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SHORT COMMUNICATION

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Occurrence of the vulnerable smalltooth sand tiger shark, *Odontaspis ferox*, in the Canary Islands, first evidence of philopatry

C. Barría[1] | A. I. Colmenero[1] | A. del Rosario[2] | F. del Rosario[2]

[1]Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain

[2]The Ocean Brothers, Tamaduste, Canary Island, Spain

Correspondence
Claudio Barría, Institut de Ciències del Mar (ICM-CSIC), Barcelona, Spain.
Email: barria@icm.csic.es

1 | INTRODUCTION

The smalltooth sand tiger shark *Odontaspis ferox* (Odontaspididae) is a demersal offshore species (Acuña-Marrero, Zimmerhackel, Mayorga, & Hearn, 2013) inhabiting deep waters along continental and oceanic shelves and upper slopes, at depths ranging from 10 to 883 m (Fergusson, Graham, & Compagno, 2008). It has a circumglobal but patchy distribution throughout warm temperate and tropical waters (Compagno, 2001); and it is considered unusual encountered, or naturally has low population numbers (Bonfil, 1995).

Little is known on the biology and ethology of *O. ferox*. The largest recorded size at maturity for males is 250 cm total length (TL) and 350 cm TL for females (Fergusson et al., 2008). This species has a low reproductive capacity (two pups every 2 years) and Compagno (2001) suggested uterine cannibalism in the form of oophagy. Although *O. ferox* is not a targeted species it is incidentally caught by bottom gill nets, longlines and trawlers (Fergusson et al., 2008). This, together with its low fecundity and small population, make this species highly vulnerable to exploitation and potentially susceptible to local extinction; and it is listed as Vulnerable in the International Union for Conservation of Nature (Graham et al., 2016).

The Canary Islands records include two large females found floating dead in Lanzarote and Fuerteventura (Fergusson et al., 2008), and three more specimens preserved at the Museo Insular (Brito, 1991).

This work presents the first reports of live specimens of *O. ferox* from El Hierro with comments about their behaviour, return rates and site fidelity.

2 | MATERIALS AND METHODS

El Hierro (Canary Islands, NE Atlantic Ocean) is a volcanic island situated off the African coast (Figure 1); and it characterized by oligotrophic waters (Davenport, Neuer, Helmke, Perez-Marrero, & Llinas, 2002) due to its offshore position. Despite its low productivity, fisheries resources are abundant (Bortone, Van Tassell, Brito, Falcón, & Bundrick, 1991) since the establishment in 1996 of the marine protected area (MPA) of Punta de la Restinga-Mar de las Calmas. This MPA is a volcanic rocky reef with holes, caves and tunnels, sheltered from the trade winds and dominant currents with a shallow narrow platform followed by a drop-off to more than 300 m.

Since 2005, four females of *O. ferox* have been observed in the MPA of Punta de la Restinga-Mar de las Calmas. The observations were documented by digital photographs, video and by personal notes from the divers. Since the specimens were not caught, the identification of the species was based on the external features following Compagno (2001) description and confirmed by examining the photographs and videos (Figure 2a).

3 | RESULTS

Divers reported three encounters with the same *O. ferox* individual, a female shark named Ofe_1. The first encounter took place between 13 July and 02 August 2005, together with a second female specimen named Ofe_2. Ofe_1 was estimated to be 400 cm TL, based on length comparison with a diver situated next to her (Figure 2b). The encounters with these specimens lasted as long as the divers were in the water

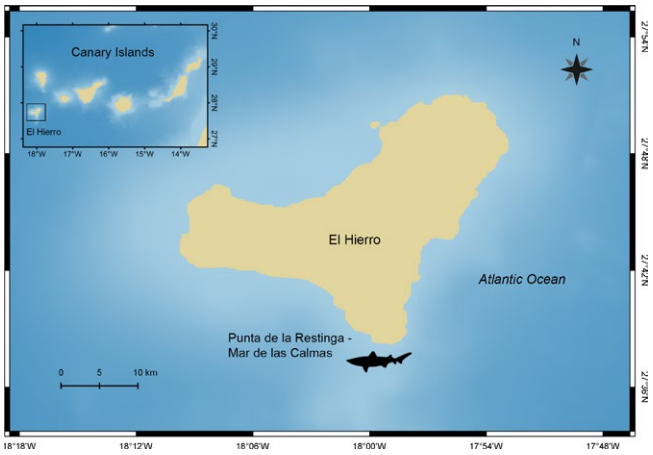

FIGURE 1 Map of El Hierrro showing the location of the *Odontaspis ferox* encounters

(4 hr), at depths of 1–10 m. Both of them were swimming peacefully around the area during the encounters; and seemed not to be bothered by the presence of divers. Although they changed slightly their velocity when they felt observed, swimming slowly away but remaining in the same area. A third encounter with a female *O. ferox* named Ofe_3 occurred during July 2006, at depths of 7–10 m. This female had a fearful behaviour, swimming away to the deep when it noticed the presence of divers. The second encounter with Ofe_1 took place from mid-July to beginning of August 2010; at the same time a fourth female specimen, named Ofe_4, was observed. The depth of the observation ranged from 3 to 10 m. Both females presented behaviour between quiet and distrustful against divers. The third encounter with Ofe_1 occurred from July to September 2016. The observation of this specimen took place at depths of 3–20 m. In this last encounter, the female showed an easily frightened behaviour; swimming around on a fairly large area, sometimes in shallow waters and most of the time

FIGURE 2 *Odontaspis ferox* "Ofe_1" observed in 2005, 2010 and 2016 in El Hierro. (a) Detail of the body characters used for specimen identification, (b) next to a diver for size estimate based on length comparison, (c) showing a distended abdomen indicating that it may be pregnant

TABLE 1 Occurrence of diver observations of *Odontaspis ferox* in El Hierro

Species ID	Years	Length (cm)	Sex	Substrate type	Bathymetric range (m)	Temperature (°C)
Ofe_1	2005, 2010, 2016	400	F	Volcanic rock, algae	1–20	21–25
Ofe_2	2005	350–400	F	Volcanic rock, algae	1–10	>20
Ofe_3	2006	350–400	F	Volcanic rock, algae	7–10	>20
Ofe_4	2010	350–400	F	Volcanic rock, algae	3–10	>20

to a depth that was not visible diving. Observations of the specimens with distended abdomen and lack of feeding behaviour suggest all four specimens might have been pregnant during encounters (Figure 2c). All encounters and its characteristics are summarized in Table 1.

4 | DISCUSSION

Sharks, as predators, are key species in the ecosystems (Barría, Coll, & Navarro, 2015), so knowing their patterns of movement, distribution and reproduction may be critical to their conservation.

The observations reported in this study confirm the first records of live *O. ferox* in Canary Islands waters; and extend the known depth range of this species up to 1 m deep. Moreover this paper describes for the first time site fidelity of *O. ferox* females to a particular area, El Hierro. The digital images captured by citizen scientists, are key to identify and to monitoring the return rate of individuals of long lived species, scarce, hard to see or unusual such as *O. ferox*.

The highly discrete geographical distribution of this species points towards a strong preference for particular type of habitat (Bonfil, 1995). However, the areas where there are more sightings are the tropics and oceanic islands with steep relief to depths of several hundred meters (Fergusson et al., 2008). *O. ferox* is a deep-sea shark and females of this species are likely to migrate to shallower waters in breeding periods near the birth of their offspring, as observed in other sharks such as *Ginglymostoma cirratum* (Carrier, Pratt, & Martin, 1994). This migrating behaviour could happen to reduce the risk of predation (or cannibalism) of the offspring by adult sharks, as well as to provide more food and optimal temperature to enhance neonatal growth (Economakis & Lobel, 1998). Females described in this study showed a distended abdomen, which could suggest that they were pregnant, as documented previously in Acuña-Marrero et al. (2013).

A priori we could say that the Canary Islands, in particular El Hierro, is one of the most important areas for the conservation of *O. ferox*, both for the frequency of their sightings and for the possibility of females using this zone to give birth to their young. El Hierro is currently protected, however the main economic activities of the Island is tourism and diving, therefore, it is recommended to establish a code of conduct in underwater encounters with *O. ferox* similar to those used with *Carcharias taurus* (Smith, Scarr, & Scarpaci, 2010) to minimize their impact.

While the records reported in this study provide additional information on the occurrence and distribution of *O. ferox* in this region, further research is required to fully understand its ecology and to investigate specific behaviours exhibited by *O. ferox* in the presence of divers. If this area is indeed a nursery ground, an investigation involving users, scientists and authorities is essential for the preservation of this species and its habitat.

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ORCID

C. Barría http://orcid.org/0000-0001-6769-4578

REFERENCES

Acuña-Marrero, D., Zimmerhackel, J. S., Mayorga, J., & Hearn, A. (2013). First record of three shark species, *Odontaspis ferox*, *Mustelus albipinnis* and *Centrophorus squamosus*, from the Galápagos Islands. *Marine Biodiversity Records*, *6*, e87. https://doi.org/10.1017/S1755267213000596

Barría, C., Coll, M., & Navarro, J. (2015). Unravelling the ecological role and trophic relationships of uncommon and threatened elasmobranchs in the western Mediterranean Sea. *Marine Ecology Progress Series*, *539*, 225–240. https://doi.org/10.3354/meps11494

Bonfil, R. (1995). Is the ragged-tooth shark cosmopolitan? First record from the western North Atlantic. *Journal of Fish Biology*, *47*, 341–344. https://doi.org/10.1111/j.1095-8649.1995.tb01902.x

Bortone, S. A., Van Tassell, J., Brito, A., Falcón, J. M., & Bundrick, C. M. (1991). A visual assessment of the inshore fishes and fishery resources off El Hierro, Canary Islands: A baseline survey. *Scientia Marina*, *55*, 529–541.

Brito, A. (1991). *Catálogo de los peces de las Islas Canarias*. La Laguna, Spain: Francisco Lemus.

Carrier, J. C., Pratt, H. L., & Martin, L. K. (1994). Group reproductive behaviors in free-living nurse sharks, *Ginglymostoma cirratum*. *Copeia*, *1994*, 646–656. https://doi.org/10.2307/1447180

Compagno, L. J. V. (2001). *FAO species catalogue. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks (Heterodontformes, Lamniformes and Orectolobiformes)*. Rome, Italy: FAO.

Davenport, R., Neuer, S., Helmke, P., Perez-Marrero, J., & Llinas, O. (2002). Primary productivity in the northern Canary Islands region as inferred from SeaWiFS imagery. *Deep Sea Research Part II: Topical Studies in Oceanography*, *49*, 3481–3496. https://doi.org/10.1016/S0967-0645(02)00095-4

Economakis, A. E., & Lobel, P. S. (1998). Aggregation behavior of the grey reef shark, *Carcharhinus amblyrhynchos*, at Johnston Atoll, Central Pacific Ocean. *Environmental Biology of Fishes*, *51*, 129–139. https://doi.org/10.1023/A:1007416813214

Fergusson, I. K., Graham, K. J., & Compagno, L. J. (2008). Distribution, abundance and biology of the smalltooth sandtiger shark *Odontaspis ferox* (Risso, 1810)(Lamniformes: Odontaspididae). *Environmental Biology of Fishes*, *81*, 207–228.

Graham, K. J., Pollard, D. A., Gordon, I., Williams, S., Flaherty, A. A., Fergusson, I., & Dicken, M. (2016). *Odontaspis ferox*. The IUCN Red List of Threatened Species 2016: e.T41876A103433002.

Smith, K., Scarr, M., & Scarpaci, C. (2010). Grey nurse shark (*Carcharias taurus*) diving tourism: Tourist compliance and shark behaviour at Fish Rock, Australia. *Environmental Management*, *46*, 699–710. https://doi.org/10.1007/s00267-010-9561-8

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