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SHORT PAPER

Some Biological Information on a Female Kitefin Shark, *Dalatias licha* (Bonnaterre, 1788) Stranded in the Laconikos Gulf of Greece (SE Ionian Sea)

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Abstract

The kitefin shark Dalatias licha is a deep sea shark rarely recorded in the eastern Mediterranean Sea, where it has been incidentally caught by deep waters long-lines and trawling. The present study concerns a female of 99 cm in total length stranded on a Greek coast (SE Ionian Sea). It was found severely decomposed. Basic morphological measures were recorded and its stomach was removed for diet examination. The current work provides for the first time valuable biological information on this rare deep sea shark and new records of prey preference in the Mediterranean Sea.

Introduction

The kitefin shark *Dalatias licha* is a deep-water species exhibiting a widespread distribution (Capape, Hemida, Quignard, Ben Amor, & Reynaud, 2008). In the Mediterranean, it is common in the central and western basin (Navaro, López, Coll, Barría, & Saez-Liante, 2014) but is considered as rare in the eastern part of the basin (Ergüden, Çekic, Alagoz Erguden, Altun, & Uygur,2017). In the Ionian Sea few specimens of *D. licha* have been recorded from deep-sea studies (Sion, Bozzano, D'Onghia, Capezzuto, & Panza,2004; Politou, Mytilineou, D'Onghia, & Dokos,2008), with no biological information included.

D. licha is a moderately sized, short and blunt-snouted shark with large eyes and thick lips. Its upper teeth are small slender-cusped and the lower teeth are with erect triangular serrated cusps and distal blades (Compagno, 1984), which makes it a powerful, solitarypredator that takes many different types of prey (Erguden et al., 2017). It is listed as Not Evaluated in the Red Book of Endangered Animals of Greece (Megalofonou, 2009) while in the IUCN Red List of Threatened Species it is concerned as Near Threatened (Walls & Guallart, 2016). This is the first report of *D. licha* in the Laconikos gulf of the Greek Ionian Sea and the first dissected specimen from the Greek waters. Our aim is to increase our knowledge on this rare deep-sea shark occurring in the area.

Materials and Methods

On March 2018 a female kitefin shark was stranded on a coast of Peloponnese, in Greece (Figure 1). Members of "Tulipa Goulimi", a local environmental organization based in Neapoli (SE Greece), reported the incident to "iSea" (https://isea.com.gr/), a Greek Environmental Organization, and took pictures and measurements of the specimen. It was identified from its teeth rows since it was severely decomposed (Figure

2) and the only samples collected were its stomach and teeth.

Morphometric measures of the specimen were recorded in the field according to Compagno (1984). The digestive system and each prey, examined in the laboratory of the Hellenic Center for Marine Research (HCMR), were weighted to the nearest 0.1 g. Identification of prey species was made using stereoscopic lens, taxonomic books and HCMR reference collections of frozen species and cephalopod beaks.

Stomach fullness was estimated by using an empirical scale with 0 as empty and 5 as full gut (Anastasopoulou et al., 2013). Diet indices used to describe the presence of prey in the individuals sampled were (1) relative abundance *(% N*) of prey to the total number of prey items, (2) percentage weight *(% W)* of prey item in relation to the total weight of prey items and (3) frequency of prey occurrence (*% F*). The importance of each prey in the diet of the specimen was studied through 2 indices (Hureau, 1970): the alimentary coefficient Q (*Q=% F* × *% W*) and the index of relative importance (% I_{RI}) expressed as a percentage [I_{RI}=(% *N* + % *W*) × % *F*]. Using the *Q* coefficient, prey items were separated into three categories: principal for *Q*>200, secondary for 20<*Q*<200 and accidental for *Q* <20.To estimate cephalopod prey specimen size, the beak was extracted and the rostral length of the lower beak (LRL) was measured.

Results

Morphometric characteristics obtained for

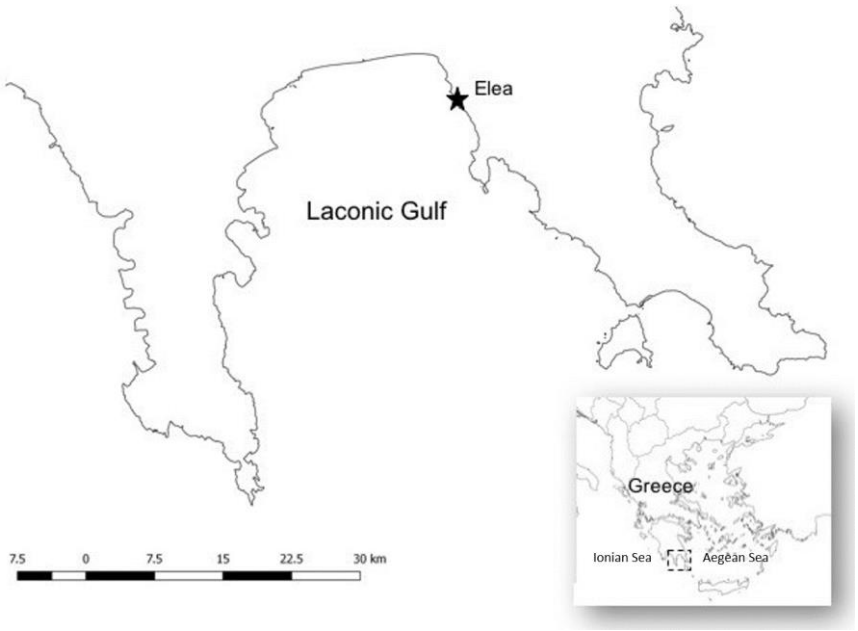

Figure 1. Map of the area where *D. licha* was stranded

Figure 2. Head images of the stranded female kitefin shark showing its characteristic teeth rows

Dalatias licha in the SE Ionian Sea are presented in Table 1. Stomach fullness was estimated to be 4 (almost full). Two prey items were identified from one cephalopod crown and few appendages from one crustacean (Table 2). The cephalopod remains composed the greatest part of the stomach content, with no signs of digestion. The crown belonged to the umbrella squid species *Histioteuthis bonnellii* (Férussac, 1834) confirmed by the extracted beak. The lower rostral length of the beak was 5.87 mm and the mantle length calculated according to the equation of Würtz, Poggi, and Clarke (1992) was 113 mm.

The shrimp appendages collected from the stomach were compared to frozen samples of deep water shrimps and found to match with those of the giant red shrimp (*Aristaeomorpha foliacea;* Risso, 1827*)* swimming appendages (endopods and exopods of some pleopods) and mandibles. The most dominant prey in the stomach was *H. bonnellii* while *A. foliacea* was considered as secondary prey, with *Q*=4.89 and *Q*=107 respectively.

Discussion

Studies on the deep waters of the Ionian Sea have documented the biomass and bathymetric distribution of demersal species, including the kitefin shark (Sion et al., 2004; Politou et al., 2008). The highest catches per unit effort for *D. licha* in the eastern Ionian Sea has been recorded at 700-900 m in depth (Politou et al., 2008), which is in agreement with the depth ranges of its two prey items found in its stomach (Papaconstantinou, & Kapiris, 2003*;* Lefkaditou, 2007). Similar morphometric values for *D. licha* to those reported here have been previously published from the Iskenderun bay (E. Mediterranean) (Erguden et al., 2017).

Overall, this is the first time to report the presence of *A. foliacea* and *H. bonellii* among the prey items of *D. licha* in the literature. However, *H. bonnellii* has been found among preys of several shark and large pelagic fish species in the Eastern Mediterranean (Lefkaditou, 2007; Kousteni, Karachle, Megalofonou, & Lefkaditou,2018), whereas *A. foliacea* has been reported in the stomach of deep sea sharks in the area (Anastasopoulou, Mytilineou, Smith, & Papadopoulou,2018).

There is little information on the trophic strategy of *D. licha*, coming mainly from the western part of the Mediterranean basin, where the importance of small sharks in the diet of *D. licha* have been documented and thus its high trophic position within the food web (Navaro et al., 2014). Our findings showed the presence of a whole squid in the stomach, which is not in agreement with previous studies where *D. licha* is described to take bites instead of swallowing the entire prey. Due to the lack of beaks from the examined stomach of specimens in other studies *H. bonnellii* has never been described as prey item for the kitefin shark. This may suggest that *D. licha* might follow different feeding strategies due to geographical differences in prey availability, since the eastern Mediterranean is an oligotrophic area in comparison to the western basin. Further studies are necessary to support this hypothesis.

The kitefin shark may be an important predator of Mediterranean deep-sea ecosystems (Navaro et al., 2014). Knowing the trophic position of sharks is important to understand their ecological position in relation to other organisms in the ecosystem. New information provided here for *D. licha* will trigger further studies on the role that predatory species play in Mediterranean deep-sea foodwebs.

Table 1. Morphometry (mm) and percentages (%) of *Dalatias licha* from the Laconic gulf

Measurements	mm	% of TL
Total length	990	-
Fork Length	760	76.77
Head length	210	21.21
Pre first dorsal length	560	56.57
Pre second dorsal length	690	69.70
Pre pelvic Length	620	62.63
Precaudal length	800	80.81

Table 2. Stomach content weights and diet indices of the female *Dalatias licha*

Measurements	W (gr)	*% N &% F**	*%W*	*% I_{RI}*	*Q*
Stomach	187.2				
H. bonnellii	91.6	50	97.86	7.393	4,893
A. foliacea	2.0	50	2.14	2.607	107

**%N and % F had similar values due to the presence of one prey item for each prey group*

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