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1. INTRODUCTION

Studies about cetacean distribution in the western Mediterranean Sea were very advanced. Extensive researches have been conducted to examine the large-scale ecology of these marine mammals. A number of environmental features have been cited as driving cetacean distribution. They include water depth, sea floor gradient, bottom topography, sea surface temperature and salinity, thermocline depth, primary productivity, thermal fronts and upwelling areas (Moulins et al., 2007; Aissi et al., 2008; Azzellino et al., 2008).

Available data about cetacean distribution in the eastern Mediterranean basin are very scarce. Cetacean knowledge, in Tunisian waters for example, derives from data collected during occasionally dedicated surveys (e.g. Ben Naceur et al., 2004), opportunistic surveys aboard fishing boats (e.g. Ayadi et al., 2009) or from surveys performed in the whole Mediterranean using standard transects lines and information is fragmented on regional scale (e.g. Zanardelli et al., 2002). Some other data have been collected from the very rare stranding or from entangled animals in fishing gears (Ktari-Chakroun, 1980; Bradai, 1991; Bradai & Ghorbel, 1998; Attia El Hili et al., 2009).

Boat-based field efforts that focused on assessing cetacean populations along the Tunisian coast have been previously undertaken by the *Institut National des Sciences et Technologies de la Mer* (INSTM) during 2003 (Ben Naceur et al., 2004). Results were very limited in space and time and did not cover either the whole Tunisian coasts or the offshore waters. In consequence, ACCOBAMS classed Tunisian water in the poorly studied area (Notabartolo di Sciara.& Bradai, 2007). Reviewing the available data about bottlenose dolphins in Tunisian waters, it is clear that the distribution is poorly known and presents a large gap on the north coast.

Bottlenose dolphin *Tursiops truncatus* (Montagu, 1821) is the only Mediterranean species that is mainly coastal (Marini et al., 1996; López et al., 2002) whereas the specie can be found in both coastal and offshore waters around the world. Based on stomach content analysis of stranded individuals inside or outside the Mediterranean, the diet of this species is mainly composed by a wide variety of fish without excluding the presence of some cephalopod and crustacean species (Relini et al., 1994; Mikovic et al., 1997; Barros & Wells, 1998; Blanco et al., 2001). Due to the dominance of fish in its diet, there has been a long history of either positive or negative interactions between the species and fisheries. It was reported that dolphins herd directly fish schools in fishermen nets (Hall, 1984; Corkeron et al., 1990).

Nevertheless, cooperation is not the only type of interaction. While little is known about bottlenose dolphin population in Tunisian waters, a number of impacts have been documented for this species; it appears that bottlenose dolphins regularly damage nets feeding on the net catch and thus inducing economic losses for fisheries due to catch reduction. Moreover, sometimes, dolphins get trapped in the nets leading to deaths (Bradai, 1991; Ben Naceur et al., 1997; Raitsos et al., 2003; Ben Naceur et al., 2004). The Mediterranean bottlenose dolphin population is clearly affected by by-catch (Bearzi et al., 2008) but the population in Tunisian waters suffers also from other threats as prey depletion (Notabartolo di Sciara & Bradai, 2007). The conservation of the Mediterranean bottlenose dolphin populations have therefore been considered as a priority, in the last decades, throw the qualification of its status as vulnerable according to the International Union for Conservation of Nature (IUCN) Red List criteria (Reeves & Notabartolo di Sciara, 2006).

These social species with long-lasting, close associations among individuals use acoustic communication extensively, indicating that this would be the most likely channel for individual recognition, if it were to occur. Several authors have suggested the individual recognition through vocal whistle 'signatures' (Caldwell & Caldwell 1965; Tyack 1986; Sayigh et al. 1990). However, its population often has greater than 50% of individuals' identifiable (Würsig & Würsig, 1977). So, mark-recapture technique throw the photo identification protocol is the ''best'' way to recognize or to identify individuals.

The purpose of this project was to increase sample sizes available for odontocete population assessment/stock structure off the northern Tunisian coasts using the mark recapture technique. Furthermore, one of the goals of this effort was to create the first catalog of individually distinctive bottlenose dolphins through the photo-identification protocol; the more information that can be obtained over time from several individuals, the more we can learn about populations of that species, their size, individual growth, associations, mortality, and reproductive rate.

This report documents survey effort and preliminary results from field work from June to October 2010 financed totally by the Regional Activity Centre for Specially Protected Area (*RACSPA*). Distribution and habitat selection of bottlenose dolphin observed within the study area is assessed on a fine scale. This study contributes to our understanding of this dolphin's biology by examining the relationships between their distribution and their habitat. To understand why bottlenose dolphins choose particular habitats, topographic and oceanographic variables were collected.

2. MATERIALS AND METHODS

2.1. DESCRIPTION OF THE STUDY AREA

From June to October 2010, the north Tunisian coast was monitored to study bottlenose dolphin distribution and behaviour. The study area extends from the coastline to 37°26' N and from 009°31' to 010°16' E totalizing 1,424 km^2 (Figure 1). The area is located in the central Mediterranean Sea; it encompasses a coastal lagoon extending for about 130 km^2 and connecting to the sea by a narrow strait. Off Bizerte, there are the Sardinia Channel in the northeast, and the Strait of Sicily in the northwest. The last one is connection point between the western and eastern Mediterranean basins.

The topography of the study area interacts with some hydrodynamic features, mainly caused by winds, and inducing an accumulation of chlorophyll. This accumulation is particular because it is hold in the Bizete lagoon that serves as retention area. It explains also why the study area is characterized by a high productivity. This area is located in the path of the Atlantic modified current which has a very important effect on the composition of the marine fauna and flora. According to Agostini and Bakun (2002), the prevailing westerly winds produce a coastal upwelling off the south coasts of Sardinia and a downwelling along the north-eastern coast of Tunisia. The Ekman forces carry thus waters from the rich area towards the Tunisian coasts concentrating the nutrients. In fact, the study area is a potential spawning ground and corresponds to a significant reproductive ground for anchovy, mullet and round sardine (Gaamour et al., 2005; Zarrad et al., 2007). These small pelagic species represent the main diet components of delphinid (Blanco et al., 2001).

Bizerte lagoon is characterized by a recent increasing of industrialization and urbanization. The main activities in the south-east are agriculture and aquaculture, both extensively using fertilizer and agro-chemicals. Indeed, based on recent analysis of physico-chemical water and sediment, the study area is extremely most exposed to toxic elements (El Ati-Helal et al., 2005; Trabelsi & Driss, 2005; Yoshida, 2006).

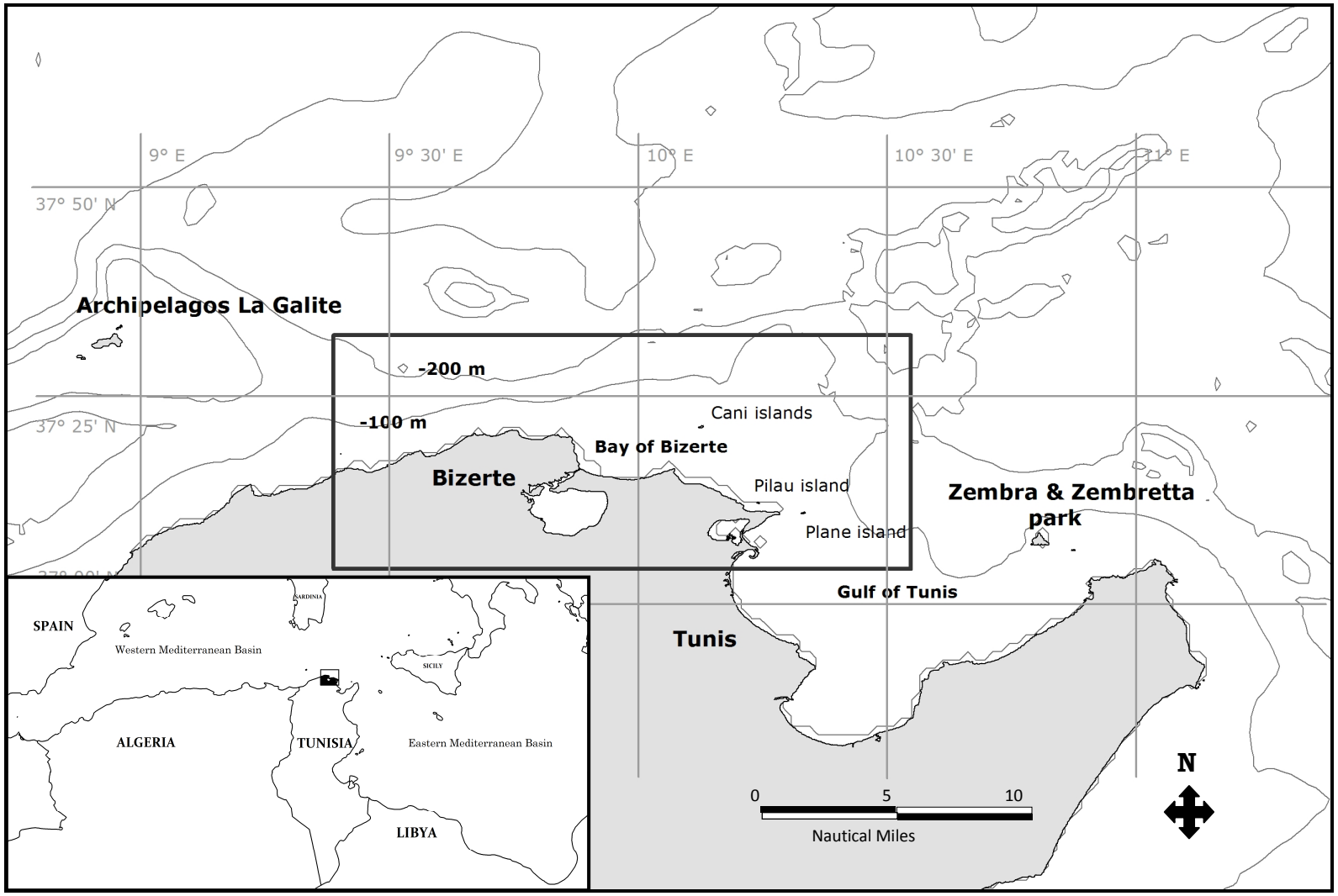

Fig.1: Location of the study area on a geographical context map of the central Mediterranean Sea with bathymetric background.

2.2. CETACEAN SIGHTINGS

Our surveys were conducted aboard a 7 m rigid craft powered by 40 HP four-stroke outboard engines. (Due to the unavailability of this platform, a 5m rigid boat motorized by 25 HP was sometimes used). The boat had a searching deck with an eye height of 2.5m above sea level. Track lines follow mainly a systematic design; the effort was distributed according to a random strategy in order to maximize encounters with bottlenose dolphins. Sometimes, we used indications supplied by fishing boats in the area. To maintain consistent sighting effort, 2 trained observer lookout with naked eyes the 180° in front of the boat. Surveys were realized with favourable weather conditions: with calm sea, wind speeds never exceeding 3 on the Beaufort scale and the sky not totally cloudy.

When cetaceans were observed, groups were approached to confirm species identity, determine location, and to estimate group size. In most cases we would simultaneously attempt to obtain identification photographs (e.g., dorsal fin photos) of all individuals present using digital camera (*Canon* 450D), as well as photographs of the body in front of and behind the dorsal fin, to examine pigmentation patterns and external morphology. Factors that limited ability to obtain identification photos included sea conditions and/or the behavior of the individuals (e.g., some groups were lost). Major of our efforts were expended when sea conditions were particularly good.

Sighting effort was measured as the number of covered nautical miles and individual rates were calculated by dividing the number of dolphins by the covered distance.

2.3. DOLPHINS' BEHAVIOUR

Behaviour was characterized in function of the predominant activity of each group for the 5 first minutes of an encounter (Mann, 1999). Information about dolphins' activity was also completed recording some parameters as dive duration, swimming head and speed, physical contacts among individuals and sighted prey. The analyses of locomotion and dive duration/surfacing intervals helped to discriminate among apparently similar behavioural pattern (Würsig et al., 1984; Peharda & Bearzi, 1993). Indeed, breathing patterns differ during different behavior and activity levels; thus data is useful to characterize such behavioural states (Bearzi & Politi, 1999; Lafortuna et al., 2003; Gannier, 2005).

In this study bow riding is not interpreted as natural behaviour; it is considered as an interaction between dolphins and our boat. 'Resting' is displayed by a stationary position, immobile, most of the time, or moving only with slowly swimming during surfacing for respiration. The pattern of respiration during the rest consisted to alternate respiratory pauses with periods of ventilation (Lyamin et al., 2008).

‘Feeding’ is strongly related to the pattern of distribution of prey. Dolphins can display in many ways, according to availability of food resources. The characteristics of ‘aggregative forage’ and ‘dispersed forage’ suggest that both modes exploit prey resources of different densities. For instance, the dispersed forage mode suggests a low-density prey resource, i.e. solitary or weakly schooling prey species (Chilvers & Corkeron, 2001). According to Acevedo-Gutiérrez & Parker (2006), four ‘feeding’ sub-categories were defined: (1) moving rapidly with no diving, (2) milling with no diving, (3) diving in several locations, and (4) diving in one location. These 4 sub-categories were characterized by an extremely convoluted trend well suited to the capture of the prey. ‘Traveling’ is displayed by a quasi-linear trajectory moving steadily in one direction with synchronized dives (Shane et al., 1986).

2.4. PHOTO IDENTIFICATION PROTOCOL

Mark recapture techniques may be applied to obtain an estimate of population size. For such estimates, natural marks should be recognizable over time, be unique to the individual and have an approximately equal probability of being sighted and resighted. Features which may help to identify individuals include; 1) shape of the dorsal fin, 2) shading of the fin and upper body, 3) scrapes, scratches and wound marks, 4) and pigment patterns. A well marked individual is one that is recognized not by a single feature, but by a matrix of marks (Würsig and Jefferson, 1990).

Individuals with no dorsal fin notches were considered not to be distinctive, though they could often still be sorted within encounters based on pigmentation patterns and scarring. Photographs of these individuals were compared or matched using the profile of each dorsal fin using appropriate software. In this report results about mark recapture techniques will not be present due to the incomplete of our database input and matching analyses.

3. RESULTS & DISCUSSION

3.1. SURVEY EFFORT

Surveys were undertaken between June and October 2010. This period was normally characterized by calm to moderate winds, with only a few bad weather days. But this year we assist to a succession of windy days making our monitoring spread in time (Table 1). A total of 32 daily surveys were conducted mainly by a 7 m rigid craft powered by 40 HP four-stroke outboard engines. Due to the unavailability of this platform from time to time, a 5m rigid boat motorized by 25 HP was sometimes used. Thus survey effort covered largely the coastal area not exceeding the isobaths of 150m.

A special attention was given to areas surrounding the small Tunisian islands encompassed in this zone such as *Cani*, *Plane* and *Pilau* islands situated directly in front of the *Cape Zebib* and *Cape of Sidi Ali El Mekki* (Figure 2).

The navigation effort totaled 711 km, resulting of 26 sightings of bottlenose dolphins *Tursiops truncatus* (the only cetacean species observed). To account for the uneven geographical distribution of the survey effort, the study area was subdivided into cells of 5' latitude by 5' longitude (7376 x 8687 m). Encounter rates were calculated by dividing the sighting number by the total distance covered under favourable conditions.

Presence of dolphins inside the lagoon of Bizerte was signalled by fishermen or local authorities. At six times we made our oriented monitoring to check the group size, dolphin activities and to carry out the photo ID protocol. The navigation inside the lagoon totalled about 140 Km resulting of six dolphin group sightings reaching 20 individuals (Figure 3).

June 2010

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

July 2010

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September 2010

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

October 2010

				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Table 1: Temporal distribution of the cetacean survey along the northern Tunisian coasts (represented in grey cells).

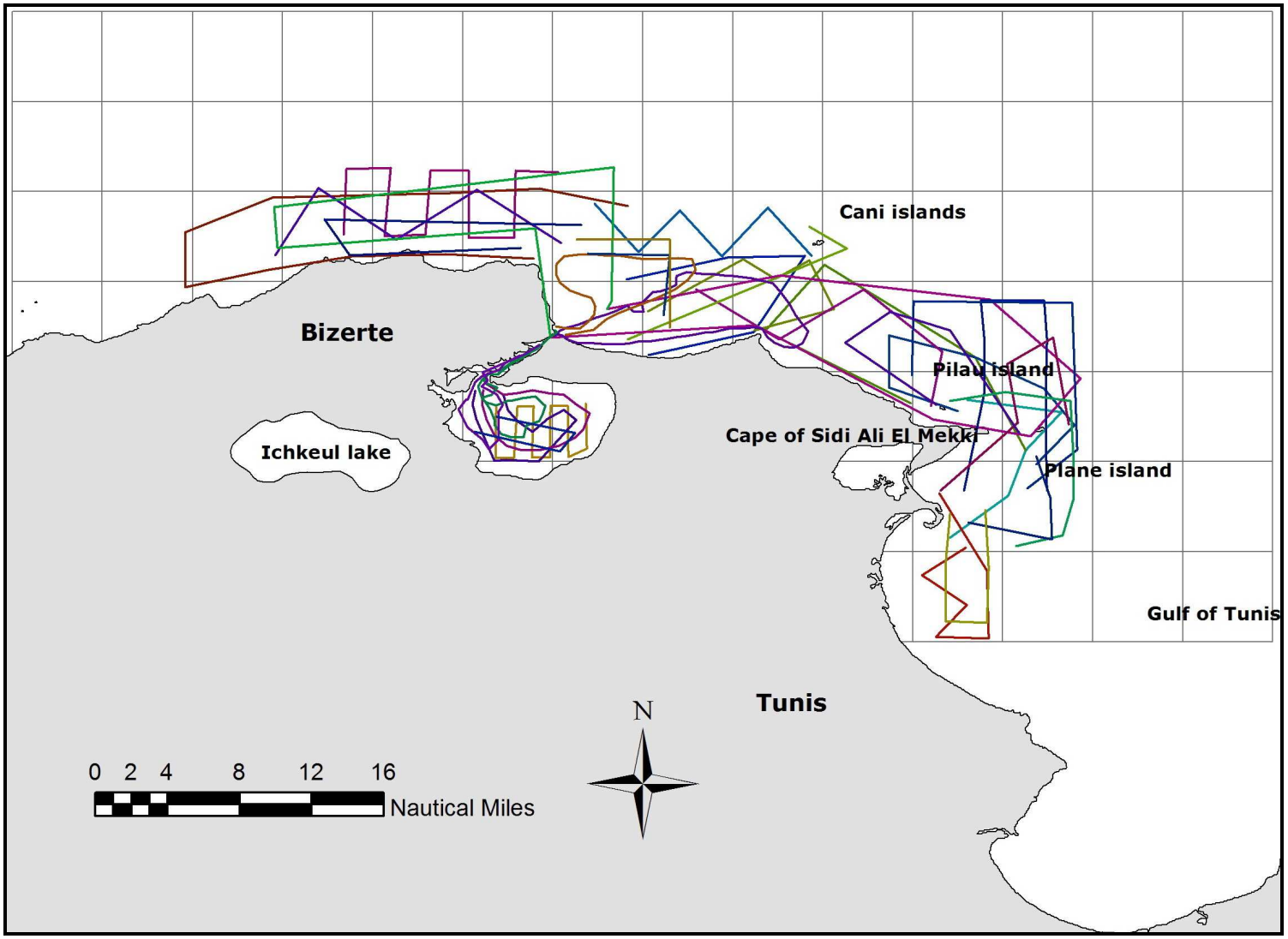

Fig.2: Partitioning of the study area into a grid of cells of 5' x 5' and distribution of the effort from June to October 2010.

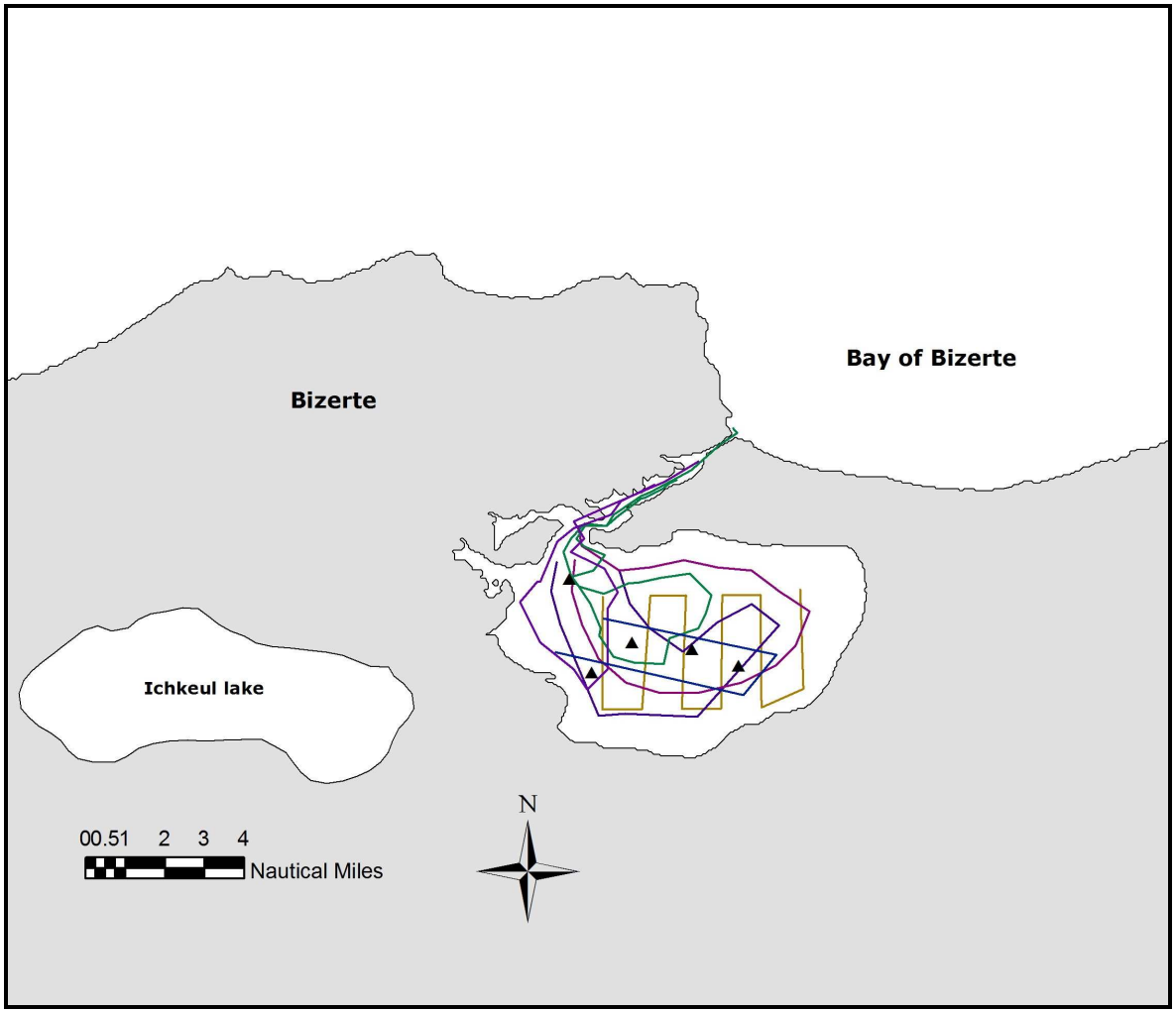

Fig.3: Distribution of our effort inside the Lagoon of Bizerte dedicated for the study of dolphin distribution along the northern Tunisian coasts from June to October 2010. Sighting positions were mentioned by black triangles.

3.2. DOLPHIN ENCOUNTERS

Small groups of less than 8 individuals were predominantly encountered. Figure 4 indicates the preference of the species for ‘’large groups‘’ of individuals; thirty five per cent of the sightings were of five individuals, however single, couple and four individuals were equally sighted reaching 15% of all sightings. Mean group size was 2.96 (SD= 2.11, range=1-7). The density in the study area was estimated to be 3.93 groups/ 100 Km.

Because of our coastal monitoring never exceeding the isobaths of 200m, bottlenose dolphins were often sighted over the wide Tunisian plateau close to the coastline (Figure 5).

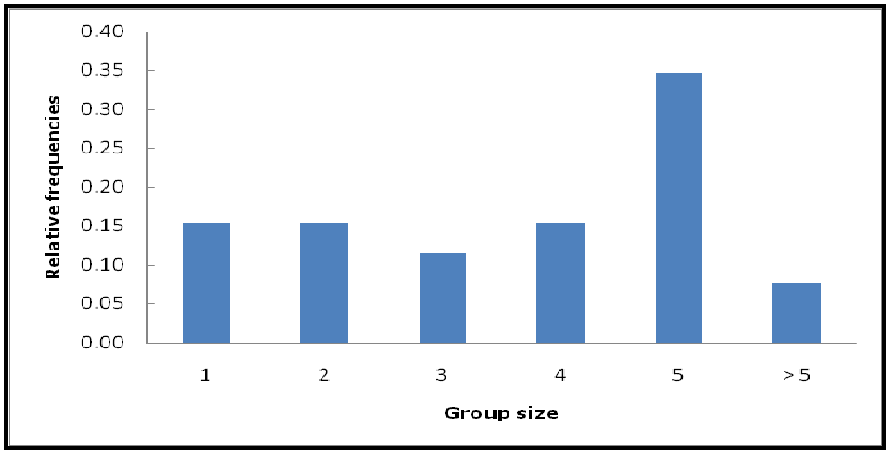

Fig.4: Group size of the encountered bottlenose dolphins of the northern Tunisian coast during our 2010 monitoring.

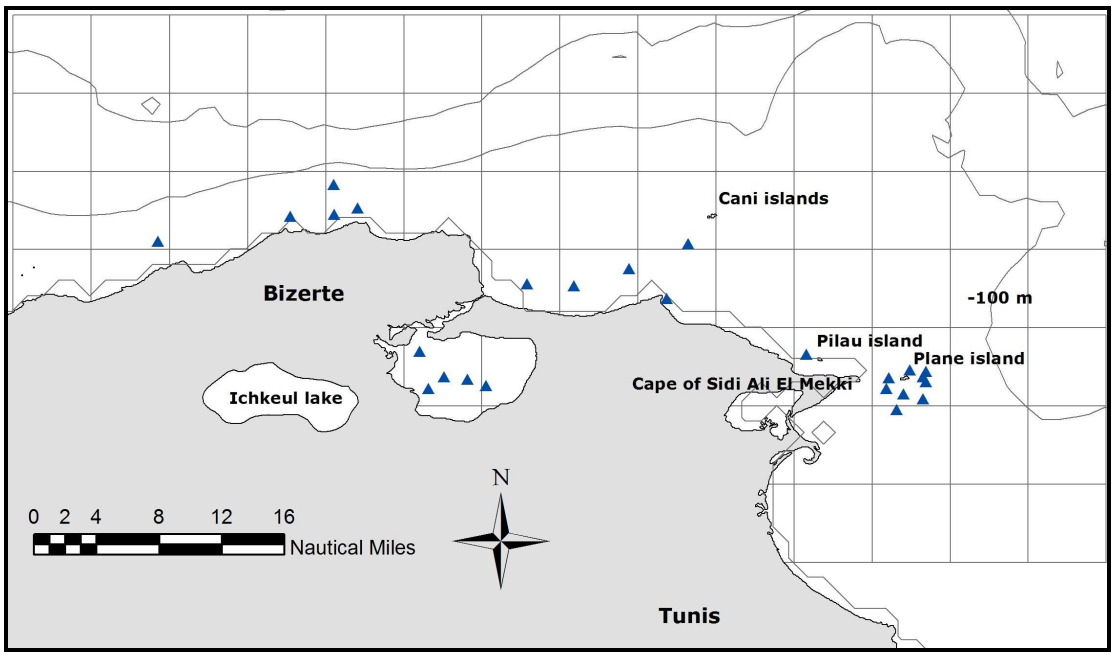

Fig.5: Sightings of bottlenose dolphins in the northern coasts of Tunisia during our monitoring on 2010.

To have an idea about the dolphin density along the northern Tunisian coasts belonging to our study area, we will exclude the effort and sightings made inside the Lagoon of Bizerte. Indeed, main monitoring in this small part of area was principally made based to previous information received from fishermen or local authorities. So, navigation effort totalled 571 Km. Twenty dolphin group sightings were recorded reaching 75 bottlenose dolphin individuals (Figure 6). Mean group size was 2.88 (SD=2.19, range=1-7). The density in this part of area was estimated to be 3.5 groups/ 100 Km.

Fig.6: Group of bottlenose dolphin group encountered near the *Plane Island* during our monitoring established from June to October 2010.

A group of five individuals was encountered at 7 times near the *Plane Island* in front of the *Cape of Sidi Ali el Mekki*. (13-06-2010 / 03-09-2010 / 20-09-2010 / 22-09-2010 / 23-09-2010 / 24-09-2010 / 25-09-2010) (Figure 7).

Fig.7: Dorsal fin of bottlenose dolphin group encountered at seven times near the Plane Island during our survey dedicated to study cetacean distribution along the northern Tunisian coasts from June to October 2010.

3.3. OTHER SPECIES

3.3.1. SEA TURTLES

Loggerhead sea turtle (*Caretta caretta*) was sighted during our surveys from June to October 2010 at four times. Only on one occasion we succeed to come close to this individual (near the *Plane Island* on 13-06-2010), to estimate visually its size, to check the presence of injuries and to take some photos. So we prefer to take into account this sighting as the unique recorded and others are estimated as uncertain observations. The length of the individual sighted was approximated to be more or less about 60 cm. It wasn't tagged and it hasn't visible external injuries (Figure 7).

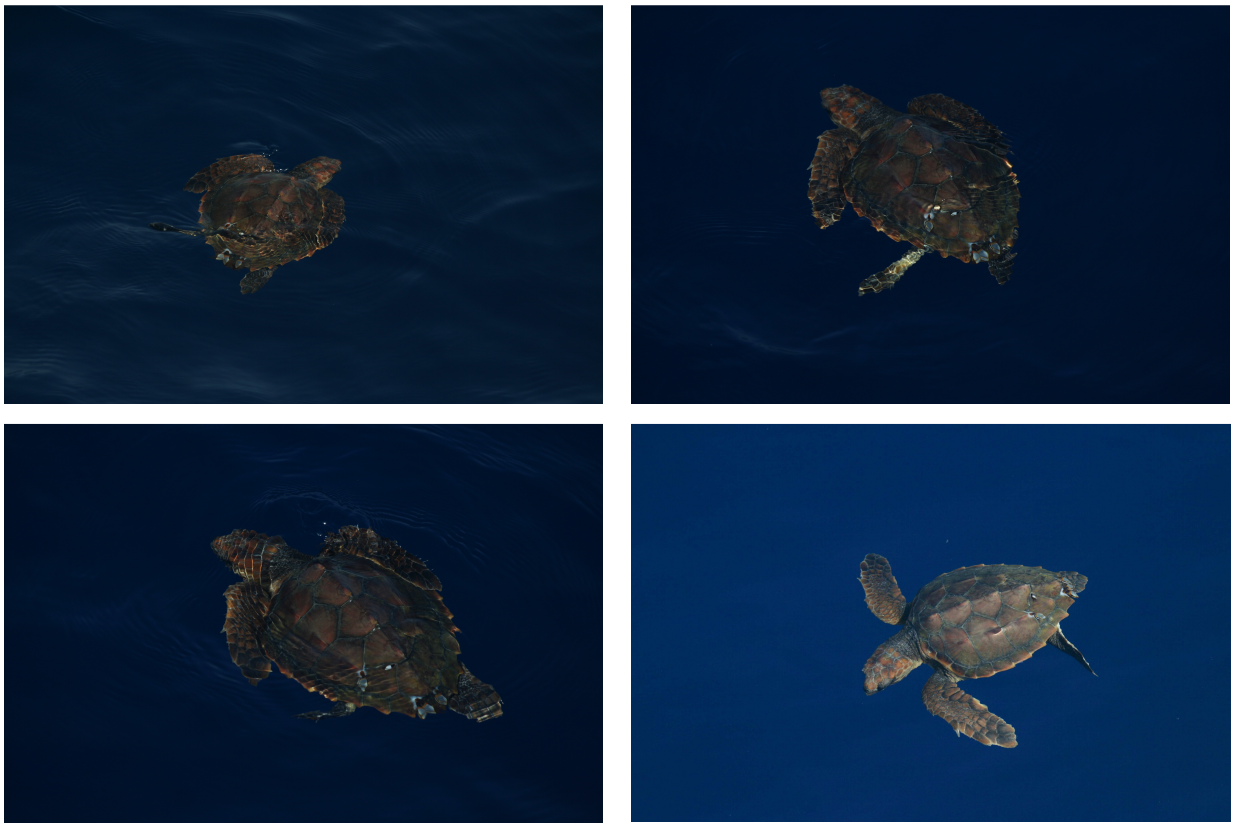

Fig.7: Photos of the loggerhead sea turtle (*Caretta caretta*) observed near the *Plane Island* during our survey made on 13 June 2010.

3.3.2. JELLYFISH

An abnormal bloom of jellyfish has occurred in northern Tunisian waters especially this year. Indeed, we assist to a simultaneous proliferation and year round presence of two different species *Pelagia noctiluca* and *Aurelia aurita*. These species have normally two different temporal ''invasions'' during winter and late summer. These proliferations can't persist fall due to the breakdown of the zooplankton stock.

However, this year we estimate the mean density about 20 ind.m^{-3} during October (data not related only to our monitoring but also to the continued sampling program realized by the Faculty of Sciences of Bizerte under the direction of Pr. Mohamed Néjib Daly Yahia).

Some individuals of *Rhizostoma pulmo* have been signalled but with a mean density reaching 0.7 ind.m^{-3} (Figure 8). A new species of jellyfish has been sighted during our monitoring in Tunisian waters especially during June and July. It was identified by Pr. *Daly Yahia* as *Rhopilema esculentum.* It's an immigrant jellyfish in the eastern Mediterranean introduced in Tunisian waters more than five years ago signalled the first time by Daly Yahia M.N. & Daly Yahia-Kéfi O. in the Gulf of Tunis. We supposed that this species declined due to its absence from jellyfish species sighted since that date. All individuals sighted have as a minimum a diameter of 30 cm and a height of 35 cm. This species is very much painfully. The syndrome often causes fever, exhaustion, to aching muscles, breath difficulties or a waste of the blood pressure, and can lead even to the death. (For further details about jellyfish please contact Pr. *Daly Yahia*).

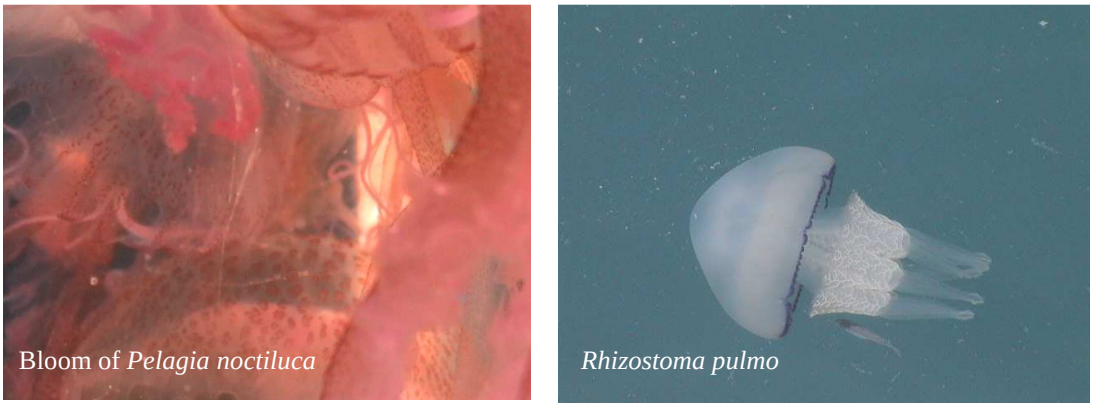

Fig.8: Photos of some jellyfish species encountered during our monitoring dedicated for cetacean studies in the northern Tunisian coasts from June to October 2010.

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