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SQUALI E RAZZE MEDITERRANEE

MEDITERRANEAN SHARKS AND RAYS

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THE FIRST SUBSTANTIATED RECORDS OF SMOOTHBACK ANGELSHARK *SQUATINA OCULATA* (SQUATINIDAE) FROM THE ALGERIAN COAST (SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

In this paper, the authors report the captures of three specimens of smoothback angelshark Squatina oculata *Bonaparte, 1840 from the eastern region of the Algerian coast. Two of the specimens were males, measuring 1555 mm and 1520 mm in total length (TL) and weighing 25.5 and 21 kg in total body weight (TBW), respectively. The third specimen was a female, measuring 1600 mm in TL and weighing 27 kg. The female exhibited fully yolked oocytes ready to be released from both ovaries. The diameter of 10 of the oocytes was measured, ranging between 58 and 70 mm (mean = 63.2 mm ± 4.8 mm). These findings constitute the first substantiated records of* S. oculata *in the Algerian ichthyofauna. However, while the occurrence of a viable population in the area cannot be totally ruled out, the species needs a management plan to prevent its drastic decline.*

Key words: *Squatina oculata*, distribution, viable populations, first record, ovarian fecundity

PRIME SEGNALAZIONI COMPROVATE DI SQUADRO PELLE ROSSA, *SQUATINA OCULATA* (SQUATINIDAE), LUNGO LA COSTA ALGERINA (MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

In questo articolo gli autori riportano le catture di tre esemplari di squadro pelle rossa, Squatina oculata *Bonaparte, 1840, provenienti dalla regione orientale della costa algerina. Due degli esemplari erano maschi, misuravano 1555 mm e 1520 mm di lunghezza totale (TL) e pesavano rispettivamente 25,5 e 21 kg di peso corporeo totale (TBW). Il terzo esemplare era una femmina, misurava 1600 mm in TL e pesava 27 kg. La femmina mostrava ovociti completamente maturi pronti per essere rilasciati da entrambe le ovaie. È stato misurato il diametro di 10 ovociti, compreso tra 58 e 70 mm (media = 63,2 mm ± 4,8 mm). Questi risultati costituiscono le prime testimonianze documentate di* S. oculata *nell'ittiofauna algerina. Tuttavia, anche se non si può confermare del tutto la presenza di una popolazione vitale nella zona, la specie necessita di un piano di gestione per prevenirne il drastico declino.*

Parole chiave: *Squatina oculata,* distribuzione, popolazioni vitali, prima segnalazione, fecondità ovarica

INTRODUCTION

The smoothback angelshark *Squatina oculata* Bonaparte, 1840 is present along the eastern tropical Atlantic coast from Morocco (Lloris & Rucabado, 1998) to Angola (Roux, 1984). In some areas, such as the coast of Senegal, *S. oculata* holds an important economic interest and is targeted by craft fisheries (Diatta *et al.*, 2009). The relative abundance of the species has allowed researchers to gather some insights into its reproductive biology (Capapé *et al.*, 2002).

Squatina oculata occurs in the Mediterranean Sea together with two congeneric species: the sawback angelshark, *S. aculeata* Cuvier, 1829, and the common angelshark, *S. squatina* (Linnaeus, 1758). According to Roux (1984), *S. oculata* was previously unknown off the Mediterranean coast of France (Capapé *et al.*, 2000). Conversely, Tortonese (1956) noted its presence in Italian waters, and Zava *et al.* (2016) collected 4 juvenile specimens from the Strait of Sicily. More recently, Zava *et al.* (2022) reported of 21 specimens observed off the Malta Islands and six specimens detected between 2005 and 2021, while Ounifi-Ben Amor *et al.* (2023) reported the capture of two additional specimens in Tunisian marine waters.

In the eastern Mediterranean, *S. oculata* was first reported in the Levant Basin, off the Syrian coast, by Ali (2003, 2018), and later confirmed off the Lebanese coast by Bariche & Fricke (2020). Ergüden *et al.* (2019) and Akyol *et al.* (2023) have reported all instances of *S. oculata* in Turkish waters, where it is sporadically caught and considered a rare species.

With regard to the Algerian coast in particular, *S. squatina* is the single squatinid species reported by Dieuzeide *et al.* (1953), whereas Refes *et al.* (2010) noted the occurrence of *S. oculata*, but no specimen was available for confirmation. Scientific investigations regularly conducted in this area have allowed us to collect some specimens of *S. oculata*, which are described herein along with comments on the distribution of the species.

MATERIAL AND METHODS

The present specimens of *S. oculata* were sampled at the main fish market of Algiers, where fish caught from areas along the Algerian coast, between the Moroccan and Tunisian borders, are landed. During the sampling period, which extended from 2010 to 2020, only these three specimens were observed. They were captured by commercial trawl at a depth of 100 m, on sandy-muddy bottoms off Annaba, in the eastern region, at 35°42′35″N and 1°22′17″W (Fig. 1). They were carefully examined and identified using field guides and ichthyological fauna. They were also photographed and measured for total length (TL) to the nearest millimetre, while the total body weight (TBW) to the nearest kilogram was provided by fishermen and/or sellers. In general, obtaining morphometric measurements proved challenging since the specimens were sold rapidly, mainly in large quantities, for local consumption.

RESULTS AND DISCUSSION

The first specimen was captured on 27 March 2012. It was a male measuring 1555 mm TL and

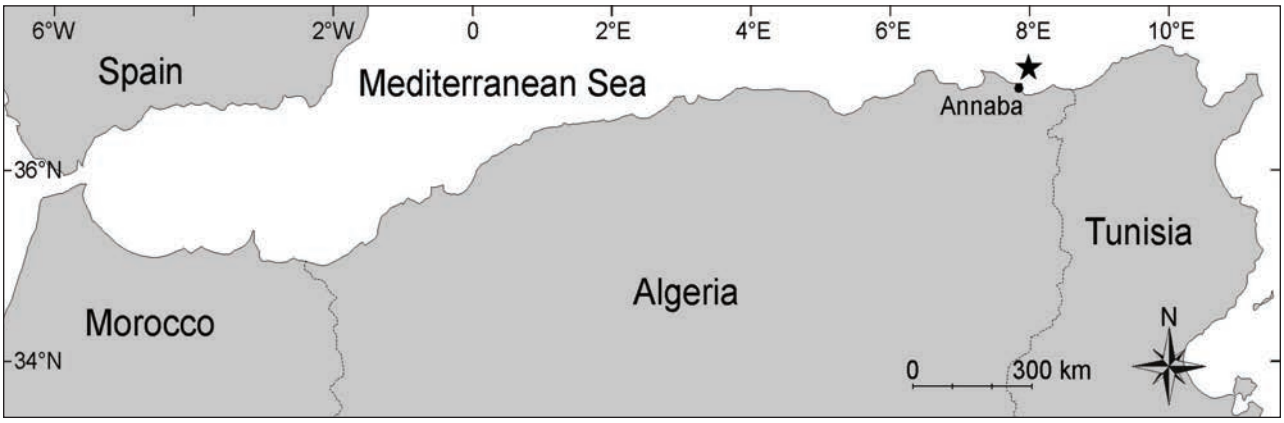

Fig. 1: Map of the Algerian coast, with the black star indicating the capture site of the specimens of *Squatina oculata* ***(redrawn from Capapé*** *et al.****, 2023).***
Sl. 1: Zemljevid alžirske obale z označenim območjem ulova primerkov vrste *Squatina oculata* ***(prirejeno po Capapé in sod., 2023).***

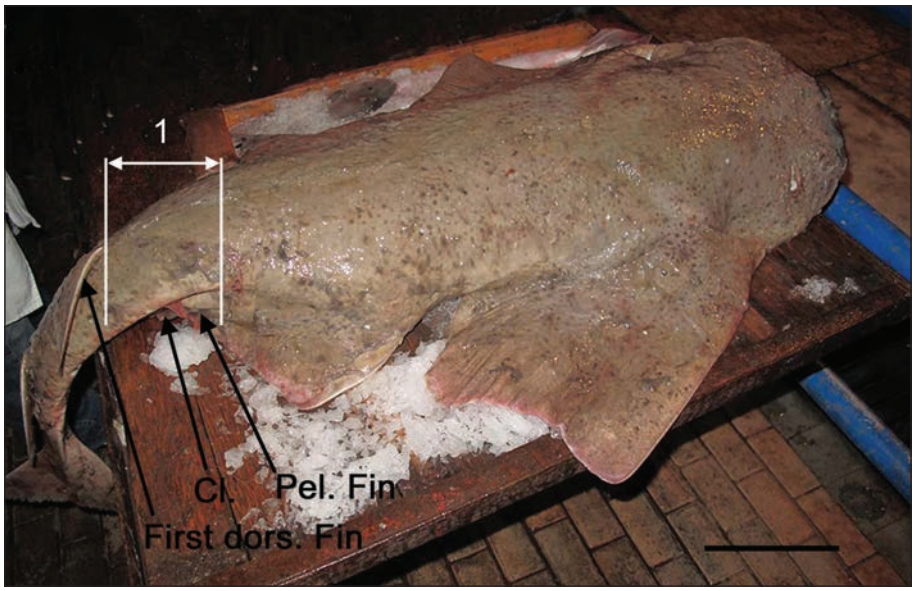

Fig. 2: Male specimen of** Squatina oculata**. 1. Space showing that the hind tip of the pelvic fin (Pel. Fin) does not reach the level of the first dorsal fin origin (First Dors. Fin). Cl = clasper. Scale bar = 200 mm (Photo: F. Hemida).
Sl. 2: Samec vrste** Squatina oculata**. 1. Presledek kaže, da zadnja konica trebušne plavuti (Pel. Fin) ne doseže začetka korena prve hrbtne plavuti (First Dors. Fin). Cl = klasper. Merilo = 200 mm (Foto: F. Hemida).

weighing 25.5 kg TBW (Fig. 2). The second specimen, caught on 26 December 2016, was also a male. It measured 1520 m TL and weighed 21 kg. The third specimen, a female measuring 1600 mm in TL and weighing 27 kg, was caught on 16 December 2020. All three specimens were identified as *S. oculata* based on the combination of main morphological characters: external nasal flap with two barbels bordering a fringed median lobe (Fig. 3, 1); dermal folds on sides of head slightly undulate (Fig. 3, 2); pectoral fins very high and broad with rounded rear tips; hind tips of pelvic fins not reaching level of first dorsal fin origin; dorsal surface rough with a median line of small spines on front margin of pectoral and pelvic fins; teeth pointed, slightly curved at the distal end and with triangular base; colour greyish-brown with several white spots, belly beige. The description and coloration of the three specimens were in complete accordance with those provided by Roux (1984), Capapé & Roux (1980), Compagno (1984), Kabasakal and Kabasakal (2014), Ergüden *et al.* (2019), Rafrafi-Nouira *et al.* (2022), and Akyol *et al.* (2023). Based on these findings alone, it would not be unreasonable to consider *S. oculata* as present in Algerian marine waters and include it in the local ichthyofauna.

The dissection of the female specimen revealed the presence of 24 fully yolked oocytes ready to be released (Fig. 3), with 18 in the left uterus and 6 in the right uterus (Fig. 4). The value of ovarian fecundity in this specimen was slightly higher than that found in specimens from the Tunisian and Senegalese coasts, where it ranged between 6 and 10 oocytes (Capapé *et al.*, 1990) and between 8 and 20 oocytes (Capapé *et al.*, 2002), respectively. This difference is likely due to the larger size of the Algerian specimen. In fact, as noted by Mellinger (1989), both ovarian and uterine fecundity consistently increase with size in elasmobranch viviparous species. In contrast, the diameter of the fully yolked oocytes in the present specimen was similar to those recorded in other regions and ranged between 58 and 70 mm (n = 10; mean = 63.2 mm; ± 4.8 mm). Each fully yolked oocyte appeared to be enveloped by a fine diaphanous membrane (Fig. 5, 1), and together, they were enclosed within a single membranous capsule (Fig. 5, 2). Similar structures were previously described in a pregnant female bluntnose sixgill shark *Hexanchus griseus* (Bonnaterre, 1788) from the Tunisian coast (Ounifi-Ben Amor *et al.*, 2017; Oddone & Capapé, 2022). Unfortunately, we were unable to extract the eggs from the ovaries and weigh them.

Initially, Roux (1984) reported that the maximum TL for *S. oculata* is 1500 mm; subsequently, Ergüden *et al.* (2019) suggested that the species can reach up to 1600 mm TL, with a common TL of 1200 mm. Large

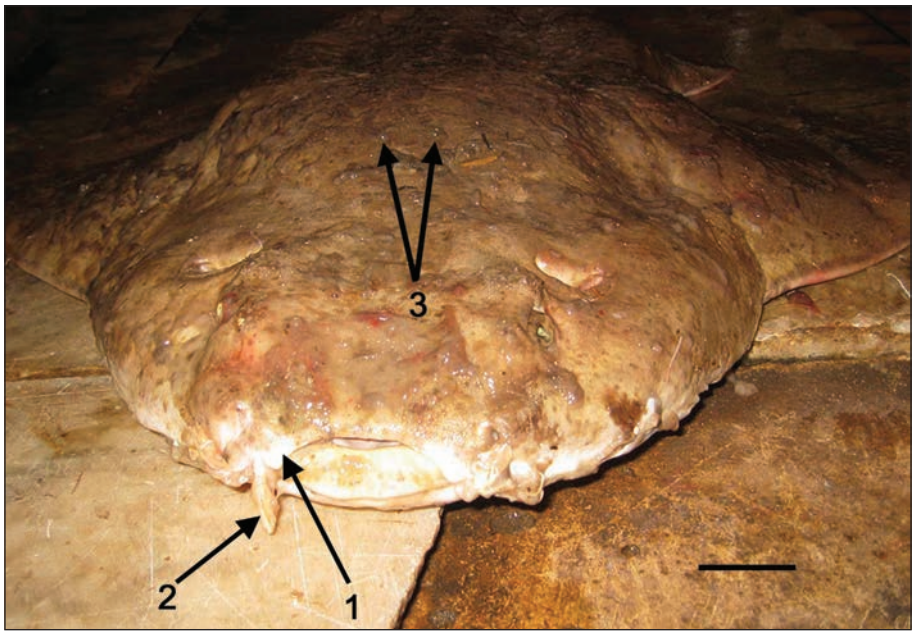

Fig. 3: Male specimen of** Squatina oculata **with front of head showing: 1. Dermal folds on the sides of the head slightly undulate. 2. Barbels bordering a fringed median lobe. 3. White spots. Scale bar = 50 mm (Photo: F. Hemida).
Fig. 3: Samec vrste** Squatina oculata **s sprednjim delom glave, ki kaže: 1. Kožni gubi sta na straneh glave rahlo valoviti. 2. Mesnati izrastki mejijo na resasti sredinski reženj. 3. Bele pege. Merilo = 50 mm (Foto: F. Hemida).

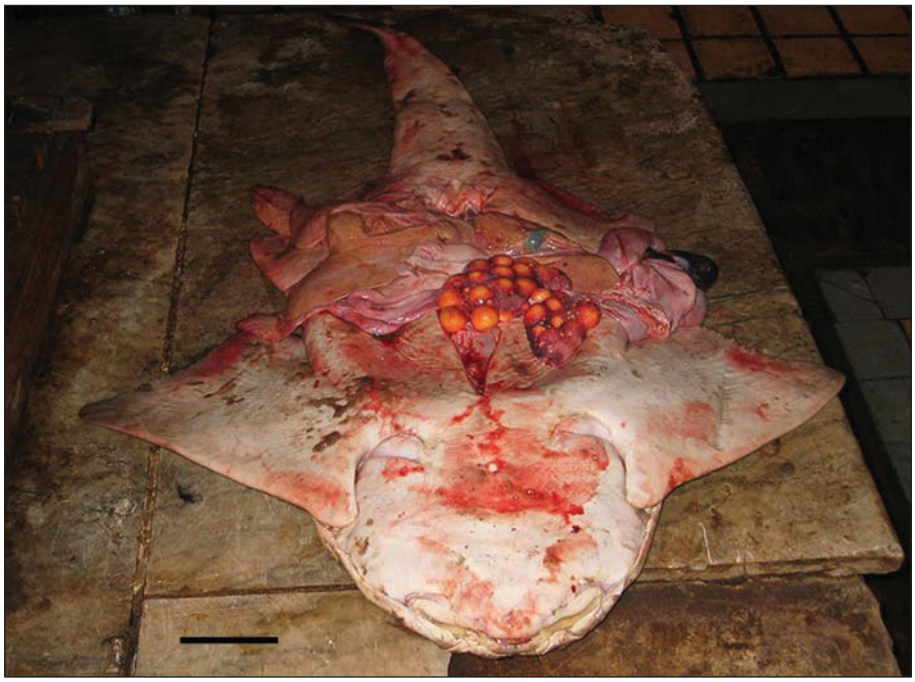

Fig 4: Ventral surface of specimen female of** Squatina oculata **exhibiting fully yolked oocytes, scale bar = 100 mm (Photo: F. Hemida).
Sl. 4: Trebušna površina samice vrste** Squatina oculata **z oocitami z razvitim rumenjakom.

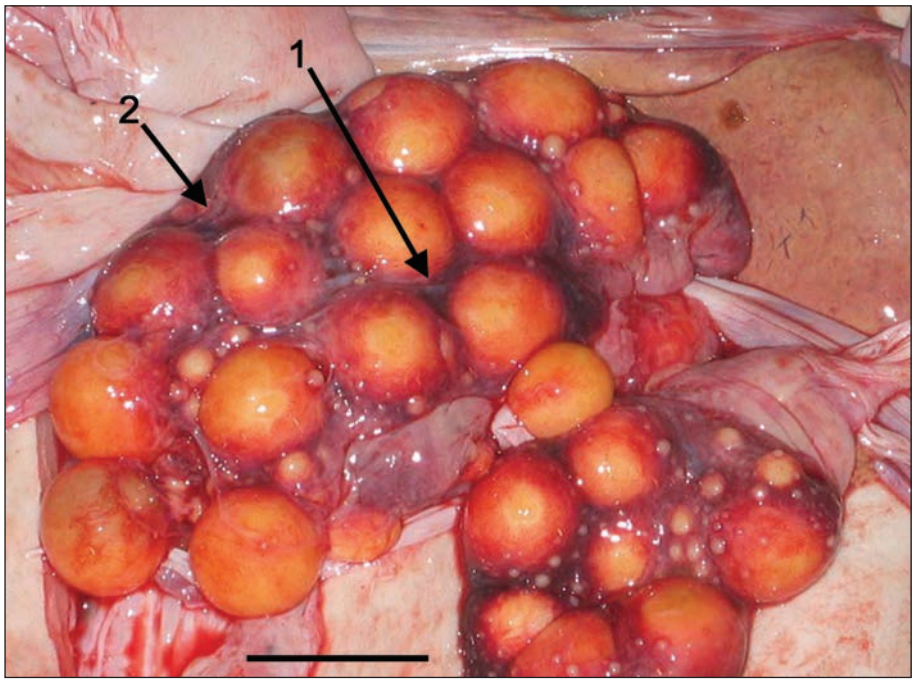

Fig. 5: Fully yolked oocytes from the female of** Squatina oculata**. 1. Oocytes, each enveloped by a fine diaphanous membrane. 2. All oocytes together enclosed in one single membranous capsule. Scale bar = 100 mm (Photo: F. Hemida).
Sl. 5: Oocite z razvitim rumenjakom pri samici vrste** Squatina oculata**. 1. Oocite, zavite v fino prosojno membrano. 2. Vse oocite so skupaj zaprte v eno membransko kapsulo. Merilo = 100 mm (Foto: F. Hemida).

specimens have recently been recorded in the Tunisian coast, measuring between 1350 and 1700 mm (Rafrafi-Nouira *et al*., 2022; Ounifi-Ben Amor *et al*., 2023), and this is consistent with the present specimens, which measured between 1450 and 1555 mm TL. Captures of *S. oculata* are considered rare in the study area, as only 3 specimens were observed over two decades and also the information provided by fishermen suggests that squatinid species are captured only sporadically and sometimes discarded at sea.

S. oculata has been reported in various regions of the Mediterranean Sea. For instance, Ergüden *et al*. (2019) and Akyol *et al*. (2023) documented the captures of specimens from the eastern Mediterranean indicating a continuous presence of the species in the region despite the infrequency of captures. Zava *et al*. (2022) and Ounifi-Ben Amor *et al*. (2023) have observed a relative abundance of the species in the central Mediterranean. However, the unexpected discovery of the three Algerian specimens described herein raises some questions. Their presence could suggest that, locally, the elasmobranch species has not been thoroughly investigated. It is also possible that the species is entirely absent in the region, and the observed specimens migrated from nearby areas, likely the Tunisian coast, as they were captured in the proximity of the Tunisian border. Similar patterns have been reported by Capapé *et al*. (2022) for the marbled stingray, *Dasyatis marmorata* (Steindachner, 1892), and by Capapé *et al*. (2023) for the round fantail stingray *Taeniurops grabatus* (Geoffroy Saint-Hilaire, 1817).

Regardless, as noted by Kabasakal (2021), Zava *et al*. (2022), Akyol *et al*. (2023), and Ounifi-Ben Amor *et al*. (2023), due to its *k*-selected reproductive characteristics, the species requires preservation to prevent a drastic population decline and potential extinction in the short term. Therefore, it is essential to implement a management plan within local fisheries and engage fishermen in efforts to preserve a viable population of *S. oculata* in the area.

PRVI UTEMELJENI ZAPIS O POJAVLJANJU PEGASTEGA SKLATA *SQUATINA OCULATA* (SQUATINIDAE) IZ ALŽIRSKE OBALE (JUGOZAHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji v pričujočem prispevku poročajo o ulovih treh primerkov pegastega sklata Squatina oculata *Bonaparte, 1840 iz vzhodnega dela alžirske obale. Dva primerka sta bila samca, ki sta merila 1555 mm in 1520 mm v totalno dolžino (TL) in tehtala 25,5 in 21 kg celokupne telesne mase (TBW). Tretji primerek je bila samica, ki je merila 1600 mm v dolžino in tehtala 27 kg. Samica je imela oocite z razvitim rumenjakom, pripravljene na sprostitev iz obeh jajčnikov. Izmerili so premer 10 oocit, ki so merile med 58 in 70 mm (v povprečju 63,2 mm ± 4,8 mm). Te ugotovitve predstavljajo prve utemeljene zapise o pojavljanju vrste* S. oculata *v alžirski ihtiofavni. Čeprav ne izključujejo dejstva, da bi se na tem območju lahko pojavljala populacija sposobna preživetja, avtorji menijo, da ta vrsta potrebuje načrt upravljanja, da bi s tem preprečili njen drastični upad.*

Ključne besede: *Squatina oculata*, razširjenost, viabilna populacija, prvi zapis o pojavljanju, plodnost jajčnikov

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PERSPECTIVE ON GREAT WHITE SHARKS (*CARCHARODON CARCHARIAS*) IN THE NORTHWESTERN MEDITERRANEAN AND RECOMMENDATIONS FOR FURTHER FIELD RESEARCH

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ABSTRACT

*We put into perspective the knowledge about white sharks (*Carcharodon carcharias*) in the Mediterranean Sea to identify if the northwestern part is an area of interest and the most efficient methodologies to highlight the presence of the species. We have compiled the main peer-reviewed works, officials' reports and theses, both worldwide and more specifically in the Mediterranean. We focused on studies that allow us to define a more precise framework to search the species. In the Mediterranean, a particular link has been highlighted with bluefin tuna (*Thunnus thynnus*). The northwestern Mediterranean Sea has unique characteristics compared to other parts of the sea regarding primary productivity, surface temperature, presence of tuna, and is bordered by two white sharks' hotspots. We list methodologies for detecting the species worldwide, including BRUVS and environmental DNA. We also make recommendations for field studies.*

Keywords: white sharks, Mediterranean, distribution, diet, recommendations

PROSPETTIVA SUI GRANDI SQUALI BIANCHI (*CARCHARODON CARCHARIAS*) NEL MEDITERRANEO NORD-OCCIDENTALE E RACCOMANDAZIONI PER ULTERIORI RICERCHE SUL CAMPO

SINTESI

*Gli autori hanno messo in prospettiva le conoscenze sul grande squalo bianco (*Carcharodon carcharias*) nel Mediterraneo per identificare se la parte nord-occidentale del bacino sia un'area di interesse e le metodologie più efficaci per evidenziare la presenza della specie. Hanno esaminato i principali articoli scientifici, i rapporti ufficiali e le tesi di laurea, sia a livello mondiale che più specificamente nel Mediterraneo. Si sono concentrati sugli studi che hanno permesso di definire un quadro più preciso per la ricerca della specie. Nel Mediterraneo è stato evidenziato un legame particolare con il tonno rosso (*Thunnus thynnus*). Il Mediterraneo nord-occidentale presenta caratteristiche uniche rispetto ad altre parti del bacino per quanto riguarda la produttività primaria, la temperatura superficiale e la presenza di tonni, ed è delimitato da due hotspot di squali bianchi. Vengono elencate le metodologie per il rilevamento della specie a livello mondiale, tra cui il BRUVS e il DNA ambientale. Si formulano inoltre raccomandazioni per gli studi sul campo.*

Parole chiave: squali bianchi, Mediterraneo, distribuzione, dieta, raccomandazioni

INTRODUCTION

The great white shark *Carcharodon carcharias* (Linnaeus, 1758) is a charismatic but vulnerable species at a global scale (Rigby *et al.*, 2019). Some preferred sites have been identified even though the species has a wide distribution from temperate to tropical waters (Bonfil *et al.*, 2005; Duffy *et al.*, 2012; Christiansen *et al.*, 2014). The main identified hotspots are the northeast Pacific, South Africa, Australia, New Zealand, the Mediterranean, and the east coast of the United States of America (Christiansen *et al.*, 2014).

The reasons put forward for this wide-ranging distribution are many. The first reason is food availability (Becerril-García *et al.*, 2020; Bradford *et al.*, 2020), including the productive areas attracting prey (Bradford *et al.*, 2020). The environment also impacts the species' distribution, with occupation preferences depending on temperature and depth (Boustany *et al.*, 2002; Coxon *et al.*, 2022). Breeding sites (Domeier *et al.*, 2012; Domeier & Nasby-Lucas, 2013) and nurseries also contribute to the distribution of the species (Weng *et al.*, 2007; Domeier & Nasby-Lucas, 2013; Oñate-González *et al.*, 2017). Stages of development can also induce a wide-ranging spatial distribution (Bruce, 2008). In the Mediterranean little is known about the distribution of white sharks (De Maddalena & Heim, 2012).

Genetical studies based on sequencing the mitochondrial control region of Mediterranean specimens demonstrated key findings (Gubili et al., 2010). The examined specimens showed little genetic differentiation from Indo-Pacific lineages. They exhibited strong separation from geographically closer Atlantic/western Indian Ocean haplotypes. The genetic proximity of individuals from the Mediterranean to those from the Pacific lightens the origin of the population (Gubili *et al.*, 2015). Three recent studies provide a global view of this species' past and current distribution over the entire Mediterranean basin (De Maddalena & Heim, 2012; Boldrocchi *et al.*, 2017; Moro *et al.*, 2020). A census of the Mediterranean's observations and catches has been published (De Maddalena & Heim, 2012). The distribution and ecology of the species have also been studied (Boldrocchi *et al.*, 2017), and the hypothesis of the presence of several nurseries in the Mediterranean has been developed: the Sicily Channel (Fergusson, 1996; Fergusson *et al.*, 2000; Boldrocchi *et al.*, 2017), the Adriatic Sea and the Aegean Sea (Kabasakal, 2014, 2020). These studies pointed out a decline in the Mediterranean population, where the species is considered as critically endangered (Dulvy *et al.*, 2016). This phenomenon is illustrated by a reconstruction of the presence of white sharks in the Mediterranean from the 19th century to the present (Moro *et al.*, 2020).

Other studies have focused on specific sectors of the Mediterranean by carrying out analyses on a sub-regional scale. For the central part of this sea, the distribution of sightings and catches of this species was carried out off Sicily at Lampedusa (De Maddalena & Heim, 2012; Micarelli & Sperone, 2016) and Tunisia (Saïdi *et al.*, 2005; Rafrafi-Nouira *et al.*, 2015; Zaouali *et al.*, 2020). Predation on a bottlenose dolphin (*Tursiops truncatus*) has also been detected in this area (Celona *et al.*, 2006). It is not known whether this presence is linked to the narrow and compulsory passage between the two Mediterranean basins. Further east, sightings have been studied in the Adriatic Sea (De Maddalena, 2000; Soldo & Jardas, 2002; Soldo & Dulčić, 2005). A peak of presence in August and September was highlighted (De Maddalena, 2000). In the Sea of Marmara and the waters of the Bosphorus, there may be synchronicity between the decline of *T. thynnus* and *C. carcharias* (Kabasakal, 2016).

Several studies exist for the northwestern Mediterranean, where this species is recorded *e.g.* in the Balearic Islands (Morey *et al.*, 2003). Sightings in this area could be related to food availability in winter with the presence of *Thunnus thynnus* (Barrull & Mate, 2001). For the French waters of Corsica, the reports about the species are also listed (Maliet *et al.*, 2013). A study focused on observations and catches of the species more widely in the French Mediterranean (De Maddalena & Zuffa, 2009). A publication reported a large individual captured in France in 1956 and then taxidermied (De Maddalena *et al.*, 2003). However, this type of capture remains exceptional and opportunistic since this species is considered rare in the Languedoc region of southern France (Capapé *et al.*, 2000).

This study is mainly based on peer-reviewed publications on white sharks in the Mediterranean and worldwide. The work aims to be innovative by providing a different point of view on the issue of the presence of this species in this specific spatial framework. This study is divided into three parts: The first part concerns the diet of the white shark in the world, focusing on the knowledge acquired in the Mediterranean, particularly regarding the bluefin tuna. Then the second part will propose hypotheses on potential spatiotemporal frameworks for white sharks in the northwestern Mediterranean based on knowledge of prey availability and environmental data. Finally, the third part will submit realistic field ideas to highlight their presence considering the small amount of this population.

MATERIAL AND METHODS

Publications included are based on library and electronic databases containing Google Scholar, Web of Science, ResearchGate, and HAL. To find scientific studies, we used different combinations of keywords: white shark, Mediterranean, diet, food, trophic level, ecology, bluefin tuna, *Carcharodon carcharias*, *Thunnus thynnus*, BRUVS, eDNA, primary production, temperature, France, Spain, distribution, world, seamount. We recognize that electronic database research may lead to miss articles, so we used library databases and cited important works from initial findings. We have chosen works written in English, since we believe we have minimized the bias because most current studies are written in English. We also searched for articles in French or Italian, and identified reviews referring to them. We have mainly studied work that has been published in the Mediterranean. We have focused on the north-western part because it has been little studied compared to other areas and has some unique features detailed in this work. But we have also used those carried out on populations worldwide when it could bring ideas to missing knowledge in the Mediterranean. From the information available in the scientific literature, we have chosen to focus on three main parts. We have therefore gathered the information according to the white shark's diet, ecology, and effective *in situ* study methods.

RESULTS AND DISCUSSION

Our paper focuses on studies already published in peer-reviewed scientific journals and "grey" literature like reports or theses. A total of 97 published studies were included in this perspective, published between 1996 and 2023.

Diet of white sharks in the world and the Mediterranean

Worldwide

Adult white sharks are known to have a varied diet composed of elasmobranchs (Hussey *et al.*, 2012; Grainger, 2022), cetaceans (Hussey *et al.*, 2012; Grainger, 2022), teleosts (Hussey *et al.*, 2012; Grainger, 2022), turtles (Heithaus *et al.*, 2008), pinnipeds (Skomal *et al.*, 2012) and cephalopods (Becerril-García *et al.*, 2020; Grainger, 2022). The main food sources for adult specimens are fish for the North Atlantic (Hamady, 2014); tuna for offshore food and pinnipeds for coastal food in the northeast Pacific (Jaime-Rivera *et al.*, 2014); elasmobranchs and teleosts in Australia (Hussey *et al.*, 2012); and pinnipeds at least seasonally in the different oceans (Hussey *et al.*, 2012; Semmens *et al.*, 2013; Jaime-Rivera *et al.*, 2014; Francis *et al.*, 2015). Dietary differences are known between developmental stages and sexes (French *et al.*, 2018). Nevertheless, in general, the trophic level and the prey size will increase with the age of the shark (Estrada *et al.*, 2006; Hussey *et al.*, 2012). Thus the trophic level of an individual exceeding 278 cm is between 4.5 and 5 for individuals from the Northwest Atlantic (Estrada *et al.*, 2006). The trophic level calculated for adult individuals from South Africa is broadly similar, ranging between 4.2 and 5 (Hussey *et al.*, 2012).

The species is highly adaptable, and food sources can vary according to their availability depending on the geographical area (Hamady, 2014; Jaime-Rivera *et al.*, 2014). Indeed, white sharks are known to be highly migratory and capable of moving from one ecosystem to another (Bonfil *et al.*, 2005; Weng *et al.*, 2007; Carlisle *et al.*, 2012; Duffy *et al.*, 2012).

Mediterranean Sea

The stomach content analysis of 24 white sharks caught in the Mediterranean indicate a diverse diet (Fergusson, 1996; Fergusson *et al.*, 2000). Pelagic bony fish such as bluefin tuna *Thunnus thynnus*, Atlantic skipjack *Sarda sarda*, broad-billed swordfish *Xiphias gladius* and bullet tuna *Auxis rochei* were recorded in the diet (Fergusson *et al.*, 2000). Elasmobranchs are also found, including the blue shark *Prionace glauca*, the shortfin mako shark *Isurus oxyrinchus* and the stingrays *Dasyatis spp.* In the Mediterranean, the population diet comprises dolphins such as *Tursiops truncatus*, *Delphinus delphis* and *Stenella coeruleoalba* (Fergusson, 1996; Fergusson *et al.*, 2000). A predation mark is noted on a living bottlenose dolphin *Tursiops truncatus* in Lampedusa (Celona *et al.*, 2006), or sometimes on green turtles *Chelonia mydas* and loggerhead turtle *Caretta caretta* (Fergusson *et al.*, 2000). Finally, it is still possible to find organic or non-terrestrial waste and mollusks. Only one pinniped species exists in the Mediterranean basin, the Mediterranean monk seal *Monachus monachus*. Given the number of individuals, this critically endangered species (Aguilar & Lowry, 2010) does not seem to meet the white shark's energy needs (Semmens *et al.*, 2013). In addition, we have not identified any recent predation, and only one juvenile individual has already been identified in white shark stomach contents (De Maddalena & Zuffa, 2009). Despite recurrent predatory behaviors of white sharks on pinnipeds worldwide (Hamady, 2014), this food source cannot be predominant in the Mediterranean (Semmens *et al.*, 2013; Pethybridge *et al.*, 2014).

Particular attention is given to bluefin tuna, which have been found most often in the stomachs of Mediterranean white sharks (Boldrocchi *et al.*, 2017). Large numbers of white sharks have been caught in tuna traps, including 27 individuals in 38 observations in the Balearic Islands, Italy, and France (Morey *et al.*, 2003; De Maddalena & Heim, 2012). A sighting in continental France even mentions a school of tuna followed by a shark (De Maddalena & Heim, 2012). It is noted that tuna is identified as the primary diet for white sharks in the northeastern Pacific (Jaime-Rivera *et al.*, 2014). Therefore, the relationship between wild bluefin tuna and white sharks has already been studied and highlighted (De Maddalena, 2000; Barrull & Mate, 2001; Soldo & Jardas, 2002; De Maddalena & Heim, 2012; Kabasakal, 2014, 2016; Boldrocchi *et al.*, 2017; Moro *et al.*, 2020). An adult white shark diet hypothesis was suggested based essentially on the bluefin tuna *Thunnus thynnus* in the Mediterranean in the face of a poor choice of prey (Moro *et al.*, 2020). Isotopic analysis of two individuals shows that this population may feed mainly on fish and cephalopods rather than marine mammals (Bevacqua *et al.*, 2021). So we focus on the exploited bluefin tuna species to identify possible hunting areas on hotspots, but we do not consider that this shark feeds exclusively on it. The problem of the drastic reduction in bluefin tuna numbers has allowed the accumulation of new research on this species, in particular for the French Mediterranean.

Productive waters and frameworks of the bluefin tuna (*Thunnus thynnus*) in the northwestern Mediterranean

Mediterranean bioregions can be classified according to non-coastal phytoplankton developments from satellite data (Lavigne *et al.*, 2013). It shows only one non-coastal bloom bioregion in the Mediterranean: the "Bloom North-West" bioregion covering the Liguro-Provencal basin. It's the most productive non-coastal area in primary production (Lavigne *et al.*, 2013). Therefore, there is a significant and transient development of biomass from March to May. The attraction of bluefin tuna to another upwelling area of the Mediterranean is known (Battaglia *et al.*, 2022). From Spring to Fall, the Pacific bluefin tuna (*Thunnus orientalis*) has been located in areas with the highest primary productivity levels available in the California Current ecosystem (Boustany *et al.*, 2010). It is, therefore, likely to find bluefin tuna in the "Bloom North-West" bioregion in the Spring, which is in agreement with the known distribution of the species (Cermeño *et al.*, 2015). A key area of high presence of bluefin tuna was identified (Fromentin & Lopuszanski, 2014; Bauer *et al.*, 2017) and is located at coordinates 4–6 °E and 43–41 °N. A greater dispersion of animals in this sector was noted for the Spring season. It is noted that a possible fidelity of bluefin tuna to its tagging site may be a bias in the representation of the movements of tuna from other regions visiting these waters. In contrast, the Gulf of Lion is a feeding habitat for bluefin tuna (Druon *et al.*, 2011), where adults are less abundant than individuals in their maturing stages (Bauer *et al.*, 2015).

Possible spatial and temporal frameworks of the white shark *(Carcharodon carcharias)* in the northwestern Mediterranean

Possible link with bluefin tuna distribution

To suggest potential habitat zones, we used the knowledge acquired on populations worldwide. The inshore behaviors of white sharks are consistent with a pinniped hunting strategy (Weng *et al.*, 2007). While their behavior in offshore waters is hypothesized to be at least partially related to pelagic prey (Jorgensen *et al.*, 2012). From this information applied to the context of the Mediterranean basin, we can hypothesize a link between the habitat of bluefin tuna and the white shark in offshore waters (De Maddalena & Heim, 2012). We note that the western Mediterranean sectors are important for the reproduction and feeding of bluefin tuna (Cermeño *et al.*, 2015). This species and the white shark (*Carcharodon carcharias*) are both apex predators, and it could be interesting for them to move to areas with significant prey biomass for energy reasons (Korsmeyer & Dewar, 2001; Semmens *et al.*, 2013). Moreover, the demography of the great white shark could be linked to one of its main prey (Moro *et al.*, 2020). Understanding the spatial and temporal distribution of the studied bluefin tuna in the "Bloom North-West" bioregion can restrict the search areas of white sharks. A recent statistical analysis of the observations identifies three hotspots in the Mediterranean: the Balearic Islands, Corsica, and Malta (Moro *et al.*, 2020). Two of these three hotspots border the "Bloom North-West" bioregion. Because of the diet supposedly based mainly on bluefin tuna and the recorded presence of the white shark, we suspect the Provencal basin to be a frequented sector. The presence of the white shark at least seasonally seems likely during the Spring bloom based on historical observations, which does not mean this is still the case today.

Data from scientific literature also support the hypothesis of a seasonal presence in the Provencal basin. Thus in the Balearic Islands, catches of white

sharks are more important just before Spring (Morey *et al.*, 2003) in neighbouring waters of the "Bloom North-West" bioregion. One study speculated that sightings in the Balearic Islands were related to food and appeared to occur in winter (Barrull & Mate, 2001). During this season, bluefin tuna are present on the north coast of Mallorca, according to a study of Bauer *et al.* (2017), when a greater presence of white sharks was identified in these months in historical data (Barrull & Mate, 2001). The migratory character of bluefin tuna (Richardson *et al.*, 2016) is known for its high energy requirements (Brill, 1996). The bioregion "Bloom North-West" could be important at least seasonally. This presence in the western Mediterranean is perhaps partially linked to the area's environmental characteristics.

Movements related to environmental variables and possible bias in the observations

The white shark Mediterranean population is genetically distinct from the Atlantic (Gubili *et al.*, 2010), and evidence of migration has already been provided in other parts of the world for males (Boustany *et al.*, 2002) and females (Bonfil *et al.*, 2005). The hypothesis of movements only within the Mediterranean Sea remains the most credible to explain this genetic distinction but is not yet confirmed. Individuals could have differences in spatial occupancy depending on sex or age, like for example in South Africa (Kock *et al.*, 2013) or Australia (Robbins & Booth, 2012). Therefore, sexual and size segregation may exist in the Mediterranean Sea in relation to environmental variables.

The temperature range in which the world's great white sharks evolve is wide, tolerating 5 to 25°C (Boustany *et al.*, 2002; Bonfil *et al.*, 2010; Skomal *et al.*, 2017; Ebert *et al.*, 2021). It is noted that the northwestern Mediterranean sector is unique for its low sea surface temperature (SST) in Spring compared to the entire basin (Pisano *et al.*, 2020). The Mediterranean can offer a wide range of temperatures, as shown by the great diversity of ingested prey feeding on habitats of different types (Boldrocchi *et al.*, 2017). A movement pattern of white sharks following a latitudinal distribution has already been observed (Skomal *et al.*, 2017); it is unknown if the same happens in the Mediterranean. The numerous observations in the south-central Mediterranean is, therefore, not in opposition to the presence of hotspots in the northwestern Mediterranean (Moro *et al.*, 2020), due to the thermal amplitude of the two areas. In addition, the northwest sector could instead be a seasonal feeding sector for adults, while the central-south (Fergusson, 2002; Saïdi *et al.*, 2005) and Turkish waters (Kabasakal, 2020) could be considered as nurseries sectors. Site fidelity and seasonality are reported for white sharks in the northeast Pacific (Jorgensen *et al.*, 2009). Offshore migration is also known in Spring for eastern North Pacific sharks (Weng *et al.*, 2007). It could be helpful to conduct a statistical study combining the satellite data monitoring white sharks worldwide with their environmental data. This analysis could highlight the compatibility between the waters of the northwestern Mediterranean and the habitat of white sharks. Thus it would be possible to say whether the surface temperature in these areas is similar to the regions visited by this species in the other parts of the world according to a potential latitudinal distribution.

We can hypothesize about promising areas within the northwest bioregion in Spring (Fig. 1). Fine-scale structures in the open ocean (Wurtz & Rovere, 2015) must be checked first in these areas because of an increasing fish concentration effect (Fiori *et al.*, 2016; Baudena *et al.*, 2021). Balearics are interesting during February according to the seasonal increase in observations (Morey *et al.*, 2003), with possible fine-scale structures such as Sóller, Bertran and Cresques seamounts. Just after the bloom, the more offshore part of the high-use area of bluefin tuna in May has unique conditions in the Mediterranean of low SST and tuna-rich waters. Possible fine-scale structures are Aragó seamount, La Renaixença hills, Felibres hills and Calypso hills. Finally, offshore Corsica's west coast during April-May is of interest because of the proximity of this hotspot (Moro *et al.*, 2020) with productive and cool waters.

We should have bycatch or recent observations if white sharks were present annually in French Mediterranean waters. However, today's low fishing pressure in the Provencal basin (Micheli *et al.*, 2013) and the important reduction of individuals (Moro *et al.*, 2020) may explain the subsided proportion of white shark catches. The contemporary observations are more numerous in the south-central Mediterranean than in the Gulf of Lion (Moro *et al.*, 2020). Hypotheses can be formulated to explain this phenomenon, but without confirmation so far: attraction for a nursery in the south-central Mediterranean (Fergusson, 2002), more coastal behavior in the south-central Mediterranean like in South Africa (Johnson *et al.*, 2009), change in behavior or number comparing to the past distribution in northwestern Mediterranean, important historical fishing leading to the disappearance of nurseries in Europe as in Croatia (De Maddalena & Heim, 2012) in favor of North African nurseries, the historical disappearance of pinnipeds from the french Mediterranean coast (Karamanlidis *et al.*, 2016), more observation or fishing effort in the

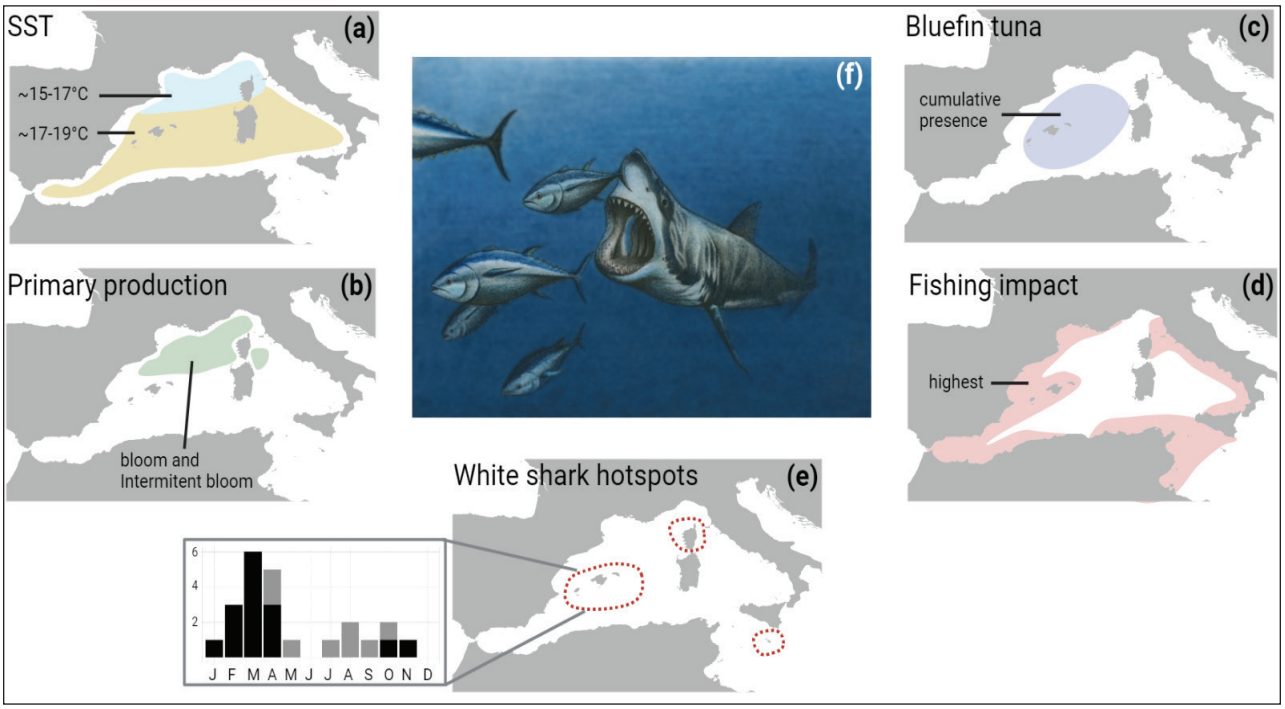

Fig. 1: Variables of interest in the northwestern Mediterranean to better understand the distribution of white sharks *(Carcharodon carcharias)**. (a) Mean sea surface temperature (SST) field (°C) from 1982 to 2018 in the Copernicus Marine Environment Monitoring Service (CMEMS) Mediterranean area (inspired by Pisano et al., 2020). (b) Spatial distribution of the non-costal bloom and intermittent bloom obtained from the DR09 methodology applied on a weekly climatology calculated from a 16-year database (inspired by Mayot et al., 2016). (c) Utilization Distributions of tagged bluefin tuna (Thunnus thynnus) (inspired by Cermeño et al., 2015). (d) Spatial distribution of the highest cumulative fishing impact (all fishing types combined) (inspired by Micheli et al., 2013). (e) Hotspots of white sharks (inspired by Moro et al., 2020) with histograms of observations for the Balearic Islands (data from Morey et al., 2003). Black: white sharks catches. Grey: attacks upon cetaceans or turtles). (f) Biological illustration of a white shark hunting a school of bluefin tuna. Illustration by Juliette Vallin, digital improvements by Tanguy Carpaye-Taïlamée.***
Sl. 1: Ključne spremenljivke v severozahodnem Sredozemlju za boljše razumevanje porazdelitve belega morskega volka *(Carcharodon carcharias)**. Legenda: a) Polje srednje površinske (°C) temperature morske vode od 1982 do 2018 v sredozemskem območju Kopernikove službe za spremljanje morskega okolja (CMEMS) (po vzoru Pisano in sod., 2020). b) Prostorska porazdelitev cvetenja stran od obale in občasnega cvetenja na podlagi metodologije DR09 in tedenske klimatologije, izračunane iz 16-letne baze podatkov (prirejeno po Mayot in sod., 2016). C) Razširjenost modroplavutega tuna (Thunnus thynnus) (prirejeno po Cermeño in sod., 2015). D) Prostorska porazdelitev največjega kumulativnega ribolova (vse vrste ribolova skupaj) (prirejeno po Micheli in sod., 2013). E) Vroče točke pojavljanja belih morskih volkov (po Moro in sod., 2020) z opazovanji na Balearih (po Morey in sod., 2003). Črna: ulovi belih morskih volkov. Siva: napadi na kite ali želve. F) Biološka ilustracija belega morskega volka, ki lovi jato modroplavutega tuna (ilustracija Juliette Vallin, digitalna izboljšava Tanguy Carpaye-Taïlamée).***

south-central Mediterranean (Micheli *et al.*, 2013), the poor transmission of historical data in south-central Mediterranean countries.

Suggestions for field research

Choice of methodologies

We are entitled to question the veracity of the hypotheses proposed above. To verify or reject them, we can rely on several complementary methodologies that highlight the presence of shark species (Boussarie *et al.*, 2018). Thus we can use methodologies based on environmental DNA, baited remote underwater videos (BRUVs), opportunistic underwater visual census, opportunistic observations census by participatory sciences (Bargnesi *et al.*, 2020) and fisheries registration (Baum & Blanchard, 2010). These last three techniques require considerable sampling effort to increase the number of current observations. We will focus on methodologies with a better chance of achievement

depending on their cost and chances of success. Therefore, the two methodologies selected are environmental DNA and BRUVS.

Use of environmental DNA

Environmental DNA has a proven track record for detecting shark species (Bakker *et al.*, 2017). This methodology could highlight the presence of this unidentified species in these sectors as they were identified in the Sicilian Channel (Jenrette *et al.*, 2023). Increasing the eDNA sampling effort could make it possible to detect species in the sector where it was not yet detected (Boussarie *et al.*, 2018).

Today different methods exist for eDNA sampling, but the method of filtration is the most adapted to our situation in offshore waters (Tsuji *et al.*, 2019). The eDNA of this fish is most likely to be captured by 1-10 µm pore size filters (Turner *et al.*, 2014). Glass microfiber can be used to increase the efficacy of eDNA collection (Tsuji *et al.*, 2019). A first water sampling method could be a Niskin rosette sampler with a CTD attached that can take samples from great depths (Truelove *et al.*, 2019). Another possibility in water sampling could be using a remotely controlled vehicle (ROV) equipped with Niskin collection bottles (Truelove *et al.*, 2019). A water pump could be another possibility with adequate pressure, flow rate and water volume (Thomas *et al.*, 2018) applied to offshore waters.

In any case, there could be no detection of a species of interest with a low amount of DNA in the ocean environment because of DNA degradation (Jenrette *et al.*, 2023). Therefore, it is necessary to play on several variables to maximize the chances of results to overcome this problem. The constraints on field variables are e.g. calm meteorological conditions before and during sampling without strong currents, having a large number of replicas, the depth of sampling in the water column (Andruszkiewicz *et al.*, 2017; Curtis *et al.*, 2021).

It is possible to change the sampling depth, targeting the probable locations and depths of appearances of adult white sharks in offshore waters. Several depths of interest are mentioned in the literature: 300-500 m depth range during the day and in the 50-250 m range at night (Nasby-Lucas *et al.*, 2009), 100-600m depth range (Skomal *et al.*, 2017), 200-900 m depth range (Bonfil *et al.*, 2005). Depths corresponding to temperatures between 20-22.5°C are also interesting (Nasby-Lucas *et al.*, 2009). Surface waters could be occupied even if there are no pinnipeds (Bonfil *et al.*, 2005). More globally, the mesopelagic zone is known to be a major feeding habitat for white sharks (Le Croizier *et al.*, 2020). These depths remain suggestions without confirmation of the presence of genetic material in the Mediterranean Sea.

Use of BRUVs

BRUV stations are used worldwide for white shark studies (Harasti *et al.*, 2019). Pelagic stereo or mono BRUVs are alternative sampling methods that are non-intrusive and non-lethal (Santana-Garcon *et al.*, 2014). Some studies contradict each other on their efficiencies: complementarity with other so-called "standard" methods has already been identified (Boussarie *et al.*, 2018). Conversely, comparable proportions of species of the family Carcharhinidae have already been shown using specific procedures (Santana-Garcon *et al.*, 2014). However, BRUVs are known to have highlighted the presence of juvenile white sharks on the coast of Australia (Harasti *et al.*, 2019). Stereo-BRUVs allow continuous behavioral recordings for the target species or other mobile animals (Santana-Garcon *et al.*, 2014). In our case, standardization is interesting over broad spatiotemporal scales and to determine the relative abundance of the species (Santana-Garcon *et al.*, 2014).

BRUV could be interesting to use in areas of great depth and far from shore, which differs from what has already been done in Australia for juveniles. Tuna, particularly tropical, are known to aggregate under "fish aggregating devices" (FAD) (Pérez, 2021) and placing BRUVs on these FADs could be another option to increase the likelihood of identifying white sharks. This kind of device equipped with a camera may be an idea to develop, the attracted tuna acting as live bait. Due to the remoteness of the study site in the Mediterranean, there are many constraints for multiple monthly deployments, unlike coastal studies (Harasti *et al.*, 2019). Pelagic low-cost BRUVs have been proposed for pelagic sharks, but we must retrieve the device before and after (Torres *et al.*, 2020). Because of the possibility of a strong swell with the winds causing seasonal bloom, equipment must be waterproof and solid to resist.

In a favourable environment for observations in Australia, one shark was recorded approximately every 15 hours (Harasti *et al.*, 2019). We therefore assume that in our unfavourable situation the required deployment time should be much longer to obtain a single sighting. It will also be possible to verify the presence of declining species like other large sharks.

CONCLUSIONS

There is no spot with a strong coastal presence of white sharks in the Mediterranean compared to other areas worldwide. We had to make assumptions about this species to define plausible spatial and temporal frameworks, including the assumed main diet. We do not know if the species' current distribution is representative of historical observations due to strong anthropogenic impacts. Despite all the precautions, the chances of identifying white shark DNA in the offshore environment are probably very low. However, this remains the most efficient and cheapest identification technique for an effective long-term study of this rare species in some areas of the Mediterranean (Jenrette *et al.*, 2023). It would therefore be interesting to carry out this type of analysis on the observation hotspots in the Mediterranean, namely the Balearic Islands, Corsica and Malta (Moro *et al.*, 2020). However, the main priority in the Mediterranean remains the reduction of threats to the conservation of the species (Huveneers *et al.*, 2018).

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POGLED NA VELIKEGA BELEGA MORSKEGA VOLKA (*CARCHARODON CARCHARIAS*) V SEVEROZAHODNEM SREDOZEMLJU IN PRIPOROČILA ZA NADALJNE TERENSKE RAZISKAVE

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POVZETEK

*Avtorji so preiskali znanje o belih morskih volkovih (*Carcharodon carcharias*) v Sredozemskem morju, da bi ugotovili, ali je severozahodni del območja zanimiv in analizirali najbolj učinkovite metode za ugotavljanje prisotnosti vrste. Analizirali so vsa razpoložljiva recenzirana dela, uradna poročila in teze tako v svetovnem merilu kot tudi na nivoju Sredozemskega morja. Osredotočili so se na raziskave, ki so omogočale določitev natančnejšega okvira pojavljanja vrste. Še posebej je bila poudarjena povezava z modroplavutim tunom (*Thunnus thynnus*) v Sredozemskem morju. Severozahodni del bazena ima v primerjavi z drugimi deli edinstvene značilnosti kot so primarna produkcija, površinska temperatura in pojavljanje tunov, poleg tega pa meji na dve vroči točki pojavljanja belih morskih volkov. Avtorji navajajo metode za odkrivanje vrste po vsem svetu, vključno z metodami BRUVS in okoljske DNK. Poleg tega podajajo priporočila za terenske raziskave.*

Ključne besede: beli morski volkovi, Sredozemsko morje, razširjenost, prehrana, priporočila

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A PRELIMINARY SOCIAL MEDIA-BASED SURVEY OF SHARKS AND BATOIDS CAPTURED IN COMMERCIAL FISHERIES OF THE NORTHERN AEGEAN SEA

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ABSTRACT

In recent years, the use of social media films has been increasingly considered a promising method in elasmobranch research. The present study provides a regional example of good practice in using social media films for gathering additional and complementary information on the sharks and batoids in the northern Aegean Sea. A total of 67 shark and batoid individuals representing 8 orders, 15 families, and 21 species appeared in the examined video footages. The majority of the identified elasmobranchs consisted of sharks. Incidental captures of identified elasmobranchs mostly occurred in association with demersal fishing gears, frequently in demersal long-line fishery. The incidental captures of newborn specimens of blue shark and common angel shark support the suggestion that the northern Aegean Sea may serve as a parturition and/or nursery ground for both species.

Keywords: Elasmobranchs, captures, conservation, social media, opportunistic sampling

INDAGINE PRELIMINARE BASATA SUI SOCIAL MEDIA SU SQUALI E BATOIDI CATTURATI NELLA PESCA COMMERCIALE DEL MAR EGEO SETTENTRIONALE

SINTESI

Negli ultimi anni, l'uso dei filmati pubblicati sui social media è stato sempre più considerato un metodo promettente nella ricerca sugli elasmobranchi. Il presente studio fornisce un esempio regionale di buona pratica nell'uso dei filmati dei social media per raccogliere informazioni aggiuntive e complementari su squali e batoidi dell'Egeo settentrionale. Nei filmati esaminati sono apparsi un totale di 67 individui di squali e batoidi che rappresentano 8 ordini, 15 famiglie e 21 specie. La maggior parte degli elasmobranchi identificati era costituita da squali. Le catture accidentali degli elasmobranchi identificati si sono verificate soprattutto in associazione con attrezzature da pesca demersali, principalmente durante la pesca con palangari. Le catture accidentali di esemplari neonati di verdesca e pesce angelo supportano l'ipotesi che l'Egeo settentrionale possa fungere da area di nascita e/o crescita per entrambe le specie.

Parole chiave: elasmobranchi, catture, conservazione, social media, campionamento opportunistico

INTRODUCTION

Assessment of species diversity and abundance in chondrichthyans is an important step in the evaluation of their conservation status (Serena *et al.*, 2020). In the Mediterranean Sea, chondrichthyans, particularly large predatory sharks, have experienced a dramatic decline in numbers over the last two centuries (Ferretti *et al.*, 2008; Bargnesi *et al.*, 2020); therefore, every effort devoted to contributing to a better understanding of their life histories, distribution, etc., is valuable. For over 50 years, research programs have investigated the occurrence and distribution of chondrichthyans throughout the Mediterranean Sea, enhancing our in-depth understanding of their richness in the region (e.g., Capapé, 1989; Başusta *et al.*, 1998; Barrull *et al.*, 1999; De Maddalena & Pisticelli, 2001; Storai, 2004; Kabasakal & Kabasakal, 2004; Capapé *et al.*, 2006; Storai *et al.*, 2006; İşmen *et al.*, 2009; Damalas & Megalofonou, 2012; Sperone *et al.*, 2012; Ragonese *et al.*, 2013; Rafrafi-Nouira *et al.*, 2015; Ennajar *et al.*, 2022). Tracing the material and methods sections of these references, it becomes evident that the majority of the sampling has been carried out either using conventional methods of systematic scientific sampling or through opportunistic sampling in commercial fishing operations. Undoubtedly, monitoring the bycatch of commercial fisheries is a prolific source of data in chondrichthyan research (Kabasakal & Kabasakal, 2004; Kabasakal *et al.*, 2017; Mancusi *et al.*, 2020; Bonanomi *et al.*, 2018, 2022; Gallo *et al.*, 2022). However, the mining of social media has become an increasingly applied alternative method for collecting data in shark and batoid research (Boldrocchi & Storai, 2020; Kabasakal & Bilecenoğlu, 2020; Mancusi *et al.*, 2020; Taklis *et al.*, 2020; Kesici *et al.*, 2021; Gallo *et al.*, 2022; Bargnesi *et al.*, 2020, 2022).

The chondrichthyan fauna of the northeastern Aegean Sea has been investigated both in general ichthyological inventory studies (Eryılmaz, 2003; İşmen *et al.*, 2009; Cengiz *et al.*, 2011; Gönülal, 2016), and in a shark-specific survey (Kabasakal & Kabasakal, 2004). In this paper, the author reports the incidental captures of chondrichthyans in commercial fisheries operating in the northern Aegean Sea between September 2021 and August 2023, mainly based on data mined from mainstream social media channels. As a secondary objective, the author provides notes on the sharks and batoids that appeared in the examined footages.

MATERIAL AND METHODS

Area of investigation and type of fishery

The present study mostly covers the marine area surrounding the Gökçeada island and the mouth of Saroz Bay in the northeastern Aegean Sea (Fig. 1). In this region, artisanal fishermen deploy trammel nets with a 42 mm knot-to-knot mesh opening (locally known as "marya" nets), along with demersal long-lines. In these fisheries, the primary targeted species include bony fishes such as the common dentex, *Dentex dentex* (Linnaeus, 1758), angler fish, *Lophius piscatorius* (Linnaeus, 1758), tub gurnard, *Chelidonichthys lucerna* (Linnaeus, 1758), and hake, *Merluccius merluccius* (Linnaeus, 1758). Commercial species of secondary importance include crustaceans, such as the European lobster, *Homarus gammarus* (Linnaeus, 1758) and European spiny lobster, *Palinurus vulgaris* Latreille, 1804, and cephalopods, such as *Octopus* sp. and *Sepia* sp. On rare occasions, pelagic teleosteans such as swordfish, *Xiphias gladius* Linnaeus, 1758, and little tunny, *Euthynnus alletteratus* (Rafinesque, 1810) may also be captured.

Sampling methodology

The sampling approach in the present study was a typical example of opportunistic research (Jessup 2003), with data obtained solely from social media platforms Facebook, Instagram, and YouTube. To extract data from these platforms, a regular data mining survey was carried out once a week using the "Date Posted" filter in order to identify the most recent posts (Taklis *et al.*, 2020). The data search covers the period from September 2021 to August 2023. Furthermore, video footages recorded by local fishers between September 2021 and August 2023, documenting their catches and including scenes of incidentally captured elasmobranchs, were shared with the author for species identification. A total of 31 video footages (with a combined duration of 9 hours, 10 minutes, and 5 seconds) were analysed. An individual elasmobranch record was considered valid if the specimen depicted in a digital photograph was clearly visible in a side view; in the case of video footage, the specimen had to be visible for approximately 5 seconds, allowing for the capture of a still image for species identification (Kabasakal & Bilecenoğlu, 2020). To achieve this, the "Image Capture" function of the VLC Media Player was used. To facilitate the search and filter the information from the web, we used the following hashtags in Turkish (Kim *et al.*, 2016): "köpekbalıkları [sharks], yakalandı [captured], camgöz [dogfish], domuz köpekbalığı [angular rough shark], keler [angel shark], sapan balığı [thresher shark], mavi köpekbalığı [blue shark], büyük beyaz [great white shark], canavar (sea monster), kuzey Ege [north Aegean], Gökçeada [Gökçeada island], Saroz [Saroz Bay]". To avoid repetition or duplication of records and to confirm their provenance, the owner of the original post was contacted for every incidence.

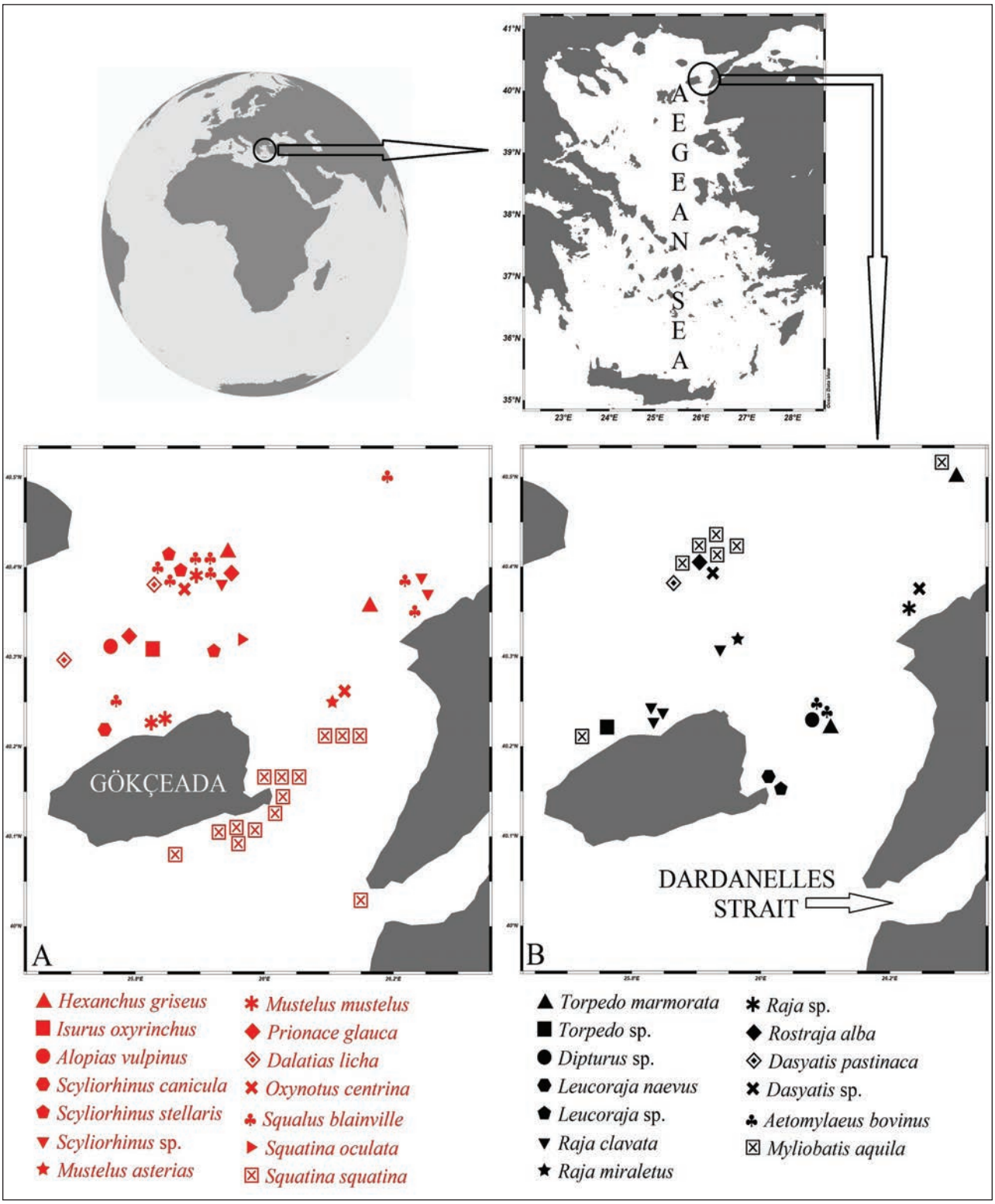

Fig. 1: Maps showing the approximate locations of capture of sharks (a) and batoids (b) in the northern Aegean Sea. Circles on the small maps indicate the locality of investigation in the Aegean Sea, as well as on the globe.
Sl. 1: Zemljevidi s prikazi lokacij ulova morskih psov (a) in skatov (b) v severnem Egejskem morju. Krogci na manjših zemljevidih označujejo obravnavano območje v Egejskem morju, katerega lega je prikazana na planetarnem nivoju.

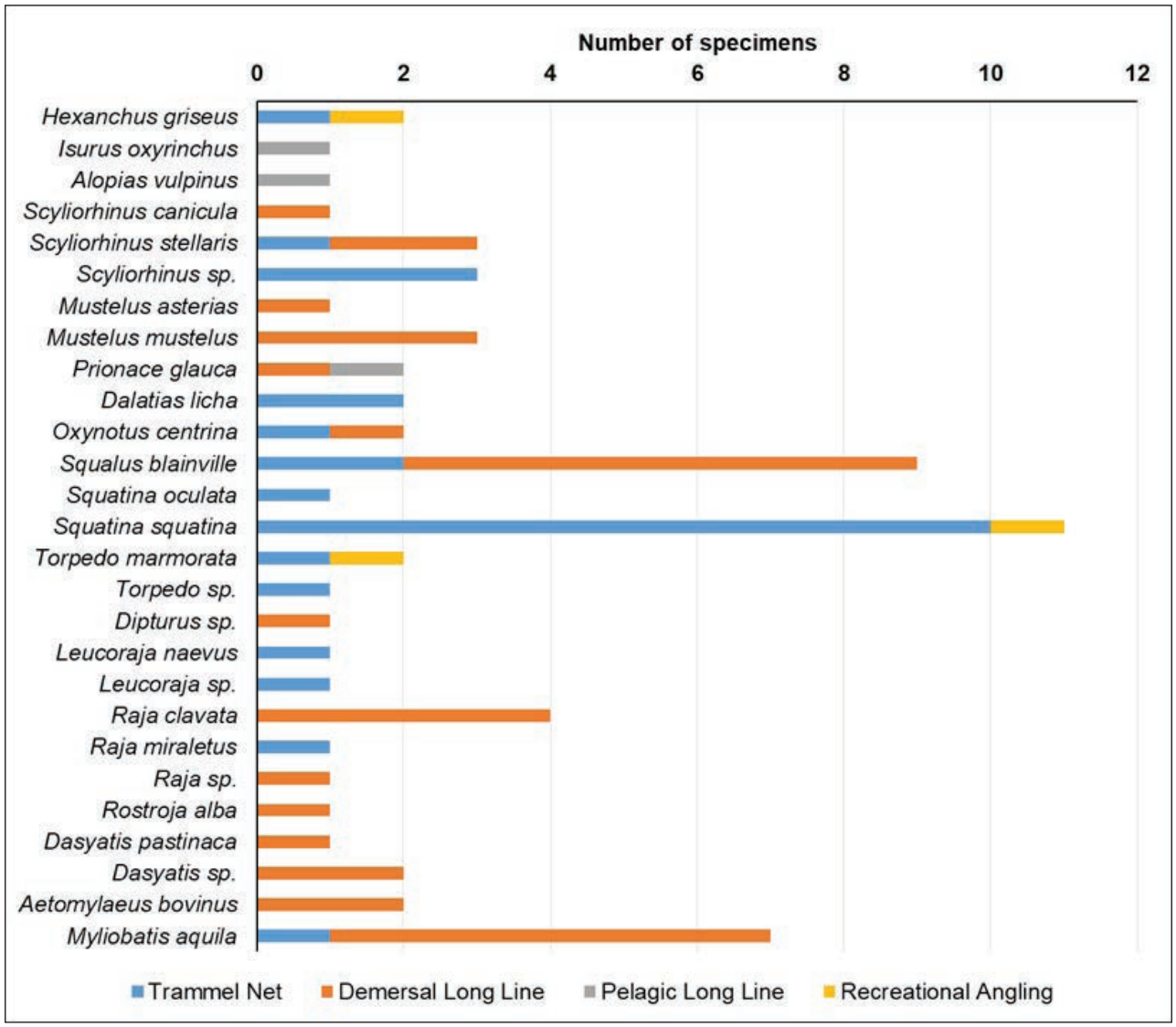

Fig. 2: Numerical occurrence of identified sharks and batoids with respect to fishing gear.
Sl. 2: Število primerkov določenih morskih psov in skatov glede na ribolovno orodje.

Since online communities and website administrators may react negatively to the utilisation of their online content by researchers, all internet content scraping activity was performed responsibly, following the ethical code proposed by Monkman *et al*. (2017) and avoiding compromising any personal data or image. Species identification follows Barone *et al*. (2022), while taxonomic nomenclature follows Froese and Pauly (2023). The IUCN Red List status of the identified elasmobranchs in the Mediterranean Sea follows Otero *et al*. (2019). Wherever possible, the following information was collected for each identified species through contacts with the owner of the post: total length (TL), total weight (TW), depth of capture (image of the echosounder screen), and locality of deployment. To determine the sex of the specimens, the best image depicting the genital opening (for females) or claspers (for males) was captured, and the time code of the image was recorded. Neonates are defined as post-hatching or post-birth free-swimming young bearing fresh, unhealed, or healing umbilical scars in the case of placental species, or those at or near-birth size in the case of aplacental or ovoviviparous species (Castro, 1993). Juveniles include all post-neonatal individuals prior to sexual maturation (Castro, 1993). The downloaded source videos as well as the captured frames of the identified species are preserved in the author's archives and available upon request for further examination.

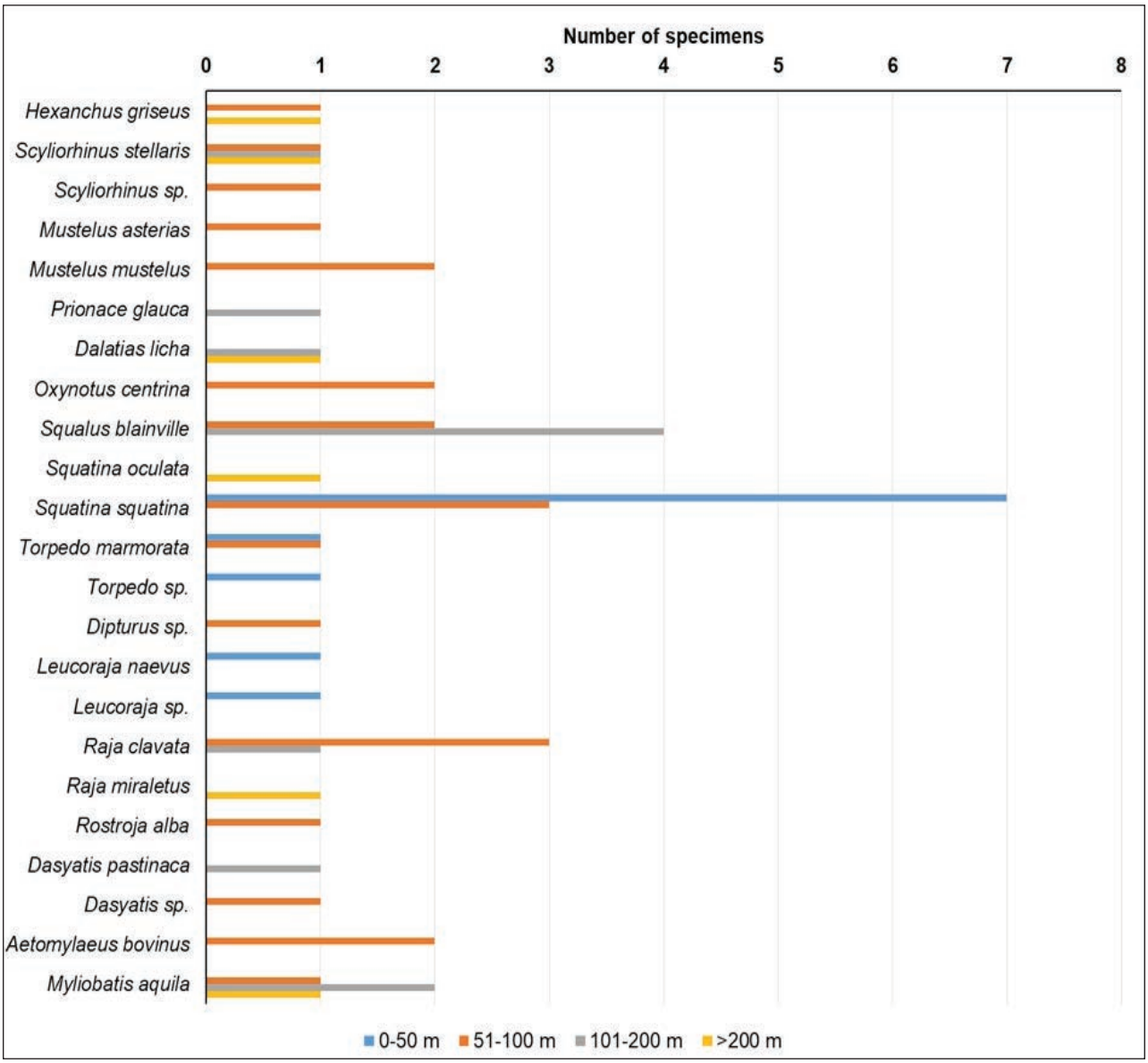

Fig. 3: Numerical occurrence of identified sharks and batoids with respect to depth of capture.
Sl. 3: Število primerkov določenih morskih psov in skatov glede na globino ulova.

Data analysis

Differences in the number of identified elasmobranch species and the respective numbers of specimens were analysed with regards to type of fishing gear, depth of capture, and season of capture using Welch ANOVA, Kruskal-Wallis, and Dunn's post hoc tests. The latter was performed using Bonferroni-adjusted *p*-values (Parab & Bhalerao, 2010; Özaltındiş *et al.*, 2021). The chosen *p*-value was set at 0.05. Statistical analyses were performed employing PAST-Palaeontological statistics, version 4.03 (Hammer *et al*. 2001).

RESULTS

Total elasmobranchs

A total of 67 shark and batoid specimens representing 8 orders, 15 families, and 21 species appeared in the examined video footages. In addition to the identified species, there were several specimens identified at the generic level (a total of 6 genera). The identified species are presented in Tab. 1 in taxonomic order. Collated data regarding the date of capture, depth of capture, type of fishing gear used, species observed, and individual

Tab. 1: Taxonomic order of elasmobranch species identified in the video footages, along with the respective number of specimens (n=67) and the percentages of occurrence in the total number of specimens. DD: Data Deficient; LC: Least Concern; NT: Near-Threatened; VU: Vulnerable; EN: Endangered; CR: Critically Endangered. The asterisk (*) denotes species protected by law in Turkish seas.
Tab. 1: Taksonomski pregled prepoznanih vrst hrustančnic v videoposnetkih, število primerkov (n=67) in delež pojavljanja glede na celotno število primerkov. DD: Pomanjkljivi podatki; LC: Najmanj ogrožene; NT: potencialno ogrožene; VU: ranljive; EN: ogrožene; CR: skrajno ogrožene. Zvezdica (*) označuje z zakonom zaščitene vrste v turških morjih.

TAXONOMICAL ORDER	N	% of Total N	IUCN Red List Status for Mediterranean
HEXANCHIFORMES			
Hexanchidae			
Hexanchus griseus (Bonnaterre, 1788)	2	1.34	LC
LAMNIFORMES			
Lamnidae			
Isurus oxyrinchus Rafinesque, 1810*	1	0.67	CR
Alopiidae			
Alopias vulpinus (Bonnaterre, 1788)*	1	0.67	EN
CARCHARHINIFORMES			
Scyliorhinidae			
Scyliorhinus canicula (Linnaeus, 1758)	1	0,67	LC
Scyliorhinus stellaris (Linnaeus, 1758)	3	2.01	NT
Scyliorhinus sp.	3	2.01	
Triakidae			
Mustelus asterias Cloquet, 1819	1	0.67	VU
Mustelus mustelus (Linnaeus, 1758)	3	2.01	VU
Carcharhinidae			
Prionace glauca (Linnaeus, 1758)*	2	1.34	CR
SQUALIFORMES			
Dalatiidae			
Dalatias licha (Bonnaterre, 1788)	2	1.34	VU
Oxynotidae			
Oxynotus centrina (Linnaeus, 1758)*	2	1.34	CR
Squalidae			
Squalus blainville (Risso, 1827)*	9	6.03	DD
SQUATINIFORMES			
Squatinidae			
Squatina oculata Bonaparte, 1840*	1	0.67	CR
Squatina squatina (Linnaeus, 1758)*	11	7.37	CR
TORPEDINIFORMES			
Torpedinidae			
Torpedo marmorata Risso, 1810	2	1.34	LC
Torpedo sp.	1	0.67	
RAJIFORMES			
Rajidae			
Dipturus sp.	1	0.67	
Leucoraja naevus (Müller & Henle, 1841)	1	0.67	NT
Leucoraja sp.	1	0.67	
Raja clavata Linnaeus, 1758*	4	2.68	NT
Raja miraletus Linnaeus, 1758	1	0.67	LC
Raja sp.	1	0.67	
Rostroja alba (Lacepède, 1803)	1	0.67	EN
MYLIOBATIFORMES			
Dasyatidae			
Dasyatis pastinaca (Linnaeus, 1758)	1	0.67	VU
Dasyatis sp.	2	1.34	
Aetobatidae			
Aetomylaeus bovinus (Geoffroy St. Hilaire, 1817)	2	1.34	CR
Myliobatidae			
Myliobatis aquila (Linnaeus, 1758)	7	4.69	VU

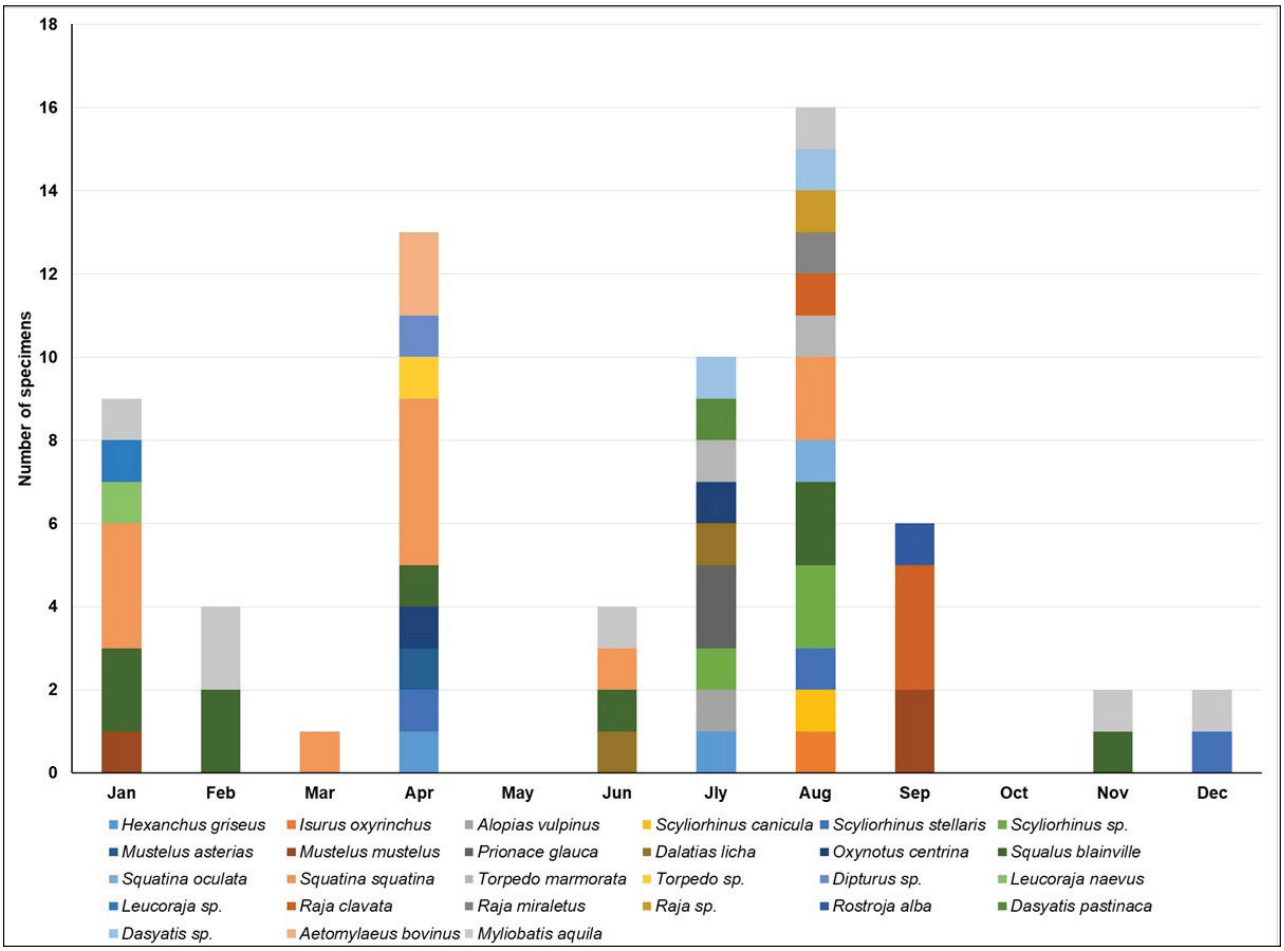

Fig. 4: Numerical occurrence of identified sharks and batoids with respect to season of capture.
Sl. 4: Število primerkov določenih morskih psov in skatov glede na sezono ulova.

remarks are presented in Appendix 1. The majority of the identified elasmobranchs consisted of sharks (n=42; 62.69%), whereas batoids comprised 37.31% (n=25) of the identified species. The most frequently observed species was *Squatina squatina* (n=11; 7.37%), followed by *Squalus blainville* (n=9; 6.03%), and *Myliobatis aquila* (n=7; 4.69%) (Tab. 1). As seen in Table 1, the percentage of occurrences for the remaining elasmobranchs was less than 6 percent of the total sample. Demersal elasmobranchs comprised the majority of the identified elasmobranchs (n=63; 94.03%), with only 5.97% of the total sample (n=4) represented by pelagic sharks (*Isurus oxyrinchus*, *Alopias vulpinus*, and *Prionace glauca*) (Tab. 1).

Elasmobranch species vs. fishing gears

Incidental captures of identified elasmobranchs mostly occurred in association with demersal fishing gears, with 50.75% (n=34) of the total sample captured in demersal long-line fishery, followed by trammel netting (n=27; 40.30%). Pelagic long-lining (n=3) and recreational angling (n=3) individually comprised 4.48 percent of the total captures (Fig. 2). When analysing the captures based on the type of fishing gear used, there was no statistically significant difference (Kruskal-Wallis test, $p>0.05$, $p=0.24$). Since most of the captures (91.04%) occurred in demersal long-lining and trammel netting, a second analysis was conducted, focussing solely on catches in these two fisheries. However, no statistically significant difference was observed between demersal long-lining and trammel netting (Welch ANOVA, $p>0.05$, $p=0.68$; Kruskal-Wallis test, $p>0.05$, $p=0.32$).

Elasmobranch species vs. depth of capture

Depth of capture information was recorded for 51 specimens (76.12% of total elasmobranchs). The deepest depth of capture ranged from 500 to 600

m, with recreational anglers deploying a purpose-made shark tackle for game fishing targeting bluntnose sixgill shark (*Hexanchus griseus*); however, the majority of captures occurred at depths between 51 and 100 m (n=23; 45.10%), followed by the 0-50 m, 101-200 m (n=11; 21.57% for both strata), and >200 m depth ranges (n=6; 11.76%) (Fig. 3). No statistically significant difference was found between the numerical distribution of captured specimens and depth of capture (Kruskal-Wallis test, $p>0.05$, $p=0.38$).

Elasmobranch species vs. season of capture

The seasonal distribution of elasmobranch captures is depicted in Figure 4, showing occurrences throughout the year. Captures were most abundant in August (n=16; 23.88%), followed by April (n=13; 19.40%), July (n=10; 14.93%), and January (n=9; 13.43%). The percentage of elasmobranch species present in commercial catches during the remaining months was less than 10 percent (ranging from 8.96% to 1.49%) (Fig. 4), with a complete absence of any elasmobranch species in the video footages of commercial catches in May and October. Nevertheless, no statistically significant difference was found in the seasonal distribution of elasmobranch captures (Kruskal-Wallis test, $p>0.05$, p=0.17; Dunn's post hoc test, $p>0.05$).

Notes on reproductive biology of several rare and endangered elasmobranchs observed in the studied videos

A close examination of the video footage (n=31; total duration 9:10:05 hours) in this study has revealed remarkable data suggesting that the northeastern Aegean Sea may serve as a potential nursery and/or breeding ground for several rare and endangered elasmobranchs.

On 30 July 2023, a young-of-the-year bluntnose sixgill shark (*H. griseus*; TL ca. 150 cm) was incidentally captured in trammel net fishery at a 46-60 m depth range (Fig. 5a, b). The shark was completely motionless during the retention period onboard, and its post-release survival is uncertain.

On 22 June 2023, a newborn blue shark (*P. glauca*; TL ca. 50 cm) with a healing umbilical scar visible on the ventral surface between the pectoral fins, was incidentally captured in demersal longlines deployed at a depth of 109 m (Fig. 5c, d). The newborn blue shark was released alive.

On 14 April 2022, a pregnant female common angel shark (*S. squatina*) became entangled in trammel nets deployed at a depth range of 19 to 25 m off the southwestern coast of Gökçeada island. The specimen aborted an unknown number of near-term embryos onboard. On 3 March 2023, another pregnant female of *S. squatina* (TL ca. 170 cm) was captured by recreational anglers at a depth of 33 m, and aborted 5 near-term embryos upon being pulled onboard (Fig. 6a, b). In both instances, the pregnant females and pups were all released alive; however, their post-release survival status is not known. Available data suggest that mature and pregnant females, and juveniles (TL ca. 30—40 cm) frequently aggregate in the shallow areas (≤25 m depth) off the southwestern coast of Gökçeada island, while adult males occur more frequently in deeper areas (~60 m depth) between the island and the Gallipoli Peninsula.

Two mature females of *Mustelus mustelus* (TL ca. 110 cm and ca. 140 cm) and one year-of-the-young specimen (TL ca. 40 cm) were incidentally captured. Both females were retained and landed.

A juvenile shortfin mako shark (*Isurus oxyrinchus*; TL ca. 100 cm) was captured by a recreational angler off the northern coast of Gökçeada on 5 August 2023 (Fig. 6c).

Two female kite fin sharks (*Dalatias licha*; both TL ≥100 cm) were captured upon entanglement in trammel nets at a depth range of 171 to 300 m (Fig. 6d). Their swollen bellies suggested possible pregnancy, as preying on other specimens after becoming ensnared in trammel net, unlike when they get tangled in cod-ends of bottom trawls, may not be possible. Similarly, two mature female angular rough sharks (*Oxynotus centrina*; both TL ca. 60 cm) were captured individually in demersal longlining and trammel netting in the northern littoral waters of Gökçeada. Their swollen bellies suggested potential pregnancy.

No data were obtained on the reproductive biology of other elasmobranchs identified from the video footages.

DISCUSSION AND CONCLUSIONS

For the last 50 years, the chondrichthyan fauna of the northern Aegean Sea has been investigated by several researchers through general ichthyological inventory studies, megafauna observations, or elasmobranch-specific studies. In a general ichthyological inventory study, Papaconstantinou and Tortonese (1980) reported 15 species of demersal elasmobranchs from the Gulf of Thermaikos (northwestern Aegean Sea). Ulutürk (1987) identified 13 species of demersal and pelagic chondrichthyans in the waters surrounding the Gökçeada island (northeastern Aegean Sea). In a more recent general ichthyological inventory study, Eryılmaz (2003) documented 15 species of demersal sharks and batoids in the waters of the island of Bozcaada (also northeastern Aegean Sea).

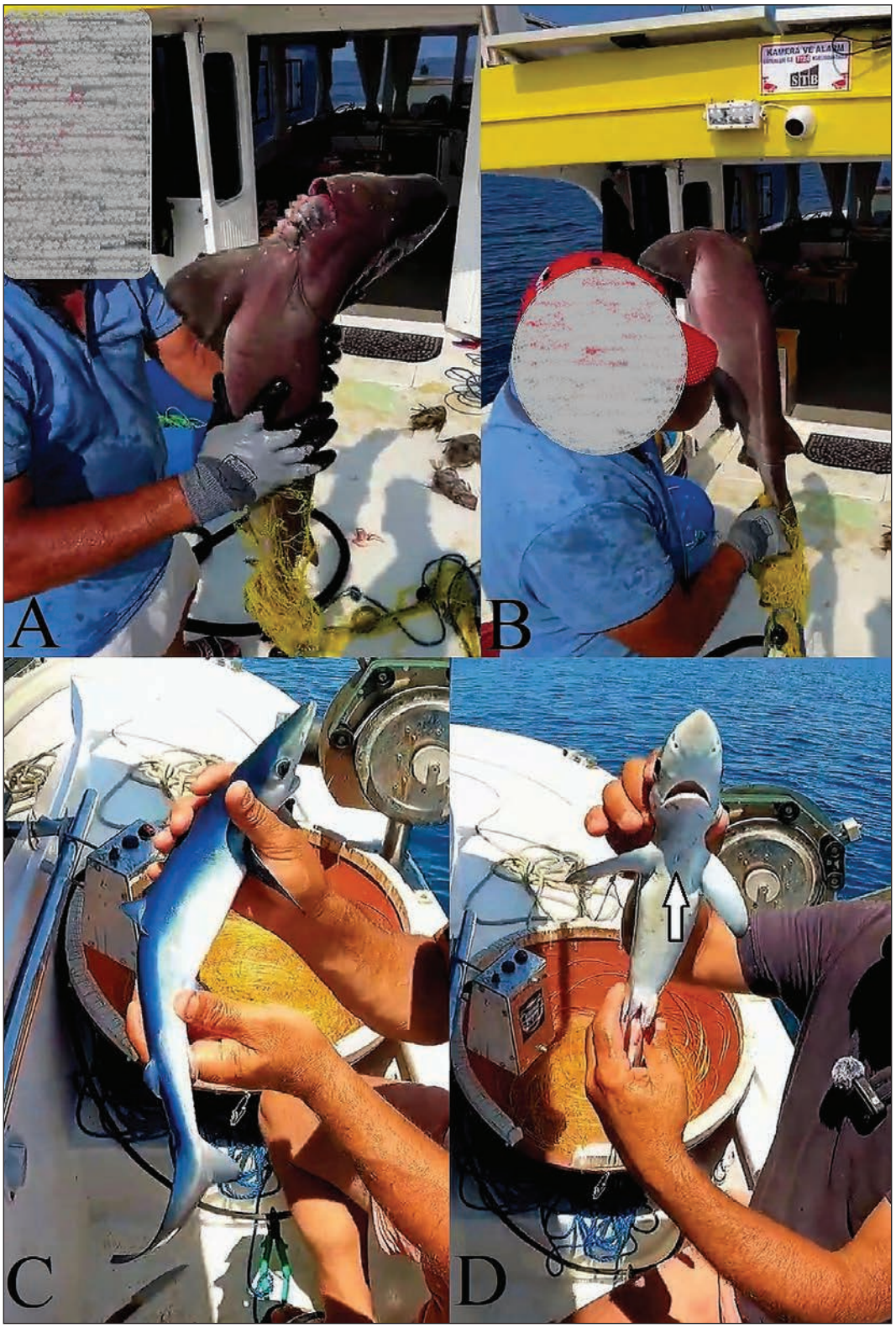

Fig. 5: (a, b) Juvenile specimen of *Hexanchus griseus* ***(TL ca. 150 cm); (c, d) newborn specimen of*** *P. glauca* ***(TL ca. 50 cm), arrow indicating the unhealed umbilical scar.***
Sl. 5: (a, b) Mladostni primerek vrste *H. griseus* ***(dolžina približno 150 cm); (c, d) novoskoteni primerek vrste*** *P. glauca* ***(dolžina približno 50 cm), puščica označuje nezaceljeno poporodno brazgotino.***

In one of the few studies specifically focussed on sharks, Kabasakal and Kabasakal (2004) recorded 20 species in the region, including megafauna members such as *Carcharodon carcharias* and *Cetorhinus maximus*, and rare squaliform sharks such as *D. licha* and *O. centrina*. According to Cengiz *et al.* (2011), the fish fauna of the Gulf of Saroz comprises 28 chondrichthyan species, including the rare lamniform shark, *Carcharias taurus*. However, since the authors have no information on where the examined specimen of the latter was deposited, this record is considered questionable. In an extensive study on the biodiversity of the northern Aegean Sea, Altuğ *et al.* (2011) reported the presence of 12 species of demersal sharks and batoids in the study area. In a recent survey on deep-sea fishes of the northern Aegean Sea, Gönülal (2016) recorded 13 species of chondrichthyans occurring in depths ranging between 500 and 1000 m.

The common feature of the studies mentioned so far is that the sampling method has always been extractive sampling, carried out using fishing gears such as bottom trawl, beam trawl, trammel net, gill net, or demersal longline. Also, for many years, fishery-dependent surveys have been the primary, if not the only, source of scientific information on most chondrichthyan species in the northern Aegean Sea and in the Mediterranean Sea (e.g., Kabasakal & Kabasakal, 2004; Damalas & Megalofonou, 2012; Sperone *et al.*, 2012; Kabasakal *et al.*, 2017). In recent years, however, the contribution of local ecological knowledge (LEK) and citizen science has steadily increased. And although social media-based data mining as a research method cannot substitute traditional stratified/random *in situ* surveys in the studies on chondrichthyans in the northern Aegean Sea, it can provide complementary data to fill the knowledge gaps arising from financial constraints or a shortage of researchers.

A recent study carried out by Taklis *et al.* (2020) underscored the value and importance of social media in collecting baseline information, while identifying and/or addressing important conservation issues related to sharks in Greece, with a specific mention of chondrichthyan records from the northern Aegean Sea. Kabasakal and Bilecenoğlu (2020) compiled an inventory of rare and large shark species in Turkish waters solely from internet-based news, which also included current northern Aegean records. Marine top predators found in the waters around Gökçeada have been investigated in a study that used LEK as a supporting tool for data collection (Kesici *et al.*, 2021) and reported rare occurrences of *C. carcharias* (n=2) and *I. oxyrinchus* (n=4) around the island. Following data mining digital archives and gathering supportive data from citizen science and social media, Moutopoulos *et al.* (2022) examined historical records of shark presence during the early developmental phases of the Greek fishery, highlighting historical records of *C. carcharias* and *C. maximus* in the northern Aegean Sea. As corroborated by the cited current studies (Kabasakal & Bilecenoğlu, 2020; Taklis *et al.*, 2020; Kesici *et al.*, 2021; Moutopoulos *et al.*, 2022), social media have proven to be an increasingly efficient tool in the efforts for the conservation of and raising awareness on large predatory sharks, which can notably supplement the monitoring of the cartilaginous fish status in a certain region and time interval (Boldrocchi & Storai, 2021; Casola *et al.*, 2022).

Fishery-dependent extractive surveys have revealed that chondrichthyan species are being incidentally captured in multi-modal fisheries operating across an extensive area of the northern Aegean Sea, ranging from the shallows of the continental shelf to bathyal grounds (≤ 1000 m depth) (Papaconstantinou & Tortonese, 1980; Ulutürk, 1987; Eryılmaz, 2003; Kabasakal & Kabasakal, 2004; Gönülal, 2016). The majority (>90%) of shark and batoid species identified in the present study were captured by small-scale fishermen (trammel-netters and demersal long-liners). This is consistent with the findings of Giovos *et al.* (2021), who emphasised that the underreporting of catches by small-scale fisheries poses a threat to elasmobranchs. According to Giovos *et al.* (2021), commercial gill-netting and demersal long-lining each contribute to over 40 percent of the bycatch of sharks and batoids in the north Aegean Sea. With the implementation of laws aimed at protecting cartilaginous fish, fishers tend to not report such catches, as highlighted by Giovos *et al.* (2021). Therefore, an ethical examination of the videos uploaded by fishermen on social media, driven as much by the desire to showcase their (legal) catches as by self-promotion (Monkman *et al.*, 2017; Shiffman, 2018), can be an effective method of recording previously unreported cartilaginous fish catches. The present preliminary study relies on the examination of 31 video footages, but a more comprehensive understanding of the bycatch impact would require the implementation of a questionnaire and onboard monitoring involving fisheries observers, and social media-based investigations complementing the data collected through large-scale fisheries surveys.

The present data set provides useful observations on the potential reproductive areas for

Fig. 6: (a) Pregnant female of *Squatina squatina* ***(TL ca. 170 cm) aborting near-term embryos while retained on board, with the arrow indicating the aborted specimen; (b) a near-term embryo of*** *S. squatina* ***before being released alive; (c) juvenile specimen of*** *Isurus oxyrinchus* ***(TL ca. 100 cm); (d) the arrow indicates a female specimen of*** *Dalatias licha* ***with two tub gurnards*** *(Chelidonichthys lucerna)* ***on the right.***
Sl. 6: (a) Breja samica vrste *Squatina squatina* ***(dolžina približno 170 cm), ki je na krovu splavila skoraj razvite zarodke, s puščico, ki označuje splavljen primerek; (b) skoraj popolno razvit zarodek vrste*** *S. squatina****, preden so ga živega izpustili; (c) mladostni primerek vrste*** *Isurus oxyrinchus* ***(dolžina približno 100 cm); (d) puščica označuje samico vrste*** *Dalatias licha* ***z dvema velikima krulcema*** *(Chelidonichthys lucerna)* ***na desni.***

several elasmobranch species in the area encompassing the islands of Gökçeada and Semadirek, the Gulf of Saroz, and the Gallipoli Peninsula. Previous occurrences of newborns, juveniles, and pregnant females in this region can be summarised as follows: Newborn specimens of *H. griseus* (TL 660 mm) and *D. licha* (TL range 338-372.5 mm), observed bearing unhealed umbilical scars, have been reported from the upper slope waters off the northern coast of the island of Gökçeada (Kabasakal & Kabasakal, 2002, 2004). Rare occurrences of newborn specimens of *O. centrina* observed in bottom-trawling have been reported from the Gulf of Thermaikos (TL

248 mm; Papaconstantinou & Tortonese, 1980) and off the southwestern coast of the island of Bozcaada (TL 225 mm; Eryılmaz, 2003). On 22 September 2008, a mature female of *O. centrina* carrying 12 developing ova (TL 651 mm) was captured in a scientific bottom-trawl survey in the Gulf of Saros (Yığın *et al.*, 2016). Taklis *et al.* (2020) reported captures of juvenile specimens of *P. glauca* (TW range 2000-5000 g) in commercial fisheries in various locations across the northern Aegean Sea. The capture of a newborn blue shark in demersal long-lining (which was subsequently released alive), documented in the present study, supports the suggestion that the northern Aegean Sea may serve as a parturition and nursery ground for *P. glauca*. Recent records of newborn specimens of *I. oxyrinchus* and *C. carcharias* from several locations in the northern Aegean Sea have been mentioned in Kabasakal (2015), Tunçer and Kabasakal (2016), Taklis *et al.* (2020), and Kabasakal *et al.* (2022).

While not included in the present study, juvenile specimens of *Etmopterus spinax* (TL range 120-227 mm), incidentally captured in commercial bottom-trawling at depths of 300 to 400 m, have also been reported (Kabasakal & Kabasakal, 2004). A juvenile specimen of *Squatina oculata* (TL 300 mm) and a subadult specimen of *S. squatina* (TL 750 mm) have been reported off the island of Gökçeada (Kabasakal & Kabasakal, 2004). İşmen *et al.* (2009) reported the observation of a newborn *S. squatina* (TL 232 mm) in the Gulf of Saros. In the present study, observations of newborn specimens and pregnant females of *S. squatina* confirmed the presumed areas of reproduction for the common angel shark in the northern Aegean Sea. Last but not least, pregnant females of *Mustelus asterias* (TL 1530 mm; bearing 21 near-term embryos) and of *S. blainville* (TL 870 mm; bearing 7 near-term embryos) have been incidentally captured in the Gulf of Saros (Kabasakal & Kabasakal, 2004). Therefore, past and recent occurrences of newborns, juveniles, and pregnant females in the studied region support the possibility of multiple elasmobranch nurseries across the shelf and bathyal grounds of the northern Aegean Sea. This has led to the designation of an Important Shark and Ray Area (ISRA) and an Area of Interest (AoI) (Jabado *et al.*, 2023).

The geographical area in which the study was conducted falls within the boundaries of the proposed buffer zone of the recently designated Thracian Sea Shelf ISRA on account of the presence of threatened species (e.g., *A. bovinus*), range-restricted species (*Raja radula*), reproductive areas (e.g., *S. canicula*), and undefined aggregations (*D. pastinaca*) (Jabado *et al.*, 2023). Furthermore, the geographical boundaries of the Truva Shelf AoI, where potential reproduction areas for *Squatina* species are assumed to exist, overlap with the southern part of the area investigated in the present study (Jabado *et al.*, 2023). As a result, the findings of this study contribute supportive new data that reinforce the establishment of the Thracian Sea Shelf ISRA and the Truva Shelf AoI.

Eight of the species identified in this study are protected in Turkish seas. In addition, the majority of these species (n=16; 76.19%) fall within the susceptible categories of Near Threatened, Vulnerable, Endangered, or Critically Endangered of the IUCN Red List (Otero *et al.*, 2019). The majority of captured elasmobranchs (n=63; 94.02%) were released alive without prolonged retention on deck and harsh handling, which is promising for the survival of bycaught elasmobranchs in the region. The fishermen's statements in the examined footages demonstrate their awareness of conservation laws as well as recognition of protected (e.g., *Squatina* spp., *O. centrina*) or vulnerable species (e.g., *D. licha*), as does their release of the captured specimens back to the sea. This corroborates the suggestion by Boldrocchi and Storai (2020) that social media can play a crucial role in raising fishermen's awareness about cartilaginous fish and bridging knowledge gaps.

To conclude, this study presents a regional example of a good practice in using social media films to gather additional and complementary information about the life histories and current status of elasmobranch species in a specific region. In recent years, the utilisation of footage published on social media films has emerged as an increasingly promising data collection method and an approach supported by the findings of various researchers (Boldrocchi & Storai, 2020; Mancusi *et al.*, 2020; Taklis *et al.*, 2020; Kesici *et al.*, 2021; Bargnesi *et al.*, 2020, 2022; Gallo *et al.*, 2022). Compared to traditional systematic scientific sampling, it is clear that this study approach still presents some uncertainties (e.g., TL information dependent on the statements of the fishermen) and weaknesses (e.g., the intervals at which the fishermen upload footage may not accurately reflect the true periodicity of fishing days). However, considering the *K-selected* life history characteristics of elasmobranchs (e.g., slow growth, late maturation, low fecundity, etc.) and the current extinction crisis that threatens their survival (Fowler *et al.*, 2005; Dulvy *et al.*, 2021), this non-invasive and non-extractive visual sampling method, if applied according to

the methodology described herein, can complement traditional systematic sampling by addressing the knowledge gaps that arise from limited research staff or expansion of the study area. Last but not least, the present study evidently suffers from a very small sample size. Therefore, more effort is needed before drawing any conclusions about the impact of bycatch on the populations of sharks and batoids in the northern Aegean Sea.

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Appendix 1: Elasmobranch species (n=67) captured in commercial fisheries in the northern Aegean Sea and appearing in social media videos, along with fishing data, remarks about the observed specimens, and sources of video footages. Specimen time code indicates the time interval during which an elasmobranch specimen is visible in the respective video.

Priloga 1: Hrustančnice (n=67 vrst), ujete v komercialnem ribolovu v severnem Egejskem morju, ki se pojavljajo v videoposnetkih v socialnih medijih, skupaj s podatki o ulovu, opombami v zvezi z opazovanimi primerki in viri videoposnetkov. Časovna koda primerka označuje časovni interval, v katerem je bil primerek opažen v danem videoposnetku.

Date	Locality	Depth (m)	Fishing gear	Species	Nr	Specimen time codes	Remarks	Source
14 Sep 2021	Gökçeada, off Yıldız Bay	85-92	Demersal long line	*Mustelus mustelus*	1	9:49-12-26	Female, TL ca. 110 cm; taken on board	https://www.youtube.com/watch?v=LeNLmXCKkm0
14 Sep 2021	Gökçeada, off Yıldız Bay	85-92	Demersal long line	*Raja clavata*	1	12:58-13:38	Female, DW ca. 40 cm; released alive	https://www.youtube.com/watch?v=LeNLmXCKkm0
14 Sep 2021	Gökçeada, off Yıldız Bay	85-92	Demersal long line	*Raja clavata*	1	13:48-14:14	Female, DW ca. 50 cm; released alive	https://www.youtube.com/watch?v=LeNLmXCKkm0
14 Sep 2021	Gökçeada, off Yıldız Bay	85-92	Demersal long line	*Raja clavata*	1	15:25-15:50	Male, adult, claspers very longer than pelvic fins and visible at the time code (15:29) of the source video; DW ca. 70 cm; released alive	https://www.youtube.com/watch?v=LeNLmXCKkm0
14 Sep 2021	Gökçeada, off Yıldız Bay	85-92	Demersal long line	*Mustelus mustelus*	1	16:40-19:20	Female, genital opening is visible at the time code (19:01) of the source video, TL ca. 140 cm; taken on board	https://www.youtube.com/watch?v=LeNLmXCKkm0
20 Nov 2021	Between Gökçeada and Semadirek islands, off SW of Semadirek island, between Enez and Gökçeada	102-107	Demersal long line	*Squalus blainville*	1	22:17-22:36	Female, genital opening is visible at the time code (22:30) of the source video, TL ca. 50 cm; released alive; depth information given at the time codes (18:32 and 33:55)	https://www.youtube.com/watch?v=PNcCAyt7f7g
20 Nov 2021	Between Gökçeada and Semadirek islands, off SW of Semadirek island, between Enez and Gökçeada	102-107	Demersal long line	*Myliobatis aquila*	1	22:44-23:08	Female, DW ca. 100 cm; dorsal fin is behind pelvic fins (22:48); released alive; depth information given at the time codes (18:32 and 33:55)	https://www.youtube.com/watch?v=PNcCAyt7f7g
15 Dec 2021	Between Gökçeada and Semadirek islands, around Zürafa rocks point	90-320	Demersal long line	*Scyliorhinus stellaris*	1	21:15-21:53	Female, TL ca. 100 cm; released alive; depth information is given at the time codes (3:18-3:21) of the source video	https://www.youtube.com/watch?v=rTr1_WgVA84
15 Dec 2021	Between Gökçeada and Semadirek islands, around Zürafa rocks point	90-320	Demersal long line	*Myliobatis aquila*	1	29:57-30:35	Female, DW ca. 100 cm; no claspers (30:31); dorsal fin is behind pelvic fins (30:35); released alive; depth information is given at the time codes (3:18-3:21) of the source video	https://www.youtube.com/watch?v=rTr1_WgVA84
15 Jan 2022	Between Gökçeada and Semadirek islands, around Zürafa rocks point	?	Demersal long line	*Myliobatis aquila*	1	8:45-8:56	DW ca. 60 cm; released alive	https://www.youtube.com/watch?v=lHfYuOwNolk
15 Jan 2022	Between Gökçeada and Semadirek islands, around Zürafa rocks point	?	Demersal long line	*Squalus blainville*	1	16:04-16:26	TL ca. 40 cm; released alive	https://www.youtube.com/watch?v=lHfYuOwNolk

15 Jan 2022	Between Gökçeada and Semadirek islands, around Zürafa rocks point	?	Demersal long line	*Mustelus mustelus*	1	21:49-22:04	TL ca. 40 cm; released alive	https://www.youtube.com/watch?v=lHfYuOwNolk
1 Apr 2022	Gökçeada-Büyükkemikli	500-600	Rod and reel	*Hexanchus griseus*	1	14:40-19:45	Captured with a purpose-made shark rig for big game fishery, baited with bonito, *Sarda sarda*, released alive, TL ca. 450 cm, female	https://www.youtube.com/watch?v=k6T-LjX8kN0
7 Apr 2022	Tuzla	14-16	Trammel net	*Squatina squatina*	1	1:43-2:27	All female and released alive	Video provided by the fisherman and available on request
14 Apr 2022	Between Kaşkaval cape and Kbatepe on mainland	70	Demersal long line	*Aetomylaeus bovinus*	1	6:10-6:30	Claspers are visible between the time codes (6:10-6:30) of the source video, released alive	https://www.youtube.com/watch?v=bF8lwek96sc
14 Apr 2022	Between Kaşkaval cape and Kabatepe on mainland	70	Demersal long line	*Aetomylaeus bovinus*	1	14:19-14:54	Claspers are visible at the time code (14:44) of the source video, released alive	https://www.youtube.com/watch?v=bF8lwek96sc
14 Apr 2022	Between Kaşkaval cape and Kabatepe on mainland	70	Demersal long line	*Mustelus asterias*	1	9:15-9:50	Landed for auction	https://www.youtube.com/watch?v=bF8lwek96sc
14 Apr 2022	Between Kaşkaval cape and Kabatepe on mainland	70	Demersal long line	*Oxynotus centrina*	1	10:28-12:46	Female, TL ca. 60 cm, genital opening is visible at the time code (11:56) of the source video, released alive	https://www.youtube.com/watch?v=bF8lwek96sc
14 Apr 2022	Between Kaşkaval cape and Kabatepe on mainland	70	Demersal long line	*Dipturus* sp.	1	13:10-13:32	Released alive	https://www.youtube.com/watch?v=bF8lwek96sc
14 Apr 2022	Pirgos	19-25	Trammel net	*Squatina squatina*	1	1:15-1:30	Pregnant female, aborted nearterm embryons onboard, all released alive but their post-release survival status uncertain	Video provided by the fisherman and available on request
6 Jun 2022	Tepeköy coast	10-15 m	Trammel net	*Torpedo* sp.	1	12:51-13:00	Released alive	https://www.youtube.com/watch?v=iNbVVQoQs-g
10 Jun 2022	Kefaloz	20	Trammel net	*Squatina squatina*	1	0:00-1:07	4 adult females (TL 80-90 cm and TW 10-20 kg) 4 juveniles (TL 30-40 cm), sexes not reported	Video provided by the fisherman and available on request
11 Aug 2022	Between Kaşkaval cape and Kabatepe on mainland	60	Trammel net	*Torpedo marmorata*	1	5:43-5:46 13:37-13:50	Spiracle tentacles and dorsal texture are visible between the time codes (13:37-13:39) of the source video, released alive	https://www.youtube.com/watch?v=Wv3ck9wCsqU
11 Aug 2022	Between Kaşkaval cape and Kabatepe on mainland	60	Trammel net	*Squatina squatina*	1	7:31-7:50	Male, claspers are visible at the time code (7:40) of the source video, released alive	https://www.youtube.com/watch?v=Wv3ck9wCsqU
11 Aug 2022	Between Kaşkaval cape and Kabatepe on mainland	60	Trammel net	*Squatina squatina*	1	7:59-8:01	Specimen is visible at the time codes (7:59-8:01) of the source video, released alive	https://www.youtube.com/watch?v=Wv3ck9wCsqU
11 Aug 2022	Between Kaşkaval cape and Kabatepe on mainland	60	Trammel net	*Squatina squatina*	1	9:52-10:12	Specimen is visible at the time codes (9:52-10:12) of the source video, juvenile male with minute claspers shorter than pelvic fins (10:09), released alive	https://www.youtube.com/watch?v=Wv3ck9wCsqU
17 Aug 2022	North coast of Gökçeada	?	Demersal long line	*Myliobatis aquila*	1	10:18-10:24	Released alive	https://www.youtube.com/watch?v=fgXlKx2dUTo

17 Aug 2022	North coast of Gökçeada	?	Demersal long line	*Scyliorhinus canicula*	1	23:20-23:29	Released alive	https://www.youtube.com/watch?v=fgXlKx2dUTo
2 Sep 2022	Between Gökçeada and Semadirek islands, around Zürafa rocks point	95-100	Demersal long line	*Rostroraja alba*	1	13:39-14:03	Immature male, short clasper is visible at the time code (13:49) of the source video; snout very long and pointed (13:51); tip of pectoral fins angular (13:52); released alive	https://www.youtube.com/watch?v=rgtYVaHoLPI
1 Jan 2023	North coast of Gökçeada	117-171	Demersal long line	*Squalus blainville*	1	13:51-14:10	Female, genital opening is visible at the time code (14:08) of the source video; released alive	https://www.youtube.com/watch?v=3b0gHFvSQyE
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Leucoraja naevus*	1	12:39-12:50	Male, claspers are visible at the time code (12:43) of the source video, released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Squatina squatina*	1	15:33-16:00	Subadult male, claspers are visible at the time code (15:52) of the source video, released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Squatina squatina*	1	16:32-16:52	Subadult male, claspers are visible at the time code (16:33) of the source video, released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Squatina squatina*	1	17:00-17:11	Released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Leucoraja* sp.	1	17:46-17:55	Released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
14 Jan 2023	Between Kefaloz point and Kabatepe on mainland	27	Trammel net	*Squatina squatina*	1	19:34-19:48	Both released alive	https://www.youtube.com/watch?v=LBkx3zFGE-Y
3 Feb 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	231	Demersal long line	*Myliobatis aquila*	1	11:31-11:38	Released alive	https://www.youtube.com/watch?v=nXo9pPNUcvk
3 Feb 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	231	Demersal long line	*Squalus blainville*	1	12:03-12:28	Female, genital opening is visible at the time code (12:26) of the source video; no anal fin; TL ca. 50 cm; released alive	https://www.youtube.com/watch?v=nXo9pPNUcvk
3 Feb 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	231	Demersal long line	*Squalus blainville*	1	15:14-15:27	Female, genital opening is visible at the time code (15:16) of the source video; no anal fin; TL ca. 50 cm; released alive	https://www.youtube.com/watch?v=nXo9pPNUcvk
3 Feb 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	231	Demersal long line	*Myliobatis aquila*	1	16:20-16:23	DW ca. 100 cm, released alive	https://www.youtube.com/watch?v=nXo9pPNUcvk
3 Mar 2023	Çanakkale Strait, southern entrance	?	Recreational angling	*Squatina squatina*	1	0:00-1:20	1 pregnant female, TL ca. 170 cm, giving birth on board; 5 newborns; all released alive, but post-release survival is unknown	https://www.instagram.com/reel/CpUZYMOghmz/?igshid=YmMyMTA2M2Y=

22 Apr 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	86	Demersal long line	*Squalus blainville*	1	7:20-7:42	Female, genital opening is visible at (7:40); time codes of the descriptive characters in the source video are as follows: free rear tips of pectoral fins, and continous posterior edge of caudal fin (7:40), spurs in front of dorsal fins (7:41), released alive	https://www.youtube.com/watch?v=TbSdp2-F0Tg
22 Apr 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	86	Trammel net	*Scyliorhinus stellaris*	1	11:59-13:02	Female, genital opening is visible at the time code (12:54) of the source video, TL ca. 100 cm; descriptive characters are visible at the following time codes: widely separated nasal flaps (12:35), dorsally positioned long eyes (12:35), released alive	https://www.youtube.com/watch?v=TbSdp2-F0Tg
12 Jun 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	103	Trammel net	*Squalus blainville*	1	9:04-10:22	All released alive; time codes of the descriptive characters in the source video are as follows: white coloration of the posterior edge of first dorsal fin (9:10), white coloration and continous contour of the ventral edge of upper caudal lobe (9:12), free rear tip of pectoral (9:13) and spur (11:53)	https://www.youtube.com/watch?v=PegjsdVPFMg
12 Jun 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	103	Trammel net	*Myliobatis aquila*	1	15:21-15:35	Female, genital opening is visible at the time code (15:29) of the source video; some other descriptive characters are visible at the following time codes of the same video; whip-shaped tail (15:30), short and obtuse snout (15:32) released alive	https://www.youtube.com/watch?v=PegjsdVPFMg
19 Jun 2023	Between Gökçeada and Semadirek islands	300	Trammel net	*Dalatias licha*	1	0:00-0:11	Not alive, the swollen belly of the specimen suggests that it was a pregnant female, TL > 100 cm	https://www.instagram.com/reel/Ctqe31UASpc/?igshid=MzRlODBiNWFlZA==
8 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	125	Demersal long line	*Dasyatis pastinaca*	1	16:13-16:24	Released alive	https://www.youtube.com/watch?v=HXFIrVvayR8
15 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	171	Trammel net	*Dalatias licha*	1	10:35-10:45	Not alive, the swollen belly of the specimen suggests that it was a pregnant female, TL > 100 cm	https://www.youtube.com/watch?v=y8yU1bgrfJM
15 Jly 2023	Between Gökçeada and Semadirek islands	?	Pelagic long line for sword fish	*Alopias vulpinus*	1	1:30-1:52	Female, TL ca. 400 cm	Video provided by the fisherman and available on request
15 Jly 2023	Between Gökçeada and Semadirek islands	?	Pelagic long line for sword fish	*Prionace glauca*	1	0:00-1:00	Female, TL 250-300 cm	Video provided by the fisherman and available on request
22 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	109	Demersal long line	*Prionace glauca*	1	14:14-15:23	New-born female; TL ca. 50 cm, healing umblical scar on ventral surface is visible at the time code (14:52) of the source video, released alive	https://www.youtube.com/watch?v=-BtS00_DN8Q
30 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	46-60	Trammel net	*Scyliorhinus* sp.	1	10:29-10:31	Released alive	https://www.youtube.com/watch?v=ZX6VglNwdcM

30 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	46-60	Trammel net	*Oxynotus centrina*	1	16:48-17:43	Female, TL ca. 60 cm, genital opening is visible at the time code (17:35) of the source video; retained in a recirculating water container to recovery, then released alive	https://www.youtube.com/watch?v=ZX6VglNwdcM
30 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	46-60	Trammel net	*Hexanchus griseus*	1	19:28-21:34	TL ca. 150 cm, juvenile, the following descriptive characters are visible at the time codes of the source video: 6 gill slits (21:05), single dorsal fin (21:06) and dentition (21:15); the specimen swallowed a piece of net and spiral valve is extended out from the cloaca (19:30-19:35); fishermen released the specimen, but it's post-release survival is not certain	https://www.youtube.com/watch?v=ZX6VglNwdcM
30 Jly 2023	Between Gökçeada and Semadirek islands, around Zürafa rocks point	46-60	Demersal long line	*Dasyatis* sp.	1	38:23-38:37	Breake the line and escaped	https://www.youtube.com/watch?v=ZX6VglNwdcM
31 Jly 2023	Saroz Bay	33	Recreational angling	*Torpedo marmorata*	1	0:00-0:23	In the footage it is visible that the head and pectoral fins are fused, head-pectoral fin complex moving with continous undulations, and the origin of the second dorsal fin is at the level of pelvic fin tips; released alive	https://www.instagram.com/reel/CvULGBnN4wR/?igshid=MTc4MmM1YmI2Ng==
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Demersal long line	*Squalus blainville*	1	5:16-5:28	Released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Demersal long line	*Raja* sp.	1	5:31-5:46	Released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Demersal long line	*Dasyatis* sp.	1	5:48-6:03	Released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Trammel net	*Scyliorhinus* sp.	1	14:16-14:23	Released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Trammel net	*Scyliorhinus* sp.	1	22:32-22:50	TL ca. 100 cm; released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
4 Aug 2023	Entrance of Saroz Bay, Büyükkemikli	?	Trammel net	*Squalus blainville*	1	24:23-24:45	TL ca. 50 cm; released alive	https://www.youtube.com/watch?v=jAlyQD-U2as
5 Aug 2023	Gökçeada	?	Pelagic long line for sword fish	*Isurus oxyrinchus*	1	0:00-0:38	TL ca. 100 cm; no umblical scar is visible between pectoral fins on ventral surface; released alive	https://www.tiktok.com/@agasonfishing/video/7263391305470872837?_t=8egjCQnMnZd&_r=1
8 Aug 2023	Gökçeada	224-300	Trammel net	*Raja miraletus*	1	5:46-6:00	DW ca. 40 cm; retained onboard	https://www.youtube.com/watch?v=u2pLcdiKCds
8 Aug 2023	Gökçeada	224-300	Trammel net	*Squatina oculata*	1	11:42-12:20	Female, TL ca. 120 cm; released alive	https://www.youtube.com/watch?v=u2pLcdiKCds
8 Aug 2023	Gökçeada	160	Demersal long line	*Scyliorhinus stellaris*	1	21:20-21:25	Female, TL ca. 100 cm; depth information is given at the time code (16:44-16:46) of the source video; released alive	https://www.youtube.com/watch?v=u2pLcdiKCds
8 Aug 2023	Gökçeada	160	Demersal long line	*Raja clavata*	1	22:01-22:12	Female, DW ca. 50 cm; released alive	https://www.youtube.com/watch?v=u2pLcdiKCds

PRELIMINARNA RAZISKAVA O MORSKIH PSIH IN SKATIH, UJETIH V KOMERCIALNEM RIBIŠTVU SEVERNEGA EGEJSKEGA MORJA NA OSNOVI PODATKOV IZ SOCIALNIH MEDIJEV

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POVZETEK

V zadnjih letih so filmi v socialnih medijih vedno bolj uporabni kot obetavna metoda za pridobivanje podatkov o hrustančnicah. Pričujoča raziskava predstavlja primer dobre prakse pri uporabi filmov v socialnih medijih za zbiranje dodatnih in dopolnilnih informacij o morskih psih in skatih v severnem Egejskem morju. V pregledanih videoposnetkih je avtor prepoznal 67 primerkov morskih psov in skatov, ki so pripadali 8 redovom, 15 družinam in 21 vrstam. Večina je bilo morskih psov. Naključno ujete hrustančnice so bile ujete s pridnenim ribolovnim orodjem, pri čemer so dobro polovico primerkov ujeli s parangalom. Naključni ulovi novoskotenih primerkov sinjega morskega psa (Prionace glauca) in navadnega sklata (Squatina squatina) podpirajo domnevo, da lahko predstavlja severno Egejsko morje jaslice za obe vrsti morskih psov.

Ključne besede: hrustančnice, ulovi, ohranjanje, socialni mediji, oportunistično vzorčenje

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ON THE OCCURRENCE OF NORWEGIAN SKATE, *DIPTURUS NIDAROSIENSIS* (RAJIDAE) ON THE ALGERIAN COAST (SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

The authors report the capture of several specimens of the Norwegian skate Dipturus nidarosiensis *(Storm, 1881) off the western Algerian coast. These are predominantly large specimens ranging between 141 cm and 164 cm in total length and between 69 cm and 71.5 cm in disc width. It is likely that these specimens originated from the eastern Atlantic and entered the Mediterranean through the Straits of Gibraltar, which would make* D. nidarosiensis *a Herculean species. The relatively high abundance of captures off the Algerian coast suggests that at present, a viable population may be successfully established in the region.*

Keywords: *Dipturus nidarosiensis*, Rajidae, migration, Straits of Gibraltar, Mediterranean Sea

PRESENZA DELLA RAZZA NORVEGESE, *DIPTURUS NIDAROSIENSIS* (RAJIDAE), AL LARGO DELLA COSTA ALGERINA (MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

Gli autori riportano la cattura di diversi esemplari della razza norvegese Dipturus nidarosiensis *(Storm, 1881) al largo delle coste algerine occidentali. Si tratta prevalentemente di esemplari di grandi dimensioni, compresi tra 141 cm e 164 cm di lunghezza totale e tra 69 cm e 71,5 cm di larghezza del disco. È probabile che questi esemplari provengano dall'Atlantico orientale e siano entrati nel Mediterraneo attraverso lo stretto di Gibilterra, il che renderebbe* D. nidarosiensis *una specie erculea. L'abbondanza relativamente elevata di catture al largo della costa algerina suggerisce che attualmente una popolazione vitale si sia stabilita con successo nella regione.*

Parole chiave: *Dipturus nidarosiensis*, Rajidae, migrazione, Stretto di Gibilterra, Mediterraneo

INTRODUCTION

The Norwegian skate, *Dipturus nidarosiensis* (Storm, 1881), is known off the eastern Atlantic coast from Iceland, southern Norway, and Ireland to northern Mauritania and South Africa (Geraci *et al*., 2019). It was first recorded in the Mediterranean Sea off the southeastern coast of Sardinia (Follesa *et al*., 2010), where further captures have been reported (Follesa *et al*., 2012). The species was also found in the Adriatic Sea (Cariani *et al*., 2017) and in the Ionian Sea (Carbonara *et al*., 2019). Massi *et al*. (2017) suggested the presence of the species in the Strait of Sicily, off the Island of Pantelleria, following the discovery of an empty egg case. The occurrence of the species was confirmed by the capture of a male specimen in a trawl survey at a depth of 551 m (Geraci *et al*., 2019). Westward the species is also reported in the Alboran Sea, where specimens were captured between 2013 and 2016 (Ramírez-Amaro *et al*., 2017).

Following Silva *et al*. (2012), rajid species (skates) remain an important component of fish assemblages in several marine areas, including the Algerian coast, where investigations that have been continuously conducted since Dieuzeide *et al*. (1953) (see Hemida, 2005; Refes *et al*., 2010; Capapé *et al*., 2023) have confirmed the presence of about 15 skate species.

While some species have been regularly captured in Algerian marine waters, others appear to be notably rare, caught only sporadically or absent from the fishmongers' stalls (Hemida, 2005). The present paper aims to report unusually high records of *D. nidarosiensis*, a species considered rare and endangered, and classified as near threatened by Stehmann *et al*. (2015). The Norwegian skate had been previously cited from the Algerian coast (Hemida *et al*., 2015), but no specimen was described, making confirmation unavailable. This report confirms the occurrence of the species off the Algerian coast, enhancing and expanding the knowledge of its distribution in the study area and in the wider Mediterranean Sea.

MATERIAL AND METHODS

The specimens of *D. nidarosiensis* were observed at primary fish markets in Algiers, where catches from areas along the Algerian coast, spanning from the Moroccan to the Tunisian border, are landed. Between 2000 and the present, at least one hundred specimens have been captured by trawlers at a depth of 330 m on sandy-muddy bottoms in the western region off Bouzedjar, located at 35°42′′35″ N and 1°22′17″ W (Fig. 1). They were often caught together with the spiny lobster *Palinurus elephas* (Fabricius, 1787), the Norway lobster *Nephrops norvegicus* (Linnaeus, 1758), the angler fish *Lophius piscatorius* Linnaeus, 1758, the slender rockfish *Scorpaena elongata* Cadenat, 1943 (Fig. 2), and occasionally with the cuckoo ray *Leucoraja naevus* (Müller and Henle, 1841). The specimens studied in this paper were carefully examined and identified using field guides to ichthyological fauna. They were photographed and, when possible, measured. Obtaining morphometric measurements was challenging, as the specimens were rapidly sold for local consumption.

RESULTS AND DISCUSSION

The specimens were identified as *D. nidarosiensis* based on the following morphological

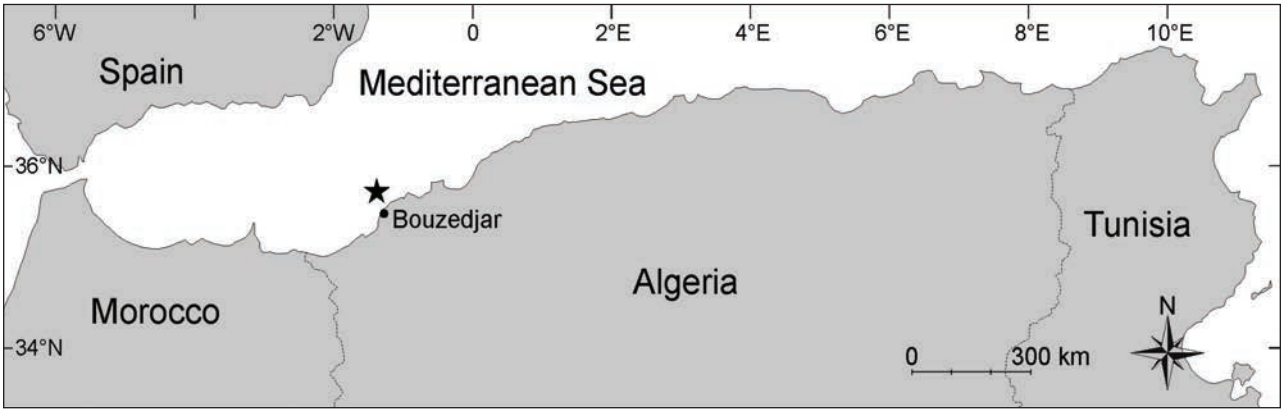

Fig. 1: Map of the Algerian coast indicating the capture site of the Norwegian skate, *Dipturus nidarosiensis****, off Bouzedjar (black star).***
Sl. 1: Zemljevid alžirske obale z označbo lokacije ulova norveške raže, *Dipturus nidarosiensis****, v vodah blizu Bouzedjarja (črna zvezdica).***

Fig. 2: Specimens of** Dipturus nidarosiensis **caught together with the spiny lobster** Palinurus elephas **(1), the Norway lobster** Nephrops norvegicus **(2), and the angler fish** Lophius piscatorius **(3) off the Algerian coast (photo by F. Hemida). Sl. 2: Primerki vrste** Dipturus nidarosiensis **ujeti skupaj z rarogi,** Palinurus elephas **(1), škampi,** Nephrops norvegicus **(2) in morskimi žabami,** Lophius piscatorius **(3) ob alžirski obali (foto: F. Hemida).

characters: disc broadly rhombic, wider than long, with acute outer corners; snout very long, pointed and pronounced; tail strong and rather short with a median row of 40–50 thorns up to the first dorsal fin, and 1–3 small thorns between the dorsal fins; upper surface smooth with one pair of pre-orbital thorns, one post-orbital thorn; colour greyish-brown dorsally and entirely dark ventrally, with darkly pigmented ampullary pores (Fig. 3). These characteristics are in total accordance with previous descriptions of the species (Stehmann & Bürkel, 1984; Ebert & Stehmann, 2013; Last *et al*., 2016; Geraci *et al*., 2019). They confirm the presence of *D. nidarosiensis* on the Algerian coast, warranting its inclusion in the local ichthyofauna.

The Norwegian skates captured off the Algerian coast consisted mainly of large specimens, including both males and females. The total lengths of the 20 specimens randomly selected for observation ranged between 1410 mm and 1640 mm, with disc widths ranging between 690 mm and 715 mm. This suggests that a viable population of *D. nidarosiensis* may have successfully established itself in Algerian marine waters, though, admittedly, no juvenile specimens were observed, and the captures were rather restricted to the western region (Fig. 4). According to the survey conducted by Geraci *et al*. (2019) *D. nidarosiensis* currently inhabits the Mediterranean Sea. However, the species has not been recorded to date in the eastern basin, possibly due to warmer waters in that

Fig. 3: Specimens of** Dipturus nidarosiensis **caught off the Algerian coast, scale bar = 200 mm (photo by F. Hemida). Sl. 3: Primerki vrste** Dipturus nidarosiensis**, ujeti ob alžirski obali, merilo = 200 mm (foto: F. Hemida).

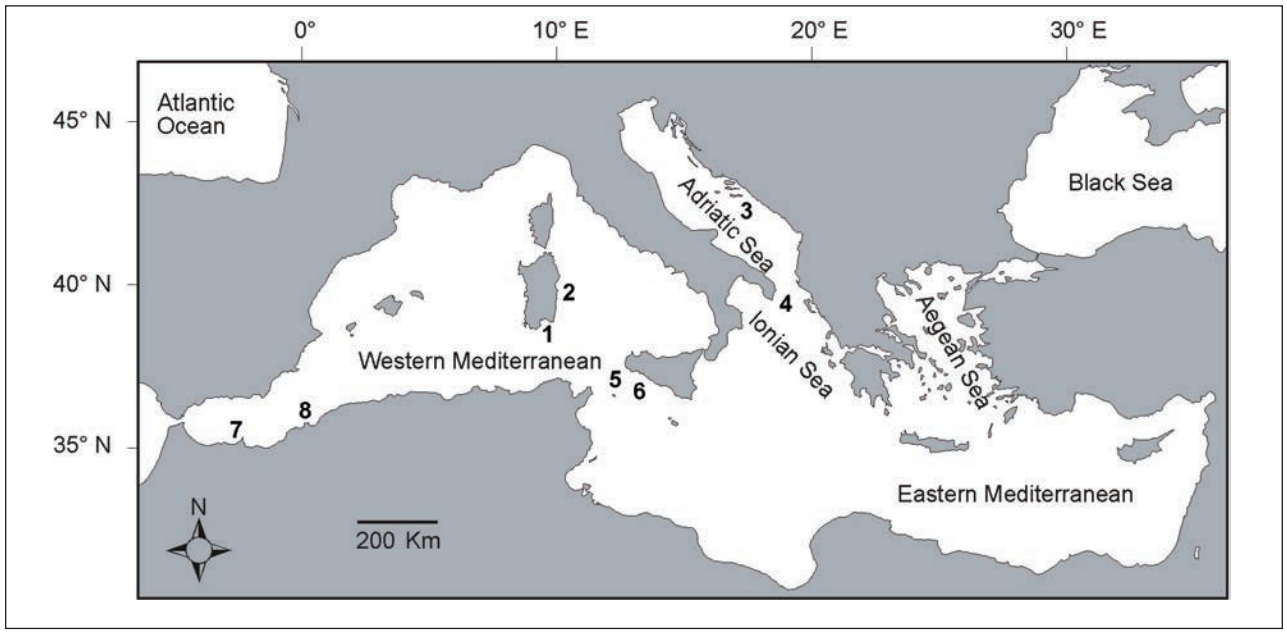

Fig. 4: Map of the Mediterranean Sea indicating the locations of records of *Dipturus nidarosiensis*. ***South-eastern coast of Sardinia: 1. Follesa*** *et al.* ***(2010), 2. Follesa*** *et al.* ***(2012). Adriatic Sea: 3. Cariani*** *et al.* ***(2017). Ionian Sea: 4. Carbonara*** *et al.* ***(2019). Strait of Sicily, off the Island of Pantelleria: 5. Massi*** *et al.* ***(2017), 6. Geraci*** *et al.* ***(2019). Alboran Sea: 7. Ramírez-Amaro*** *et al.* ***(2017). Algerian coast off Bouzedjar: 8. this study.***
Sl. 4: Zemljevid Sredozemskega morja prikazuje lokacije zapisov o pojavljanju vrste *Dipturus nidarosiensis*. ***Jugovzhodna obala Sardinije: 1. Follesa*** *et al.* ***(2010), 2. Follesa*** *et al.* ***(2012). Jadransko morje: 3. Cariani*** *et al.* ***(2017). Jonsko morje: 4. Carbonara*** *et al.* ***(2019). Sicilijanska ožina, ob otoku Pantelleria: 5. Massi*** *et al.* ***(2017), 6. Geraci*** *et al.* ***(2019). Alboransko morje: 7. Ramírez-Amaro*** *et al.* ***(2017). Alžirska obala ob Bouzedjarju: 8. Ta študija.***

region compared to the western basin. This distribution pattern could also explain the higher frequency of captures in the areas closer to the Straits of Gibraltar, such as the Alboran Sea and the western Algerian coast, and only sporadic catches in the Italian seas, for instance (Geraci *et al.*, 2019).

Golani *et al.* (2021) noted that the exotic species found in the Mediterranean Sea are either Lessepsian migrants (*sensu* Por, 1971), *i.e.*, originating from the warm or warm-to-temperate waters of the Red Sea, or Herculean migrants (*sensu* Golani *et al.*, 2000), i.e., having an origin in the eastern tropical Atlantic. Since the occurrence of *D. nidarosiensis* in the Mediterranean Sea is likely the consequence of migrations from the eastern Atlantic coast through the Strait of Gibraltar, the species could be classified as a Herculean migrant. However, the main question is whether to consider it as an exotic species deserving of inclusion in Golani *et al.* (2021).

Geraci *et al.* (2019) reported that *D. nidarosiensis* is the deepest living skate species, with recorded depths ranging from 600 to 1400 m in the Mediterranean Sea according to Cannas *et al.* (2010) and over 1000 m in the northeastern Atlantic (Stehmann & Bürkel, 1984). The scarcity of sightings of this species may be attributed to the limited commercial fishing and bottom trawl surveys carried out in these deep areas (Geraci *et al.*, 2019). Following Geraci *et al.* (2019), trawl surveys at depths exceeding 1000 m will be necessary to increase the captures of *D. nidarosiensis* and generally gain a more comprehensive knowledge of this and other deep-sea elasmobranch species.

O POJAVLJANJU NORVEŠKE RAŽE, *DIPTURUS NIDAROSIENSIS* (RAJIDAE), OB ALŽIRSKI OBALI (JUGOZAHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o ulovu več primerkov norveške raže Dipturus nidarosiensis *(Storm, 1881) ob alžirski obali. Večinoma so bili veliki primerki, ki so merili med 141 cm in 164 cm totalne dolžine in med 69 cm in 71,5 cm v premeru diska. Primerki verjetno izvirajo iz vzhodnega Atlantika in so prišli v Sredozemsko morje skozi Gibraltarsko ožino, zato gre za Herkulove migrante. Relativno veliko število ulovov kaže, da se je na obravnavanem območju ustalila populacija te vrste, ki je sposobna preživetja.*

Ključne besede: *Dipturus nidarosiensis*, Rajidae, selitev, gibraltarska ožina, Sredozemsko morje

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THE FIRST RECORD OF COMPLETE ALBINISM IN COMMON STINGRAY *DASYATIS PASTINACA* (LINNAEUS, 1758)

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ABSTRACT

An unusually colored stingray was video-recorded on 15 August 2022 in the eastern central Adriatic. Its morphological characteristics corresponded with the descriptions of the common stingray Dasyatis pastinaca *(Linnaeus, 1758), however, the specimen observed was entirely white on the dorsal and ventral surfaces, including the tail, except for the tips of the spines. Furthermore, the iris of the specimen lacked pigmentation and exhibited an abnormal orange-yellow (xanthochromic) coloration. This discovery marks the first recorded instance of complete albinism in this particular species and a rare occurrence among elasmobranchs in general.*

Keywords: *Dasyatis pastinaca*, common stingray, albinism, leucism, Adriatic Sea

PRIMA DOCUMENTAZIONE DI ALBINISMO COMPLETO NELLA PASTINACA *DASYATIS PASTINACA* (LINNAEUS, 1758)

SINTESI

Una razza dai colori insoliti è stata videoregistrata il 15 agosto 2022 nell'Adriatico centro-orientale. Le sue caratteristiche morfologiche corrispondevano alle descrizioni della pastinaca Dasyatis pastinaca *(Linnaeus, 1758), tuttavia l'esemplare osservato era interamente bianco sulle superfici dorsale e ventrale, coda compresa, ad eccezione delle punte delle spine. Inoltre, l'iride del campione mancava di pigmentazione e mostrava una colorazione giallo-arancio anomala (xantocromica). Questa scoperta segna il primo caso registrato di albinismo completo in questa particolare specie e un evento raro tra gli elasmobranchi in generale.*

Parole chiave: *Dasyatis pastinaca*, pastinaca, albinismo, leucismo, mare Adriatico

INTRODUCTION

Various types of abnormal coloration have been observed in wild and farmed fishes. These disorders occur either as a deficiency of pigmentation (hypomelanosis), *e.g.*, albinism, leucism, piebaldism, and xanthism, or an excess of pigmentation (hypermelanosis), *e.g.*, melanism (Dawson & Heal, 1976; Jawad & Ibrahim, 2018). In most cases, the exact cause of such abnormal coloration remains unclear, as it can result from different factors or their combination, including non-pathological genetic mutations, skin pathologies, hormonal imbalances, specific diets, and interspecific hybridization (Quigley *et al.*, 2016). Albinism is a genetically inherited disorder characterized by a congenital absence of pigmentation in the skin and iris (eyes). It is caused by a disruption to the enzymatic pathway responsible for producing melanin. In contrast, leucism is associated with abnormal skin pigmentation caused by a prenatal enzyme deficiency involved in melanin metabolism. Leucism differs from true albinism in that it is characterized by a reduction in melanin over the entire or part of the body, while the retinal coloration remains normal (Ball *et al.*, 2013; Bigman *et al.*, 2015; Quigley *et al.*, 2016). Sometimes leucism is referred to as partial albinism, but such a condition is, by definition, impossible.

The common stingray *Dasyatis pastinaca* (Linnaeus, 1758) is a coastal demersal species found in temperate waters with a depth range of 5 to 200 m, but typically inhabiting shallower areas between 20 and 60 m in depth. It is distributed along the coasts of the eastern North Atlantic, in the Mediterranean and the Black Sea. It is a yolk-sac viviparous species, with a gestation period of approximately 4 months. Litters range from 4 to 9 young, whose size at birth is about 8 cm in disc width. The common stingray feeds mainly on demersal invertebrates, such as crustaceans, but also on small mollusks and fishes (Ebert & Stehmann, 2013; Ebert & Dando, 2021). With its whiplash tail intact, it can reach a maximum total length of about 250 cm; its disc can attain a maximum width of 60 cm. In the Mediterranean, females mature at about 28 to 38 cm, and males at 26 to 32 cm disc width (Ebert & Stehmann, 2013; Ebert & Dando, 2021).

Soldo & Lipej (2022) classified the common stingray as an occasional species in the Adriatic based on several published records. However, they noted that recent reports from citizen science suggested it might be more common than previously believed and speculated about the presence of a small Adriatic population. The common stingray can be found throughout the Adriatic Sea, primarily in the channel areas of the eastern part (Jardas, 1984). In Croatia, *D. pastinaca* is strictly protected as a vulnerable species (Soldo & Lipej, 2022), with its conservation status consistent with the rest of the Mediterranean area (Dulvy *et al.*, 2016).

The usual color of the common stingray is plain greyish, olive or brown dorsally and white ventrally, with broad greyish-brown margins on the disc and pelvic fins, and a dark whiplash tail section (Ebert & Stehmann, 2013; Ebert & Dando, 2021).

This paper describes the first observed record of complete albinism in *D. pastinaca*.

Fig. 1: Map of the observation area (★ indicates the exact location) of the albino specimen of common stingray. Sl. 1: Zemljevid obravnavanega območja z označeno lokaliteto ulova (★) albinističnega primerka navadnega morskega biča.

MATERIAL AND METHODS

The author of this paper was contacted by a professional diver who made several videos (totaling over 5 minutes in length) of a uniquely colored stingray on 15 August 2022 in the eastern central Adriatic. The videos were recorded at a depth of 21 m, on the northern side of the Krk Island, near the town of Omišalj (Fig. 1). In all videos, including close-ups, the white stingray can be seen resting on or swimming above a rocky bottom (Fig. 2). The videos also showcase two other specimens of the same species of stingray, but with their usual color.

RESULTS AND DISCUSSION

The videos show two specimens of stingray characterized by diamond-shaped discs, very short snouts, and a greyish to olive dorsal coloration, with a clearly visible white underside, as well as broad dark margins on the disc and pelvic fins, and a dark whiplash tail section. These characteristics are consistent with the descriptions of the common stingray *D. pastinaca* found in the literature

Fig. 2. Extract from the video showing the white dorsal and ventral sides of the albino specimen of common stingray.
Sl. 2: Izsek iz videoposnetka, ki prikazuje hrbtno in trebušno stran albinističnega primerka navadnega morskega biča.

(Ebert & Stehmann, 2013; Ebert & Dando, 2021). Additionally, a third specimen with the same body characteristics, including two visible spines, was observed. However, this specimen had an entirely white dorsal surface with only sporadic small darker spots of different sizes scattered across it. The underside was also completely white, as was the tail, except for the tips of the spines. The size comparison of the common stingray to other fish in the vicinity indicated that it was an adult individual, likely female, as no claspers were observed. Additionally, the presence of small darker spots visible on the ventral side suggested that this might be a case of leucism rather than complete albinism. However, a closer examination of this specimen in the video revealed that even the irises lacked pigmentation; in fact, the specimen exhibited an abnormal orange-yellow (xanthochromic) eye coloration, while retinal pigmentation was clearly visible in the other two normally colored specimens.

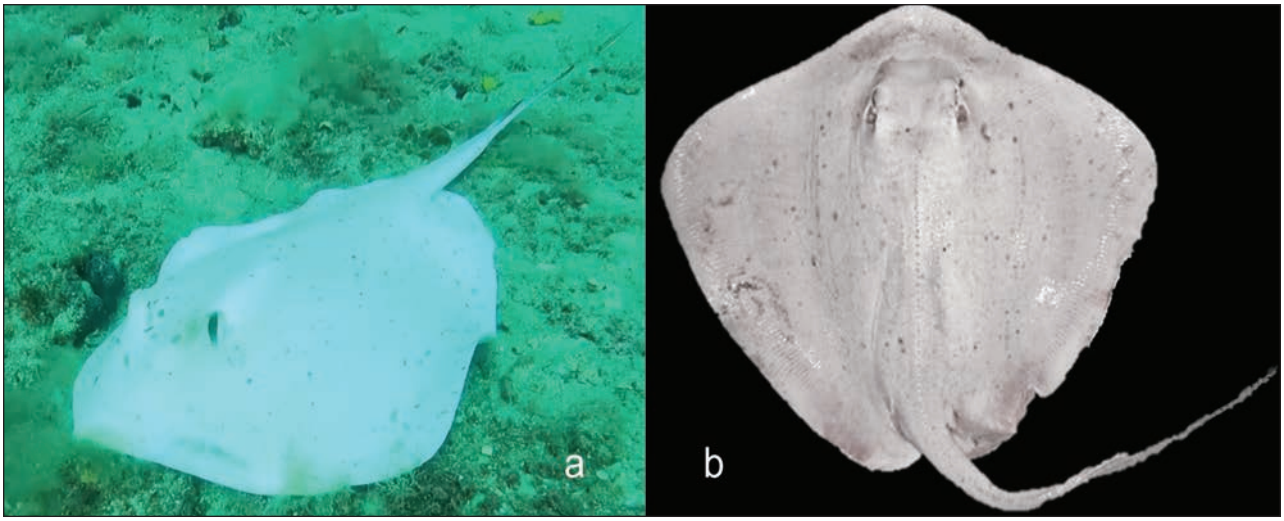

Fig. 3. Comparison between (a) the** Dasyatis pastinaca **from this study and (b) the southern stingray** Hypanus americanus **specimen reported by Wakida-Kusunoki (2015).
Sl. 3: Primerjava primerka vrste** Dasyatis pastinaca **(a) iz pričujoče študije s (b) primerkom južnega morskega biča, o katerem je poročal Wakida-Kusunoki (2015).

Given the specimen's extremely whitish coloration, we can conclude that this is the first known case of true complete albinism in the common stingray. This finding is consistent with the results presented by Wakida-Kusunoki (2015), who first reported an instance of complete albinism in another stingray species, *Hypanus americanus* (Hildebrand & Schroeder, 1928). A comparison of the photos of the specimens clearly shows that both specimens have very similar coloration: they are entirely white, except for a few darker spots dorsally, and with unpigmented irises (Fig. 3).

So far, no case of complete albinism has ever been reported for *D. pastinaca*. Only partial albinism has been observed in this species by Capapé & Pantoustier (1975). In contrast, complete albinism has been reported for *H. americanus* by Schwartz & Safrit (1977), and more recently by Wakida-Kusunoki (2015). These are the only instances, to date, of complete albinism in the Dasyatidae family, which is consisted of 99 valid species (Fricke *et al*., 2023).

Moreover, out of the approximately 1,300 species of sharks, rays and chimeras (Fricke *et al*., 2023), complete albinism or leucism has been reported in fewer than 60 species of elasmobranchs (Bigman *et al*., 2015; Wakida-Kusunoki, 2015; Quigley *et al*., 2018). Among these reports, more species are described as leucistic than fully albino. Therefore, albinism remains a very rare condition, especially among the adult population, probably because the lack of coloration in albinos can increase an individual's susceptibility to predation or make them less attractive for reproduction (Sandoval-Castillo *et al*., 2006). However, since large albino elasmobranchs have been reported, although more rarely than immature ones, it would seem that albinism does not necessarily lead to a lower chance of survival in elasmobranchs (Bigman *et al*., 2015). It is worth noting that the reported albino species are predominantly pelagic elasmobranchs, implying that coloration may not play as significant a role in the water column, while flattened demersal fishes would be highly visible whilst foraging despite their burying behavior (Ben Souissi *et al*., 2007; Ball *et al*., 2013).

In addition to being only the second record of complete albinism within the Dasyatidae family, this record represents the second instance of albinism in elasmobranchs inhabiting the Adriatic Sea. Out of the 60 species of sharks and rays reported from the Adriatic (Soldo & Lipej, 2022), complete albinism had only been previously documented in the marble electric ray *Torpedo marmorata* Risso, 1810 (Lipej *et al*., 2011), when juvenile male and female albino specimens were caught by trawl in the northern Adriatic, off Piran.

While the rarity of albinism records in elasmobranchs can partly be explained by their relatively low natural abundance in nature (Bottaro *et al*., 2005), it is more reasonable to conclude that the lack of coloration makes them highly visible while foraging for prey, which is a great disadvantage for these general predators. Furthermore, the absence of iris pigmentation in full albinos is likely linked to poor eyesight. Therefore, it can be expected that albinism, particularly in its full form, will remain rare among this group of predatory fishes.

PRVI ZAPIS O NAJDBI POPOLNEGA ALBINISTIČNEGA PRIMERKA NAVADNEGA MORSKEGA BIČA, *DASYATIS PASTINACA* (LINNAEUS, 1758)

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POVZETEK

V vzhodnem srednjem Jadranu so 15. avgusta 2022 posneli videoposnetek nenavadno obarvanega morskega biča. Na podlagi morfoloških značilnosti so ga določili za navadnega morskega biča Dasyatis pastinaca *(Linnaeus, 1758), primerek pa je bil povsem bel na hrbtni in trebušni strani trupa in repa, le vrhovi bodic niso bili beli. Brez pigmenta je bila tudi šarenica, ki je imela oranžno-rumeno (ksantokromično) obarvanost. Najdba predstavlja prvi evidentirani primer popolnega albinizma pri tej vrsti, ki je obenem tudi redek primer med hrustančnicami nasploh.*

Ključne besede: *Dasyatis pastinaca*, navadni morski bič, albinizem, levizem, Jadransko morje

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CAPTURE OF A GIANT ROUND FANTAIL STINGRAY *TAENIUROPS GRABATUS* (DASYATIDAE) FROM THE ALGERIAN COAST (SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

The authors document the capture of a large specimen of round fantail stingray Taeniurops grabatus *(Geoffroy Saint-Hilaire, 1817) from the coast of Algeria. The individual* T. grabatus *measured 2.90 m in disc width and its total body weight was assessed to 300 kg. The specimen stands as the largest known to date, probably surpassing other dasyatid species and warranting recognition as a giant specimen. Additionally, this capture serves as evidence that Algerian marine waters provide favorable conditions for the species to thrive, with a viable population already successfully established in the region.*

Keywords: Stingray, *Taeniurops grabatus*, population, size, total body weight

CATTURA DI UN GRANDE TRIGONE AFRICANO *TAENIUROPS GRABATUS* (DASYATIDAE) LUNGO LA COSTA ALGERINA (MAR MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

Gli autori documentano la cattura di un grande esemplare di trigone africano Taeniurops grabatus *(Geoffroy Saint-Hilaire, 1817) lungo le coste dell'Algeria. L'individuo di* T. grabatus *in questione misurava 2,90 m di larghezza del disco e il suo peso corporeo totale è stato stimato a 300 kg. L'esemplare è il più grande finora ritrovato e probabilmente supera altre specie di dasiatidi. Viene pertanto riconosciuto come esemplare gigante. Questa cattura serve inoltre come prova del fatto che le acque marine algerine forniscono condizioni favorevoli alla prosperità della specie, con una popolazione vitale già stabilita con successo nella regione.*

Parole chiave: trigone*, Taeniurops grabatus,* popolazione, taglia, peso corporeo totale

INTRODUCTION

The round fantail stingray *Taeniurops grabatus* (Geoffroy Saint-Hilaire, 1817) has been documented along the western African coast from Mauritania to Angola, as well as around the Sào Tiago Island in the Cape Verde archipelago and the Azores (Ben Amor *et al.*, 2019). *T. grabatus* is distributed throughout the southeastern Mediterranean, with reports of its occurrences in Turkish waters (Tunka Bengil & Basusta, 2018), the Levant Basin (Golani, 2005), and the Syrian and Lebanese coasts, which represent the easternmost extension of its range (Ali *et al.*, 2013; Bariche & Fricke, 2020). One isolated case recorded in the north Tyrrhenian Sea was an accidental catch by an artisanal fishing vessel (Serena *et al.*, 1999).

A viable population of *T. grabatus* was initially documented in the Gulf of Gabès, southern Tunisia, by Capapé (1989), but subsequently – probably prompted by interspecific competition pressure from other dasyatid species and the rising temperature of marine waters due to global warming (*sensu* Francour *et al.*, 1994) – the species migrated to the Gulf of Tunis (Boudaya *et al.*, 2018) and further north to the area off the city of Bizerte (Ben Amor *et al.*, 2019). *T. grabatus* also migrated westward, reaching the Algerian coast, where it was recorded for the first time (Capapé *et al.*, 2023). Subsequent observations have corroborated the occurrence of *T. grabatus* in Algerian marine waters, with most of these specimens attaining considerable sizes, including the largest one described in the present paper.

MATERIAL AND METHODS

All *T. grabatus* specimens from Algerian waters were collected in a region located off the eastern coast, between Skikda and Annaba, at 37°10′ N and 7°15′ E (Fig. 1), in the period from 1999 to 2020, and landed at the great fish market of Algiers. The largest specimen, a female captured on 16 April 2016, was measured for disc width (DW), while the fishermen provided an estimate of its total body weight (TBW). Morphometric measurements were not feasible because the specimen was sliced and promptly sold for local consumption.

RESULTS AND DISCUSSION

The specimen under study was identified as *Taeniurops grabatus* following McEachran & Capapé (1984) and Ben Amor *et al.* (2019): disc nearly circular, wider than long; the distal part of the tail was missing, but at its beginning, it appeared to be compressed and with a membranous fold underneath; dorsal surface almost entirely rough, exhibiting several rows of spines extending from the middle of the disc to the beginning of the tail; dorsal surface brown with irregularly arranged dark blotches and vermiculations, belly beige (Fig. 2).

McEachran & Capapé (1984) and Capapé (1989) previously reported that the maximum disc width of *T. grabatus* could reach up to 1 m. However, the specimen described by Ben Amor *et al.* (2019) surpassed this measurement with a disc width of 1.12 m, along with a total length of 2.7 m and

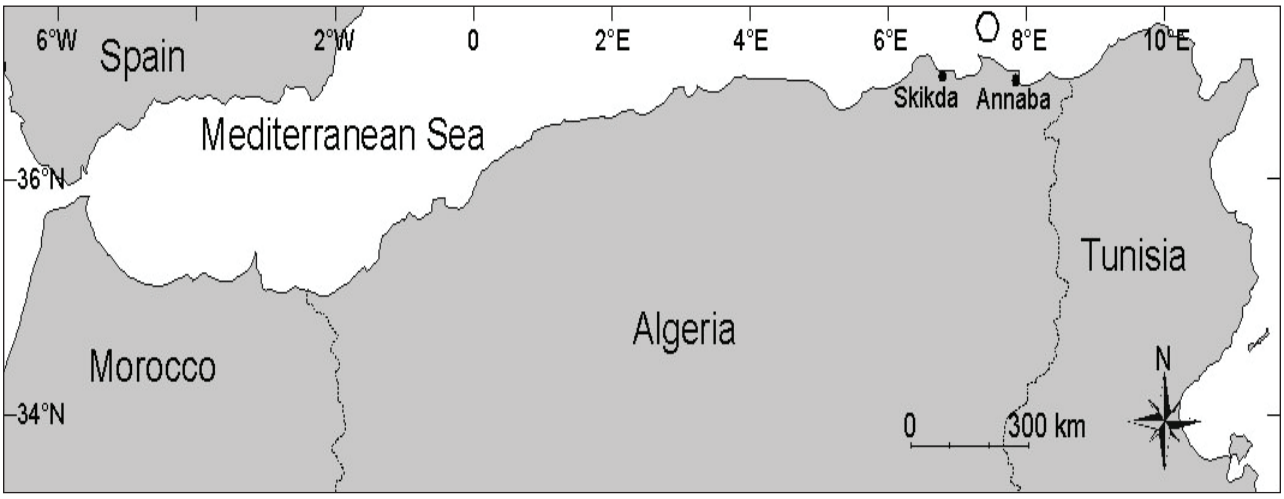

Fig. 1: Map of the Algerian coast, with a circle indicating the area between Skikda and Annaba where the giant female specimen of** Taeniurops grabatus **was caught (adapted from Capapé** et al.**, 2023).
Sl. 1: Zemljevid alžirske obale s krogcem, ki označuje predel med Skikdo and Annabo, kjer je bila ujeta orjaška samica vrste** Taeniurops grabatus **(prirejeno po Capapé** et al.**, 2023).

Fig. 2. Giant female specimen of** Taeniurops grabatus **captured off the Algerian coast, scale bar = 50 cm. Photo by Farid Hemida.
Sl. 2: Orjaška samica vrste** Taeniurops grabatus**, ujeta ob alžirski obali. Merilo = 50 cm. Foto: Farid Hemida.

a total body weight of 110 kg. It was considered the largest and heaviest *T. grabatus* ever recorded in Tunisian waters and possibly across the entire Mediterranean and beyond. In comparison, the present *T. grabatus*, with a disc width of 2.50 m and an estimated total body weight of 300 kg (but possibly more, as its tail was not preserved in its entirety to avoid sting injuries) was larger and heavier than the specimen from Ben Amor *et al*. (2019). Its remarkable size and weight could qualify it as a giant *T. grabatus* and one of the largest dasyatid specimens known to date. The discovery of such a large specimen suggests that *T. grabatus* has found in Algerian marine waters the most favorable conditions for development and possibly reproduction on a global scale. Capapé *et al*. (2023) noted that the occurrence of the species in the region could be a result of migrations from the Tunisian coast, where the species is captured in relative abundance. While this hypothesis is possible, regular observations of specimens and information provided by fishermen indicate that a viable population of *T. grabatus* is now successfully established in the study area.

This discovery also serves as evidence that large elasmobranch species continue to inhabit the Mediterranean Sea; in fact, several instances of such species have been reported from the Maghreb shore for several decades, particularly off the Algerian coast (Hemida *et al.*, 2002; Capapé *et al.*, 2005; Hemida & Capapé, 2008; Hemida *et al.*, 2022). In full agreement with Giovos *et al.* (2019, 2022) and Kabasakal (2021), it is vital to implement a management plan within local fisheries that would involve an active participation of local fishermen, who already play an important role in preserving these species and preventing their possible extinction in areas where they habitually aggregate.

ULOV OKROGLEGA MORSKEGA BIČA (*TAENIUROPS GRABATUS*) (DASYATIDAE) IZ ALŽIRSKE OBALE (JUGOZAHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o ulovu velikega primerka okroglega morskega biča Taeniurops grabatus *(Geoffroy Saint-Hilaire, 1817) iz alžirske obale. Meril je 2,90 m v premeru diska, težo pa so ocenili na 300 kg. Gre za orjaka, saj je do zdaj eden največjih izmerjenih primerkov, verjetno pa tudi eden največjih primerkov iz družine morskih bičev nasploh. Poleg tega ta ulov dokazuje, da alžirske morske vode nudijo ugodne razmere za uspevanje vrste, ki je v tem okolju že ustaljena, njena populacija pa je vitalna in sposobna preživetja.*

Ključne besede: morski bič, *Taeniurops grabatus*, populacija, velikost, telesna teža

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RECENT RECORD OF THE ATLANTIC POMFRET *BRAMA BRAMA* (BONNATERRE, 1788) (SCOMBRIFORMES: BRAMIDAE) IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA)

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ABSTRACT

On 20 June 2023 a specimen of Atlantic pomfret Brama brama *(Bonnaterre, 1788) (Bramidae) was caught by trammel net at 5 m depth in the Gulf of Trieste*. B. brama *is a pelagic neritic oceanodromous species distributed throughout temperate and warm-temperate oceans at depth ranging from 0 to 1,000 m and occasionally coming close to the shore. It is considered a rare species in the eastern Mediterranean and Adriatic Sea. The present record is the most recent in the Gulf of Trieste, after those historical deposited in the Natural History Museum of Trieste*.

Keywords: Atlantic pomfret, *Brama brama*, Gulf of Trieste, northern Adriatic Sea

RECENTE SEGNALAZIONE DEL PESCE CASTAGNA *BRAMA BRAMA* (BONNATERRE, 1788) (SCOMBRIFORMES: BRAMIDAE) NEL GOLFO DI TRIESTE (ALTO ADRIATICO)

SINTESI

Un esemplare di pesce castagna Brama brama *(Bonneterre, 1788) è stato catturato il 20 giugno 2023, con una rete tramaglio alla profondità di 5 metri*. B. brama *è una specie oceanodroma neritico-pelagica distribuita in tutti gli oceani temperati e temperato-caldi a profondità comprese tra 0 e 1.000 m, ma che occasionalmente si avvicina alla costa. Nel Mediterraneo orientale e nell'Adriatico è considerata una specie rara. La presente segnalazione è la più recente per il Golfo di Trieste, dopo quelle storiche depositate nel Museo di Storia naturale di Trieste*.

Parole chiave: pesce castagna, *Brama brama*, Golfo di Trieste, Alto Adriatico

INTRODUCTION

Pomfrets belong to a relatively small family (Bramidae) comprising 7 genera and 22 species of highly migratory, oceanodromous, pelagic, benthopelagic and bathypelagic marine fishes, found in tropical and warm temperate waters of the Atlantic, Indian and Pacific Oceans (Quigley, 2008). The Atlantic pomfret *Brama brama* (Bonnaterre, 1788) is the unique species representing the genus *Brama* in the Mediterranean Sea and its occurrence in this basin is considered rare (Golani *et al*., 2006; Ergüden *et al*., 2019). *B. brama* is a pelagic neritic oceanodromous species found throughout temperate and warm-temperate oceans at depths ranging from 0 to 1,000 m, generally on the continental slope (Bianchi *et al*., 1999), occasionally coming close to the shore (Smith, 1986; Bensahla-Talet, 2020). Being a cosmopolitan and highly migratory species, its geographical distribution is widespread from 65°N to 70°S of latitude and 180°W to 180°E of longitude (Bensahla-Talet, 2020). In the eastern Atlantic it occurs from central Norway to Algoa Bay in South Africa. *B. brama* is considered a valuable by-catch resource of semi-industrial fishing, purse seines, trawls, gillnets, but it becomes a seasonal target only for the semi-pelagic longlines in Galicia (North western Spain), Portugal and off North West Africa (Quinzán *et al*., 2016). It is also occasionally caught in the western Mediterranean (Bensahla-Talet, 2020). The species is classified as Least Concern in the IUCN Red List (Bensahla-Talet, 2020). On regard the Mediterranean Sea, this species reaches some economic importance in the Strait of Gibraltar and in the Ligurian Sea (Lobo & Erzini, 2001; Czerwinski *et al*., 2008), but it is rare in the eastern Mediterranean (Golani *et al*., 2006; Corsini-Foka, 2009; Mytilineou *et al*., 2013; Bo *et al*., 2020). Perugia (1866) included this species in his catalogue of Adriatic fishes, while Stossich (1876) described it as rare in the eastern Adriatic (then identified as *Brama rayi* Bloch). Later, Jardas (1996) considered it fairly rare in the Adriatic Sea. The last official record in the Adriatic dates back to 2002, when a specimen was caught with a bottom trawl in the central Adriatic (Dulčić *et al*., 2003). The present paper represents the most recent record of this species for the Gulf of Trieste, the northernmost area of the Adriatic Sea and also the Mediterranean.

MATERIAL AND METHODS

A specimen of *Brama brama* was caught on 20 June 2023 by a trammel net targeting cuttlefish. The capture site was located close to Grado (45° 41′ 35″ N; 013° 17′ 43″ E) (Fig. 1) at 5 m depth on a *Cymodocea nodosa* meadow. The fisherman photographed the specimen with a smartphone (Fig. 2), weighed it and sold at the Marano Lagunare fish market and therefore it was not possible to obtain the main morphometric data. The species identification was based on Bensahla-Talet (2020), who gave

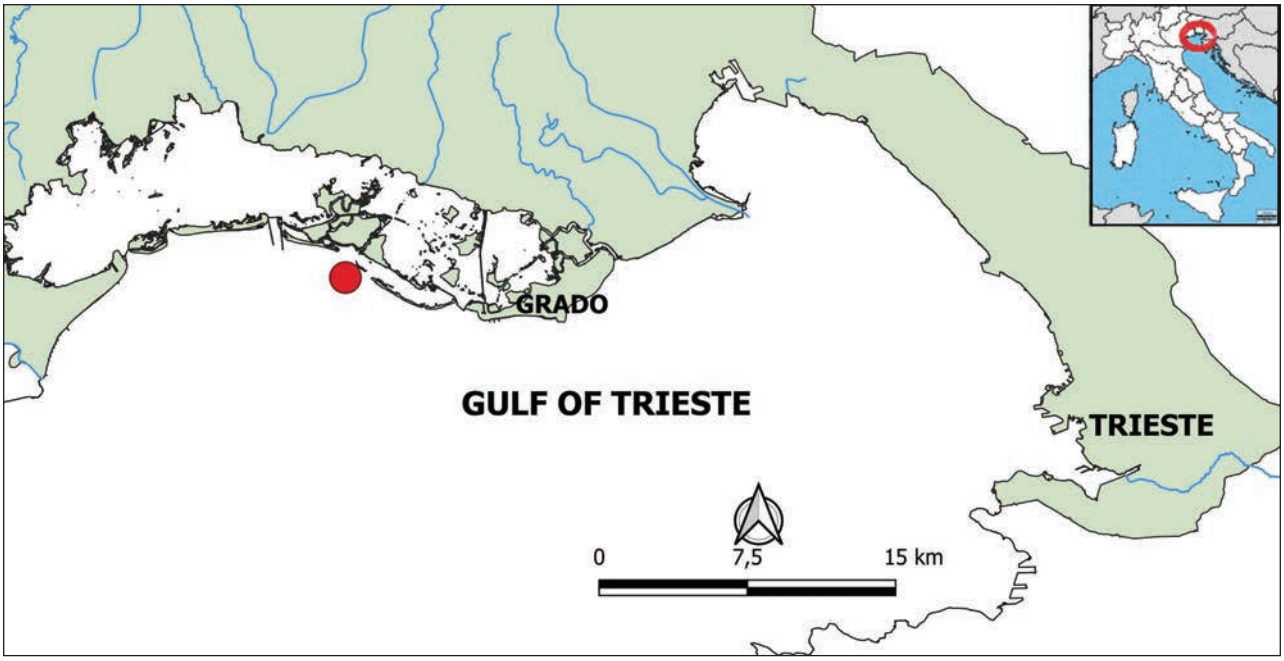

Fig. 1: Map of the recent record of** B. brama **in the Gulf of Trieste (northern Adriatic Sea).
Sl. 1: Zemljevid najnovejšega primera pojavljanja vrste** B. brama **v Tržaškem zalivu (severni Jadran).

Fig. 2: Lateral view of the body without the caudal fin of the** Brama brama **specimen caught in the Gulf of Trieste on 20 June 2023; scale bar = 10 cm (Photo: M. Regeni).
Sl. 2: Pogled s strani na primerek kostanjevke brez repne plavuti, ujete 20. junija 2023 v Tržaškem zalivu. Merilo = 10 cm (Foto: M. Regeni).

the following morphological description according to Haedrich (1986) and Gomes (1990): moderate body height and somewhat compressed; head very compressed with a very convex dorsal profile; very rounded interorbital space; large sloping mouth; wide and scaly upper jaw extending at least to the centre of the eye; lower edge of the mandibles in close contact on the ventral median line behind the symphysis, with the isthmus between them not visible; pectoral fins extending beyond the lobe of the anal fin; pelvic fin inserted below the base of the pectoral fins or slightly further back and surmounted by a large axillary scale; lateral line barely visible in adults; smooth scales, with uneven edges, covering the head, the body and extending to the anal fins; coloration characterized by a silvery black, anal fins slightly lighter.

RESULTS AND DISCUSSION

The total weight (TW) of the specimen was about 700 g, while the total length (TL) was estimated between 400 and 450 mm. The commercial catches of Atlantic pomfrets off the coast of Morocco and Mauritania consisted mainly of large adult fish, with a TL between 400 and 480 mm (Gulyugin & Maslyankin, 2019). The maximum TL of *B. brama* was reported to be 1,000 mm in the waters of Cuba, the published maximum weight was 6,000 g (Claro, 1994), while longevity was estimated to be at least 25 years (Paul *et al*., 2004). The largest specimen in the Mediterranean was recorded in the Greek waters of the Aegean Sea, with 710 mm TL and 5,696 g TW (Akyol & Ulaş, 2019). The specimens analyzed by Ergüden *et al*. (2019) in the eastern

Mediterranean (Turkey) were caught at a depth of around 35 m, with TL ranging from 211 to 342 mm and TW from 103.14 to 401.44 g, while the single specimen analyzed by Bensahla-Talet (2020) from the western Mediterranean (Algeria) had a TL of 850.53 mm. On regard the Adriatic Sea, Dulčić *et al*. (2003) recorded one specimen in 2002, caught by bottom trawl in the Pomo Pit, at about 150 m depth (TL=406.2 mm and TW=644.2 g). Earlier records in the eastern Adriatic were reported in local newspapers (1980, 1981 and 1982 near Rijeka, Croatia), while another record appeared in 1984 in the Kaštela Bay-Split area with a TL=457 mm (Pallaoro & Jardas, 1996). Finally, it is noteworthy that for the first time two larval stages were recorded at a depth of 22 m (Neretva estuary, Croatia) (TL=4.36 mm and TL=5.00 mm) (Dulčić, 1999). One specimen is deposited in the Ichthyological Collection of the Natural History Museum in Rijeka, but without data (Kovačić, 1998). Seven specimens are deposited in the Civic Museum of Natural History of Trieste: the only two specimens with documented location in the Gulf of Trieste were caught in 1906 (Ic-1539) and on 18 September 1930 (Ic-1540) (Tomasin & Bressi, pers. comm.).

The Atlantic pomfret is a seasonal migrant occurring in small schools and its movements seems to be temperature related (Jardas, 1996). *B. brama* feeds opportunistically on small fishes, cephalopods, amphipods and euphausiids (Haedrich, 1986). The spawning period is generally comprised between July and October in the eastern Atlantic (Gulyugin & Maslyankin, 2019), with the spawning area located in the tropical waters and the feeding grounds in the northern areas of the ocean (Quinzán *et al*., 2016). *B. brama* reaches sexual maturity at a TL >300 mm, which corresponds to the 3rd year of life (Lobo & Erzini, 2001). On this basis, Gulyugin & Maslyankin (2019) aged the specimens with a TL between 400-480 mm to 5-9 years.

Dulčić *et al*. (2003) still considered *B. brama* a rare species in the Adriatic Sea and, to our knowledge, the specimen caught near Grado represents the most recent record in the Gulf of Trieste. It is also interesting that this adult specimen was caught at a very shallow depth (5 m), as this species is more characteristic of deeper areas.

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RECENTNI ZAPIS O POJAVLJANJU KOSTANJEVKE *BRAMA BRAMA* (BONNATERRE, 1788) (SCOMBRIFORMES: BRAMIDAE) V TRŽAŠKEM ZALIVU (SEVERNO JADRANSKO MORJE)

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POVZETEK

Dvajsetega junija 2023 so ribiči v trislojno mrežo ujeli primerek kostanjevke Brama brama *(Bonnaterre, 1788) (Bramidae) na 5 m globine v Tržaškem zalivu.* B. brama *je pelaška neritična oceanodromna vrsta, ki se pojavlja povsod v zmernih in toplih morjih v globinskem razponu med 0 in 1000 m globine, občasno pa se približa obali. V vzhodnem Sredozemskem morju in Jadranskem morju jo smatrajo za redko vrsto. Pričujoči zapis je najnovejši v Tržaškem zalivu, so pa znani zgodovinski zapisi, katerih primerki so shranjeni v Tržaškem prirodoslovnem muzeju.*

Ključne besede: kostanjevka, *Brama brama*, Tržaški zaliv, severni Jadran

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THE CONFIRMED OCCURRENCE OF *SCHEDOPHILUS MEDUSOPHAGUS* (COCCO, 1839) AND *PETROMYZON MARINUS* LINNAEUS, 1758 IN MALTESE WATERS, CENTRAL MEDITERRANEAN SEA

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ABSTRACT

Specimens of two uncommon fish species, Schedophilus medusophagus *and* Petromyzon marinus*, were recently collected in nearshore waters off the island of Malta in the central Mediterranean. Several morphological and biological parameters for the specimens are described. The findings ascertain the occurrence of the two species in the area and corroborate furthermore the substantial contribution to wildlife sightings made through social media and by citizen scientists, thus further increasing knowledge on Mediterranean biodiversity.*

Keywords: Centrolophidae, Petromyzontidae, Malta, Mediterranean Sea, citizen science

PRESENZA CONFERMATA DI *SCHEDOPHILUS MEDUSOPHAGUS* (COCCO, 1839) E *PETROMYZON MARINUS* LINNAEUS, 1758 NELLE ACQUE MALTESI, MEDITERRANEO CENTRALE

SINTESI

Esemplari di due specie di pesci non comuni, Schedophilus medusophagus *e* Petromyzon marinus*, sono stati recentemente raccolti nelle acque dell'isola di Malta nel Mediterraneo centrale. Alcuni parametri morfologici e biologici degli esemplari sono descritti. I ritrovamenti accertano la presenza di queste due specie nell'area, corroborando inoltre l'importante contributo che i social media e i citizen scientists danno per quanto concerne le osservazioni in natura e quindi per un ulteriore incremento della conoscenza della biodiversità del Mediterraneo.*

Parole chiave: Centrolophidae, Petromyzontidae, Malta, Mediterraneo, citizen science

INTRODUCTION

In the Mediterranean Sea, four species of the family Centrolophidae are known: *Hyperoglyphe perciformis* (Mitchill, 1818), *Centrolophus niger* (Gmelin, 1789), *Schedophilus ovalis* (Cuvier, 1833) and *Schedophilus medusophagus* (Cocco, 1839) (Kovačić *et al*., 2021). According to Borg *et al*. (2023), in the waters around the Maltese archipelago, the occurrence of *C. niger* and *S. ovalis* is well documented, while the presence of *S. medusophagus* requires confirmation.

In the same basin, two species of Petromyzontidae occur, *Lampetra fluviatilis* (Linnaeus, 1758) and *Petromyzon marinus* Linnaeus, 1758, of which only the latter species has been previously reported from the Maltese Islands (Borg *et al*., 2023).

Through the cooperation with citizen scientists, individuals of *S. medusophagus* and *P. marinus* were collected from Maltese waters. The main morphological features and meristic characters of the individuals were described. The present note confirms the occurrence of both species in Maltese waters and adds knowledge on the characteristic fish diversity in this area of the central Mediterranean Sea.

MATERIAL AND METHODS

On 10 February 2023, a slowly-swimming individual of *S. medusophagus* was scooped by a fisher from the surface at Pieta yacht marina, island of Malta (coordinates 35°53'38.21"N, 14°29'52.49"E), by means of a handnet.

On 23 March 2023, a dead individual of *P. marinus* was observed stranded on the beach, after a severe storm, at Fomm ir-Rih, along the north-west coast of the island of Malta (35°54'24.17"N; 14°20'27.90"E); the individual was collected by an angler.

Both fishes were unusual to those who collected them, such that they immediately contacted one of the authors (A.D.) through the "Spot the Alien Fish" citizen science platform on Facebook (https://www.facebook.com/aliensmalta), a campaign implemented since 2017 within the Department of Geosciences at the University of Malta.

The samples of *S. medusophagus* and *P. marinus* are currently preserved in the collection of the Department of Geosciences at the University of Malta under the catalogue numbers OMRG/GS/01/2023 and OMRG/GS/02/2023, respectively.

Abbreviations used: Total length, TL; Standard length, SL; Head length, HL.

Fig. 1: The de-frozen specimen of** Schedophilus medusophagus **collected in Malta in 2023 (scale bar = 10 cm). [Detail: freshly caught specimen].
Sl. 1: Odmrznjen primerek meduzojedca** (Schedophilus medusophagus**), ujetega na Malti v letu 2023 (merilo = 10 cm). [Detajl: sveže ujeti primerek].

RESULTS

Schedophilus medusophagus (Cocco, 1839)

The specimen was a juvenile with TL 145 mm and weight 39.3 g. Brief description (Fig. 1): body compressed and high; a single long dorsal fin, its origin before pectoral fin origin; snout short, slightly less than eye diameter; pectoral and pelvic fins inserted at the same level; caudal fin bilobate; lateral line relatively curved anteriorly, over the operculum and the pectoral fin. Dorsal fin rays III+46; Anal fin spines plus soft rays 32; Pectoral fin rays 19; Ventral fin rays 5; Caudal fin rays 22; gill rakers 11+1+6 on first gill arch; 15 spines on preoperculum. Body depth 47, head length 28.3, predorsal 25.4, preventral 31, preanal 54.6, all as % of SL; caudal peduncle length 52.2, eye diameter 21.6, preorbital distance 18.8, postorbital 59.1, all as % of HL (Tab. 1). Colour of fresh and de-frozen specimen were similar: background of body light blue; irregular darker grey patches and wavy horizontal stripes on sides, some patches extending at the base of dorsal and anal fins; pectoral and pelvic fins dark; a continuous dark stripe at the middle of the dorsal and anal fins (Fig. 1).

Petromyzon marinus (Linnaeus, 1758)

The lamprey was an adult with TL 505 mm and weight 360 g. Main morphological characters: body anguilliform, two dorsal fins in the posterior half of the body (Fig. 2A), the base of the first 65 mm long, the base of the second 142 mm; eye length 5.9 mm. Six branchial openings on the left side (Fig. 2B), seven on the right; branchial length 48 mm; interbranchial opening distance 10.3 mm. Oral disc (Fig. 2C): length 38.5 mm; teeth on concentric series; one bicuspid supraoral tooth, 4 endolateral bicuspid teeth on each side, bilobed lingual teeth, infraoral lamina with 8 unicuspid teeth. Colour: body mottled black dorsally and laterally, in a marbled pattern and uniformly pale ventrally.

Tab. 1: Morphometric measurements (mm) of the** Schedophilus medusophagus **specimen from Malta.
Tab. 1: Morfometrične meritve (v mm) primerka meduzojedca (**Schedophilus medusophagus**) iz Malte.

Measurements	mm
Total length (TL)	145
Standard length (SL)	113
Maximum body depth	53
Minimum body depth	10.8
Caudal peduncle length	16.7
Head length (HL)	32
Eye diameter	6.9
Preorbital distance	6
Postorbital distance	18.9
Interorbital distance	12.6
Dorsal fin base length	88.1
Anal fin base length	42
Pectoral fin length	24
Ventral fin length	23.8
Predorsal length	28.7
Preventral length	35
Preanal length	61.7
Maximum height of dorsal fin	24.4
Maximum height of anal fin	14.8

DISCUSSION

The morphological and meristic characters as well as the colour of the Centrolophidae specimen under study were in full agreement with the description of *S. medusophagus* given by Tortonese (1959), Heidrich (1986), Fahay (2007) and Milana *et al.* (2011). Our specimen differed from its close relative *S. ovalis* by virtue of its soft and limp body (rigid and firm in *S. ovalis*) and based on differences in the dorsal fin count: *S. ovalis* is generally characterized by 30-32 rays in its dorsal fins, whilst our specimen displayed 46 dorsal fin rays (Heidrich, 1986; Rafrafi-Nouira *et al.*, 2015a).

The Cornish blackfish *S. medusophagus* is a mesopelagic fish encountered in the temperate waters of the north Atlantic and the Mediterranean, prevalently within the western half of the basin, but also in the Adriatic Sea and in the central Mediterranean, such as in Tunisia and within the Strait of Sicily (Bauchot, 1987; Dulčić, 1998; Dulčić & Lipej, 2002; Bradai *et al.*, 2004; Bañón *et al.*, 2012; Battaglia *et al.*, 2014; Rafrafi-Nouira *et al.*, 2015a; Hattour & Koched, 2017; Kovačić *et al.*, 2020). Up to date, no records of the species are documented in the eastern side of the basin (Golani *et al.*, 2006; Bilecenoğlu *et al.*, 2014; Akel & Karachle, 2017; Ali, 2018; Bariche & Fricke, 2020; Golani, 2021) and its presence in Hellenic waters is considered

Fig. 2: The whole de-frozen specimen of** Petromyzon marinus **collected in Malta in 2023 (A), the abnormal six gill openings in the left side (B) (scale bars in A and B= 10 cm) and the oral disc, 38.5 mm in length (C).
Sl. 2: V celoti odmrznjen primerek morskega piškurja (**Petromyzon marinus**), ujetega na Malti v 2023 (A), nenavadnih šest škržnih rež na levi strani (B) (merilo za A in B = 10 cm) in oralni disk, 38,5 mm v dolžino (C).

questionable (Papaconstantinou, 2014). It reaches a maximum TL of 50 cm; adult specimens are mainly found at 300-900 m of depth. Juveniles are usually detected at the surface, as in the present case, frequently associated with jellyfish (Haedrich, 1986; Bauchot, 1987), especially *Pelagia noctiluca* (family Pelagiidae), that constitute the main food source for adults and juveniles of this species (Garibaldi *et al*., 2010; Battaglia *et al*., 2014).

In March and May 2022, during a bloom of *Pelagia noctiluca*, unknown centrolophids, possibly *S. medusophagus*, were repeatedly observed in the surface waters around the Maltese Islands, and photos were submitted to the above-mentioned Maltese platform (cf. Deidun *et al*., 2022), but samples were not retained. The Cornish blackfish *S. medusophagus* and the Imperial blackfish *S. ovalis* may be sometimes confused with each other, especially at juvenile stage, or may be confused with species of other families (see Nour *et al*., 2022; Borg *et al*., 2023). In the case reported in the present study, the availability of a sample allowed the authors to ascertain the identity of the same as belonging to *S. medusophagus* and to confirm the occurrence of the species in Maltese waters. Therefore, *S. medusophagus* can be added to the list of 349 bony fish species that are to date confirmed as occurring in the same waters (Borg *et al*., 2023).

The morphological characters, dentition, and other associated structures of the oral disc, as well as the colour of the lamprey under study fully agreed with the description of *L. marinus* given by Bauchot (1987) and Renaud (2011). The latter cited literature and the work by Maitland (1972) allowed us to discard *L. fluviatilis* when identifying the specimen, by virtue of the marbled dark pattern on its back and along the sides (uniform colour pattern in *L. fluviatilis*), the occurrence of closely-packed teeth in radiating rows on the oral disc (teeth are widely-spaced in *L. fluviatilis*) as well as the occurrence of two large teeth in the supra-oral dental plate (one small tooth at most in *L. fluviatilis*). The number of branchial openings, six instead of seven on the left side of the body, was probably a morphological aberration. Six branchial openings on one side, generally on the left, as well as multiple tails, have been observed in rare cases in lampreys (Renaud, 2011;

Hume *et al*., 2014). It is to be noted that in the *P. marinus* specimen from Syria reported in Saad *et al*. (2021), the first dorsal fin appears positioned in the anterior half of the body, while in the Petromyzontidae both dorsal fins are usually positioned in the posterior half. This could perhaps be another type of morphological abnormality in lampreys, although, to our knowledge, this is as yet unreported in the literature.

The sea lamprey *P. marinus* occurs at depths ranging between 1 m and 4000 m, in the marine, freshwater and brackish waters of the north Atlantic Ocean, the western and central Mediterranean Sea and in the Adriatic (Catalano *et al*., 1997; Renaud, 2011; Milana *et al*., 2011; Karachle & Machias, 2014; Rafrafi-Nouira *et al*., 2015b; Tutman *et al*., 2020; Giglio & Sperone, 2021; Froese & Pauly, 2023; Antognazza *et al*., 2023). Scattered records of the species have also been reported from the eastern Ionian Sea (Karachle & Machias, 2014), the north Aegean (Economidis *et al*., 1999; Papaconstantinou, 2014) and the southeastern Aegean Sea (Filiz *et al*., 2012), as well as from the Levantine Sea waters of Turkey and Syria (Çevik *et al*., 2010; Saad *et al*., 2021).

Sea lampreys are parasitic on sharks, large bony fishes and marine mammals. The sample studied here probably has lost its host during the mentioned storm, and after death it was washed up on the beach.

The sea lamprey has been historically reported in coastal waters of the Maltese archipelago, but there are no recent records (Borg *et al*., 2023), suggesting that this species is uncommon. In the Tunisian coasts, close to the Maltese Islands, the species is recorded as an occasional visitor, and it is not considered to have established viable populations (Rafrafi-Nouira *et al*., 2015b). The finding described in the present study indicates that *P. marinus* occasionally occurs in the wider area around the Maltese islands. Nevertheless, it is difficult to ascertain if there is a viable population of this anadromous species established within Maltese waters given the non-retrieval of live individuals but only of a stranded one; in addition, along the Maltese coastline, there is a lack of freshwater systems suitable for its reproduction in the area.

The GBIF database was consulted on the 24th of August 2023 and, although several Mediterranean Atlantic findings exist within the database for both *S. medusophagus* and for *P. marinus*, no specimens of these species are listed for Maltese waters.

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POTRJENO POJAVLJANJE MEDUZOJEDCA, *SCHEDOPHILUS MEDUSOPHAGUS* (COCCO, 1839), IN MORSKEGA PIŠKURJA, *PETROMYZON MARINUS* LINNAEUS, 1758, V MALTEŠKIH VODAH, OSREDNJE SREDOZEMSKO MORJE

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POVZETEK

*V malteških vodah osrednjega Sredozemskega morja so avtorji pred kratkim ulovili primerke dveh manj pogostih vrst, meduzojedca (*Schedophilus medusophagus*) in morskega piškurja (*Petromyzon marinus*). Opisujejo številne morfološke in biološke parametre primerkov. Ugotovitve dokazujejo pojavljanje obeh vrst na obravnavanem območju in potrjujejo pomemben prispevek socialnih medijev in ljubiteljske znanosti, s čimer se dodatno povečuje poznavanje o biotski raznovrstnosti Sredozemskega morja.*

Ključne besede: Centrolophidae, Petromyzontidae, Malta, Sredozemsko morje, ljubiteljska znanost

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AN OVERLOOKED FINDING OF *MOLA ALEXANDRINI* (RANZANI, 1839) IN THE ADRIATIC SEA

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ABSTRACT

The identity of a large sunfish, stranded in 1999 on a beach of the north-western Adriatic Sea, has been shifted from Mola mola *(Linnaeus, 1758) to* Mola alexandrini *(Ranzani, 1839), considering the recent taxonomic revision of the family Molidae. The faithful fiberglass model of the specimen is displayed at the Museo Civico di Storia Naturale di Comiso, Ragusa, Italy. The record of the species is the second one ascertained in the Adriatic Sea and one of the few records of the Bumphead sunfish documented to date in the Mediterranean Sea.*

Keywords: Molidae, *Mola mola*, *Mola alexandrini*, Mediterranean Sea

UN RITROVAMENTO SOTTOVALUTATO DI *MOLA ALEXANDRINI* (RANZANI, 1839) NEL MAR ADRIATICO

SINTESI

L'identità di un pesce luna di notevoli dimensioni, spiaggiato nel 1999 su un litorale del mar Adriatico nord-occidentale, è stata corretta da Mola mola *(Linnaeus, 1758) a* Mola alexandrini *(Ranzani, 1839), tenendo in considerazione le recenti revisioni tassonomiche della famiglia Molidae. Il modello in fibra di vetro che riproduce fedelmente l'esemplare è esposto al Museo Civico di Storia Naturale di Comiso, Ragusa, Italia. La segnalazione della specie è la seconda accertata nell'Adriatico e una delle poche documentate finora nel Mediterraneo.*

Parole chiave: Molidae, *Mola mola*, *Mola alexandrini*, Mediterraneo

INTRODUCTION

Recent comprehensive reviews, based on morphological and molecular studies, ascertain three valid species in the genus *Mola* (Tetraodontiformes: Molidae): *Mola alexandrini* (Ranzani, 1839), *Mola mola* (Linnaeus, 1758) and *Mola tecta* Nyegaard *et al*. 2017, with *M. alexandrini* senior synonym of *Mola ramsayi* (Giglioli, 1883) (Nyegaard *et al*., 2018a,b; Sawai *et al*., 2018; Froese & Pauly, 2023; WoRMS Editorial Board, 2023). The Bumphead sunfish *M. alexandrini* was described for the first time as *Orthragoriscus alexandrini* by Ranzani (1839), based on a specimen collected from the Adriatic Sea. According to Sawai *et al*. (2018), the holotype of *M. alexandrini* is the old specimen preserved and displayed at the Museo di Zoologia dell'Università di Bologna (MZUB), Italy. The so-called rediscovery of *M. alexandrini* and the existence of the holotype of the species at the MZUB is nevertheless confuted by Britz (2022).

For a long time, *M. alexandrini* was regarded as a junior synonym of *M. mola* all over the world oceans (Sawai *et al*., 2018). Therefore, *M. alexandrini* was not included in the Mediterranean fish diversity (Bauchot, 1987; Quignard & Tomasini, 2000; Psomadakis *et al*., 2012), as well as in the regional fish checklists, where only *M. mola* was reported (Bradaï *et al*., 2004; Relini & Lanteri, 2010; Papaconstantinou, 2014; Bilecenoğlu *et al*., 2014; Akel & Karachle, 2017; Béarez *et al*., 2017; Ali, 2018; Báez *et al*., 2019; Bariche & Fricke, 2020; Kovačić *et al*., 2020; Golani, 2021; Borg *et al*., 2023). Due to the above mentioned taxonomic researches and clarifications, *M. alexandrini* is presently listed as a component of the fish diversity of the Mediterranean basin (Kovačić *et al*., 2021).

Our brief note documents the second ascertained occurrence of *M. alexandrini* in the Adriatic waters. Morphological characters and measurements of the fish are presented.

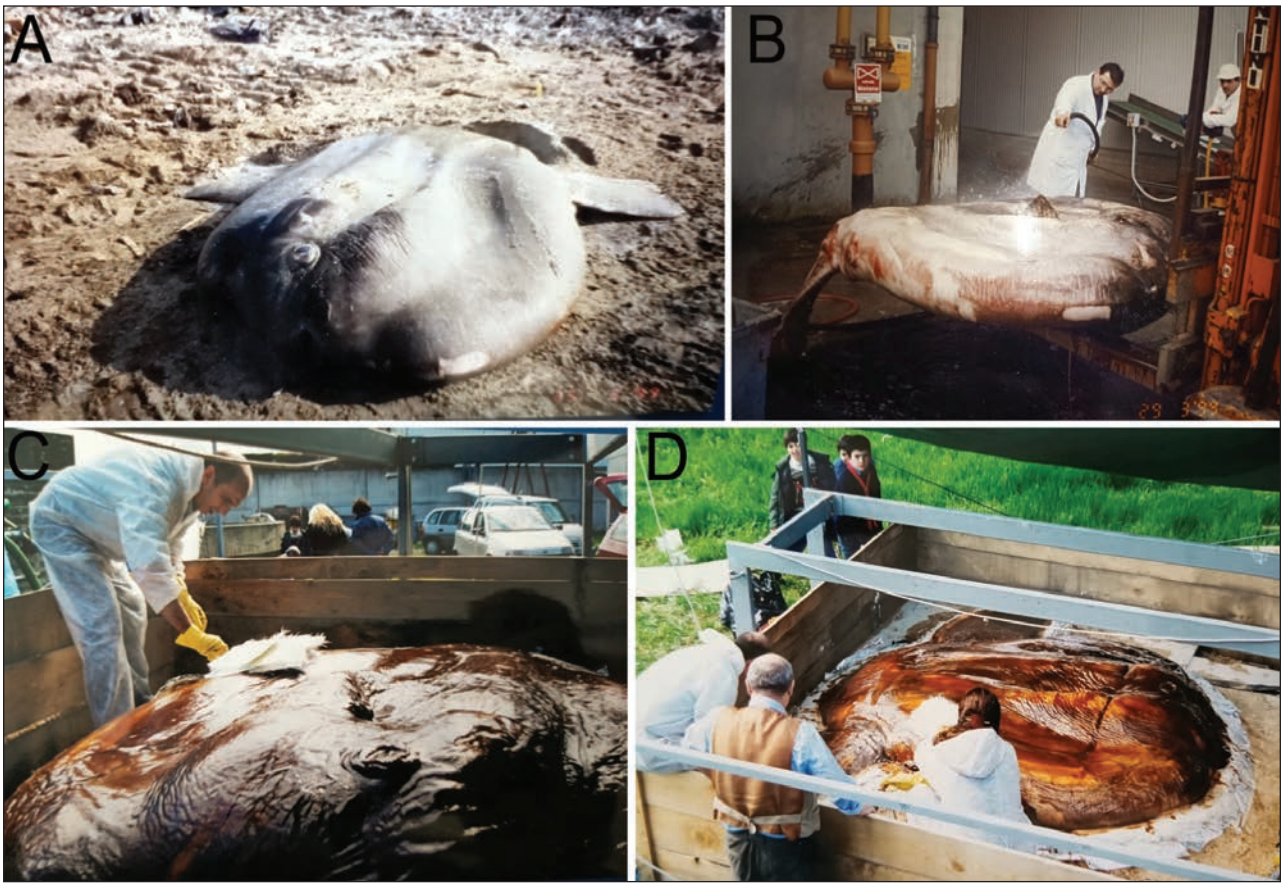

Fig. 1: The specimen of** Mola alexandrini **stranded at Cervia, Italy, in 1999 (A), its cleaning and weighing (B) and steps of the plaster mould preparation (C, D) (Photos: Archives MSNC).
Sl. 1: Nasedli primerek vrste** Mola alexandrini **iz Cervie (Italija) iz leta 1999 (A), njegovo čiščenje in tehtanje (B) in nadaljnji koraki za pripravo mavčnega kalupa (C, D) (Fotografije: arhiv MSNC).

MATERIAL AND METHODS

A large sunfish was found stranded on the beach of Cervia, Ravenna, Italy (north-western Adriatic Sea), on 24 March 1999 (44°15'30.22"N, 12°21'46.61"E). The regional scientific community was alerted and the staff of the Museo Civico di Scienze Naturali di Faenza, Ravenna, immediately activated, under the technical coordination of one of the authors (G.G.) of the Agenzia Regionale Prevenzione e Ambiente dell'Emilia Romagna (ARPA). The stranded fish (Fig. 1A) was photographed, weighed (Fig. 1B) and some measurements were taken grossly. At field, a plaster mould of the whole fresh fish was accurately done by an expert taxidermist (Figs. 1C, 1D). Anatomical samples of the specimen (one eye, a piece of gill, heart and brain) were preserved before the final disposing of the fish. A fiberglass model reproducing faithfully the body shape, size, color and details of the original specimen, was later produced. Initially the model was displayed at the Museo Civico di Storia Naturale di Faenza. In 2019 the model was acquired by the Museo Civico di Storia Naturale di Comiso (MSNC), Ragusa, Italy, for public display (Catalogue number MSNC 4504) (Fig. 2). Also, the above anatomical samples are stored.

The specimen was identfied following Nyegaard *et al*. (2018a) and Sawai *et al*. (2018)

RESULTS

The large sunfish (Fig. 1A) was an adult male with a weight of 900 kg obtained by a platform scale (Fig. 1B). The specimen (Figs. 1 and 2) shows the following main characteristics: body deep and laterally compressed, head bump from above eyes to front of dorsal-fin base, bumped chin, small mouth and eyes, small and oval gill openings, located in front of pectoral fins, pectoral fins small and rounded, dorsal fin located opposite anal fin, and both with straight anterior and curved posterior margin, a rounded unlobed clavus, a band at base of clavus between dorsal and anal fins, lateral ridges from head, above and below eyes, to beyond pectoral fins. Measurements were taken according to Yoshita *et al*. (2009) from the model (Fig. 2) and they are given as absolute values and as % of total length (TL), in parenthesis: total length 226 cm, head bump length 36.9 cm (16.3 %), pre-clavus band length 186 cm (82.3 %), body depth 138 cm (61.1 %), total body depth 269 cm (119 %). Approximate number of rays obtained from the model: Pectoral fin rays 10-11, Dorsal fin rays 16, Anal fin rays 15, clavus rays 16. Colour of the stranded specimen (Fig. 1A): gray dorsally and along the ridges, dusky white ventrally and between the ridges, all fins gray, irregular pale patches over the body. Colour of the fiberglass model (Fig. 2): grayish dorsally and along the ridges, creamy-gray ventrally and between the ridges, all fins grayish, many large or small paler spots and irregular pattern over the body.

DISCUSSION

According to Sawai *et al*. (2018), the main characters to distinguish *M. alexandrini* from *M. mola* are: the head profile with bump, the chin with bump, the body scales rectangular and the rounded unlobed clavus with an average of 17 fin rays (14-24) and 12 ossicles (8-15) on the rear margin. It is to be remarked that among these characters, the bump on the head may be not considered as a distinctive character of *M. alexandrini*, since apparently Eastern Atlantic *M. mola* can have a bump on the head similar to *M. alexandrini*, as underlined by Wirtz & Biscoito (2019).

The sample reported in the present study was initially identified as an Ocean sunfish *Mola mola*, following the literature existing in the past (*e.g.*, Tortonese, 1986; Bauchot, 1987). Recently, the sample was re-examined and, on the basis of the body features, morphological characters and proportions and colour described above, its identification was corrected and assigned to an adult of the Bumphead sunfish *M. alexandrini*, according to Nyegaard *et al*. (2018a) and Sawai *et al*. (2018). The results of fin rays' counts, although not completely reliable because they were recorded from the model, appear included in the ranges reported for *M. alexandrini* by Sawai *et al*. (2018). The weight of 900 Kg given for the TL of our specimen (226 cm) exceeded the weight of 730 kg obtained from the length-weight relationship of *M. alexandrini* by Sawai & Nyegaard (2022).

The recent comprehensive taxonomic reviews of Molidae (Nyegaard *et al*., 2018a; Sawai *et al*., 2018) allowed reexamining the distribution of *Mola* spp. all over the world as well as the reassignment of sunfish specimens identity preserved in museum collections and the reassessment of data on catches and their biological characteristics in Southwest Pacific (Nyegaard & Sawai, 2018; Nyegaard *et al*., 2018b; Sawai *et al*., 2018). The above studies revealed that the pelagic-oceanic fish *M. alexandrini* is a circumglobal taxon, widely distributed in the world oceans of both hemispheres, except for the polar regions, and can reach a maximum TL of 330 cm (Sawai *et al*., 2018; Sawai & Nyegaard, 2022). The Bumphead sunfish *M. alexandrini* is to date the bony fish holding the world's primacy in weight: 2744 kg, for a specimen 325 cm of TL caught in 2021 in the oceanic archipelago of the Azores,

Fig. 2: The fiberglass model of** Mola alexandrini **realized by Ermano Bianchi and displayed at the Museo Civico di Storia Naturale di Comiso (MSNC). (Photo: Archives MSNC).
Sl. 2: Model, ki ga je izdelal Ermano Bianchi iz steklenih vlaken in je prikazan v prirodoslovnem muzeju v Comisu (MSNC) (Foto: Arhiv MSNC).

mid-north-east Atlantic, Portugal (Gomes-Pereira *et al.*, 2022).

According to the IUCN Red List of threatened species, the Ocean sunfish *M. mola* is assessed as a Vulnerable species at global level (Liu *et al.*, 2015), and as Data Deficient at European level (Rijnsdorp & Papakonstantinou, 2015).

In addition to the works of Nyegaard & Sawai (2018), Sawai *et al.* (2018), Sawai & Nyegaard (2022), Nyegaard *et al.* (2018a,b), further revisions of *Mola* specimens preserved in museum collections as well as an accurate examination of published *Mola* findings and of old and recent available photographic material and/or underwater videos of sunfishes all over the world (cf. Wirtz & Biscoito, 2019; Pedersen *et al.*, 2022, 2023), will probably lead to the identification as *M. alexandrini* other sunfish specimens previously assigned to *M. mola*. This will improve knowledge on the global distribution of the Bumphead sunfish, including the Mediterranean Sea and, in parallel with the re-elaboration of data on sunfish catches and

strandings, will contribute to assess the status of both species populations.

In the Mediterranean Sea, ascertained records of *M. alexandrini* are the oldest one from the Adriatic Sea (Ranzani, 1839) and more recently those from Turkey, Spain, Libya, and Malta (Ahuir-Baraja *et al.*, 2017; Nyegaard *et al.*, 2018a; Sawai *et al.*, 2018). The finding of *M. alexandrini* described in the present study appears therefore the second confirmed record for the Adriatic Sea and could indicate that this species is a permanent inhabitant of this basin, although uncommon, as its sympatric *M. mola* (Dulčić *et al.*, 2007; Lipej *et al.* 2007; Pastore, 2009). Considering the above cited taxonomic revisions of Molidae, other sunfishes detected in the past in the Adriatic Sea and identified as *M. mola*, could be probably assigned to *M. alexandrini*, as in our case.

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SPREGLEDANA NAJDBA VRSTE *MOLA ALEXANDRINI* (RANZANI, 1839) V JADRANSKEM MORJU

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POVZETEK

Avtorji so na podlagi recentne taksonomske revizije družine Molidae razrešili identiteto velikega morskega meseca, ki ga je 1999 naplavilo na obalo plaže v severozahodnem Jadranu, za katerega se je izkazalo, da gre za vrsto Mola alexandrini *(Ranzani, 1839) in ne za vrsto* Mola mola *(Linnaeus, 1758). Izdelan model tega primerka iz steklenih vlaken je shranjen v prirodoslovnem muzeju v Comisu (Ragusa, Italija). Gre za drugo najdbo te vrste v Jadranu in eno redkih v Sredozemskem morju.*

Ključne besede: Molidae, *Mola mola*, *Mola alexandrini*, Sredozemsko morje

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ADDITIONAL DATA ON THE BUMP-HEAD SUNFISH, *MOLA ALEXANDRINI* (RANZANI, 1839) IN THE ADRIATIC SEA

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ABSTRACT

*On 3 June 2017, a group of divers mapping benthic habitats in a locality south of Dubrovnik, Croatia, spotted and photographed a giant specimen of sunfish accompanied by a school of imperial blackfish (*Schedophilus ovalis*) at a depth of 40 m. The specimen was identified as a bump-head sunfish* Mola alexandrini (Ranzani, 1839). *This is one of the few records of this little-known and overlooked species in the Adriatic Sea and one of the few cases in the whole Mediterranean.*

Keywords: *Mola mola, Mola alexandrini,* Adriatic Sea*, Schedophilus ovalis*

NUOVI DATI SUL PESCE LUNA MERIDIONALE, *MOLA ALEXANDRINI* (RANZANI, 1839) NEL MARE ADRIATICO

SINTESI

*Il 3 giugno 2017, un gruppo di subacquei che ha mappato gli habitat bentonici in una località a sud di Dubrovnik, in Croazia, ha avvistato e fotografato un esemplare gigante di pesce luna accompagnato da un banco di centrolofo viola (*Schedophilus ovalis*) a una profondità di 40 m. L'esemplare è stato identificato come pesce luna meridionale* Mola alexandrini *(Ranzani, 1839). Si tratta di una delle poche segnalazioni di questa specie poco conosciuta e trascurata nel mare Adriatico e uno dei pochi casi nell'intero Mediterraneo.*

Parole chiave: *Mola mola, Mola alexandrini,* mare Adriatico, *Schedophilus ovalis*

INTRODUCTION

Three species of sunfish (family Molidae) have been reported for the Adriatic Sea so far. While the presence of *Ranzania laevis* (Pennant, 1776) (Jardas & Knežević, 1983; Dulčić *et al*., 2007) and *Mola mola* (Linnaeus, 1758) (Jardas & Knežević, 1983; Dulčić *et al.,* 2007; Kovačić *et al.,* 2020) has been well known in this region for quite some time, the third molid species was confirmed only recently, when Insacco *et al*. (2023) identified a large sunfish stranded in 1999 on a beach in the northwestern Adriatic Sea as a *Mola alexandrini* (Ranzani, 1839). This was actually the second recorded instance of this species in the Adriatic Sea – the first specimen, however, discovered in an unspecified location in the Adriatic, was classified by Ranzani (1839) as *Orthragoriscus alexandrini*. The comprehensive overview of the Adriatic fish fauna published by Kovačić *et al*. (2020), who analysed the Adriatic ichthyological populations with an evidence-based approach, does not mention *M. alexandrini*. However, the species is included in a subsequent survey of the Mediterranean ichthyofauna by Kovačić *et al*. (2021), with a note that the holotype is preserved at the Swedish Museum of Natural History in Stockholm.

Historically, there were numerous taxonomic confusions within the *Mola* genus resulting in many misidentifications, but recent studies have begun to address these issues (e.g., Yoshita *et al*., 2009; Nyegaard *et al*., 2017). In 2018, Sawai et al. realised that *Mola alexandrini* (Ranzani, 1839) was synonymous with *M. ramsayi* (Giglioli, 1883) and provided a revised description of the species based on the rediscovered holotype and 21 fresh and preserved specimens.

MATERIAL AND METHODS

On 3 June 2017, a group of divers from the NGO "Sunce" performed a mapping of the sea bottom ecosystems south of Dubrovnik near Cavtat, in an area just below Velje brdo (42°31'14.78"N, 18°17'43.04"E) (Fig.

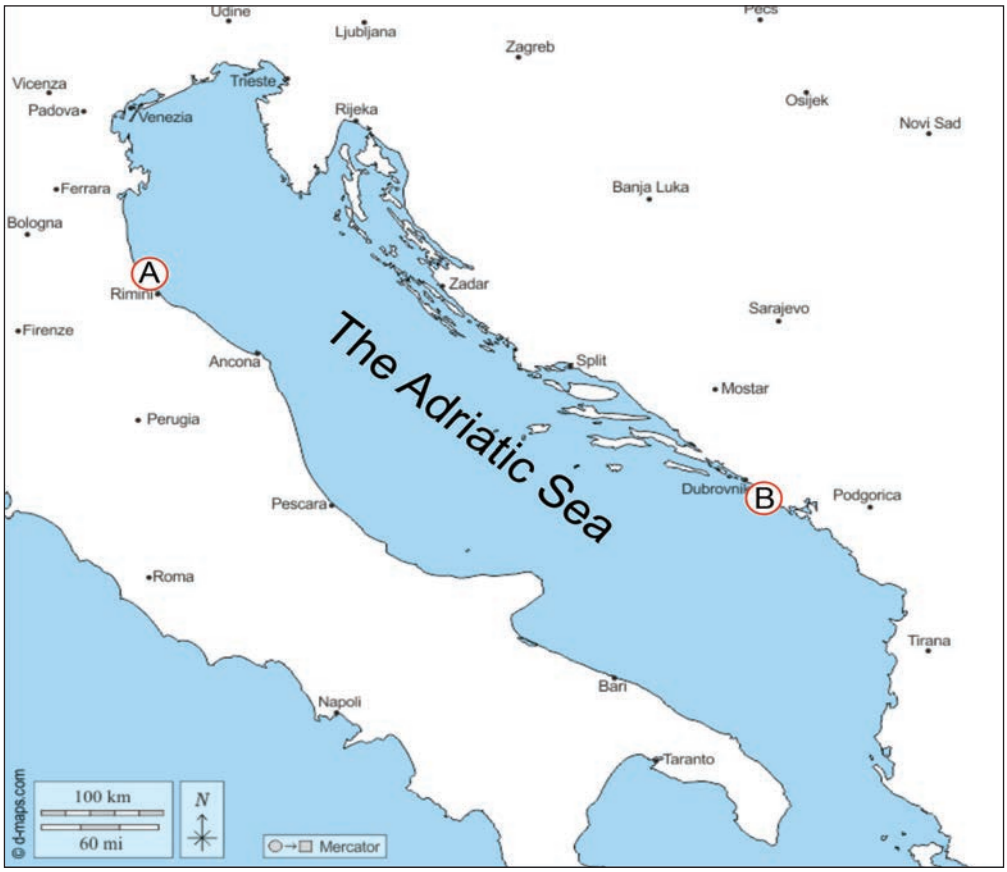

Fig. 1: Locations in the Adriatic Sea where** Mola alexandrini **was confirmed after the species was discovered by Ranzani (1939) at an unspecified location in the Adriatic. Legend: A – Cervia (Ravenna), 24 March 1999 (Insacco** et al.**, 2023) and B – southern Adriatic (near Cavtat), 3 June 2017 (this paper).
Sl. 1: Lokalitete v Jadranskem morju, kjer je bilo potrjeno pojavljanje vrste** Mola alexandrini**, potem, ko je Ranzani (1939) opisal vrsto na neznani lokaliteti v Jadranu. Legenda: A – Cervia (Ravenna), 24. marec 1999 (Insacco** et al.**, 2023) in B – južni Jadran (blizu Cavtata), 3. junij 2017 (ta prispevek).

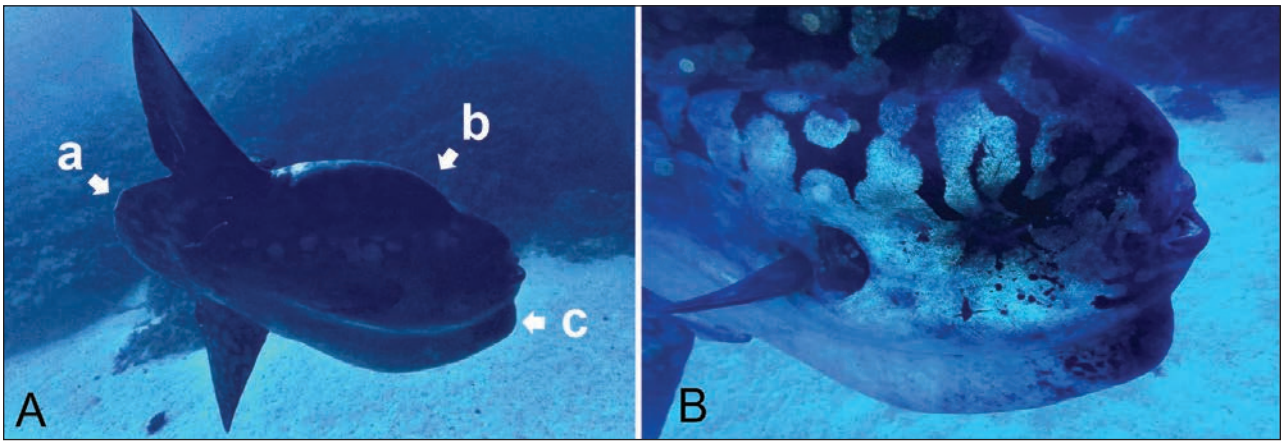

Fig. 2: Bump-head sunfish** (Mola alexandrini) **photographed on 3 June 2017 in the waters off Dubrovnik. Diagnostic features: a – rounded clavus with no indentations, b – bulbous head with bump, c – bump on the chin (A); close-up of the head with clearly visible bumps on the head and chin (B); (Photos: J. Belamarić).
Sl. 2: Grbasti morski mesec** (Mola alexandrini)**, fotografiran 3. junija 2017 v vodah blizu Dubrovnika. Diagnostični znaki: a – zaobljen klavus brez zajed, b – zaokrožena glava z grbo, c – grba na bradi (A); bližinski posnetek glave z očitnimi grbami na glavi in bradi (B); (Fotografije: J. Belamarić).

1). They surveyed a sea grass meadow of *Posidonia oceanica* along sampling transects at a depth of 33 m. At a depth of 40 m, they spotted and photographed a giant specimen of sunfish (Fig. 2). It was gliding slowly, moving its perpendicular fins from left to right. The sunfish was accompanied by a group of imperial blackfish (*Schedophilus ovalis)* (Fig. 3).

RESULTS AND DISCUSSION

The specimen was identified based on photographs taken at the time of sighting. The bump-head sunfish (*Mola alexandrini*) can be distinguished from the similar ocean sunfish *Mola mola* by having a distinct bump on the head and another one on the chin (Sawai *et al*., 2018) (Figs. 2 and 4). In addition, its body scales are rectangular, the clavus is rounded, without indents (Figs. 2 and 4), and *Mola alexandrini* has 14–24 rays in the clavus (Sawai *et al.,* 2018), while *M. mola* typically exhibits a lower number. Nevertheless, it is worth noting that, according to Wirtz & Biscoito (2019), the bump on the head can also be found in *Mola mola* specimens from the eastern Atlantic populations. The studied specimen was grey on the upper part of the body and paler on the ventral side, with large pale patches present all over the trunk and on the dorsal and anal fins. It was not measured; however, the divers estimated the size of the fish to be approximately 3 metres from the tip of the dorsal fin to the tip of the anal fin.

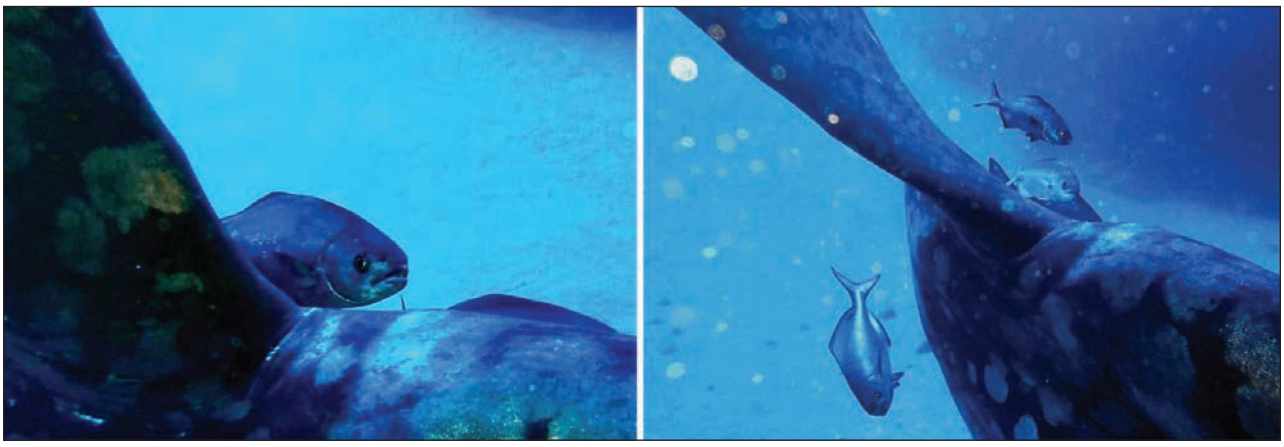

Fig. 3: The imperial blackfish** (Schedophilus ovalis) **swimming together with the specimen of bump-head sunfish (Photo: J. Belamarić).
Sl. 3: Cesarski črnuhi** (Schedophilus ovalis)**, ki plavajo poleg primerka grbastega morskega meseca (Foto: J. Belamarić).

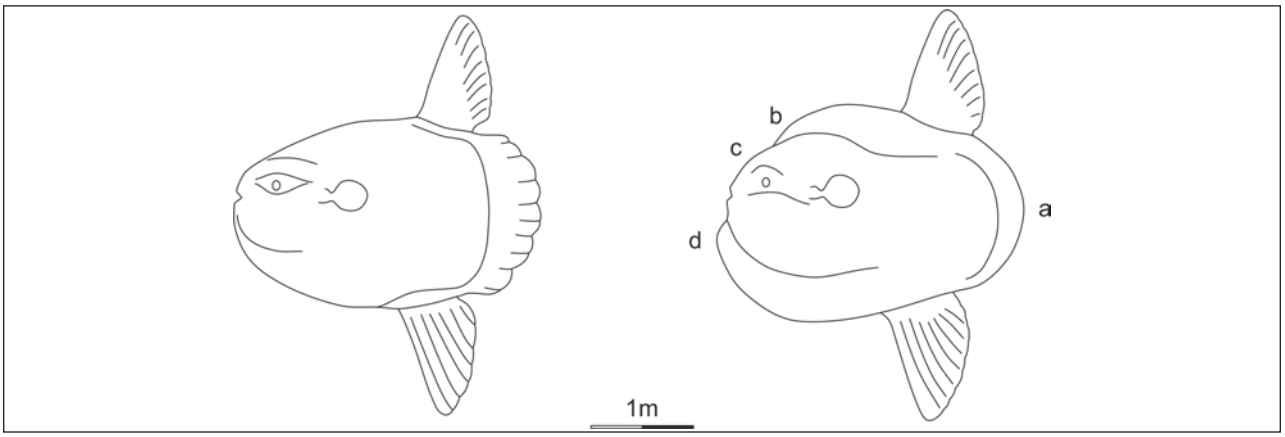

Fig. 4: The differentiation between** M. mola **(left) and** M. alexandrini **(right) based on key morphological characteristics. Legend: a – clavus, b – head bump, c – head profile, and d – chin bump (Drawing: M. Šiško).
Sl. 4: Ločevanje med vrstama** M. mola **(levo) in** M. alexandrini **(desno) na podlagi ključnih morfoloških znakov. Legenda: a – klavus, b – grba na glavi, c – profil glave, in d – grba na bradi (risba: M. Šiško).

The bump-head sunfish was previously believed to inhabit only the southern hemisphere (Parkinson, 2021). However, recent Mediterranean records (Kovačić *et al*., 2021; Insacco *et al*., 2023; this paper) and findings in Atlantic (Wirtz & Biscoito, 2019) suggest its presence in the northern hemisphere as well. Due to the revision of species within the genus *Mola* and the related misidentification with *Mola mola*, it is highly probable that new cases of overlooked *M. alexandrini* will emerge in the future (*sensu* Parkinson, 2019). This prediction is further supported by the fact that photographic identification is now considered a valid source of data on species presence (Colombo & Langeneck, 2013; Bello *et al.*, 2014).

Although no specific studies have been conducted on the diets of *Mola mola* and *M. alexandrini*, the bump-head sunfish can mainly be considered a predator of gelatinous planktonic animals, such as salps and siphonophores (Pope *et al.,* 2010; Parkinson, 2021). The specimens accompanying the sunfish were identified as imperial blackfish (*Schedophilus ovalis*). This species is also poorly known in the Adriatic Sea and was considered very rare by Jardas (1996). Previously, it was mostly observed in the southern part of the Adriatic Sea (Dulčić *et al.*, 2003), while during the recent decades, it has been reported to be spreading to its northern areas as well (Dulčić *et al.*, 2012). Some authors emphasised that the occurrence of both species of the genus *Schedophilus* (*S. ovalis* and *S. medusophagus*) is influenced by environmental factors, including higher temperatures (Dulčić, 1998; Corsini-Foka & Frantzis, 2009), and suggested that the northward expansion of *S. ovalis* was related to sea warming. The imperial blackfish is known as an obligate gelativore, so it seeks gelatinous organisms together with the bump-head sunfish. The sighting of species from the genus *Schedophilus* alongside the bump-head sunfish has previously been noted by Parkinson (2021).

In the past, the *Mola mola* species and molids in general received only sporadic scientific attention, and even scarcer are the data regarding *M. alexandrini*. To ascertain the actual presence of the bump-head sunfish in the Adriatic Sea and to elucidate its status within the region, a thorough review of the photographic material depicting specimens previously identified as *Mola mola* is necessary (Insacco *et al*., 2023). In fact, during the preparation of this article we uncovered at least one other possibly overlooked case of the bump-head sunfish's presence in the Adriatic Sea through various web sources. On 10 April 1933, a specimen of what appears to be a bump-head sunfish was caught off the coast of Rimini (Colonia Bolognese) and exhibited for public viewing in several Italian locations. Still, this report requires further detailed investigation to be fully confirmed.

Counting the record presented in this paper, the total number of confirmed specimens of *M. alexandrini* in the Adriatic Sea presently stands at three. This work highlights the importance of photo documentation and thorough analysis of various photo archives and other historical data that can be valuable in shedding light on the presence of certain species over time and in different locations, especially those that are rare and not well known. Nyegaard *et al.* (2023) have shown that photographs can also be used to identify individuals and even observe their behaviour and growth when a comprehensive photo collection is available. This further underscores the importance of thoroughly analysing the already extensive amount of photographic material that is expanding rapidly due to the availability of high-quality and affordable photo cameras and the growing community of underwater researchers, divers, and enthusiasts. However, it is essential to exercise caution when assessing the reliability of sources and the accompanying data, especially regarding the location and time of the photographed events.

DODATNI PODATKI O POJAVLJANJU GRBASTEGA MORSKEGA MESECA, *MOLA ALEXANDRINI* (RANZANI, 1839) V JADRANSKEM MORJU

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POVZETEK

*Skupina potapljačev je 3. junija 2017 pri popisovanju pridnenih habitatov na lokaciji blizu Dubrovnika (na Hrvaškem) opazila in fotografirala orjaški primerek morskega meseca, ki ga je spremljala jata cesarskih črnuhov (*Schedophilus ovalis*) na globini 40 m. Primerek so določili za grbastega morskega meseca,* Mola alexandrini *(Ranzani, 1839). To je eden izmed redkih zapisov o pojavljanju te slabo poznane in spregledane vrste v Jadranskem morju in eden od redkih primerov v Sredozemskem morju nasploh.*

Ključne besede: *Mola mola*, *Mola alexandrini*, Jadransko morje, *Schedophilus ovalis*

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FIRST SUBSTANTIATED RECORD OF PAINTED EEL *ECHELUS MYRUS* (OPHICHTHIDAE) FROM SYRIAN MARINE WATERS (EASTERN MEDITERRANEAN SEA)

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ABSTRACT

The present paper reports the first substantiated record of the painted eel Echelus myrus *(Linnaeus, 1758) from the coast of Syria. The specimen measured 591 mm in total length, with a total body weight of 220 g. This record confirms the occurrence of this species in Syrian marine waters and the Levant Basin, filling the gap between the coast of Lebanon and other areas of the eastern Mediterranean, including the coast of Turkey.*

Keywords: *Echelus myrus*, Ophichthidae, distribution, Levant Basin

PRIMA IDENTIFICAZIONE COMPROVATA DEL MIRO, *ECHELUS MYRUS* (OPHICHTHIDAE), DALLE ACQUE MARINE SIRIANE (MAR MEDITERRANEO ORIENTALE)

SINTESI

Il presente articolo riporta la prima segnalazione documentata del miro, Echelus myrus *(Linnaeus, 1758), lungo le coste della Siria. L'esemplare misurava 591 mm di lunghezza totale, con un peso corporeo totale di 220 g. Questo ritrovamento conferma la presenza della specie nelle acque marine siriane e nel bacino del Levante, colmando il divario tra la costa del Libano e altre aree del Mediterraneo orientale, compresa la costa della Turchia.*

Parole chiave: *Echelus myrus*, Ophichthidae, distribuzione, Bacino del Levante

INTRODUCTION

The painted eel *Echelus myrus* (Linnaeus, 1758) occurs in the waters of the northeastern Atlantic, spanning from the Bay of Biscay to the coast of Portugal (Quéro *et al.*, 2003). South of the Straits of Gibraltar, *E. myrus* has been reported from Morocco (Lloris & Rucabado, 1998), Mauritania, and Senegal (Maurin & Quéro, 1981), extending to the Gulf of Guinea (Blache, 1968), and as far as Angola according to Bauchot (1986). *E. myrus* occurs throughout the Mediterranean, though somewhat more abundantly in southern and western areas (Bauchot, 1986; Golani, 2005), and in the Adriatic Sea (Lipej & Dulčić, 2010). The species is very rarely found off the Tunisian coast and has only been recorded in the southern Gulf of Gabès by Ben Othman (1971) and off Ras Jebel city on the northern coast of Tunisia (Rafrafi-Nouira *et al.*, 2015).

Eastward, *E. myrus* has been documented along the Mediterranean shore of Egypt and the coast of Turkey (Bilecenoglu *et al.*, 2014), as well as in the Levant Basin (Golani, 2005; Bariche & Fricke, 2020). The species had been previously reported from the Syrian coast by Sbaihi (1994), but no specimen was available for confirmation, nor does *E. myrus* appear in the fish species list compiled for this region by Saad (2005) and Ali (2018). Regular investigations conducted in the Syrian marine waters and the assistance of local fishermen have allowed for the capture of the specimen that is herein described and accompanied by remarks about the species distribution.

MATERIAL AND METHODS

On 3 June 2023, a specimen of painted eel *Echelus myrus* was captured by an angler at a depth of 9 m, off Jableh city on the Syrian coast (35°22′12.33″N, 35°54′50.82″E) (Fig. 1). All meristic counts and morphometric measurements, with the length recorded to the nearest millimetre and the total body weight to the nearest gram, are included in Table 1. The specimen was preserved in 10% buffered formaldehyde and deposited in the Ichthyological Collection of the Marine Sciences Laboratory, Faculty of Agriculture, Tishreen University, with catalogue number MSL 1/2023.

RESULTS AND DISCUSSION

The specimen measured 591 mm in total length (TL), its total body weight was 220 g. Compared to the maximum TLs noted by Tortonese (1970) and Bauchot (1986), 800 mm and 1 m, respectively, it was a medium-sized specimen. It was identified as *E. myrus* based on the combination of the following diagnostic characters: body very elongate, compressed posteriorly, anus slightly anterior to midbody; snout subconical; anterior nostril tubular, directed downward and with trilobate edge, opening near snout tip; posterior nostril an oval pore covered by a dermal fold, opening before eye, in margin of upper lip; rictus of mouth below posterior edge of eye; dorsal and anal fins well developed, folding into a deep dermal groove; dorsal fin origin slightly behind pectoral fin base; teeth conical, long, slightly acute and curved on both jaws, shorter, almost granular on vomer; colouration greyish mixed with dark yellow or brownish, darker dorsally; cephalic lateral lines unpigmented; dorsal and anal fins blackish in posterior third, lighter anteriorly (Fig. 2).

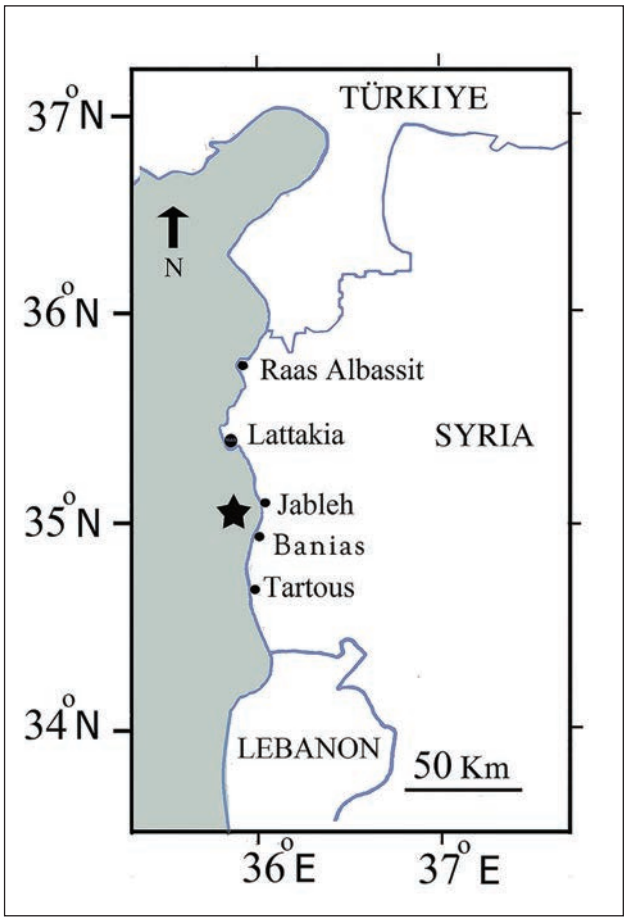

Fig. 1. Map of the Syrian coast with a star indicating the capture site of the studied specimen of *Echelus myrus* ***(ref. MSL 1/2023), off Jableh.***
Sl. 1: Zemljevid sirske obale z označeno lokacijo ulova (zvezdica) primerka vrste *Echelus myrus* ***(ref. MSL 1/2023) ob Jablehu.***

Tab. 1: Morphometric measurements in mm and as percentages of total length (% TL) recorded in the** Echelus myrus **specimen (ref. MSL-1/2023) captured off Jableh, compared with the respective data recorded in a specimen (ref. FSB-Ech-myr.01) captured off Ras Jebel in northern Tunisia (Rafrafi-Nouira** et al.**, 2015).
Tab. 1: Morfometrične meritve v mm in delež telesne dolžine (% celotne dolžine) primerka vrste** Echelus myrus **(ref. MSL-1/2023), ujetega ob Jablehu, v primerjavi s podatki primerka (ref. FSB-Ech-myr.01), ujetega ob lokaciji Ras Jebel v severni Tuniziji (Rafrafi-Nouira** et al.**, 2015).

Morphometric measurements	**This study (MSL 1/2023)**		**Rafrafi-Nouira *et al.* (2015) (FSB-Ech-myr.01)**	
	mm	%TL	mm	%TL
Total length	591	100.0	550	100.0
Body depth	29	4.9	23	4.1
Head length	57	9.6	42	7.6
Preanal length	250	42.3	250	45.4
Predorsal length	80	13.5	91	16.6
Prepectoral length	61	10.3	68	12.3
Dorsal fin length	491	83	457	83
Anal fin length	331	56	304	55.2
Pectoral fin length	17	2.8	7	1.2
Eye diameter	7	1.2	11	1.8
Preorbital length	12	2	15	2.7
Interorbital length	10	1.7	8	1.4
Length of upper jaw	18	3.1	28	5.0
Length of lower jaw	16	2.7	26	4.6
Meristic counts				
Number of pores in *linea lateralis*	114		103	
Pectoral fin soft rays	12		13	
Total body weight in grams	220		129	

The general morphology, morphometric measurements, meristic counts, and colour of the specimen were in total agreement with previous descriptions of the species by Dieuzeide *et al.* (1954), Tortonese (1970), Bauchot (1986), and Rafrafi-Nouira *et al.* (2015). This capture confirms the occurrence of *E. myrus* in Syrian marine waters and the species can therefore be included in the local ichthyofauna. This makes *E. myrus* one of the 3 species of the family Ophichthyidae present in the area, alongside the longjaw snake eel, *Ophisurus serpens* (Linnaeus, 1758), and the armless snake eel *Dalophis imberbis* (Delaroche, 1809), as documented by Al Shawy *et al.* (2019) and Capapé *et al.* (2021).

E. myrus generally inhabits soft bottoms up to 110 m in depth (Tortonese, 1970), however, horizontal and vertical migrations occur according to the season, with specimens approaching shallow coastal waters in spring and summer (Rafrafi-Nouira, 2016). The species is considered rare in all areas, but especially in Tunisian marine waters, where it holds low economic interest and is likely discarded at sea after capture (Rafrafi-Nouira *et al.*, 2015). *E. myrus* is believed to be a carnivorous species (Bauchot, 1986), and preliminary observations carried out on specimens caught off the northern Tunisian coast confirm this opinion (Rafrafi, pers. comm., 2023). Reproduction occurs at the end of summer off the Algerian coast (Dieuzeide *et al.*, 1954) and throughout

Fig. 2. A. The specimen of E**chelus myrus* **(ref. MSL 1/2023), captured off Jableh, scale bar = 100 mm. B. Insert with the arrow indicating the teeth of the same specimen, scale bar = 5 mm.
Sl. 2: A. Primerek vrste** Echelus myrus* **(ref. MSL 1/2023), ujet ob Jablehu, merilo = 100 mm. B. Prikaz, na katerem puščica označuje zobovje raziskanega primerka, merilo = 5 mm.

the summer in the Italian seas, as corroborated by the discovery of eggs with a diameter of 3–3.8 mm in the Straits of Messina (Tortonese, 1970). Taylan & Aydin (2021) provide additional information on certain aspects of the species' reproduction based on specimens from the Aegean Sea.

The capture of this specimen in Syrian marine waters confirms the presence of a viable population in the Levant Basin and fills the gap between the coast of Lebanon and other areas in the eastern Mediterranean, including the coast of Turkey.

PRVI UTEMELJENI ZAPIS O POJAVLJANJU PISANE JEGULJE, *ECHELUS MYRUS* (OPHICHTHIDAE), IZ MORSKIH VODA SIRIJE (VZHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o prvem utemeljenem zapisu o pojavljanju pisane jegulje, Echelus myrus *(Linnaeus, 1758) iz sirske obale. Primerek je meril 591 mm v celotno dolžino in tehtal 220 g. Ta zapis potrjuje pojavljanje te vrste v sirskih vodah in v Levantskem morju, s čimer je zapolnjena vrzel o razširjenosti te vrste med obalo Libanona in drugimi območji vzhodnega Sredozemskega morja, vključno s turško obalo.*

Ključne besede: *Echelus myrus*, Ophichthidae, razširjenost, Levantski bazen

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BIOTSKA GLOBALIZACIJA

GLOBALIZZAZIONE BIOTICA

BIOTIC GLOBALIZATION

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THE PRESENCE OF *HIPPOCAMPUS FUSCUS* RÜPPELL, 1838, IN THE NORTHEASTERN MEDITERRANEAN SEA

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ABSTRACT

In the present study, five specimens of seahorse Hippocampus fuscus *Rüppell, 1838 are reported from the northeastern Mediterranean waters. The visual records were obtained during an underwater scuba survey conducted from 27 to 30 March 2007 and on 5 April 2007, in a depth range of 2-3 m in Mersin port (Mersin Bay, Turkey). This is the first occurrence of* H. fuscus *in the northeastern Mediterranean coast of Turkey, specifically in Mersin Bay, and the second record in Turkish Mediterranean waters. Furthermore, the presence of many adults and juveniles (n>10) in the observations indicates that this species has established a population in the region that has adapted well to the environment. This study addresses a significant gap in the literature and will be helpful for scientists working on fisheries, as well as providing an important contribution to the forthcoming Red List assessment in the Mediterranean.*

Keywords: seahorse, Syngnathidae, extension, Mersin Bay, Turkey

PRESENZA DI *HIPPOCAMPUS FUSCUS* RÜPPELL, 1838, NEL MAR MEDITERRANEO NORD-ORIENTALE

SINTESI

Nel presente studio vengono segnalati cinque esemplari di cavalluccio marino Hippocampus fuscus *Rüppell, 1838 provenienti dalle acque del Mediterraneo nordorientale. Le registrazioni visive sono state ottenute durante un›indagine subacquea condotta dal 27 al 30 marzo 2007 e il 5 aprile 2007, ad una profondità di 2-3 m nel porto di Mersin (baia di Mersin, Turchia). Questo è il primo ritrovamento di* H. fuscus *lungo la costa mediterranea nord-orientale della Turchia, in particolare nella baia di Mersin, e la seconda segnalazione nelle acque turche del Mediterraneo. Inoltre, la presenza di numerosi adulti e giovani (n>10) indica che questa specie ha stabilito nella regione una popolazione che si è ben adattata all'ambiente. Questo studio affronta una lacuna significativa nella letteratura e sarà utile per i ricercatori che lavorano nel settore della pesca, oltre a fornire un importante contributo alla prossima valutazione della Lista Rossa nel Mediterraneo.*

Parole chiave: cavalluccio marino, Syngnathidae, estensione, baia di Mersin, Turchia

INTRODUCTION

The genus *Hippocampus* Rafinesque, 1810, is represented by three species in Mediterranean waters: the short-snouted seahorse *Hippocampus hippocampus* (Linnaeus, 1758), the long-snouted seahorse *Hippocampus guttulatus* (Cuvier, 1829), and the seahorse *Hippocampus fuscus* Rüppel, 1838 (Golani *et al.,* 2006).

The seahorse *Hippocampus fuscus* is a member of the Syngnathidae family and is found in shallow coastal waters of the western Indian Ocean, Red Sea, and Mediterranean Sea (Golani & Fine, 2002; Lourie *et al.,* 2016; Froese & Pauly, 2023).

The occurrence of *H. fuscus* in the Mediterranean basin was first reported from the Israeli coast (Golani & Fine, 2002), and only later recorded in Turkish Mediterranean waters (Gokoglu e*t al.,* 2004). Recently, Mahapatro *et al.* (2017) reported the presence of this species in the Bay of Bengal in the northeastern part of the Indian Ocean.

In Turkey, *Hippocampus fuscus* was first reported in the Bay of Antalya by Gokoglu *et al.* (2004). Subsequently, it was included in the annotated checklist of fish of Turkey (Fricke *et al.,* 2007). However, up to now, no specimens of *H. fuscus* were reported from the northeastern Mediterranean coast of Turkey (Mersin Bay).

In the present study, we report the presence of confirmed *H. fuscus* specimens from the northeastern Mediterranean coast of Turkey, specifically Mersin Bay. This study not only fills an important gap in the literature, but also demonstrates the spread of this species towards the northeastern Mediterranean coasts of Turkey.

MATERIAL AND METHODS

From 27 to 30 March 2007 and on 5 April 2007, two adult and three juvenile specimens of *H. fuscus* were observed at a depth of 2 to 3 m during a scuba dive in Mersin port (Mersin Bay) (36°47′11.2″ N, 34°37′58.3″ E) (Fig. 1). The specimens were photographed and recorded using a video camera (Canon PowerShot G12) (Fig. 2). The morphological descriptions and coloration of *H. fuscus* agree with those presented by Lourie *et al.* (2004) and Golani & Fine (2002).

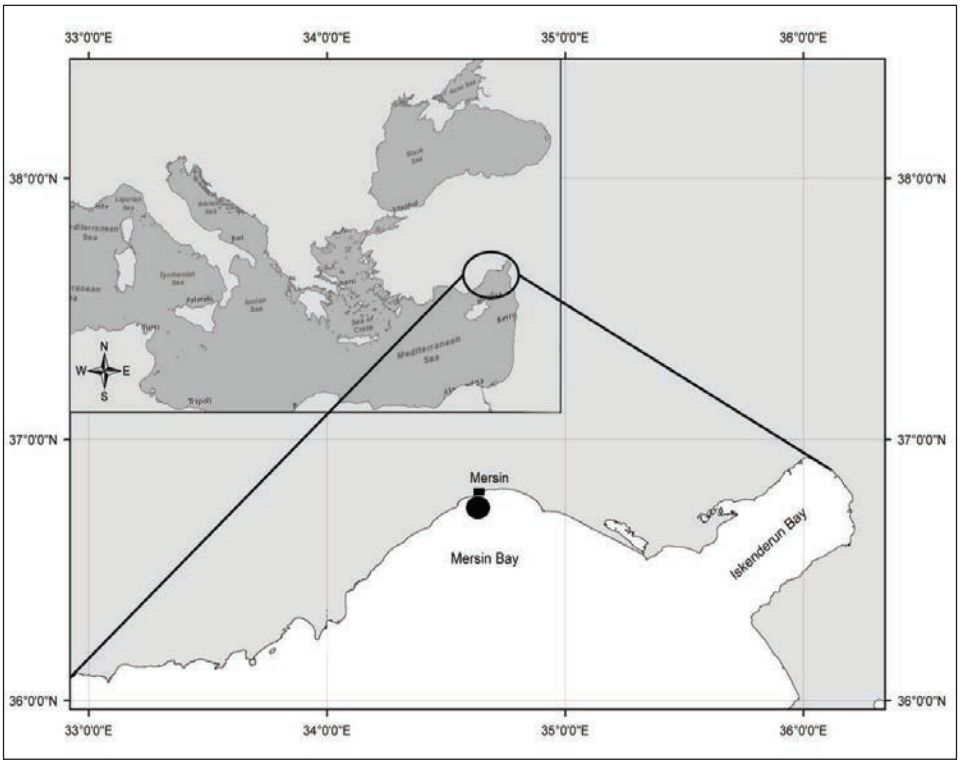

Fig. 1: Map indicating the capture site (•) of specimens of seahorse *Hippocampus fuscus* ***Rüppell, 1838 in Mersin Bay (northeastern Mediterranean).***
Sl. 1: Zemljevid obravnavanega območja z označeno lokaliteto ulova primerkov morskega konjička vrste *Hippocampus fuscus* ***Rüppell, 1838 v zalivu Mersin (severovzhodno Sredozemsko morje).***

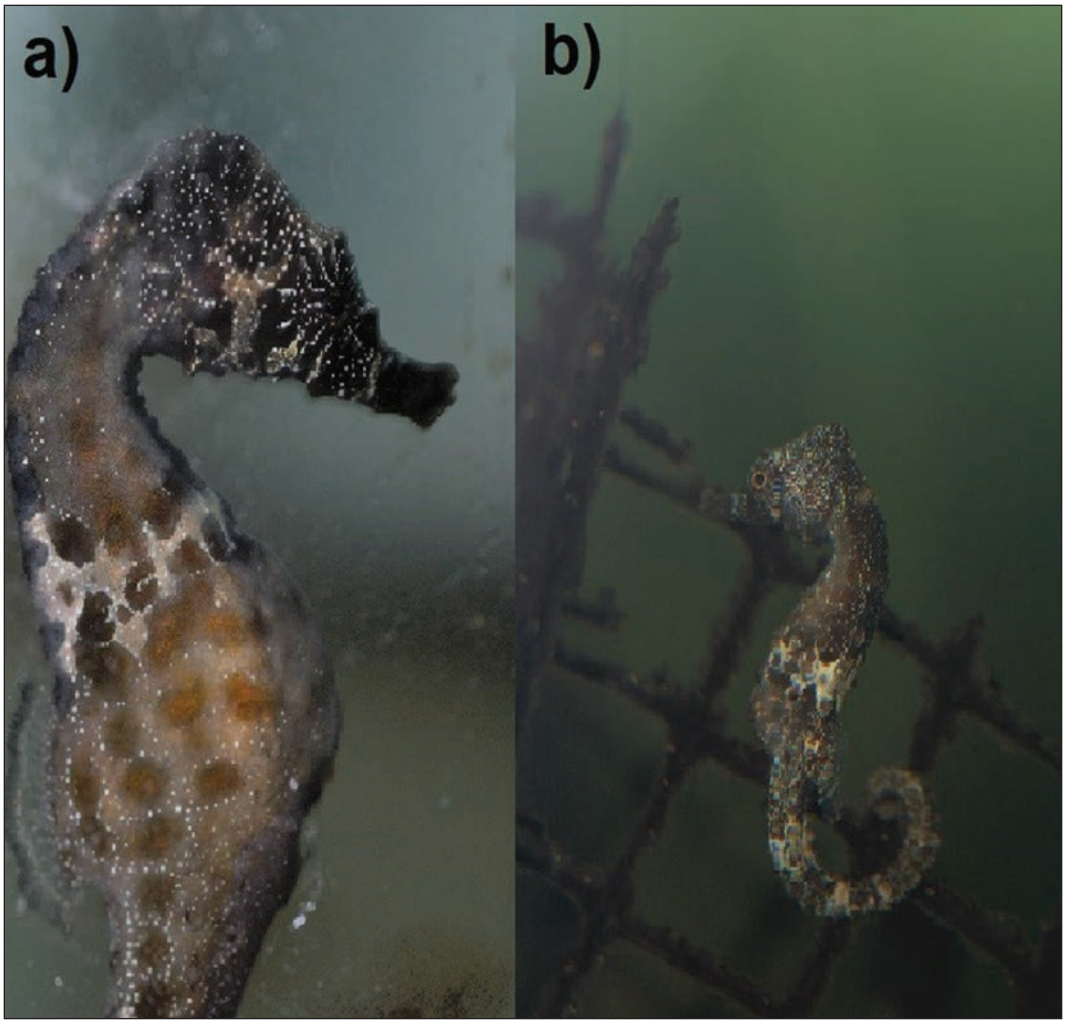

Fig. 2: Photographs of adult (a) and juvenile (b) specimens of *Hippocampus fuscus* ***from Mersin port, Turkey.***
Sl. 2: Fotografiji odraslega (a) in juvenilnega primerka vrste *Hippocampus fuscus* ***iz zaliva Merein, Turčija.***

RESULTS AND DISCUSSION

The following morphological features were observed in the two adult specimens: The bodies consisted of bony rings arranged in dermal plates and exhibited no spines. The total lengths of the specimens were 12.0 and 12.5 cm, respectively. The dorsal fin in each had 16/17 rays, the anal fin 4 rays, the pectoral fin 15/16 rays. The specimens had 11 trunk rings, 34/36 tail rings, their head lengths equalled 4.2 and 5.4 of their total lengths, respectively. The snouts were cylindrical in shape, and their lengths measured 2.4 and 2.5 times the head lengths, respectively. They each exhibited a prominent spine above the eyes. Their coronets were only slightly elevated and had tiny protrusions, and their heads were not larger than the bodies. There were no skin flaps on the heads. Their body coloration varied from dark or pale brown to bright yellow and brown, featuring white spots on the trunk and head.

To date, three species of the genus *Hippocampus* have been known to inhabit the Mediterranean (Golani *et al.,* 2006). Among these, *H. fuscus* is typically found in seagrass beds, particularly among stones and gravel, and often in the calm waters of harbors and bays (Golani *et al.,* 2021). It feeds on zooplankton. In terms of physical appearance, male *H. fuscus* individuals have proportionally longer tails and shorter snouts compared to females (Vincent, 1990). The female lays eggs into the male's brood pouch located under its tail, where they remain for the entire gestation period (Breder & Rosen, 1966), which is approximately 14 days, but may vary depending on water temperature (Lourie *et al.,* 1999).

H. fuscus usually occurs in the size range of 3 to 14 cm (Golani *et al.,* 2021). The maximum recorded adult length for this species in the Mediterranean Sea is 14.4 cm (Golani & Fine, 2002). Individuals are commonly found at depths of 0–10 m (Foster & Vincent, 2004). In this study, seahorse specimens were discovered at a depth of 2–3 m, clinging to a rope. This depth range is in full agreement with the existing literature. Subsequent Scuba observations revealed an even greater abundance of seahorses.

The seahorse *H. fuscus* closely resembles the short-snouted seahorse *Hippocampus hippocampus* (Linnaeus, 1758), which also inhabits the Mediterranean Sea. However, in comparison, *H. fuscus* has a smaller body with a smoother surface, fewer tail rings, and a coronet that is not significantly raised above the arch of the neck. In contrast, *H. hippocampus* has more dorsal fin rays and fewer pectoral fins. Additionally, the snout length in the studied specimens of *H. fuscus* was approximately 2.5 times the head length, while for *H. hippocampus* it typically measures 2.8 times the head length. Compared to the third species of the genus *Hippocampus* present in the Mediterranean, *Hippocampus guttulatus*, *H. fuscus* lacks dorsal spines and dermal flaps on the head and neck (Golani *et al.,* 2021).

H. fuscus is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Froese & Pauly, 2023). According to CITES, all seahorse specimens in trade should have a minimum height of 10 cm (CITES II, since 5.15.04). The main threats to this species are incidental capture in trawl fisheries, habitat degradation, and pollution. However, *H. fuscus* has not yet been considered for inclusion in the IUCN Red List category (IUCN, 2023).

Although Zenetos *et al.* (2008) mentioned in their study that *H. fuscus* is likely established in the Bay of Antalya, there was no information on its range expansion since it was first recorded and reported from this region in 2003. This current record is, therefore, the first suggestion of an eastward migration for *H. fuscus* in the Mediterranean coast of Turkey, and the first confirmation of the presence of *H. fuscus* in the northeastern Mediterranean coast of Turkey, specifically in Mersin Bay. Moreover, the presence of numerous adults and juveniles (n>10) in the observations indicates that this species has established a population in this region and has successfully adapted to the environment.

CONCLUSIONS

There is limited information regarding changes in numbers and habitat status of seahorse species along Turkey's Mediterranean coast. Therefore, this study is very important for monitoring seahorse populations in the Mediterranean and determining and assessing their conservation status. Moreover, the findings of this study can provide valuable insight for decision-makers and fisheries managers. However, it is essential to emphasize the need for further monitoring and additional studies in this area.

POJAVLJANJE MORSKEGA KONJIČKA VRSTE *HIPPOCAMPUS FUSCUS* RÜPPELL, 1838, V SEVEROVZHODNEM SREDOZEMSKEM MORJU

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POVZETEK

Avtorji poročajo o pojavljanju petih primerkov morskega konjička vrste Hippocampus fuscus *Rüppell, 1838 v severovzhodnih sredozemskih vodah. Opazili so jih potapljači z avtonomno potapljaško opremo na podvodnih vzorčenjih med 27. in 30. marcem 2007 in 5. aprila 2007, opravljenih v globinskem pasu 2-3 m v pristanišču Mersin (zaliv Mersin, Turčija). To je prvi zapis o pojavljanju vrste* H. fuscus *v severovzhodnem Sredozemskem morju v Turčiji, natančneje v zalivu Mersin, in drugi zapis o pojavljanju v turških sredozemskih vodah. Poleg tega kaže pojavljanje velikega števila odraslih in mladostnih primerkov (n>10), da se je vrsta v tem okolju že ustalila in na njega dobro prilagodila. Ta raziskava odpravlja veliko vrzel v strokovni literaturi in bo v pomoč strokovnjakom, ki se ukvarjajo z ribištvom, obenem pa bo pomembno prispevala k oceni v prihajajočem Rdečem seznamu v Sredozemlju.*

Ključne besede: morski konjički, Syngnathidae, širjenje areala, zaliv Mersin, Turčija

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CONFIRMED OCCURRENCE OF PHARAOH CARDINAL FISH *APOGONICHTHYOIDES PHARAONIS* (OSTEICHTHYES: APOGONIDAE) FROM THE SYRIAN COAST (EASTERN MEDITERRANEAN SEA)

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ABSTRACT

The paper documents the capture of a second specimen of pharaoh cardinal fish Apogonichthyoides pharaonis *(Bellotti, 1874) from the Syrian coast. The specimen was an adult measuring 97 mm in total length (TL), 75 mm in standard length (SL), and weighing 19 g. This capture serves as confirmation of the presence of a viable population of A. pharaonis in the area, indicating it has found here adequate resources for development and reproduction.*

Key words: Apogonidae, distribution, population, Levant Basin

PRESENZA CONFERMATA DI *APOGONICHTHYOIDES PHARAONIS* (OSTEICHTHYES: APOGONIDAE) LUNGO LA COSTA SIRIANA (MAR MEDITERRANEO ORIENTALE)

SINTESI

L'articolo documenta la cattura di un secondo esemplare di Apogonichthyoides pharaonis *(Bellotti, 1874) lungo le coste siriane. L'esemplare in questione è un adulto di 97 mm di lunghezza totale (TL), 75 mm di lunghezza standard (SL) e 19 g di peso. Questa cattura conferma la presenza di una popolazione vitale di A. pharaonis nell'area, indicando che la specie abbia trovato qui risorse adeguate allo sviluppo e la riproduzione.*

Parole chiave: Apogonidae, distribuzione, popolazione, Bacino del Levante

INTRODUCTION

The pharaoh cardinal fish *Apogonichthyoides pharaonis* (Bellotti, 1874) is a Lessepsian migrant (*sensu* Por, 1971), originating from the Red Sea and the western Indian Ocean, which entered the Mediterranean Sea through the Suez Canal. The first recorded instances occurred off Port-Saïd, Egypt (Norman, 1927) and subsequently in the Palestinian coast, but the species was initially misidentified as *Apogon taeniatus* by Haas & Steinitz (1947). *A. pharaonis* has since been reported in various areas of the eastern Mediterranean, particularly the Levant Basin, where a viable population is successfully established (Golani *et al.*, 2021). To the west, the species has been recorded off the Egyptian coast (Ragheb *et al.*, 2019) and as far as Libyan waters (Al Mabruk *et al.*, 2021).

The first specimen of *A. pharaonis* was recorded from the Syrian coast in 1992, but was originally misidentified as *A. taeniatus* following Sbaihi & Saad (1995). Subsequent investigations focussing on non-indigenous species, conducted in Syrian marine waters, and actively supported by local fishermen, allowed the researchers to collect the *A. pharaonis* specimen that is herein described in detail and provided with comments about the species' distribution.

Tab. 1: Morphometric measurements with percentages of total length (TL), counts and total body weight recorded in the specimen reported by Sbaihi & Saad (1995) and in the present specimen.
Tab. 1: Morfometrične meritve z deležem totalne dolžine, merističnim štetjem in celokupno težo primerkov, ki ju navajata Sbaihi in Saad (1995) in iz pričujoče raziskave.

References	**Sbaihi & Saad (1995)**		**This study**	
Morphometric measurements	mm	% TL	mm	% TL
Total length	105	100.0	97	100.0
Standar length	93	88.6	75	77.3
Body depth	34	32.4	32.	32.9
Head length	32	30.4	32	32.9
Eye diameter	8	7.6	8	8.2
Length of dorsal fin base	-	-	14	14.4
Length of Anal fin base	-	-	13	13.4
Pre-pectoral length	-	-	30	30.9
Pre-anal length	-	-	52	53.6
Pre-pelvic length	-	-	28	28.9
Meristic counts				
First dorsal fin rays	VII		VII	
Second dorsal fin rays	I +8		I +8	
Ventral fin rays	-		I +5	
Pectoral fin rays	-		15	
Anal fin rays	II + 6		II + 6	
Total body weight in gram	-		19	

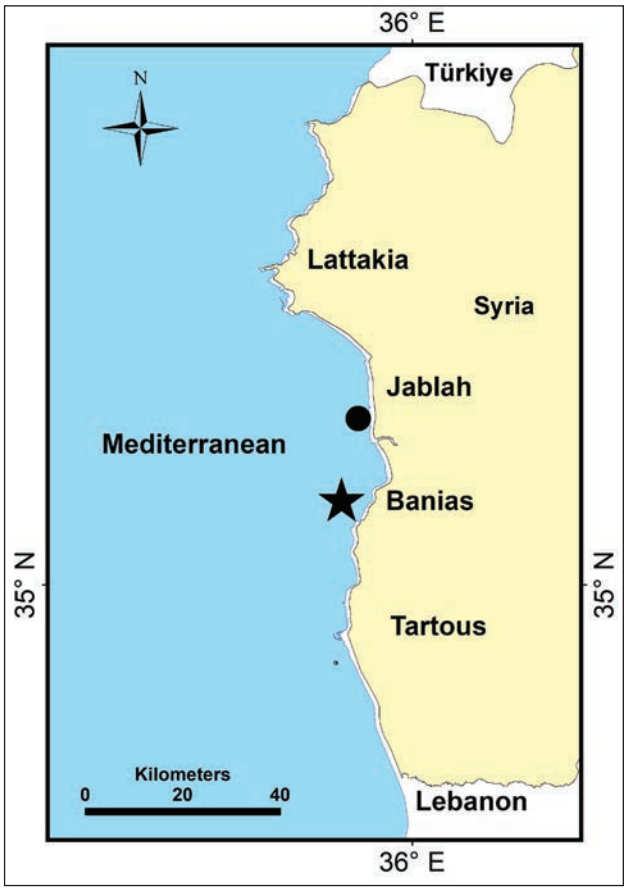

Fig. 1: Map of the Syrian coast indicating the capture sites of the two** Apogonichthyoides pharaonis **specimens, with the black star marking the specimen collected in the present study and the black circle representing the specimen described in Sbaihi & Saad (1995).
Sl. 1: Zemljevid sirske obale z označenimi lokalitetami ulova dveh primerkov vrste** Apogonichthyoides pharaonis**. Črna zvezdica označuje lokaliteto ulova primerka iz pričujoče raziskave, črni krogec pa označuje lokaliteto ulova primerka iz raziskave Sbaihi in Saad (1995).

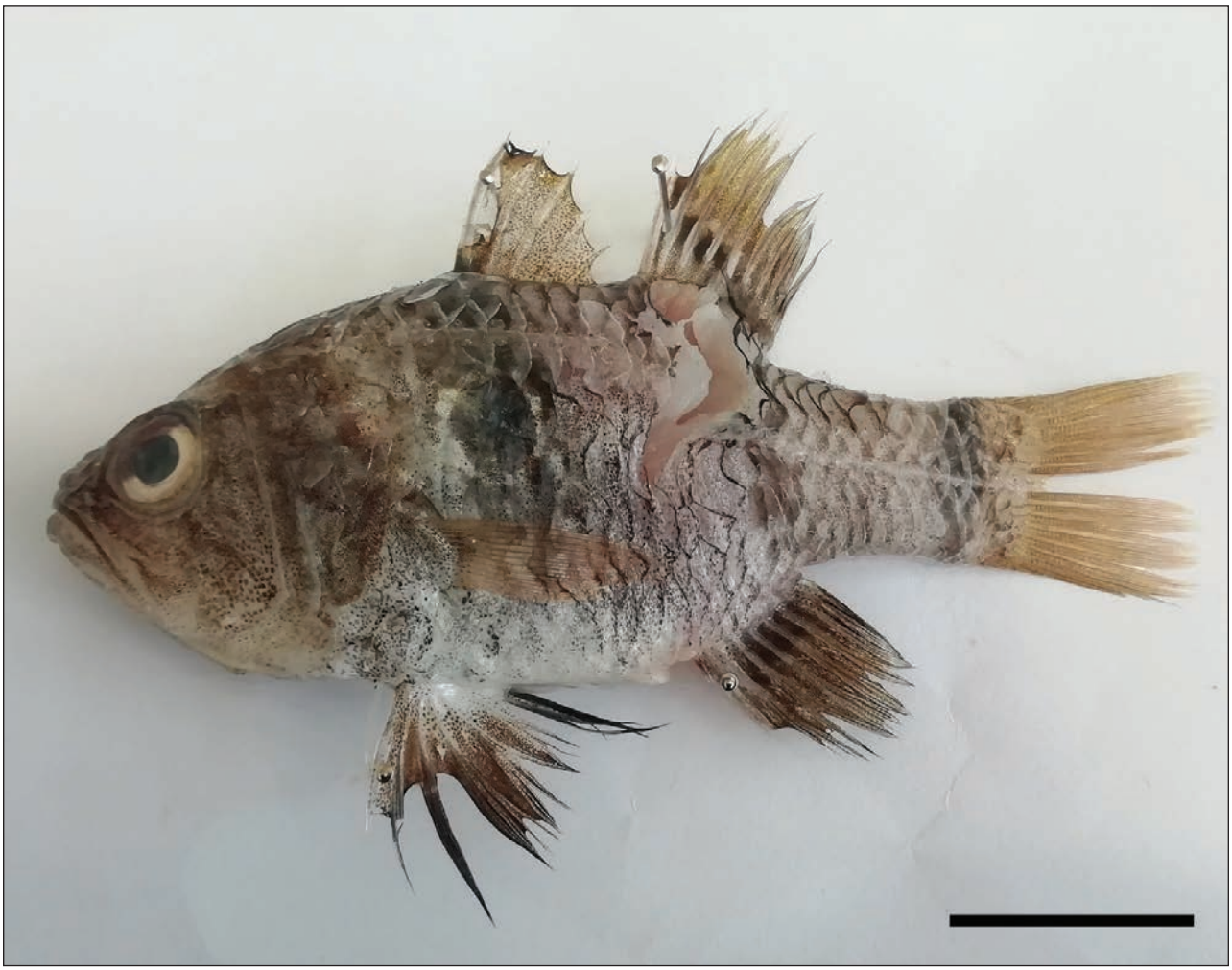

Fig. 2. Specimen of *Apogonichthyoides pharaonis* ***captured off Banias, Syrian coast (scale bar = 20 mm).***
Sl. 2: Primerek vrste *Apogonichthyoides pharaonis****, ujet v vodah pri lokaliteti Banias ob sirski obali (merilo = 20 mm).***

MATERIAL AND METHODS

The present specimen of *A. pharaonis* was caught on 22 September 2022, by a spear fisher at a depth of 12 metres, on sandy-pebbly bottom, south of Banias, a city located on the Syrian coast (at 35°63′45′′ N and 35°53′12′′ E, Fig. 1). The measurements of the specimen were taken using callipers and recorded to the nearest millimetre; its total body weight (TBW) was determined and rounded to the nearest gram. Morphometric measurements with percentages of total length are provided in Table 1, along with data pertaining to the specimen discovered by Sbaihi & Saad (1995). The more recently captured specimen was fixed in a 10% buffered formaldehyde solution, preserved in 75% ethanol, and deposited in the collection of the Marine Sciences Laboratory at Tishreen University, catalogue number MSL 24-2023.

RESULTS AND DISCUSSION

This particular specimen of *A. pharaonis* measured 97 mm in total length (TL), 75 mm in standard length (SL), and weighed 19 g in TBW (Fig. 2). It was identified as *A. pharaonis* based on a combination of distinct morphological characters: body oblong and laterally compressed; two distinct dorsal fins, the first displaying two very short spines and a longer third one, and the second exhibiting a single spine; origin of the pelvic fin under the base of the pectoral fin; truncate tail; relatively large eyes; three vertical black bars on a grey-brown background, with the first bar located under the first dorsal fin and featuring a black eye-like spot encircled by a yellow ring at the midside, the second bar starting under the second dorsal fin and extending to the tip of the fin, and the third bar positioned on the caudal peduncle; a fourth brownish bar was noted

at the base of the caudal fin. The patterns observed in the present specimen were consistent with those documented by Sbaihi & Saad (1995). The description, measurements, counts and coloration are in complete agreement with Gon & Randall (2003), Al Mabruk *et al*. (2021), and Golani *et al*. (2021).

The pharaoh cardinal fish is one of the earliest non-indigenous fish species documented in the Mediterranean Sea (Golani *et al*., 2021). This second discovery of this Lessepsian migrant in Syrian waters, occurring approximately 30 years after its first record, provides unequivocal confirmation that *A. pharaonis* has become part of the Syrian ichthyofauna. The current finding could also indicate that a viable population of *A. pharaonis* has successfully established itself in the studied area, mirroring the situation observed in the entire Levant Basin. It should be noted that, based on its initial record, the pharaoh cardinal fish has been recognised as an established Lessepsian species in Syrian waters (Ali, 2018). The common size range of *A. pharaonis* individuals is between 50 and 80 mm, with a maximum reported size of 120 mm (Golani *et al*., 2021) and the smallest mature female on record attaining only 34 mm in total length (Gon & Randall, 2003). Consequently, both *A. pharaonis* specimens caught in Syrian waters were large adult individuals, suggesting that the species is able to find sufficient resources for growth and reproduction in the region. However, *A. pharaonis* still appears to be relatively uncommon in the area, likely due to a combination of factors. Its small size and lack of a streamlined swimmer morphology may render the fish vulnerable to predators, thus limiting its abundance. Also, being small, it can easily escape through the meshes of fishing nets and is most often caught by spear fishers (see Al Mabruk *et al*., 2021), as was the case in our study. Finally, monitoring the species' abundance is challenging due to its nocturnal habits, and its relatively low economic value further discourages thorough observation. Additionally, it is likely that, as in other Mediterranean regions (Ragheb *et al*., 2019), *A. pharaonis* is discarded by fishermen in Syria after capture.

POTRJENO POJAVLJANJE FARAONSKEGA KRALJIČKA *APOGONICHTHYOIDES PHARAONIS* (OSTEICHTHYES: APOGONIDAE) IZ SIRSKE OBALE (VZHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorja poročata o najdbi drugega primerka faraonskega kraljička, Apogonichthyoides pharaonis *(Bellotti, 1874), iz sirske obale. Primerek je bil odrasel in meril 97 mm v celokupno dolžino (TL), 75 mm v standardno dolžino (SL) in tehtal 19 g. Ta ulov potrjuje prisotnost viabilne populacije vrste A. pharaonis na obravnavanem območju in kaže, da je tu našla primerne vire za razvoj in razmnoževanje.*

Ključne besede: Apogonidae, razširjenost, populacija, levantski bazen

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FIRST RECORD OF *EPINEPHELUS AREOLATUS* (EPINEPHELIDAE) FROM THE SOUTH-EASTERN MEDITERRANEAN, TURKEY

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ABSTRACT

The present paper represents the first report of areolate grouper Epinephelus areolatus *Forsskal, 1775, from the Mediterranean coast of Turkey. A specimen of* E. areolatus *was caught by hook and line, at a depth of 8 m, off the coast of Arsuz in the Bay of Iskenderun, on 22 April 2023. The captured specimen of* E. areolatus *measured 28.5 cm in total length and 23.5 cm in standard length. This species entered the Mediterranean via the Suez Canal. The current record increases the number of exotic grouper species reported in the Mediterranean Sea, Turkey, to five.*

Key words: exotic grouper, new record, migration, Turkish coast

PRIMA SEGNALAZIONE DI *EPINEPHELUS AREOLATUS* (EPINEPHELUS) NEL MEDITERRANEO SUD-ORIENTALE, TURCHIA

SINTESI

L'articolo riporta la prima segnalazione della cernia areolata Epinephelus areolatus *Forsskal, 1775 lungo la costa mediterranea della Turchia. Un esemplare di* E. areolatus *è stato catturato con un amo e una lenza a una profondità di 8 m, al largo della costa di Arsuz, nella baia di Iskenderun, il 22 aprile 2023. L'esemplare catturato di* E. areolatus *misurava 28,5 cm di lunghezza totale e 23,5 cm di lunghezza standard. Questa specie è entrata nel Mediterraneo attraverso il Canale di Suez. Il presente ritrovamento aumenta a cinque il numero di specie esotiche di cernia segnalate nel Mediterraneo, in Turchia.*

Parole chiave: cernia esotica, nuovo record, migrazione, costa turca

INTRODUCTION

The opening of the Suez Canal in 1869 allowed many species originating in the Red Sea to enter the Mediterranean Sea. This ongoing process continues to exert a significant ecological impact on the Mediterranean (Heemstra & Randall, 1993).

To date, ten grouper species of the Epinephelidae family have been known to inhabit the Mediterranean Sea (Heemstra & Randall, 1993; Froese & Pauly, 2023). Among these, six species are Lessepsian migrants, i.e., originating from the Red Sea: *Epinephelus areolatus* (Forsskål, 1775), *E. coioides* (Hamilton, 1822), *E. fasciatus* (Forsskål, 1775), *E. geoffroyi* (Klunzinger, 1870), *E. malabaricus* and *E. merra* Blotch, 1793 (Parenti & Bressi 2001; Golani *et al*., 2002; Lelelong, 2005; Golani *et al.,* 2015; Schembri & Tonna, 2011; Bariche & Heemstra, 2012; Rothman *et al.,* 2016); and four come from the Atlantic Ocean: *E. aeneus* (Geoffroy Saint-Hilaire, 1817), *E. caninus* (Valenciennes, 1843), *E. costae* (Staindachner, 1878), and *E. marginatus* (Lowe, 1834) (Heemstra & Randall, 1993; Heemstra & Randall, 1999; Froese & Pauly, 2023).

The areolate grouper *E. areolatus* was first recorded in 2015 in the Mediterranean Sea off the coast of Israel and documented by Rothman *et al.* (2016). Subsequently, this species was captured the second and third times off the coast of Lebanon, as reported by Bariche & Edde (2020). More recently, *E. areolatus* has been reported in Syrian waters by Al Mabruk *et al*. (2021).

Previously, there have been four exotic grouper species recorded in Turkish Mediterranean waters (Engin *et al.,* 2016; Gokoglu & Ozvarol, 2015; Erguden *et al.,* 2021; Yapici & Sevingel, 2020; Gokoglu & Bicer, 2022), namely the yellowfin hind *Cephalopholis hemistiktos* Rüppell, 1830, the orange-spotted grouper *E. coioides* (Hamilton, 1822), the blacktip grouper *E. fasciatus* (Forsskål, 1775), and the creole fish *Paranthias furcifer* (Valenciennes, 1828). With the addition of this new record, a new exotic grouper species has been identified within the marine ichthyofauna of Turkey.

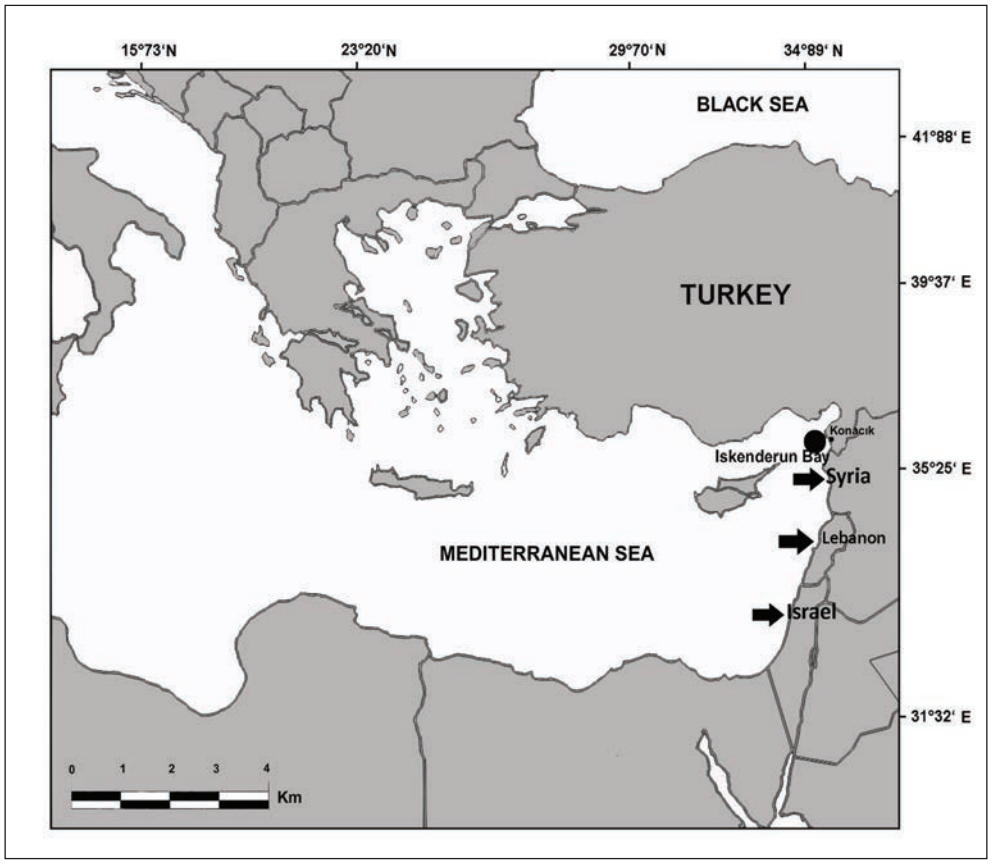

Fig. 1: Map of the Eastern Mediterranean indicating the capture sites of the specimen presented in the study (black dot) and of previous records of *Epinephelus areolatus* ***(arrows).***
Sl. 1: Zemljevid vzhodnega Sredozemskega morja z označeno lokaliteto, kjer je bil ujet primerek vrste *Epinephelus areolatus* ***(črni krogec) in prejšnji zapisi o pojavljanju vrste (puščice).***

Fig. 2: The** Epinephelus areolatus **captured in the Iskenderun Bay.
Sl. 2: Primerek vrste** Epinephelus areolatus **ujet v zalivu Iskenderun.

Although *E. areolatus* has been sighted in eastern Mediterranean waters, there have been no previous reports of its presence in Turkish waters. Thus, the present marks the first record of this species from the Mediterranean Sea coast of Turkey (Bay of Iskenderun).

MATERIAL AND METHODS

A single specimen of *E. areolatus* was caught by hook and line off the coast of Arsuz (Konacik) in the Bay of Iskenderun (at 36º29′ N, 35º78′ E) on 22 April 2023 (Fig. 1). The fish was solitary and swimming at a depth of 8 m. The surface temperature of the sea was 22.5 ºC. The morphometric measurements were taken using digital calipers and recorded to the nearest 0.1 cm, and the specimen's total body weight was determined and recorded to the nearest 0.1 g (Fig. 2). The morphological and colour descriptions used for the identification of this specimen of *E. areolatus* have been presented by Heemstra & Randall (1993) and Rothman *et al.* (2016).

RESULTS AND DISCUSSION

The captured specimen of *E. areolatus* measured 28.5 cm in total length (TL), 23.5 cm in standard length, and weighed 529.0 g in total weight. The species typically exhibits a moderately elongated body and a large head, with a large mouth containing two rows of teeth. The continuous dorsal fin with interspinous membrane is slightly incised. The anal, pectoral, and pelvic fins are rounded, while the caudal fin is slightly emarginated in adults. The posterior edge of the pre-operculum is serrated with larger serrations (Golani *et al.,* 2002). Dorsal fin with XI, 15 rays, pectoral fin rays 17, anal fin rays III, 8. Caudal fin rays 17. Head length (HL) is 33.16% of TL; body depth is 26.84% of TL; eye diameter is 14.73% of HL; interorbital width is 12.63% of HL; snout length is 18.84% of HL.

Colour: The body's background colour was whitish, with closely-set orange-brown or greenish-yellow spots, most of which were sub-equal to the diameter of the eye. The posterior margin of the caudal fin was white and the pectoral fins pale, featuring small dark spots on the rays (in agreement with Heemstra & Randall, 1999; Allen & Erdmann, 2012).

Although *E. areolatus* shares similarities with other grouper species, such as *E. coioides*, *E. marginatus*, and *E. geoffroyi*, it differs from them in the size of spots on its body and its distinct colour pattern.

The areolate grouper *E. areolatus* is widespread in the Indo-Pacific Ocean, its range extending from the Red Sea, the Persian Gulf and Natal in South Africa in the west, to Fiji in the east, Japan in the north, and northern Australia in the south (Froese & Pauly, 2023). The distribution of the species in Mediterranean waters, as presented in Fig. 1, is based on previous capture records and the present

report from the Bay of Iskenderun.

E. areolatus is a reef-associated species, typically found in seagrass beds or near rocky habitats (Heemstra & Randall, 1993) in shallow continental waters. It feeds on fish and large invertebrates (Randall & Heemstra, 1991). The areolate grouper is a protogynous hermaphrodite, with females maturing at 20 cm TL, and males at 30 cm TL. Most individuals measure between 20 and 40 cm TL, with a recorded maximum length at 47 cm TL (Moran *et al.,* 1988).

In this study, *E. areolatus* was captured at a depth of 8 m in the Bay of Iskenderun (Arsuz, Turkey), within a rocky area partly covered with algae. Randall *et al*. (1990) reported a depth range of 6 to 200 m for this species. Thus, the observed depth of 8 m aligns with the literature (Froese & Pauly, 2023).

CONCLUSIONS

Our finding from the Bay of Iskenderun represents the first occurrence and evidence of *E. areolatus* along the south-eastern Mediterranean coast of Turkey. This current record brings the number of exotic grouper species recorded in the Mediterranean Sea coast of Turkey to five. The presence of this new grouper species is likely a result of migrations from the eastern Mediterranean basin. However, further monitoring studies are necessary to confirm the establishment of a viable population in this region.

ACKNOWLEDGMENTS

The authors would like to thank the fisherman Isa TURAN for providing the sample.

PRVI ZAPIS O POJAVLJANJU RDEČEPIKČASTE KIRNJE *EPINEPHELUS AREOLATUS* (EPINEPHELIDAE) V JUGOVZHODNEM SREDOZEMSKEM MORJU (TURČIJA)

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POVZETEK

Avtorji poročajo o prvi najdbi rdečepikčaste kirnje Epinephelus areolatus *Forsskal, 1775, iz sredozemske turške obale. Primerek vrste* E. areolatus *so ujeli 22. aprila 2023 na trnek na globini 8 m ob obali Arsuza v zalivu Iskenderun. Ujeti primerek je meril 28,5 cm totalne dolžine in 23,5 cm standardne dolžine. Ta vrsta je v Sredozemsko morje prišla skozi Sueški prekop. Pričujoči zapis povečuje število eksotičnih vrst kirnj, potrjenih v turškem Sredozemskem morju, na pet vrst.*

Ključne besede: eksotična kirnja, nova najdba, migracija, turška obala

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FIRST RECORD OF THE MARINE HETEROBRANCH *SPINOAGLAJA WILDPRETII* (ORTEA, BACALLADO & MORO, 2003) (CEPHALASPIDEA: AGLAJIDAE) IN SICILY (IONIAN SEA) WITH NOTES ON ITS BIOLOGY AND ECOLOGY

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ABSTRACT

The present note documents the first report of the Aglajidae Spinoaglaja wildpretii *along the central-eastern coast of Sicily, a coastal stretch which has been recently examined regarding marine heterobranchia fauna. This rare sea slug was found discontinuously in its distribution range by both enthusiasts and specialists (Canary Islands and Mediterranean Sea) from the time of its description until today. In this short note, all the available biological and ecological information about* S. wildpretii *is here reviewed and discussed. From resumed and new data about this species, it can be hypothesized that* S. wildpretii *can be a generalist marine heterobranch species, having been found in very ubiquitous habitats during most of the months of the year and in a large range of temperatures.*

Key words: Head-shield marine slugs, Heterobranchia, Ionian Sea, Philinoidea, sea slugs

PRIMA SEGNALAZIONE DELL'ETEROBRANCO MARINO *SPINOAGLAJA WILDPRETII* (ORTEA, BACALLADO & MORO, 2003) (CEPHALASPIDEA: AGLAJIDAE) IN SICILIA (MAR IONIO) CON CENNI SULLA SUA BIOLOGIA ED ECOLOGIA

SINTESI

La presente nota documenta il primo ritrovamento di Spinoaglaja wildpretii *(Aglajidae) lungo la costa centro-orientale della Sicilia, un tratto costiero che è stato recentemente esaminato per quanto riguarda la fauna a eterobranchi marini. Questa rara specie è stata rinvenuta sia da appassionati che specialisti in maniera discontinua nel suo areale di distribuzione (Isole Canarie e mar Mediterraneo) da quando è stata descritta. In questa breve nota vengono riviste e discusse tutte le informazioni disponibili riguardanti la biologia ed ecologia di* S. wildpretii. *Dai nuovi dati e da quelli raccolti su questa specie, può essere ipotizzato che* S. wildpretii *sia una specie di eterobranco marino generalista, essendo stata rinvenuta in diverse tipologie di ambienti, durante la maggior parte dei mesi dell'anno e a un ampio range di temperature.*

Parole chiave: cefalaspidei, Heterobranchia, mar Ionio, Philinoidea, lumache di mare

INTRODUCTION

Spinoaglaja Ortea, Moro & Espinosa, 2007 is one of the 16 genera belonging to the family Aglajidae Pilsbry, 1895 (1847) (MolluscaBase, 2023a), the second richest in species family of the order Cephalaspidea (Zamora-Silva & Malaquias, 2018).

Members of this genus are mainly characterized by: a cephalic shield narrower than the shell region and with its posterior edge following horizontally the body level; a fully calcified internal shield-shaped shell with a variable number of spiniform processes attached to the protoconch; caudal lobes of the body similar in shape and size; and a head devoid of sensory whiskers (Ortea *et al.*, 2007). Nowadays this genus is represented by a total of five species: *Spinoaglaja aeci* (Ortea & Espinosa, 2001); *S. navia* Ortea, 2022; *S. orientalis* (Baba, 1949); *S. petra* (Ev. Marcus, 1976) and *S. wildpretii* (Ortea, Bacallado & Moro, 2003) (MolluscaBase, 2023b). Every species of this genus shows a characteristic chromatic pattern that makes them easily distinguishable. This genus seems to be prevalently distributed in the western part of the Atlantic [Costa Rica, Bahamas and Cuba for *S. aeci* (Ortea & Espinosa, 2001; Ortea *et al.*, 2007); French Guiana for *S. navia* (Ortea, 2022); Bahamas, Tobago, Martinique and north of Brazil for *S. petra* (Ornelas-Gatdula & Valdés, 2012)]. However, two species of this genus, *S. orientalis* and *S. wildpretii*, are distributed in other areas of the world: the former in the Indo-Pacific (Gosliner *et al.*, 2018; Nakano, 2019), while the latter in the Mediterranean Sea and the Canary Islands.

In the last decade, one of these five species, *S. wildpretii*, has aroused the interest of several marine heterobranch specialists in both the Macaronesian and Mediterranean areas due to its presumed rarity and its discontinuous findings (Ballesteros *et al.*, 2016; Horst *et al.*, 2021) (Fig. 1 and Tab. 1). *Spinoaglaja wildpretii* was documented for the first time in 1998 for the Canary Islands through a photo posted in 2001 on the famous Bill Rudman's website, Sea Slug Forum, by one of its users (Koehler, 2001). This species was officially described only five years later under the name *Melanochlamys wildpretii* by Ortea *et al.* (2003) through the examination of three specimens collected at Sardina del Norte

Fig. 1: Map of the Mediterranean and Macaronesian reports of *Spinoaglaja wildpretii*.
Sl. 1: Zemljevid Sredozemskega morja in Makaronezije z najdbami vrste *Spinoaglaja wildpretii*.

Tab. 1: Available information about** Spinoaglaja wildpretii **from scientific literature, books and websites. The question marks indicate absence of data concerning the mentioned type of information.
Tab. 1: Razpoložljivi podatki o vrsti** Spinoaglaja wildpretii **iz strokovne literature, knjig in spletnih strani. Vprašaj označuje pomanjkanje podatkov v viru.

References	Dates	N° of specimens	Location	Substrates	Depth (m)	Temperature °C
Koehler, 2001	?-?-1998	1	Gran Canaria Island (Canary Islands, Spain)	on alge covered by detritus	1	?
Ortea *et al.*, 2003	18-06-2003	3	Gáldar (Canary Islands)	on and below muddy sediment covered by rocks	4-15	?
Manousis *et al.*, 2012	?	2 (shells)	Cape (Epanomi, Greece)	*Zostera*	0.2	?
Trainito & Doneddu, 2014a; 2014b	27-11-2012	1	Punta Saline (Olbia, Italy)	on a leaf of *Posidonia oceanica*	3	?
	12-12-2012	1	Punta Saline (Olbia, Italy)	detritus/sediment	3	?
	28-10-2013	2	Lido del Sole Bay (Olbia, Italy)	on a valve of dead *Pinna nobilis*	5	?
	7-12-2013	1	Porto San Paolo Bay (Loiri Porto San paolo, Italy)	on stolons of *Caulerpa cylindracea*	5	?
Horst & Juan, 2015	23-07-2012	1	Les Vieilles (Anthéor, France)	on a tile covered by *Acetabularia* sp. and *Liagora* sp.	3	?
Romani & Pagli, 2015	?	1 (shell)	Port of Livorno (Livorno, Italy)	muddy bottom	10	?
	?	1 (shell)	Zannone Island (Latina, Italy)	coralligenous bottom	36	?
Ballesteros *et al.*, 2016	13-12-2011	1	Tossa de Mar (Spain)	among *Posidonia oceanica* and masses of photophilic algae	?	?
	5-12-2013	1	Sa Tuna (Begur, Spain)	among *Posidonia oceanica* and masses of photophilic algae	?	?
	3-10-2014	1	Morro del Vedell (Palamós, Spain)	among *Posidonia oceanica* and masses of photophilic algae	?	?
	31-10-2015	1	Cap de Creus (Spain)	among *Posidonia oceanica* and masses of photophilic algae	?	?
Prkić *et al.*, 2018	?	1	Kasjuni (Split, Croatia)	?	25	?
Furfaro *et al.*, 2020; Salento Sommerso, 2023	?-11-2015	1	Porto Cesareo (Lecce, Italy)	on dead algae	0.2	?
	23-02-2023	1	Porto Badisco (Otranto, Italy)	on a sponge	10	11-12
Horst *et al.*, 2021	16-05-2016	1	L'Eglise (Cagnes-sur-mer, France)	on and below sand	7	?
	21-09-2017	1	Golfe de Lava (Appietto, France)	above turf of filamentous algae on *Posidonia oceanica* matte	4	?
Present note	17-07-2023	1	Acque fredde (Santa Tecla, Italy)	on a thallus of *Halopteris scoparia*	6.2	24-25

(Gáldar, Gran Canaria, Canary Islands). Subsequently, Ortea *et al*. (2007) included this species in the new genus *Spinoaglaja* Ortea, Moro & Espinosa, 2007 due to the presence in the shell of this species of conic spines on the protoconch. For almost a decade, no live specimen of *S. wildpretii* was found. Indeed, the only finding of this species was that of two shells reported for Cape Epanomi in Greece (as *Melanochlamys wildpretii*) (Manousis *et al.*, 2012).

However, after the publication of this Greek report, the first Mediterranean record of a living *S. wildpretii* specimen was published by Horst and Juan (2015) for the waters of Les Vieilles (Anthéor, France). Almost in the same period, Trainito and Doneddu (2014a; 2014b) reported the finding of five specimens for the areas of Olbia and Loiri Porto San Paolo (Sardinia, Italy), while Romani and Pagli (2015) documented two shells of this species at Livorno (Italy) and Zannone island (Italy). Subsequently, four specimens of this Aglajidae were found in four locations along the Catalan coast (Spain) (Ballesteros *et al.*, 2016) and one in the area of Kasjuni (Split, Croatia) (Prkić *et al.*, 2018). Other additional findings of this mollusc were documented from 2015 to 2023 by Furfaro *et al*. (2020) and Salento Sommerso (2023) for Italy (two specimens reported for Apulia) and by Horst *et al*. (2021) for France (one for the French Riviera and the other one for western Corsica).

Recently, during a scuba dive a specimen of *S. wildpretii* was found in a site of the central-eastern coast of Sicily (Ionian Sea). Consequently, the present note here documents the first report for Sicily of this rare species with a brief review of all the information available from scientific articles, books and websites about this marine heterobranch.

MATERIAL AND METHODS

The specimen of *Spinoaglaja wildpretii* was found during a morning dive carried out on 17 July 2023 at Acque fredde (37°38′15.5″N, 15°10′51.1″E), a site located within the hamlet of Santa Tecla (Municipality of Acireale). Acque fredde is one of the only three sites along the central-eastern coast of Sicily in which there is a stable and healthy population of *Ericaria zosteroides* (C. Agardh) Molinari & Guiry (Marletta & Lombardo, 2023) and thus it presents general good environmental conditions. The encountered specimen was not collected but was documented photographically through an Olympus TG-4 underwater camera. Through the examination of the photos and the pertinent literature (see reference) it was possible to identify the individual as *S. wildpretii*. In addition, through the observation of the photos, it was possible to determine even the substrates in which the specimen was found. The depth and temperature were registered at the moment of the finding via a Suunto D6i dive computer. Moreover, to measure the specimen and obtain the best photographic output, the specimen was put on a black plastic board.

RESULTS

The specimen of *Spinoaglaja wildpretii* (Fig. 2 A-G) was found in a turf composed of several thalli of the brown algae *Halopteris scoparia* (Linnaeus) Sauvageau (6.2 m of depth, 24-25°C). In particular, the individual was found at the base of a thallus of *H. scoparia* among/above a mix of detritus/sand, filamentous and laminar small algae. Overall, the animal presented a rest/contract position that gave him a general stubby aspect. Once removed from the substrate and placed above a plastic board, the animal became immediately active (crawling rapidly) and regained its normal body shape (about 13 mm in length).

DISCUSSION

With the present note the cephalaspidean *Spinoaglaja wildpretii* is reported for the first time along the coasts of Sicily, specifically for the central-eastern coast of this island, a coastal stretch that has been recently studied regarding the marine Heterobranchia fauna (Lombardo & Marletta, 2020). Due to the scant findings and its inconspicuous lifestyle, this species is generally considered rare (Trainito & Doneddu, 2014a; Horst *et al.*, 2021). Moreover, as can be seen through the documented findings of this species, *S. wildpretii*'s preferential habitats are, almost always, those with a soft substrate (sand, mud, detritus), a coverage (more or less dense) of different types of marine plants (seagrasses and algae) or rocks and pebbles. In these habitats, the finding of sea slugs is often difficult and it is possible only either when they move to less shaded areas [e. g. on the upper part of plants (Koehler, 2001; Trainito & Doneddu, 2014a; Ballestero *et al.*, 2016; Horst *et al.*, 2021) or on uncovered areas (Ortea *et al.*, 2003; Trainito & Doneddu, 2014a; Horst *et al.*, 2021) or on conspicuous substrates (Trainito & Doneddu, 2014a; Horst & Juan, 2015; Furfaro *et al.*, 2020; Salento Sommerso, 2023)]. Consequently, the life habitat of this species plays an important role in its inconspicuousness and presumed rarity.

Regarding the geographical origin of this species, in the last years two possible hypotheses were assumed. The first one is by Trainito and Doneddu (2014a) and Ballesteros *et al*. (2016), who stated

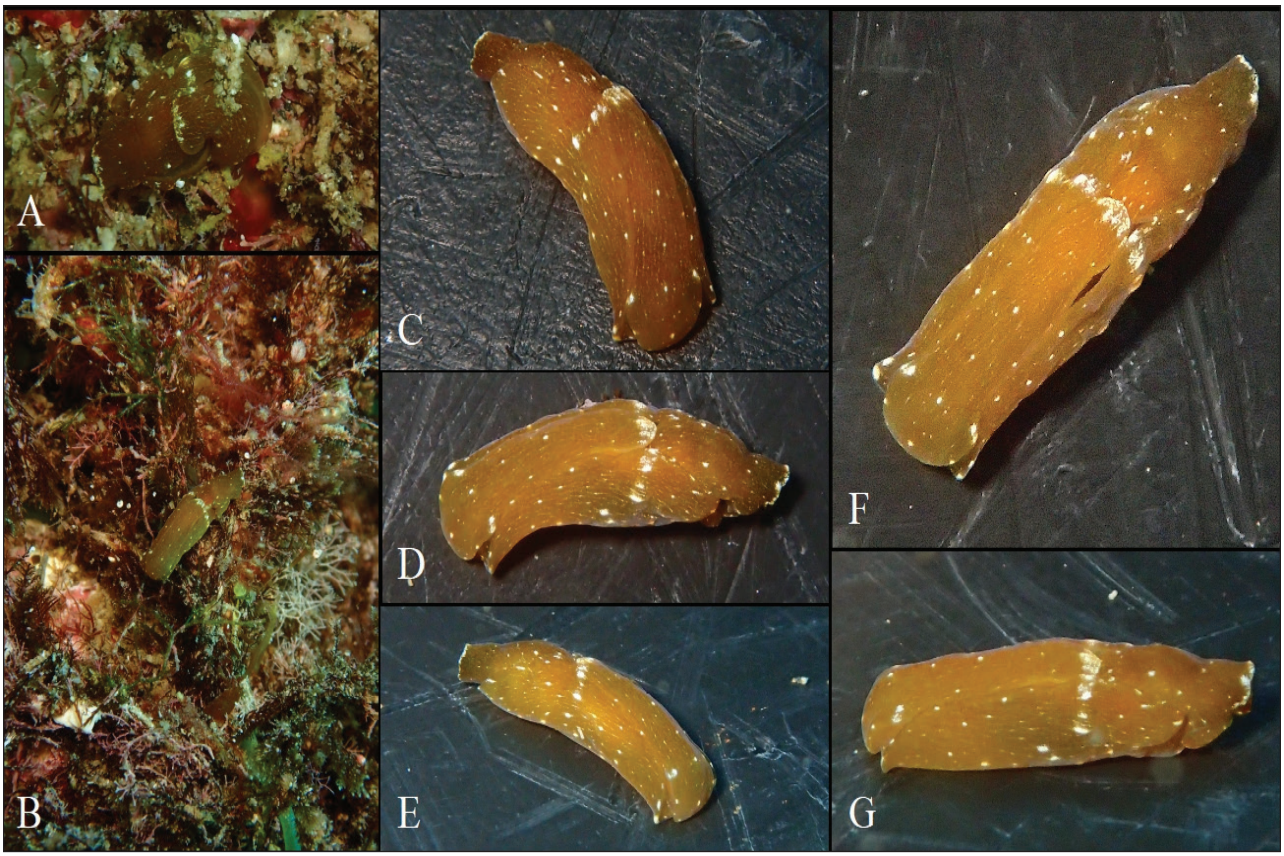

Fig. 2: The specimen of** Spinoaglaja wildpretii **found at Acque fredde. A) the individual, with a stubby aspect, at the moment of the finding; B) the specimen relocated on its substrate; C) anterodorsal view of the animal; D) left dorsolateral view; E) right dorsolateral view; F) dorsal view; G) left lateral view (photos by A. Lombardo).
Sl. 2: Primerek vrste** Spinoaglaja wildpretii**, najden na lokaliteti Acque fredde. A) čokat primerek v trenutku najdbe; B) primerek v njegovem okolju; C) anterodorzalni pogled na živa; D) levi dorzolateralni pogled; E) desni dorzolateralni pogled; F) hrbtni pogled; G) pogled z levega boka (fotografije: A. Lombardo).

that due to the location of the reports documented at the time, *S. wildpretii* might be an Atlanto-Mediterranean species. The second hypothesis was stated also by Ballesteros *et al.* (2016) who, following the information reported in a study of another *Spinoaglaja* species (*S. petra*) (Ornelas-Gatdula & Valdés, 2012), suggested that the distribution of *S. wildpretii* may indicate the existence of two sympatric-cryptic species, a Canarian and a Mediterranean one.

In particular, the case of *S. wildpretii* seems to be halfway between that of *O. picoensis*, with few reports in the Macaronesia versus a huge quantity of findings in the Mediterranean (Lombardo & Marletta, 2021; Trainito *et al.*, 2022); and that of *T. mazda*, with a single record for the Macaronesia and two for the Mediterranean basin (Lombardo, 2023). Although the difference in the number of reports, the geographical pathway made by these species from the Atlantic Ocean and Mediterranean Sea is very similar. Moreover, due to the presumed similarity in the pattern of findings of these three species, understanding one of them could permit us to assume that of the other two.

Regarding the biology of this species, there is very little and scattered information among literature and websites (Tab. 1). In general, *S. wildpretii* is a burrowing animal that lives in sandy and muddy environments with half-buried stones (Ortea *et al.*, 2003; Ballesteros *et al.*, 2016). However, through the examination of published data, *S. wildpretii* does not seem a complete burrower animal. Indeed, in many reports, it was documented above different solid substrates. Consequently, although this species has probably burrowing habits, it can easily adapt to several types of substrates, but always in proximity of covered areas. As concerns this, meadows of seagrass, turfs of macroalgae and

rocks fit perfectly in this category. Overall, this species was found: once in February (Furfaro *et al.*, 2020; Salento Sommerso, 2023), once in May (Horst *et al.*, 2021), once in June (Ortea *et al.*, 2003), twice in July (Horst & Juan, 2015; present note), once in September (Horst *et al.*, 2021), three times in October (Trainito & Doneddu, 2014a; Ballesteros *et al.*, 2016), twice in November (Trainito & Doneddu, 2014a; Furfaro *et al.*, 2020; Salento Sommerso, 2023) and four times in December (Trainito & Doneddu, 2014a; Ballesteros *et al.*, 2016). Therefore, most reports were documented during autumn months. Moreover, although temperature data were registered only twice (Salento Sommerso, 2023; present note), it can be assumed that *S. wildpretii* is a eurytherm species, having been found both at 11-12 °C (Salento Sommerso, 2023) and 24-25 °C (present note). As regards the bathymetric range of *S. wildpretii* (considering live specimen records), this species was found from under the level of seawater to 25 m of depth (Salento Sommerso, 2023; Prkić *et al.*, 2018). To conclude, from the sum of the new data reported here and those taken from the literature, it would appear that *S. wildpretii* can be found in various marine habitats, for most months of the year and over a wide range of temperatures.

PRVI ZAPIS O POJAVLJANJU MORSKEGA ZAŠKRGARJA VRSTE *SPINOAGLAJA WILDPRETII* (ORTEA, BACALLADO & MORO, 2003) (CEPHALASPIDEA: AGLAJIDAE) NA SICILIJI (JONSKO MORJE) Z ZAPISKI O NJENI BIOLOGIJI IN EKOLOGIJI

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POVZETEK

Avtorja poročata o prvem zapisu o pojavljanju vrste Spinoaglaja wildpretii *iz družine Aglajidae na obalnem odseku vzdolž srednjevzhodne obale Sicilije, kjer sta raziskovala polže zaškrgarje. Tega redkega morskega polža so od njegovega opisa tako strokovnjaki kot navdušenci do danes v njegovem arealu le občasno našli (Kanarsko otočje in Sredozemsko morje). V tej beležki avtorja podajata vse razpoložljive biološke in ekološke podatke o vrsti* S. wildpretii. *Na podlagi razpoložljivih in novih podatkov domnevata, da je* S. wildpretii *med zaškrgarji vrsta generalista, ki jo najdemo v zelo različnih habitatih večino mesecev v letu in v velikem razponu temperatur.*

Ključne besede: Cephalaspidea, Heterobranchia, Jonsko morje, Philinoidea, polži zaškrgarji

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FIRST EVIDENCE OF THE PRESENCE OF *OKENIA PICOENSIS* PAZ-SEDANO, ORTIGOSA & POLA, 2017 (GASTROPODA: NUDIBRANCHIA) IN THE ADRIATIC SEA

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ABSTRACT

The authors report the finding of some specimens (8 sightings) of Okenia picoensis *(Gastropoda: Nudibranchia) at three different sites in Croatia (northern Adriatic Sea). Although this seaslug species has only recently been described, this record confirms its rapid spread throughout the Mediterranean Sea. This finding represents the first substantiated record in the Adriatic Sea.*

Key words: Heterobranchia, spreading, northern Adriatic Sea

PRIME PROVE DELLA PRESENZA DI *OKENIA PICOENSIS* PAZ-SEDANO, ORTIGOSA & POLA, 2017 (GASTROPODA: NUDIBRANCHIA) NEL MARE ADRIATICO

SINTESI

Gli autori riportano il ritrovamento di alcuni esemplari (8 avvistamenti) di Okenia picoensis *(Gastropoda: Nudibranchia) in tre diversi siti della Croazia (Adriatico settentrionale). Sebbene questa specie di nudibranco sia stata descritta solo di recente, i dati confermano la sua rapida diffusione in tutto il Mediterraneo. Questo ritrovamento rappresenta il primo ritrovamento documentato nell'Adriatico.*

Parole chiave: Heterobranchia, espansione, Adriatico settentrionale

INTRODUCTION

Heterobranch gastropods have been gaining increasing attention from the scientific community, with fresh evidence consistently being published in specialised scientific literature. A significant contribution to their knowledge also comes from citizen science, which is recognised for its efficacy in collecting valuable and dependable data for diverse research purposes, as highlighted by Langeneck *et al*. (2022). According to Trainito *et al*. (2022), the intense fascination with 'nudibranchs', along with the technological development of increasingly powerful cameras, and their widespread use by divers have made diving a basic documentation tool for most researchers, as demonstrated by Bohnsack (1979) and Cattaneo-Vietti & Mojetta (2021). Moreover, with the growing number of underwater photographers (Parera *et al.*, 2020), discoveries of new, rare, or lesser-known heterobranchs are rapidly shared through social media, leading to the publication of many new heterobranch detections (e.g., Fortič *et al.*, 2021; Kousteni *et al.*, 2022; Montesanto *et al.*, 2022; Trainito *et al.*, 2023). The team of authors gathered around this article testifies to the well-established cooperation between underwater photographers and researchers, confirming it with a new sighting of *Okenia picoensis* Paz-Sedano, Ortigosa & Pola, 2017 in the northern Adriatic Sea. This species was originally described from the Azores by Paz-Sedano *et al*. (2017), who identified two colour patterns: one white with yellow tips of the rhinophores and cerata, and the other pale yellow with orange tips (Paz-Sedano *et al.*, 2017). The first record of *O. picoensis* in the Mediterranean Sea was reported by Pontes and Madrenas (2022) at four different localities in Malta and off the coast of Almuñécar (Granada), Spain. Later, specimens of *O. picoensis* were recorded in different locations in Sicily (Crocetta *et al.,* 2021; Lombardo & Marletta, 2021). Afterwards, Trainito *et al*. (2022) published the first record of this species in Sardinia and provided a comprehensive list of all thirty documented sightings in the Mediterranean Sea to date, based on published records and specialist portals (DORIS; OPK-Opistobranquis). They noted that almost all the records were derived from reports by non-specialists. Trainito *et al*. (2022) concluded that the spreading of *O. picoensis* involves the entire Mediterranean Sea save the Adriatic Sea.

Fig. 1: Locations of sighting. The red square indicates the location of the investigated area in the Adriatic Sea.
Sl. 1: Lokacije opazovanj. Rdeč okvir označuje lokacijo raziskanega predela v Jadranskem morju.

Tab. 1: Findings of** Okenia picoensis **specimens in the studied area with data about dates, sites, coordinates, number of specimens, depths, and habitats.
Tab. 1: Podatki o datumih, lokalitetah, številu primerkov, globinah in habitatih najdenih primerkih vrste** Okenia picoensis **na obravnavanem območju.

Date		Site	Coordinates		n	Depth (m)	Habitat
			N	E			
1	dec. 22	Kostrena	45.30323	14.48866	1	11	Rocky bottom on *Codium bursa*
2	apr. 23	Marco Polo Diving	45.34083	14.37235	3	7	Rocky bottom on *Codium bursa*
3	jun. 23	Girandella diving	45.07949	14.17512	1	27	Rocky bottom on *Codium bursa*
4	jun. 23	Marco Polo Diving	45.34083	14.37235	1	22	Rocky bottom on *Codium bursa*
5	jun.23	Girandella diving	45.07949	14.17512	1	17,5	Rocky bottom on *Codium bursa*
6	aug. 23	Kostrena	45.30323	14.48866	1	23	Rocky bottom on *Codium bursa*

Herein, we report the first record of *O. picoensis* in the Adriatic Sea and discuss the accompanying information obtained in the region.

MATERIAL AND METHODS

A first specimen of *Okenia picoensis* was found in December 2022 at a depth of 11 m in Kostrena (Rijeka, Croatia) (Fig. 1). Subsequently, in April and May 2023, three more specimens were discovered at a depth of 6-7 m at the Marco Polo diving site near Rijeka, not far from the first location (Tab. 1). Finally, in June, the species was observed in the waters off Rabac (reef near the Girandella diving centre) in the eastern part of the Istrian Peninsula at a depth of 17 m, and again in August in the Kostrena area at a depth of 23 m. The specimens were identified using the diagnostic features described by Paz-Sedano *et al.* (2017). The validity of the Latin name was checked against the World Register of Marine Species [WoRMS]. The specimen from Kostrena was photographed using a Canon M50 with a mini flash backscatter, while the specimens from Rijeka were shot using a Nikon D800 and a Seacam150 flash with a macro lens Inon ucl67. The first specimen is now housed in the collection of the Marine Biology Station Piran (NIB).

RESULTS AND DISCUSSION

Eight specimens of *Okenia picoensis* (Gastropoda: Nudibranchia) were recorded at three different sites in Croatia (northern Adriatic Sea). The discovery areas were characterised by rocky bottom boulders of varying sizes and small inlets covered with a sciaphilous assemblage at depths ranging from 7 to 27 m. All the individuals were found on *Codium bursa* algae. According to published monographs and scientific papers (Betti, 2011; Ciriaco & Poloniato, 2016; Zenetos *et al.*, 2016; Lipej *et al.*, 2018; Prkić *et al.*, 2018, Ciriaco *et al.*, 2023), the species had not been previously recorded in the Adriatic Sea (Fig. 2).

Since *O. picoensis* has only recently been described, its ecological and biological characteristics are still poorly known. This sighting is the first documented record of this species in the Adriatic Sea. Considering the map of all records summarised by Trainito *et al.* (2022), which confirmed records for all parts of the Mediterranean except the Adriatic Sea, a first record in the latter was expected. In the northern Adriatic, *O. picoensis* was found at shallower depths (6 to 17 m) compared to other areas, where depths ranged from 15 to 34 m (Orfanidis *et al.*, 2021; Crocetta *et al.*, 2021; Lombardo & Marletta, 2021; Trainito *et al.*, 2022).

According to Pola *et al.* (2019), to date, at least five species of the genus *Okenia* have been recorded in the Adriatic Sea: *Okenia elegans* (Leuckart, 1828), *O. mediterranea* (Von Ihering, 1886), *O. aspersa* (Alder & Hancock, 1945), *O. longiductis* (Pola, Paz-Sedano, Macali, Minchin, Marchini, Vitale, Licchelli & Crocetta, 2019), *O. problematica* (Pola, Paz-Sedano, Macali, Minchin, Marchini, Vitale, Licchelli & Crocetta, 2019). All of these were also reported in the northern region of the Adriatic. The present finding of *O. picoensis*

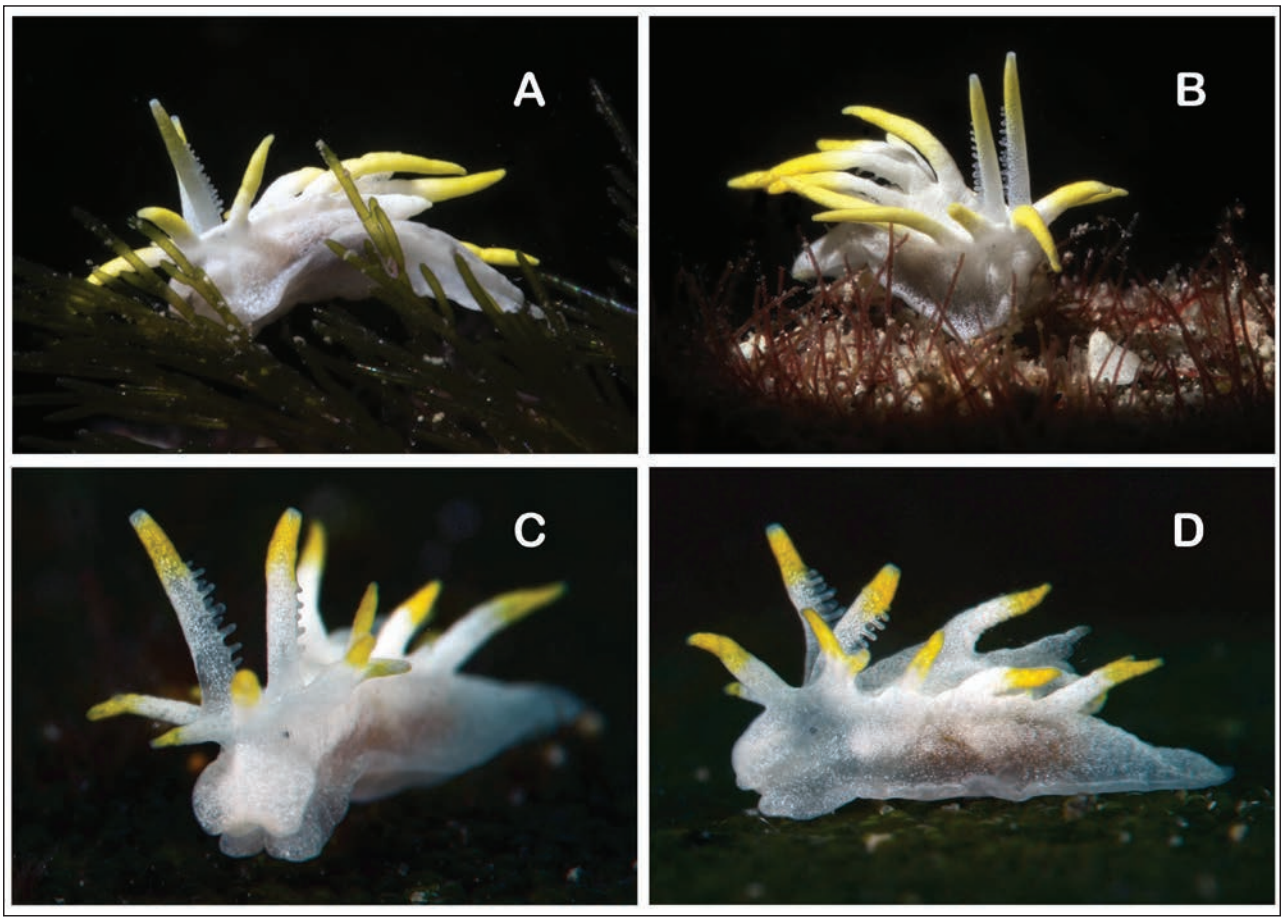

Fig. 2: A white morph of *Okenia picoensis*. ***A, B – a specimen photographed in Kostrena (Rijeka, northern Adriatic Sea) in December 2022 (photo: J. Vecchi); C, D – specimens photographed at the Marco Polo Diving Centre (Rijeka, Croatia) in April 2023 (photo: C. Scrigner).***
Sl. 2: Bela različica vrste *Okenia picoensis*. ***A, B – primerek, fotografiran v Kostreni (Rijeka, severno Jadransko morje) v decembru 2022 (foto: J. Vecchi); C, D – primerka, fotografirana na lokaciji Marco Polo Diving Centre (Rijeka, Hrvaška) v aprilu 2023 (foto: C. Scrigner).***

brings the total number of species in the Adriatic Sea to six for this genus.

Trainito *et al.* (2022) expressed some doubts regarding the status of *O. picoensis* as an alien species, suggesting that it might be more reasonable to consider *O. picoensis* a native species of the entire Atlanto-Mediterranean region. This consideration raises the question whether the species has spread to the Adriatic from a specific part of the Mediterranean Sea or is simply a case of a previously overlooked nudibranch.

Due to its rapid expansion throughout the Mediterranean Sea, it is realistic to expect reports of this species from other parts of the Adriatic Sea as well.

PRVI ZAPIS O POJAVLJANJU VRSTE GOLOŠKRGARJA *OKENIA PICOENSIS* PAZ-SEDANO, ORTIGOSA & POLA, 2017 (GASTROPODA: NUDIBRANCHIA) IZ JADRANSKEGA MORJA

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POVZETEK

Avtorji poročajo o najdbi osmih primerkov vrste Okenia picoensis *(Gastropoda: Nudibranchia) na treh različnih lokacijah na Hrvaškem (severno Jadransko morje). Čeprav je bila ta vrsta šele pred kratkim opisana, pričujoči podatki potrjujejo, da se hitro razširja po Sredozemskem morju. Te najdbe predstavljajo prvi zapis o pojavljanju te vrste v Jadranskem morju.*

Ključne besede: Heterobranchia, razširjanje, severno Jadransko morje

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FLORA

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LA FLORA DI LAMA DEI PELIGNI (ABRUZZO, ITALIA): AGGIORNAMENTO SISTEMATICO E NUOVE SEGNALAZIONI

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SINTESI

Il Comune di Lama dei Peligni è situato in Provincia di Chieti (Regione Abruzzo), è parzialmente compreso nel Parco Nazionale della Maiella e occupa la superficie di 31,33 km². Il presente lavoro segue un altro del 2011 e ha la finalità di riportare un elenco floristico aggiornato dei taxa presenti nell'ambito di studio. La compilazione di una nuova check-list è indispensabile poiché dopo il 2011, i nuovi studi hanno portato a rimaneggiamenti tassonomici, altre segnalazioni e l'esclusione di taxa in precedenza considerati presenti. L'elenco floristico attuale comprende 1360 taxa tra cui 94 specie endemiche che accrescono l'importanza fitogeografica dell'area di studio. Lo spettro corologico mostra che i taxa censiti appartengono a 52 diversi corotipi, ripartiti in 9 contingenti geografici.

Parole chiave: Lama dei Peligni, Maiella, Abruzzo, flora, fiume Aventino

THE FLORA OF LAMA DEI PELIGNI (MAIELLA NATIONAL PARK, ABRUZZO, ITALY): SYSTEMATIC UPDATE AND NEW REPORTINGS.

ABSTRACT

The territory of Lama dei Peligni covers 31,33 km², is located in the province of Chieti, Abruzzo Region (Italy) and is a part of the National Maiella Park. This work follows another from 2011 and aims to report a new updated checklist of floristic species present in the study area. This compilation is essential because after 2011 the new studies carried out led to taxonomic changes, other reports and the exclusion of various taxa previously considered present. The current floristic list consists of 1360 taxa including 94 endemic species which increase the phytogeographic importance of the study area. The chorological spectrum shows that all taxa belong to 52 different chorotypes divided into 9 geographical contingents.

Key words: Lama dei Peligni, Maiella, Abruzzo, flora, Aventino River.

INTRODUZIONE

Nel territorio di Lama dei Peligni Pezzetta (2011) segnalava 937 taxa. In seguito, i rimaneggiamenti tassonomici e le nuove ricerche di Ciaschetti *et al*. (2015), Conti *et al*. (2019, 2020), Di Santo & Pezzetta (2012), Pezzetta *et al*. (2022), Tesei *et al*. (2021) e Ubaldi (2012) hanno ampliato le conoscenze esistenti segnalando nuove entità ed escludendo taxa che in precedenza si consideravano presenti. Alla luce di questi fatti si rende necessaria la compilazione di un nuovo elenco floristico con tutte le novità riscontrate.

Inquadramento dell'area d'indagine

Lama dei Peligni è un Comune abruzzese (Fig. 1) situato all'altitudine media di 669 metri s.l.m. e che occupa la superficie di 31,33 km². La popolazione residente è costituita da 1057 individui, con una densità media di circa 34 abitanti/km² (Demo ISTAT, 2022). Essa vive in gran parte nel capoluogo e il resto costituito da poche centinaia d'individui è sparso in varie frazioni.

Il territorio comunale (Fig. 2), compreso tra le altitudini di 286 e 2690 metri s. l. m., si può ripartire in un settore montuoso posto sul versante orientale del massiccio della Maiella e uno collinare percorso nella parte più bassa dal fiume Aventino, un affluente del Sangro. Il settore collinare presenta una pendenza media di circa il 12% ed è costituito dai nuclei abitati, infrastrutture viarie, ambiti incolti, pochi terreni coltivati e lembi di bosco sparsi. A sua volta quello montuoso, completamente disabitato è caratterizzato da una forte acclività tra l'altitudine di 750 e 1500 metri, dal pendio più dolce sino a 2400 metri e oltre questa quota da estesi pianori altitudinali.

Nel Comune si osservano diverse formazioni sedimentarie che iniziarono a depositarsi nel Giurassico Superiore e proseguirono nelle ere geologiche successive: rocce calcaree e detriti di falda del settore montuoso; terreni calcarei, depositi alluvionali quaternari, rocce conglomeratiche, argillose, marnose, sabbiose e flyschoidi presenti in quello collinare.

Mentre i terreni calcarei sono di natura permeabile, gli strati argillosi sono impermeabili. Su di essi si osservano stagni e ruscelli più o meno temporanei e scorrono le acque meteoriche che in alcune zone hanno provocato profonde incisioni dando origine a fenomeni calanchivi. Nelle zone di contatto tra terreni argillosi e calcarei affiorano sorgenti che in passato hanno rivestito una notevole importanza per l'irrigazione e l'approvvigionamento idrico. Altre meno numerose affiorano anche in alcuni ambiti del settore montuoso e un tempo erano utilizzate dai pastori e i loro armenti.

Per quanto riguarda il clima è da evidenziare che il territorio lamese gode di una favorevole esposizione alla luce solare, mentre il retrostante massiccio montuoso lo protegge dai venti freddi settentrionali e crea le condizioni per gli incrementi dei valori termici locali. Tuttavia, a causa dell'ampia escursione altitudinale non è possibile definire per l'area un'unica tipologia del clima locale. I valori medi dei parametri climatici sotto riportati sono stati ottenuti dall'elaborazione dei

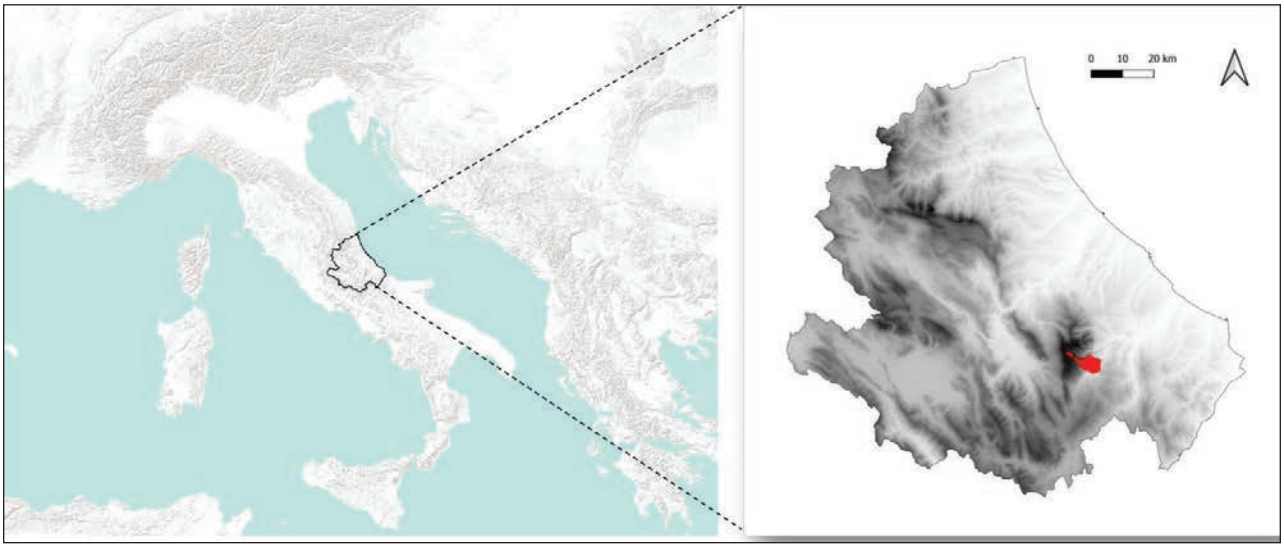

Fig. 1: Posizione della Regione Abruzzo in Italia e di Lama dei Peligni (indicata in rosso).
Sl. 1: Geografska lega regije Abruci in predela Lama dei Peligni (označen z rdečo barvo).

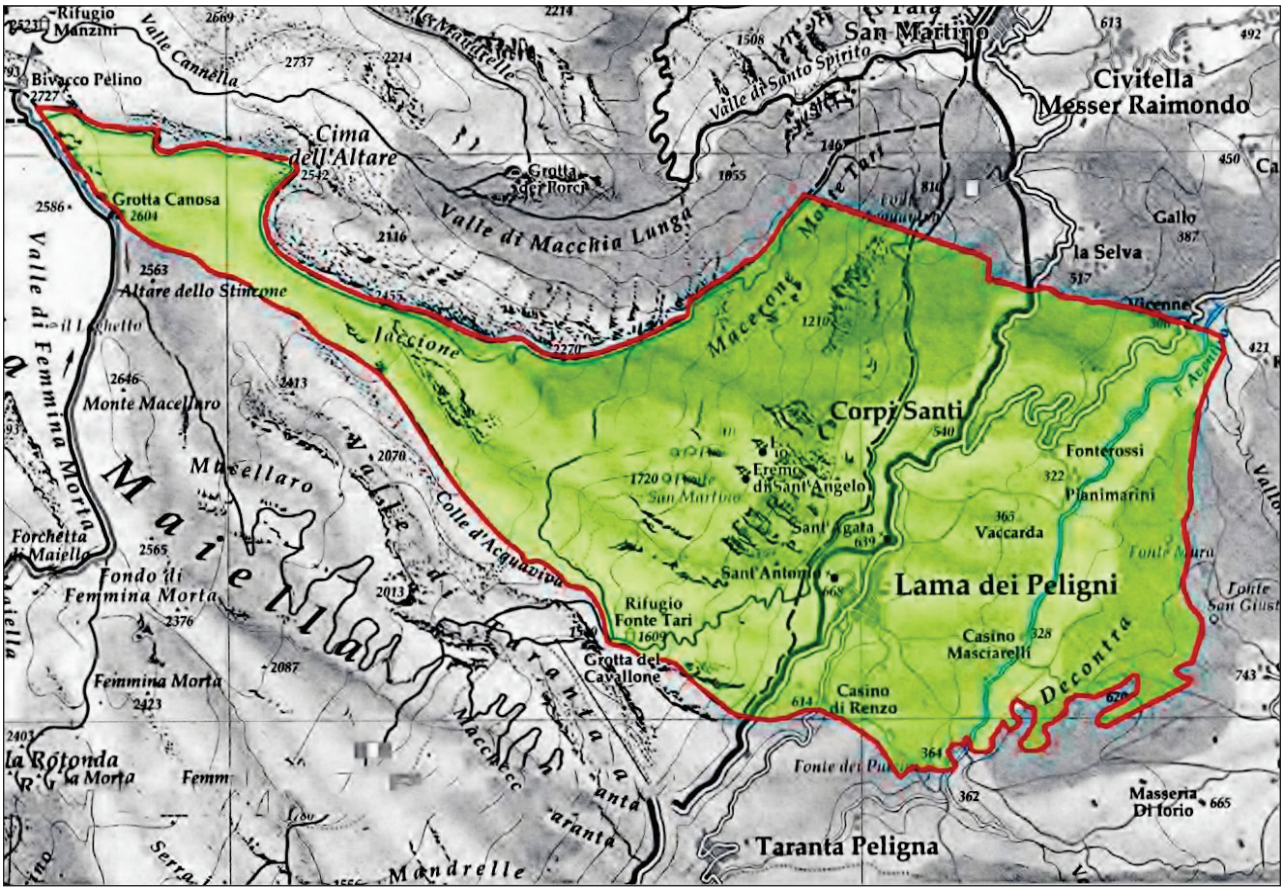

Fig. 2: Il territorio comunale di Lama dei Peligni (circondato dalla linea rossa).
Sl. 2: Občinski teritorij Lame dei Peligni (obkrožen z rdečo črto).

dati statistici dal 1920 al 2010 che sono stati forniti alcuni anni fa dal Servizio Idrografico di Pescara e dall'Ufficio Coordinamento servizi vivaistici e agri meteo di Scerni (CH). In seguito, i dati elaborati sono stati inseriti nel saggio di Pezzetta (2011). Nel centro abitato si registrano i seguenti parametri termo-pluviometrici che sono tipici di un clima submediterraneo di transizione: temperatura media annua 12°C; mese più freddo (gennaio) con 4°C; mese più caldo (agosto) con 23°C; precipitazioni medie annue circa 800 mm; stagione con precipitazioni più abbondanti l'autunno con circa 244 mm; stagione con precipitazioni minime: l'estate con circa 133 mm. Nel resto del territorio posto ad altitudini diverse, come hanno rilevato Frattaroli *et al.* (2006), si osservano altre tipologie climatiche che in base al metodo di classificazione di Rivas-Martinez (1996), sono caratterizzate dai seguenti termotipi che esprimono la componente termica del clima e ombrotipi, a loro volta sono legati alle precipitazioni: il termotipo mesotemperato superiore e l'ombrotipo umido/subumido che sono tipici della fascia altitudinale posta sino a 800 metri; il termotipo collinare-montano e l'ombrotipo umido che comprendono la fascia altitudinale tra 800 e 1500 metri; il termotipo montano-subalpino e l'ombrotipo umido inferiore che caratterizzano la fascia tra 1500 e 2200 metri; il termotipo orotemperato inferiore e l'ombrotipo iperumido inferiore che caratterizzano le aree poste oltre 2200 metri.

Il paesaggio e le formazioni vegetali

Le formazioni vegetali del territorio lamese sono molto varie e la conseguenza delle caratteristiche geo-morfologiche locali, della rilevante escursione altimetrica e della plurimillenaria pressione antropica (Pezzetta, 1991, Di Santo & Pezzetta, 2012).

L'ambito in esame è abitato dalla preistoria e per diversi millenni, la popolazione vi ha operato per ricavare terreni coltivabili, pascoli, legna da ardere e materiali da costruzione. Queste pratiche hanno portato alla fondazione di aree urbane, abitazioni secondarie sparse, la riduzione delle superfici forestali e la formazione di terreni aperti. I pochi di

lembi di bosco presenti sino a un recente passato testimoniavano l'aspetto che aveva il paesaggio vegetale prima che l'uomo iniziasse a trasformarlo. Ora la popolazione residente ha registrato una forte flessione, la pastorizia è quasi assente e l'attività agricola è limitata alla cura di pochi terreni e colture specializzate (orti, uliveti e vigneti). A causa della pressione antropica molto ridotta e della conseguente bassa azione di disturbo si osserva la riduzione dei terreni aperti e il progressivo aumento della superficie occupata dalla vegetazione prenemorale e dal manto forestale. Il paesaggio attuale è costituito da un mosaico che associa boschi in espansione, centri abitati, antichi pascoli, terreni agricoli e aree incolte. Le principali formazioni vegetali che lo compongono sono le seguenti: boschi ripariali disposti lungo le sponde del fiume Aventino; formazioni idrofile varie situate presso le sorgenti, i bordi di strade con ruscellamenti, i fossi e le aree con ristagni d'acqua; formazioni vegetali sinantropiche situate presso le abitazioni, le aree incolte, marginali e i campi coltivati o abbandonati; prati aridi disposti sui terreni calcarei e le aree argillose interessata da un'attività erosiva; formazioni arboreo-arbustive sparse; boschi termofili misti di caducifoglie con infiltrazioni di essenze arboree mediterranee sclerofille; una faggeta termofila mista posta in località Valle di Sant'Angelo; formazioni glaericole e rupestri poste a varie altitudini; due pinete artificiali a pino nero; pascoli montani di derivazione secondaria posti tra 1200-2200 metri di altitudine; formazioni arbustive alto-montane con pino mugo e ginepro nano in fase di espansione sui pascoli abbandonati; praterie alpine primarie poste oltre 2200 metri d'altitudine. Alla loro composizione concorrono le entità riportate nell'elenco floristico che segue.

Le ricerche botaniche a Lama dei Peligni

Le prime esplorazioni floristiche dell'ambito di studio iniziarono nel XIX secolo con il botanico napoletano Michele Tenore (1832) che lo visitò nel 1831 e l'anno dopo pubblicò i dati delle sue ricerche. Nelle escursioni del territorio lamese Tenore fu accompagnato da Marco Cocco, un contadino analfabeta che alcuni decenni dopo fornì a Gennaro Finamore (1889, 1894) notizie e piante utilizzate per la medicina popolare locale. A questi personaggi, nella seconda metà del XIX secolo si aggiunse Cesati (1872) che citò alcune specie presenti nel territorio lamese. A inizio del nuovo secolo Abbate (1901) segnalò altri ritrovamenti floristici.

Le nuove e più consistenti segnalazioni floristiche si ebbero agli inizi degli anni 80 del secolo scorso, con la pubblicazione di una ricerca di Feoli-Chiapella (1979-80). Qualche anno dopo Tammaro (1986) in un saggio cita oltre 50 specie presenti a Lama dei Peligni. Altre notizie sulla flora e/o vegetazione di Lama dei Peligni sono riportate nei saggi dei seguenti autori: Caprara (1986), Pezzetta (1991, 2012, 2019), Conti (1993, 1997, 1998, 2003), Daiss & Daiss (1997), Ubaldi *et al*. (1998), Del Pizzo (1999), Martelli (1997), Manzi (1999, 2001, 2003, 2006), Comitato Scientifico Filippo Di Donato del Club Alpino di Pescara (2002), Frattaroli *et al*. (2006), Di Pietro *et al*. (2008), Gottlisch (2009), Di Santo & Pezzetta (2012), Ubaldi (2012), Ciaschetti *et al*. (2015), Conti *et al*. (2008, 2019, 2020), Bartolucci *et al*. (2019), Tesei *et al*. (2021) e Pezzetta *et al*. (2022). Anche Di Francesco (2004) e Di Fabrizio (2006), due laureandi, per la stesura delle loro tesi si sono occupati della flora e vegetazione lamese. All'incremento delle conoscenze floristiche ha contribuito anche il personale del Giardino Botanico Michele Tenore, fondato a Lama nel 1995. Esso ogni anno pubblica in rete un index seminum in cui riporta l'elenco dei semi raccolti in giardino ed in natura, specificando per questi ultimi la località di raccolta.

MATERIALI E METODI

L'elenco aggiornato della flora di Lama dei Peligni deriva dalla rilettura di vari saggi precedenti, i dati ricavati dalla nuova letteratura consultata e le ricerche sul campo effettuate dopo il 2011 da Pezzetta e Paolucci.

L'elenco floristico attuale comprende le specie e le sottospecie, mentre non sono stati considerati gli ibridi e le varietà cromatiche e morfologiche. La nomenclatura adottata e l'ordine di elencazione delle varie famiglie e taxa seguono Conti *et al*. (2020), con l'eccezione di alcuni taxa per i quali la nomenclatura è stata rivista recentemente. Accanto ad ogni taxon sono riportati: il tipo corologico, gli autori che l'hanno segnalato ed eventuali note o osservazioni.

Al fine di non ripetere troppe volte gli autori delle segnalazioni si è deciso di utilizzare al loro posto delle sigle costituite da lettere maiuscole. Esse hanno il seguente significato: AH: Tenore, 1832; AK: Tenore, 1842; AX: Cesati, 1872; AY: Abbate, 1901; BK: Feoli Chiapella, 1979-80; BX: Tammaro, 1986; CK: Pezzetta, 1991; CX: Conti, 1993; DK: Conti, 1997; DN: Conti, 1998; DX: Daiss & Daiss, 1997; DY: Erbario Parco della Maiella; EK: Pellegrini, 1997; EX: Ubaldi *et al*., 1998; EY; Del Pizzo, 1999; FK: Manzi, 1999; FX: Manzi, 2001; FY: Comitato Scientifico Filippo Di Donato, 2002; GH: Conti, 2003; GK: Di Francesco, 2004; GX: Blasi *et al*., 2005; GY: Di Fabrizio, 2006; IK: Frattaroli *et al*., 2006; IX: Conti *et al*., 2008; IY: Di Pietro *et al*., 2008; KH: Gottschlich, 2009; KX: Di Santo & Pezzetta, 2012; KY: Index seminum, 2012; LK: Index seminum, 2014; LX:

Ciaschetti *et al.,* 2015; LY: Index seminum, 2016; LW: Index seminum, 2018; MX: Conti *et al.,* 2019; MY: index seminum, 2019; OK: Pezzetta, 2019; OX: Conti *et al.,* 2020; OY: index seminum, 2020; PX: Index seminum, 2021; PY: Tesei *et al.,* 2021; QX: Index seminum, 2022; QY: Pezzetta *et al.,* 2022; RX: Di Santo, informazione personale; RY: Manzi, informazione personale; SX: Paolucci, osservazione personale; SY: Pezzetta, osservazione personale.

Si riportano anche in tale lavoro le segnalazioni di Aurelio Manzi e Daniele Di Santo, utilizzate in Pezzetta (2011). I taxa che dopo il corotipo sono contrassegnate da un asterisco non erano riportati nel precedente saggio sulla flora lamese (Pezzetta, 2011).

Per l'assegnazione dei tipi corologici si è tenuto conto di quanto riportato in Pignatti (2018) tranne i seguenti due casi. Al corotipo Subendemico sono stati assegnati i taxa con un areale che comprende qualche regione italiana e altre di stati europei. Al corotipo Appennino-Balcanico sono stati assegnati i taxa presenti solo nel territorio delimitato dai seguenti confini fisici (Pezzetta 2010): a) per la Penisola Italiana, le isole e l'arco appenninico dalla Liguria all'Aspromonte; b) per la Penisola Balcanica, Creta, le isole dell'Egeo e il territorio continentale posto a sud dell'asse fluviale che va dalle sorgenti della Sava alle foci del Danubio e dal Mar Nero all'Adriatico-Ionio.

Nella compilazione della Tabella 1 è stato utilizzato il concetto di "Contingente Geografico" e in tale voce sono stati fatti dei raggruppamenti di corotipi in base al seguente schema:

- nel Contingente "Endemico e Subendemico" sono inclusi i corotipi con la stessa dicitura;
- nel Contingente "Mediterraneo" sono inclusi i corotipi Eurimediterraneo, Mediterraneo-Macaronesico, Mediterraneo-Occidentale, Mediterraneo-Orientale, Mediterraneo-Montano, Nord-Mediterraneo, Nord-Est-Mediterraneo, Nord-Ovest-Mediterraneo, Stenomediterraneo, Sud-Mediterraneo, Sud-Est-Mediterraneo e Sud-Ovest-Mediterraneo;
- nel Contingente "Eurasiatico" sono inclusi i corotipi Europeo-Caucasico, Eurasiatico s.s., Eurosiberiano, Mediterraneo-Turaniano, Paleotemperato, Pontico, Subpontico e Sud-Europeo-Sud-Siberiano;
- nel Contingente Nordico sono inclusi i corotipi Artico-Alpino e Circumboreale;
- nel Contingente "Europeo" sono inclusi i corotipi Europeo s.s., Orof. Centro-Europeo Orof. Sud-Ovest-Europeo, Orof. Sud- Europeo, Orof. Sud-Est-Europeo, Orof. Sud-Ovest-Europeo, Centro-Europeo, Sud-Est-Europeo, Sud-Europeo, Sud-Ovest-Europeo e Appennino-Balcanico;
- nel Contingente "Atlantico" sono inclusi i corotipi Atlantico, Mediterraneo-Atlantico e Subatlantico;
- nel contingente Avventizio ed Extraeuropeo sono inclusi i corotipi Americano, Nord-Americano, Sud-Americano, Avventizio, Asiatico, Asiatico-Centro-Occidentale, Asiatico-Orientale, Neotropicale, Paleotropicale e Pantropicale;
- nel contingente Cosmopolita sono inseriti i corotipi Cosmopolita e Subcosmopolita.

La bibliografia comprende tutti i saggi consultati che riportano segnalazioni floristiche riguardanti il territorio in esame.

RISULTATI E DISCUSSIONE

L'elenco floristico è costituito da 1360 taxa ripartiti in 105 famiglie (Appendice 1). Le entità non riportate nell'elenco floristico precedente ammontano a 446. Le nuove ricerche non hanno confermato le seguenti entità segnalate in precedenza: *Blechnum spicant* (L.) Roth, *Cupressus arizonica* Green, *Gypsophila repens* L. Borbás, *Mandragora autumnalis* Bertol., *Minuartia graminifolia* (Ard.) Jáv. ssp. *clandestina* (Port.) Mattf, *Orlaja daucorlaja* Murb., *Pinus pinea* L., *Potentilla tabernaemontani* Asch., *Rosa pendulina* L., *Thymus glabrescens* Willd., ssp. *decipiens* (Heinr. Braun) Domin. e *Veratrum nigrum* L.

L'area ospita il 13,7% della flora vascolare italiana che in base alle ricerche più recenti (Bartolucci *et al.,* 2022) raggiunge il valore di 9948 taxa. La flora lamese costituisce anche il 58,9% della flora del Comprensorio del Parco Nazionale della Maiella che ammonta a 2310 taxa (Stinca *et al.,* 2021) e il 37,7% della flora abruzzese, a sua volta costituita da 3604 entità (Bartolucci *et al.,* 2022).

Le famiglie vegetali più rappresentate sono le seguenti: Asteraceae (162 taxa). Fabaceae (139), Poaceae (106), Brassicaceae (70), Lamiaceae (62), Apiaceae (58), Cariophyllaceae (54), Rosaceae (49), Orchidaceae (47), Ranunculaceae (42) e poi seguono le altre con valori minori.

L'elenco comprende oltre 60 taxa alloctoni dei quali alcuni invasivi, altri utilizzati a fini ornamentali, per le alberature stradali, i rimboschimenti e coltivati che si sono spontaneizzati e continuano a vegetare nei terreni abbandonati.

Nell'elenco sono riportati i seguenti taxa che ad avviso di Conti *et al*. (2020) raggiungono nel Parco della Maiella il limite meridionale di distribuzione geografica in Italia: *Campanula spicata*, *Centranthus angustifolius* subsp. *angustifolius*, *Delphinium peregrinum*, *Epilobium alsinifolium*, *Erigeron alpinus*, *Gentiana orbicularis*, *Hornungia alpina* subsp. *alpina*, *Iberis saxatilis* subsp. *saxatilis*,

Tab. 1: Corotipi della flora di Lama dei Peligni.
Tab. 1: Horotipi flore občine Lama dei Peligni.

Contingenti geografici	Numero taxa	%	Contingenti geografici	Numero taxa	%
Endemico e Subendemico	**99**	**7,3**	Orof. Sud-Europeo	29	
Endemico	94		Orof. Sud-Est-Europeo	10	
Subendemico	5		Orof. Sud-Ovest-Europeo	5	
Mediterraneo	**491**	**36,1**	Ovest-Europeo.	5	
Eurimediterraneo	255		Sud-Est-Europeo	26	
Stenomediterraneo	121		Sud-Europeo	8	
Mediterraneo-Macaronesico	1		Sud-Ovest-Europeo	4	
Mediterraneo-Montano	71		**Atlantico**	**25**	**1,8**
Mediterraneo-Orientale	9		Atlantico	3	
Mediterraneo-Occidentale	13		Mediterraneo-Atlantico	11	
Nord-Mediterraneo	6		Subatlantico	11	
Nord-Est-Mediterraneo	1		**Nordico**	**77**	**5,7**
Nord-Ovest-Mediterraneo	3		Artico-Alpino	24	
Sud-Mediterraneo	8		Circumboreale	53	
Sud-Ovest-Mediterraneo	2		**Cosmopolita**	**70**	**5,1**
Sud-Est-Mediterraneo	1		Cosmopolita	41	
Eurasiatico	**311**	**22,9**	Subcosmopolita	29	
Eurasiatico s. s.	118		**Avventizio ed Extraeuropeo**	**63**	**4,6**
Europeo-Caucasico	26		Avventizio	22	
Eurosiberiano	27		Asiatico	7	
Mediterraneo-Turaniano	21		Asiatico-Centro-Occidentale	1	
Paleotemperato	79		Asiatico-Occidentale	3	
Pontico	37		Asiatico-Orientale	3	
Subpontico	1		Americano	5	
Sud-Europeo-Sud-Siberiano	2		Nord-Americano	8	
Europeo	**224**	**16,5**	Sud-Americano	4	
Appennino-Balcanico	65		Neotropicale	2	
Centro-Europeo	15		Pantropicale	2	
Europeo s. s.	56		Paleotropicale	4	
Orof. Centro-Europeo	1		Subtropicale	2	

Isatis apennina, Malcolmia orsiniana subsp. *orsiniana*, *Oreomecon alpina* subsp. *alpina*, *Ranunculus seguieri* subsp. *seguieri* e *Trifolium noricum* subsp. *praetutianum*. *Athamanta sicula*, invece raggiunge il limite settentrionale di distribuzione geografica. Queste entità accrescono l'importanza naturalistica del territorio in esame e del Parco stesso.

La Tabella 1 riporta i risultati dell'analisi fitogeografica, con la ripartizione percentuale dei vari elementi corologici. Da essa si osserva che i taxa si ripartiscono in 52 diversi corotipi raggruppati in 9 contingenti geografici, un dato confermativo che il massiccio della Maiella e l'Abruzzo, essendo situati al centro della penisola, costituiscono un importante crocevia di flussi floristici che ha ricevuto ondate migratorie di diversa origine geografica. Questa configurazione arealica è anche la conseguenza delle diverse condizioni ambientali causate dall'ampia escursione altitudinale, la presenza di aree esposte ai venti freddi settentrionali e nord-orientali e di altre riparate e molto soleggiate che nel loro insieme consentono l'attecchimento di piante con esigenze ecologiche molto varie. In particolare, nell'area di studio sono presenti taxa artico-alpini, eurosiberiani, circumboreali, subatlantici, europei, etc. tipici di ambiti mesofili e microtermici e altri termofili che attecchiscono alle basse quote del settore collinare e ad altre insolite costiuite dalle isole di mediterraneità poste sul massiccio della Maiella.

Dalla Tabella 1 si rileva che nel complesso domina il contingente Mediterraneo con 491 taxa (36,1% delle entità censite). Esso è seguito dai contingenti Eurasiatico con 311 taxa (22,9%), Europeo con 224 taxa (16,5%), Endemico con 99 taxa (7,3 %), Nordico con 77 taxa (5,7%), Cosmopolita con 70 taxa (5,1%), Avventizio ed Extraeuropeo con 63 (4,6%) e Atlantico con 25 taxa (1,8%). L'alta presenza di taxa mediterranei e eurasiatici dimostra che l'area è dominata da una componente floristica a baricentro sud-orientale.

Un contingente molto importante è quello endemico con circa il 7,3% dei taxa censiti, un valore percentuale inferiore a quello dell'intero comprensorio del Parco della Maiella che comunque conferma l'importanza naturalistica dell'area d'indagine. La maggior parte degli endemismi del territorio lamese è collocata in ambiti molto specializzati e con scarsa competizione vegetale quali le praterie alpine, subalpine e gli ambiti glareicoli e rupestri. Tra essi *Aquilegia magellensis, Crepis magellensis* e *Pinguicula fiorii* sono esclusivi del massiccio della Maiella.

I taxa del contingente Avventizio ed Extraeuropeo invece sono presenti solo nel settore collinare e alle basse quote di quello montuoso.

Sono degni di nota anche 24 taxa appartenenti al corotipo Artico-Alpino e 65 a quello Appennino-Balcanico poiché entità relittiche che documentano le migrazioni floristiche avvenute nel corso di diverse ere geologiche da nord in direzione sud e da est in direzione ovest. Anche tra la flora mediterranea censita sono presenti entità relittiche, in questo caso dette "xerotermiche", che si diffusero durante le ere geologiche caratterizzate da un clima caldo e secco. Un tempo esse erano presenti in territori più vasti, mentre ora sopravvivono solo in ambiti ristretti molto riparati e caldi. Appartengono a questa categoria: *Anethum piperitum*, *Catananche lutea*, *Ephedra major* ssp. *major*, *Laurus nobilis*, *Lomelosia crenata* ssp. *crenata*, *Ononis viscosa* ssp. *breviflora*, *Pyracantha coccinea*, *Quercus ilex, Rhamnus alaternus* ssp. *alaternus*, *Rosa sempervirens*, *Umbilicus horizontalis* ed altre. Le migrazioni floristiche sono state favorite anche dall'uomo che con la sua attività ha creato nuove nicchie e corridoi ecologici. In particolare, nell'area in esame, l'agricoltura e la pastorizia esercitate per millenni hanno favorito la diffusione delle archeofite e delle specie tipiche delle aree pascolative.

Al fine di ricavare altre informazioni fitogeografiche, in accordo con Poldini (1991), sono stati fatti tre raggruppamenti di corotipi definiti macrotermici, mesotermici e microtermici. Il raggruppamento macrotermico che comprende i contingenti Mediterraneo (escluso il corotipo Mediterraneo-Montano), Avventizio Extra-Europeo e i corotipi Sud-Est-Europeo, Sud-Europeo, Sud-Ovest-Europeo, Pontico e Subpontico nell'area in esame è rappresentato da 559 taxa (41,1%). Poiché nel gruppo è presente il maggior numero di taxa, si dimostra che nella flora lamese primeggia una componente termofila.

Il raggruppamento mesotermico con i corotipi Appennino-Balcanico, Atlantico, Centro-Europeo, Cosmopolita, Europeo, Eurasiatico, Eurosiberiano, Mediterraneo-Atlantico, Mediterraneo-Turaniano, Ovest-Europeo, Europeo-Caucasico, Paleotemperato, Sud-Europeo-Sud-Siberiano, Subcosmopolita e Subendemico è rappresentato da 503 taxa (37%).

Il raggruppamento microtermico in cui sono stati inclusi i corotipi Subatlantico, Circumboreale, Artico-Alpino, Mediterraneo-Montano, Orof. Centro-Europeo, O. Sud-Europeo, O. Sud-Est-Europeo e O. Sud-Ovest-Europeo è rappresentato da 204 taxa (15%). Questo raggruppamento è caratterizzato dal minor numero di taxa, a dimostrazione che nel territorio lamese ci sono limitate aree in cui attecchiscono entità tipiche di ambiti freschi, riparati e con temperature medie molto basse.

Gli altri corotipi non sono stati considerati poiché di difficile collocazione in uno dei tre gruppi. In particolare, non sono stati considerati i taxa endemici poiché ci sono alcuni che prediligono gli ambiti microtermici delle alte quote e altri mesofili o spiccatamente termofili che si rinvengono più in basso.

La presenza contemporanea dei tre raggruppamenti conferma che il territorio in esame è un ambito di transizione fitogeografico con varie tipologie ambientali, climatiche e di corrispondenti fasce vegetazionali.

RINGRAZIAMENTI

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Appendice 1: Elenco floristico aggiornato dei taxa presenti sul territorio di Lama dei Peligni. Legenda: * Specie non riportata in Pezzetta (2011). ## Specie nuova per il Parco Nazionale della Majella. °° Il taxon raggiunge nel Parco Nazionale della Majella il limite meridionale di distribuzione geografica in Italia.
Priloga 1: Posodobljen floristični seznam taksonov, prisotnih na teritoriju Lame dei Peligni. Legenda: * Vrste, ki jih Pezzetta (20112) ne omenja, ## nova vrsta za Nacionalni Park Majella, °° na območju Nacionalnega parka Majella takson dosega svojo južno mejo razširjenosti v Italiji.

Elenco floristico

	Elenco floristico	**TIPO COROLOGICO**	**AUTORI E OSSERVAZIONI**
	PTERIDOPHYTA		
	EQUISETACEAE		
1	*Equisetum arvense* L. ssp. *arvense*	Circumboreale	EY, SX, SY
2	*Equisetum ramosissimum* Desf.	Circumboreale	SX
3	*Equisetum telemateja* Ehrh	Circumboreale	SX
	OPHIOGLOSSACEAE		
4	*Botrychium lunaria* (L.) Sw	Subcosmopolita	IY
	DENNSTAEDTIACEAE		
5	*Pteridium aquilinum* (L.) Kuhn ssp. *aquilinum*	Cosmopolita	SX, SY
	PTERIDACEAE		
6	*Adiantum capillus-veneris* L	Pantropicale	EK, EX, GK
	CYSTOPTERIDACEAE		
7	*Cystopteris alpina* (Lam.) Desv	Cosmopolita	BX, SX
8	*Cystopteris fragilis* (L.) Bernh.	Cosmopolita	BX, SX
	ASPLENIACEAE		
9	*Asplenium ceterach* L.	Eurasiatico	EX, SY
10	*Asplenium fIssum* Kit. ex Willd.	Orof. Sud-Est-Europeo	SX
11	*Asplenium lepidum* C. Presl ssp. *l epidum*	Orof. Sud-Est-Europeo	BK, BX
12	*Asplenium onopteris L*	Subtropicale *	SX
13	*Asplenium ruta-muraria* L. ssp. *ruta-muraria*	Circumboreale	SX, SY
14	*Asplenium scolopendrium* L. ssp. *scolopendrium*	Circumboreale *	SX
15	*Asplenium trichomanes* L. ssp. *quadrivalens* D.E. Mey	Cosmopolita	EX, SX
16	*Asplenium viride* Huds.	Circumboreale	SY
	DRYOPTERIDACEAE		
17	*Dryopteris filix-mas* (L.) Schott	Cosmopolita	EY
18	*Polystichum aculeatum* (L.) Roth	Eurimediterraneo *	SX
19	*Polystichum lonchitis* (L.) Roth	Circumboreale	SY
	POLYPODIACEAE		
20	*Polypodium cambricum* L.	Eurimediterraneo *	SX
	GYMNOSPERMAE		
	EPHEDRACEAE		
21	*Ephedra major* Host ssp. *major*	Sud-Mediterraneo *	LX, MX, OX
	PINACEAE		
22	*Abies alba* Mill.	Orof. Sud-Europeo	EY, SY. Utilizzato per rimoboschimenti

23	*Abies cephalonica* Loudon	Avventizio	RX. Utilizzato per rimoboschimenti
24	*Cedrus atlantica* (Endl) Carrière	Sud-Ovest-Mediterraneo	RX
25	*Cedrus libani* A. Richard	Sud-Est-Mediterraneo	RX. Utilizzato per rimoboschimenti
26	*Pinus halepensis* Mill.	Stenomediterraneo	EY, SY
27	*Pinus mugo* Turra ssp. *mugo*	Eurasiatico	EK, EX, GK, SY
28	*Pinus nigra* J. F. Arnold ssp. *nigra*	Sud-Europeo	CK, EK, EX, EY, GK, PY, SY. Utilizzato per rimoboschimenti
	CUPRESSACEAE		
29	*Cupressus sempervirens* L.	Mediterraneo-Orientale	RX, SY
30	*Juniperus communis* L.	Circumboreale	CK, EK, EX, GK, PY, SY
31	*Juniperus deltoides* R. P. Adams	Eurimediterraneo	EK, EX, GK, SY
32	*Juniperus sabina* L.	Circumboreale	EK, GK
33	*Platycladus orientalis*	Est-Asiatico *	SX
	TAXACEAE		
34	*Taxus baccata* L.	Paleotemperato	EK, GK
	ANGIOSPERMAE		
	LAURACEAE		
35	*Laurus nobilis* L.	Stenomediterraneo	EY, SY. Coltivato, spontaneizzato
	ARISTOLOCHIACEAE		
36	*Aristolochia lutea* Desf.	Eurimediterraneo *	SX
	ARACEAE		
37	*Arum italicum* Mill. ssp. *italicum*	Stenomediterraneo	SY
	ALISMATACEAE		
38	*Alisma lanceolatum* With.	Subcosmopolita	SX
	DIOSCOREACEAE		
39	*Dioscorea communis* (L.) Caddick & Wilkins	Eurimediterraneo	SX, SY
	COLCHICACEAE		
40	*Colchicum neapolitanum* (Ten.) Ten. ssp. *neapolitanum*	Endemico *	SY
	MELANTHIACEAE		
41	*Paris quadrifolia* L.	Eurasiatico	SY
42	*Veratrum album* L.	Eurasiatico *	SY
	SMILACACEAE		
43	*Smilax aspera* L.	Stenomediterraneo	EX
	LILIACEAE		
44	*Gagea villosa* (M. Bieb.) Sweet	Eurasiatico	RX
45	*Lilium bulbiferum* L. ssp. *croceum* (Chaix) Jan	Orof. Centro-Europeo	RX
46	*Lilium candidum* L.	Mediterraneo-Orientale *	SY. Coltivato, naturalizzato
47	*Lilium martagon* L	Eurasiatico	EX

	ORCHIDACEAE		
48	*Anacamptis coriophora ssp. fragrans (Pollini) R.M. Bateman, Pridgeon & M.W. Chase*	Eurimediterraneo	QY
49	*Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase	Europeo-Caucasico	EK, EX, GK, KX, OK, QY
50	*Anacamptis pyramidalis* (L.) Rich.	Eurimediterraneo.	EK, KX, OK, QY
51	*Cephalanthera damasonium* (Mill.) Druce	Eurimediterraneo	EX, KX, OK, PY, QY
52	*Cephalanthera longifolia* (L.) Fritsch	Eurasiatico	DX, KX, OK, QY
53	*Cephalanthera rubra* (L.) Rich.	Eurasiatico	KX, OK, QY
54	*Dactylorhiza maculata* ssp. *saccifera* (Brongn.) Diklić	Paleotemperato	QY, SX
55	*Dactylorhiza sambucina* (L.) Soó	Europeo	KX, OK, QY
56	*Dactylorhiza viridis* (L.) R.M. Bateman, Pridgeon & M.W. Chase	Circumboreale *	QY
57	*Epipactis atrorubens* (Hoffm.) Besser	Europeo	EK, KX, OK
58	*Epipactis helleborine* ssp. *helleborine* (L.) Crantz	Paleotemperato	EK, EX, KX, OK
59	*Epipactis microphylla* (Ehrh.) Sw.	Europeo-Caucasico	QY, SX
60	*Epipactis muelleri* Godfery	Centro-Europeo *	QY
61	*Gymnadenia conopsea* (L.) R. Br. in W.T. Aiton	Eurasiatico	EX, KX, OK, QY
62	*Himantoglossum adriaticum* H. Baumann	Eurimediterraneo	KX, OK, QY
63	*Limodorum abortivum* (L.) Sw.	Eurimediterraneo	DX, EK, GK, KX, OK, QY
64	*Neotinea maculata* (Desf.) Stearn	Mediterraneo-Atlantico	KX, OK, QY
65	*Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.W. Chase	Eurimediterraneo	KX, OK, QY
66	*Neotinea ustulata* (L.) R.M. Bateman, Pridgeon & M. W. Chase	Europeo-Caucasico	KX, OK, QY
67	*Neottia nidus-avis* (L.) Rich.	Eurasiatico	EK, KX, QY
68	*Neottia ovata* (L.) Bluff & Fingerh.	Eurasiatico *	KX, OK, QY
69	*Ophrys apifera* Huds.	Eurimediterraneo	EK, GK, KX, OK, QY
70	*Ophrys argolica* ssp. *crabronifera* Faurh.	Endemico *	SX
71	*Ophrys bertolonii* ssp. *bertolonii* Moretti	Appennino-Balcanico	KX, OK, QY
72	*Ophrys bombyliflora* Link	Stenomediterraneo	DN, DX, KX, OK, OX, QY
73	*Ophrys holosericea* (Burm. f.) Greuter ssp. *appennina* (Romolini & Soca) Kreutz	Endemico *	QY
74	*Ophrys holosericea* ssp. *gracilis* (Büel, O. Danesch & E. Danesch) Büel, O. Danesch & E. Danesch	Endemico *	SX
75	*Ophrys holosericea* (Burm. f.) Greuter ssp. *dinarica* (Kranjcev & P. Delforge)	Appennino-Balcanico *.	QY
76	*Ophrys holosericea* (Burm. f.) Greuter ssp. *pinguis* (Romolini & Soca) Kreutz	Endemico*	SX
77	*Ophrys holosericea* ssp. *tetraloniae* (W.P. Teschner) Kreutz	Appennino-Balcanico	DX, KX, OK, QY
78	*Ophrys incubacea* Bianca ssp. *incubacea*	Stenomediterraneo	EY, KX, OK, QY
79	*Ophrys lutea* Cav.	Stenomediterraneo	KX, OK, QY
80	*Ophrys molisana* Delforge	Endemico *.	SX
81	*Ophrys promontorii* O. Danesch & E. Danesch	Endemico	KX, OK, QY

82	*Ophrys sphegodes* ssp. *sphegodes* Mill.	Eurimediterraneo	EK, GK, KX, OK, QY
83	*Ophrys sphegodes* ssp. *tommasinii (*Vis.) Soó	Appennino-Balcanico	OK, QY
84	*Orchis anthropophora* (L.) All.	Mediterraneo-Atlantico	KX, OK, QY
85	*Orchis italica* Poir.	Stenomediterraneo	KX, OK, QY
86	*Orchis mascula* L.ssp. *mascula*	Centro-Europeo *	QY
87	*Orchis militaris* L.	Eurasiatico	EK, KX, OK, QY
88	*Orchis pauciflora* Ten.	Stenomediterraneo	KX, OK, QY
89	*Orchis purpurea* Huds.	Eurasiatico	CK, DX, EK, GK, KX, OK, QY
90	*Platanthera bifolia* (L.) Rchb. ssp. *bifolia*	Paleotemperato	KX, OK, QY
91	*Platanthera chlorantha* (Custer) Rchb.	Eurosiberiano *	KX, OK, QY
92	*Pseudorchis albida* (L.) A. Löve & D. Löve	Artico-Alpino *	EX
93	*Serapias parviflora* Parl.	Stenomediterraneo *	SX
94	*Serapias vomeracea* (Burm.f.) Briq. ssp. *vomeracea*	Eurimediterraneo *	QY, SX
	IRIDACEAE		
95	*Crocus neapolitanus* (Ker Gawl.) Loisel.	Eurimediterraneo	SY
96	*Gladiolus italicus* Mill.	Eurimediterraneo	SY
97	*Iris florentina* L.	Avventizio	SY
98	*Iris germanica* L.	Avventizio	SY
99	*Iris marsica I.* Ricci & Colas.	Endemico	RY
	A SPHODELACEAE		
100	*Asphodeline liburnica* (Scop.) Rchb.	Appennino-Balcanico *	LW, MY. La segnalazione del taxon è dubbia
101	*Asphodeline lutea* (L.) Rchb.	Mediterraneo-Orientale	EX, SY
102	*Asphodelus fistulosus* L.	Subtropicale *	SX
103	*Asphodelus macrocarpus* Parl. ssp. *macrocarpus*	Mediterraneo-Montano	SY
	AMARYLLIDACEAE		
104	*Allium cepa L.*	Ovest-Asiatico	SY. Coltivato e spontaneizzato
105	*Allium longispathum* Redouté	Paleotemperato	SY
106	*Allium lusitanicum* Lam.	Eurasiatico	SY
107	*Allium moschatum* L.	Sud-Est-Europeo	RY
108	*Allium nigrum* L.	Stenomediterraneo *	SX
109	*Allium polyanthum* Schult. & Schult.f.	Avventizio *	SX
110	*Allium roseum L. ssp. roseum*	Stenomediterraneo *	SX
111	*Allium sativum L.*	Asiatico-Centro-Occidentale	SY. Coltivato, spontaneizzato
112	*Allium sphaerocephalon* L.	Paleotemperato	EX, LY
113	*Allium tenuiflorum* Ten.	Stenomediterraneo *	SX
114	*Allium ursinum*	Eurasiatico	SY
115	*Allium vineale* L.	Eurimediterraneo *	SX
116	*Galanthus nivalis* L.	Sud-Est-Europeo	EX, SY
117	*Narcissus poeticus* L.	Orof. Sud-Europeo	RX
118	*Narcissus x medioluteus* Mill.	Ovest-Europeo *	SX
119	*Stenbergia lutea* (L.) Ker Gawl. ex Spreng.	Mediterraneo-Montano	IX, MX, OX

	ASPARAGACEAE		
120	*Anthericum liliago* L.	Subatlantico	RX, SX
121	*Asparagus acutifolius* L.	Stenomediterraneo	CK, EK, EX, EY, FK, FX, GK, PY
122	*Asparagus officinalis* L.	Eurimediterraneo *	SX
123	*Bellevalia romana* (L.) Sweet	Eurimediterraneo *	SX
124	*Loncomelos brevistylum* (Wolfner) Dostál	Sud-Est-Europeo	SY
125	*Loncomelos pyrenaicum* (L.) L. D. Hrouda	Eurimediterraneo *	SX
126	*Ornithogalum comosum* L.	Mediterraneo-Montano	RX
127	*Muscari comosum* (L.) Mill.	Eurimediterraneo	RX, SY
128	*Muscari neglectum* Guss. Ex Ten.	Eurimediterraneo	EX, LY, SY
129	*Polygonatum multiflorum* (L.) All.	Eurasiatico	RX
130	*Prospero autumnale* (L) Speta ssp. *autumnale*	Eurimediterraneo	SY
131	*Ruscus aculeatus* L	Eurimediterraneo	EK, EY, GK,SY
132	*Scilla bifolia* L.	Europeo	EX
133	*Yucca gloriosa L.*	Nord-Americano *	SX
	TYPHACEAE		
134	*Typha angustifolia* L.	Circumboreale *	SX
135	*Typha latifolia* L	Cosmopolita	SY
	JUNCACEAE		
136	*Juncus articulatus L.*	Circumboreale *	SX
137	*Juncus bufonius* L.	Cosmopolita *	SX
138	*Juncus inflexus* L.	Paleotemperato	SX
139	*Oreojuncus monanthos* (Jacq.) Záv.Drábk. & Kirschner	Artico-Alpino	EK
	CYPERACEAE		
140	*Carex caryophyllea* Latourr.	Eurasiatico	EX
141	*Carex digitata* L	Eurasiatico *	SX
142	*Carex distachya* Desf.	Stenomediterraneo *	SX
143	*Carex distans* L.	Eurimediterraneo *	SX
144	*Carex divisa* Huds.	Atlantico *	SX
145	*Carex divulsa* Stokes	Eurimediterraneo *	SX
146	*Carex flacca* Schreb. ssp. *erythrostachys* (Hoppe) Holub	Europeo *	SX
147	*Carex flacca* Schreb. ssp. *flacca*	Europeo	EX
148	*Carex halleriana* Asso	Eurimediterraneo *	SX
149	*Carex humilis* Leyss.	Eurasiatico	SY
150	*Carex kitaibeliana* Degen ex Beck.	Appennino-Balcanico	EK, EX, GX, GY, IY
151	*Carex macrolepis* DC.	Appennino-Balcanico	EX
152	*Carex myosuroides* Vill.	Artico-Alpino	GY
153	*Carex otruba* e Podp.	Atlantico *	SX
154	*Carex parviflora* Host	Mediterraneo-Montano	SY

155	*Carex pendula* Huds.	Eurasiatico	SX, SY
156	*Carex sylvatica* Huds.	Eurasiatico *	SX
157	*Cyperus longus* L.	Paleotemperato	SY
158	*Luzula campestris* (L.) DC.	Europeo	SY
159	*Luzula multiflora* (Ehrh.) Lej ssp. *multiflora*	Appennino-Balcanico *	EX
160	*Luzula spicata* (L.) DC. ssp. *italica* (Parl.) Arcang.	Endemico	GY
161	*Luzula sylvatica* (Huds.) Gaudin ssp. *sieberi* (Tausch) K. Richt.	Orof. Sud-Europeo *	SX
162	*Scirpoides holoschoenus* (L.) Soják	Eurimediterraneo *	SX
	POACEAE		
163	*Achnatherum bromoides* (L.) P. Beauv.	Stenomediterraneo *	SX
164	*Achnatherum bromoides* (L.) P. Beauv.	Stenomediterraneo *	SX
165	*Agrostis stolonifera* L.	Circumboreale *	SX
166	*Alopecurus myosuroides* Huds. ssp. *myosuroides*	Paleotemperato	SX
167	*Anisantha diandra* (Roth) Tzvelev	Eurimediterraneo *	SX
168	*Anisantha madritensis* (L.) Nevski ssp. *madritensis*	Eurimediterraneo *	SX
169	*Anisantha sterilis* (L.) Nevski	Mediterraneo-Turaniano	SX
170	*Anisantha tectorum (L.) Nevski*	Paleotemperato	EX
171	*Anthoxanthum nipponicum* Honda	Artico-Alpino	IK
172	*Anthoxanthum odoratum* L.	Eurasiatico *	IK, SX
173	*Briza media* L.	Eurosiberiano	RX, SY
174	*Arrhenatherum elatius* (L.) P. Beauv. Ex J. & C. Presl ssp. *elatius*	Paleotemperato	AH,SY
175	*Arundo donax L.*	Subcosmopolita	SY
176	*Arundo plinii* Turra	Stenomediterraneo	SY
177	*Avellinia festucoides* (Link) Valdés & H. Scholz	Stenomediterraneo *	SX
178	*Avena barbata* Pott ex Link – Eurimediterraneo	Eurimediterraneo	IK
179	*Avena fatua* L. ssp. *fatua*	Eurasiatico	IK
180	*Avena sativa* L.	Avventizio	SY. Coltivato, naturalizzato
181	*Avena sterilis* L.	Eurimediterraneo	EX
182	*Bellardiochloa variegata* (Lam.) Kerguélen ssp. *variegata*	Orof. Sud-Europeo	EX
183	*Bothriochloa ischaemum* (L.) Keng	Cosmopolita *	SX
184	*Brachypodium genuense* (DC.) Roem. & Schult.	Orof. Sud-Europeo	EX, IK
185	*Brachypodium distachyon* (L.) P. Beauv.	Mediterraneo-Turaniano	RY
186	*Brachypodium rupestre* (Host) Roem. & Schult.	Subatlantico	EK, EX, GK, PY
187	*Brachypodium sylvaticum* (Huds.) P. Beauv.	Paleotemperato *	SX
188	*Bromus arvensis* L. ssp. *arvensis*	Eurosiberiano	AH, SX
189	*Bromus commutatus* Schrad. ssp. *commutatus*	Europeo *	SX
190	*Bromopsis erecta* (Huds.) Fourr.	Paleotemperato	EK, EX, GK, IK
191	*Bromopsis ramosa (Huds.)* Holub ssp. *ramosa*	Eurasiatico *	SX
192	*Bromus hordeaceus L* . ssp. *hordeaceus*	Cosmopolita	EX, IK, SY
193	*Bromus lanceolatus* Roth	Paleotemperato *	SX

194	*Bromus squarrosus* L.	Paleotemperato	AH, IK
195	*Catapodium rigidum* (L.) C. E. Hubb. ex Dony ssp. *rigidum*	Eurimediterraneo	EX, IK
196	*Cleistogenes serotina* (L.) Keng	Eurimediterraneo *	SX
197	*Cynodon dactylon* (L.) Pers.	Cosmopolita	SX, SY
198	*Cynosurus cristatus* L.	Europeo-Caucasico *	SX
199	*Cynosurus echinatus* L.	Eurimediterraneo	EX, IK
200	*Dactylis glomerata* L. ssp. *glomerata*	Paleotemperato	EX, IK
201	*Dactylis glomerata* L. ssp. *hispanica* (Roth) Nyman	Stenomediterraneo	IK
202	*Dasypyrum villosum* (L.) P. Candargy	Mediterraneo-Turaniano *	SX
203	*Deschampsia flexuosa* (L.) Trin.	Cosmopolita	EX
204	*Digitaria sanguinalis* (L.) Scop.	Cosmopolita *	SX
205	*Echinochloa crus-galli* (L.) P.Beauv	Subcosmopolita *	SX
206	*Elymus repens* (L.) Gould ssp. r*epens*	Circumboreale	BX, EY
207	*Eragrostis cilianensis* (All.) Vignolo ex Janch.	Cosmopolita *	
208	*Festuca alfrediana* Foggi & Signorini ssp. *ferrariniana* F oggi, Parolo & Gr. Rossi	Endemico	BX, EY
209	*Festuca circummediterranea* Patzke	Eurimediterraneo	EX, IK
210	*Festuca inops* De Not.	Subendemico	IK
211	*Festuca laevigata* Gaudin	Orof. Sud-Ovest-Europeo	CK, IK. Assegnate al taxon le precedenti segnalazioni di *Festuca robustifolia* Markgr.-Dann.
212	*Festuca myuros* L. ssp. *myuros*	Subcosmopolita *	SX
213	*Festuca rubra* L. ssp. c*ommutata* (Gaudin) Markgr. -Dann.	Circumboreale	EX
214	*Festuca stricta Host* ssp. *trachyphylla* (Hack.) Patzke e Pils	Centro-Europeo *	SX
215	*Festuca violacea* Ser. ex Gaudin ssp. *italica* Foggi, Gr. Rossi & Signorini	Endemico *	GX, GY, IY
216	*Gastridium ventricosum* (Gouan) Schinz & Thell.	Mediterraneo-Atlantico *	SX
217	*Glyceria notata* Chevall.	Subcosmopolita *.	SX
218	*Helictochloa praetutiana* (Parl. ex Arcang.) Bartolucci, F. Conti, Peruzzi & Banfi ssp. *praetutiana*	Endemico	EX, GX, IY
219	*Holcus lanatus L.*	Circumboreale *	AX, SX
220	*Hordelymus europaeus* (L.) Harz.	Europeo-Caucasico	SY
221	*Hordeum marinum* Huds.	Mediterraneo-Occidentale *	SX
222	*Hordeum murinum* L. ssp. *murinum*	Circumboreale	CK
223	*Hordeum vulgare L. ssp. vulgare*	Avventizio	SY. Coltivato e inselvatichito
224	*Hyparrhenia hirta* (L.) Stapf ssp. *hirta*	Paleotropicale *	SX
225	*Koeleria splendens* C. Presl	Endemico	BX, EX. Ricondotte al taxon le segnalazioni di *Koeleria lobata* (M. Bieb.) Roem. & Schult.
226	*Leucopoa dimorph* a (Guss.) H. Scholz & Foggi	Subendemico	CK, EK, EX, GK

227	*Lolium arundinaceum (* Schreb.) Darbysh.	Paleotemperato *	SX
228	*Lolium multiflorum* Lam.	Eurimediterraneo *	SX
229	*Lolium perenne* L.	Circumboreale *	SX
230	*Lolium temulentum* L.	Subcosmopolita	SY
231	*Macrobriza maxima* (L.) Tzvelev	Paleotropicale *	SX
232	*Melica ciliata* L. ssp. *ciliata*	Eurimediterraneo	AH, EX
233	*Melica uniflora* Retz	Paleotemperato	EX
234	*Oloptum miliaceum* (L.) Röser & H.R. Hamasha	Mediterraneo-Turaniano *	SX
235	*Oloptum thomasii* (Duby) Banfi & Galasso	Stenomediterraneo *	SX, SY
236	*Parapholis cylindrica* (Willd.) Romero Zarco	Eurimediterraneo *	SX, SY
237	*Parapholis incurva* (L.) C.E. Hubb	Mediterraneo-Atlantico *	SX, SY
238	*Parapholis strigosa* (Dumort.) C.E.Hubb.	Mediterraneo-Atlantico *	SX
239	*Phalaris brachystachys* Link	Stenomediterraneo *	SX
240	*Phalaris canariensis* L.	Avventizio	SY
241	*Phalaris coerulescens* Desf.	Stenomediterraneo *	SX
242	*Phalaris paradoxa* L.	Stenomediterraneo *	SX
243	*Phleum hirsutum* Honck. ssp. *ambiguum* (Ten.) Tzvelev	Mediterraneo-Montano	EX, IK
244	*Phleum pratense* L.	Centro-Europeo *	SX
245	*Phleum rhaeticum* (Humphries) Rauschert	Sud-Europeo	GY, IY
246	*Phragmites australis* (Cav.) Trin. ex Steud. ssp. *australis*	Cosmopolita	SY
247	*Poa alpina* L. ssp. *alpina*	Circumboreale	GX, GY, IK, IY
248	*Poa angustifolia* L.	Cosmopolita	EX
249	*Poa annua* L.	Cosmopolita	SY
250	*Poa badensis* Haenke ex Willd.	Mediterraneo-Montano	GY. Dubbia presenza sul massiccio della Maella (Conti *et al.*, 2019, 2020)
251	*Poa bulbosa* L. ssp. *bulbosa*	Paleotemperato	IK
252	*Poa molinerii* Balb.	Sud-Est Europeo	EX, GX, IY
253	*Poa nemoralis* L. ssp. *nemoralis*	Circumboreale *	SX
254	*Poa pratensis* L. ssp. *pratensis*	Circumboreale	SY
255	*Poa trivialis* L.	Eurasiatico	SX
256	*Polypogon viridis* (Gouan) Breistr. ssp. *viridis*	Paleotropicale *	SX
257	*Rostraria cristata* (L.) Tzvelev	Paleotemperato *.	SX
258	*Sclerochloa dura* (L.) P. Beauv.	Eurimediterraneo *	SX
259	*Sesleria juncifolia* Suffren ssp. *juncifolia*	Appennino-Balcanico	EK, EX, GK, GX. Ricondotte al taxon le segnalazioni di *S. apennina* Ujhelji e *S. tenuifolia* Schrad
260	*Sesleria nitida* ssp. *nitida* Ten.	Endemico	EK, EX, GK, IK, PY
261	*Setaria italica* (L.) P. Beauv. ssp. *viridis* (L.) Thell.	Subcosmopolita	SY
262	*Setaria verticillata (* L.) P.Beauv.	Cosmopolita *	SX
263	*Sorghum halepense* (L.) Pers.	Cosmopolita *	SX
264	*Stipa dasyvaginata* Martinovsky ssp. *apenninicola* Martinovsky & Moraldo	Endemico	SY
265	*Thinopyrum acutum* (DC.) Banfi	Eurimediterraneo *	SX
266	*Triticum aestivum* L. ssp. *aestivum*	Avventizio	SY. Coltivato, spontaneizzato
267	*Triticum turgidum* L.	Avventizio	SY. Coltivato, spontaneizzato

268	*Triticum vagans* (Jord. & Fourr.) Greuter	Mediterraneo-Turaniano *	SX
	BERBERIDACEAE		
269	*Berberis vulgaris* L. ssp. *vulgaris*	Eurasiatico	CK
	RANUNCULACEAE		
270	*Actaea spicata* L.	Eurasiatico	RX
271	*Adonis aestivalis* L.	Eurasiatico	SY
272	*Adonis annua* L.	Eurimediterraneo	SY
273	*Adonis distorta* Ten.	Endemico	BX, EK, FY, GK, IY,SY
274	*Anemonastrum narcissiflorum* (L.) Holub, ssp. *narcissiflorum*	Artico-Alpino	EX, SY
275	*Anemone apennina*. L. ssp. *apennina*	Sud-Est-Europeo	RX
276	*Anemone hortensis* L. ssp. *hortensis*	Nord-Mediterraneo	SX, SY
277	*Anemonoides nemorosa* (L.) Holub	Circumboreale	RX
278	*Anemonoides ranunculoides* (L.) Holub	Europeo-Caucasico	SY
279	*Aquilegia magellensis* F. Conti & Soldano	Endemico	EK, EX, GK
280	*Clematis flammula* L.	Eurimediterraneo	EX, FX, PX
281	*Clematis recta* L.	Eurosiberiano *	PY
282	*Clematis vitalba* L.	Europeo	CK, FK
283	*Delphinium consolida* L.	Eurimediterraneo	SY
284	*Delphinium fissum* Waldst. & Kit. ssp. *fissum*	Eurasiatico	AH
285	*Delphinium halteratum* Sm.	Stenomediterraneo *	SX
286	*Delphinium peregrinum* L.	Sud-Est Europeo °°	SY
287	*Ficaria verna* Huds. subsp. *fertilis* (Lawalrée ex Laegaard) Stace	Eurasiatico	SY
288	*Helleborus foetidus* L. ssp. *foetidus*	Subatlantico	EX, EY, SY
289	*Hepatica nobilis* Mill.	Circumboreale	EX
290	*Nigella damascena* L.	Eurimediterraneo	SX, SY
291	*Pulsatilla alpina* (L.) Delarbre ssp. *millefoliata* (Bertol.) D.M. Moser	Circumboreale	CK, EK, FY, GY, IK
292	*Ranunculus acris* L. ssp. *acris*	Cosmopolita	SY
293	*Ranunculus apenninus.* (Chiov.) Pignatti	Endemico	EX, SY
294	*Ranunculus arvensis* L.	Paleotemperato	SX, SY
295	*Ranunculus brevifolius* Ten.	Appennino-Balcanico	EK, FY, GX, IY
296	*Ranunculus breyninus* Crantz	Orof. Sud-Europeo	GY
297	*Ranunculus bulbosus* L.	Eurasiatico	SX, SY
298	*Ranunculus illyricus* L.	Appennino-Balcanico *	SX
299	*Ranunculus lanuginosus* L.	Europeo-Caucasico *	SX
300	*Ranunculus magellensis* Ten.	Endemico	CK, EK, FY, IK
301	*Ranunculus millefoliatus* Vahl	Mediterraneo-Montano *	SX
302	*Ranunculus monspeliacus* L. ssp. *monspeliacus*	Nord-Ovest-Mediterraneo *	SX
303	*Ranunculus muricatus* L.	Eurimediterraneo *	SX
304	*Ranunculus neapolitanus* Ten.	Nord-Est-Mediterraneo *	QX
305	*Ranunculus pollinensis.* (N. Terracc.) Chiov.	Endemico	BX, GX
306	*Ranunculus repens* L.	Eurasiatico *	SX
307	*Ranunculus sceleratus* L.	Paleotemperato *	SX
308	*Ranunculus seguieri* Vill. ssp. *seguieri*	Mediterraneo-Montano °°	FY, GX, GY, IY
309	*Ranunculus trichophyllus* Chaix	Europeo *	SX
310	*Thalictrum minus* L. ssp. *minus*	Eurasiatico	SY
311	*Trollius europaeus* L. ssp. *europaeus*	Artico-Alpino	SY
	PAPAVERACEAE		

312	*Chelidonium majus* L.	Eurasiatico	KY
313	*Corydalis cava* (L.) Schweigger & Kōrte ssp. *cava*	Europeo *	SX
314	*Fumaria capreolata* L. ssp. *capreolata*	Eurimediterraneo	SX, SY
315	*Fumaria officinalis* L. ssp. *officinalis*	Paleotemperato	SX, SY
316	*Fumaria vaillantii* Loisel.	Eurimediterraneo	IK
317	*Oreomecon alpina* (L.) Banfi, Bartolucci, J. M. Tison & Galasso ssp. *alpina*	Endemico °°	CK, EK, GK, GX
318	*Papaver dubium* L. ssp. *dubium*	Eurimediterraneo	IK
319	*Papaver rhoeas.* L. ssp. *rhoeas*	Mediterraneo-Orientale	CK, EY
320	*Papaver somniferum* L.	Subcosmopolita	EY
321	*Roemeria sicula* (Guss.) Galasso, Banfi, L.Sáez & Bartolucci	Mediterraneo-Turaniano	SY
322	*Pseudofumaria alba* (Mill.) Lidén ssp. *alba*	Appennino-Balcanico	SY
	CRASSULACEAE		
323	*Hylotelephium maximum* (L.) Holub	Centro-Europeo *	SX
324	*Petrosedum montanum* (Songeon & E.P. Perrier) Grulich	Mediterraneo-Montano	IK
325	*Petrosedum rupestre* (L.) P.V. Heath	Europeo	EX, IK, SY
326	*Petrosedum sediforme* (Jacq.) Grulich	Stenomediterraneo *	SX
327	*Phedimus stellatus* (L.) Raf.	Stenomediterraneo *	SX
328	*Sedum acre* L.	Europeo	EX, GY, IY, SY
329	*Sedum album* L. ssp. *micranthum* (Bast. ex DC.) Syme	Eurimediterraneo	AH, EX, FX, SY
330	*Sedum annuum* L.	Artico-Alpino	SY
331	*Sedum atratum* L.	Mediterraneo-Montano	GX, IY, SY
332	*Sedum caespitosum* (Cav.) DC.	Stenomediterraneo *	SX
333	*Sedum dasyphyllum* L. ssp. *dasyphyllum*	Eurimediterraneo	SX, SY
334	*Sedum hispanicum* L.	Pontico	EX
335	*Sedum magellense* Ten. ssp. *magellense*	Endemico	SY
336	*Sedum rubens* L.	Eurimediterraneo	AH, SX
337	*Sedum sexangulare* L.	Europeo	EX
338	*Sempervivum arachnoideum* L.	Orof. Sud-Europeo	BX, GY, IY, SY
339	*Sempervivum tectorum* L.	Mediterraneo-Montano	EX, SY
340	*Umbilicus horizontalis (* Guss.) DC.	Stenomediterraneo	FX, LY, SY
341	*Umbilicus rupestris* (Salisb.) Dandy	Mediterraneo-Atlantico *	PX
	GROSSULARIACEAE		
342	*Ribes uva-crispa* L.	Eurasiatico *	SX
	SAXIFRAGACEAE		
343	*Saxifraga adscendens* L. ssp. *adscendens*	Mediterraneo-Montano	GX, IY
344	*Saxifraga caesia* L	Mediterraneo-Montano	SY
345	*Saxifraga callosa* Sm. ssp. *callosa*	Orof. Sud-Ovest-Europeo	AH, CK, EK, EX
346	*Saxifraga exarata* Vill. ssp. *ampullacea* (Ten.) D. A. Webb	Endemico	GX, GY, SY
347	*Saxifraga granulata* L. ssp. *granulata*	Subatlantico	EX
348	*Saxifraga italica* D. A. Webb	Endemico	SY
349	*Saxifraga oppositifolia* L. ssp. *oppositifolia*	Artico-Alpino	GY, IY, SY
350	*Saxifraga paniculata* Mill.	Artico-Alpino	AH, GX, GY
351	*Saxifraga porophylla* Bertol. ssp. *porophylla*	Endemico	AH, EK, GK, SY
352	*Saxifraga rotundifolia* L. ssp. *rotundifolia*	Mediterraneo-Montano	RX
353	*Saxifraga tridactylites* L.	Eurimediterraneo	IK,SX
	VITACEAE		

354	*Vitis vinifera* L. ssp. *vinifera*	Avventizio	EY. Coltivato, spontaneizzato
	FABACEAE		
355	*Anthyllis montana* L. susbp. *jacquinii* (A Kern.) Rohlena	Orof. Sud-Est-Europeo	BK, EX
356	*Anthyllis vulneraria* L. ssp. *poliphylla* (DC.) Nyman	Sud-Est-Europeo	EX
357	*Anthyllis vulneraria L.* ssp. *pulchella* (Vis.) Bornm.	Sud-Est Europeo	GX, IY
358	*Anthyllis vulneraria* L. ssp. *rubiflora* (DC.) Arcang.	Eurimediterraneo	CK, EX, GY, IK. Ricondotte al taxon le segnalazioni di *A. vulneraria* L. ssp. *maura* (Beck) Maire
359	*Anthyllis vulneraria* L. ssp. *weldeniana* (Rchb.) Cullen	Appennino-Balcanico	SY
360	*Argyrolobium zanonii* (Turra) P.W. Ball ssp. *zanonii*	Mediterraneo-Occidentale *	SX
361	*Astragalus australis* (L.) Lam.	Eurasiatico	EX
362	*Astragalus depressus* L. ssp. *depressus*	Eurasiatico	BX, EX, BX, IY
363	*Astragalus glycyphyllos* L.	Eurasiatico *	SX
364	*Astragalus hamosus* L.	Mediterraneo-Turaniano *	SX
365	*Astragalus monspessulanus* L. ssp. *monspessulanus*	Eurimediterraneo	EX, SY
366	*Astragalus sempervirens* Lam.	Mediterraneo-Montano	EX
367	*Astragalus sesameus* L.	Stenomediterraneo	SX
368	*Astragalus sirinicus* Ten. ssp. *sirinicus*	Appennino-Balcanico	SY
369	*Astragalus vesicarius* L. ssp. *vesicarius*	Sud-Europeo- Sud-Siberiano *	SX
370	*Bituminaria bituminosa* (L.) C. H. Stirt	Eurimediterraneo	EX
371	*Cercis siliquastrum* L. ssp. *siliquastrum*	Pontico	SX, SY
372	*Cicer arietinum* L.	Pontico	SY. Coltivato, spontaneizzato
373	*Colutea arborescens* L.	Eurimediterraneo	EY, SY
374	*Coronilla minima* L. ssp. *minima*	Mediterraneo-Occidentale	EX
375	*Coronilla scorpioides* (L.) W. D. J. Koch	Eurimediterraneo	LY, PX, SY
376	*Coronilla vaginalis* Lam.	Sud-Est-Europeo.	IK
377	*Coronilla valentina* L.	Sud-Ovest-Mediterraneo	EK, EY
378	*Cytisophyllum sessilifolius* (L.) O. Lang	Sud-Ovest-Europeo	EX, FX
379	*Cytisus hirsutus* L.	Eurosiberiano *	SX
380	*Cytisus spinescens* Sieber ex Spreng.	Appennino-Balcanico	AH, EX, IK, PY, SY
381	*Emerus major* Mill. ssp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti	Pontico	CK, EX, PY
382	*Emerus major* Mill. ssp. *major*	Centro-Europeo *	QX
383	*Ervilia sativa* Link	Eurimediterraneo	AH
384	*Ervum gracile* DC.	Stenomediterraneo *	SX
385	*Galega officinalis* L.	Pontico	CK
386	*Genista januensis* Viv.	Sud-Est-Europeo *	SX
387	*Genista sagittalis* L.	Europeo	SX, SY
388	*Genista tinctoria* L.	Eurasiatico	EX
389	*Hippocrepis biflora* Spreng.	Eurimediterraneo *	SX
390	*Hippocrepis ciliata* Willd.	Stenomediterraneo *	SX
391	*Hippocrepis comosa* L. ssp. *comosa*	Europeo	EX, IK, SY
392	*Laburnum anagyroides* Medik. ssp. *anagyroides*	Eurimediterraneo	EK, EX, GK, PY, SY
393	*Lathyrus annuus* L.	Eurimediterraneo *	SX
394	*Lathyrus aphaca* L. ssp. *aphaca*	Eurimediterraneo	SX
395	*Lathyrus cicera* L.	Eurimediterraneo	MX, OX

396	*Lathyrus clymenum* L	Stenomediterraneo *	SX
397	*Lathyrus hirsutus* L.	Eurimediterraneo	SX, SY
398	*Lathyrus nissolia* L.	Eurimediterraneo *	SX
399	*Lathyrus ochrus* (L.) DC.	Stenomediterraneo *	SX
400	*Lathyrus odoratus L.*	Endemico *	SX
401	*Lathyrus pratensis* L.	Paleotemperato *	SX
402	*Lathyrus sativus* L.	Eurimediterraneo	SY. Coltivato, spontaneizzato
403	*Lathyrus sphaericus* Retz.	Eurimediterraneo *	SX
404	*Lathyrus setifolius* L.	Eurimediterraneo *	SX
405	*Lathyrus sylvestris* L. ssp. *sylvestris*	Europeo	CK, SX
406	*Lathyrus venetus* (Mill.) Wohlf.	Pontico	EX
407	*Lathyrus vernus* (L.) Bernh.	Eurasiatico *	SX
408	*Lotus corniculatus* L. ssp. *alpinus* (DC.) Rothm.	Mediterraneo-Montano	CK, EX, IK
409	*Lotus herbaceus* (Vill.) Jauzein	Pontico *	SX
410	*Lotus hirsutus*L.	Eurimediterraneo	RX
411	*Lotus ornithopodioides* L.	Stenomediterraneo *	SX
412	*Lotus tenuis* Waldst. & Kit. ex Willd.	Paleotemperato *	SX
413	*Lotus tetragonolobus* L.	Stenomediterraneo *	SX
414	*Medicago arabica* (L.) Huds.	Eurimediterraneo *	SX
415	*Medicago disciformis* DC.	Stenomediterraneo * ##	SX
416	*Medicago falcata* L. ssp. *falcata*	Eurasiatico	RX
417	*Medicago lupulina* L.	Paleotemperato	CK, EX, IK
418	*Medicago minima* (L.) L.	Eurimediterraneo	SX, SY
419	*Medicago monspeliaca* (L.) Trautv.	Eurimediterraneo *	SX
420	*Medicago orbicularis* (L.) Bartal.	Eurimediterraneo *	SX
421	*Medicago polymorpha* L.	Subcosmopolita *	SX
422	*Medicago prostrata* Jacq. ssp. *prostrata*	Pontico	EX
423	*Medicago rigidula* (L.) All.	Eurimediterraneo *	SX
424	*Medicago sativa* L.	Eurasiatico *	CK. Coltivato, spontaneizzato
425	*Medicago scutellata* Mill.	Eurimediterraneo *	SX
426	*Medicago truncatula* Gaertn.	Stenomediterraneo *	SX
427	*Onobrychis alba* (Waldst. & Kit.) Desv. ssp. *alba*	Appennino-Balcanico	EX
428	*Onobrychis caput-gallli* (L.) Lam.	Stenomediterraneo	SY
429	*Onobrychis viciifolia* Scop.	Mediterraneo-Montano	SX, SY
430	*Ononis cristata* MIll. ssp. *apennina* Tammaro & Catonica	Endemico	OX
431	*Ononis mitissima* L.	Stenomediterraneo *	SX
432	*Ononis pusilla* L. ssp. *pusilla*	Eurimediterraneo	EX, SX
433	*Ononis reclinata* L.	Mediterraneo-Occidentale *	SX
434	*Ononis spinosa* L. ssp. *spinosa*	Eurimediterraneo	SY
435	*Ononis viscosa* L. ssp. *breviflora* (DC.) Nyman	Sud-Mediterraneo *	SX
436	*Oxytropis campestris* (L.) DC. ssp. *campestris*	Circumboreale	EX, GX, GY, IY
437	*Oxytropis neglecta* Ten.	Orof. Sud-Europeo	DY, GX
438	*Pisum sativum* L. ssp. *biflorum* (Raf.) Soldano	Eurimediterraneo	KY
439	*Pisum sativum* L. ssp. *sativum*	Subcosmopolita	SY. Coltivato, spontaneizzato
440	*Robinia pseudacacia* L.	Nord-Americano	CK, EK, EY
441	*Scorpiurus muricatus* L.	Eurimediterraneo *	SX
442	*Securigera securidaca* (L.) Degen & Dorf.	Eurimediterraneo	SY

443	*Securigera varia* (L.) Lassen	Sud-Est Europeo	RX
444	*Spartium junceum* L.	Eurimediterraneo	CK, EK, EX, GK
445	*Sulla coronaria* (L.) Medik.	Mediterraneo-Occidentale	CK. Coltivato, naturalizzato
446	*Trifolium alexandrinum* L.	Eurimediterraneo	RY, SX
447	*Trifolium alpestre* L.	Europeo	SX
448	*Trifolium angustifolium* L.	Eurimediterraneo *	SX
449	*Trifolium arvense* L. ssp. *arvense*	Paleotemperato	EX, IK
450	*Trifolium campestre* Schreb.	Paleotemperato	EX
451	*Trifolium echinatum* M. Bieb.	Mediterraneo-Turaniano *	SX
452	*Trifolium fragiferum* L. ssp. *fragiferum*	Paleotemperato	AY, BX
453	*Trifolium incarnatum* L. ssp. *incarnatum*	Eurimediterraneo *	SY
454	*Trifolium incarnatum* L. ssp. *molinerii* (Balb. ex Hornem.) Ces.	Eurimediterraneo *	SX
455	*Trifolium lucanicum* Gasp. ex Guss.	Eurimediterraneo *	SX
456	*Trifolium nigrescens* Viv. ssp. *nigrescens*	Eurimediterraneo	SX, SY
457	*Trifolium noricum* Wulfen ssp. *praetutianum* (Savi) Arcang.	Appennino-Balcanico °°	GY, IY
458	*Trifolium ochroleucon* Huds.	Pontico	EX
459	*Trifolium pallidum* Waldst. & Kit.	Mediterraneo-Orientale *	SX
460	*Trifolium pratense* L. ssp. *pratense*	Eurasiatico	CK, EX
461	*Trifolium pratense* L. ssp. *semipurpureum* (Strobl) Pignatti	Endemico	EX, GX, IK
462	*Trifolium repens* L. ssp. *repens*	Paleotemperato	SY
463	*Trifolium resupinatum* L.	Paleotemperato *	SX
464	*Trifolium scabrum* L. ssp. *scabrum*	Eurimediterraneo	SX
465	*Trifolium squamosum* L.	Eurimediterraneo *	SX
466	*Trifolium squarrosum* L.	Eurimediterraneo *	SX
467	*Trifolium stellatum* L.	Eurimediterraneo	EX, IK, SY
468	*Trifolium thalii* Vill.	Mediterraneo-Montano	EK, EX, GX, GY, SY
469	*Trigonella alba* (Medik.) Coulot & Rabaute	Eurasiatico	SX
470	*Trigonella foenum-graecum* L.	Eurimediterraneo	SY
471	*Trigonella officinalis* (L.) Coulot & Rabaute	Eurasiatico *	CK
472	*Trigonella sulcata* (Desf.) Coulot & Rabaute	Sud-Mediterraneo *	QX, SX
473	*Trigonella woijciechowskii* . Coulot & Rabaute	Stenomediterraneo *	MX, OX
474	*Vicia angustifolia* L.	Stenomediterraneo *	SX
475	*Vicia bithynica* **(**L.) L.	Eurimediterraneo *	SX
476	*Vicia cracca* L.	Eurasiatico	SY
477	*Vicia dasycarpa* Ten.	Eurimediterraneo	SY
478	*Vicia ervoides* (Brign.) Hampe	Pontico *	SX
479	*Vicia disperma* DC.	Mediterraneo-Occidentale	IK
480	*Vicia faba* L.	Stenomediterraneo	SY. Coltivato, spontaneizzato
481	*Vicia hirsuta* (L.) Gray	Paleotemperato	EX
482	*Vicia hybrida* L.	Eurimediterraneo *	SX
483	*Vicia incana* Gouan	Eurimediterraneo *	SX
484	*Vicia johannis* Tammasch	Sud-Europeo-Sud-Siberiano	MX, NX, OX
485	*Vicia lathyroides* L.	Eurimediterraneo * ##	SX
486	*Vicia lentoides* (Ten.) Coss. & Germ.	Stenomediterraneo * ##	SX
487	*Vicia lutea* L.	Eurimediterraneo *	SX
488	*Vicia peregrina* L.	Mediterraneo-Turaniano *	SX
489	*Vicia sativa* L. ssp. *sativa*	Eurimediterraneo	RY

490	*Vicia sepium* L.	Eurosiberiano *	SX
491	*Vicia tenuifolia* Roth ssp. t*enuifolia*	Eurasiatico *	SX
	POLYGALACEAE		
492	*Polygala alpestris* Rchb. ssp. *angelisii* (Ten.) Nyman	Endemico	SX. Ricondotte al taxon le segnalazioni di *P . alpestris* Rchb.
493	*Polygala major* Jacq.	Pontico	EX, IK
494	*Polygala nicaensis* W. D. J. Koch ssp. *Mediterranea* Chodat	Eurimediterraneo	SX, SY
	PLATANACEAE		
495	*Platanus orientalis* L.	Appennino-Balcanico	SY
	ROSACEAE		
496	*Agrimonia eupatoria* L. ssp. *eupatoria*	Subcosmopolita	SX, SY
497	*Alchemilla alpina* L.	Artico-Alpino *	SY
498	*Alchemilla colorata* Buser	Eurasiatico	SY
499	*Amelanchier ovalis* Medik. ssp. *ovalis*	Mediterraneo-Montano	EK, GK
500	*Aphanes arvensis* L. – Subcosmopolita. (RX).		
501	*Aremonia agrimonoides (L* .) DC. ssp. *agrimonoides*	Sud-Europeo *	PY
502	*Cotoneaster integerrimus* Medik.	Pontico	BX, EK, GK
503	*Crataegus monogyna* Jacq.	Paleotemperato	CK, EK, EX, EY, FX, GK
504	*Cydonia oblonga* Mill.	Ovest-Asiatico	EY. Coltivato, spontaneizzato
505	*Dryas octopetala* L. ssp. *octopetala*	Artico-Alpino	AH, CK, EK, EX, SY
506	*Filipendula ulmaria* (L.) Maxim.	Eurosiberiano	RX, SY
507	*Filipendula vulgaris* Moench	Centro-Europeo *	SY
508	*Fragaria vesca* L. ssp. *vesca*	Eurosiberiano	SX, SY
509	*Geum urbanum* L.	Circumboreale *	SX
510	*Malus domestica* (Borkh.) Borkh.	Eurasiatico	FX, SY. Coltivato, spontaneizzato
511	*Malus sylvestris* (L.) Mill.	Centro-Europeo	EY
512	*Mespilus germanica* L.	Pontico	EY, SY. Coltivato, spontaneizzato
513	*Potentilla apennina* Ten. ssp. *apennina*	Appennino-Balcanico *	GY
514	*Potentilla caulescens* L. ssp. *caulescens*	Mediterraneo-Montano	AH, CK, EK, EX, GK
515	*Potentilla crantzii (* Crantz) Beck ex Fritsch ssp. *crantzii*	Artico-Alpino	EX, GY, IY
516	*Potentilla pedata* Willd. ex Hornem	Eurimediterraneo	SX
517	*Potentilla reptans L.*	Paleotemperato *.	SX
518	*Potentilla rigoana* Th. Wolf	Endemico	SX, SY
519	*Poteriuum sanguisorba* L. ssp. *balearica* (Bourg. Ex Nyman) Stace	Sud-Ovest-Europeo	EX, IK
520	*Prunus armeniaca* L.	Europeo-Caucasico	SY. Coltivato, spontaneizzato
521	*Prunus avium* L. ssp. *avium*	Pontico	EX, EY, SY
522	*Prunus cerasifera* Ehrh. – Pontico	Pontico	EY, SY. Coltivato, spontaneizzato
523	*Prunus cerasus* L.	Pontico	EY, SY. Coltivato, spontaneizzato
524	*Prunus domestica* L.	Europeo-Caucasico	SY. Coltivato, spontaneizzato
525	*Prunus dulcis* (Mill.) D. A. Webb	Eurimediterraneo	EY, SX, SY
526	*Prunus mahaleb* L.	Pontico	SY

527	*Prunus persica* (L.) Batsch	Asiatico	EY, FX, SY. Coltivato, spontaneizzato
528	*Prunus spinosa* L. ssp. *spinosa*	Europeo	CK, EX, EY, FK, FX
529	*Pyracantha coccinea* M. Roem.	Stenomediterraneo	SY
530	*Pyrus communis* L.L. ssp. *communis*	Avventizio	FX, SX, SY. Coltivato, spontaneizzato
531	*Rosa arvensis* Huds.	Mediterraneo-Atlantico	SY
532	*Rosa canina* L.	Paleotemperato	EK, EX, EY, FK, FX, GK
533	*Rosa dumalis* Bechst.	Europeo-Caucasico	SY
534	*Rosa sempervirens* L.	Stenomediterraneo	SY
535	*Rubus caesius* L.	Eurasiatico	SY
536	*Rubus canescens* DC.	Eurimediterraneo	SX, SY
537	*Rubus hirtus* Waldst. & Kit.	Europeo	EY
538	*Rubus saxatilis* L.	CIrcumboreale *	SY
539	*Rubus ulmifolius* Schott	Mediterraneo-Atlantico	CK, EX, EY
540	*Sibbaldia procumbens* L.	Artico-Alpino	SX, SY
541	*Sorbus aria* (L.) Crantz ssp. *aria*	Paleotemperato	AH, EK, EX, FK, FX
542	*Sorbus aucuparia* L. ssp. *aucuparia*	Europeo	EK, GK
543	*Sorbus domestica* L.	Eurimediterraneo	EK, EX, EY, SY
544	*Sorbus torminalis* (L.) Crantz	Eurasiatico	EK, GK
	RHAMNACEAE		
545	*Atadinus alpinus* (L.) Raf.	Mediterraneo-Occidentale *.	EX
546	*Atadinus pumilus* (Turra) Hauenschild ssp. *pumilus*	Mediterraneo-Montano	EK, GK
547	*Paliurus spina-christi* Mill.	Pontico	CK
548	*Rhamnus alaternus* L. ssp. *alaternus*	Stenomediterraneo	SY
549	*Rhamnus saxatilis* Jacq. – ssp. *saxatilis*	Pontico *	GK
550	*Rhamnus saxatilis* Jacq. ssp. *infectorius* (L.) P. Fournier	Sud-Est-Europeo	AH, BX, CK, EX
551	*Ziziphus jujuba* Mill.	Avventizio	EY. Coltivato, naturalizzato
	ULMACEAE		
553	*Ulmus minor* Mill. ssp. *minor*	Europeo-Caucasico	CK, EY
	CANNABACEAE		
554	*Celtis australis* L.	Eurimediterraneo *	SX
555	*Humulus lupulus* L.	Circumboreale *	SX
	MORACEAE		
556	*Broussonetia papyrifera* (L.) Vent.	Asiatico-Orientale *	MX. Coltivato, spontaneizzato
557	*Ficus carica* L.	Eurimediterraneo	EY, SX, SY. Coltivato, spontaneizzato
558	*Morus alba* L.	Asiatico	EY, SY. Coltivato, spontaneizzato
559	*Morus nigra* L.	Asiatico	EY, SY. Coltivato, spontaneizzato
	URTICACEAE		
560	*Parietaria judaica* L.	Eurimediterraneo	SY
561	*Parietaria officinalis L .*	Europeo	AH, CK
562	*Urtica dioica L .*	Cosmopolita	CK, EX, EY
563	*Urtica membranacea* Poir.	Sud-Mediterraneo *	SX

564	*Urtica urens* L	Subcosmopolita *	SX
	FAGACEAE		
565	*Fagus sylvatica* L.	Centro-Europeo	EK, EX, EY, GK, SY
566	*Quercus cerris* L.	Eurimediterraneo	EK, EX, EY
567	*Quercus ilex* L. ssp. *ilex*	Stenomediterraneo	EK, EX, EY, GK, PY, SY
568	*Quercus pubescens* Willd. ssp. *pubescens*	Pontico	BX, CK, EK, EX, EY, GK, PY
	JUGLANDACEAE		
569	*Juglans nigra* L.	Nord-Americano *	SX, SY. Coltivato, spontaneizzato
570	*Juglans regia* L.	Asiatico	SX, SY. Coltivato, spontaneizzato
	BETULACEAE		
571	*Alnus cordata* (Loisel.) Duby	Sud-Est Europeo	RX, SY
572	*Alnus glutinosa* L. Gaertn.	Paleotemperato	RX, SY
573	*Carpinus betulus* L.	Europeo	SX, SY
574	*Carpinus orientalis* Mill. ssp. *orientalis*	Pontico	EK, EY, SY
575	*Corylus avellana* L.	Europeo	CK, EK, EY, FX, GK
576	*Ostrya carpinifolia* Scop.	Pontico	CK, EK, EX, EY, GK, PY
	CUCURBITACEAE		
577	*Bryonia dioica* Jacq.	Eurimediterraneo	SX
578	*Citrullus lanatus* (Thunb.) Matsum. & Nakai ssp. *lanatus*	Paleotropicale *	SY, Coltivato, spontaneizzato
579	*Ecballium elaterium* (L.) A. Rich.	Eurimediterraneo	EY, SY
580	*Lagenaria siceraria* (Molina) Standl.	Avventizio *	SX
	CELASTRACEAE		
581	*Euonymus europaeus* L	Eurasiatico	EK, EX, EY, GK
582	*Parnassia palustris* L. ssp. *palustris*	Eurosiberiano	SY
	OXALIDACEAE		
582	*Oxalis articulata* Savigny	Sud-Americano *	SX
583	*Oxalis corniculata* L.	Cosmopolita *	SX
584	*Oxalis latifolia* Kunth	Americano *.	SX
	VIOLACEAE		
585	*Viola alba* Besser ssp. *dehnardii* (Ten.) W. Becker	Eurimediterraneo	EX, PY
586	*Viola arvensis* Murray ssp. *arvensis*	Eurasiatico *	SY
587	*Viola eugeniae* Parl. ssp. *eugeniae*	Endemico	CK, EX, FY, GX, GY, IK, IY
588	*Viola kitaibeliana* Schult.	Europeo-Caucasico *	SX
589	*Viola majellensis* Porta & Rigo ex Strobl	Appennino-Balcanico	BX, CK, EK, FY, GK, GX, GY, IY
590	*Viola odorata* L.	Eurimediterraneo	EY, SX, SY
591	*Viola riechenbachiana* Jord. ex Boreau	Eurosiberiano	SX. Ricondotta al taxon la segnalazone di *Viola umbrosa* Hoff (Cesati, 1872) presso la Fonte della Spogna di Lama
	SALICACEAE		
592	*Populus alba* L.	Paleotemperato	BX, EY, FX, SY
593	*Populus nigra* L.	Paleotemperato	CK
594	*Populus tremula* L.	Eurosiberiano	CK, EY

595	*Salix alba* L.	Paleotemperato	CK, EY
596	*Salix eleagnos* Scop. ssp. *eleagnos*	Mediterraneo-Montano	SY
597	*Salix purpurea* L. ssp. *purpurea*	Eurasiatico	CK, SX
598	*Salix retusa* L.	Europeo	EK, GX, IY
599	*Salix triandra* L. ssp. *triandra*	Eurosiberiano	CK
	LINACEAE		
600	*Linum alpinum* Jacq.	Mediterraneo-Montano	EX, IK, SY
601	*Linum bienne* Mill.	Subatlantico	SX, SY
602	*Linum capitatum* Kit. ex Schult. ssp. *serrulatum* (Bertol.) Hartvig	Appennino-Balcanico	EX, IK
603	*Linum catharticum* L.	Eurimediterraneo *	EX
604	*Linum corymbulosum* Rchb.	Stenomediterraneo *	SX
605	*Linum nodiflorum* L.	Eurimediterraneo *	SX
606	*Linum strictum* L.	Stenomediterraneo	SX
607	*Linum tenuifolium* L.	Pontico	EX, SY
608	*Linum tryginum* L.	Eurimediterraneo	EX
609	*Linum usitatissimum* L. ssp. *angustifolium* (Huds.) Thell.	Eurimediterraneo *	AH
610	*Linum viscosum* L.	Orof. Sud-Europeo *	SX
	HYPERICACEAE		
611	*Hypericum hyssopifolium* Chaix	Orof. Sud-Europeo *	DY, LX, MX
612	*Hypericum montanum* L.	Europeo-Caucasico *	SX
613	*Hypericum perforatum* L. ssp. *perforatum*	Eurimediterraneo	CK, EX, IK
614	*Hypericum richeri* Vill. ssp. *richeri*	Orof. Sud-Europeo	EX
615	*Hypericum tetrapterum* Fr.	Paleotemperato *	SX
	EUPHORBIACEAE		
616	*Euphorbia amygdaloides* L.	Europeo	SX
617	*Euphorbia chamaesyce* L.	Eurimediterraneo *	SX
618	*Euphorbia characias* L.	Stenomediterraneo	BX, CK, EX, IK
619	*Euphorbia cyparissias* L.	Europeo	SY
620	*Euphorbia exigua* L.	Eurimediterraneo *	SX
621	*Euphorbia falcata* L.	Mediterraneo-Turaniano *	SX
622	*Euphorbia helioscopia* L. ssp. *helioscopia*	Cosmopolita	SX, SY
623	*Euphorbia lathyris* L.	Mediterraneo-Turaniano *	SX
624	*Euphorbia maculata* L.	Nord-Americano *	SX
625	*Euphorbia myrsinites* L. ssp. *myrsinites*	Pontico	EX, IK
626	*Euphorbia nicaensis* All. ssp. *nicaensis*	Eurimediterraneo	SY
627	*Euphorbia peplus* L.	Cosmopolita *	SX
628	*Euphorbia platyphyllos* L.	Eurimediterraneo *	SX
629	*Euphorbia prostrata* Aiton	Nord-Americano *	SX
630	*Euphorbia spinosa* L. ssp. *spinosa*	Nord-Mediterraneo *	GK, SX
631	*Mercurialis annua* L.	Paleotemperato	SX
632	*Mercurialis ovata* Sternb. & Hoppe	Pontico	EX
633	*Mercurialis perennis* L.	Europeo	RX
	GERANIACEAE		
634	*Erodium alpinum* L'Hér.	Endemico	IK
635	*Erodium ciconium* (L.) L'Hér.	Eurimediterraneo *	SX
636	*Erodium cicutarium* (L.) L'Hér.	Cosmopolita	SX, SY
637	*Erodium malacoides* (L.) L'Her.	Eurimediterraneo	SX
638	*Geranium columbinum* L.	Subcosmopolita *	SX
639	*Geranium dissectum* L.	Eurasiatico *	SX

640	*Geranium lucidum* L.	Eurimediterraneo *	SX
641	*Geranium molle* L.	Eurasiatico	AH, BX, SY
642	*Geranium nodosum* L.	Mediterraneo-Montano	SY
643	*Geranium purpureum* Vill.	Eurimediterraneo *	SX
644	*Geranium pusillum* L.	Europeo	SY
645	*Geranium pyrenaicum* Burm. f. ssp. *pyrenaicum*	Eurimediterraneo	EX, IK
646	*Geranium robertianum* L.	Cosmopolita	SX, SY
647	*Geranium rotundifolium* L.	Paleotemperato *	SX
648	*Geranium tuberosum* L. ssp. *tuberosum*	Sud-Europeo *	SX
	ONAGRACEAE		
649	*Chamaenerion angustifolium* (L.) Scop.	Circumboreale *	SY
650	*Epilobium alsinifolium* Vill.	Artico-Alpino °°	AH
651	*Epilobium hirsutum* L.	Paleotemperato	SY
652	*Epilobium montanum* L.	Eurasiatico *	SX
653	*Epilobium parviflorum* Schreb.	Paleotemperato *	SX
654	*Epilobium tetragonum* L. ssp. *tetragonum*	Eurimediterraneo	CK
	LYTHRACEAE		
655	*Lythrum salicaria* L.	Cosmopolita	RY
656	*Punica granatum* L.	Asiatico	EY, SY. Coltivato, spontaneizzato
	ANACARDIACEAE		
657	*Pistacia terebinthus* L. ssp. *terebinthus*	Eurimediterraneo	EK, GK
	SAPINDACEAE		
658	*Acer campestre* L.	Europeo-Caucasico	CK, EK, EX, EY, GK, PY
659	*Acer monspessulanus* L. ssp. *monspessulanus*	Eurimediterraneo	EX, GK
660	*Acer negundo* L.	Nord-Americano *	SX
661	*Acer opalus* Mill. ssp. *obtusatum* (Waldst. & Kit. ex Willd.) Gams	Appennino-Balcanico	EK, EX, GK, PY
662	*Acer pseudoplatanus* L.	Europeo-Caucasico	EX, SX
663	*Aesculus hippocastanum* L.	Sud-Est-Europeo	SY. Utilizzato per le albearture stradali
	RUTACEAE		
664	*Ruta chalepensis* L.	Stenomediterraneo	FX
	THYMELACEAE		
665	*Daphne laureola* L.	Subatlantico	EK
666	*Daphne mezereum* L.	Eurosiberiano	AH, EK
667	*Daphne oleoides* Schreb.	Eurimediterraneo	EK, EX, GK
668	*Thymelaea passerina* (L.) Coss. & Germ.	Eurimediterraneo *	SX
	CISTACEAE		
669	*Cistus creticus* L. ssp. *creticus*	Stenomediterraneo *	BX, QX, SY
670	*Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter & Burdet	Stenomediterraneo	KY
671	*Cistus salviifolius* L.	Stenomediterraneo	CK, EY
672	*Fumana ericifolia* Wallr.	Stenomediterraneo	SX
673	*Fumana procumbens* (Dunal) Gren. & Godr.	Pontico	EX
674	*Fumana thymifolia* (L.) Spach ex Webb	Stenomediterraneo	SX
675	*Helianthemum appeninum* (L.) Mill. ssp. *apenninum*	Sud-Ovest-Europeo	EX, IK, SY
676	*Helianthemum nummularium* (L.) Mill. ssp. *grandiflorum* (Scop.) Schinz & Thell.	Europeo-Caucasico	EX
677	*Helianthemum nummularium* (L.) Mill. ssp. *obscurum* (Celak) Holub	Europeo-Caucasico	EX

678	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *alpestre* (Jacq.) Ces.	Orof. Sud-Europeo	GX, GY, IY
679	*Helianthemum oleandicum* (L.) Dum. Cours. ssp. *incanum* (Willk.) G. Lopez	Europeo-Caucasico	EX, SX
680	*Helianthemum oelandicum* (L.) Dum.Cours. ssp. *italicum* (L.) Ces.	Orof. Sud-Ovest-Europeo *	SX
681	*Helianthemum salicifolium* (L.) Mill.	Eurimediterraneo *	SX
	SIMAROUBACEAE		
682	*Ailanthus altissima* (Mill.) Swingle	Avventizio	CK, EK, EY
	MALVACEAE		
683	*Abutilon theophrasti* Medik.	Eurasiatico *	SX
684	*Alcea rosea* L.	Avventizio	SY. Coltivato, spontaneizzato
685	*Malope malacoides* L.	Eurimediterraneo	SY
686	*Malva multiflora* (Cav.) Soldano, Banfi & Galasso	Stenomediterraneo *	SX
687	*Malva neglecta* Wallr.	Paleotemperato	AX, SX
688	*Malva pusilla* Sm.	Eurosiberiano	SY
689	*Malva setigera* K.F. Schimp. & Spenn.	Eurimediterraneo *	SX
690	*Malva sylvestris* L. ssp. *sylvestris*	Eurosiberiano	AX, CK
691	*Malva trimestris* (L.) Salisb.	Stenomediterraneo *	SX
692	*Tilia cordata* Mill.	Europeo	SY
693	*Tilia platyphyllos* Scop. ssp. *platyphyllos*	Europeo	EK, EY, GK, SY
	RESEDACEAE		
694	*Reseda alba* L. ssp. *alba*	Eurimediterraneo	SY
695	*Reseda lutea* L. ssp. *lutea*	Europeo	AH
696	*Reseda luteola* L.	Circumboreale	LK
697	*Reseda phyteuma* L.	Eurimediterraneo*	SX
	BRASSICACEAE		
698	*Aethionema saxatile* (L.) R. Br. ssp. *saxatile*	Mediterraneo-Montano	AH, BX, EX, IK, SY
699	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	Eurasiatico *	SX
700	*Alyssum alyssoides* (L.) L.	Eurimediterraneo *	SY
701	*Alyssum cuneifolium* Ten.	Endemico	AH, EK, GX, GY, IY, SY
702	*Alyssum diffusum* Ten. ssp. *diffusum*	Mediterraneo-Montano	AH, EX
703	*Alyssum montanun* L. ssp. *montanum*	Pontico	
704	*Alyssum strigosum* (Banks & Sol.) Jalas	Mediterraneo-Orientale	BX, SX
705	*Arabidopsis thaliana* (L.) Heynh.	Paleotemperato	EX, SX
706	*Arabis alpina* L. ssp. *alpina*	Artico-Alpino	IK, SY
707	*Arabis alpina* L. ssp. *caucasica* (Willd.) Briq.	Mediterraneo-Montano	EX, GY
708	*Arabis auriculata* Lam.	Orof. Sud-Europeo *	SX
709	*Arabis collina* Ten. ssp. *collina*	Mediterraneo-Montano	SX
710	*Arabis hirsuta* (L.) Scop.	Orof. Sud-Europeo *	SX
711	*Arabis surculosa* N. Terracc.	Appennino-Balcanico	BX, GX, GY
712	*Aubrieta columnae* Guss. ssp. *columnae*	Endemico	AH, AX
713	*Aurinia sinuata* (L.) Griseb.	Appennino-Balcanico *	SX
714	*Barbarea vulgaris* W.T. Aiton	Eurosiberiano *	SX
715	*Biscutella laevigata* L. ssp. *australis* Raffaelli & Baldoin	Endemico	SX, SY
716	*Brassica nigra* (L.) W. D. J. Koch	Eurimediterraneo	SY
717	*Brassica oleracea* (L.)	Ovest-Europeo	SY
718	*Brassica rapa* L. ssp. *rapa*	Eurimediterraneo	SY
719	*Bunius eucago* L.	Eurimediterraneo	SY

720	*Calepina irregularis* (Asso) Thell.	Mediterraneo-Turaniano *	QX
721	*Capsella bursa-pastoris* (L.) Medik. ssp. *bursa-pastoris*	Cosmopolita	SX, SY
722	*Capsella rubella* Reut.	Cosmopolita *	LW, MY, OY
723	*Cardamine amporitana* Sennen & Pau	Subendemico *	SX
724	*Cardamine enneaphyllos* (L.) Crantz	Appennino-Balcanico	BX
725	*Cardamine graeca* L.	Nord-Mediterraneo *	SX
726	*Cardamine hirsuta* L.	Cosmopolita	SX
727	*Cardamine kitaibelii* Bech.	Orof. Sud-Europeo *	SX
728	*Cardamine monteluccii* Brilli-Catt. & Gubellini	Endemico	CX, MX, OX
729	*Clypeola jonthlaspi* L. ssp. *jonthlaspi*	Stenomediterraneo	IK, SX
730	*Diplotaxis erucoides* (L.) DC. ssp. *erucoides*	Stenomediterraneo	FK, FX
731	*Diplotaxis muralis* (L.) DC.	Mediterraneo-Atlantico *	SY
732	*Diplotaxis tenuifolia* (L.) DC.	Subatlantico	SY
733	*Draba aizoides* L. ssp. *aizoides*	Mediterraneo-Montano	AH, EX, GX, GY, IY
734	*Draba aspera* Bertol.	Mediterraneo-Montano	BX
735	*Draba aizoides* L. ssp. *aizoides*	Mediterraneo-Montano	AH, EX, GX, GY, IY
736	*Drabella muralis* (L.) Fourr.	Circumboreale *	SX
737	*Eruca vesicaria* (L.) Cav.	Eurimedterraneo	SY
738	*Erysimum cheiri* (L.) Crantz.	Eurimedterraneo *	SX
739	*Erysimum majellense* Polatscheck	Endemico	EX, IK
740	*Erysimum pseudorhaeticum* Polatscheck	Endemico	BK, IK, SY
741	*Fibigia clypeata* (L.) Medik	Orof. Sud-Est Europeo	SX
742	*Hesperis laciniata* All. ssp. *laciniata*	Nord-Mediterraneo *	SX
743	*Hornungia alpina* (L.) O. Appel ssp. *alpina*	Mediterraneo-Montano °°	BX, GY
744	*Hornungia petraea* (L.) Rchb. ssp. *petraea*	Eurimediterraneo	SY
745	*Iberis saxatilis* L. ssp. *saxatilis*	Mediterraneo-Montano °°	BX, FY, GX, IY
746	*Iberis violacea* W.T. Aiton	Mediterraneo-Montano	DY
747	*Isatis apennina* Ten. ex Grande	Subendemico °°	EK, FY
748	*Isatis tinctoria* L. ssp. *tinctoria*	Eurasiatico	EX, IK, SY
749	*Lepidium campestre* (L.) W.T. Aiton	Europeo-Caucasico *	SX
750	*Lepidium draba* L. ssp. *Draba*	Mediterraneo-Turaniano	SX
751	*Lepidium graminifolium L.*	Eurimediterraneo *	SX
752	*Lunaria annua* L.	Sud-Est Europeo	RX
753	*Lunaria rediviva* L.	Europeo	RX
754	*Malcolmia orsiniana* (Ten.) Ten. ssp. o*rsiniana*	Appennino-Balcanico °°	BK, BX
755	*Matthiola incana* (L.) R. Br. ssp. *incana*	Stenomediterraneo.	SX, SY
756	*Microthlaspi perfoliatum* (L.) F. K. Mey	Paleotemperato	IK, SX
757	*Mummenhoffia alliacea* (L.) Esmailbegi & Al-Shehbaz	Mediterraneo-Atlantico *	SX
758	*Nasturtium officinale* W.T. Aiton	Cosmopolita *	SX
759	*Noccaea stylosa* (Ten.) Rchb.	Endemico	FY, GX, GY, IY
760	*Pseudoturritis turrita* (L.) Al-Shehbaz.	Stenomediterraneo	EX
761	*Raphanus raphanistrum* L. ssp. *landra* (Moretti ex DC.) Bonnier & Layens	Stenomediterraneo *	SX
762	*Rapistrum rugosum* (L.) Arcang.	Eurimediterraneo	SX, SY
763	*Sinapis alba* L. ssp. *alba*	Mediterraneo-Orientale *	SX
764	*Sinapis arvensis* L. ssp. *arvensis*	Stenomediterraneo *	SX
765	*Sisymbrium irio* L.	Paleotemperato *	SX
766	*Sisymbrium officinale* (L.) Scop.	Eurasiatico *	SX
767	*Sisymbrium orientale* L.	Eurimediterraneo *	SX
768	*Turritis glabra* L.	Artico-Alpino *	SX

	LORANTHACEAE		
769	*Loranthus europaeus* Jacq.	Europeo	EY
	SANTALACEAE		
770	*Osyris alba* L.	Eurimediterraneo	BX, EK, EX, GK, PY
771	*Thesium humifusum* DC.	Eurimediterraneo	EX
772	*Thesium linophyllon* L.	Sud-Est Europeo	IK
773	*Thesium parnassii* A. DC.	Appennino-Balcanico	IY
774	*Viscum album* L. ssp. *album*	Eurasiatico	RX
	PLUMBAGINACEAE		
775	*Armeria gracilis* Ten. ssp. *gracilis*	Endemico	GX
776	*Armeria gracilis* Ten. ssp. *majellensis (* Boiss.) Arrigoni	Endemico	CK, EK, EX, GY, IY
777	*Plumbago europaea* L.	Stenomediterraneo	FX
	POLYGONACEAE		
778	*Bistorta officinalis* Delarbre	Circumboreale *	EY
779	*Bistorta vivipara* (L.) Delarbre	Artico-Alpino	GX, IY
780	*Fallopia baldschuanica* (Regel) Holub	Eurasiatico *	SX
781	*Fallopia convolvulus* (L.) Á.Löve	Circumboreale *	SX
782	*Persicaria lapathifolia* (L.) Delarbre	Cosmopolita *	SX
783	*Polygonum aviculare* L. ssp. *aviculare*	Cosmopolita	EX, EY
784	*Rumex acetosa* L. ssp. *acetosa*	Circumboreale	BX, EX
785	*Rumex conglomeratus* Murray	Eurasiatico *	SX
786	*Rumex crispus* L.	Cosmopolita	SX
787	*Rumex nebroides* Campd.	Appennino-Balcanico	SX, SY
788	*Rumex pulcher* L. ssp. *pulcher*	Eurimediterraneo *	SX
789	*Rumex scutatus* L. ssp. *scutatus*	Mediterraneo-Montano	EK, EX, EY, FK, FX, GK
	TAMARICACEAE		
790	*Tamarix africana* Poir.	Mediterraneo-Occidentale *	SX
791	*Tamarix gallica* L.	Eurimediterraneo	RX
792	*Tamarix parviflora* DC.	Mediterraneo-Orientale *	SX
	CARIOPHYLLACEAE		
793	*Agrostemma githago* L.	Eurasiatico	SY
794	*Arenaria bertoloni* Fiori	Endemico	IK
795	*Arenaria grandifora* L. ssp. *grandifora*	Mediterraneo-Montano	AX, GX, GY, IY
796	*Arenaria serpyllifolia* L. ssp. *serpyllifolia*	Subcosmopolita	SX, SY
797	*Cerastium arvense* L. ssp. *arvense*	Paleotemperato	CK, EX, IK, IX
798	*Cerastium arvense L.* ssp. *suffruticosum* (L.) Ces.	Orofita Sud-Europeo	IK
799	*Cerastium brachypetalum* Desp. ex Pers. ssp. *brachypetalum*	Eurimediterraneo	SX
800	*Cerastium brachypetalum* Desp. ex Pers. ssp. *roeseri* (Boiss. & Heldr.) Nyman	Eurimediterraneo *	EX
801	*Cerastium cerastoides* (L.) Britton	Artico-Alpino.	
802	*Cerastium glomeratum* Thuill.	Cosmopolita *	SX
803	*Cerastium pumilum* Curtis	Eurimediterraneo	SY
804	*Cerastium thomasii* Ten.	Endemico	EX, GX, GY, IY
805	*Cerastium tomentosum* L.	Ovest-Europeo	EK, EX, EY, FX, IK, SY
806	*Dianthus carthusianorum* L. ssp. *tenorei (* Lacaita) Pignatti	Endemico	SX, SY
807	*Dianthus ciliatus* Guss. ssp. *ciliatus*	Appennino-Balcanico	AH, EK, EX
808	*Dianthus deltoides* L.	Eurasiatico *	EX

809	*Dianthus hyssopifolius* L.	Mediterraneo-Montano	EX
810	*Dianthus virgineus* L.	Stenomediterraneo	IK
811	*Drypis spinosa* L. ssp. *spinosa*	Appennino-Balcanico	AH, CK, EK, EX, EY, FX, GK
812	*Heliosperma pusillum* (Waldst. & Kit.) Rchb.	Mediterraneo-Montano.	
813	*Herniaria bornmuelleri* Chaudhri	Endemico.	
814	*Herniaria incana* Lam.	Eurimediterraneo	AH
815	*Holosteum umbellatum* L. ssp. *umbellatum*	Paleotemperato *	SX
816	*Mcneillia graminifolia* (Ard.) Dillenb. & Kadereit ssp. *rosanoi* (Ten.) F. Conti, Bartolucci, Iamonico & Del Guacchio	Endemico	AK, GH, SX
817	*Minuartia glomerata* (M. Bieb) Degen ssp. *trichocalycina* (Ten. & Guss.) F. Conti	Endemico	DK, DN
818	*Moehringia trinervia* (L.) Clairv.	Eurasiatico *	SX
819	*Paronykia kapela* (Hacq.) A. Kern. ssp. *kapela*	Appennino-Balcanico	EK, EX, LK
820	*Pethroragia prolifera* (L.) P. W. Ball & Heywood	Eurimediterraneo	IK
821	*Pethroragia saxifraga* (L.) Link ssp. *saxifraga*	Eurimediterraneo	CK, EX, IK
822	*Polycarpon tetraphyllum* L.	Eurimediterraneo *	SX
823	*Sabulina tenuifolia* (L.) Rchb.ssp. *tenuifolia*	Paleotemperato *	SX
824	*Sabulina verna* (L.) Rchb. ssp. *verna*	Eurasiatico	EX, GX, GY, IK, IY
825	*Sagina apetala* Ard.	Eurimediterraneo *	SX
826	*Sagina glabra* (Willd.) Fenzl	Orof. Sud-Ovest-Europeo *	GX
827	*Sagina saginoides* (L.) H. Karst. ssp. *saginoides*	Artico-Alpino	GY
828	*Saponaria ocymoides* L. ssp. *ocymoides*	Mediterraneo-Montano.	
829	*Saponaria officinalis* L.	Eurosiberiano	RX
830	*Silene acaulis* (L.) Jacq. ssp. *bryoides* (Jord.) Nyman	Artico-Alpino	CK, EK, EX, GX, GY, IY
831	*Silene catholica* (L.) W. T. Aiton	Appennino-Balcanico	AH
832	*Silene cattariniana* Ferrarini & Cecchi	Endemico	IK
833	*Silene ciliata* Pourr. ssp. *graefferi* (Guss.) Nyman	Appennino-Balcanico	EX
834	*Silene conica* L.	Appennino-Balcanico	EX
835	*Silene italica* L.) Pers. ssp. *italica*	Eurimediterraneo	EX, IK, PX
836	*Silene latifolia* Poir.	Paleotemperato	SY
837	*Silene multicaulis* Guss. ssp. *multicaulis*	Appennino-Balcanico	GY
838	*Silene nemoralis* Waldst. & Kit.	Eurimediterraneo.	
839	*Silene nocturna* L. ssp. *nocturna*	Mediterraneo-Macaronesico*	SX
840	*Silene notarisii* Ces.	Endemico	EX come Silene parnassica
841	*Silene otites* (L.) Wibel ssp. *otites*	Eurasiatico	EX, PX
842	*Silene paradoxa* L.	Appennino-Balcanico	IK
843	*Silene roemeri* Friv. ssp. *staminea* (Bertol.) Nyman	Endemico *	EX. Ricondotta al taxon la segnalazione di *Silene graminea* Vis.
844	*Silene viridiflora* L.	Eurasiatico *	SX
845	*Silene vulgaris* (Moench) Garcke ssp. *Vulgaris*	Paleotemperato	EX
846	*Stellaria media* (L.) Vill. ssp. *media*	Cosmopolita	SX
	AMARANTHACEAE		
847	*Amaranthus deflexus L.*	Sud-Americano*	SX
848	*Amaranthus graecizans* L.	Paleotemperato *	SX
849	*Amaranthus retroflexus* L.	Cosmopolita	SY

850	*Atriplex hortensis* L. ssp. *hortensis*	Eurasiatico *	SX
851	*Atriplex patula* L.	Circumboreale	RX
852	*Atriplex prostrata* Boucher ex DC.	Circumboreale *	SX
853	*Beta vulgaris* L. ssp. *maritima* (L.) Arcang.	Eurimediterraneo *	SX
854	*Beta vulgaris* L. ssp. *vulgaris*	Eurimediterraneo	SX . Coltivato, spontaneizzato
855	*Blitum bonus-henricus* (L.) Rchb.	Circumboreale	EX, GX
856	*Chenopodiastrum murale* (L.) S. Fuentes, Uotila & Borsch	Subcosmopolita *	SX
857	*Chenopodium album* L. ssp. *album*	Cosmopolita	CK
858	*Chenopodium opulifolium* Schrad. ex W.D.J.Koch & Ziz	Paleotemperato*	SX
859	*Chenopodium vulvaria* L.	Eurimediterraneo *	SX
	PORTULACACEAE		
860	*Portulaca oleracea* L.	Subcosmopolita *.	Foglie utilizzate a fini alimentari
	CACTACEAE		
861	*Opuntia ficus indica* (L.) Mill.	Neotropicale	SY
	CORNACEAE		
862	*Cornus mas* L.	Pontico	CK, EK, EX, FK, FX, GK, PX
863	*Cornus sanguinea* ssp. *hungarica* (Kàrpàti) Soò	Eurasiatico	CK, EK, EX, FX
	PRIMULACEAE		
864	*Androsace mathildae* Levier	Endemico	EK, GY
865	*Androsace villosa* L. ssp. *villosa*	Eurasiatico	EK, EX, FY, GX, GY, IY
866	*Androsace vitaliana* (L.) Lapeyr. ssp. *praetutiana* (Sund.) Kress	Endemico	CK, EX, FY, GX, GY, IY
867	*Cyclamen hederifolium* Aiton ssp. *hederifolium*	Stenomediterraneo	FX
868	*Cyclamen repandum* Sm. ssp. *repandum*	Nord-Mediterraneo	GK
869	*Lysimachia arvensis* (L.) U. Manns & Anderb. ssp. *arvensis*	Eurimediterraneo	SX, SY
870	*Lysimachia linum-stellatum* L.	Stenomediterraneo *	SX
871	*Primula auricula* L. ssp. *ciliata* (Moretti) Ludi	Mediterraneo-Montano	SY
872	*Primula veris* L. ssp. *columnae* (Ten.) Maire & Petitm.	Eurimediterraneo	BK. Ricondotta al taxon la segnalazione di *Primula veris* L. ssp. *suaveolens* (Bertol.) Guterm. et Ehdf.
873	*Primula vulgaris* Huds. ssp. *vulgaris*	Europeo	SY
874	*Samolus valerandi* L.	Subcosmopolita *	SX
	ERICACEAE		
875	*Arbutus unedo* L.	Stenomediterraneo *	EK, GK
876	*Arctostaphylos uva-ursi* (L.) Spreng.	Artico-Alpino	EK, EX, GK
877	*Moneses uniflora* (L.) A. Gray	Circumboreale *	EK, EX
878	*Monotropa hypopitys* L.	Circumboreale	EX, SX
879	*Orthilia secunda* (L.) House	Circumboreale	EK
880	*Vaccinium myrtillus* L.	Circumboreale *	EX
	RUBIACEAE		
881	*Asperula aristata* L. s.l.	Mediterraneo-Montano	SX, SY
882	*Asperula arvensis* L.	Mediterraneo-Montano	SX, SY

883	*Asperula cynanchica* L. s.l.	Mediterraneo-Montano	SX, SY
884	*Asperula purpurea* (L.) Ehrend. ssp. *purpurea*	Mediterraneo-Montano	SX, SY
885	*Cruciata laevipes* Opiz	Mediterraneo-Montano	SX, SY
886	*Cruciata pedemontana* (Bellardi) Ehrend.	Eurimediterraneo *	SX ##
887	*Galium album* Mill. ssp. *album*	Eurasiatico	EX, PY
888	*Galium anisophyllon* Vill.	Mediterraneo-Montano	EX, IK
889	*Galium aparine* L.	Eurasiatico	EX, SY
890	*Galium lucidum* All. ssp. *lucidum*	Eurimediterraneo	EX, IK
891	*Galium magellense* Ten.	Endemico	GX, IY
892	*Galium mollugo* L.	Eurasiatico	CK
893	*Galium murale* (L.) All.	Stenomediterraneo *	SX
894	*Galium parisiense*	Eurimediterraneo *	SX
895	*Galium rotundifolium* L. ssp. *rotundifolium*	Eurasiatico	IK
896	*Galium tricornutum* Dandy	Eurimediterraneo *	SX
897	*Galium verum* L. ssp. *verum*	Eurasiatico	EX, SY
898	*Rubia peregrina* L. ssp. *peregrina*	Stenomediterraneo	EK, GK
899	*Rubia tinctorium* L.	Eurasiatico	FX
900	*Sherardia arvensis* L.	Eurimediterraneo	SX
901	*Theligonum cynocrambe* L.	Stenomediterraneo *	SX
	GENTIANACEAE		
902	*Blackstonia perfoliata* (L.) Huds. ssp. *perfoliata*	Eurimediterraneo	SY
903	*Centaurium erythraea* Rafn ssp. *erythraea*	Paleotemperato	EX, LY
904	*Centaurium pulchellum* (Sw.) Druce	Paleotemperato *	SX
905	*Centaurium tenuiflorum* (Hoffmanns. & Link) Fritsch ssp. *acutiflorum* (Schott) Zeltner	Paleotemperato *	SX
906	*Gentiana dinarica* Beck	Appennino-Balcanico	AH, CK, EK, EX
907	*Gentiana lutea* L. ssp. *lutea*	Orofita Sud-Europeo	EX, SX, SY
908	*Gentiana nivalis* L.	Artico-Alpino	SY
909	*Gentiana orbicularis* Schur	Orofita Sud-Europeo °°	EK, FY, GK, SY
910	*Gentiana verna* L. ssp. *verna*	Eurasiatico	EX, GX, IY, SY
911	*Gentianella columnae* (Ten.) Holub	Endemico	RX
912	*Gentianopsis ciliata* (L.) Ma ssp. *ciliata*	Mediterraneo-Montano	RX
	APOCYNACEAE		
913	*Nerium oleander L.*	Sud-Mediterraneo *	SX
914	*Vinca major* L. ssp. *Major*	Eurimediterraneo	SY
915	*Vinca minor* L.	Europeo *	SX, SY
916	*Vincetoxicum hirundinaria* Medik. ssp. *hirundinaria*	Eurasiatico *	PY, SX. A Lama dei Peligni con il vincetossico si curavano i morsi dei serpenti (Finamore, 1894)
	CONVOLVULACEAE		
917	*Convolvulus arvensis* L.	Paleotemperato	CK
918	*Convolvulus cantabrica* L.	Eurimediterraneo	EX, PX, SY
919	*Convolvulus sepium* L.	Eurasiatico *	SX
920	*Convolvulus silvaticus* Kit.	Sud-Est-Europeo *	SX
921	*Cuscuta campestris* Yunck.	Nord-Americano *	SX
922	*Cuscuta europaea* L.	Paleotemperato	RX
923	*Cuscuta planiflora* Ten.	Eurimediterraneo	AH
	SOLANACEAE		

924	*Atropa bella-donna* L.	Mediterraneo-Montano	CK
925	*Datura stramonium* L. ssp. *stramonium*	Cosmopolita	SY
926	*Hyoschamus albus* L.	Eurimediterraneo	FX
927	*Lycium europaeum* L.	Eurimediterraneo *	SX
928	*Solanum dulcamara* L.	Paleotemperato	CK
929	*Solanum lycopersicum* L.	Americano	SY. Coltivato, spontaneizzato
930	*Solanum tuberosum* L.	Sud-Americano	SY. Coltivato, spontaneizzato
931	*Solanum villosum* Mill.	Eurimediterraneo *	SX
	NYCTAGINACEAE		
932	*Mirabilis jalapa L.*	Avventizio*	SX
	BORAGINACEAE		
933	*Aegonychon purpurocaeruleum* (L.) Holub.	Pontico	RX
934	*Anchusa azurea* Mill.	Eurimediterraneo	CK, SY
935	*Asperugo procumbens* L.	Paleotemperato	SY
936	*Borago officinalis* L.	Eurimediterraneo	BX, EY, SY
937	*Buglossoides arvensis* (L.) I. M. Johnst.	Eurimediterraneo	DY
938	*Cynoglossum magellense* Ten.	Endemico	EK, GK, SY
939	*Cynoglottiss barrellieri* (All.) Vural & Kit Tan. ssp. *barrel lieri*	Appennino-Balcanico	RX
940	*Echium italicum* L. ssp. *italicum*	Eurimediterraneo	CK
941	*Echium plantagineum* L.	Eurimediterraneo	SX, SY
942	*Echium vulgare* L. ssp. *vulgare*	Europeo	BX, CY
943	*Lithospermum offcinale* L.	Eurosiberiano	RX
944	*Myosotis arvensis* (L.) Hill ssp. *arvensis*	Eurasiatico *	SX
945	*Myosotis graui* Selvi.	Endemico	EK, GK, GX, IY, SY. Ricondotte al taxon le segnalazioni di *Myosotis alpestris* F. W. Schmidt e *M. ambigens* (Bég.) Grau.
946	*Myosotis incrassata* Guss.	Appennino-Balcanico	RX
947	*Myosotis ramosissima* Rochel ssp. *ramosissima*	Eurasiatico *	SX
948	*Myosotis sylvatica* Hoffm. ssp. *sylvatica*	Paleotemperato	SY
949	*Onosma echioides* (L.) L.	Appennino-Balcanico	SY
950	*Pulmonaria vallarsae* A.Kern. ssp. *apennina* (Cristof. & Puppi) L. Cecchi & Selvi	Endemico	SX, SY
951	*Symphytum bulbosum* K.F. Schimp.	Sud-Europeo *	SX
	HELIOTROPIACEAE		
952	*Heliotropium europaeum* L.	Eurimediterraneo	SY
	OLEACEAE		
953	*Fraxinus angustifolia* Vahl subsp. *oxycarpa* (M.Bieb. ex	Pontico*	SX
954	*Fraxinus ornus* L. ssp. ornus	Pontico	CK, EK, EX, EY, GK, PY
955	*Ligustrum lucidum* W.T. Aiton	Est-Asiatico. *	MX, SY
956	*Ligustrum vulgare* L.	Europeo	CK, EX
957	*Olea europaea* L.	Stenomediterraneo	GK, SY. Coltivato, spontaneizzato
958	*Phillyrea latifolia* L.	Stenomediterraneo	EK, GK
959	*Syringa vulgaris* L.	Mediterraneo-Montano *	CK
	PLANTAGINACEAE		

960	*Antirrhinum latifolium* Mill.	Nord-Ovest-Mediterraneo *	SY
961	*Antirrhinum majus* L.	Avventizio	SY
962	*Chaenorhinum minus* (L.) Lange ssp. *minus*	Eurimediterraneo	IK
963	*Cymbalaria muralis* Gaertn., B. Mey & Scherb. subsp *muralis*	Subcosmopolita	EX, SY
964	*Cymbalaria pallida* (Ten.) Wettst.	Endemico	EK, GK
965	*Digitalis ferruginea* L. –Nord-Est Mediterraneo.	Endemico	RX
966	*Digitalis micrantha* Roth ex Schweigg.	Endemico	EX, PY, SY
967	*Erinus alpinus* L.	Mediterraneo-Montano	BK, DN, EK, GK, SY
968	*Globularia bisnagarica* L.	Mediterraneo-Montano	EY
969	*Globularia meridionalis* (Podp.) O. Schwarz.	Appennino-Balcanico	EX, IK, SY
970	*Kickxia spuria* (L.) Dumort. ssp. *spuria*	Eurasiatico	SX
971	*Linaria alpina* (L.) Mill.	Mediterraneo-Montano	EK, EX, GK, GX, GY, IY
972	*Linaria purpurea* (L.) Mill.	Endemico	EX, IK, SY
973	*Linaria simplex* (Willd.) Desf.	Eurimediterraneo *	SX
974	*Linaria vulgaris* Mill. ssp. *vulgaris*	Eurasiatico	CK, IK
975	*Misopates orontium* Raf. ssp. *orontium*	Eurimediterraneo	SX, SY
976	*Plantago afra* L. ssp. *afra*	Stenomediterraneo *	SX
977	*Plantago atrata* Hoppe ssp. *atrata*	Mediterraneo-Montano	GX, GY, IY
978	*Plantago coronopus* L.	Eurimediterraneo *	SX
979	*Plantago lanceolata* L.	Eurasiatico	BX, EX, IK
980	*Plantago major* L.	Eurasiatico	SX, SY
981	*Plantago media* L. ssp. *media*	Eurasiatico	SY
982	*Plantago sempervirens* Crantz	Eurimediterraneo	EX
983	*Plantago serraria* L.	Stenomediterraneo *	SX
984	*Veronica alpina* L.	Artico-Alpino	SY
985	*Veronica anagallis-acquatica* L. ssp. *anagallis acquatica*	Cosmopolita	
986	*Veronica aphylla* L. ssp. *aphylla*	Mediterraneo-Montano.	
987	*Veronica arvensis* L.	Cosmopolita	IK
988	*Veronica beccabunga* L. ssp. *beccabunga*	Eurasiatico	SX
989	*Veronica cymbalaria* Bodard ssp. *cymbalaria*	Eurimediterraneo *	SX
990	*Veronica hederifolia* L. ssp. *hederifolia*	Eurasiatico	BX
991	*Veronica orsiniana* Ten. ssp. *orsiniana*	Orofita Sud-Europeo	IK, SY
992	*Veronica persica* Poir.	Eurasiatico	SX
993	*Veronica polita Fr.*	Subcosmopolita	SX
994	*Veronica praecox* All.	Eurimediterraneo	SX, SY
	SCROPHULARIACEAE.		
995	*Scrophularia canina* L.	Eurimediterraneo	AH, PX
996	*Scrophularia juratensis* Schleicher	Orofita-Sud-Europeo	SY
997	*Scrophularia scopolii* Hoppe ex Pers.	Eurasiatico *	SX
998	*Scrophularia umbrosa* Dumort. . ssp. *umbrosa*	Subatlantico *	SX
999	*Scrophularia vernalis* L.	Europeo-Caucasico *	SX
1000	*Verbascum blattaria* L.	Paleotemperato	SY
1001	*Verbascum longifolium* Ten.	Appennino-Balcanico	IK
1002	*Verbascum phlomoides* L.	Eurimediterraneo	AH, SY
1003	*Verbascum pulverulentum* Vill.	Centro-Europeo *	SX
1004	*Verbascum sinuatum L.*	Eurimediterraneo *	SX
1005	*Verbascum thapsus* L. ssp. *thapsus*	Europeo	EX, EY
	LAMIACEAE		

1006	*Ajuga reptans* L.	Europeo-Caucasico	RX
1007	*Ballota nigra* L. ssp. *meridionalis* (Bég.) Bég.	Eurimediterraneo *	SX
1008	*Clinopodium menthifolium* (Host) Merino ssp. *menthifolium*	Europeo *	SX
1009	*Clinopodium nepeta* (L.) Kuntze ssp. *nepeta*	Mediterraneo-Montano	EX, EY
1010	*Clinopodium vulgare* L. ssp. v*ulgare*	Circumboreale	CK, EX
1011	*Galeopsis angustifolia* Hoffm. ssp. *angustifolia*	Eurimediterraneo	AH, RX
1012	*Hyssopus officinalis* L. ssp. *aristatus* (Godr.) Nyman	Eurasiatico	AH, AX, EK, EY
1013	*Lamium amplexicaule L.*	Eurasiatico *	SX
1014	*Lamium bifidum Cirillo ssp. bifidum*	Stenomediterraneo *	SX
1015	*Lamium bifidum Cirillo ssp. balcanicum* Velen.	Orof. Sud-Est-Europeo *	SX
1016	*Lamium garganicum* L. ssp. *longiflorum* (Ten.) Kerguélen	Mediterraneo-Montano *	AH
1017	*Lamium garganicum* L. ssp. *striatum* (Hayek) Sm.	Appennino-Balcanico	SX
1018	*Lamium maculatum* L.	Eurasiatico	SX, SY
1019	*Lamium purpureum* L.	Eurasiatico *	SX
1020	*Lavandula angustifolia* Mill.	Stenomediterraneo *	SY. Coltivato, spontaneizzato
1021	*Lycopus europaeus* L.	Circumboreale *	SX
1022	*Marrubium incanum* Desr.	Circumboreale *	SX
1023	*Marrubium peregrinum* L.	Sud-Est-Europeo	AH, BX
1024	*Melissa officinalis L.*	Euromediterraneo *	SX
1025	*Melittis melissophyllum* L. ssp. *melissophyllum*	Europeo *	SX
1026	*Mentha aquatica* L.	Paleotemperato *	SX
1027	*Mentha longifolia* (L.) Huds.	Paleotemperato	FX
1028	*Mentha pulegium* L. ssp. *pulegium*	Eurimediterraneo	FX
1029	*Mentha spicata* L.	Eurimediterraneo *	SX
1030	*Micromeria graeca* (L.) Benth. ex Rchb. ssp. *graeca*	Stenomediterraneo	IK
1031	*Micromeria juliana* (L.) Benth. Ex Rchb.	Stenomediterraneo	BX, EX
1032	*Ocimum basilicum* L.	Asiatico	FX
1033	*Origanum majorana* L.	Avventizio	SY. Coltivato, spontaneizzato
1034	*Origanum vulgare* L. ssp. *vulgare*	Eurasiatico	AH, CK, EX, EY
1035	*Phaseolus vulgare* L.	Americano	SY. Coltivato, spontaneizzato
1036	*Prunella laciniata* (L.) L.	Eurimediterraneo	SY
1037	*Prunella vulgaris* L.	Circumboreale *	SX
1038	*Salvia glutinosa* L.	Eurasiatico	RX
1039	*Salvia officinalis* L.	Stenomediterraneo	AH, SY. Coltivato, spontaneizzato
1040	*Salvia pratensis* L. ssp. *pratensis*	Eurimediterraneo	SY
1041	*Salvia rosmarinus* Spenn.	Stenomediterraneo	EY, FX. Coltivato, spontaneizzato
1042	*Salvia sclarea* L.	Eurimediterraneo	RX
1043	*Salvia verbenaca* L.	Eurimediterraneo *	PX
1044	*Satureja hortensis* L.	Eurimediterraneo	SY. Coltivato, spontaneizzato
1045	*Satureja montana* L. ssp. *montana*	Orof. Sud-Europeo	AH, CK, EX, EY
1046	*Satureja subspicata* Bartl. ex Vis. ssp. *liburnica* Silic.	Appennino-Balcanico	AH. Segnalato come *Satureja hissopifolia* (Tenore, 1832) e mai più ritrovato

1047	*Scutellaria columnae* All. ssp. *columnae* .		
1048	*Stachys annua* (L.) L. ssp. *annua*	Stenomediterraneo*	SX
1049	*Stachys italica* Mill.	Eurimediterraneo *	SX
1050	*Stachys germanica* L. ssp. *germanica*	Endemico	AH, GY, KY, LK, SY
1051	*Stachys germanica* L. ssp. *salviifolia* (Ten.) Gams.	Eurimediterraneo	LK, SY
1052	*Stachys montana* (L.) Peruzzi & Bartolucci ssp. *montana*	Appennino-Balcanico	SY
1053	*Stachys ocymastrum* (L.) Briq.	Mediterraneo-Turaniano *	SX
1054	*Stachys romana* (L.) E. H. L. Krause	Mediterraneo-Occidentale *	SX
1055	*Stachys recta* L. ssp. *grandiflora* (Caruel) Arcang.	Stenomediterraneo	KY
1056	*Stachys recta* L. ssp. *recta*	Mediterraneo-Orientale *	EX
1057	*Stachys thirkei* C. Koch	Mediterraneo-Montano	EX
1058	*Stachys thymphaea* Hausskn.	Appennino-Balcanico	DN, MX, OX, SY
1059	*Teucrium capitatum* L. ssp. *capitatum*	Appennino-Balcanico	EX, SX, SY
1060	*Teucrium chamaedrys* L. ssp. *chamaedrys*	Stenomediterraneo	BX, FX, GK
1061	*Teucirum flavum* L. ssp. *flavum*	Eurimediterraneo	CK, EX, IK, PX, PY
1062	*Teucrium montanum* L.	Stenomediterraneo	BX, CK
1063	*Thymus longicaulis* C. Presl. ssp. *longicaulis*	Mediterraneo-Montano	AH, EX, SY
1064	*Thymus praecox* Opiz ssp. *polytrichus* (Borbàs) Jalas	Eurimediterraneo	EX
1065	*Thymus vulgaris L.* ssp. *vulgaris*	Appennino-Balcanico	GX, GY, IK, IY. Coltivato, spontaneizzato
1066	*Ziziphora acinos* (L.) Melnikov	Stenomediterraneo	EY
1067	*Ziziphora capitata L. ssp. capitata*	Eurimediterraneo *	SX
1068	*Ziziphora granatensis* (Boiss. & Reut.) Melnikov ssp. *alpina* (L.) Bräuchler & Gutermann	Subpontica *	SX
		Orofita Sud-Europeo	GX, GY, IK, IY
	OROBANCHACEAE		
1069	*Bellardia trixago* (L.) All.	Eurimediterraneo *	SX
1070	*Bellardia viscosa* (L.) Fisch. & C.A. Mey.	Eurimediterraneo *	SY
1071	*Euphrasia italica* Wettst.	Subendemico	EX
1072	*Euphrasia salisburgensis* Funck ex Hoppe	Europeo	SX, SY
1073	*Euphrasia stricta* D. Wolff. Ex J. F. Lehm.	Europeo	SX, SY
1074	*Melampyrum arvense* L. ssp. *arvense*	Eurasiatico *	SX
1075	*Melampyrum barbatum* Waldst. & Kit. *ssp. carstiense* Ronniger.	Appennino-Balcanico	AK. Segnalato da Tenore (1832), da confermare
1076	*Melampyrum italicum* Soò	Endemico	RX
1077	*Odontites luteus* (L.) Clairv.	Eurimediterraneo	EX, IK
1078	*Odontites vernus* (Bellardi) Dumort. ssp. *serotinus* Corb.	Eurasiatico	BX , SX
1079	*Orobanche caryophyllacea*	Eurimediterraneo	RX
1080	*Orobanche crenata* Forssk.	Mediterraneo-Turaniano	RX
1081	*Orobanche gracilis* Sm.	Europeo-Caucasico *	SX
1082	*Orobanche hederae* Vauchere ex Duby	Eurimedieterraneo *	SY
1083	*Orobanche minor* Sm.	Paleotemperato *	SX
1084	*Parentucellia latifolia* (L.) Caruel	Eurimediterraneo	SY
1085	*Pedicularis comosa* L. ssp. *comosa*	Mediterraneo-Montano	EX, SX
1086	*Pedicularis elegans* Ten.	Endemico	BX, EX, GX, GY, IY
1087	*Pedicularis petoliaris* Ten.	Appennino-Balcanico	SY
1088	*Pedicularis verticillata* L. ssp. *verticillata*	Artico-Alpino *	LK
1089	*Phelipanche nana* (Reut.) Soják	Paleotemperato *	SX

1090	*Rhinanthus alectorolophus* (Scop.) Pollich ssp. *alectorolophus*	Centro-Europeo	IK
1091	*Rhinanthus wettsteinii* (Sterneck) Soò	Endemico	EX
	VERBENACEAE		
1092	*Verbena officinalis* L.	Paleotemperato	CK, FX. Le foglie di verbena si utilizzavano a Lama dei Peligni per calmare i dolori (Finamore, 1894)
	LENTIBULARIACEAE		
1093	*Pinguicula fiorii* Tammaro & Pace	Endemico *	EK
	AQUIFOLIACEAE		
1094	*Ilex acquifolium* L.	Subatlantico	EK, GK
	CAMPANULACEAE		
1095	*Campanula bononiensis L.*	Centro-Europeo *	SX
1096	*Campanula cochleariifolia* Lam.	Mediterraneo-Montano	SY
1097	*Campanula erinus* L.	Stenomediterraneo *	SX
1098	*Campanula fragilis* Cirillo ssp. *cavolinii* Ten.	Endemico	AH, CK, EK, GK
1099	*Campanula glomerata* L.	Eurasiatico	EX
1100	*Campanula rapunculus* L.	Paleotemperato	LY, SY
1101	*Campanula scheuchzeri* Vill. ssp. *scheuchzeri*	Mediterraneo-Montano	AH, EX, GX, GY, IK, IY. Ricondotta al taxon la segnalazione di *Campanula linfolia* Cesati (1872)
1102	*Campanula spicata* L.	Orofita Sud-Europeo °°	BK, BX, CY
1103	*Campanula tanfanii* Podlech	Endemico	GX
1104	*Campanula trachelium* L.	Eurasiatico *	SX
1105	*Edraianthus graminifolius* (L.) A. DC. ssp. *graminifolius*	Appennino-Balcanico	CK, EK, EX, GX, GY, IY
1106	*Legousia falcata* (Ten.) Fritsch	Stenomediterraneo *	SX
1107	*Legousia hybrida* (L.) Delarbre.	Atlantico *	SX
1108	*Legousia speculum-veneris* (L.) Chaix	Eurimediterraneo	SX, SY
1109	*Phyteuma orbiculare* L.	Mediterraneo-Montano	IY
	ASTERACEAE		
1110	*Achillea ageratum* L	Mediterraneo-Occidentale	BX, SY
1111	*Achillea barrellieri* Ten. ssp. *barellieri*	Endemico	EK, GX, GY, IY
1112	*Achillea collina* Becker ex Rchb.	Sud-Est Europeo	EX
1113	*Achillea millefolium* L. ssp. *millefolium*	Eurosiberiano	EX, SY
1114	*Achillea setacea* Waldst. & Kit. ssp. *setacea*	Sud-Est-Europeo	CK
1115	*Achillea stricta* (W. D. J. Koch) Schleich. Ex Gremli	Orofita Sud-Europeo	IK. Segnalazione dubbia (Conti et al. 2019, 2020)
1116	*Achillea tenorii* Grande	Endemico	EX
1117	*Adenostyles australis* (Ten.) Iamonico & Pignatti	Endemico	SY. Ricondotta al taxon la segnalazione di *Adenostyles glabra*
1118	*Antennaria dioica* (L.) Gaertn.	Circumboreale	RX
1119	*Anthemis arvensis* L. ssp. *arvensis*	Subcosmopolita	SY
1120	*Anthemis cretica* l. ssp. *petraea* (Ten.) Greuter	Endemico	GY

1121	*Arctium lappa* L.	Eurasiatico	FK
1122	*Arctium minus* (Hill) Bernh.	Eurimediterraneo *	SX
1123	*Artemisia absitnthium* L.	Subcosmopolita	SY
1124	*Artemisia alba* Turra	Sud-Europeo	AH, BX, EX, SY
1125	*Artemisia eriantha* Ten.	Orofita Sud-Europeo	EK, GY, IY
1126	*Artemisia vulgaris* L.	Circumboreale *	SX
1127	*Aster alpinus* L. ssp. *alpinus*	Circumboreale	EX, GX
1128	*Bellis perennis* L.	Circumboreale	EY,LW
1129	*Bellis sylvestris* Cirillo	Stenomediterraneo *	SX
1130	*Bombycilaeana erecta* (L.) Smoljan	Eurosiberiano	SX
1131	*Calendula arvensis* L.	Eurimediterraneo	SY
1132	*Cardopatum corymbosum* (L.) Pers.	Appennino-Balcanico	RX
1133	*Carduus affinis* Guss. ssp. *affinis*	Endemico *	EX
1134	*Carduus carlinifolius* Lam. ssp. *carlinifolius*	Mediterraneo-Montano	AH, AX, BX, EX, IK
1135	*Carduus chrysacanthus* Ten. ssp. *chrysacanthus*	Appennino-Balcanico	SY
1136	*Carduus corymbosus* Ten.	Endemico *	SX
1137	*Carduus nutans* L. ssp. *nutans*	Ovest-Europeo	EX, SY
1138	*Carduus pycnocephalus* L. ssp. *pycnocephalus*	Eurimediterraneo	SY
1139	*Carlina acaulis* L. ssp. *caulescens* (Lam.) Schubl. & G. M artens	Europeo	EX
1140	*Carlina corymbosa* L.	Stenomediterraneo	EX, SY
1141	*Carlina lanata* L.	Stenomediterraneo	SX, SY
1142	*Carlina vulgaris* L. *ssp. spinosa* (Velen.) Vandas	Nord-Mediterraneo	SY
1143	*Carthamus lanatus* L. ssp. *lanatus*	Eurimediterraneo	SY
1144	*Catananche lutea* L.	Sud-Mediterraneo *	SX
1145	*Centaurea ambigua* Guss. ssp. *ambigua*	Endemico	AH, SY
1146	*Centaurea calcitrapa* L.	Eurimediterraneo	RX
1147	*Centaurea ceratophylla* Ten. ssp. *ceratophylla*	Endemico	EK, EX
1148	*Centaurea cyanus*	Stenomediterraneo	SY
1149	*Centaurea diluta* Aiton	Mediterraneo-Occidentale *	SX
1150	*Centaurea jacea L.* ssp. *jacea*	Eurasiatico	RX
1151	*Centaurea solstitialis* L. ssp. *solstitialis*	Stenomediterraneo	SY
1152	*Centaurea tenoreana* Willk.	Endemico	EK, EX, IK
1153	*Centaurea triumfetti* All.	Europeo	EX, SY
1154	*Chondrilla juncea* L.	Eurosiberiano	SY
1155	*Cichorium endivia* L. ssp. *endivia*	Stenomediterraneo	AH. Coltivato, spontaneizzato, dev'essere confermato (Conti *et al* ., 2019, 2020)
1156	*Cichorium endivia* L. ssp. *pumilum* (Jacq.) Cout.	Stenomediterraneo	AH, BX
1157	*Cichorium intybus* L.	Paleotemperato	AY, CK, EY
1158	*Cirsium acaulon* (L.) Scop. ssp. *acaulon*	Eurasiatico	IK
1159	*Cirsium arvense* (L.) Scop.	Eurasiatico	IK
1160	*Cirsium creticum* (Lam.) d'Urv. ssp. *triumfettii* (Lacaita) K. Werner	Appennino-Balcanico *	SX
1161	*Cirsium lobelii* Ten.	Endemico	SY
1162	*Cirsium tenoreanum* Petr.	Endemico	EX
1163	*Cirsium vulgare* (Savi) Ten.	Paleotemperato	SY
1164	*Cota altissima* (L.) J. Gay	Sud-Europeo-Sud-Siberiano *	SX
1165	*Cota tinctoria* (L.) J. Gaj ssp. *tinctoria*	Pontico	EX, IK

1166	*Crepis aurea* (L.) Cass. ssp. *glabrescens* (Caruel) Arcang.	Appennino-Balcanico	GX, GY
1167	*Crepis lacera* Ten.	Appennino-Balcanico	AH, EX, IK
1168	*Crepis magellensis* F. Conti & Uzunov	Endemico	IY, MX
1169	*Crepis neglecta* L. ssp. *neglecta*	Eurimediterraneo	EX
1170	*Crepis pygmaea* L.	Orofita Sud-Ovest-Europeo	GY
1171	*Crepis sancta* (L.) Babc. ssp. *nemausensis* (P. Fourn.) Babc.	Mediterraneo-Turaniano	IK, SY
1172	*Crepis vesicaria* (L.)	Subatlantico *	SX
1173	*Crupina vulgaris* Cass.	Eurosiberiano	EX
1174	*Cynara cardunculus* L. ssp. *cardunculus*	Stenomediterraneo	SY
1175	*Dittrichia viscosa* (L.) Greuter	Eurimediterraneo *	SX
1176	*Doronicum columnae* Ten.	Orofita Sud-Europeo	FY
1177	*Echinops ritro* L. ssp. *ritro*	Stenomediterraneo	BX, SY
1178	*Echinops siculus* Strobl	Endemico *	SX
1179	*Erigeron alpinus* L.	Eurasiatico °°	SY
1180	*Erigeron bonariensis* L.	Americano	BX
1181	*Erigeron canadensis L.*	Nord-Americano *	SX
1182	*Erigeron epiroticus* (Vier.) Halàcsy	Appennino-Balcanico	FY, GX, GY, IY
1183	*Erigeron sumatrensis* Retz.	Americano	SX, SY
1184	*Eupatorium cannabinum* L. ssp. *cannabinum*	Paleotemperato	CK
1185	*Filago pyramidata* L.	Eurimediterraneo *	SX
1186	*Galactites tomentosus* Moench.	Stenomediterraneo *	SX
1187	*Galatella linosyris* (L.) Rchb. f.	Eurimediterraneo	RY
1188	*Geropogon hybridus* (L.) Sch.Bip.	Stenomediterraneo *	SX
1189	*Glebionis coronaria* (L.) Spach	Stenomediterraneo	CK
1190	*Hedypnois rhagadioloides* (L.) F.W. Schmidt	Stenomediterraneo *	SX
1191	*Helianthus tuberosus* L.	Nord-Americano	RX
1192	*Helichrysum italicum* (Roth) G. Don ssp. *italicum*	Eurimediterraneo	CK, EK, EX, GK
1193	*Helminthotheca echioides* (L.) Holub	Eurimediterraneo	SY
1194	*Hieracium amplexicaule* L. s. l.	Mediterraneo-Montano	EX
1195	*Hieracium racemosum* Waldst. & Kit. ex Willd. ssp. *pulmonarifolium*	Endemico	EX, KH
1196	*Jacobaea erucifolia* (L.) G. Gaertn., B.Mey. & Scherb. ssp. *erucifolia*	Eurasiatico *	SX
1197	*Hyoseris scabra* L.	Stenomediterraneo *	SX
1198	*Hypochaeris achyrophorus* L.	Stenomediterraneo	EX
1199	*Jurinea mollis* (L.) Rchb. ssp. *mollis*	Sud-Est Europeo	EX
1200	*Lactuca perennis L.*	Europeo *	SX
1201	*Lactuca saligna L.*	Mediterraneo-Turaniano *	SX
1202	*Lactuca sativa* L. ssp. *sativa*	Avventizio	SY. Coltivato, spontaneizzato
1203	*Lactuca sativa* ssp. *serriola* (L.) Galasso, Banfi, Bartolucci & Ardenghi	Eurimediterraneo	IK
1204	*Lactuca viminea* (L.) J.& C. Presl. ssp. *viminea*	Eurimediterraneo	AH, SY
1205	*Lapsana communis L. ssp. communis*	Paleotemperato *	SX
1206	*Leontodon crispus* Vill.	Sud-Europeo	EX, IK, IY
1207	*Leontodon hispidus* L. ssp. *dubius* (Hoppe) Pawłowska	Orofita Sud-Europeo *	MX
1208	*Leontodon hispidus* L. *ssp. Hispidus*	Europeo-Caucasico	IY
1209	*Leontodon rosanoi* (Ten.) DC.	Nord-Ovest-Mediterraneo	SY

1210	*Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz.	Appennino-Balcanico	CK, EK, EX, FY, GX, IY
1211	*Leucanthemum pallens* (J.Gay ex Perreym.) DC.	Eurimediterraneo *	SX
1212	*Leucanthemum tridactylites* (Kern. & Huter) Huter, Porta & Rigo	Endemico	SY
1213	*Leucanthemum vulgare* Lam. ssp. *vulgare*	Eurimediterraneo	SY
1214	*Mantisalca duriaei* (Spach) Briq. & Cavill.	Stenomediterraneo	SX
1215	*Matricaria chamomilla* L.	Subcosmopolita	SY
1216	*Mycelis muralis* (L.) Dumort. ssp. *muralis*	Eurasiatico *	SY
1217	*Omalotheca diminuta* (Braun-Blanq.) Bartolucci & Galasso	Appennino-Balcanico	BX, GX, GY, IY
1218	*Onopordum acanthium L.*	Eurasiatico *	SX
1219	*Onopordum illyricum* ssp. *illyricum*	Stenomediterraneo	RX
1220	*Pallenis spinosa* (L.) Cass. ssp. *spinosa*	Eurimediterraneo	BX, SY
1221	*Pentanema montanum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Mediterraneo-Occidentale	EX
1222	*Pentanema salicinum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort.	Eurasiatico *	SX
1223	*Pentanema squarrosum* (L.) D. Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M. Mart.Ort	Centro-Europeo	AH, EX
1224	*Petasites albus* (L.) Gaertn.	Europeo	SY
1225	*Petasites hybridus* (L.) P. Gaertn. B. Mey. & Scherb.	Eurasiatico	
1226	*Picris hieracioides* L. ssp. *hieracioides*	Eurosiberiano	EX, LY
1227	*Pilosella cymosa* s. l. (L.) F.W. Schultz & Sch.Bip.	Europeo *	KH
1228	*Pilosella lactucella* (*Wallr*.) P.D. Sell & C.West	Europeo	KH
1229	*Pilosella officinarum* Vaill.	Europeo-Caucasico *	EX, GX, GY, IK, IY, KX, PY
1230	*Pilosella piloselloides* (Vill.) Soják ssp. *praealta* (Vill. ex Gochnat) S. Bräut. & Greuter	Europeo *	EX, GX, GY, IK, IY, KX, PY, SX
1231	*Pilosella ziziana* (Tausch) F.W. Schultz & Sch.Bip.	Orofita Sud-Europeo	KH
1232	*Prenanthes purpurea* L.	Europeo	SY
1233	*Pseudopodospermum hispanicum* s. l. (L.) Zaika, Sukhor. & N. Kilian	Sud-Est-Europeo *	SX
1234	*Ptilostemon strictus* (Ten.) Greuter	Appennino-Balcanico	EX
1235	*Pulycaria dysenterica* (L.) Bernh.	Eurimediterraneo	RX
1236	*Reichardia picroides* (L.) Roth	Stenomediterraneo	EX, IK
1237	*Rhagadiolus stellatus* (L.) Gaertn.	Eurimediterraneo	SX, SY
1238	*Robertia taraxacoides* (Loisel.) DC.	Endemico	AH, EX, IK
1239	*Santolina chamaecyparissus* L.	Avventizio	EY. Coltivato, spontaneizzato
1240	*Scolymus hispanicus* L.	Eurimediterraneo	CK
1241	*Scorzonera cana* (C.A. Mey.) Griseb.	Pontico *	SX
1242	*Scorzonera laciniata* L. ssp. *laciniata*	Paleotemperato	RX
1243	*Scorzoneroides cichoriacea* (Ten.) Greuter	Mediterraneo-Montano	SY
1244	*Scorzoneroides montana* (Lam.) Holub ssp. *breviscapa* (DC.) Greuter.	Endemico	GX, GY, IY.
1245	*Senecio doronicum* (L.) L. ssp. *orientalis* J. Calvo.	Appennino-Balcanico	EX
1246	*Senecio inaequidens* DC.	Avventizio *	SX
1247	*Senecio scopolii* Hoppe & Hornsch. ssp. *floccosus* (Bertol.) Greuter	Endemico	SY
1248	*Senecio squalidus* L. ssp. *rupestris* (Waldst. & Kit.) Greuter	Orofita Sud-Est-Europeo	GY, KY
1249	*Senecio vulgaris* L.	Eurimediterraneo	CK, IK
1250	*Silybum marianum* (L.) Gaertn.	Eurimediterraneo	EY

1251	*Solidago virgaurea* L. ssp. *virgaurea*	Circumboreale	RX
1252	*Sonchus arvensis* L. ssp. *arvensis*	Eurosiberiano *	SY
1253	*Sonchus asper* (L.) Hill. ssp. *asper*	Cosmopolita *	SX
1254	*Sonchus bulbosus* (L.) N. Kilian & Greuter	Stenomediterraneo *	SX . Non riportato in Conti *et al.* (2019, 2020)
1255	*Sonchus oleraceus* L.	Eurasiatico *	SX
1256	*Symphyotrichum squamatum* (Spreng.) G.L.Nesom	Neotropicale *	SX
1257	*Tanacetum corymbosum* (L.) Sch.Bip. ssp. *achilleae* (L.) Greuter	Sud-Est-Europeo *	SX
1258	*Taraxacum apenninum* (Ten.) Ten.	Endemico	EK, FX, GX, GY, IY
1259	*Taraxacum glaciale* E. & A. Huet. ex Hand.-Mazz.	Appennino-Balcanico	GX, GY
1260	*Taraxacum officinale* Weber	Circumboreale	CK, EY
1261	*Tragopogon eriospermus* Ten.	Eurimediterraneo *	SX
1262	*Tragopogon porrifolius* L. ssp. *porrifolius*	Eurimediterraneo	EX, FK, FX
1263	*Tragopogon pratensis* L.	Eurosiberiano	EY
1264	*Tragopogon samaritanii* Heldr. & Sartori ex Boiss.	Orof Sud-Est-Europeo *	SX
1265	*Tusillago farfara* L.	Paleotemperato	FX, SX, SY
1266	*Urospermum dalechampii* (L.) F. W. Schmidt	Eurimediterraneo	EX, LY
1267	*Urospermum picroides* (L.) Scop. ex F.W. Schmidt	Eurimediterraneo *	LY, PX
1268	*Xanthium spinosum* L.	Sud-Americano *	SX
1269	*Xanthium strumarium* L. ssp. *strumarium*	Cosmopolita	SY
1270	*Xeranthemum cylindraceum* Sm.	Eurasiatico	SX
1271	*Xeranthemum inapertum (* L.) Mill.	Pontico *	SX
	VIBURNACEAE		
1272	*Sambucus ebulus* L.	Eurimediterraneo	SX, SY
1273	*Sambucus nigra* L.	Europeo	CK, EY
1274	*Viburnum lantana* L.	Eurasiatico *	CK
1275	*Viburnum tinus* L. ssp. *tinus*	Stenomediterraneo	EK, GK
	CAPRIFOLIACEAE .		
1276	*Lonicera caprifolium* L.		
1277	*Lonicera etrusca* Santi	Pontico.	EX
	DIPSACACEAE		
1278	*Cephalaria leucantha* (L.) Roem. & Schult.	Sud-Europeo	BX, EX
1279	*Cephalaria transsylvanica (L.) Roem. & Schult.*	Pontico *	SX
1280	*Dipsacus fullonum* L.	Eurimediterraneo	EY, FX, SY
1281	*Knautia calycina* (C. Presl) Guss.	Endemico	EX, IK. Assegnate al taxon le precedenti segnalazioni di *Knautia purpurea*
1282	*Lomelosia crenata* (Cirillo) Greuter & Burdet ssp. *crenata*	Sud-Mediterraneo	AH, EX
1283	*Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseudisetensis* (Lacaita) Greuter & Burdet	Endemico *	SX
1284	*Lomelosia graminifolia* (L.) Greuter & Burdet ssp. *graminifolia*	Mediterraneo-Montano	
1285	*Scabiosa columbaria* L. ssp. *columbaria*	Eurasiatico *	PY
1286	*Scabiosa columbaria* L. ssp. *portae* (Huter) Hayek	Sud-Est-Europeo	EX
1287	*Scabiosa holosericea* Bertol.	Orofita Sud-Est-Europeo	IK
1288	*Scabiosa pyrenaica* All.	Sud-Ovest Europeo	AH, MX, OX
1289	*Scabiosa uniseta* Savi	Endemico	SY
1290	*Sixalix atropurpurea* (L.) Greuter & Burdet	Stenomediterraneo	SX

	VALERIANACEAE		
1291	*Centranthus angustifolius* (Mill.) DC. ssp. *angustifolius*	Mediterraneo-Occidentale °°	MX, OX
1292	*Centranthus ruber* (L.) DC. ssp. *ruber*	Stenomediterraneo	SY
1293	*Valeriana montana* L.	Mediterraneo-Montano	LK, SX)
1294	*Valeriana saliunca* All.	Orofita Sud-Europeo	GX, GY, IY
1295	*Valeriana tripteris* L. ssp. *tripteris*	Mediterraneo-Montano	AH
1296	*Valeriana tuberosa* L.	Mediterraneo-Montano	EX, IK
1297	*Valerianella carinata* Loisel.	Eurimediterraneo	IK
1298	*Valerianella coronata* (L.) DC.	Eurimediterraneo *	SX
1299	*Valerianella echinata* (L.) DC.	Stenomediterraneo *	SX
1300	*Valerianella eriocarpa* Desv.	Stenomediterraneo *	SX
1301	*Valerianella locusta* (L.) Laterr.	Subcosmopolita *	SX
	ARALIACEAE		
1302	*Hedera helix* L. ssp. *helix*	Mediterraneo-Atlantico	EX, EY, PY, SY
	APIACEAE		
1303	*Ammi majus* L.	Eurimediterraneo *	SX
1304	*Anethum foeniculum* L.	Eurimediterraneo	LY, SX
1305	*Anethum graveolens* L.	Avventizio	EY
1306	*Anethum piperitum* Ucria	Sud-Mediterraneo *	SX
1307	*Angelica sylvestris* L.	Eurosiberiano *	SX
1308	*Apium graveolens* L.	Paleotemperato	EY
1309	*Athamanta sicula* L.	Sud-Ovest-Mediterraneo *	SX. Raggiunge sul massiccio della Majella il limite settentrionale di distribuzione geografica
1310	*Berula erecta* (Huds.) Coville	Circumboreale*	SX
1311	*Bifora testiculata* (L.) Spreng.	Stenomediterraneo *	SX
1312	*Bunium bulbocastanum* L.	Ovest-Europeo *	SX
1313	*Bunium petraeum* Ten.	Endemico *	CK
1314	*Bupleurum baldense* Turra	Eurimediterraneo	EX, IK
1315	*Bupleurum falcatum* L. ssp. *cernuum* (Ten.) Arcang.	Orofita Sud-Europeo	AH, EX, IK
1316	*Buplerurum praealtum* L.	Pontico	EX , SX
1317	*Bupleurum subovatum* Link ex Spreng.	Eurimediterraneo *	MX, OX
1318	*Carum heldreichii* Boiss.	Appennino-Balcanico	AH
1319	*Caucalis platycarpos* L.	Mediterraneo-Turaniano *	QX
1320	*Cervaria rivini* Gaertn.	Eurosiberiano *	SX
1321	*Chaerophyllum magellense* Ten.	Endemico *	EX
1322	*Chaerophyllum nodosum* (L.) Crantz.	Stenomediterraneo *	SX
1323	*Chaerophyllum temulum* L.	Eurasiatico *	SX
1324	*Conium maculatum* L. ssp. *maculatum*	Eurimediterraneo	EX
1325	*Coristospermum cuneifolium* (Guss.) Bertol.	Endemico	EX
1326	*Daucus broteroi* Ten.	Appennino-Balcanico	EX . Dev'essere confermato (Conti *et al*., 2019, 2020)
1327	*Daucus carota* L. ssp. *carota*	Paleotemperato	CK, EX, FX)
1328	*Eryngium amethystinum* L.	Sud-Est-Europeo	CK, EX, IK
1329	*Eryngium campestre* L.	Eurimediterraneo	RX
1330	*Ferula glauca* L.	Stenomediterraneo	SY

1331	*Helosciadium nodiflorum* (L.) W.D.J. Koch ssp. *nodiflorum*	Eurimediterraneo *	SX
1332	*Katapsuxis silaifolia* (Jacq.) Reduron, Charpin & Pimenov	Sud-Est-Europeo*	SX
1333	*Oreoselinum nigrum* Delarbre	Europeo-Caucasico	EX
1334	*Orlaya grandiflora* (L.) Hoffm.	Centro-Europeo *	SX
1335	*Orlaya platycarpos W.D.J. Koch* .	Stenomediterraneo	SX
1336	*Pastinaca sativa* L. ssp. *urens* (Req. ex Godr.) Celak.	Subcosmopolita	FK, FX
1337	*Petroselinum crispum* (Mill.) Fuss	Eurimediterraneo	SY
1338	*Pimpinella anisum* L.	Asiatico	SY. Coltivato, spontaneizzato
1339	*Pimpinella saxifraga* L. ssp. *saxifraga*	Europeo	EX
1340	*Pimpinella major* (L.) Huds.	Europeo-Caucasico *	SX
1341	*Pimpinella peregrina* L.	Eurimediterraneo *	SX
1342	*Pimpinella tragium* Vill.	Eurimediterraneo	EX
1343	*Prangos ferulacea (L.) Lindl.*	Mediterraneo-Turaniano *	SX
1344	*Sanicula europea* L.	Mediterraneo-Montano	SX, SY
1345	*Scandix australis* L. ssp. *australis*	Stenomediterraneo *	SX
1346	*Scandix pecten veneris* L.	Eurimediterraneo	SX
1347	*Seseli libanotis* (L.) W.D.J. Koch	Centro-Europeo *	SX
1348	*Seseli montanum* L. ssp. *montanum*	Mediterraneo-Montano	SY
1349	*Seseli tommasinii* Rchb.	Sud-Est-Europeo	EX. Ricondotte al taxon le segnalazioni di *Seseli pallasii* Besser.
1350	*Siler montanum* Crantz *ssp. garganicum* (Ten.) Iamonico, Bartolucci & F. Conti	Mediterraneo-Turaniano	BK, BX. Il taxon dev'essere confermato (Conti *et al* ., 2019, 2020)
1351	*Siler montanum* Crantz ssp. *siculum (* Spreng.) Iamonico, Bartolucci & F. Conti	Endemico	EX
1352	*Sison amomum* L.	Subatlantico *	SX
1353	*Thapsia asclepium* L.	Stenomediterraneo *	SX
1354	*Tordylium apulum* L.	Stenomediterraneo	EX
1355	*Tordylium maximum* L.	Eurimediterraneo *	SX
1356	*Torilis africana* Spreng.	Subcosmopolita *	SX
1357	*Torilis arvensis* (Huds.) Link	Subcosmopolita *	SX
1358	*Torilis nodosa* (L.) Gaertn. ssp. *nodosa*	Mediterraneo-Turaniano *	SX
1359	*Trinia dalechampii* (Ten.) Janch.	Appennino-Balcanico	CK, EX, GX, HY, IY
1360	*Xanthoselinum venetum* (Spreng.) Soldano & Banfi	Europeo *	SX

Nell'appendice *Phaseolus vulgare* L. è inserito erroneamente nella famiglia delle Lamiaceae. Il taxon appartiene alla famiglia delle Fabaceae.

FLORA OBČINE LAMA DEI PELIGNI (ABRUCI, ITALIJA): SISTEMATIČNA POSODOBITEV IN NOVE NAJDBE

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POVZETEK

Občina Lama dei Peligni se nahaja v provinci Chieti (regija Abruci), je delno vključena v nacionalni Park Maiella in pokriva 31,33 km² površine. Pričujoči prispevek se naslanja na prispevek iz leta 2011 in v njem avtorja poročata o posodobljenenu floističnemu prikazu taksonov, prisotnih na obravnavanem območju. Sestava novega seznama vrst je bila nujna, saj so po letu 2011 nove študije vodile do sprememb, novih najdb in izločitve taksonov, ki so prej veljali za prisotne. Trenutni floristični seznam šteje 1360 taksonov, med katerimi je 94 endemičnih vrst, ki povečujejo fitogeografski pomen obravnavanega območja. Horološki spekter kaže, da pripadajo zabeleženi taksoni 52 različnim horotipom, razdeljenih v devet geografskih kontingentov.

Ključne besede: Lama dei Peligni, Maiella, Abruci, flora, reka Aventino

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BIRD (AVES) DESCRIPTIONS OF JOANNES ANTONIUS SCOPOLI (1723-1788): GENERAL OVERVIEW

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ABSTRACT

Author of at least 175 new bird taxa, of which 59 taxa are still valid today, Joannes Antonius Scopoli (1723-1788) is one of the most important creators of ornithological history worldwide, yet often overlooked because his ornithological legacy remains poorly researched and known. His most important scientific work was conducted in Carniola (present-day Slovenia) between 1754 and 1769 and resulted in numerous publications. These include bird studies published in Annus I. Historico Naturalis, Descriptiones Avium (1769), while later studies were devoted to the revision of other explorer datasets, the most important being descriptions of birds from Pierre Sonnerat's expeditions. The paper presents an overview of the all new bird taxa described by Scopoli.

Key words: history of science, ornithology, collection, taxonomy, type specimens, zoological nomenclature

DESCRIZIONI DEGLI UCCELLI (AVES) DI GIOVANNI ANTONIO SCOPOLI (1723-1788): PANORAMICA GENERALE

SINTESI

Autore di almeno 175 nuovi taxa di uccelli, di cui 59 taxa ancora validi oggi, Giovanni Antonio Scopoli (1723-1788) è uno dei più importanti creatori di storia ornitologica a livello mondiale, ma spesso trascurato perché la sua eredità ornitologica rimane poco studiata e conosciuta. Il suo lavoro scientifico più importante fu condotto in Carniola (l'attuale Slovenia) tra il 1754 e il 1769, e portò a numerose pubblicazioni. Queste includono studi sugli uccelli pubblicati in Annus I. Historico Naturalis, Descriptiones Avium (1769), mentre gli studi successivi furono dedicati alla revisione di altri set di dati di esploratori, le più importanti furono le descrizioni degli uccelli delle spedizioni di Pierre Sonnerat. L'articolo presenta una panoramica di tutti i nuovi taxa di uccelli descritti da Scopoli.

Parole chiave: storia della scienza, ornitologia, collezione, tassonomia, esemplari tipo, nomenclatura zoologica

INTRODUCTION

Although Joannes Antonius Scopoli (1723-1788; Fig. 1) was one of the first adherents of modern Linnean classification of organisms and pioneered the study of biodiversity, including birds, in the previously unexplored part of SE Europe, little is known about his work related to ornithology. In fact, Scopoli is not mentioned at all (Bezzel & Prinzinger, 1990, Mearns & Mearns, 1998, Birkhead, 2008, Chansigaud, 2009) or only very briefly (Walters, 2003; Gebhardt, 2006) in many compilations on the history of ornithology, although he was one of the first descriptors of birds in Europe after Carl Linneaus (1707-1778) and also one of his correspondents (Soban, 2004). In the letters, Scopoli and Linnaeus discussed taxonomic issues concerning various bird species, including the Wallcreeper *(Tichodroma muraria)*, which was later described by Linnaeus (1766) according to Scopoli's description (Barbagli *et al.,* 1997). Scopoli's main works were based on original field observations made by Scopoli himself or by his correspondents such as Franz Xaver Wulfen (1728-1805), Count Josef Brigido von Bresowitz (1733-1817), Balthasar Hacquet (1739-1815), and others (Petkovšek, 1977), mainly in the territory of Carniola (Slovenia), Carinthia (Austria), and Friuli (Italy). Scopoli's fundamental works concern plants (Scopoli, 1760, 1772), insects and other arthropods (Scopoli, 1763), and birds (Scopoli, 1769). His most important field studies took place between the years 1754 and 1769, when he was appointed by imperial decree as a physician to Idria (W Slovenia), but from there he conducted several expeditions to different parts of Carniola, nowadays mostly W Slovenia (Petkovšek, 1977; Vrezec *et al*., 2017; Vrezec, 2023). After leaving Idria and Carniola in 1769, he devoted more time to professorship and cabinet study of written sources or material brought to him by correspondents, and to building his collection.

The first and most important ornithological work by J.A. Scopoli was *Annus I. Historico Naturalis, Descriptiones avium,* published in 1769, in which Scopoli described 254 bird taxa. The descriptions were based on Scopoli's personal examination of bird specimens in the field (and in his own collection), in the bird collection of Count Francesco Annibale Della Torre (germ. Franz Hannibal von Thurn), and the examination of live bird specimens at the imperial ZOO Schönbrunn in Vienna. The ZOO specimens came mainly from the expedition of the Viennese chemistry and botany professor Nikolaus Joseph von Jacquin (1727-1817), who undertook an expedition to South America (West Indies, Venezuela, Carthagena) between 1754-1759 (Fitzinger, 1853). Bird specimens, which were brought alive to Vienna, were collected mainly by Giovanni Buonamici and Fernando Barculli, who joined Jacquin's expedition (Fitzinger, 1856). Scopoli (1769) was the first to scientifically describe bird species from Jacquin's South American expedition, while illustrations of the birds with additional descriptions were later provided by Jacquin's son Joseph Franz von Jacquin (1766-1839) in *Beiträge zur Geschichte der Vögel* (Jacquin, 1784). Scopoli's (1769) *Descriptiones avium* was written in Latin, but it was so important that it was translated into German by Friderich Christian Günther the very next year after its publication (Scopoli, 1770). Günther's German translation was in fact the first revision of Scopoli (1769), as Günther attempted to combine Scopoli's Latin names with existing German bird names. Günther believed, as he explained in the preface, that it was important for Germans (Austria, including Carniola, was then part of the German Holly Roman Empire) to read about their nature in their own native language. However, this revision was not checked or approved by Scopoli himself, as Günther stated in the preface, although Scopoli mentions F.C. Günther among his collaborators in his autobiography *Vitae Mea Vices*, published in *Deliciae Flora et Fauna Insubricae* (Scopoli 1788). Following Günther's interpretations, which did not aim to taxonomically revise Scopoli's bird names, there were several taxonomic revisions of Scopoli (1769) de-

Fig./Sl. 1: Joannes Antonius Scopoli (1723-1733).

scriptions in 19th century, which were summarized by Hartert (1903, 1905, 1912, 1913, 1920a, 1920b, 1921a, 1921b). However, Hartert (1903, 1905, 1913, 1920a, 1921b) wrongly interpreted type localites from Carniola, what was criticized and corrected by Scheibel (1919), although these corrections were not fully adopted in later taxonomic revisions and overviews (*e.g.* Vaurie 1959, 1965; Mayr & Paynter 1964; del Hoyo *et al.*, 2005). Recently, Gregori (2008) presented an overall revision and interpretation of all descriptions in Scopoli (1769), with some taxa being still unresolved.

However, *Descriptiones avium* (Scopoli, 1769) was not Scopoli's only ornithological publication. In 1777, Scopoli published another work that included birds, *Introductio ad historiam naturalem sistens genera lapidum, plantarum et animalum* (Scopoli, 1777). This publication, however, was intended as a high-level taxonomic contribution dealing with the classification of minerals, plants, and animals based on Linnean systematics, classifying and describing genera rather than species. Scopoli (1777) also introduced some new genus names for birds in this work. Other ornithological publications, while not as comprehensive, were nevertheless important to modern ornithology and were first summarized by Newton (1882). Scopoli described birds in several treatises published in three volumes of his last work, *Deliciae Flora et Fauna Insubricae* (Scopoli 1786a, 1786b, 1788). In Part I (Scopoli 1786a) he revised the species described under the generic name *Alauda (De Alaudis Nostratibus)*, including seven species. Part II (Scopoli 1786b) described the species *Falco rufus* (synonym of the Red-footed Falcon *Falco vespertinus* Linnaeus 1766), for which he also provided the illustration, and the Linnean nomenclatural revision of the mammal and bird descriptions of the French naturalist Pierre Sonnerat (1748-1814). Sonnerat published his extensive observations from expeditions in Southeast Asia and Africa, including fauna (Sonnerat, 1776, 1782), which he did not describe according to new Linnean principles of naming. In Part III (Scopoli, 1788) there is only a description of *Fringilla alpina*, synonym of the Citril Finch *Carduelis citrinella* (Pallas, 1764), with an illustration. Although Scopoli made and published many illustrations especially of plants and insects, he provided only two original and above-mentioned illustrations of birds.

In the paper an overview of Scopoli's ornithological work is given with a review of the new bird taxa described by Scopoli. Since Scopoli's legacy is still unresolved with respect to the taxa he described, all existing bird figures used by J.A. Scopoli for his new bird taxa are presented, including tracking of bird collections with Scopoli's type specimens with comments on their current status. Published on the occasion of the 300th anniversary of J.A. Scopoli's birth, this work is intended to serve as an overview of current status of Scopoli's bird names and descriptions as a baseline for further historical studies of Scopoli's ornithological work, and for conducting further taxonomic and faunistic studies of birds in a period when accurate scientific data on avifauna were rare. This review is therefore not aiming in taxonomic revision of Scopoli's descriptions, but to highlight main taxonomic challenges connected to Scopoli's bird taxa.

MATERIAL AND METHODS

For determing new bird taxa described by Scopoli all four ornithological works were taken into consideration (Scopoli, 1769, 1786a, 1786b, 1788). Scopoli (1777) was not considered as it deals only with descriptions of taxa at genus level. Each described taxon was checked wether Scopoli listed already known taxon published in previous works of other authors that described species following Linnaean nomenclature system. Scopoli usually cited reference works, but in some cases I considered already published taxon also if Scopoli used the same name for the same species that was used already in preceding publications, but without exact citation given by Scopoli. For defined new Scopoli's taxa I have collected type localities stated by Scopoli in his descriptions. Following previous studies the localities cited in Scopoli (1769) were considered reliable (Hartert, 1903, 1905, 1913, 1920a, 1921b; Scheibel, 1919), while taxa published in other works less so. In particular Scopoli (1786b) descriptions of birds from Sonnerat (1776, 1782) the referred localities are known to be frequently wrong and misleading, partly because of inaccurate redescriptions of Sonnerat's localities in Scopoli's interpretations (Newton, 1882), but mostly because Sonnerat himself was giving wrong localities in his bird descriptions (Stresemann, 1952; Clancey, 1959; Mees, 1972). Therefore, beside original localities cited by Scopoli, possible interpretations of type localites at country level have been given folowing taxonomic review literature (only for currently valid bird taxa) or my own interpretations of them (interpretations of localities from Scopoli (1769)). For each described taxon the collections containing types given by Scopoli or interpreted from his descriptions is given as a baseline for further museological research of possible surviving Scopoli's type specimens. From the available literature and online sources also existing or newly designated types of Scopoli's taxa were extracted, but these data might be still incomplete since type specimens holdings from all museums

are still not published or available. Form Scopoli's descriptions citations of figures of described taxa were collected and presented as a key reference material for further historical taxonomic interpretations. For each taxon published interpretations of (sub)species identity were collected, but not all Scopoli's taxa were interprated and analysed yet. Some additional identity suggestions are given based on cited reference figures, which were compared with global avifaunal overview (del Hoyo, 2020). According to collected identifications the current taxonomic status of Scopoli's new bird descriptions was derived.

RESULTS AND DISCUSSION

New bird taxa described by Joannes A. Scopoli

As new species J.A. Scopoli described 175 bird taxa (Appendix 1). In Scopoli (1769) mainly birds from Carniola (nowadays Western Slovenia) were described with some specimens from Friuli and south Tyrol (NE Italy), Carinthia (South Austria), and non-European species mainly from South America. In all descriptions Scopoli refered to specimens from three collections he examined himself. Specimens were most likely examined also in Scopoli (1786a, 1788), although collections were not specified. On the other hand, Scopoli (1786b) exotic bird taxa mainly rely on figures and text from Sonnerat (1776, 1782), and not by examing the specimens. Therefore, figures from Sonnerat (1776, 1782) can be regarded as figures of types. According to the currently valid bird taxonomy (Gill *et al.*, 2023), J.A. Scopoli authors 59 valid bird taxa (34 % of all of his described new taxa), 52 species and 7 subspeces, and in addition 3 genera. The genus name *Apus* was established after Belon (1555) (Scopoli, 1777), while the genuses *Sylvia* and *Branta* were first proposed in Scopoli (1769). Furthermore, I have found that at least 11 Scopoli's bird taxa (6 %) are senior synonyms and were apparently overlooked in past taxonomic revisions, although at least some are already known (*e.g.* Oberholser, 1918), among them 6 taxa at species and 5 at subspecies level. There are additional 38 taxa (22 %) being still unresolved according to the current revisons and are in need of further examination taking into account all Scopoli's references, text and figure references, as well as other historical backgrounds to restore Scopoli's taxonomic heritage. Altogether I have tracked only three types of Scopoli's bird taxa preserved in museum collections, all of them in Muséum National d'Histoire Naturelle in Paris, which originated from the Sonnerat's collection (Voisin *et al.*, 2004; Voisin & Voisin, 2008, 2010). Additionally, the neotype of *Halcyon albiventris* (Scopoli, 1786), a female specimen from Mount Edgecombe near Durban (South Africa), was designated and stored in the Natal Museum collection in South Africa (Clancey, 1959) with no further information available.

Bird descriptions in Scopoli (1769) followed the taxonomic standards, which includes name proposal, overview of current knowledge by citing key references including figures, detailed morphological diagnosis, reference collection (types were not designated at that time), and additional descriptive notes about species morphology and life history. Some species were supplemented with vernicular names in Carniolian (Slovenian), Italian and German languages. Unfortunately, according to current knowledge Scopoli did not prepare any illustrations of his bird specimens published in Scopoli (1769), although they might exist as separate illustrations as recently found illustrations of Scopoli's fungi and lichnens by Thomas Hörmann in museums in Paris and Vienna (Piltaver, 2023). I identified 70 bird taxa as new descriptions in Scopoli (1769) and 56 of them are considered resolved and among them 13 taxa are today valid species or subspecies. However, there are 6 taxa which can be considered as senior synonyms, and some were resolved only recently (Gregori, 2008). For example, the Capercaille male was described by Scopoli following Linnaeus (1758) description of *Tetrao urogallus*, but female was described separately as *Tetrao nemesianus* referring also to the figure from Aldrovandi (1637) (Fig. 8) as revealed by Gregori (2008). Both, Aldrovandi figure and Scopoli's specimen from Della Torre collection origined from southern Capercaille population that belongs to the subspecies *Tetrao urogallus major* Brehm, 1831 (Madge & McGowan, 2002). The subspecies was recently renamed to *Tetrao urogallus crassirostris* Brehm, 1831 since *Tetrao major* Brehm, 1831 was preoccupied by *Tetrao major* Gmelin, 1789, the name for the other species (Trust for Avian Systematics, 2021). Older Scopoli's name was apparently overlooked since the name *Tetrao urogallus nemesianus* Scopoli, 1769 would be correct following the Principle of Priority (International Commission on Zoological Nomenclature, 1999). New taxa described in Scopoli (1769) should be explored more with designation of neotypes to stabilize names and type localities as already pointed out by Scheibel (1919).

In describing birds according to Sonnerat (1776, 1782) or even in transcribing Sonnerat's descriptions according to the principles of Linnean nomenclature (Newton, 1882), Scopoli did not see any of Sonnerat's specimens preserved in Paris (Berlioz, 1950). However, in 1785 Scopoli bacame a member of Agricultural

Fig./Sl. 2: *Corvus maximus* ***Scopoli, 1769, Jonston (1650), Tab. 16*** *(Corvus)*. ***Fig./Sl. 3:*** *Corvus vulgaris* ***Scopoli, 1769, Meyer (1752), Tab. 99. Fig./Sl. 4:*** *Corvus rusticus* ***Scopoli, 1769, Jonston (1650), Tab. 17 (Pica). Fig./Sl. 5:*** *Anas subterranea* ***Scopoli, 1769, Steinberg (1758), Tab. 22. Fig./Sl. 6:*** *Mergus albulus* ***Scopoli, 1769, Jonston (1650), Tab. 47*** *(Albulus aquaticus)*. ***Fig./Sl. 7:*** *Procellaria diomedea* ***Scopoli, 1769, Jonston (1650), Tab. 46*** *(Diomedea avis)*. ***Fig./Sl. 8:*** *Tetrao nemesianus* ***Scopoli, 1769, Aldrovandi (1637), Lib. 13, Cap. 18. Fig./Sl. 9:*** *Motacilla boarula* ***Scopoli, 1769, Aldrovandi (1637), Lib. 17, Cap. 25. Fig./Sl. 10:*** *Sylvia muscipeta* ***Scopoli, 1769, Jonston (1650), Tab. 45*** *(Muscipeta)*. ***Fig./Sl. 11:*** *Alauda turdina* ***Scopoli, 1786, Aldrovandi (1637), Lib. 17, Cap. 26.***

Fig./Sl. 12: *Falco rufus* ***Scopoli, 1786, Scopoli (1786), Tab. 19. Fig./Sl. 13:*** *Vultur radiatus* ***Scopoli, 1786, Sonnerat (1782), Pl. 103. Fig./Sl. 14:*** *Vultur calvus* ***Scopoli, 1786, Sonnerat (1782), Pl. 104. Fig./Sl. 15:*** *Vultur indicus* ***Scopoli, 1786, Sonnerat (1782), Pl. 105. Fig./Sl. 16:*** *Lanius phillippinus* ***Scopoli, 1786, Sonnerat (1776), Pl. 25. Fig./Sl. 17:*** *Lanius nasutus* ***Scopoli, 1786, Sonnerat (1776), Pl. 70. Fig./Sl. 18:*** *Lanius ruber* ***Scopoli, 1786, Sonnerat (1776), Pl. 71. Fig./Sl. 19:*** *Lanius albus* ***Scopoli, 1786, Sonnerat (1776), Pl. 72. Fig./Sl. 20:*** *Lanius rufus* ***Scopoli, 1786, Sonnerat (1782), Pl. 106. Fig./Sl. 21:*** *Lanius chinensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 107. Fig./Sl. 22:*** *Psittacus papou* ***Scopoli, 1786, Sonnerat (1776), Pl. 111. Fig./Sl. 23:*** *Psittacus signatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 42. Fig./Sl. 24:*** *Psittacus quianensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 43. Fig./Sl. 25:*** *Psittacus pileatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 44. Fig./Sl. 26:*** *Psittacus cingulatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 41. Fig./Sl. 27:*** *Psittacus melanopterus* ***Scopoli, 1786, Sonnerat (1776), Pl. 40***

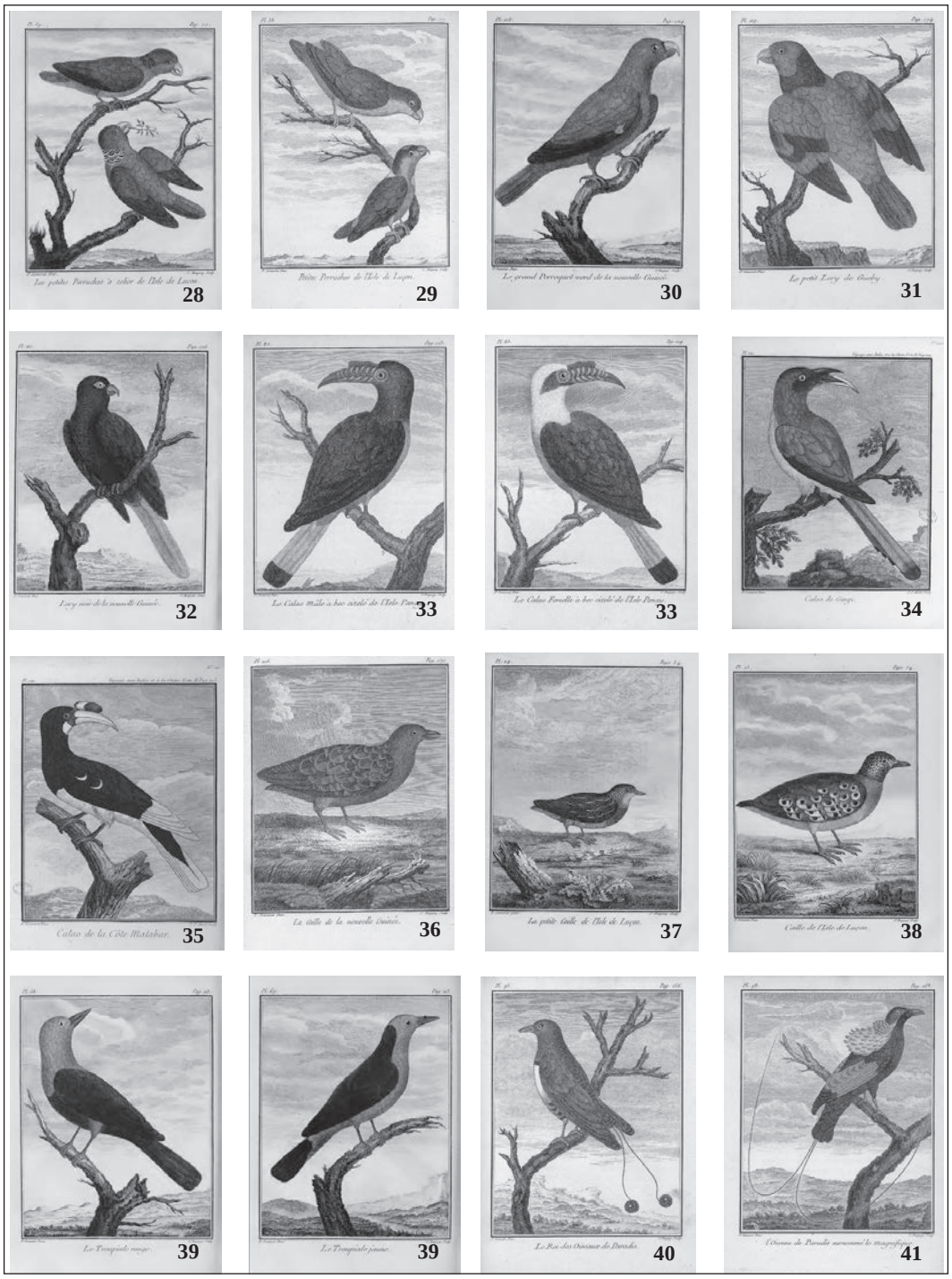

Fig./Sl. 28: *Psittacus lunulatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 39. Fig./Sl. 29:*** *Psittacus leucopthalmos* ***Scopoli, 1786 (upper/zgoraj),*** *Psittacus pumilus* ***Scopoli, 1786 (lower/spodaj), Sonnerat (1776), Pl. 38. Fig./Sl. 30:*** *Psittacus polychloros* ***Scopoli, 1786, Sonnerat (1776), Pl. 30. Fig./Sl. 31:*** *Psittacus guenbyensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 109. Fig./Sl. 32:*** *Psittacus ater* ***Scopoli, 1786, Sonnerat (1776), Pl. 110. Figs./Sl. 33:*** *Buceros panayensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 82, 83. Fig./Sl. 34:*** *Buceros birostris* ***Scopoli, 1786, Sonnerat (1782), Pl. 121. Fig./Sl. 35:*** *Buceros pica* ***Scopoli, 1786, Sonnerat (1782), Pl. 121 (second Pl. 121). Fig./Sl. 36:*** *Oriolus cothurnix* ***Scopoli, 1786, Sonnerat (1776), Pl. 105. Fig./Sl. 37:*** *Oriolus lineatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 24. Fig./Sl. 38:*** *Oriolus ocellatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 33. Figs./Sl. 39:*** *Xanthornus holosericeus* ***Scopoli, 1786, Sonnerat (1776), Pl. 68, 69. Fig./Sl. 40:*** *Paradisea rex* ***Scopoli, 1786, Sonnerat (1776), Pl. 95. Fig./Sl. 41:*** *Paradisea penicillata* ***Scopoli, 1786, Sonnerat (1776), Pl. 97.***

Fig./Sl. 42: *Paradisea viridis* ***Scopoli, 1786, Sonnerat (1776), Pl. 99. Fig./Sl. 43:*** *Gracula caerulea* ***Scopoli, 1786, Sonnerat (1782), Pl. 108. Fig./Sl. 44:*** *Gracula cristata* ***Scopoli, 1786, Sonnerat (1782), Pl. 109. Fig./Sl. 45:*** *Trogon luzonensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 34. Fig./Sl. 46:*** *Cuculus variegatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 78. Fig./Sl. 47:*** *Cuculus flaviventris* ***Scopoli, 1786, Sonnerat (1776), Pl. 79. Fig./Sl. 48:*** *Cuculus viridis* ***Scopoli, 1786, Sonnerat (1776), Pl. 80. Fig./Sl. 49:*** *Cuculus merulinus* ***Scopoli, 1786, Sonnerat (1776), Pl. 81. Fig./Sl. 50:*** *Picus guineensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 35. Fig./Sl. 51:*** *Picus menstruus* ***Scopoli, 1786, Sonnerat (1776), Pl. 36. Fig./Sl. 52:*** *Picus lucidus* ***Scopoli, 1786, Sonnerat (1776), Pl. 37. Fig./Sl. 53:*** *Picus maculatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 77. Fig./Sl. 54:*** *Alcedo coromandeliana* ***Scopoli, 1786, Sonnerat (1782), Pl. 118. Fig./Sl. 55:*** *Alcedo albiventris* ***Scopoli, 1786, Sonnerat (1776), Pl. 31. Fig./Sl. 56:*** *Alcedo collaris* ***Scopoli, 1786, Sonnerat (1776), Pl. 33. Fig./Sl. 57:*** *Alcedo undulata* ***Scopoli, 1786, Sonnerat (1776), Pl. 106.***

Fig./Sl. 58: *Alcedo variegata* ***Scopoli, 1786, Sonnerat (1776), Pl. 107. Fig./Sl. 59:*** *Merops bruneus* ***Scopoli, 1786, Sonnerat (1776), Pl. 100. Fig./Sl. 60:*** *Merops maximus* ***Scopoli, 1786, Sonnerat (1776), Pl. 101. Fig./Sl. 61:*** *Certhia canora* ***Scopoli, 1786 (1),*** *Certhia malacensis* ***Scopoli, 1786 (2), Sonnerat (1782), Pl. 116. Fig./Sl. 62:*** *Certhia coccinea* ***Scopoli, 1786 (1),*** *Certhia trigonostigma* ***Scopoli, 1786 (2),*** *Certhia grisea* ***Scopoli, 1786 (3), Sonnerat (1782), Pl. 117. Fig./Sl. 63:*** *Certhia lutea* ***Scopoli, 1786, Sonnerat (1782), Pl. 119. Fig./Sl. 64:*** *Certhia quadricolor* ***Scopoli, 1786, Sonnerat (1776), Pl. 30-A, B. Fig./Sl. 65:*** *Apterodita longirostris* ***Scopoli, 1786, Sonnerat (1776), Pl. 113. Fig./Sl. 66:*** *Apterodita longirostris* ***Scopoli, 1786, Pennant (1781), Pl. 14. Fig./Sl. 67:*** *Apterodita platirhingos* ***Scopoli, 1786, Sonnerat (1776), Pl. 114. Fig./Sl. 68:*** *Sterna anaethetus* ***Scopoli, 1786, Sonnerat (1776), Pl. 84. Fig./Sl. 69:*** *Sterna pileata* ***Scopoli, 1786, Sonnerat (1776), Pl. 85. Fig./Sl. 70:*** *Sterna multicolor* ***Scopoli, 1786, Sonnerat (1776), Pl. 55. Fig./Sl. 71:*** *Platalea alba* ***Scopoli, 1786, Sonnerat (1776), Pl. 51. Fig./Sl. 72:*** *Platalea cristata* ***Scopoli, 1786, Sonnerat (1776), Pl. 52. Fig./Sl. 73:*** *Tantalus rufus* ***Scopoli, 1786, Sonnerat (1776), Pl. 47.***

Fig./Sl. 74: *Tantalus variegatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 48. Fig./Sl. 75:*** *Tringa fasciata* ***Scopoli, 1786, Sonnerat (1782), Pl. 96. Fig./Sl. 76:*** *Tringa chirurgus* ***Scopoli, 1786, Sonnerat (1776), Pl. 45. Fig./Sl. 77:*** *Charadrius dubius* ***Scopoli, 1786, Sonnerat (1776), Pl. 46. Fig./Sl. 78:*** *Charadrius cristatus* ***Scopoli, 1786, Sonnerat (1776), Pl. 49. Fig./Sl. 79:*** *Otis secretarius* ***Scopoli, 1786, Sonnerat (1776), Pl. 79. Fig./Sl. 80:*** *Pavo malacensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 99. Fig./Sl. 81:*** *Pavo malacensis* ***Scopoli, 1786, Edwards (1747), Tab. 67. Fig./Sl. 82:*** *Phasianus rouloul* ***Scopoli, 1786, Sonnerat (1782), Pl. 100. Fig./Sl. 83:*** *Tetrao pintadeanus* ***Scopoli, 1786, Sonnerat (1782), Pl. 97. Fig./Sl. 84:*** *Tetrao madagarensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 98. Fig./Sl. 85:*** *Columba nitidissima* ***Scopoli, 1786, Sonnerat (1782), Pl. 101. Fig./Sl. 86:*** *Columba chinensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 102. Fig./Sl. 87:*** *Columba nivea* ***Scopoli, 1786, Sonnerat (1776), Pl. 20. Fig./Sl. 88:*** *Columba luzonica* ***Scopoli, 1786, Sonnerat (1776), Pl. 21. Fig./Sl. 89:*** *Columba cinerea* ***Scopoli, 1786, Sonnerat (1776), Pl. 22.***

Fig./Sl. 90: *Columba myristicivora* ***Scopoli, 1786, Sonnerat (1776), Pl. 102. Figs./Sl. 91:*** *Columba viridis* ***Scopoli, 1786, Sonnerat (1776), Pl. 64, 65. Fig./Sl. 92:*** *Columba pileata* ***Scopoli, 1786, Sonnerat (1776), Pl. 66. Fig./Sl. 93:*** *Columba bicolor* ***Scopoli, 1786, Sonnerat (1776), Pl. 103. Fig./Sl. 94:*** *Columba pulcherrima* ***Scopoli, 1786, Sonnerat (1776), Pl. 67. Fig./Sl. 95:*** *Alauda malabarica* ***Scopoli, 1786 (1),*** *Alauda grisea* ***Scopoli, 1786 (2), Sonnerat (1782), Pl. 113. Fig./Sl. 96:*** *Turdus malacensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 110. Fig./Sl. 97:*** *Ampelis malabarica* ***Scopoli, 1786 (1),*** *Sylvia lutea* ***Scopoli, 1786 (2), Sonnerat (1782), Pl. 114. Fig./Sl. 98:*** *Emberiza signata* ***Scopoli, 1786, Sonnerat (1776), Pl. 75. Fig./Sl. 99:*** *Tanagra macroura* ***Scopoli, 1786, Sonnerat (1776), Pl. 74. Fig./Sl. 100:*** *Motacilla luzonensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 29. Fig./Sl. 101:*** *Muscicapa caeruleocephala* ***Scopoli, 1786 (1) Sonnerat (1776), Pl. 26. Fig./Sl. 102:*** *Muscicapa macroura* ***Scopoli, 1786 (1),*** *Muscicapa tessacourbe* ***Scopoli, 1786 (2), Sonnerat (1776), Pl. 27. Fig./Sl. 103:*** *Muscicapa goiavier* ***Scopoli, 1786, Sonnerat (1776), Pl. 28. Fig./Sl. 104:*** *Muscicapa panayensis* ***Scopoli, 1786, Sonnerat (1776), Pl. 73.***

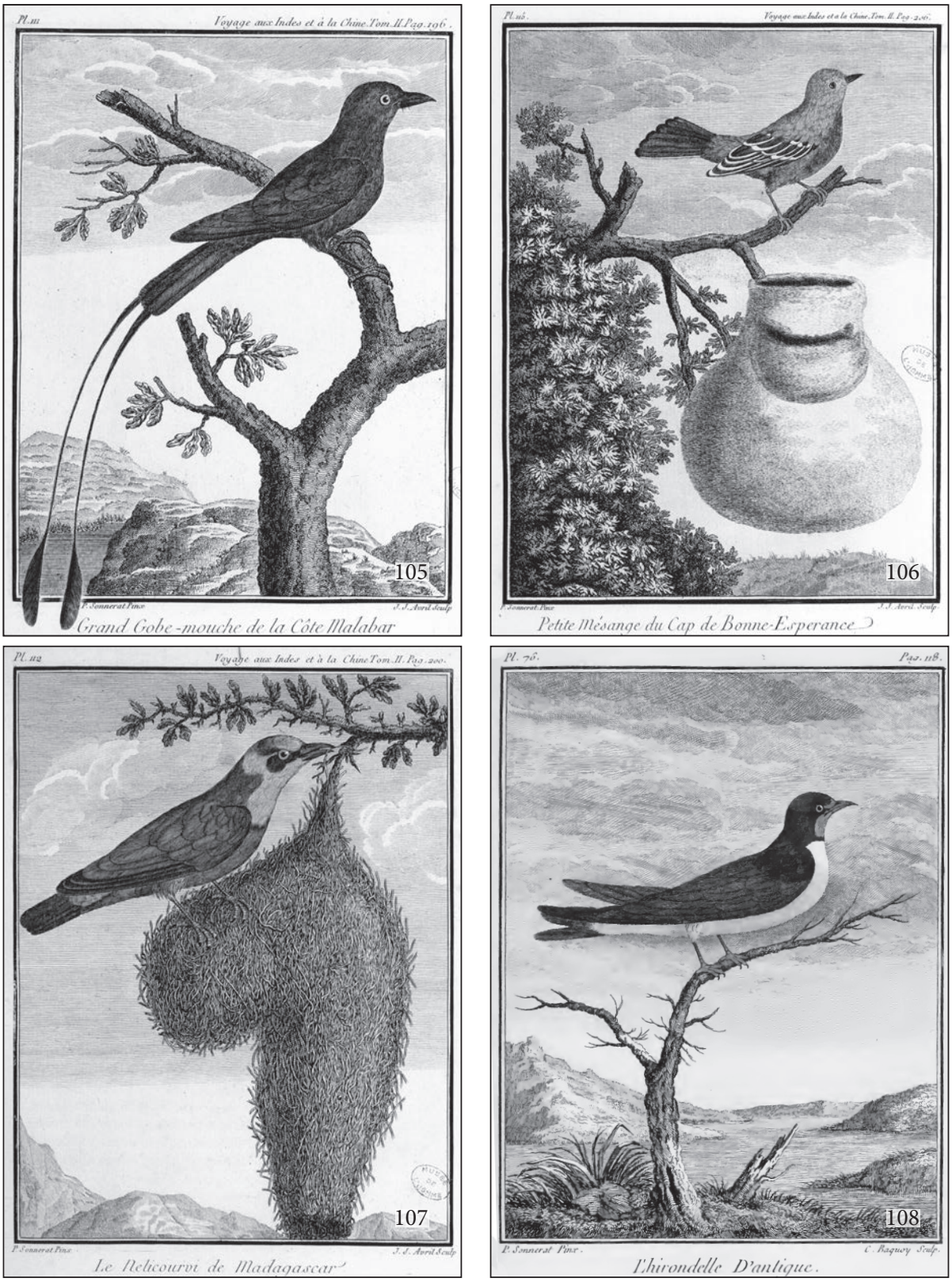

Fig./Sl. 105: *Muscicapa malabarica* ***Scopoli, 1786, Sonnerat (1782), Pl. 111. Fig./Sl. 106:*** *Sylvia capensis* ***Scopoli, 1786, Sonnerat (1782), Pl. 115. Fig./Sl. 107:*** *Parvus nelicourvi* ***Scopoli, 1786, Sonnerat (1782), Pl. 112. Fig./Sl. 108:*** *Hirundo gutturalis* ***Scopoli, 1786, Sonnerat (1776), Pl. 76.***

Fig./Sl. 109: *Fringilla alpina* ***Scopoli, 1788, Scopoli (1788), Tab. 18.***

Society in Paris *(Soc. Regia Oeconomica Parisiensis)* and among his correspondents Scopoli listed also french naturalist Michel Adanson (1727–1806) (Scopoli, 1788; Voss, 1881). The correspondence between Scopoli and Adanson was not yet studied, and Adanson might gave more data on Sonnerat's specimens that were accessible to Scopoli beside Sonnerat's figures and texts. There is no evidence that Scopoli and Sonnerat would have any direct correspondence. Anyhow, there is no evidence that Scopoli would travel outside Holy Roman Empire (Voss, 1881; Petkovšek, 1977), so he could not had seen Sonnerat's specimens stored in Paris. His descriptions were therefore based exclusively on Sonnerat's writings and especially on illustrations. Sonnerat and, consequently, Scopoli based their descriptions mainly on adult males, but not in all cases, e.g., females in Asian Blue Quail *Synoicus chinensis lineatus* (Fig. 37) and Nelicourvi Weaver *Ploceus nelicourvi* (Fig. 107), or non-breeding or immature birds in Pheasant-tailed Jacana *Hydrophasianus chirurgus* (Fig. 76), Bridled Tern *Onychoprion anaethetus* (Fig. 68), and African Spoonbill *Platalea alba* (Fig. 71). Since Scopoli's descriptions are not based on type specimens, but only on figures an important taxonomic question raises here. If figures were the only material background of new species descriptions, then they should be regarded as types as well. In botany this is solved with designation of iconotypes (Silva, 1993), which are lacking in zoology (International Commission on Zoological Nomenclature, 1999). The Scopoli's descriptions of Sonnerat birds are not the only descriptions that were based solely on figures (and text) and not on specimens, since this was practicised also by other early Linnean taxonomists, including Carl Linnaeus himself (*e.g.* Linnaeus descriptions of the Wallcreeper *Tichodroma muraria* and the Fat Dormouse *Glis glis* in Linnaeus (1766) were based solely on written descriptions of Scopoli and not by specimens examinations; Barbagli *et al.*, 1997; Kryštufek *et al.*, 2021). However, there is no review yet that would evaluate non-specimen based descriptions in ornithology or zoology neither what value these illustrations have as types in zoological nomenclature and taxonomy. However, clear historical identification of specimens, that served in the preparation of key figures (Voisin *et al.* 2004), or designation of neotypes (Kryštufek *et al.,* 2021) are needed to stabilize the taxon names and define type localities.

The most interesting illustration of Sonnerat, however, is that of the Buff- spotted Flameback *Chrysocolaptes lucidus*. Four woodpecker figures are illustrated in Sonnerat (1776), and two of them refer to a larger woodpecker, Pl. 36 (Fig. 51) and 37 (Fig. 52). However, Scopoli (1786b) made a mistake and referred Pl. 36 to two descriptions, *Picus menstruus* and *Picus lucidus*. Newton (1882) suggested a correction and assigned Pl. 37 to *Picus lucidus*, while Stark (1903) assigned *Picus menstruus* to African species *Dendropicos griseocephalus* (Boddaert, 1783). The scaly pattern of the underside of the woodpecker at Pl. 37 certainly fits the adult Buff-spotted Flameback, but the specimen illustrated has no crest, a dark upperpart including the head, and particularly conspicuous white spots on the tail forming a white tail band, which Sonnerat (1776) also specifically refers to in the text. No such large woodpecker is currently known from the Philippines, from where this species was described, nor are there any similar large woodpeckers elsewhere (Winkler *et al.*, 1995). It is therefore possible that the specimens on Pl. 37 actually represents a currently undescribed and possibly extinct species. All currently known recent extinctions of woodpeckers (Picidae) are from the New World (Hume & Walters, 2012), and this would be the first example from Asia. Indeed, this would not be the first discovery of an extinct species in the writings of Pierre Sonnerat, what is also the case of the extinct shrew *Diplomesodon sonnerati* from southern India (Cheke, 2011). There is one extant specimen of the Buff-spotted Flameback in the Sonnerat collection held at the Muséum National d'Histoire Naturelle in Paris (Fig. 110), but of an atypical dark juvenile female

Fig. 110: Atypical specimen of young female of *Chrysocolaptes lucidus* ***(Scopoli, 1786) collected by Pierre Sonnerat between 1769 and 1775 on Philipines (MNHN-ZO-2009-955; Muséum National d'Histoire Naturelle in Paris).***
Sl. 110: Netipični primerek mlade samice vrste *Chrysocolaptes lucidus* ***(Scopoli, 1786), ki jo je Pierre Sonnerat ujel med leti 1769 in 1775 na Filipinih (MNHN-ZO-2009-955; Muséum National d'Histoire Naturelle, Pariz).***

(Voisin & Voisin, 2010), which does not resamble the bird on Pl. 37 (Fig. 52).

Collections with Scopoli's type specimens and their preservation status

Scopoli's type specimens were stored in at least four collections (Appendix 1): (1) own Scopoli's collection (coll. Joannes A. Scopoli), (2) collection of count Francesco Annibale Della Torre (coll. Franz Hannibal von Thurn), (3) Imperial ZOO in Vienna (here Scopoli observed only live specimens) and (4) collection of Pierre Sonnerat (Coll. Pierre Sonnerat), which Scopoli had used only indirectly since he made his descriptions only on Sonnerat's figures and texts and not by examining the specimens.

1.) Collection of Joannes Antonius Scopoli

In Idria, J.A. Scopoli built a large natural history collection of plants, insects, and vertebrates, including birds (Stresemann, 1923; Gregori, 2008), which were described in Scopoli (1769). The collection included type material for at least 34 new bird taxa. In addition, there was probably also a type specimen of the Wallcreeper *Tichodroma muraria* described by Linnaeus (1766) to be sent by Scopoli to Linneaus, but it is not clear from the letters that Scopoli actually sent it and that Linneaus based the description only on Scopoli's letters (Barbagli *et al*., 1997; Soban, 2004). No specimen of the Wallcreeper is preserved in the Linnaeus collection at the museums in Uppsala and Stockholm (Wallin, 2001; U. Johansson, *pers. comm.*). When Scopoli left Idria in 1769, he probably took his collection with him and eventually brought it to Pavia (Italy), Scopoli's last residence,

where he also died in 1788. The ornithological part of the collection in Pavia consisted of 250 bird specimens, which were kept in the Natural History Museum of the University of Pavia, but unfortunately the collection did not survive (Steinheimer, 2005; Violani & Rovati, 2010). However, Scopoli also exchanged material with other collectors, as evidenced by letters to Linnaeus, so some specimens may survive in other collections. Scopoli's successor in Idria, Baltazar Hacquet, built a large collection that was later stored in Ljubljana (Jezernik, 2009). With the exception of the herbarium (now stored in the Slovenian Museum of Natural History; Praprotnik, 2015), all other parts of the collection were destroyed. Albegger (2015) reported that some specimens of Scopoli and Hacquet may have survived in the collection of Count Egger of Carinthia, which came to the Universalmuseum Joanneum in Graz in 1815, although further study of this historical collection is needed because the original labels have been lost.

2.) Collection of count Francesco Annibale Della Torre (germ. Franz Hannibal von Thurn)

In the letter of 7 March 1765, Scopoli reported to Linnaeus about the bird collection of Della Torre *(Aves Musaei Torriani)* in Vienna, which he had visited in 1763, as can be seen from the letter of 22 October 1763, in which he writes about his three-month stay in Vienna (Soban, 2004). From the Della Torre collection, Scopoli (1769) described at least 27 new bird species (Appendix 1). Scopoli (1769) described that this was a collection of Count Francesco Annibale Della Torre *(Excell. Comitis Francisci Annib. Turriani)*. Count Francesco Annibale Della Torre (1699-1768) was born in Gradisca near Gorica in Italy near the Italian-Slovenian border and was a member of the Friulian noble family Della Torre, Lords of Duino (Dorsi 2021). He studied law and theology in Graz, Salzburg, Parma, and Rome, but his uncle Raimondo Ferdinando Rabatta, archbishop of Passau, helped him become an official archbishop's representative in Vienna (Santon, 2011). He died in Vienna in 1768. Since he was a celibate clergyman, he appointed his brother Federico Luigi Della Torre (1709-1773), Lord of Duino, as his heir (Dorsi, 2021), but the bird collection was taken by Jesuits after his death in 1768 (Fitzinger, 1856). In 1773 after abolishment of Jesuit order the collection was handed over to the University of Vienna (Fitzinger, 1856; Stresemann, 1923) and stored in zoological collection at the Faculty of Life Sciences, where no certain specimens are found (Steinheimer, 2005). The origin of the specimens in the Della Torre collection is not known, although they probably came mainly from NE Italy (Friuli, Duino) and the northern Adriatic (Friuli Venezia Giulia), although some exotic specimens came from menegeries, probably in Austria.

3.) Imperial ZOO Schönbrunn (Vivarium Caesareum)

The imperial ZOO Schönbrunn (*der Menagerie zu Schönbrunn*) was a rich collection of exotic and rare animals, mainly mammals and birds, collected during various expeditions by naturalists on behalf of the Austrian emperor (Fitzinger, 1853). The first managerie was founded in 1552 by Maximilian II., but later ceased to operate continuously. The third establishment was founded in 1716 by Prince Eugene of Savoy and was purchased by Emperor Carl VI. after his death. In 1732 the menagerie was moved to Schönbrunn by Emperor Franz I. Stephan, the husband of Maria Theresa. J. A. Scopoli probably visited ZOO in 1763, as stated in a letter to Linnaeus dated on 22 October 1763, in which he briefly mentioned the Della Torre collection and the Imperial ZOO (Soban, 2004). Fitzinger (1853) gives a detailed overview of the animals that ZOO owned at that time, and some of them were also illustrated (Jacquin, 1784). Unfortunately, no Schönbrunn specimens from this period are preserved in the museum collection (von Pezeln, 1890). According to Scopoli (1769), there was at least 8 new species described from Imperial ZOO, but not all are resolved as a revision of Scopoli's descriptions of birds from the *Vivarium Caesareum*, provided in part by Gregori (2008), is needed in comparison with the list of Fitzinger (1853) and the illustrations of Jacquin (1784).

4.) Collection of Pierre Sonnerat

The bird descriptions in Scopoli (1786b) were based on two publications by the French naturalist Pierre Sonnerat on his expeditions to Indonesia, the Philippines, the Seychelles, and parts of Africa (Sonnerat, 1776) and to China, India, Malaysia, Madagascar, and Mauritius (Sonnerat, 1782). Sonnerat actually did not land on New Guinea, which is mentioned by several species as type locality, but he visited nearby island Pulau Gebe (Pasfield, 1892). In 1768 Sonnerat joined the expedition to Mascarene Islands with naturalist Pierre Poivre (1719 – 1786), Sonnerat's uncle, and secondly in 1771 to Moluccas (Pasfield, 1892), where both naturalists collected also bird specimens, therefore Poivre's specimens were later also included into Sonnerat's collection (Streseman, 1952). Sonnerat's descriptions were accompanied by illustrations made from collected material. Sonnerat's bird specimens were kept in the King's Cabinet in Paris (Berlioz, 1950), which was curated by Georges-Louis Leclerc, Comte de Buffon (1707-1788). Although J.A. Scopoli never saw specimens of Sonnerat, but only illustrations based on them, the specimens of Sonnerat and Poivre can be considered syntypes for the descriptions of Scopoli (1786b), 101 new bird taxa. Today, the collection is kept at the Muséum National d'Histoire Naturelle in Paris (Berlioz, 1950), and at least eight bird taxa collected by Sonnerat are still preserved according to the published specimen catalogue (https://science.mnhn.fr/institution/mnhn/collection/zo/item/search/form). Two specimens are referred to as syntypes of the descriptions of Scopoli (1786b) (Appendix 1; Voisin *et al.,* 2004): Mauritius Blue Pigeon *Alectroenas nitidissimus* (Fig. 111, cf. Fig. 85) and Seychelles Blue Pigeon *Alectroenas pulcherrimus* (Fig. 112, cf. Fig. 94).

Fig. 111: The syntype of *Alectoenas nitidissimus* ***(Scopoli, 1786), today extinct species, collected by Pierre Sonnerat between 1769 and 1781 on Mauritius (MNHN-ZO-MO-2000-727; Muséum National d'Histoire Naturelle in Paris).***
Sl. 111: Sintip vrste *Alectoenas nitidissimus* ***(Scopoli, 1786), danes izumrle vrste, ki jo je ujel Pierre Sonnerat med leti 1769 in 1781 na Mavricijusu (MNHN-ZO-MO-2000-727; Muséum National d'Histoire Naturelle, Pariz).***

Fig. 112: The syntype of *Alectoenas pulcherrimus* ***(Scopoli, 1786) collected by Pierre Sonnerat between 1769 and 1775 on Seychelles (MNHN-ZO-MO-2002-138; Muséum National d'Histoire Naturelle in Paris).***
Sl. 112: Sintip vrste *Alectoenas pulcherrimus* ***(Scopoli, 1786), ki jo je ujel Pierre Sonnerat med leti 1769 in 1775 na Sejšelih (MNHN-ZO-MO-2002-138; Muséum National d'Histoire Naturelle, Pariz).***

Fig. 113: Syntype (referred to as holotype) of** Psittacus guenbyensis **Scopoli, 1786 collected by Pierre Sonnerat between 1769 and 1772 on Pulau Gebe Island, Halmahera / Maluku Islands (MNHN-ZO-MO-2004-129; Muséum National d'Histoire Naturelle in Paris).
Sl. 113: Sintip vrste (smatran kot holotip)** Psittacus guenbyensis **Scopoli, 1786, ki ga je ujel Pierre Sonnerat med leti 1769 in 1772 na otoku Pulau Gebe / otočje Maluku (MNHN-ZO-MO-2004-129; Muséum National d'Histoire Naturelle, Pariz).

In the collection of Sonnerat at the Muséum National d'Histoire Naturelle in Paris there is another specimen designated as a type specimen of *Psittacus guenbyensis* Scopoli, 1786 (Fig. 113; MNHN-ZO-MO -2004-129). The specimen is currently referred to as a holotype (Voisin & Voisin, 2008), which is clearly incorrect because the specimen was not referred to as a holotype by Scopoli, nor had Scopoli seen it, so the correct designation would be a syntype or lectotype. The description by Scopoli (1786b) was based on Pl. 109 (Fig. 31) in Sonnerat (1776). However, the taxon is a senior synonym of *Eos squamata riciniata* (Bechstein, 1811) and therefore does not conform to the concept of the Principle of Priority, whereby the valid name of a taxon is the oldest available name applied to it (International Commission on Zoological Nomenclature 1999), what was already proposed by Oberholser (1918). The Sonnerat-Piovre bird collection in Muséum National d'Histoire Naturelle in Paris still must be studied in terms of determing syntypes of Scopoli's bird taxa.

CONCLUSIONS

The aim of this work was to review the existing knowledge on the new bird taxa descriptions by Joannes Antonius Scopoli, a still underestimated early European ornithologist. With respect to Scopoli's ornithological legacy, there are still many questions to be addressed, especially considering still incomplete taxonomic revision of his bird descriptions, some of which are the first scientific descriptions after Linnaeus (1758) and should be considered in the concept of the Principle of Priority and validation of scientific bird names (International Commission on Zoological Nomenclature, 1999). Secondly, from a museological point of view, there are still open questions regarding the existence of Scopoli's type specimens that could be kept in some museum collections. This article summarizes some basic information from published and online sources, but further work should focus on researching archives and museum collections. Moreover, in museums worldwide there are few specimens of birds from type localities in Carniola (Slovenia) described by Scopoli (1769), so the Slovenian Museum of Natural History in Ljubljana could serve as a potential set of neotypes for future taxonomic studies. From Carniola (Slovenia) there are at least 28 new bird taxa described by J.A. Scopoli with type localities in Slovenia (all described in 1769). Five of them are also valid species today: Little Crake *Zapornia parva* (Scopoli, 1769), Squacco Heron *Ardeola ralloides* (Scopoli, 1769), Little Owl *Athene noctua* (Scopoli, 1769), Alpine Accentor *Prunella collaris* (Scopoli, 1769) and Black-Headed Bunting *Emberiza melanocephala* Scopoli, 1769.

Appendix 1: Overview of new bird taxa described by Joannes A. Scopoli listed in chronological publication order with remarks on type localities cited by Scopoli (in brackets are given countries interpreted according to given exact type localities or in valid taxa countries were corrected according to taxonomic revision since original type localites might be wrong, especially in species names following Sonnerat's descriptions; type localities on other descriptions remained unresolved), cited collections with types, figure references of types or species illustrations, overview of survived existing types in museum collections, current taxonomic status of Scopoli's bird taxa with literature interpretation of (sub)species identity, interpretation sources and remarks explaining existing taxonomic issues and further examination needs. Figures of Sonnerat (1776, 1782) has been corrected according to Newton (1882). Countries of origin of the name-bearing type specimen according to the last taxonimic revisons are extracted from del Hoyo et al. (1992, 1994, 1996, 1997, 1999, 2001, 2002, 2004, 2005, 2007, 2008, 2009) & Avibase database: https://avibase.bsc-eoc.org/).

Priloga 1: Pregled taksonov ptic, ki jih je kot nove opisal Joannes A. Scopoli. Taksoni so razvrščeni po kronološkem vrstnem redu objavljanja z dodanimi tipskimi lokalitetami, ki jih je navedel Scopoli (v oklepaju so podane države lokacij tipskih lokalitet glede na sodobne interpretacije podane v taksonomskih revizijah, saj so originalno navedene lokacije lahko napačne, zlasti pri taksonih iz Sonneratovih opisov; tipske lokacije ostalih opisov so nerazrešene), navedenimi zbirkami s tipskim materialom, referenčne ilustracije, pregled ohranjenih tipskih primerkov v muzejskih zbirkah, trenuten taksonomski status Scopolijevih taksonov ptic z objavljenimi interpretacijami (pod)vrstne identitete in literaturnimi viri ter opombe s taksonomskimi obrazložitvami in potrebami po nadaljnjih študijah. Številke Sonneratovih (1776, 1782) risb so bile popravljene po Newtonu (1882). Izvorne države tipskih primerkov glede na zadnje taksonomske revizije so povzete po del Hoyo et al. (1992, 1994, 1996, 1997, 1999, 2001, 2002, 2004, 2005, 2007, 2008, 2009) & Avibase database: https://avibase.bsc-eoc.org/).

Scopoli's new species descriptions	Authority	Type localities as cited by Scopoli (in brackets are countries with type localities according to current taxonomic revisions)	Type collections cited by Scopoli	Figure references	Extisting or newly designated type specimens	Current taxonomic status	Interpretation	Source of interpretation	Remarks
Strix giu	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Otus scops* (Linnaeus, 1758)	Rey (1872), Hartert (1913)	
Strix sylvestris	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			uncertain		Latham (1781), Gmelin (1788), Rey (1872), Hartert (1913), Ponebšek (1917), Vrezec (2009)	should be examined further: the taxon is attributed to *Strix aluco Linnaeus,* 1758 (Rey 1872) or *Strix uralensis Pallas,* 1771 (Latham 1781, Gmelin 1788, Hartert 1913, Ponebšek 1917, Vrezec *et al.* 2007, Vrezec 2009)
Strix alba	Scopoli (1769)	Friuli-Giulia (Italy)	Coll. Joannes A. Scopoli			valid taxon	*Tyto alba* (Scopoli, 1769)	Hartert (1913), Gill *et al.* (2023)	
Strix noctua	Scopoli (1769)	Ljubljana (Slovenia)	Coll. Joannes A. Scopoli			valid taxon	*Athene noctua* (Scopoli, 1769)	Hartert (1913), Baker (1930a), Gill *et al.* (2023)	
Strix rufa	Scopoli (1769)	Idrija (Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Strix aluco* Linnaeus, 1758	Rey (1872)	
Psittacus formosus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			senior synonym	*Pezoporus wallicus* (Kerr, 1792)	Gregori (2008)	should be examined further: under the same name Latham (1790) descibed different species, so Scopoli's description was regarded doubtful (Slavadori 1891). Gregori (2008) attributed the taxon to *Pezoporus wallicus* (Kerr, 1792).
Psittacus merulinus	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			junior synonym	*Aratinga solstitialis* (Linnaeus, 1758)	Salvadori (1891)	
Psittacus krameri	Scopoli (1769)	(Senegal)	Coll. Joannes A. Scopoli			valid taxon	*Psittacula krameri* (Scopoli, 1769)	Baker (1930a), Gill *et al.* (2023)	

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Psittacus ruber	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain			
Psittacus pileatus	Scopoli (1769)	(Brasil)	Coll. Count Franz Hannibal von Thurn (Vienna)			valid taxon	*Pionopsitta pileata* (Scopoli, 1769)	Salvadori (1891), Gill *et al.* (2023)	
Psittacus cyanocephalus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			nomen nudum	*Pionus menstruus* (Linnaeus, 1766)	Salvadori (1891)	the name *Psittacus cyanocephalus* was preoccupied by *Psittacus cyanocephalus* Linnaeus, 1766 for another species (Salvadori 1891)
Corvus maximus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Jonston 1650, Tab. 16 (Corvus) (Fig. 2)		junior synonym	*Corvus corax* Linnaeus, 1758	Hartert (1903)	
Corvus vulgaris	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Meyer 1752, Tab. 99 (Fig. 3)		junior synonym	*Corvus corone* Linnaeus, 1758	Gregori (2008)	
Corvus rusticus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Jonston 1650, Tab. 17 (Scopoli wrongly cited Tab. 18) (Pica) (Fig. 4)		junior synonym	*Pica pica* (Linnaeus, 1758)	Hartert (1903)	
Coracias cartagenensis	Scopoli (1769)	Cartagena (Colombia)	Imperial ZOO (Vienna) - live specimen			uncertain			
Certhia viridis	Scopoli (1769)		Coll. Joannes A. Scopoli			uncertain			
Anas leucocephala	Scopoli (1769)	(Italy ?)	Coll. Count Franz Hannibal von Thurn (Vienna)			valid taxon	*Oxyura leucocephala* (Scopoli, 1769)	Blanford (1898), Baker (1930b), Gill *et al.* (2023)	
Anas monacha	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Branta bernicla* (Linnaeus, 1758)	Gregori (2008)	
Anas ruficollis	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Aythya ferina* (Linnaeus, 1758)	Rey (1872), Hartert (1920a), Baker (1930b)	Rey (1872) attributed the taxon to *Branta ruficollis* (Pallas, 1769), but attribution to more common *Aythya ferina* (Linnaeus, 1758) is more possible (Hartert 1920a, Baker 1930b)
Anas melaura	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain			

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Anas subterranea	Scopoli (1769)	Cerknica Lake (Slovenia)	Coll. Joannes A. Scopoli	Steinberg 1758, Tab. 22 (Fig. 5)		uncertain		Scheibel (1919), Hartert (1920a), Vrezec (2023)	should be examined further: referred illustration in Steinberg (1758) in not detailed enough for interpretation, but different authors so far attributed the taxon to different species: *Aythya marila* (Linnaeus, 1761) (Linnaeus in a letter to Scopoli; Scopoli himself disagreed with Linnaeus; Soban 2004), *Aythya fuligula* (Linnaeus, 1758) (Scheibel 1919), Tadorna tadorna (Linnaeus, 1758) (Hartert 1920a), *Aythya nyroca* (Güldenstädt, 1770) (Vrezec 2023)
Branta torrida	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			uncertain			
Branta albifrons	Scopoli (1769)	(Italy ?)	Coll. Count Franz Hannibal von Thurn (Vienna)			valid taxon	*Anser albifrons* (Scopoli, 1769)	Blanford (1898), Hartert (1920a), Baker (1930b), Gill *et al.* (2023)	
Mergus gulo	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Mergus merganser* Linnaeus, 1758	Hartert (1920b), Baker (1930b)	
Mergus aethiops	Scopoli (1769)	Ljubljana (Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Mergus merganser* Linnaeus, 1758	Hartert (1920b)	
Mergus albulus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Jonston 1650, Tab. 47 (Albulus aquaticus) (Fig. 6)		junior synonym	*Mergellus albellus* (Linnaeus, 1758)	Rey (1872), Hartert (1920b), Baker (1930b)	
Mergus pannonicus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Mergellus albellus* (Linnaeus, 1758)	Hartert (1920b)	
Plotus caudicans	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain		Hartert (1920b), Baker (1930b)	should be examined further: Hartert (1920b) attributed the taxon to *Gavia stellata* (Pontoppidan, 1763), while Baker (1930b) to *Gavia arctica* (Linnaeus, 1758)
Procellaria diomedea	Scopoli (1769)	(Italy)	Coll. Count Franz Hannibal von Thurn (Vienna)	Jonston 1650, Tab. 46 (Diomedea avis) (Fig. 7)		valid taxon	*Calonectris diomedea* (Scopoli, 1769)	Peters (1931), Gill *et al.* (2023)	
Colymbus nigricans	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Tachybaptus ruficollis* (Pallas, 1764)	Hartert (1920b)	
Colymbus vulgaris	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			senior synonym	*Podiceps grisegena* (Boddaert, 1783)	Hartert (1920b)	

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Larus cinereus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Larus canus* Linnaeus, 1758	Hartert (1921a)	
Larus albus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			senior synonym	*Hydrocoloeus minutus* (Pallas, 1776)	Hartert (1921a)	
Larus merulinus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Chlidonias niger* (Linnaeus, 1758)	Hartert (1921a)	
Larus quadricolor	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			senior synonym	*Larus audouinii* Payraudeau, 1826	Hartert (1921a)	
Larus bicolor	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain		Hartert (1921a), Gregori (2008)	should be examined further: Hartert (1921a) attributed the taxon to *Sterna hirundo Linnaeus*, 1758, while Gregori (2008) to *Sternula albifrons* (Pallas, 1764)
Larus sterna	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Sterna hirundo* Linnaeus, 1758	Hartert (1921a)	
Larus columbinus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Sterna hirundo* Linnaeus, 1758	Hartert (1921a)	
Ardea rufa	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Ardea purpurea* Linnaeus, 1766	Hartert (1920a)	
Ardea ralloides	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			valid taxon	*Ardeola ralloides* (Scopoli, 1769)	Hartert (1920a), Cill *et al.* (2023)	
Ardea nivea	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Egretta garzetta* (Linnaeus, 1766)	Gregori (2008)	
Scolopax rufa	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Plegadis falcinellus* (Linnaeus, 1766)	Hartert (1920a), Baker (1930b), Gregori (2008)	
Scolopax australis	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain			
Scolopax pica	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Haematopus ostralegus* Linnaeus, 1758	Hartert (1921a)	
Scolopax leucoptera	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			uncertain			
Scolopax glottis	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			senior synonym	*Gallinago media* (Latham, 1787)	Gregori (2008)	
Tringa porzana	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			uncertain			
Fulica fuliginosa	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Fulica atra* Linnaeus, 1758	Hartert (1921b)	

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Fulica albiventris	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Fulica atra* Linnaeus, 1758	Hartert (1921b)	
Rallus lariformis	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			uncertain			
Rallus parvus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			valid taxon	*Zapornia parva* (Scopoli, 1769)	Hartert (1921b), Baker (1930a), Gill *et al.* (2023)	
Rallus fulicula	Scopoli (1769)	Ljubljana (Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Porzana porzana* (Linnaeus, 1766)	Hartert (1921b)	
Tetrao nemesianus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)	Aldrovandi 1637, Lib. 13, Cap. 18 (Fig. 8)		senior synonym	*Tetrao urogallus crassirostris Brehm*, CL, 1831	Gregori (2008)	
Tetrao betulinus	Scopoli (1769)		Coll. Count Franz Hannibal von Thurn (Vienna)			junior synonym	*Lyrurus tetrix* (Linnaeus, 1758)	Hartert (1921b)	
Columba mugiens	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			junior synonym	*Goura cristata* (Pallas, 1764)	Latham (1823), Gregori (2008)	
Columba tetraoides	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			uncertain			
Alauda brumalis	Scopoli (1769)	Tyrol (Italy)	not specified (probably coll. Scopoli)			junior synonym	*Anthus pratensis* (Linnaeus, 1758)	Scopoli (1786a), Gregori (2008)	
Sturnus collaris	Scopoli (1769)	Carniolia (NW Slovenia), Carinthia (Austria)	Coll. Joannes A. Scopoli			valid taxon	*Prunella collaris* (Scopoli, 1769)	Hartert (1905), Gill *et al.* (2023)	according to opinon of Scheibel (1919) the type locality is only Carniola (W Slovenia)
Loxia torrida	Scopoli (1769)	(Venezuela)	Imperial ZOO (Vienna) - live specimen			valid taxon	*Sporophila angolensis torrida* (Scopoli, 1769)	Paynter & Storer (1970), Gill *et al.* (2023)	
Emberiza melanocephala	Scopoli (1769)	Carniolia (SW Slovenia)	Coll. Joannes A. Scopoli			valid taxon	*Emberiza melanocephala* Scopoli, 1769	Hartert (1903), Gill *et al.* (2023)	as type locality Scheibel (1919) suggested area near the coast in Carniola (SW Slovenia)
Emberiza barbata	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Emberiza cia* Linnaeus, 1767	Hartert (1903)	
Emberiza brumalis	Scopoli (1769)	Tyrol (Italy)	Coll. Joannes A. Scopoli			junior synonym	*Carduelis citrinella* (Pallas, 1764)	Hartert (1903)	
Emberiza luctuosa	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			junior synonym	*Ficedula hypoleuca* (Pallas, 1764)	Hartert (1903)	
Fringilla mariopsa	Scopoli (1769)		Imperial ZOO (Vienna) - live specimen			junior synonym	*Passerina ciris* (Linnaeus, 1758)	Gregori (2008)	

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Motacilla boarula	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Aldrovandi 1637, Lib. 17, Cap. 25 (Fig. 9)		junior synonym	*Motacilla flava* Linnaeus, 1758	Gregori (2008)	Scopoli (1769) probably made mistake and attributed name *Motacilla flava* to the *Motacilla cinerea Tunstall*, 1771, and *Motacilla boarula* to *Motacilla flava Linnaeus*, 1758.
Sylvia zya	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Saxicola rubetra* (Linnaeus, 1758)	Hartert (1905)	
Sylvia muscipeta	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli	Jonston 1650, Tab. 45 (Muscipeta) (Fig. 10)		junior synonym	*Saxicola rubicola* (Linnaeus, 1766)	Hartert (1905)	
Parus barbatus	Scopoli (1769)	Carniolia (W Slovenia)	Coll. Joannes A. Scopoli			junior synonym	*Panurus biarmicus* (Linnaeus, 1758)	Gregori (2008)	
Hirundo alpina	Scopoli (1769)	Tyrol (Austria)	Coll. Joannes A. Scopoli			junior synonym	*Tachymarptis melba* (Linnaeus, 1758)	Hartert (1912), Gregori (2008)	
Hirundo rupestris	Scopoli (1769)	Tyrol (Austria)	Coll. Joannes A. Scopoli			valid taxon	*Ptyonoprogne rupestris* (Scopoli, 1769)	Hartert (1905), Gill *et al.* (2023)	
Alauda turdina	Scopoli (1786a)	Insubria, Tyrol (Italy)	not specified (probably coll. Scopoli)	Willughby 1676, Lib. 2, § 10: cited therein Aldrovandi 1637, Lib. 17, Cap. 26. (Fig. 11)		junior synonym	*Anthus trivialis* (Linnaeus, 1758)	Zander (1853)	Aldrovandi (1637) figure indicates *Prunella modularis* (Linnaeus, 1758) or even *Prunella collaris* (Scopoli, 1769)
Alauda turlu	Scopoli (1786a)		not specified (probably coll. Scopoli)			uncertain			
Falco rufus	Scopoli (1786b)	Ducatu Mediolensi (Italy)	not specified (probably coll. Scopoli)	Scopoli 1786b, Tab. 19 (Fig. 12)		junior synonym	*Falco vespertinus* Linnaeus, 1766	Newton (1882)	
Vultur radiatus	Scopoli (1786b)	Madagascar (Madagascar)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 103 (Fig. 13)		valid taxon	*Polyboroides radiatus* (Scopoli, 1786)	Peters (1931), Gill *et al.* (2023)	
Vultur calvus	Scopoli (1786b)	India (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 104 (Fig. 14)		valid taxon	*Sarcogyps calvus* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Vultur indicus	Scopoli (1786b)	(India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 105 (Fig. 15)		valid taxon	*Cyps indicus* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Lanius phillippinus	Scopoli (1786b)	Philippines	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 25 (not cited by Scopoli) (Fig. 16)		junior synonym	*Artamus leucorynchus* (Linnaeus, 1771)	Walden (1877)	
Lanius nasutus	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 70 (Fig. 17)		valid taxon	*Lanius schach nasutus* Scopoli, 1786	Walden (1877), Gill *et al.* (2023)	

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Lanius ruber	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 71 (Fig. 18)		uncertain			
Lanius albus	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 72 (Fig. 19)		junior synonym	*Lanius excubitor* Linnaeus, 1758	Sherborn (1902)	
Lanius rufus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 106 (Fig. 20)		nomen nudum	*Dendrocitta vagabunda* (Latham, 1790)	Pittie & Dickinson (2010)	the name *Lanius rufus* was preoccupied by *Lanius rufus Linnaeus*, 1766 for another species (Pittie & Dickinson 2010)
Lanius chinensis	Scopoli (1786b)	(China)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 107 (not cited by Scopoli) (Fig. 21)		valid taxon	*Pterorhinus chinensis* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Psittacus papou	Scopoli (1786b)	China (New Guinea)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 111 (Fig. 22)		valid taxon	*Charmosyna papou* (Scopoli, 1786)	Salvadori (1891), Gill *et al.* (2023)	
Psittacus signatus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 42 (Scopoli wrongly cited Pl. 47) (Fig. 23)		junior synonym	*Psittacula cyanocephala* (Linnaeus, 1766)	Salvadori (1891)	
Psittacus quianensis	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 43 (Fig. 24)		uncertain			
Psittacus pileatus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 44 (Fig. 25)		junior synonym	*Tanygnathus lucionensis* (Linnaeus, 1766)	Salvadori (1891)	
Psittacus cingulatus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 41 (Fig. 26)		junior synonym	*Touit batavicus* (Boddaert, 1783)	Salvadori (1891)	
Psittacus melanopterus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 40 (Fig. 27)		junior synonym	*Loriculus philippensis* (Müller, 1776)	Salvadori (1891)	
Psittacus lunulatus	Scopoli (1786b)	China (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 39 (Fig. 28)		valid taxon	*Bolbopsittacus lunulatus* (Scopoli, 1786)	Salvadori (1891), Gill *et al.* (2023)	
Psittacus leucopthalmos	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 38 (upper) (Fig. 29)		senior synonym	*Loriculus philippensis chrysonotus* Sclater, 1872	Walden (1877), Salvadori (1891)	
Psittacus pumilus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 38 (lower) (Fig. 29)		junior synonym	*Loriculus galgulus* (Linnaeus, 1758)	Salvadori (1891)	
Psittacus polychloros	Scopoli (1786b)	China (Indonesia)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 108 (Fig. 30)		valid taxon	*Eclectus polychloros* (Scopoli, 1786)	Stresemann (1952), Gill *et al.* (2023)	

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Psittacus guenbyensis	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 109 (Fig. 31)	holotype (MNHN-ZO-MO -2004-129; Muséum National d'Histoire Naturelle, Paris, France)	senior synonym	*Eos squamata riciniata* (Bechstein, 1811)	Salvadori (1891), Oberholser (1918)	
Psittacus ater	Scopoli (1786b)	China (New Guinea)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 110 (Fig. 32)		valid taxon	*Chalcopsitta atra* (Scopoli, 1786)	Salvadori (1891), Gill *et al.* (2023)	
Buceros panayensis	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 82,83 (Fig. 33)		uncertain		Walden (1877), Finsch (1903)	should be examined further: the taxon is currently attributed to three different species, *Penelopides panini* (Boddaert, 1783), *Penelopides manillae* (Boddaert, 1783), and *Penelopides affinis Tweeddale*, A 1877
Buceros birostris	Scopoli (1786b)	Caromandel (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 121 (Scopoli wrongly cited Pl. 119) (Fig. 34)		valid taxon	*Ocyceros birostris* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Buceros pica	Scopoli (1786b)	Malabar (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 121 (second Pl. 121 in Sonnerat) (Fig. 35)		junior synonym	*Anthracoceros coronatus* (Boddaert, 1783)	Baker (1930a)	
Oriolus cothurnix	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 105 (Fig. 36)		uncertain		International Comission on Zoological Nomenclature (1963)	The International Comission on Zoological Nomenclature declared the name as dubious taxon and suppressed it for the purposes of the Law of Priority.
Oriolus lineatus	Scopoli (1786b)	(Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 24 (not cited by Scopoli) (Fig. 37)		valid taxon	*Synoicus chinensis lineatus* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Oriolus ocellatus	Scopoli (1786b)	Luzon (Phillippines), New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 23 (Fig. 38)		valid taxon	*Turnix ocellatus* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Xanthornus holosericeus	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 68, 69 (Fig. 39)		valid taxon	*Amblyramphus holosericeus* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Paradisea rex	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 95 (Fig. 40)		junior synonym	*Cicinnurus regius* (Linnaeus, 1758)	Iredale (1954)	subspecies *C. r. rex* (Scopoli, 1786) is now included in *C. r. regius* (Linnaeus, 1758) (Beehler & Pratt 2016)
Paradisea pencillata	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 97 (Fig. 41)		junior synonym	*Parotia sefilata* (Pennant, 1781)	Iredale (1954)	

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Paradisea viridis	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 99 (Fig. 42)		junior synonym	*Manucodia chalybatus* (Pennant, 1781)	Iredale (1954)	
Gracula caerulea	Scopoli (1786b)	China (China)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl.108 (Fig. 43)		valid taxon	*Myophonus caeruleus* (Scopoli, 1786)	Swinhoe (1871), Baker (1930a), Beehler & Pratt (2016)	
Gracula cristata	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl.109 (Fig. 44)		junior synonym	*Pycnonotus jocosus* (Linnaeus, 1758)	Blyth (1845)	
Trogon luzonensis	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 34 (Fig. 45)		senior synonym	*Psilopogon haemacephalus roseus* (Dumont, 1805)	Walden (1877)	
Cuculus variegatus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 78 (Fig. 46)		uncertain			
Cuculus flaviventris	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 79 (Fig. 47)		uncertain		Swinhoe (1871), Walden (1877)	should be examined further: Swinhoe (1871) attributed the taxon to *Hierococcyx hyperythrus* (Gould, 1856), and *Walden* (1877) to *Hierococcyx pectoralis* (Cabanis & Heine, 1863)
Cuculus viridis	Scopoli (1786b)	China (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 80 (Fig. 48)		valid taxon	*Centropus viridis* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Cuculus merulinus	Scopoli (1786b)	China (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 81 (Fig. 49)		valid taxon	*Cacomantis merulinus* (Scopoli, 1786)	Walden (1877), Baker (1930a), Gill *et al.* (2023)	
Picus guineensis	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 35 (Fig. 50)		senior synonym	*Dendropicos fuscescens* (Vieillot, 1818)	Neumann (1900), Peters (1948)	
Picus menstruus	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 36 (Fig. 51)		junior synonym	*Dendropicos griseocephalus* (Boddaert, 1783)	Stark (1903)	
Picus lucidus	Scopoli (1786b)	China (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 37 (Scopoli wrongly cited Pl. 36) (Fig. 52)		valid taxon	*Chrysocolaptes lucidus* (Scopoli, 1786)	Walden (1877), Peters (1948), Gill *et al.* (2023)	There is a specimen of atypical female from Sonnerat collection preserved in Muséum National d'Histoire Naturelle, Paris, but see discussion for further details.
Picus maculatus	Scopoli (1786b)	China (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 77 (Fig. 53)		valid taxon	*Yungipicus maculatus* (Scopoli, 1786)	Peters (1948), Gill *et al.* (2023)	
Alcedo caromandeliana	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl.118 (Fig. 54)		senior synonym	*Halcyon coromanda* (Latham, 1790)	Cassin (1852), Sharpe (1868-71), Swinhoe (1871), Walden (1877), Baker (1930a)	

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Alcedo albiventris	Scopoli (1786b)	New Guinea (South Africa)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 31 (Fig. 55)	neotype (The Natal Museum, South Africa)	valid taxon	*Halcyon albiventris* (Scopoli, 1786)	Sharpe (1868-71), Clancey (1959), Gill *et al.* (2023)	
Alcedo collaris	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 33 (Fig. 56)		valid taxon	*Todiramphus chloris collaris* (Scopoli, 1786)	Cassin (1852), Sharpe (1868-71), Walden (1877), Gill *et al.* (2023)	
Alcedo undulata	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 106 (Fig. 57)		junior synonym	*Dacelo novaeguineae* (Hermann, 1783)	Cassin (1852), Sharpe (1868-71)	
Alcedo variegata	Scopoli (1786b)		Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 107 (not cited by Scopoli) (Fig. 58)		uncertain		Cassin (1852), Sharpe (1868-71)	should be examined further: Cassin (1852) and Sharpe (1868-71) attributed the taxon to *Halcyon chelicuti* (Stanley, 1814), but it does not suite the reference figure, and its long legs does not suit any of Coraciiformes species either
Merops bruneus	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 100 (incompletely cited by Scopoli) (Fig. 59)		junior synonym	*Epimachus fastosus (Hermann, 1783)*	Iredale (1954)	
Merops maximus	Scopoli (1786b)		Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 101 (not cited by Scopoli) (Fig. 60)		junior synonym	*Epimachus fastosus* (Hermann, 1783)	Iredale (1954)	
Certhia canora	Scopoli (1786b)	Cape of Good Hope	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 116-1 (Fig. 61)		Uncertain			
Certhia malacensis	Scopoli (1786b)	Cape of Good Hope (Malaysia)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 116-2 (Fig. 61)		valid taxon	*Anthreptes malacensis* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Certhia coccinea	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 61(117)-1 (Fig. 62)		junior synonym	*Dicaeum cruentatum* (Linnaeus 1758)	Baker (1930a)	
Certhia trigonostigma	Scopoli (1786b)	China (Malaysia)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 61(117)-2 (Fig. 62)		valid taxon	*Dicaeum trigonostigma* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Certhia grisea	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 61(117)-3 (Fig. 62)		Uncertain			
Certhia lutea	Scopoli (1786b)	Caromandel	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 119 (Fig. 63)		Uncertain			
Certhia quadricolor	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 30-A, B (Fig. 64)		junior synonym	*Leptocoma zeylonica* (Linnaeus, 1766)	Baker (1930a)	

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Apterodita longirostris	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 113 (Fig. 65), Pennant 1781, Tab. 14 (Fig. 66)		junior synonym	*Aptenodytes patagonicus* Miller, 1778	Checklist Committee (OSNZ) (2022)	
Apterodita platirhingos	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 114 (Fig. 67)		Uncertain			
Sterna anaethetus	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 84 (Fig. 68)		valid taxon	*Onychoprion anaethetus* (Scopoli, 1786)	Swinhoe (1871), Walden (1877), Blanford (1898), Baker (1930b), Gill *et al.* (2023)	
Sterna pileata	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 85 (Fig. 69)		valid taxon	*Anous stolidus pileatus* (Scopoli, 1786)	Walden (1877), Baker (1930b), Gill *et al.* (2023)	
Sterna multicolor	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 55 (Fig. 70)		uncertain			reference figure suggests *Dendrocygna viduata* (Linnaeus, 1766)
Platalea alba	Scopoli (1786b)	New Guinea (South Africa)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 51 (Fig. 71)		valid taxon	*Platalea alba* Scopoli, 1786	Stark (1906), Gill *et al.* (2023)	
Platalea cristata	Scopoli (1786b)		Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 52 (not cited by Scopoli) (Fig. 72)		uncertain			reference figure suggests *Platalea regia* Gould, 1838
Tantalus rufus	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 47 (Fig. 73)		uncertain			
Tantalus variegatus	Scopoli (1786b)	(Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 48 (not cited by Scopoli) (Fig. 74)		valid taxon	*Numenius phaeopus variegatus* (Scopoli, 1786)	Walden (1877), Hartert (1921a), Baker (1930b), Gill *et al.* (2023)	
Tringa fasciata	Scopoli (1786b)	India	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 96 (Fig. 75)		nomen nudum	*Pterocles indicus* (Gmelin, 1789)	Hartert (1920b), Baker (1930a)	the name *Tringa fasciata* was preoccupied by *Tringa fasciata* Gmelin, 1774 for another species
Tringa chirurgus	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 45 (Fig. 76)		valid taxon	*Hydrophasianus chirurgus* (Scopoli, 1786)	Swinhoe (1871), Walden (1877), Baker (1930a), Gill *et al.* (2023)	
Charadrius dubius	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 46 (Fig. 77)		valid taxon	*Charadrius dubius* Scopoli, 1786	Walden (1877), Blanford (1898), Baker (1930b), Gill *et al.* (2023)	

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Charadrius cristatus	Scopoli (1786b)	New Guinea, Cape of Good Hope	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 49 (Fig. 78)		nomen nudum	*Megapodius cumingii* Dillwyn, 1853	Walden (1877)	the name Charadrius cristatus was preoccupied by Charadrius cristatus Linnaeus, 1758 for another species, however reference figure should be further examined as it does not resemble suggested taxon Megapodius cumingii Dillwyn, 1853
Otis secretarius	Scopoli (1786b)	Philippines, Cape of Good Hope	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 50 (Fig. 79)		junior synonym	*Sagittarius serpentarius* (Miller, 1779)	Sclater (1903)	
Pavo malacensis	Scopoli (1786b)	E India (Malaysia)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 99 (Fig. 80); Edwards 1747, Tab. 67 (Fig. 81)		valid taxon	*Polyplectron malacense* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Phasianus rouloul	Scopoli (1786b)	E India (Malaysia)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 100 (Fig. 82)		valid taxon	*Rollulus rouloul* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Tetrao pintadeanus	Scopoli (1786b)	E India (China)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 97 (Fig. 83)		valid taxon	*Francolinus pintadeanus* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Tetrao madagarensis	Scopoli (1786b)	E India (Madagascar)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 98 (Fig. 84)		valid taxon	*Margaroperdix madagarensis* (Scopoli, 1786)	Gill *et al.* (2023)	
Columba nitidissima	Scopoli (1786b)	E India (Mauritius)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 101 (Fig. 85)	syntype (MNHN-ZO-MO-2000-727; Muséum National d'Histoire Naturelle, Paris, France)	valid taxon	*Alectroenas nitidissimus* (Scopoli, 1786)	Gill *et al.* (2023)	
Columba chinensis	Scopoli (1786b)	E India (China)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 102 (Fig. 86)		valid taxon	*Spilopelia chinensis* (Scopoli, 1786)	Swinhoe (1871), Baker (1930a), Gill *et al.* (2023)	
Columba nivea	Scopoli (1786b)	Luzon (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 20 (Fig. 87)		nomen alternativum	*Gallicolumba luzonica* (Scopoli, 1786)	Walden (1877)	Scopoli described leucistic individual of Gallicolumba luzonica (Scopoli, 1786)
Columba luzonica	Scopoli (1786b)	Luzon (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 21 (Fig. 88)		valid taxon	*Gallicolumba luzonica* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Columba cinerea	Scopoli (1786b)	Luzon (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 22 (Fig. 89)		uncertain		Blyth (1845), Walden (1877)	should be examined further: the name was categorized as doubtful (Blyth 1845, Walden 1877), but further examination of the reference figure is required

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Columba myristicivora	Scopoli (1786b)	Luzon (Indonesi)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 102 (Scopoli wrongly cited Pl. 103) (Fig. 90)		valid taxon	*Ducula myristicivora* (Scopoli, 1786)	Mees (1972), Gill *et al.* (2023)	
Columba viridis	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 64, 65 (Fig. 91)		junior synonym	*Treron vernans* (Linnaeus, 1771)	Walden (1877)	
Columba pileata	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 66 (Fig. 92)		junior synonym	*Chalcophaps indica* (Linnaeus, 1758)	A	
Columba bicolor	Scopoli (1786b)	New Guinea (New Guinea)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 103 (not cited by Scopoli) (Fig. 93)		valid taxon	*Ducula bicolor* (Scopoli, 1786)	Walden (1877), Blanford (1898), Baker (1930), Gill *et al.* (2023)	
Columba pulcherrima	Scopoli (1786b)	New Guinea (Seychelles)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 67 (Fig. 94)	syntype (MNHN-ZO-MO-2002-138; Muséum National d'Histoire Naturelle, Paris, France)	valid taxon	*Alectroenas pulcherrimus* (Scopoli, 1786)	Gill *et al.* (2023)	
Alauda malabarica	Scopoli (1786b)	China (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 113-1 (Fig. 95)		valid taxon	*Galerida malabarica* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Alauda grisea	Scopoli (1786b)	China (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 113-2 (Fig. 95)		valid taxon	*Eremopterix griseus* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	
Turdus malacensis	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 110 (Fig. 96)		uncertain			should be examined further: the reference figure suggest one of the Asian Pitta species
Ampelis malabarica	Scopoli (1786b)	China (India)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 114-1 (Fig. 97)		valid taxon	*Copsychus malabaricus* (Scopoli, 1786)	Baker (1930a), Gill *et al.* (2023)	Baker (1930) as well as public taxonomic databases (GIBIF, AVIBASE) wrongly refer to Muscicapa malabarica as protonym of Copsychus malabaricus (Scopoli, 1786); correct protonym is Ampelis malabarica, while Muscicapa malabarica was described as other species
Emberiza signata	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 75 (Fig. 98)		uncertain			should be examined further: the reference figure suggest one of the Vidua species, most probably Vidua hypocherina Verreaux & Verreaux, 1856
Tanagra macroura	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 74 (Fig. 99)		uncertain			

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Motacilla luzonensis	Scopoli (1786b)	Luzon (Phillippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 29 (Fig. 100)		senior synonym	*Motacilla alba leucopsis* Gould, 1838	Walden (1877), Oates (1890)	
Muscicapa caeruleocephala	Scopoli (1786b)	Luzon	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 26-1 (Fig. 101)		junior synonym	*Hypothymis azurea* (Boddaert, 1783)	Baker (1930a)	
Muscicapa macroura	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 27-1 (Fig. 102)		uncertain			
Muscicapa tessacourbe	Scopoli (1786b)	New Guinea	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 27-2 (Fig. 102)		uncertain		International Comission on Zoological Nomenclature (1963)	The International Comission on *Zoological Nomenclature* declared the name as dubious taxon and suppressed it for the purposes of the Law of Priority.
Muscicapa goiavier	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 28 (Fig. 103)		valid taxon	*Pycnonotus goiavier* (Scopoli, 1786)	Walden (1877), Baker (1930a), Gill *et al.* (2023)	
Muscicapa panayensis	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 73 (Fig. 104)		valid taxon	*Aplonis panayensis* (Scopoli, 1786)	Walden (1877), Gill *et al.* (2023)	
Muscicapa malabarica	Scopoli (1786b)	China	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 111 (Fig. 105)		uncertain			should be examined further: wrongly interpreted by Baker (1930) as *Copsychus malabaricus* (Scopoli, 1786); the reference figure suggests *Dicrurus remifer* (Temminck, 1823)
Sylvia lutea	Scopoli (1786b)	China (China)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 114-2 (Fig. 97)		valid taxon	*Leiothrix lutea* (Scopoli, 1786)	Swinhoe (1871), Baker (1930a), Gill *et al.* (2023)	
Sylvia capensis	Scopoli (1786b)		Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 115 (Scopoli wrongly cited Pl. 208-1) (Fig. 106)		uncertain			
Parvus nelicourvi	Scopoli (1786b)	China (Madagascar)	Coll. Pierre Sonnerat	Sonnerat 1782, Pl. 112 (Fig. 107)		valid taxon	*Ploceus nelicourvi* (Scopoli, 1786)	Gill *et al.* (2023)	
Hirundo gutturalis	Scopoli (1786b)	New Guinea (Philippines)	Coll. Pierre Sonnerat	Sonnerat 1776, Pl. 76 (Fig. 108)		valid taxon	*Hirundo rustica gutturalis* (Scopoli, 1786)	Swinhoe (1871), Walden (1877), Baker (1930a), Gill *et al.* (2023)	
Fringilla alpina	Scopoli (1788)	Trentino (Italy)	not specified (probably coll. Scopoli)	Scopoli 1788, Tab. 18 (Fig. 109)		junior synonym	*Carduelis citrinella* (Pallas, 1764)	Newton (1882)	

OPISI PTIC (AVES) JOANNESA ANTONIUSA SCOPOLIJA (1723-1788): OSNOVNI PREGLED

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POVZETEK

Joannes Antonius Scopoli (1723-1788), avtor opisov najmanj 175 novih taksonov ptic, od katerih je 59 še vedno veljavnih, je bile eden najpomembnejših tvorcev ornitološke zgodovine v Evropi in na svetu, kljub temu pa je pogosto spregledan, njegova ornitološka zapuščina pa slabo raziskana in poznana. Dopisoval si je z Linnéjem in tako vplival na zgodnji razvoj razvoj sistematike in klasifikacije organizmov. Njegovo najpomembnejšo znanstveno delovanje je bilo med letoma 1754 in 1769 na Kranjskem (današnja Slovenija) in se je odrazilo v številnih publikacijah, ki temeljijo na njegovih izvirnih terenskih raziskavah. Med temi so ornitološke raziskave, objavljene v Annus I. Historico Naturalis, Descriptiones Avium (1769), medtem ko so bile kasnejše študije posvečene reviziji podatkov in opisov drugih raziskovalcev, med katerimi so najpomembnejši opisi iz odprav francoskega raziskovalca Pierra Sonnerata. Prispevek predstavlja pregled vseh taksonov ptic, ki jih je opisal Scopoli, kot nove (1) s pregledom interpretacij identitete in trenutnega taksonomskega statusa ter (2) s pregledom zbirk, ki vsebujejo tipske primerke vrst, ki jih je opisal Scopoli, s podatki o njihovem zgodovinskem in trenutnim statusom. Prispevek razkriva nekatera nova zgodovinska in taksonomska dejstva, ki so podlaga za nadaljnje zgodovinske in taksonomske študije ornitoloških prispevkov Joannesa A. Scopolija.

Ključne besede: zgodovina znanosti, ornitologija, zbirke, taksonomija, tipski primerki, zoološka nomenklatura

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OCENE IN POROČILA

RECENSIONI E RELAZIONI

REVIEWS AND REPORTS

Recenzija knjige:
PODOBE IZ MODRINE
Avtor: Lovrenc Lipej
Založnik: Morska biološka postaja Piran, Nacionalni inštitut za biologijo in Slovenski nacionalni odbor Medvladne oceanografske komisije UNESCO,
Tiskarna SCHWARTZ,
248 str.

Knjiga »*Podobe iz modrine*« profesorja Lovrenca Lipeja je posebnost v slovenskem slovstvu, saj imamo pred seboj berljivo knjigo polno zanimivosti, anekdot, nenavadnih primerjav in miselnih razponov, ki priča o avtorjevi široki, enciklopedični razgledanosti v biologiji, naravoslovju, a tudi širše o vsem, kar je človekovemu zanimanju lastno. Po drugi strani pa je knjiga znanstveno in strokovno korektna, vsebuje sodobna dognanja in – kjer je potrebno – relevantne podatke o vsaki tematiki.

Knjig o morskem življu v Jadranu oziroma – ožje – v slovenskem morju, je bilo že nekaj. Verjetno je »*Življenje našega Jadrana*« Miroslava Zeia in Jana Zhanela iz leta 1947 prvo tovrstno delo, ki je skušalo podvodni svet približati slovenskemu bralcu. Nato je leta 1951 izšla prav tako Zeieva knjjga »*Iz ribjega sveta*«, ter leta 1956 delo istega avtorja »*Morja bogati zakladi*«, ki je profesorju Lipeju burila domišljijo že v zgodnjem otroštvu, kot sam zapiše v predgovoru.

Gre za izbor esejev o morju in življenju v njem, ki jih je avtor pisal skozi leta v časopisu Primorske novice, nekaj pa tudi v časopisu Slovenske Potapljaške Zveze - Potapljaču. Eseji so smiselno zbrani v poglavja, v katerih so podpoglavja, skozi katere bralec vselej sledi rdečo nit... na primer poglavja o mehkužcih, o tujerodnih vrstah, o posledicah podnebnih sprememb, o pticah, o morskih psih, itd. Vsako od sedemnajstih poglavij je na koncu knjige opremljeno z viri, znanstvenimi in strokovnimi, od katerih je veliko avtorjevih originalnih, in v katerih so sicer subjektivno obarvani eseji objektivno »preverljivi«.

Knjiga se bere z lahkoto, in težko jo je odložiti tudi zato, ker je polna res zanimivih dejstev, občasno tudi humorja, vseskozi pa so eseji nabiti s podatki tako iz imenoslovja, zgodovine, biologije morskih organizmov, ekologije morja, pa vse do uporabne vrednosti morskih organizmov in vsakdanjega življenja z morjem.

Potapljače bo knjiga pritegnila, ker jim morda odkriva skrite svetove, na videz morda drobne, na prvi pogled nezanimive. Koliko je, na primer, drobnih ribic pisanih barv in nenavadnih oblik že v priobalnem pasu, v plitki vodi! Kaj vse skrivajo podmorski travniki, kaj vse najdemo v mulju, ali pod skalami...avtor se na primer še posebej posveča drobnim babicam in sprehajalčkom, a bralca pritegnejo tudi »Nenavadne ribe«, kjer se srečamo s pravo eksotiko – ali pa poglavje »Tragični junaki«, kjer se avtor posveti morskim psom, temi, ki ga še posebej pritegne in je napisana s posebnim žarom, osebno, a hkrati zelo verodostojno.

Podvodni svet največkrat vidimo skozi oči podvodnih ribičev, ribe »merimo« v dolžino, mehkužci nas zanimajo, ko so na mizi. Prepričan sem da bo ta knjiga vzbudila zanimanje za vse skrite svetove, ki jih ponuja morje. Še več, nevsiljivo bralcu daje vpogled v pojem in pomen biodiverzitete in predoči njeno upadanje; prav tako bralcu konkretno ponudi primere vpliva podnebnih sprememb na morske organizme in združbe. Podaja nam primere za homogenizacijo v naravi in vpliv človeka na različnih nivojih. Pa vendarle nam daje vseskozi vedeti, da ni za obupati: narava se spreminja, vendar ni kritično ogrožena, kar nam ilustrira na primerih.

V knjigi ne manjka primerjav iz leposlovja, mitologije, sveta filma in kulinarike...Dogodki in ljudje so popisani verodostojno, ne manjkajo celo datumi. Imena in opisi organizmov so nedvoumni, jasni in vselej opremljeni s slovenskimi in

znanstvenimi imeni. Avtor »skoči« tudi na kopno, če gre za »pernate ribiče«. Pojasni tudi številne ekološke zakonitosti in biogeografske orise.

Na koncu naj vendarle omenim, da se z avtorjem poznava že zelo dolgo. Sošolca sva bila že takrat, ko je nastala črnobela fotografija na strani 101, kjer radoveden, še ne desetletni fantič na dosegu roke zre v trimetrskega morskega psa šesteroškrgarja, ulovljenega v izolskih vodah. Kdo bi si mislil, da bo čez več kot pol stoletja fotografija našla mesto v avtorjevi knjigi in tako potegnila življenjski lok skozi avtorjevo otroštvo v ribiškem mandraču, mladost ob morju, študij v Ljubljani in Zagrebu, ter profesionalno pot znanstvenika in pedagoga, ki je vseskozi povezan s taistim morjem, ki se mu je posvetil ne le profesionalno, ampak tudi kot potapljač, ornitolog, fotograf, iskalec zgodb in sploh vsega novega.

Naj bo pisana vsebina knjige motivacija in vir zanimivih informacij za vsakogar, ki si nadane potapljaško masko in se zazre v skrivnostni svet podvodne modrine!

Mitja Kaligarič
Univerza v Mariboru, Fakulteta za naravoslovje in matematiko

IN MEMORIAM

IN MEMORIAM

RICORDO DEL PROFESSOR GUIDO BRESSAN

Nato il 13 gennaio 1944 a Trieste
Scomparso il 6 settembre 2023 a Trieste

La notizia è giunta all'improvviso anche se da anni non partecipava alla vita pubblica per ragioni di salute. L'ultima partecipazione nel 2019 alla manifestazione di conferimento del "Tridente d'oro". Veniva premiata la sua attività di subacqueo come sportivo, ricercatore e docente. Il premio, consegnatogli dall'archeologo professor Luigi Fozzati lo accomunava ai più grandi nomi della subacquea mondiale in tutti i settori, dalla medicina all'archeologia, allo studio dell'ambiente marino.

Guido Bressan si era laureato in Scienze Biologiche, nel 1970, all'Università di Trieste che da qualche anno aveva risvegliato la trascorsa tradizione di eccellenza nello studio del mare. Esisteva a Trieste una lunga tradizione di studi di biologia marina, negli ultimi decenni del milleottocento la Stazione Zoologica di Sant'Andrea era sede di studiosi provenienti da tutta l'Europa. La Prima guerra mondiale ed i diversi assetti politici che ne seguirono spensero l'interesse per il mare per lungo tempo. I primi anni sessanta del Novecento riaccendono gli studi sul mare all'università di Trieste con l'attivazione del Corso di Laurea in Scienze Naturali. Dopo qualche anno, segue il Corso di laurea in Scienze Biologiche. I tempi sono maturi per fare dell'Università di Trieste un riferimento internazionale di studio del mare. Il Professor Bressan dedica all'algologia e alla fitoecologia marina le sue ricerche appassionando allo studio dell'ambiente marino molti studenti grazie al metodo partecipativo dei suoi corsi. Ogni estate, per decenni, gli studenti di biologia marina trasferiscono l'apprendimento teorico dei corsi in pratica. Il mare ricco di specie vegetali e animali di Salvore, in Croazia, diviene per due settimane la palestra di studio sul campo, in immersione, degli studenti, guidati per la biologia marina vegetale dal professor Bressan. Sono gli anni di Oceanest, esperienza tra ricerca, studio e didattica "in situazione". Dopo i primi anni dedicati solo agli studenti apre anche all'aggiornamento dei molti docenti di Scienze Naturali che all'insegnamento della biologia marina erano interessati. Dal duemila al duemilaquattro, in qualità di rappresentante del Dipartimento di Biologia dell'Università di Trieste, cura la verifica scientifica di un Progetto Europeo di Ecologia Marina " Mare e Vita" (Sea & Life), unico corso didattico/scientifico approvato dal Comitato dei progetti Comenius, Azione 3.1. È un progetto che vede impegnati a produrre materiale scientifico/didattico sulla vita nel mare esperti e docenti francesi, greci e spagnoli.

È altrettanto difficile, quando si ripercorrono le esperienze di vita culturale del professor Guido Bressan, scindere la ricerca dallo studio di interpretazione dei dati e dalla trasposizione in didattica attiva. Sono percorsi strettamente interconnessi perché l›obiettivo non era mai solo produrre lavori scientifici di qualità ma condividere i risultati di ogni ricerca con i giovani che seguivano i suoi corsi. Anche questa disponibilità alla cooperazione con studenti, docenti e colleghi lo porta già dagli anni ottanta ad impegnarsi non solo in ambito universitario ma anche con le Istituzioni Scientifiche Italiane e internazionali. È docente presso l'UNESCO dove tiene i corsi in francese, partecipando ai progetti Erasmus per i quali svolge seminari di studio dal 1993 al 2002. Tiene corsi professionali specifici in francese alla Blue School. È docente alla Mediterranean Association for Marine Biology and Oceanology, sempre con l'Unesco. Tiene corsi universitari in molte università italiane. Si impegna a diffondere le sue conoscenze alla SSIS (Scuola di Specializzazione per l'insegnamento Secondario),

Il prof. Guido Bressan con un gruppo di studenti dell'università di Trieste durante uno stage estivo a Salvore (foto: archivio della famiglia Bressan).

consapevole dell'utilità di questa attività per far entrare in ruolo nella Pubblica Istruzione i tanti docenti precari del sistema scolastico italiano. Sul versante accademico era diventato già nel 1976 assistente ordinario alla cattedra di Fisiologia Vegetale per gli studenti di Scienze Naturali.

È nominato poi professore incaricato di Algologia e dal 1981 è professore associato sempre alla Facoltà di Scienze dell›Università di Trieste. Dal 1982 al 1989 dirige il Laboratorio di Biologia Marina dei Filtri di Aurisina, a Trieste. È proprio dall›attività di studio degli organismi del mare in questa struttura, che rinasce a Trieste una scuola di specialisti che intesse una rete di relazioni scientifiche con tutto il mondo. Coordina molti progetti di ricerca, sulla tossicità da alghe, sullo sviluppo del fouling in ambiente tossico, sulle barriere artificiali sommerse.

In tutti questi anni, oltre alla ricerca, continua ad impegnare gran parte del suo tempo all'aggiornamento degli insegnanti di Scienze, utilizzando la sua straordinaria disposizione naturale alla didattica. Propone in modo originale e scientifico l'approccio maieutico grazie al quale conquista l'attenzione di tutti, studenti e insegnanti, durante le sue lezioni e conferenze. Lavoro scientifico svolto sul campo, con immersioni guidate, capacità relazionali, attenzione alle esigenze culturali di chi allo studio del mare, con particolare riferimento alle alghe, vuole dedicarsi, fanno del professor Bressan un raro esempio di connubio tra qualità della ricerca e capacità di divulgazione. Ha pubblicato circa duecento lavori su riviste scientifiche internazionali, nazionali e locali. Pubblica su Botanica Marina, Phycologia, Marine Ecology, Marine Sciences, Vie et Milieu, Biblioteca Psicologica, ICES (International Council for the Exploration of the Sea), Acta Adriatica, Cahiers de Biolgie marine, Accademia Nazionale dei Lincei, Oebalia, Giorn. Bot. Ital., Periodicum Biologorum, Optima, Inf. Bot. ital., Boll. Soc. Adriat. di Scienze, Atti Museo Civico di Storia Naturale, Nova Thalassia. Approfondisce le ricerche sulle Alghe calcaree. Lavora sulla determinazione degli organismi vegetali su una nave romana integra, individuata casualmente in laguna da un pescatore e battezzata Julia Felix.

Pubblica manuali di divulgazione con metodo innovativo (Glossario Atlante) per il riconoscimento delle Alghe. Sul volumetto (rivisto anni dopo, all'interno del progetto europeo Comenius) per uso didattico "Alghe del Golfo di Trieste" (pubblicato nel 1990 da Pro Natura Carsica e scritto in collaborazione), si trova una breve recensione del Professor Sandro Pignatti, il suo Maestro, con la quale si conclude questo parziale excursus sulla vita professionale di Guido Bressan. Excursus nel quale non si trovano le parole giuste per le qualità umane che gli sono valse la stima e l'affetto di chi ha avuto il piacere di collaborare con lui: "Guido Bressan conosce bene questo argomento, anche dal lato più difficile e specialistico... per molti anni la passione per il mare lo portava a dividersi tra l'attività di ricerca e quella sportiva (come subacqueo e come velista)... Questo libro è soltanto una premessa, quasi la punta dell'iceberg, di un'opera ben più impegnativa riguardante le alghe, questa a livello scientifico, alla quale egli da anni sta lavorando... la ricchezza ed interesse dell'ambiente marino, oggi da tante parti minacciato nella sua integrità, lo richiedono".

Al prof. Guido Bressan nel 2019 è stato conferito il "Tridente d'oro" per la sua attività di subacqueo come sportivo, ricercatore e docente (foto: archivio della famiglia Bressan).

Elide Catalfamo
Presidente onoraria sezione ANISN FVG
(Associazione Nazionale degli Insegnanti di
Scienze Naturali del Friuli Venezia Giulia)

KAZALO K SLIKAM NA OVITKU

SLIKA NA NASLOVNICI: Včasih je bil črnoglavi strnad (*Emberiza melanocephala*) pogosta vrsta v kulturni krajini slovenske Istre, danes pa je zelo redek gnezdilec. Opisal ga je Janez Anton Scopoli. (Foto: D. Tome)

Sl. 1: V zadnjih letih se vrstijo nova odkritja polžev gološkrgarjev v Jadranskem morju, k čemur velik delež prispeva ljubiteljska znanost. Med odkritelji so namreč pogosto navdušenci med potapljači in podvodnimi fotografi, ki so tokrat odkrili vrsto *Okenia picoensis*. (Foto: M. Fantin)

Sl. 2: Janez Anton Scopoli (1723–1788) je bil eden najpomembnejših tvorcev ornitološke zgodovine v Evropi in na svetu, toda njegova ornitološka zapuščina je slabo raziskana in poznana. Letos praznujemo 300. obletnico njegovega rojstva. Med mnogimi vrstami ptic, ki jih je opisal, je tudi mali deževnik (*Charadrius dubius*). (Foto: E. Vrezec)

Sl. 3: Med pticami, ki jih je opisal Janez A. Scopoli, je tudi beločela gos (*Anser albifrons*), ki je v Sloveniji redna zimska gostja. (Foto: E. Vrezec)

Sl. 4: Eno izmed največjih rib kostnic, grbastega morskega meseca (*Mola alexandrini*), so v Jadranskem morju potrdili šele pred kratkim. Tudi sicer je o tem velikanu zelo malo znanega. Na sliki je model iz steklenih vlaken v prirodoslovnem muzeju v Comisu. (Foto: Arhiv MSNC)

Sl. 5: Mala tukalica (*Zapornia parva*) je skrivnostna prebivalka trstišč v mokriščih. Z dolgimi prsti na nogah se brez težav prebija po blatu ali oprijema rastlinja. (Foto: E. Vrezec)

Sl. 6: Planinsko pevko (*Prunella collaris*) naj bi Scopoli opisal po primerkih iz severozahodne Slovenije. Najdemo jo predvsem v planinskem svetu nad gozdno mejo. (Foto: E. Vrezec)

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FRONT COVER: The black-headed bunting (*Emberiza melanocephala*) was once a common species in the cultural landscape of Slovenian Istria. However, it is now considered a very rare breeder. This species was first described by J. A. Scopoli. (Photo: D. Tome)

Fig. 1: In recent years, there have been frequent new findings of nudibranch sea slugs in the Adriatic Sea, thanks in large part to citizen science. Many of these discoveries are, in fact, made by divers and underwater photographers, who, on this occasion, found a nudibranch species known as *Okenia picoensis*. (Photo: M. Fantin)

Fig. 2: Joannes Antonius Scopoli (1723–1788) was one of the most important contributors to ornithological history, both in Europe and worldwide, yet his legacy remains poorly investigated and relatively unknown. This year marks the 300th anniversary of his birth. One of the many bird species he documented is the little ringed plover (*Charadrius dubius*). (Photo: E. Vrezec)

Fig. 3: Among the birds described by Joannes A. Scopoli is the greater white-fronted goose (*Anser albifrons*), a regular winter visitor in Slovenia. (Photo: E. Vrezec)

Fig. 4: One of the largest bony fishes, the bumphead sunfish (*Mola alexandrini*), has only recently been confirmed in the Adriatic Sea, and very little is known about this giant species in general. The photograph displays a fiberglass model from the Municipal Museum of Natural History of Comiso. (Photo: Archive MSNC)

Fig. 5: The little crake (*Zapornia parva*) is an enigmatic inhabitant of reed beds in wetlands. With its elongated toes, it effortlessly wades through mud or clings to vegetation. (Photo: E. Vrezec)

Fig. 6: Scopoli is said to have described the alpine accentor (*Prunella collaris*) based on specimens from northwestern Slovenia. This species is mainly found in mountainous regions above the tree line. (Photo: E. Vrezec)

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