scale to cover the remaining gap on the Northern Tunisian coast and managed to carry on little effort and only cataloged 3 new individuals of bottlenose dolphins but with more recapture from already marked individuals from the previous seasons.

7. General Results and Indications

The survey took place mostly during the summer/autumn seasons taking into account the local weather pattern and logistics, permits issues. Most of the fieldwork took place between May and September and most of the coverage was done in the Bay of Bizerte area. A total of 21 boat trips were conducted during the whole survey period to cover more than 2,710 km in 182 hours of effort. During these trips, a total of 8,860 pictures were taken of 37 encounters (sightings). Group size varied in each encounter from single individuals and all the way to large feeding groups following trawlers up to 15 individuals.

8. Photo-identification, Catalogue Creation and Analysis

There were more than 5,840 pictures taken during the survey for dolphins, birds and others. Out of this sum, 716 pictures were selected based on the criteria required for the photo-ID analysis. These pictures were facing the dorsal fin of the dolphins on an approximately 90° angel, clear without bluer or haze, the whole fin is visible without any obstacles or splashes and show distinctive marks with good light cast on the fin (Fearnbach *et al*., 2012).

In 2015 the survey resulted in building up the preliminary photoidentification catalogue with 43 identified individuals. Despite this large number in the first year, the recapture of individuals was low, and the resulted Discovery Curve was suggesting that there were more marked individuals in the population.

Along with recapture of the previous 43 marked individuals, there were 13 new individuals catalogued in the 2016 campaign. These individuals were mainly sighted in the western area of the Bay of Bizerte (towards *Cap Blanc*) and all the way to Les Fratellis Islands. This pod was rarely encountered in 2015 sine most of the effort carried out then was in the eastern side of the Bay of Bizerte. West of the Les *Fratelli Islands* and all the way to the end of the study area, there were less encounter rate of dolphins.

In 2017, less effort has been made and only 3 new individuals were catalogued. These three individuals were sighted separately and among well known individuals from previous years. Again, there were more recaptures of known individuals and according to the resulted Discovery Curve, the survey has identified and catalogued a sufficient proportion of the marked individuals in the population (Figure 4).

The population estimation was made via two known methods, the first is based on the direct counting during the observation. This estimate will include the number of the MARKED individuals along with the well-recognized accompanied individuals (e.g. marked females with calves or juveniles). This is an underestimate of the population and will only indicate the minimum number of individuals in the population. The minimum number of individuals gained from the analysis was 64.

Also, a preliminary population estimate analysis was ran in late 2017 on the resulted data. Taking in consideration to only select individuals who possess well-recognized marks (to avoid any under estimation) and to use lift and right-side of the fins in separate models, a close population model was applied using the software MARK© and a preliminary estimate was obtained of 98 individuals from the left-side fins model (67 – 129 individuals) and 133 from the right side (112 – 154 individuals). However, these estimates should be considered cautiously and should be only used to give an insight to the population statues since there was some bias in the analysis due to the relatively small pool of data (three years' worth of data) and the uneven effort distribution in the survey area (more effort was done in the central area around the Gulf of Bizerte than the rest of the region).

9. Behavior Monitoring

Almost 78% of cues and sightings of the dolphins made during the survey were associated with feeding behavior and foraging. Especially in areas were fishing gear are present or operates (around placed nets or chasing after trawlers' nets). Along with being an important fishing ground, this might be an indication that the bay of Bizerte may include an important feeding ground to bottlenose dolphins and other megafauna species.

10. Interaction with fisheries

During the survey, interaction between dolphins and fisheries was observed in many occasions. Dolphins were sighted feeding very close to fixed nets and longline locations. They were also sighted in large numbers following trawlers and feeding very close to the nets especially when the they are hulled (Figure 8). No issues of entanglements or predations were observed during the survey. However, based on information gathered from the local fishers, cases of entanglement had occurred in the past and harassment by the fishers might have also taken place. A separate survey should be conducted to investigate the degree of the interaction and any impacts of the local fisheries on the dolphins' population.

11. Other Sightings During the Survey

The survey gathered information about other marine faunal live such as marine birds species, pelagic fish and jelly fish species. The survey also kept record of the presence and activity of fisheries, hot spots of debris and pollution. Table xx shows the list of the different species sighted and their frequency of observation.

12. Obstacles and Issues Encountered During the Survey

Looking at the aims of the survey in section (2) there are some that were not achieved, these will be discussed here along with some of the obstacles encountered during the survey:

12.1. Concerning modeling the habitat of bottlenose dolphins in the bay of Bizerte, this is an undergoing work at the moment but would require more time and data in order to have reliable results. Compiling data from other surveys running in the area for instance by NGOs like ATUTAX and KETOS is in course.

12.2. Training and collaboration with Libyan researchers also proved to be difficult to achieve due to traveling and logistic difficulties which hindered the Libyan researchers from coming to Tunisia and join the research team.

12.3. Time was also an issue in the survey. Getting the needed permits from authorities took some time and delayed the survey for few weeks. At the end of the survey time (August), there was a need for more boat trips to increase the data pool.

12.4. The previous cameras used for the photo-identification in 2015 were not ideal for the job and that reflected in the proportion of the high quality pictures required for the analysis. However, in 2017, and due to the sponsor of Ocean Care, SPA/RAC and ACCOBAMS to acquire new cameras, this obstacle was overcame.

12.5. Consideration over the weather should also be included in any future survey to try and identify the most suitable season for similar studies. Along with consulting

meteorological organizations in the area, this may also be done through an interview survey with the fishermen to see the most suitable season based on experience.

12.6. Regarding public awareness, this activity was canceled due to some administrative and logistic issues that hindered this phase from completion. A joint decision was made by the hosting NGO, TDP and ACCOBAMS to cancel this stage and consider the project closed for this budget.

13. Future Work and Reflection

13.1. Based on the results from this survey, two important conclusions were achieved are for the conservation of bottlenose dolphins on the national level. First, there are strong indication that the area is a hotspot for bottlenose dolphins and seemed to be an important feeding ground. This would promote the area to be nominated as a Critical Cetacean Habitat (CCH) (Evans 2008). An application should be prepared and put forward to promote the area which will involve more conservation plans for the species. This will also attract more funds for research and monitoring schemes.

13.2. A second step will be to consider a survey on bycatch and interaction with fisheries in the bay of Bizerte. Since there are some primary results from this survey that suggest that the dolphins do interact with the fisheries, it would be beneficial from a conservation point of view to assess this interaction and measure its impacts on the population and the fisheries in the short and long term. A questionnaire-based survey (or interviews) with the local fishing community could achieve those goals.

13.3. Consideration and funds should be located to see the feasibility of introducing a regulated, non-invasive whale watching activity in the area. This pilot project will target several selected fishermen to get involved in this activity especially that the area is considered a regular tourist's destination. If the project runs successfully, it will not only ease the pressure of competition between the fishermen and the dolphins over resources, but it will also provide a second source of income to the local community. Including the ACCOBAMS and the High Quality Whale Watching certification (ACCOBAMS resolution 5.10).

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16. Appendix:

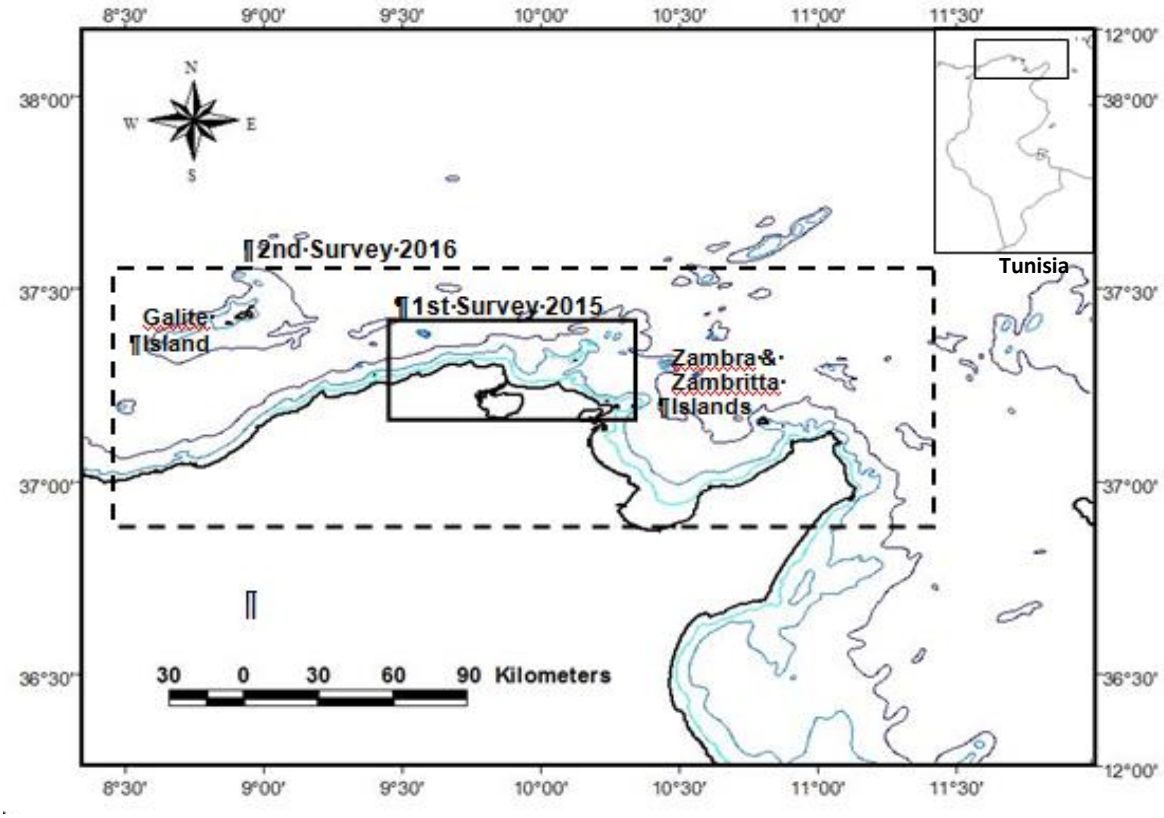

Figure (1): The SPA/RAC survey area of summer 2015, and the ACCOBAMS, SPA/RAC survey in the summer 2016 and 2017. The total area measured to roughly 4,000 sq.km.

Figure (2): capturing the dorsal fin of a dolphin when surfacing to breath. Pictures are collected for both right and left for each individual

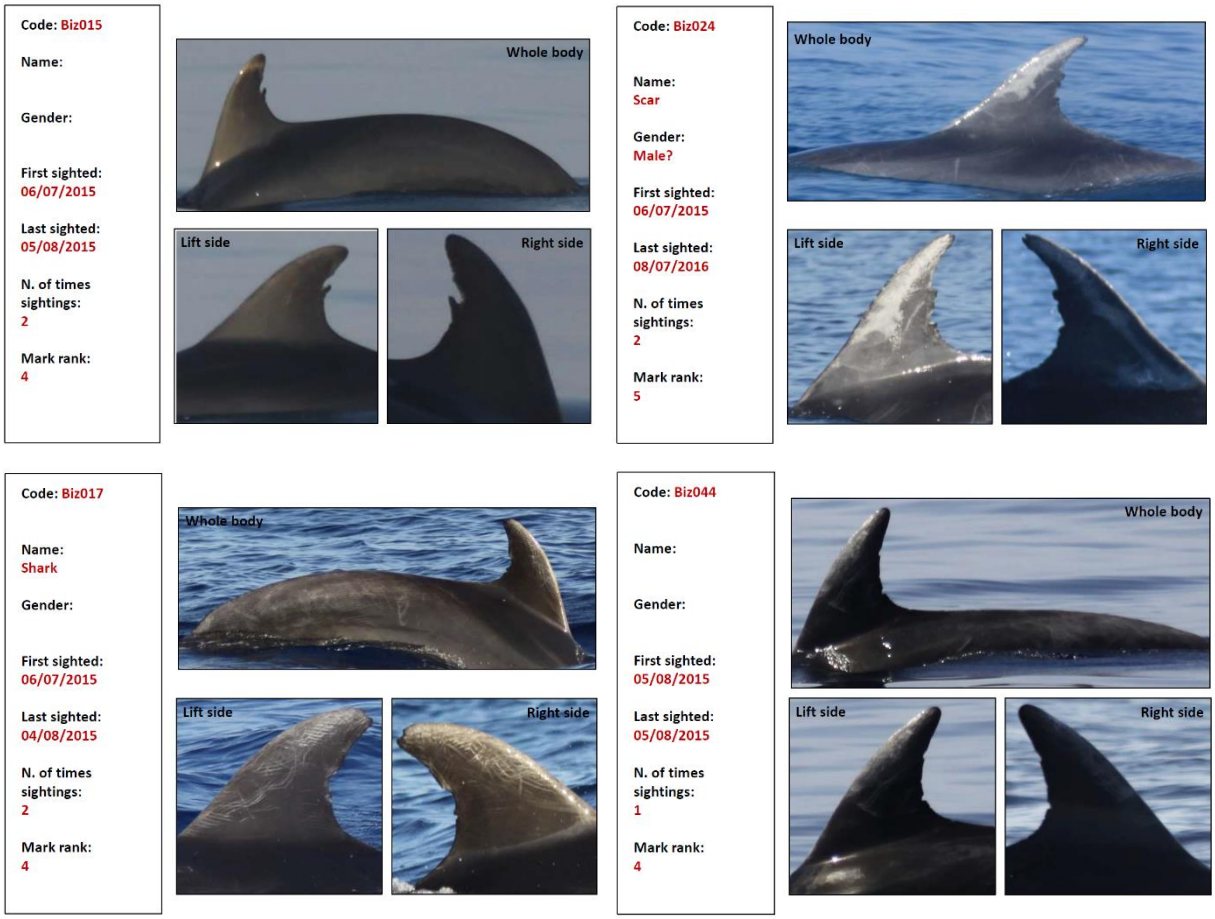

Figure (3): example fact sheet for each individual in the population.

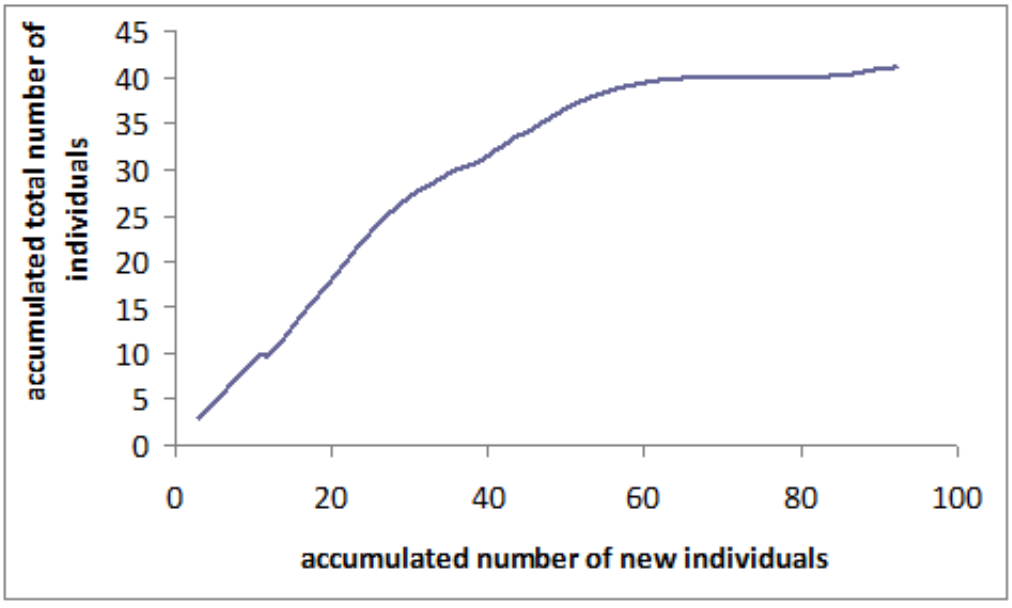

Figure (4): the discovery curve for the new marked individuals against the total marked individuals sighted

Figure (5): dolphins feeding close to fishing gear which may raise the issue of impacts done by fisheries on the dolphins' population.

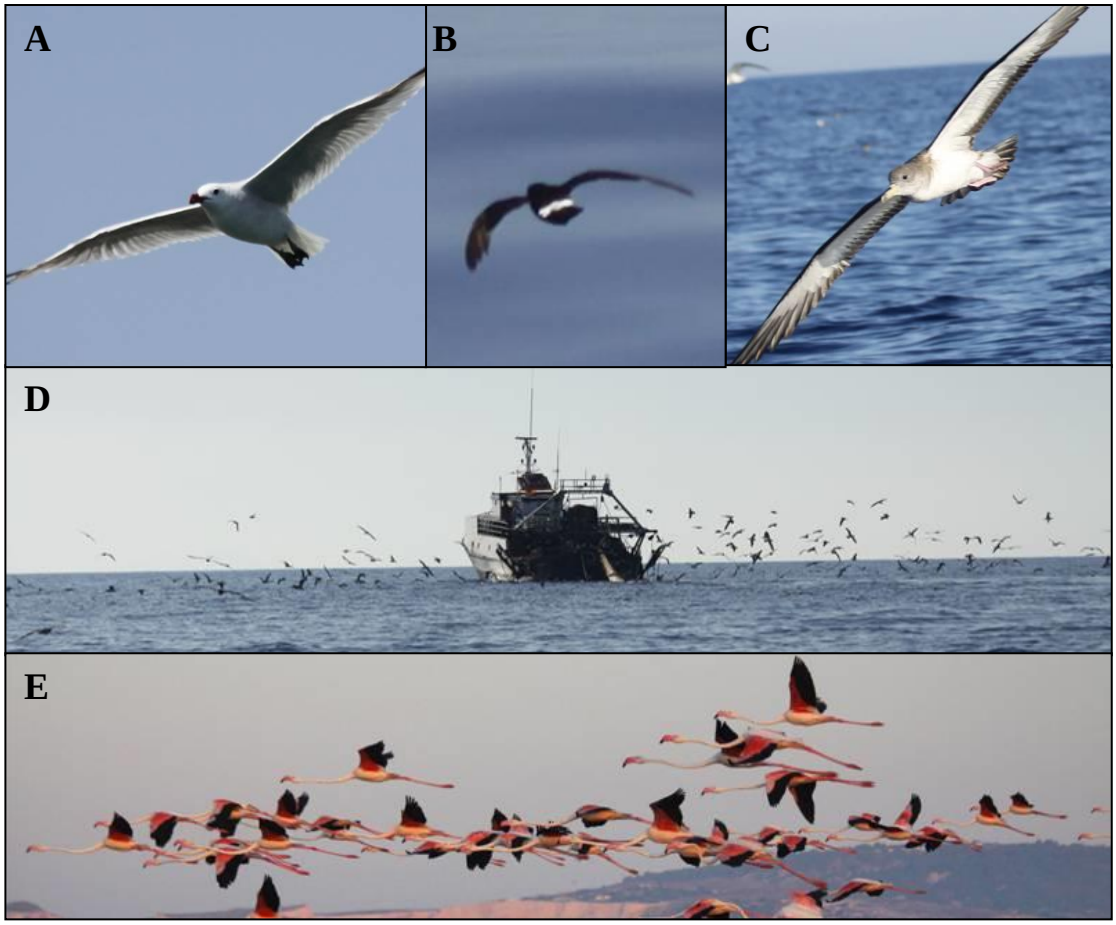

Figure (6): different bird species sighted during the survey; (A) yellow-legged gull; (B) storm petrel, (C) Scopoli's shearwater, (D) a gathering of shearwater around a trawler, (E) a flock of flamingo.

Figure (7): Example of communication tools during the ECS conference that took place in Madeira in March 2016 (poster and abstract No. CO05)

Individuals codes	25.06.2015	30.06.2015	05.07.2015	06.07.2015	19.07.2015	22.07.2015	30.07.2015	31.07.2015	04.08.2015	05.08.2015	06.08.2015	07.08.2015	08.09.2015	04.06.2016	08.07.2016	12.07.2016	24.07.2016	20.08.2016	29.08.2016	22.06.2017	12.08.2017	19.08.207
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Table (1): the sighting frequency of all individuals during the period of the study from 2015 to 2017/ individuals starting with BIZ were sighted in the Bay of Bizerte are for the first time while individuals with the initials TAB were sighted in the area west of the bay of Bizerte for the first time.

N.	English Name	Latin Name	Frequency of sightings
	Birds		
1	Scopoli's shearwater	*Calonectris diomedea*	*Numerous, large groups feeding in the area, and following fishing boats.*
2	Yelkouan shearwater	*Puffinus yelkouan*	*Rare, three sightings of individuals mixing with Scopoli's*
3	European storm petrel	*Hydrobates pelagicus*	*Rare, four sightings of lone individuals.*
4	Audouin's gull	*Larus audouinii*	*Frequent, sightings were made close to the autumn of individuals crossing the area.*
5	Slender-billed gull	*Larus genei*	*Frequent, sightings were made close to the autumn of individuals crossing the area.*
6	European Shag	*Phalacrocorax aristotelis*	*Frequent, individuals flying close to the surface or resting on islands*
7	Little Tern	*Sternola albifrons*	*Frequent, sightings are usually close to shore*
8	Great flamingo	*Phoenicopterus roseus*	*Frequent, large flocks flighting parallel to the coastline*
9	Great cormorant	*Phalacrocorax carbo*	*Frequent, individuals flying close to the surface or resting on islands*
10	Yellow-legged gull	*Larus michahellis*	*Frequent, individuals and small groups following fishing boats, resting on islands*
11	Northern gannet	*Morus bassanus*	*Rare, two sightings made of Juveniles feeding close to trawlers*
	Ichthyofauna		
13	Common dolphinfish	*Coryphaena hippurus*	*Frequent, especially in fishing season.*
14	Greater amberjack	*Seriola dumerili*	*Rare, seen close to the surface few times*
15	Tunas & skipjack species	*Euthynnus sp. & Thynnus sp.*	*Numerous, large groups seen in feeding frenzy close to the surface*
	Cnidaria		
17	Mauve stinger	*Pelagia noctiluca*	*Numerous, seen in small and large blooms close to the shoreline*
18	Barrel jellyfish	*Rhizostoma pulmo*	*Rare, seen few times in bays close to shore*
19	Nomad jellyfish	*Rhopilema nomadica*	*Frequent, seen close to shore in the bay of Bizerte and also the channel internee.*

Table (2): shows the list of other marine fauna sightings during the survey with frequencies.