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Sightings of Risso's dolphin (*Grampus griseus*) off the Southern coast of Linosa Island (south-central Mediterranean Sea)

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Abstract

The distribution, habitat preferences and site fidelity of Risso's dolphin in the Strait of Sicily are very little known. During sea surveys conducted in three summer seasons, we sighted this species offshore Linosa Island in groups of variable numbers of individuals (2-20, average 9.7 ± 7.0 SD). Sightings were concentrated in a small area whose medium depth (average, 591 m) and bathymetric features are in line with the known habitat preferences of the species. A total of 32 individuals belonging to four age classes were photo-identified; eight were re-sighted once over the years. We report for the first time the presence of Risso's dolphin in the waters around Linosa Island. The results seem to indicate a site fidelity over the years.

Keywords: *Grampus griseus*; distribution; photo-identification; Strait of Sicily.

Introduction

Risso's dolphin *Grampus griseus* (G. Cuvier, 1812) is distributed worldwide in tropical and temperate seas in both hemispheres (Baird, 2009). The species favours waters over steep slopes, canyons and seamounts and prefers offshore island habitats where these bathymetric features are close to the coastline (Azzellino *et al.*, 2008; Bearzi *et al.*, 2011; Hartman, 2018). This adaptability in habitat use and some evidence for genetic differentiation suggest the existence of various geographical units of the species (Gaspari *et al.*, 2007; Jefferson *et al.*, 2014).

A high degree of residency and site fidelity have been reported in different study areas in relation to the ecology and behaviour (particularly its mating system) of the species and to food resource availability (Remonato *et al*., 2013, Hartman *et al.*, 2015, Maglietta *et al.*, 2018)

Group size has been described to vary between regions: 6-12 individuals around the British Isles (Evans *et al*., 2003; Evans, 2008); 10-25 individuals in Spain (Cañadas & Sagarminaga, 1997; Cañadas *et al*., 2005; Gómez de Segura *et al*., 2008); and 10-40 individuals in the Ligurian Sea (Airoldi *et al*., 2000; Azzellino *et al*., 2008). Large groups of some thousand individuals have been encountered in the eastern Pacific (Kruse *et al.*, 1999), probably due to the abundance of food resources in those areas (Norris & Dohl, 1980). Association patterns have been found occurring in pairs and in numbers of 3-12 individuals and defined as long-term, stable units of a stratified social organization based on age and sex classes (Hartman *et al.*, 2008).

The adults are easily recognized from the white marks (scarification) that accumulate on their body over time as a result of intra-specific interactions. This aspect facilitates species identification at sea and recognition of individuals by photo-identifications techniques (Würsig & Jefferson, 1990, Hartman *et al.*, 2008).

Examination of the stomach contents of stranded animals has indicated that their diet is mostly composed of cephalopods and occasionally of fish and Thaliaceans (Sekiguchi *et al.*, 1992; Blanco *et al.*, 2006).

The Mediterranean sub-population trend is unknown due to the scarcity of abundance data (Gaspari & Natoli, 2012). The range of Risso's dolphin extends from the far west to the far east of the Mediterranean Sea, with a higher number of sightings in the western and north-western areas of the basin (Bearzi *et al.*, 2011).

The seasonal movements of the species have been investigated in the Ligurian Sea (north-western Mediterranean Sea), where groups seem to follow a preferential route to the west, frequenting the same sites from year to year (Azzellino *et al.*, 2008).

Abundance estimates exist for the western central and north-western Mediterranean Sea (Gómez de Segura *et al.*, 2006; Azzellino *et al.*, 2016). Azzellino *et al.* (2016) has described two long-term monitoring studies in a wide area (25,000 km^2) that yielded an estimation of population size based on photo-identification data.

Risso's dolphin has been described in the Strait of Sicily along with five other cetacean species (Filiciotto *et al.*, 2016; Notarbartolo di Sciara, 2016; Giardina & Corrias, 2019). The species has been poorly studied in this area due to a lack of sightings in the southern Mediterranean Sea. Information on strandings in Tunisia, Malta and Libya (MEDACES; Vella, 1999b; Bearzi, 2006) and on sightings in Tunisia (Ktari-Chakroun, 1980) and Malta (Vella 1999a) is limited. Ten strandings on the southern coast of Sicily were reported from 1988 to 2003 (CIBRA).

We provide new information on the presence of Risso's dolphin in the southern-central Mediterranean Sea, reporting the sightings of a unit in the waters around Linosa Island. These findings have the potential to fill some gaps in the overarching lack of data and to contribute to the regional conservation efforts of Risso's dolphin, whose status has been assessed as Data Deficient by the IUCN (Gaspari & Natoli, 2012).

Material and Methods

Study area and field observations

The Pelagie Islands are a three-island archipelago in the Strait of Sicily lying about 160 km from Sicily, 120 km from Tunisia and 120 km from Malta (Fig. 1). The area is a major biodiversity hotspot in the Mediterranean Sea, due to intense biological exchange between the main western and eastern sub-basins and to migration activities. The seabed in this area is characterized by submerged volcanic formations, deep depressions related to tectonic activity, i.e. Linosa (Tonielli *et al.*, 2019; Romagnoli *et al.*, 2020), and unique rocky shoals known as banks that host key habitats such as Posidonia meadows, coralligenous, maërl and deep corals on the continental shelf, i.e. Lampedusa and Lampione (Innangi *et al.*, 2018, 2019).

The study was carried out in the summer of 2014, 2018 and 2019 by collecting data through a boat platform.

Between April and September, a total number of 10 round trip surveys were undertaken in good marine weather conditions (Beaufort ≤ 1) and good visibility (≥ 2 km) onboard a semi-rigid boat (6.8 m) powered by a 225 hp outboard engine.

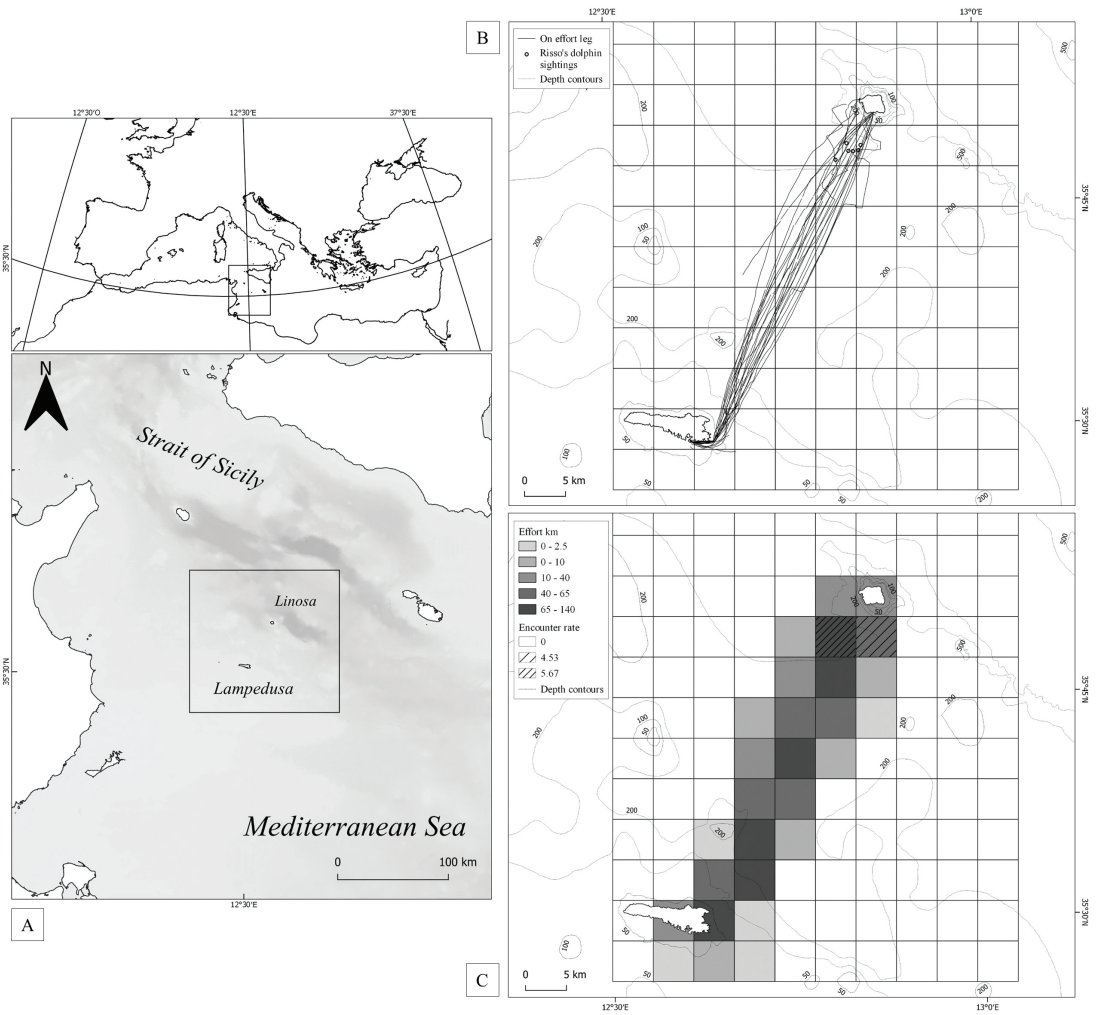

Fig. 1: A) Map of the study area. B) On-effort track legs and locations of Risso's dolphin sightings. C) Effort distribution and encounter rate calculated on a 5x5 km grid based on the 1 km grid shape file (EPSG:3035) provided by the INSPIRE geographical grid systems (EEA, 2020).

The sampling design consisted of transects of about 42 km connecting Lampedusa to Linosa (Fig.1). The transects were sampled twice a day between 08:30-11:30 and 15:30-18:30 h. The observation arc of 360° was divided into two equal sectors, each of which was scanned by a trained observer with the naked eyes and occasionally using 7 × 50 reticule binoculars (NIKON 7 × 50).

The following information was collected during the encounters: time of sighting, GPS location, depth, best estimate of group size and composition, and initial group behavioural activity (Table 1).

During each sighting, group size was estimated by visual counts defined as min-max and best estimation. A group was defined as all the dolphins that interacted socially and/or showed coordinated behaviour (chain-rule: Smolker *et al.*, 1992). The number of adults, juveniles and calves was counted according to the criteria of Hartman *et al.* (2008, 2016) based on skin appearance.

Activity patterns were recorded according to Altman (1974) and Shane (1990) as "*travelling*", "*foraging*", "*socializing*" and "*resting*". Before the boat approached the individuals sighted closely, their ongoing behaviour was recorded. Surface behaviours (breaching, lob-tailing, spy-hops, tail and flipper slaps) (Kruse *et al.*, 1999; Evans, 2008) were also noted.

Data Collection and Analysis

Once the dolphins were spotted, the boat slowed down and approached them, to take photographs of both sides of the dorsal fin, trying to capture all the individuals of each group.

Photographs were taken perpendicular to the longitudinal axis of the animal (Würsig & Jefferson, 1990) using a digital camera (NIKON D750) fitted with a 100 - 300 mm autofocus stabilized zoom lens.

To reduce the disturbance to the animals, the time spent with the group was reduced as much as possible and a distance of at least 50 m was kept at all times.

Photographs were classified into 3 overall quality categories - "good", "moderate" and "poor" - according to the following criteria: exposure, focus, angle, size of dorsal fin and part of the body. Individuals were identified by two independent assessors with the manual method using photographs of the two higher categories. Identification and matching of the dorsal fins were based on the distinctive marks on the dorsal fin (right and left side) like notches, nicks, amputations, dorsal fin shape and scarification pattern (Hartman *et al.*, 2008).

Each distinctive individual in each encounter was archived in our catalogue and subsequently compared to the other individuals in the catalogue. The age class of the identified individuals was determined according to Hartman *et al.* (2016).

Sighting frequency (SF) was calculated as the number of sightings per hour of observation (Evans & Hammond, 2004) and the encounter rate (ER) as the number of sightings per distance surveyed (km) x 100 within each cell unit of a 5 x 5 km grid (Fig.1).

Depths were calculated from bathymetric data made available by EMODnet (https://www.emodnet.eu/, 2020). Geospatial analysis was performed with Qgis 3.14 software.

Table 1. Date, effort in hours and kilometres, sightings time, group size, photo-identified individuals and group behavioural state for each sighting.

Date	Effort		Time	N. of individuals	N. of photo-id	Behaviour
	Hours	Km				
09/09/2014	03:25	95	16:50	11	11	*Socializing*
17/09/2014	04:20	99	-	-	-	-
24/04/2018	03:10	99	-	-	-	-
22/06/2018	05:14	95	-	-	-	-
02/08/2018	05:36	99	17:10	15	3	*Travelling*
14/08/2018	05:41	98	-	-	-	-
31/08/2018	04:52	98	10:28	3	3	*Travelling*
31/08/2018			11:10	7	6	*Resting*
19/07/2019	03:31	97	-	-	-	-
12/08/2019	04:45	99	17:25	20	17	*Travelling*
18/08/2019	06:00	107	11:00	2	1	*Travelling*

Results

Over 980 km (43 hours) were covered during three summers of fieldwork. We encountered 6 groups of Risso's dolphin, sighting 58 individuals (50 adults and 8 juveniles, no calves or newborns) in a total of 3 hours and 21 minutes spent on observations.

SF was 0.14 sightings/hour; two grid cell units yielded ER values of 4.53 and 5.67, as shown in Figure 1.

All sightings were made 7.9 to 4.4 km of the coastline of Linosa at depths of 554 to 690 m, over the morphological depression which extends adjacent to the volcano base on the edge of the western basin (Tonielli *et al.*, 2019).

Group size ranged from 2 to 20 individuals, mean 9.7 ± 7.0 (SD). The most frequent behavioural activity was "*travelling*" (66%).

A total of 32 individuals were uniquely identified and were included in the catalogue; images of both sides of the dorsal fin were available for 16 of them.

Over the three surveys years, 9 individuals were re-sighted, with one intra-annual and 8 inter-annual matches. The re-sighting rate was 28% of the total number of identified animals. An individual sighted in 2014 was re-sighted in 2018, whereas 3 individuals were re-sighted in 2019 (Fig. S1). Six of the individuals observed in one sighting (12/08/2019) were found in 3 different previously sighted groups that were associated by age class.

Analysis of the age class of the individuals identified in the three years indicated that we encountered 5 juveniles, 3 sub-adults, 18 adults and 6 marbled adults (Table S1).

Discussion

We present the first documented record of Risso's dolphin in the coastal waters of Linosa Island during the summer months. These findings are intended as a basis for more extensive work in order to allow comparisons with long-term studies of Risso's dolphin populations.

Our ER values suggest that their presence was confined to a limited area near the coast of Linosa compared to overall monitored area.

The relative depths of the sightings agree with the close affinity of this species for bathymetric ranges between 400 and 1200 m, reported in most Mediterranean regions (Cañadas *et al.*, 2002, Azzellino *et al.*, 2008). The characteristic preference of Risso's dolphin for steep slopes in proximity of islands was also observed in this study (Notarbartolo Di Sciara *et al.*, 1993; Bearzi *et al.*, 2011; Hartman, 2018).

The whole area around the island should provide a suitable habitat for this species, given that it is characterized by shelf breaks, steep slopes and canyons carving the volcano flanks alternating with volcanic ridges lying 5 km to more than 10 km from the coast (Romagnoli *et al.*, 2020).

The intra-annual and inter-annual photo-identification matches suggest a degree of seasonal site fidelity of the individuals to this area. Strong site fidelity of Risso's dolphin has been reported in the Ligurian Sea (Airoldi *et al.*, 2000) and the Gulf of Taranto (Carlucci *et al.*, 2020). Moreover, photo-identification data showed re-sightings of individuals associated in the same group over the years; this is the typical behaviour of the species, which often forms long-term bonds (Evans, 1987; Hartman *et al.*, 2008).

Significant additional information may be garnered from comparisons with other photo-identification catalogues of adjacent and farther areas, which provide the opportunity to understand the movements of the species over the whole region and on a larger scale as well as their seasonal residential pattern.

Further work is needed to gain a better understanding of the presence of Risso's dolphin around Linosa and to establish whether the area may be a suitable habitat for the species all year round, rather than being part of a wider home range that includes the deeper waters of the Strait of Sicily.

In our perspective, Linosa should be considered a key area for Risso's dolphin. Our study provides new information on the distribution of cetaceans in the recently designated Important Marine Mammals Area of Lampedusa (IUCN-MMPATF, 2017) and gives a contribution to cetacean conservation strategies in the region.

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Supplementary data

The following supplementary information is available online for the article:

Fig. S1: Three individuals of Risso's dolphin re-sighted south of Linosa Island: individuals #04, #05 and #07 were sighted in 2014 and re-sighted in 2018 (#04) or in 2019 (#05 and #07). L, left side of the dorsal fin; R, right side of the dorsal fin.

Table S1. Sighting/Re-sighting dates and age class of the identified individuals.