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THE OCCURRENCE OF NORWEGIAN SKATE, *DIPTURUS NIDAROSIENSIS* (ELASMOBRANCHII: RAJIFORMES: RAJIDAE), IN THE STRAIT OF SICILY, CENTRAL MEDITERRANEAN

Michele L. GERACI*, Manfredi DI LORENZO, Fabio FALSONE, Danilo SCANNELLA, Federico DI MAIO, Francesco COLLOCA, Sergio VITALE, and Fabrizio SERENA

[1]*nstitute for Biological Resources and Marine Biotechnology (IRBIM), National Research Council – CNR, Mazara del Vallo (Tp), Italy*

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Abstract. This short note describes the first record of the Norwegian skate, *Dipturus nidarosiensis* (Storm, 1881), in the Strait of Sicily. A male specimen of 95.6 cm total length and 3466 g weight was caught on December 2017 during a bottom trawl survey at a mean depth of 551 m. Information on biometric, sexual maturity, stomach content, and age estimation were provided. This finding confirms the occurrence of the species in the Strait of Sicily, previously suggested by the record of an empty egg case in 2015, thus contributing to the knowledge on the distribution of the species in the Mediterranean Sea.

Keywords: Mediterranean Sea, first record, elasmobranchs, biodiversity, deep-water species

INTRODUCTION

The Norwegian skate, *Dipturus nidarosiensis* (Storm, 1881), is a benthopelagic species living on the continental slope from 125 m to more than 1400 m depth (Stehmann and Bürkel 1984, Stehmann 1991, Last et al. 2016). The species is present mainly in the eastern Atlantic from Iceland, fjords of central and southern Norway, around Rockall, through Ireland to the Northern Mauritania and South Africa (McEachran and Dunn 1998, Compagno 1999, Williams et al. 2008, George 2009, Last et al. 2016, McEachran and Séret 2016, Weigmann 2016).

In the Mediterranean Sea the Norwegian skate was recorded for the first time off the south-eastern coasts of Sardinia, where fourteen specimens were caught in 2005–2008 (Follesa et al. 2010). Their identification was confirmed by the analysis of three mtDNA regions, compared with that of three species of the genus *Dipturus* occurring in the Mediterranean Sea and North-eastern Atlantic—*Dipturus batis* (Linnaeus, 1758), *Dipturus oxyrinchus* (Linnaeus, 1758), and *Dipturus nidarosiensis* (see Cannas et al. 2010, Fricke et al. 2018). Some further records were reported in the same area by Follesa et al. (2012). More recently, *D. nidarosiensis* was found also in the Ionian Sea and the Adriatic Sea (Carbonara et al. 2019, Cariani et al. 2017), as well as in the Alboran Sea where eight specimens were caught between 2013 and 2016 (Ramírez-Amaro et al. 2017). Finally, Massi et al. (2017) assumed the presence of *D. nidarosiensis* in the Strait of Sicily, off Pantelleria Island, on the basis of an empty egg case.

The current knowledge on the biology of the Norwegian skate is extremely limited and refers to few studies describing the egg-case morphology, diet composition, and reproduction (Gordon and Ducan 1989, Dulvy and Reynolds 1997, Ebert and Bizzarro 2007, Follesa et al. 2012, Massi et al. 2017). Regarding the reproductive aspects, it is likely that the fish under study attains maturity at about 8–10 years, depositing approximately 50 eggs per year (Anonymous 2002).

Considering that this species is globally listed in the IUCN (International Union for Conservation of Nature) Red List as Near Threatened (Stehmann et al. 2015) any improvement of the current knowledge is of priority importance for the purpose of assessing its conservation status. The present note provides a new record of Norwegian skate in the Strait of Sicily thus improving the knowledge on the geographic distribution of the species. In addition, some information on the stomach content and the age estimation were provided.

MATERIAL AND METHODS

On 9 December 2017 a specimen of *D. nidarosiensis,* hereafter called DnSoS, was caught in the Strait of Sicily

* Correspondence: Dr Michele Luca Geraci, Istituto per le Risorse Biologiche e le Biotecnologie Marine (IRBIM), Via Luigi Vaccara 61, 91026 Mazara del Vallo (Tp), Italy, phone: +39 0923 948966, fax: +39 0923 906634, e-mail: (MLG) *micheleluca.geraci@gmail.com*, (MDL) *manfredi.dilorenzo@libero.it*, (FF) *falsonefabio@gmail.com*, (DS) *scadanilo@libero.it*, (FDM) *federicodimaio@libero.it*, (FC) *francesco.colloca@cnr.it*, (SV) *sergio.vitale@cnr.it*, (FS) *fabrizio50serena@gmail.com*.

during the MEDITS (International bottom trawl survey in the Mediterranean) survey off Pantelleria Island on a bathyal sandy-muddy bottom (initial coordinates 36°52.64′N, 012°13.38′E at 513 m depth, final coordinates 36°51.62′N, 012°15.75′E at 589 m, Fig. 1). The specimen was identified according to the description given by Serena et al. (2010). Particularly, we used the following key:

1a Dorsal and ventral sides evenly dark; ventral side almost entirely prickly with darkish mucous. A median row of 30–50 thorns on the tail. (*Dipturus nidarosiensis*).

1b Dorsal side with dark and light blotches, ventral side from bluish-grey to brown, without dark mucous and prickles except for the cephalic region and the anterior margins of the disc. A median row of 5–30 thorns on the tail. (*Dipturus batis–Dipturus oxyrinchus*).

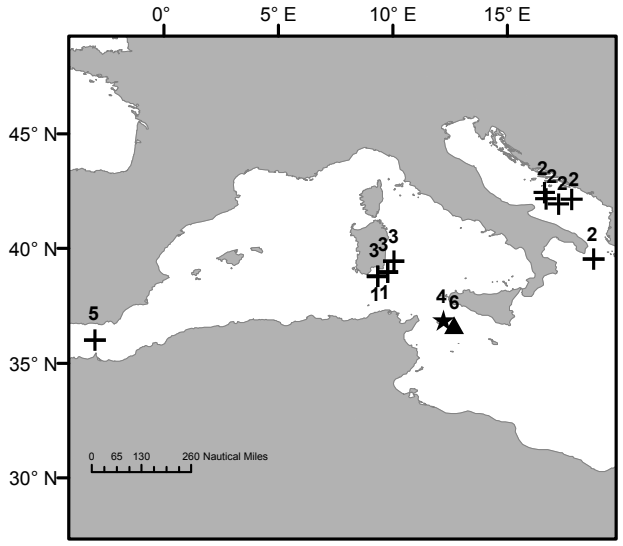

Fig. 1. Updated map showing location of Mediterranean records of Norwegian skate, Dipturus nidarosiensis, reported according to the publication date, in square brackets the years of finding: 1 black cross, Cannas et al. (2010) [2005 through 2008]; 2 black cross, Carbonara et al. (2012) [2008 through 2011]; 3 black cross, Follesa et al. (2012) [2005 through 2011]; 4 black triangle, Massi et al. (2017) [2015 (egg case)]; 5 black cross, Ramírez-Amaro et al. (2017) [2012, 2013, 2016]; 6 black star, presently reported study [2017]

Morphometric measurements were taken to the nearest 0.01 cm and also reported as the percentage of the total length (%TL) following the approach adopted by Ramírez-Amaro et al. 2017 (Table 1). Sex was determined through macroscopic inspection of gonads and maturity stage was assessed using the ICES and MEDITS scale for oviparous elasmobranchs (Anonymous 2013, 2016). Age was estimated by vertebrae reading. In particular, the second and third vertebra were extracted, left in ammonia for 2–3 h, and then a section of 1 mm was obtained from each vertebra with an IsoMet low-speed diamond bladed saw. Vertebrae sections were embedded in a hard epoxy composed by Buehler EpoThin resin and Buehler EpoThin hardener in a 5 ÷ 2 weight ratio and growth increments read using a stereomicroscope connected to a camera. Finally, the stomach content was extracted and prey items identified at the species level.

RESULTS

The presently reported specimen of *D. nidarosiensis* (DnSoS) shown a disc wider than long with the anterior margins of the pectoral fins concave. The snout was acute and long. The upper surface was smooth with one pair of pre-orbital thorns, one postorbital thorn, three rows of alar thorns (on the outer disc) and one group of malar thorns (besides the eyes). A total of 45 thorns were found along the median row of the tail. The dorsal side was grey-brownish while the ventral side uniformly dark with ampullar pores darkly pigmented; lastly, it was partially prickly on the snout (Fig. 2). It was a juvenile male in the maturing phase (stage 2) of 95.6 cm TL and 3466 g. The DnSoS was estimated to be 7 years old, confirming the delayed sexual maturity of the species. The biometrics of the DnSoS, as well as a comparison with specimens reported by Ramírez-Amaro et al. (2017), are provided in Table 1. The maturity stage at length of capture was comparable to the specimens recorded by Follesa et al. (2012) as well as to the estimated length at first maturity of the species in Atlantic waters (Sulak et al. 2009).

DISCUSSION

No clear differences were evident with the exception of orbit diameter, interorbital width, first dorsal fin base, second dorsal fin base, and interdorsal distance (see Table 1). These differences might be due to the smaller size of the Alboran specimens. Two *Polycheles typhlops*, one *Bathynectes maravigna*, and four *Parapenaeus longirostris* (all three crustaceans) were found in the stomach. This result agreed with Follesa et al. (2012) who reported a diet of *D. nidarosiensis* mainly based decapod crustaceans.

The record of a juvenile male confirmed the occurrence of *D. nidarosiensis* in the Strait of Sicily previously assumed by Massi et al. (2017) on the basis of a record of one egg capsule found off Pantelleria Island. The presence of the species supports the role of ecological corridor of the Strait of Sicily in connecting organisms living in the western basin (Cannas et al. 2010, Follesa et al. 2012, Ramírez-Amaro et al. 2017, Scannella et al. 2017) with those distributed in the Ionian Sea (Carbonara et al. 2019). The Strait of Sicily is also considered a biodiversity hotspot for cartilaginous fish in the Mediterranean Sea (Enajjar et al. 2015, Bradai et al. 2018, Di Lorenzo et al. 2018) and this new species record strengthens the importance of this area for the conservation of this vulnerable group, as has already been stated in previous studies (Lauria et al. 2015, Geraci et al. 2017). In addition, the new record of Norwegian skate in the Strait of Sicily points to a wider Mediterranean distribution than previously thought (Ramírez-Amaro et al. 2017). Indeed, in the Mediterranean, this species is one of the deepest

Table 1

Absolute and relative values of selected morphometric and meristic characters of Norwegian skate, *Dipturus nidarosiensis*, from the Strait of Sicily (this study) and from the Alboran Sea (Ramírez-Amaro et al. 2017)

Character	This study		Ramírez-Amaro et al. 2017															
	DnSoS		Spec 1 (M)		Spec 2 (M)		Spec 3 (M)		Spec 4 (M)		Spec 5 (F)		Spec 6 (M)		Spec 7 (M)		Spec 8 (F)	
	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]	[cm]	[%TL]
Total length	95.60		34.2		32.1		24.7		27		25.6		27.9		72.5		24.7	
Disc width	66.35	69.40	24.9	72.81	22.9	71.34	17.5	70.85	19.1	70.74	18.4	71.88	19.3	69.18	51.6	71.17	17.3	70.04
Disc length	52.93	55.37	19.7	57.60	18.2	56.70	13.3	53.85	14.9	55.19	14.4	56.25	15.5	55.56	43.0	59.31	13.0	52.63
Snout tip to max disc width	45.51	47.60	16.5	48.25	15.2	47.35	12.9	52.23	13.0	48.15	12.9	50.39	13.4	48.03	39.8	54.90	12.8	51.82
Preorbital snout length	18.56	19.41	7.6	22.22	6.4	19.94	4.7	19.03	5.7	21.11	5.3	20.70	5.8	20.79	16.1	22.21	4.7	19.03
Eyeball length (left)	2.35	2.46	0.7	2.05	0.8	2.49	0.7	2.83	0.8	2.96	0.7	2.73	0.8	2.87	2.0	2.76	0.8	3.24
Orbit diameter	2.05	2.14	1.2	3.51	1.0	3.12	1.0	4.05	1.1	4.07	1.0	3.91	1.2	4.30	2.2	3.03	1.0	4.05
Orbit + spiracle length	4.51	4.72	1.6	4.68	1.4	4.36	1.2	4.86	1.4	5.19	1.3	5.08	1.5	5.38	3.1	4.28	1.1	4.45
Spiracle length	2.16	2.26	0.6	1.75	0.6	1.87	0.6	2.43	0.4	1.48	0.6	2.34	0.5	1.79	1.2	1.66	0.4	1.62
Interorbital width	7.27	7.60	1.3	3.80	1.1	3.43	1.1	4.45	1.2	4.44	1.2	4.69	1.2	4.30	3.2	4.41	1.1	4.45
Distance between spiracles	7.54	7.89	2.1	6.14	1.9	5.92	2.1	8.50	1.9	7.04	1.9	7.42	2.1	7.53	4.5	6.21	2.2	8.91
Precaudal length	46.21	48.34	17.2	50.29	15.2	47.35	12.0	48.58	13	48.15	12.2	47.66	13.2	47.31	37.2	51.31	11.4	46.15
Tail length to first dorsal fin	23.10	24.16	8.3	24.27	8.7	27.10	6.7	27.13	7.5	27.78	6.8	26.56	7.5	26.88	19.7	27.17	7.2	29.15
Tail length to second dorsal fin	31.28	32.72	11.4	33.33	11.5	35.83	8.8	35.63	9.7	35.93	9.3	36.33	9.4	33.69	25.2	34.76	9.2	37.25
Tail length	43.21	45.20	15.7	45.91	14.8	46.11	13.1	53.04	13.2	48.89	12.9	50.39	13.6	48.75	35.5	48.97	12.2	49.39
Preoral length	19.20	20.08	7.9	23.10	7.2	22.43	5.1	20.65	6.1	22.59	5.6	21.88	6.1	21.86	17.5	24.14	5.1	20.65
Prenarial length	19.60	20.50	6.9	20.18	6.1	19.00	4.3	17.41	5.3	19.63	5.0	19.53	5.5	19.71	16.5	22.76	5.4	21.86
Mouth width	7.78	8.14	3.0	8.77	2.5	7.79	2.0	8.10	2.2	8.15	2.1	8.20	2.3	8.24	5.4	7.45	2.0	8.10
Internarial distance	8.36	8.74	3.3	9.65	3.2	9.97	2.1	8.50	2.6	9.63	2.3	8.98	2.5	8.96	6.5	8.97	2.2	8.91
Distance between fifth gill slit	—	—	3.7	10.82	3.5	10.90	2.4	9.72	2.4	8.89	2.2	8.59	2.5	8.96	6.3	8.69	2.3	9.31
Pelvic fin anterior lobe	11.43	11.96	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pelvic fin posterior lobe	7.61	7.96	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Clasper length	9.12	9.54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tail width at axil of pelvic fins	2.14	2.24	0.7	2.05	0.6	1.87	0.5	2.02	0.5	1.85	0.5	1.95	0.6	2.15	1.6	2.21	0.5	2.02
Tail height at axil of pelvic fins	2.34	2.45	0.75	2.19	0.7	2.18	0.7	2.63	0.65	2.41	0.6	2.50	0.8	2.72	1.5	2.07	0.6	2.43
First dorsal fin base	3.34	3.49	1.9	5.56	1.8	5.61	1.5	6.07	1.8	6.67	1.5	5.86	1.5	5.38	4.3	5.93	1.5	6.07
First dorsal fin height	3.59	3.76	0.8	2.34	0.9	2.80	0.6	2.43	0.6	2.22	0.7	2.73	0.8	2.87	2.2	3.03	0.6	2.43
Second dorsal fin base	2.39	2.50	2.3	6.73	1.8	5.61	1.5	6.07	1.8	6.67	14.3	55.86	1.5	5.38	4.8	6.62	1.6	6.48
Second dorsal fin height	3.05	3.19	1.0	2.92	0.9	2.80	0.7	2.63	0.65	2.41	0.6	2.50	0.8	2.87	2.0	2.76	0.7	2.83
First dorsal fin to caudal fin tip	16.68	17.45	5.5	16.08	4.5	14.02	5.1	20.65	4.5	16.67	4.4	17.19	4.7	16.85	11.5	15.86	4.5	18.22
Second dorsal fin to caudal fin tip	8.63	9.03	3.5	10.23	2.5	7.79	2.7	10.93	2.4	8.89	2.3	8.98	2.6	9.32	5.1	7.03	2.5	10.12
Interdorsal distance	4.80	5.02	0.7	2.05	0.8	2.49	0.8	3.24	0.5	1.85	0.7	2.73	0.8	2.87	1.7	2.34	0.6	2.43
Teeth in upper jaw	45		43		39		43		43		43		43		44		43	

M = male, F = female, TL = total length.

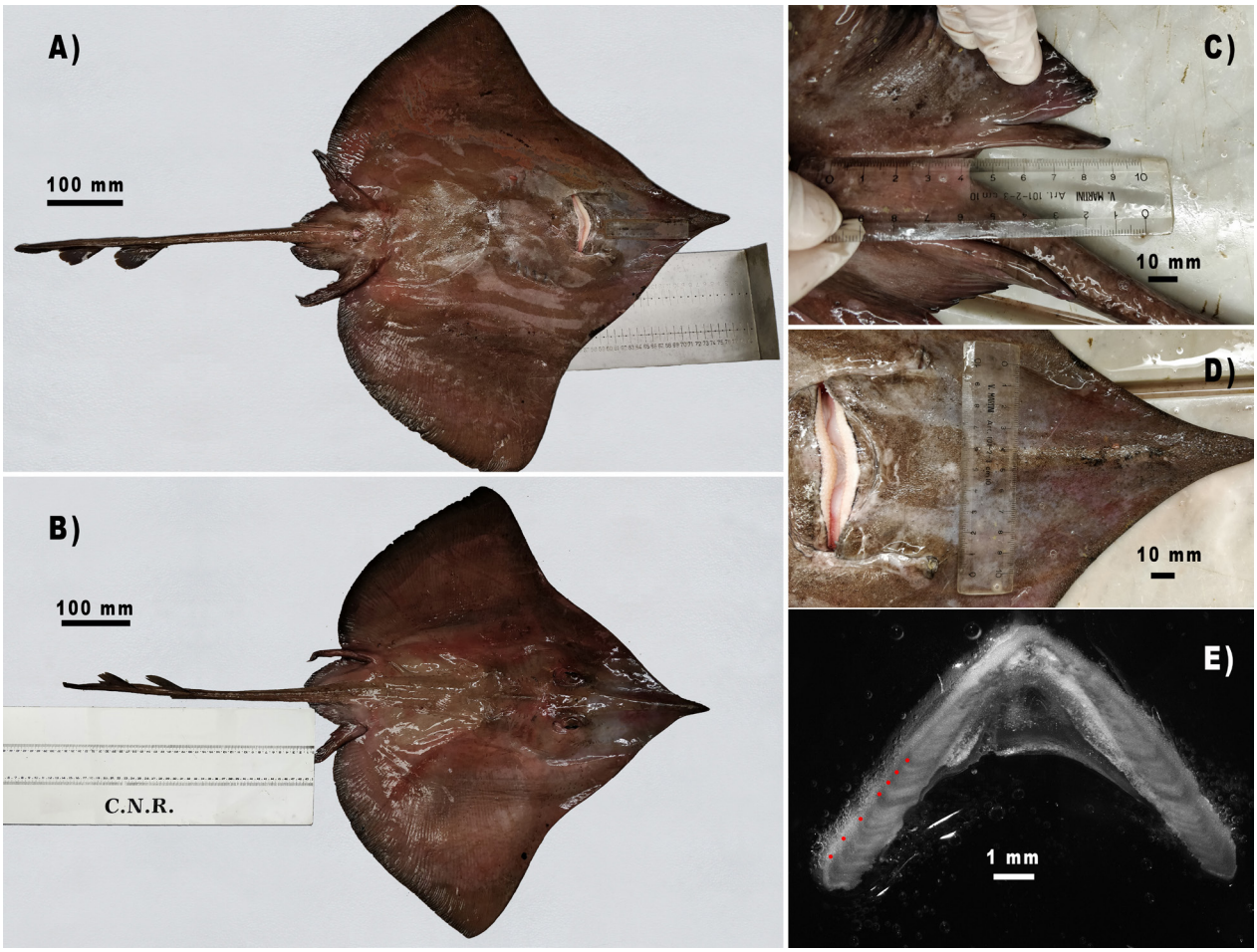

Fig. 2. Images of Norwegian skate, Dipturus nidarosiensis, presently reported from the Strait of Sicily (DnSoS); ventral side (**A**), dorsal side (**B**), clasper (**C**), the prickly snout and the jaws (**D**), and a section of vertebra (**E**)

living skates with records ranging from 600 up to 1400 m (Cannas et al. 2010). Similarly, in the NE Atlantic, it appears common between 950 and 1300 m depth (Massutì et al. 2004).

Its bathymetric distribution, covering deep areas of the continental slope beyond the range of either commercial fishing or bottom trawl surveys, could be the main reason for the few records from the Mediterranean Sea. To cover the current knowledge gaps on the species, special attention should be focused on the monitoring of the bycatch of deepwater fisheries (e.g., red shrimp fisheries). The extension of the depth range of the on-going bottom trawl surveys beyond 1000 m depth would be also another important key step to collect data on Norwegian skate and other poorly studied deep-sea Mediterranean elasmobranchs.

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