ANNALES

Anali za istrske in mediteranske študije
Annali di Studi istriani e mediterranei
Annals for Istrian and Mediterranean Studies
Series Historia Naturalis, 27, 2017, 1

UDK 5 Annales, Ser. hist. nat., 27, 2017, 1, pp. 1-88, Koper 2017 ISSN1408-533X

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KOPER 2017

ISSN 1408-533X UDK 5 Letnik 27, leto 2017, številka 1

Izdajatelj/*Editore/Published by:*

Zgodovinsko društvo za južno Primorsko - Koper / *Società storica del Litorale - Capodistria*©

Za izdajatelja/*Per Editore/*
Publisher represented by:

Salvator Žitko

Sedež uredništva/*Sede della redazione/*
Address of Editorial Board:

Nacionalni inštitut za biologijo, Morska biološka postaja Piran /
Istituto nazionale di biologia, Stazione di biologia marina di Pirano /
National Institute of Biology, Marine Biology Station Piran
SI-6330 Piran /*Pirano*, Fornače/*Fornace* 41, tel.: +386 5 671 2900, fax 671 2901;
e-mail: annales@mbss.org, ***internet:*** www.zdjp.si

Redakcija te številke je bila zaključena 15. 06. 2017.

Sofinancirajo/*Supporto finanziario/*
Financially supported by:

Javna agencija za raziskovalno dejavnost Republike Slovenije (ARRS), Luka Koper in Mestna občina Koper

Annales - series historia naturalis izhaja dvakrat letno.

Naklada/*Tiratura/Circulation:* 300 izvodov/copie/copies

Revija Annales series historia naturalis je vključena v naslednje podatkovne baze: BIOSIS-Zoological Record (UK); Aquatic Sciences and Fisheries Abstracts (ASFA); Elsevier B.V.: SCOPUS (NL).

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ANNALES · Ser. hist. nat. · 27 · 2017 · 1

Anali za istrske in mediteranske študije - Annali di Studi istriani e mediterranei - Annals for Istrian and Mediterranean Studies

UDK 5 Letnik 27, Koper 2017, številka 1 ISSN 1408-533X

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FAVNA IN FLORA

FAUNA E FLORA

FAUNA AND FLORA

short scientific article
received: 2016-12-23

DOI 10.19233/ASHN.2017.01

UNUSUAL EXPANSION OF *LAURENCIA OBTUSA* (HUDSON) J.V. LAMOUROUX IN THE ZAMBRATIJA BAY (NORTHERN ADRIATIC SEA)

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ABSTRACT

The paper reports an unusual expansion of the red alga Laurencia obtusa *in shallow waters of the Zambratija Bay (northern Adriatic Sea). The large population of* L. obtusa *was never observed during underwater surveys conducted in recent years. In this area, benthic communities dominated by brown algae from the genus* Cystoseira *were present. The authors therefore assume that some environmental factors have probably changed and have favoured the extension of this red alga. The hypothesis for this phenomenon takes into account the possibility that the establishment of the invasive green alga* Caulerpa cylindracea *in the Zambratija bay has had a negative impact on native macroalgal assemblages.*

Key words: *Laurencia obtusa,* monospecific population, Zambratija Bay, Adriatic Sea

ESPANSIONE INSOLITA DI *LAURENCIA OBTUSA* (HUDSON) J.V. LAMOUROUX NELLA BAIA DI ZAMBRATTIA (ADRIATICO SETTENTRIONALE)

SINTESI

L'articolo riporta un'insolita espansione dell'alga rossa Laurencia obtusa *in acque poco profonde della baia di Zambrattia (Adriatico settentrionale). Ampi popolamenti di* L. obtusa *non sono mai stati osservati durante le indagini subacquee effettuate negli ultimi anni. In quest'area erano presenti comunità bentoniche dominate da alghe brune del genere* Cystoseira. *Gli autori pertanto suppongono che alcuni fattori ambientali siano cambiati e abbiano favorito l'estensione di quest'alga rossa. L'ipotesi per questo fenomeno prende in considerazione la possibilità che l'insediamento dell'alga verde invasiva* Caulerpa cylindracea *nella baia di Zambrattia abbia avuto un impatto negativo sulle associazioni macroalgali autoctone.*

Parole chiave: *Laurencia obtusa,* popolamento monospecifico, baia di Zambrattia, mare Adriatico

INTRODUCTION

The red alga *Laurencia obtusa* (Hudson) J.V. Lamouroux is commonly found in the Adriatic Sea, from the northern to the central and southern part of the basin (Avčin *et al*., 1973, 1974; Matjašič *et al.,* 1975; Giaccone, 1978; Munda, 1979; Vukovič, 1980, Gómez Garreta *et al*., 2001; Antolić *et al.,* 2011; Curiel *et al*., 2012). The species usually grows on rocky substrata moderately exposed to wave actions in the lower mediolittoral belt, and with other photophilous taxa in the association *Cystoseiretum crinitae* Molinier 1958 in the upper infralittoral belt (Giaccone *et al*., 1994). However, it was found also on rocky outcrops in the lower infralittoral and circalittoral belts in the northern Adriatic Sea (Curiel *et al*., 2012).

According to the available literature, *L. obtusa* was never found forming dense and extended monospecific populations in the Adriatic Sea. However, dense stands of *Laurencia* species were reported for the Florida Bay (Zieman *et al.*, 1989) and for the Gulf of Siam in the South China Sea (Latypov, 1986). The aim of the present paper is to report the finding of a dense monospecific population of *L. obtusa* in the Zambratija Bay (northern Adriatic Sea) and to discuss the possible factors that led to this phenomenon.

Fig. 1: The map of the Zambratija Bay with the sites (1 and 2) where a dense monospecific population of *Laurencia obtusa* ***were found.***
Sl. 1: Zemljevid zambratijskega zaliva z označenima lokalitetama (1 in 2), kjer je bila ugotovljena gosta monospecifična populacija vrste *Laurencia obtusa***.**

MATERIAL AND METHODS

The Zambratija Bay is located in the northwestern part of the Istrian peninsula, near Cape Savudrija, in Croatia (Fig. 1). The sea bottom is predominantly rocky, locally mixed sandy-rocky (Sladonja & Banovac-Kuča, 2014). A recent study concerning the reduction of chlorophyll *a* concentrations in a wider area, consistent with the decrease in concentrations of phosphate and ammonia (Solidoro *et al*. 2009; Mozetič *et al*. 2012), underlined the oligotrophication of the whole northern Adriatic basin over the last decade (Mozetič *et al*. 2010).

In September 2016, during a scuba diving survey in the upper-infralittoral belt of the Zambratija Bay, a dense monospecific population of *L. obtusa* were found. The area covered by the species was photographed and filmed. Its extension was measured by the use of satellite imagery (Google Earth) and the GIS program Manifold®.

Fresh samples were taken to the laboratory of the Marine Biology Station (NIB) in Piran and fixed in 4% formaldehyde solution. The species identification was made using a stereomicroscope Olympus SZH-ILLK, and a microscope Olympus BX51, and was in accordance with Falace *et al*. (2013) and Rodríguez-Prieto *et al*. (2013).

RESULTS AND DISCUSSION

In the middle part of the Zambratija Bay, a dense monospecific population of the invasive non-indigenous species *Caulerpa cylindracea* Sonder was found in 2016, but the record is not new, since the Zambratija Bay is currently considered the northernmost site where the establishment of *C. cylindracea* was confirmed earlier (Sladonja & Banovac-Kuča, 2014; Iveša *et al*., 2015). But at two sites, which can be considered the entrance and the exit points of the bay, a dense monospecific population of *L. obtusa* (Fig. 2) were recorded for the first time. The two sites were characterized by carpets of interwoven thalli of this red alga, where holes made by fish species were evident (Fig. 3). In these cavities the presence of blennies was observed, mostly *Parablennius tentacularis* (Brünnich, 1768) and *Parablennius rouxi* (Cocco, 1833). The extension of the area covered by *L. obtusa* was estimated to be about 3215 m^2 at site 1 and 11618 m^2 at site 2 (Fig. 1), in a depth range from 1.0 m to 2.5 m. When thalli of *L. obtusa* were manually lifted from the substrate, thalli of *Halimeda tuna* (J. Ellis & Solander) J.V. Lamouroux were found at the sea bottom. The segments of thalli of this green alga were mostly whitish, which is normal after the release of gametes, when the outer involucres remain light due to the presence of calcium carbonate in cell walls (Lipej *et al*., 2016). However, in this case the whitish colour of thalli could also be related to the overgrowing by *L. obtusa* and the consequent reduction of the light that reaches the green alga.

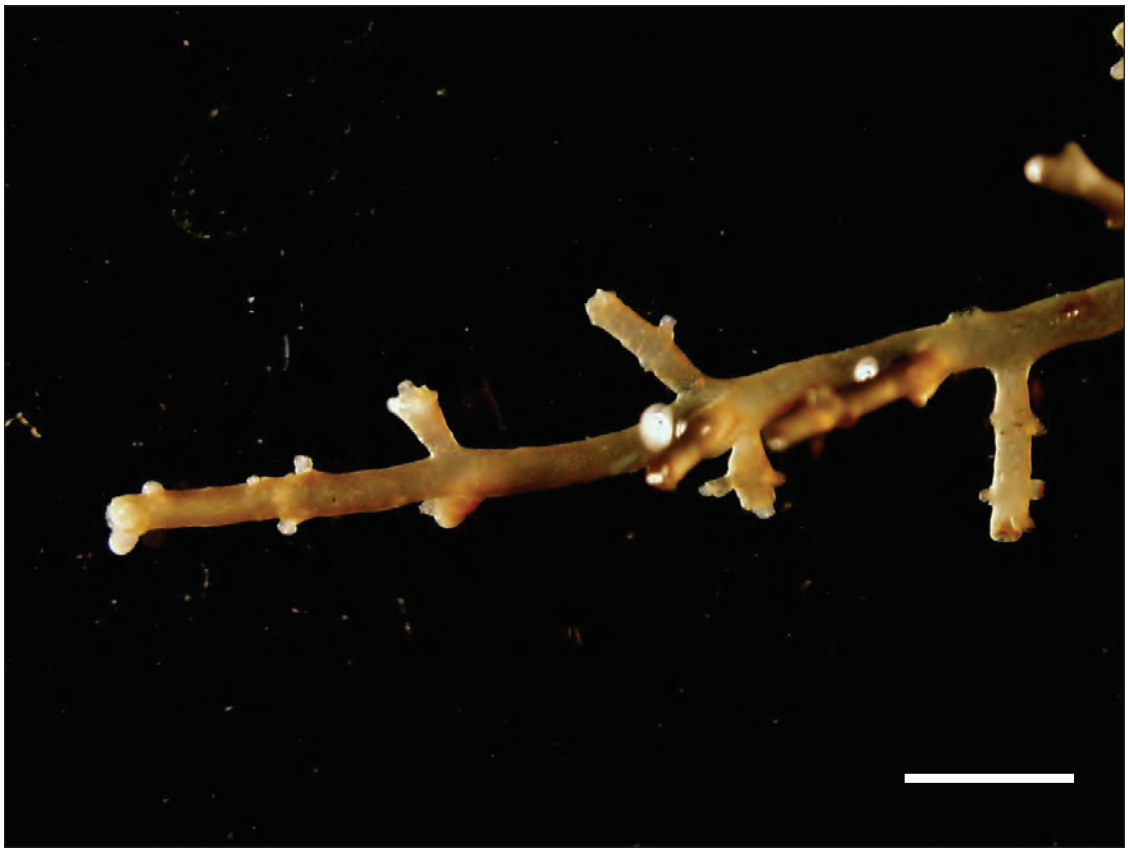

Fig. 2: Details of the apical portion of *Laurencia obtusa;* ***scale bar: 5 mm (photo: Martina Orlando-Bonaca).***
Sl. 2: Podrobnosti apikalnega dela vrste *Laurencia obtusa;* ***velikostna lestvica: 5 mm (foto: Martina Orlando-Bonaca).***

The wide population of *L. obtusa* was never observed during underwater surveys conducted in recent years. In this area, benthic communities dominated by brown algae from the genus *Cystoseira* (mainly *C. compressa* (Esper) Gerloff & Nizamuddin)), *Padina pavonica* (Linnaeus) Thivy, and *H. tuna* were present (*pers. obs.*). Therefore, we assume that some environmental factors have probably changed and have favoured the extension of this red alga. Our hypothesis for this phenomenon takes into account the possibility that the establishment of the invasive green alga *C. cylindracea* in the Zambratija bay has had a negative impact on native macroalgal assemblages, as reported by Bulleri *et al.* (2010). According to Bulleri *et al.* (2016), the species is able to enhance the competitive ability of algal turfs in respect to canopy-forming and encrusting macroalgae, by the alteration of some abiotic factors, like the enhanced trapping of sediments. Therefore, the spreading of *C. cylindracea* in the Zambratija bay, may have led to the disappearance of *Cystoseira* spp. and other canopy forming macroalgae, with the consequent dense growth of the lower vegetation cover. Such significant changes at the community level may have favoured the unusual formation of monospecific stands of *L. obtusa*. Additionally, Bulleri *et al.* (2016) reported that at pristine sites, the prevention of the re-invasion of C. *cylindracea* on experimental cleared plots, had favoured the recovery of canopy-forming and encrusting macroalgae.

However, in order to test this hypothesis, other sites along the Istrian coast, where the establishment of *C. cylindracea* was already confirmed (Sladonja & Banovac-Kuča, 2014; Iveša *et al*., 2015), should also be surveyed in the nearby future. This is needed to verify all the changes in the composition and density of native macroalgal assemblages.

ACKNOWLEDGEMENTS

The authors would like to thank dr. Monica Moras and her students Elisabetta Borlina, Antonio Callegaro, Giacomo Cattaruzza, Elena Del Pup, Anthea Isola, Veronica Mariuz, Stefania Mazzega, Francesco Porracin

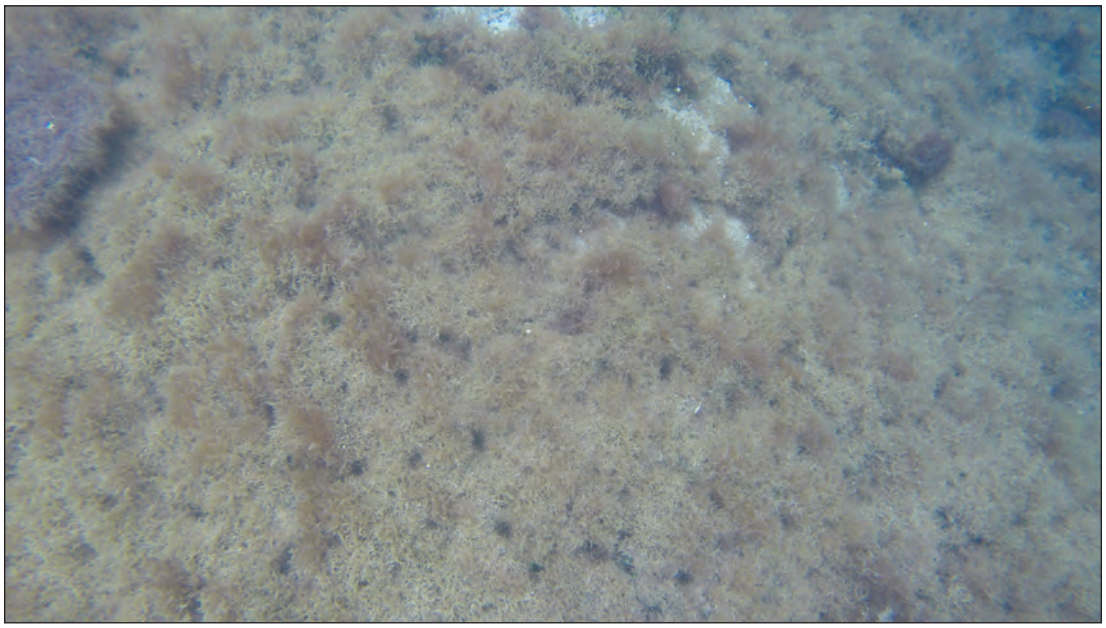

Fig. 3: A dense monospecific population of** Laurencia obtusa **were found in the Zambratija Bay (northern Adriatic Sea) in September 2016. The holes in the carpet of interwoven thalli were made by fish species, mainly blennies (photo: Monica Moras).
Sl. 3: Gosta monospecifična populacija vrste** Laurencia obtusa**, opažena v zambratijskem zalivu (severni Jadran) septembra 2016. Rove v preprogi steljk so naredile ribe, predvsem babice (foto: Monica Moras).

from the Liceo Scientifico Vendramini (Pordenone, Italy) that collaborated in the field work during their summer campus. Special thanks go to Milijan Šiško for the preparation of Figure 1, and to two anonymous reviewers for their suggestions and comments.

The first author acknowledges the financial support from the Slovenian Research Agency (research core funding No. P1-0237).

NENAVADNO RAZŠIRJANJE ALGE *LAURENCIA OBTUSA* (HUDSON) J.V. LAMOUROUX V ZAMBRATIJSKEM ZALIVU (SEVERNI JADRAN)

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POVZETEK

Avtorja poročata o nenavadnem razširjanju rdeče alge Laurencia obtusa *v plitvinah zambratijskega zaliva (severni Jadran). V zadnjih letih nista nikoli imeli priliko opazovati velike populacije te alge. V tem predelu so prevladovale rjave alge iz rodu* Cystoseira. *Avtorja domnevata, da so spremembe v okoljskih dejavnikih verjetno spodbudile razširjanje te rdeče alge. Ta hipoteza vključuje možnost, da je do tega pojava prišlo zaradi naselitve invazivne zelene alge* Caulerpa cylindracea *v zambratijskem zalivu, ki je imela negativen vpliv na samoniklo skupnost makroalg.*

Ključne besede: *Laurencia obtusa,* monospecifična populacija, zambratijski zaliv, Jadransko morje

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original scientific article
received: 2017-02-16

DOI 10.19233/ASHN.2017.02

DITTRICHIA GRAVEOLENS – HOW DOES SOIL SALINITY DETERMINE DISTRIBUTION, MORPHOLOGY, AND REPRODUCTIVE POTENTIAL?

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ABSTRACT

Road salting in winter, which improves the safety of road travel, has a strong impact on species inhabiting road verges, since it creates habitats with increased salinity. Higher levels of soil salinity represent a habitat that can be occupied by plants exhibiting special adaptations and tolerance. As a result, Dittrichia graveolens*, which is indigenous in the Mediterranean area, is moving inland and can be found in several Central European countries. We studied how soil salinity determines the* D. graveolens *plant height, reproductive potential and distribution along the road verge. Plant height was related to soil electrical conductivity (EC) – a measure for salinity. Our results show that the species grows best in soils where the EC ranges from 110 to 170* µS/cm*, while at values less than 100* µS/cm*, no plants were observed.*

Key words: invasive species, road verges, road salting, Slovenia

DITTRICHIA GRAVEOLENS – COME LA SALINITÀ DEL SUOLO DETERMINA DISTRIBUZIONE, MORFOLOGIA E POTENZIALITÀ RIPRODUTTIVA DELLA SPECIE?

SINTESI

La salatura delle strade in inverno, che migliora la sicurezza dei viaggi, ha un forte impatto sulle specie che vivono sui bordi stradali, in quanto crea habitat con salinità elevata. I livelli più alti di salinità del suolo caratterizzano un habitat che può essere occupato da piante che presentano adattamenti e tolleranze speciali. Di conseguenza, Dittrichia graveolens*, pianta indigena nell'area mediterranea, si sta muovendo verso l'interno e può essere trovata in diversi paesi dell'Europa centrale. Gli autori hanno studiato come la salinità del suolo determina l'altezza della pianta di* D. graveolens*, il potenziale riproduttivo e la distribuzione lungo il bordo stradale. L'altezza della pianta è legata alla conduttività elettrica del suolo (CE) – una misura per la salinità. I risultati mostrano che la specie cresce meglio su terreni in cui la CE varia da 110 a 170 µS/cm, mentre dove i valori sono inferiori a 100 µS/cm non sono state osservate piante.*

Parole chiave: specie invasiva, bordi stradali, salatura delle strade, Slovenia

INTRODUCTION

The introductions of the majority of naturalized alien plants to Europe has happened since 1750 (Williamson *et al.*, 2009) and has resulted in the establishment of more than 3700 species, while the current invasion rate is estimated at 6.2 new species per year (Lambdon *et al.*, 2008). These species belong to more than 200 plant families, among which Asteraceae, Poaceae, Rosaceae and Brassicaceae are predominant (*Pyšek et al.*, 2009). These are large families with many species representatives known to be weeds. Approximately one half of naturalized alien plants in Europe are alien plants from another continent (e.g. North and South America, Asia), while the other half is represented by species from another part of Europe, where the plants are native. Many of common agricultural weeds invasive in Europe are also native to the Mediterranean (Pyšek *et al.*, 2009).

There are numerous routes and vectors for alien species introduction; however, we focus here on highways, which represent an opportunity for introduction into a new region and at the same time promote further dispersal with the help of vehicular transportation along road corridors (*Pollnac et al.*, 2012 and references therein). In Central Europe several invasive species are known as "Autobahn-Pflanzen", among them *Dittrichia graveolens* (L.) Greuter (syn. *Inula graveolens* (L.) Desf.), *Senecio inaequidens* DC. and *Atriplex micrantha* Ledeb. – examples of alien plant species which are able to spread rapidly along roads (Heger & Böhmer, 2006). Even though highways are highly disturbed, stressful, and fragmenting structures in the human-dominated landscape, their maintenance results in the creation of road verges – often dry, sunny, nutrient-poor and gravel-like habitats, which are dominated by environmental conditions different from most natural habitats in their vicinity. Additionally, human activities can impact road verges in such way that they represent a new, artificial habitat, one not previously existing. They exhibit altered physical and chemical soil characteristics; for example, texture, compaction, water content, leakage of deicing chemicals causing salinity, nitrogen deposition and pollution (Thompson *et al.*, 1986; Cale & Hobbs, 1991; Truscott *et al.*, 2005). Additionally, they represent highly disturbed habitats for plants because of repeated disturbance from maintenance like mowing, shrub clearing or herbicide application (Gelbard & Belnap, 2003). The use of deicing chemicals has a profound impact on road verge habitats, since it can cause soil salinity and saline spray, directly impacting standing vegetation. Therefore, such habitats can be occupied by plants exhibiting special adaptations or tolerance, among which maritime species are particularly successful (Scott & Davison, 1982). Invasions have been reported for *Spergularia media* and *S. marina* (Kocián, 2015b), *Atriplex micrantha* (Smettan, 2002), the grasses *Puccinellia distans*, *P. maritima*, *P. fasciculata*, *Aster tripolium*, *Plantago maritima* and *P. coronopus* (Scott & Davison, 1982) and many more.

Additionally, such habitats are less likely to be dominated by numerous native plants. The combination of a high variety of non-native seeds transported along roads and the presence of road verge habitats sparsely occupied by native species makes road verges into opportunity habitats for alien plants.

We were therefore interested in the occurrence of a plant of southern origin, annual species *Dittrichia graveolens*, which has been spreading along Slovenian highways. It is distributed across the central part of the country where there is a harsher climate, while it does not occur in the coastal region of Slovenia (Frajman & Kaligarič, 2009), where a closely related perennial, *D. viscosa*, can be found native to Istria (Wraber, 1999; Jogan *et al.*, 2001). We hypothesized that *D. graveolens* is not a particularly good competitor, and therefore not present in the sub-Mediterranean region, while at the same time it is tolerant of higher concentrations of salinity, which enables its establishment further north because of winter road maintenance with deicers.

MATERIAL AND METHODS

Study species

Dittrichia graveolens is an annual herbaceous plant in the family Asteraceae. It reaches heights of 10 to 50 cm (own observation). Leaves and stem, as well as the capitulum involucre are densely glandular and hairy. Yellow flowers are female if lingulate and hermaphrodite if tubular (Brullo & de Marco, 2000). In Central Europe the flowering occurs from September to October (Kocián, 2015a). Achenes are 1.8-2 mm long, with a 4 mm pappus (Brullo & de Marco, 2000). It is native to the Mediterranean basin and partly to the Western Atlantic coast and the Middle East (Brullo & de Marco, 2000). It has invaded other European regions and regions of the world with similar climates, including California, Australia and New Zealand (Preston, 2006). In Slovenia it was first observed in 2008 along Highways A1 from Šentilj to Koper and A2 from Karavanke tunnel to Obrežje, with its densest stands on the A1 between Ljubljana and Blagovica, and between Vransko and Slovenske Konjice (Frajman & Kaligarič, 2009). It grows on road verges as well as in the central reserve.

Substrate sampling and salinity measurements

At the end of September and the beginning of October in 2009, we selected parts of Highway A1 (connecting Šentilj and Koper, passing Maribor, Ljubljana) for the collection of plants and substrate samples. The road has two lanes in each direction and a central reserve overgrown by taller vegetation. The first site was located 1 km from the highway service area at Lukovica in the

Fig. 1: Increasing height of** Dittrichia graveolens **individuals away from the road margin at the Lukovica site.
Sl. 1: Višina osebkov vrste** Dittrichia graveolens **narašča z oddaljenostjo od cestnega roba na lokaciji Lukovica.

direction of Trojane. A dense stand of *D. graveolens* plants extended for several kilometers along the entire road verge. The second site was located at the Ravne service area near Kozina. No continuous stands were observed there. Individuals of *D. graveolens* were found in smaller, discrete groups, only occasionally in dense stands along shorter road segments.

Substrate samples were collected directly at the road margin to a maximum of 50 cm away, as the closest sample to the road, and then at distances 100 cm, 120 cm, and 200 cm perpendicularly to the road margin. In this direction, a prominent gradient in plant height was observed (Fig. 1). At both locations, soil samples were collected from plots where *D. graveolens* was present. We collected 1 kg of substrate sample on each site for salinity analysis. For the two control samples, we collected the substrate at Kozina from sites where no *D. graveolens* individuals were sighted.

Samples were sieved to remove larger stones, mixed with deionized water in a ratio of 1:9 and shaken for 1 h. The conductivity of the prepared solution was measured by a portable conductometer MA 5950 (Metrel, Slovenia) at room temperature (20 °C) after the solution had been allowed to settle for 30 min. Conductivity readings were corrected regarding the temperature at which they were taken, if necessary.

For comparison of substrate salinity along the distance away from the road, a Welch-ANOVA was used to test for significant differences, since the results yielded heterogeneous variances according to Levene's test.

Reproductive potential of *D. graveolens*

In evaluating the reproductive potential of *D. graveolens* plants, we recognized three categories of plant height: 1 – from 5 to 15 cm; 2 – from 16 to 25 cm; 3 – larger than 25 cm. The potential reproductive success of *D. graveolens* plants was estimated by counting the number of flower heads per plant in each category. Average seed (achene) number per single flower head was estimated after counting seeds for 50 randomly selected flower heads for each height category, which were collected in Lukovica. The data obtained were used for calculating the total seed number for an individual plant.

RESULTS

Observation on sites with *D. graveolens* stands showed that plant height and plant density increase with distance from the road margin. Differences were also observed in the abundance of *D. graveolens* plants between the Lukovica and Kozina locations. Additionally, as expected, those sites without *D. graveolens* in Kozina showed the lowest salinity values.

The salinity of the substrate at Lukovica changed significantly within the 2 m distance next to the road (Welch ANOVA at $p>0.05$; Fig. 2), because of lower salinity figures at a distance of 1 m. However, if we exclude those measurements within 50 cm of the road, an increase in salinity was observed from 1 m to 2 m away from the road margin – in the same direction as plant size increased. Up to 50 cm away, individual plants were 5 to 15 cm tall; from 1 to 1.5 m distance from the road, plants reached 10 to 30 cm of height,

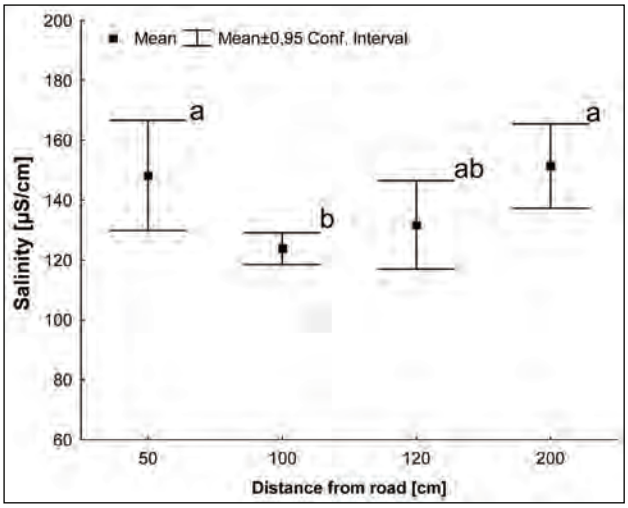

Fig. 2: Mean salinity values of the substrate away from the road margin were significantly different within the 2 m distance (Welch ANOVA, $p<0.05$) at the Lukovica location. Different letters indicate significantly different means.
Sl. 2: Srednje vrednosti slanosti substrata so se statistično značilno (Welcheva ANOVA, $p<0,05$) razlikovale z oddaljenostjo od cestnega roba znotraj razdalje 2 m na lokaciji Lukovica. Različne črke označujejo statistično značilno različne srednje vrednosti.

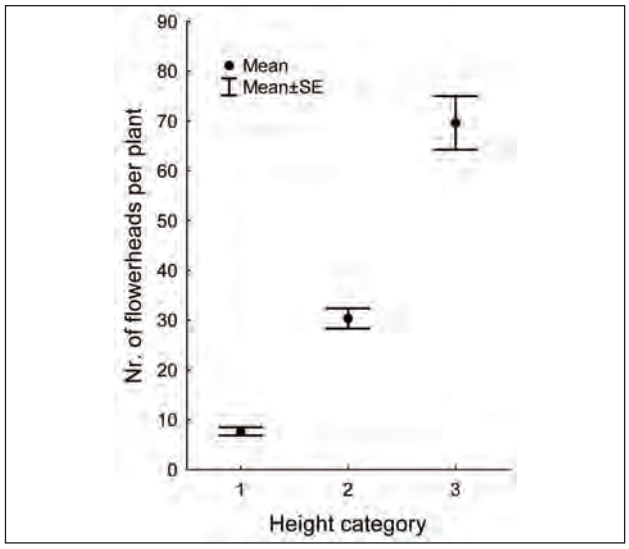

Fig. 3: Reproductive potential of** D. graveolens **plants, collected in Lukovica, from different height categories (1: 5–15 cm; 2: 16–25 cm; 3: >25 cm) measured through the number of flower heads per single plant.
Sl. 3: Reproduktivni potencial** D. graveolens **na lokaciji Lukovica izmerjen kot število koškov na posamezno rastlino, ki so pripadale trem velikostnim razredom (1: 5–15 cm; 2: 16–25 cm; 3: >25 cm).

and more than 2 m away, some individuals were taller than 40 cm. Plants grew in soils with salinity from 110 to 237 µS/cm at both locations. Average soil salinity on two sites in Kozina without *D. graveolens* plants was 97 and 82 µS/cm.

Dittrichia graveolens plants showed high reproductive potential, which increased with the plant's height and differed significantly among height categories (Welch ANOVA, $p<0.05$; Fig. 3). The average number of seeds (achenes) in a single flower head was 30 seeds, and it showed low variability among individuals of different size. According to that, estimated seed production of plants was about 90 seeds per plant in the first and 4380 seeds per plant in the third height category. In relation to distance to the road margin, in its near proximity plants produced on average 500 seeds; however, even at 1 m distance we found plants exhibiting high reproductive potential with more than 2000 seeds per plant.

DISCUSSION

Deicing chemicals, which help to improve road safety, are regularly used on Highway A1 during winter. However, we expected that on road segments toward the south of the country deicing salts would be less frequently used because of the rarer incidence of snowfall and freezing conditions. Even though the sampling was rather simple, our results indicate that the occurrence of *D. graveolens* might be connected to increased soil salinity values. Less densely developed and not continuously occurring *D. graveolens* stands were observed in the southern part of this motorway. On all the sites with *D. graveolens* plants, salinity was higher, while at values below 100 µS/cm, no plants were observed. *Dittrichia graveolens*, besides being halotolerant for soil salinity, has an additional competitive advantage over native plants: it is an annual species, surviving winter as seeds that can avoid the direct negative impact of saline spray, which perennial native species would have to endure.

Additionally, the salinity gradient measured at the road verge corresponds with previous similar reports, showing a sharp decline in soil salinity over the first 2 m distance from salted roads (Thompson *et al.*, 1986). Our results show that the saline opportunity habitat for *D. graveolens* is located only on a narrow strip 1 m or less from the road, up to the distance where the decline in salinity enables the native, more competitive species to begin to dominate the habitat. The rarer occurrence of *D. graveolens* in the southern part of the highway, which lies in a region with a sub-Mediterranean climate, suggests that the establishment of *D. graveolens* in less saline soil is limited because the species is a weak competitor compared to native sub-Mediterranean species and not because of unsuitable climatic conditions. This is furthermore underpinned by numerous records of *D. graveolens* along the roads in those Central European countries (Kocián, 2015a) that have a rather cold climate.

Our results also show that plants 1 m from the road were already 30 cm high, and these were the plants showing the highest seed production. Our previous studies on *Aster squamatus*, we stressed that one characteristic that can be key for successful invasion of alien invasive Asteraceae, especially if they can become established in less productive habitats (including saline or semi-saline habitats), is the late onset of flowering

Fig. 4: Dry fruiting** Dittrichia graveolens **plants at the Kozina location on 25th October 2009.
Sl. 4: Posušene plodeče rastline** D. graveolens **opazovane 25. oktobra 2009 na lokaciji Kozina.

(Šajna *et al.*, 2014; Šajna 2016). *Dittrichia graveolens* starts to flower in September, and flowering lasts until October (Kocián, 2015a).

We observed several dried fruiting plants at full height (Fig. 4). This is an indication that fully developed plants, able to produce seeds, are rarely impacted by mowing during road verge maintenance because mowing happens too early and because larger plants grow in the depression of the road verge, away from the road margin. Location by the road represents immediate potential for seed dispersal via the slipstream of passing vehicles (von der Lippe *et al.*, 2013), while the road corridor functions as a route of secondary dispersal. Such dispersal via traffic, enabling very rapid and often unnoticed invasions, has been recorded for many invasive plant species (von der Lippe & Kowarik, 2007).

ACKNOWLEDGMENTS

We thank two anonymous reviewers for their helpful comments and corrections, which improved the previous version of the manuscript. M. Kaligarič acknowledges the support of the P1-0164 grant, funded by the Slovenian Research Agency.

DITTRICHIA GRAVEOLENS – KAKO SLANOST TAL DOLOČA NJENO RAZŠIRJENOST, MORFOLOGIJO IN REPRODUKTIVNI POTENCIAL?

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POVZETEK

Soljenje cest pozimi pripomore k varnosti prometa, a ima močan vpliv na vrste, ki poseljujejo cestne robove. Ustvarja rastišča s slanimi tlemi, ki jih lahko poselijo rastline s posebnimi prilagoditvami in toleranco na slanost. Tak primer je avtohtona mediteranska vrsta Dittrichia graveolens*, ki se ob cestnih robovih seli v osrednjo Evropo in jo najdemo že v mnogih državah. Proučevali smo, kako slanost tal določa višino rastlin* D. graveolens*, njihov reproduktivni potencial in razširjenost ob cestnem robu. Višina rastlin je bila odvisna od električne prevodnosti (EC) tal – merilo za slanost. Naši rezultati kažejo, da vrsta najbolje uspeva v tleh z vrednostmi EC med 110 in 170* µ*S/cm, medtem ko je pri vrednostih pod 100* µ*S/cm nismo opazili. Uspeli smo identificirati tri velikostne razrede, ki se razlikujejo v reproduktivnem potencialu.*

Ključne besede: invazivna vrsta, cestni rob, soljenje cest, Slovenija

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saggio scientifico di rassegna critica di letteratura
ricevuto: 2017-01-10

DOI 10.19233/ASHN.2017.03

LE ORCHIDACEAE DEL MOLISE: AGGIORNAMENTO SISTEMATICO E NUOVA CHECK-LIST

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SINTESI

Il Molise, con una superficie di 4438 kmq, si trova sul versante adriatico della penisola italiana al confine con Abruzzo, Campania, Lazio e Puglia. La regione è molto ricca di specie vegetali. Infatti, alla fine del 2010 i taxa di piante vascolari conosciuti erano 2440. Le ricerche floristiche successive hanno portato ad altri ritrovamenti che hanno ulteriormente arricchito la flora regionale. Alla composizione del patrimonio floristico concorrono anche le Orchidaceae. A causa delle recenti revisioni tassonomiche e delle nuove entità segnalate e/o descritte è necessario riconsiderare i numeri della loro presenza nel territorio regionale. Di conseguenza il presente lavoro è finalizzato alla compilazione di una check-list di tutte le specie, sottospecie e ibridi appartenenti a tale famiglia. In alcuni casi si discute lo status tassonomico di singole specie. Inoltre è stata fatta l'analisi corologica che evidenzia la prevalenza dell'elemento Mediterraneo.

Parole chiave: Molise, Orchidaceae, check-list regionale, elementi floristici

THE ORCHID FLORA OF MOLISE: NEW SYSTEMATIC UPDATE AND CHECKLIST

ABSTRACT

Molise is a small region of 4,438 sq.km, located between Central and Southern Italy on the Adriatic side of the peninsula, bordering the regions of Abruzzo, Campania, Latium and Apulia. It is very rich in plant species; in fact, at the end of 2010, the number of vascular plant taxa identified in the area was 2,440. Subsequent floristic research led to discoveries which further expanded the database of regional flora. The compilation of the floral heritage also included the Orchidaceae. Due to recent taxonomic revisions and new entities marked and/or described, it is necessary to revise the records of their presence in the region. Accordingly, this work is aimed at compiling a checklist of all species, subspecies and hybrids belonging to that family found in the Molise region. It also discusses the taxonomic status of several individual species and provides a chorological analysis that highlights the prevalence of the Mediterranean element.

Key words: Molise, Orchidaceae, regional check-list, floristic contingents

INTRODUZIONE

Il Molise è situato nell'Italia centro-meridionale, si estende tra la dorsale appenninica e il mare Adriatico e comprende 136 Comuni ripartiti in due Province: Campobasso e Isernia. Con la superficie di circa 4438 kmq, dopo la Valle d'Aosta, è la più piccola regione italiana. Sino al 1963 costituiva un'unica regione insieme all'Abruzzo e in epoca preunitaria vi s'includevano diverse parti che ora appartengono alla Campania. I suoi confini attuali sono costituiti dall'Abruzzo, il Lazio, la Campania, la Puglia e il Mare Adriatico.

Il territorio molisano si sviluppa all'interno di un range altitudinale che va dal livello del mare sino a quote di oltre 2000 metri poste sul crinale del complesso Monti della Meta-Mainarde e sul massiccio del Matese. In particolare: il 45,3 % del territorio ricade in ambiti montuosi, le aree collinari occupano il 31,7 % e quelle pianeggianti il 23 %.

La zona montuosa è costituita da vari rilievi tra cui i più importanti sono: i monti della Meta (2241 m) incluse le Mainarde (2039 m) posti al confine tra Abruzzo e Lazio, il Matese (Monte Miletto 2050 m) che segna il confine con la Campania e i monti Frentani che degradano dolcemente verso il mare con colline poco ripide e dalle forme arrotondate. Le aree pianeggianti, a loro volta si trovano lungo la fascia costiera, nella parte centrale (piana di Boiano) e a occidente (piana di Venafro). Il resto è compreso nell'area collinare.

È consuetudine suddividere la regione in Alto Molise con vari gruppi montuosi che rappresentano la prosecuzione dell'Appennino abruzzese e Basso Molise collinare e costiero. La linea di separazione tra i due ambiti è costituita dall'isoieta di 1000 mm (Fondi 1970).

Nonostante la limitata estensione, il territorio molisano è caratterizzato da un'elevata diversità geologica che si rispecchia nei suoi caratteri fisiografici e paesaggistici. Dal punto di vista litologico, invece, è costituito da sedimenti d'origine marina antichi cui si sovrappongono depositi continentali più recenti: arenarie, argille, conglomerati, gessi, marne, rocce calcaree, depositi fluviali clastici, affioramenti evaporitici, detriti di falda, formazioni miste argilloso-arenacee e calcareo-marnose, etc.

I principali e più importanti fiumi che attraversano la Regione sono: il Sangro (120 km), il Trigno (83 km) il Biferno (120 km), il Fortore (98 km) che sfociano tutti nell'Adriatico e il Volturno (160 km) che nasce in Molise e poi prosegue in Campania per sfociare nel Tirreno. Tranne il Biferno, tutti gli altri fiumi scorrono in Molise solo per brevi tratti. Essi sono alimentati da vari affluenti dal corso più breve e dal regime torrentizio: il Vandra, il Verrino, il Callora e altri.

Il clima regionale man mano si procede dal livello del mare verso l'interno presenta molte varietà e tipologie in base ai valori che assumono i parametri termopluviometrici. Infatti, ha caratteri di mediterraneità lungo la fascia costiera e di continentalità più o meno accentuate in corrispondenza dei rilievi montuosi. Secondo Paura & Abbate (1993) esso è condizionato:

- dall'Adriatico che, essendo un mare chiuso e poco profondo, determina condizioni di ridotta marittimità;
- dalla catena appenninica che limita il transito delle correnti caldo-umide provenienti da sud-ovest;
- dall'esposizione alle correnti fredde provenienti da nord e nord-est.

Le precipitazioni seguono un gradiente crescente procedendo dalla costa al massiccio del Matese e vanno da oltre 670 mm annui di Termoli posto sul litorale Adriatico a 1900 mm di Roccamandolfi (Ferro *et al.,* 1997). Nella valle del Volturno la piovosità supera quella della costa adriatica e si mantiene sempre oltre 1000 mm annui.

La temperatura media annua varia da ca. 8 °C a 16 °C; la media dei valori minimi del mese più freddo (gennaio) va da ca. -2 °C (Capracotta, 1450 m) a oltre 5 °C (Termoli) mentre la media dei valori massimi del mese più caldo (luglio-agosto) è compresa tra 11 °C e 25 °C. Secondo Lucchese (1995) sul massiccio del Matese per circa sei mesi la temperatura media è inferiore a 10 °C. Ferro *et al.* (1997) facendo riferimento all'isoterma media di 10 °C che va da Boiano a Capracotta, suddividono la regione in due settori situati a est e ovest della stessa che presentano entrambi un incremento di valori di temperature medie annue: la fascia costiera adriatica e la valle del Volturno.

La variabilità geomorfologica e litologica dei suoli, l'esposizione dei versanti, le diverse tipologie climatiche, la bassa densità di popolazione, diversi aspetti di natura antropica e altri fattori locali di dettaglio contribuiscono alla formazione di ambienti fisici molto diversi che accentuano la ricchezza floristica e la complessità fitocenotica.

A causa della posizione centrale nella penisola e della varietà dei suoi habitat nel Molise si osserva:

- la presenza di associazioni vegetali tipiche dell'Italia centro-settentrionale e dell'Italia centro-meridionale.
- la penetrazione di contingenti floristici di diversa origine geografica: asiatico-orientali, nordici, est-europei, sud-est e ovest-mediterranei.

Nella Regione sono presenti:

- 132 specie anfiadriatiche o appennino-balcaniche (Pezzetta 2010) che evidenziano le migrazioni floristiche avvenute in passato e le affinità floro-vegetazionali esistenti tra le opposte sponde dell'Adriatico;
- 222 specie di origine occidentale (mediterraneo-atlantici, ovest-mediterranei, ovest-europei, mediterraneo-macaronesici, etc.) che a loro volta testimoniano antichi flussi migratori avvenuti in direzione orientale nel corso di diverse ere

geologiche dai territori emersi del Bacino del Mediterraneo e dell'Europa occidentale (Pezzetta 2015a).

Inoltre, come ha evidenziato Lucchese (1995), nel Molise:

- a causa della posizione di regione di transizione tra il versante tirrenico e quello adriatico, varie specie d'origine mediterranea hanno una distribuzione bipolare e sono localizzate oltre che lungo il litorale adriatico anche nella valle del Volturno;
- diverse entità mediterranee raggiungono il limite settentrionale di distribuzione geografica;
- alcune entità nordiche e subalpine raggiungono il limite meridionale del loro areale italiano;
- alcuni taxa dal Gargano e dalla Daunia risalgono verso l'interno della regione;
- altri taxa diffusi lungo la costa tirrenica vi trovano il loro limite interno peninsulare.

Dal punto di vista biogeografico, secondo Giacomini e Fenaroli (1958) il Molise rappresenta un ambito di passaggio tra la Regione Mediterranea e quella Medioeuropea, mentre Biondi & Baldoni (1991) fanno presente che la separazione tra le due regioni biogeografiche avviene lungo la valle del Volturno, il Matese e il Bacino del Biferno.

In base alle diverse tipologie floristiche esistenti, il territorio molisano si può ripartire in tre zone: la fascia costiera e delle colline litoranee, la zona delle valli interne fino alle medie altitudini e la zona montuosa.

La fascia costiera, bassa e sabbiosa è lunga circa 35 km e comprende: piccole pianure alluvionali, cordoni dunali e brevi tratti di costa alta localizzati presso Termoli**.** Essa presenta alcuni tratti poco antropizzati che dal punto di vista vegetale sono caratterizzati da cenosi prative, macchie dunali, garighe, vegetazione alofila, pinete litoranee e comunità dulci-acquicole, aline e psammofile site presso la foce dei fiumi (Stanisci *et al.,* 2007).

Negli ambiti delle colline interne in cui non sono presenti campi coltivati e aree urbanizzate, sino all'altitudine di 1200-1300 m, si rinvengono querceti misti caducifogli, radure erbose, prati-pascolo spesso ricchi di orchidee, ambienti di gariga e macchia mediterranea. Sui versanti argillosi soggetti a frane o modellati a calanchi, si sviluppa una tipica vegetazione xerofila costituita da graminacee, piccole piante legnose ed erbacee adattate a sopravvivere in tale ambito inospitale.

Tra i 1300 e i 1500 m d'altitudine sono diffusi boschi misti con faggio (*Fagus sylvatica*), abete bianco (*Abies alba*), varie specie di aceri e altre essenze arboree e, boschi puri di abete bianco tra cui i più interessanti sono quelli di Agnone, del Monte Campo e di Pescopennataro (Bosco degli Abeti Soprani).

In vari ambiti montani che potenzialmente dovrebbero essere occupati dalle faggete, l'azione antropica esercitata con il taglio degli alberi e il pascolo, ha favorito la sostituzione della vegetazione arborea con prati-pascolo secondari di vario tipo talvolta ricchi di orchidee (Fantinato *et al.,* 2016a, 2016b). Inoltre sono caratterizzati da rupi e ghiaioni popolati da una flora specializzata ove si registra la presenza di molte specie endemiche e rare.

Le formazioni forestali della regione occupano circa 71.000 ettari corrispondenti a circa il 16% del territorio. Di questi circa 52.000 si trovano nelle aree montuose e circa 19.000 in ambiti collinari. Il resto è occupato da campi coltivati, terreni incolti e/o abbandonati, aree antropizzate e prati-pascolo.

Le ricerche floristiche sulle Orchidaceae del Molise

Nel territorio molisano le prime sporadiche notizie riguardanti i ritrovamenti di piante sono d'epoca prelinneana e risalgono a Fabio Colonna, un botanico napoletano che operò tra la fine del XVI e gli inizi del XVII secolo. Tuttavia le prime citazioni e pubblicazioni di una certa importanza riguardanti la vegetazione forestale e/o le ricerche floristiche risalgono agli inizi del XIX secolo con Pepe (1809, 1834, 1844), Scarano (1811, 1812), Gussone (1826) e Tenore (1827, 1831-42, 1832, 1834). Poi proseguirono con Tenore & Gussone (1835, 1842a, 1842b), Terracciano (1872,1873, 1874, 1878, 1890), Jatta (1876), Falqui (1899) e Fiori (1899).

Agli inizi del XX secolo operò Villani (1906, 1908, 1910) e negli anni successivi le ricerche floristiche registrarono un incremento. Tali studi si limitano a piccoli settori e piccole località ben delimitate poiché sino al 1963 il Molise e l'Abruzzo costituivano una regione unica e per questo motivo non è stato mai analizzato nel suo complesso, né ha stimolato le ricerche volte alla sua conoscenza autonoma. Anche Pignatti (1982) nella sua flora d'Italia riuniva le due regioni e non forniva indicazioni precise riguardanti la presenza o meno delle specie nell'una e/o nell'altra. Per avere una prima e completa check-list della flora molisana bisogna arrivare al 1995 quando Lucchese pubblicò il saggio "Un elenco preliminare della flora spontanea del Molise" in cui segnalava la presenza di 2422 taxa. In seguito Conti *et al.* (2005) segnalavano 2412 taxa e Peruzzi (2010) tenendo conto dei nuovi ritrovamenti fa presente che è composta da 2440 taxa corrispondenti a circa il 28% della flora italiana. Le nuove ricerche favorite anche dal fatto che nella Regione è stata istituita una facoltà universitaria di scienze, hanno portato a nuovi ritrovamenti e ora si suppone che la flora regionale possa essere composta da oltre 2550 entità di piante vascolari.

Per quanto riguarda le Orchidaceae presenti, diverse citazioni di ritrovamenti si trovano in alcuni scritti prima citati ma sino a qualche decennio fa, al pari di tutte le altre famiglie, le conoscenze complessive riguardanti il patrimonio regionale erano praticamente sconosciute. E' sempre Lucchese (1995) a fornire la prima indicazione segnalando la presenza di 63 specie e un ibrido. In se-

guito Rossi (2002) riporta per la Regione 57 taxa, mentre Conti *et al*. (2005) ne riportano 61. Altri studi e ricerche successive hanno arricchito il patrimonio orchidologico e contribuito a definire in modo più dettagliato sia la consistenza numerica sia la distribuzione dei singoli taxa. Tra coloro che hanno dato un nuovo impulso alle ricerche, vanno citati: Michele Marinelli che ha operato all'interno dell'Oasi naturalistica di Guardiaregia-Campochiaro, il Centro Studi Alto Vastese, che ha organizzato escursioni botaniche in alcuni ambienti molisani della valle del Trigno, Romolini & Soca (2011, 2012, 2014) che hanno anche descritto un nuovo ibrido dedicandolo a Capracotta, Delforge (2015) che ha descritto una nuova specie dedicandola alla Regione, Pezzetta (2015b) che nel suo saggio monografico ha riportato 78 entità tra specie e sottospecie e sedici ibridi, Souche (2008), Tandè (2012) ed altri appassionati e studiosi anche stranieri citati in bibliografia che hanno trovato nel territorio molisano un ambito ideale per osservare quanto già esistente e/o scoprire e descrivere qualche nuovo taxon.

Nel recente volume curato dal GIROS (2016) si ammette la presenza nel Molise di 69 taxa di Orchidacee mentre altri segnalati in precedenza sono considerati assenti. In generale negli studi recenti si osserva che la presenza di certi taxa da alcuni è confermata mentre altri la escludono. Alla luce dei nuovi ritrovamenti e dei pareri discordanti sulla presenza o meno e/o lo status tassonomico da attribuire alle varie entità, si rende opportuno compilare un nuovo elenco facendo notare quali possono essere considerate effettivamente presenti, discutibili e/o dubbie.

MATERIALI E METODI

L'elenco floristico è stato realizzato tenendo conto dei dati ricavati da: la ricerca bibliografica, alcuni siti informatici, le segnalazioni inedite di vari studiosi e le ricerche sul campo dell'autore. Esso comprende le specie, le sottospecie e gli ibridi, mentre non sono prese in considerazione le varietà cromatiche e morfologiche.

Alla luce delle nuove scoperte, descrizioni di taxa e recenti revisioni tassonomiche, vanno escluse dalla flora molisana *Ophrys fusca* Link subsp. *fusca*, *Ophrys fusca* subsp. *iricolor* (Desf.) O. Schwarz (*Ophrys iricolor* Desf.), *O. holosericea* (Burm. fil.) Greuter subsp. *holosericea*, *Ophrys lutea* subsp. *minor* (Tod.) O. Danesch & E. Danesch e *Ophrys illyrica* S. Hertel & K. Hertel. Di conseguenza tutte le loro segnalazioni storiche o non sono state considerate o quando possibile sono state assegnate a taxa affini.

Per la nomenclatura si sono seguite le indicazioni riportate nel volume "Orchidee d'Italia" (GIROS 2016). Per l'assegnazione dei tipi corologici, si è tenuto conto di quanto riportato in Pignatti (1982), Pezzetta (2011), Delforge (2016) e GIROS (2016).

Per la consultazione del materiale bibliografico si è ritenuto opportuno tener conto dei lavori sulla flora molisana pubblicati dopo il 1985 e di tutte le opere a carattere generale che riportano segnalazioni di *Orchidaceae* successive a tale anno.

RISULTATI E DISCUSSIONE

Elenco floristico

Nell'elenco sotto riportato le lettere maiuscole indicano gli autori delle segnalazioni e hanno il seguente significato:

AH: Steffan & Steffan (1985); AX: Bianchini (1987); AY: Canullo *et al*. (1988); AZ: Conti *et al*. (1989); BX: Hoffmann (1989); BY: Biondi *et al*. (1992); BZ: Paura & Abbate (1993); CX: Conti (1995); CY: Lucchese (1995); DH: Daiss & Daiss (1996); DX: Meo & Damiano (1997); DY: Hennecke & Hennecke (1999); DZ: Pirone *et al*. (2000); EX: Abbate & Giovi (2002); EY: Rossi (2002); FX: Blasi *et al*. (2005); FY: Conti *et al*. (2005); GX: Viscosi *et al*. (2007); GY: Allegrezza & Biondi (2008); GZ: Ciaschetti (2008); HH: Faurholdt (2009); HX: Gianicola *et al*. (2009); HY: Hertel & Presser (2009); LX: Gransinigh & Buono (2010); LY: Griebl (2010); LY: Romolini & Soca (2011); LZ: Taffetani (2011); MH: Bruno (2012); MM: Palermo (2012); MX: Romolini & Souche (2012); MY: Tandé (2012); NH: Carli (2013); NX: Romolini & Soca (2014): NY: Conti & Bartolucci (2015); NZ: Delforge (2015); OX: Pezzetta (2015b); OY: GIROS (2016); PX: Serafini Ivan (*comunicazione personale*); PY: Marinelli (*comunicazione personale*); PZ: Muller (*comunicazione personale*); RX: Oasi Guardiaregia-Campochiaro (2016); RY: Souche (*comunicazione personale*); RZ: Meo e Damiano (*comunicazione personale*); SX: Tandè (*comunicazione personale*); SY: Molise alberi (2017).

1. *Anacamptis coriophora* subsp. *fragrans* (Pollini) R.M. Bateman, Pridgeon & M.W. Chase – Eurimediterraneo (AX, CY, EY, FY, OX, OY, PY, RX, RY). Tutte le segnalazioni generiche di *A. coriophora* sono state assegnate alla subsp. *fragrans*.
2. *Anacamptis laxiflora* (Lam.) R.M. Bateman, Pridgeon & M.W. Chase – Eurimediterraneo (CX, CY, DH, DY, EY, FY, HX, MM, MY, NZ, OX, OY, RY).
3. *Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase – Europeo-Caucasico (AX, BY, CY, DY, EX, EY, FY, HX, MY, NH, OX, OY, PX, PY, RX, SY, RZ).
4. Anacamptis *palustris* (Jacq.) R.M. Bateman, Pridgeon & M.W. Chase – Eurimediterraneo (CY, FY, NH, OX).
5. *Anacamptis papilionacea* (L.) R.M. Bateman, Pridgeon & M.W. Chase – Eurimediterraneo (CY, EY, FY, OX, OY).
6. *Anacamptis pyramidalis* subsp. *pyramidalis* (L.) Rich. – Eurimediterraneo (AX, BY, CY, DX, DY, EX, EY, FX, FY, HX, NH, OX, OY, PX, PY, RX).

7. *Barlia robertiana* (Loisel.) Greuter – Stenomediterraneo (CY, EY, OX, OY).
8. *Cephalanthera damasonium* (Mill.) Druce – Eurimediterraneo (AH, AX, CY, DX, DY, DZ, EX, EY, FX, FY, GY, HX, NH, OX, OY, PX, PY, RX).
9. *Cephalanthera longifolia* (L.) Fritsch – Eurasiatico (AX, CY, DX, DY, EY, FX, FY, HX, OX, OY, PX, PY, RX, RY).
10. *Cephalanthera rubra* (L.) Rich. – Eurasiatico (AX, BX, CY, DX, EX, EY, FX, FY, OX, OY, PY, RX).
11. *Coeloglossum viride* (L.) Hartm.) – Circumboreale (AH, BX, CY, EY, DY, FY, OX, 0Y, PY, RX, RY, RZ).
12. *Corallorhiza trifida* Chatel. – Circumboreale (AH, CY, EY, FY, NH, OX, OY).
13. *Dactylorhiza incarnata* (L.) Soó subsp. *incarnata* – Eurosiberiano (AY, CY, EY, FY, HX, NH, OX, OY, PY, RX).
14. *Dactylorhiza maculata* (L.) Soó subsp. *fuchsii* (Druce) Hyl. – Eurasiatico (GY, OX, OY). La specie nel Molise raggiunge il suo limite meridionale di distribuzione geografica.
15. *Dactylorhiza maculata* subsp. *saccifera* (Brongn.) Diklić (sin. *D. gervasiana* [Tod.] H. (Baumann & Künkele) – Paleotemperato (DX, DY, FY, OX, OY, RX, SY). Il taxon è inoltre segnalato per il Molise nel seguente sito informatico: *luirig.altervista.org/flora/taxa/index1.php*. Zito *et al*. (2008) segnalano genericamente il taxon per l'Appennino centrale e meridionale. Bianchini (1987), Hoffmann (1989), Lucchese (1995), Pirone *et al*. (2000), Abbate & Giovi (2002), Rossi (2002), Blasi *et al*. (2005), Ciaschetti (2009), Gianicola *et al*. (2009), Carli (2013) e Marinelli (*comunicazione personale*) segnalano per la Regione *Dactylorhiza maculata s.l*. In Molise spesso s'incontrano popolazioni con caratteri intermedi tra *fuchsii* e *saccifera* che rendono difficoltosa la discriminazione tra le due sottospecie.
16. *Dactylorhiza romana* (Sebast.) Soó – Stenomediterraneo (FX come *Orchis pseudosambucina* Ten., OX, OY).
17. *Dactylorhiza sambucina* (L.) Soó – Europeo (AX, CY, DY, EY, FY, HX, NH, OX, OY, PY, RX, SY).
18. *Epipactis atrorubens* (Hoffm.) Besser – Europeo (BX, CY, EY, FY, OX, OY, PY, RX).
19. *Epipactis helleborine* subsp. *helleborine* (L.) Crantz – Paleotemperato (AH, AX, BX, BZ, CY, DX, DY, DZ, EX, EY, FX, FY, GY, GZ, HX, OX, OY, RX).
20. *Epipactis meridionalis* H. Baumann & R. Lorenz – Endemico (BX, NZ, OX, OY). Recentemente è stato descritto *Epipactis lucana* (Hertel & Presser 2015) un taxon diffuso dalla Basilicata all'Abruzzo che in vari ambiti sostituirebbe *E. meridionalis*. Di conseguenza è possibile che le nuove ricerche portino ad assegnare tutte le segnalazioni di *E. meridionalis* al nuovo taxon.
21. *Epipactis microphylla* (Ehrh.) Sw. – Europeo-Caucasico (AH, AX, CY, EX, EY, FY, HX, OX, OY, PY, RX, RZ).
22. *Epipactis muelleri* Godfery – Centro-Europeo (BX, CY, EY, FY, NZ, OX, OY, PY, RX).
23. *Epipactis neglecta* (Kümpel) Kümpel – Centro-Europeo (OY).
24. *Epipactis palustris* (L.) Crantz – Circumboreale (CX, CY, EY, FY, NH, OX, OY).
25. *Epipactis persica* subsp. *gracilis* (B. Baumann & H. Baumann) W. Rossi (sin. *E. exilis* P. Delforge) – Sud-Est-Europeo (AH, CY, FY, NZ, OX, OY).
26. *Epipactis purpurata* Sm. – Subatlantico (LX, OX, PY, RX).
27. *Epipogium aphyllum* Sw. – Eurosiberiano (AX, CX, CY, EY, FY, OX, OY).
28. *Gymnadenia conopsea* (L.) R. Br. in W. T. Aiton – Eurasiatico (AX, BX, BY, CY, DY, EX, EY, FY, HX, NH, OX, OY, PY, RX).
29. *Himantoglossum adriaticum* H. Baumann. – Eurimediterraneo (CY, EY, FY, HX, NH, OX, OY, PX, PY, RX, RZ, SY).
30. *Himantoglossum hircinum* (L.) Spreng. – Mediterraneo-atlantico (BY, EY, OX, SX). Ad avviso di Conti & Bartolucci (2015) tutte le segnalazioni del taxon per il Parco Nazionale d'Abruzzo, Lazio e Molise vanno riferite a *Himantoglossum adriaticum*. Non riportata per il Molise in GIROS (2016). A sua volta Delforge (2016) fa presente che il taxon è assente nell'Italia centrale ed è specie vicariante di *Himantoglossum adriaticum* a sud del Gargano.
31. *Limodorum abortivum* (L.) Sw. – Eurimediterraneo (BX, CY, EY, FY, OX, OY, PX, PY, RX, RZ).
32. *Listera ovata* (L.) R. Br. – Eurasiatico (CY, DY, EX, EY, FX, FY, HX, OX, OY, PY, RX).
33. *Neotinea lactea* (Poir.) R.M. Bateman, Pridgeon & M.W. Chase – Stenomediterraneo (DH, OX). Conti *et al*. (2005) la segnalano con dubbio per il Molise. Non segnalata per il Molise in GIROS (2016).
34. *Neotinea maculata* (Desf.) Stearn – Mediterraneo-Atlantico (CY, EY, FY, OX, OY, RZ).
35. *Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.W. Chase – Eurimediterraneo (CY, DY, EY, FY, HX, NH, OX, OY, PY, RX).
36. *Neotinea ustulata* (L.) R.M. Bateman, Pridgeon & M.W. Chase – Europeo-Caucasico (CY, DH, DX, EY, FY, HX, OX, OY, PY, RX, RY).
37. *Neottia nidus-avis* (L.) Rich. – Eurasiatico (AH, AX, BX, CY, DX, DZ, EX, EY, FX, FY, GY, HX, NH, OX, OY, PY, RX).
38. *Nigritella rubra* Teppner & E. Klein subsp. *widderi* H. Baumann & R. Lorenz – Subendemico (CX, CY, EY, FY, NH, OX, OY). La specie nel Molise raggiunge il limite meridionale di distribuzione geografica.
39. *Ophrys apifera* Huds. – Eurimediterraneo (CX, CY, DX, DY, EY, FY, HX, MH, MM, MX, MY, NH, OX, OY, PX, PY, RX, RY, SY).
40. *Ophrys argolica* subsp. *crabronifera* (Sebast. & Mauri) Faurh. – Endemico (CX, CY, EY, FY, HX, MX, NZ, OX, OY).

41. *Ophrys bertolonii* subsp. *bertolonii* Moretti – Appennino-Balcanico (CY, DY, EY, FY, HX, MH, MM, MY, OX, OY, PX, PY, RX, RZ, SY). Sono state ricondotte al taxon tutte le segnalazioni di *Ophrys romolinii* Soca il cui status è controverso e di *Ophrys bertoloniformis* (O. Danesch & E. Danesch) H. Sund., segnalato da Hennecke & Hennecke (1999).
42. *Ophrys bombyliflora* Link – Stenomediterraneo (EY, FY, MX, OX, OY).
43. *Ophrys fusca* subsp. *funerea* (Viv.) Arcang. – Stenomediterraneo (OY, PZ). Conti (1995), Hennecke & Hennecke (1999), Abbate & Giovi (2002), Lucchese (1995), Rossi (2002), Conti *et al*. (2005), Gianicola *et al*. (2009) segnalano per il Molise *Ophrys fusca* subsp. *fusca*.
44. *Ophrys fusca* subsp. *lucana* (P. Delforge, Devillers-Tersch. & Devillers) Kreutz – Endemico (MX, OX, OY, PX, RX, RY, RZ, SX). Molto probabilmente sono da ricondurre al taxon le segnalazioni riguardanti *Ophrys fusca* subsp. *iricolor*, un taxon segnalato per il Molise da Lucchese (1995) e Conti *et al*. (2005) che invece Romolini & Souche (2012), Delforge (2016) e Biagioli (in GIROS 2016) considerano non presente in Italia.
45. *Ophrys holosericea* (Burm. f.) Greuter subsp. *appennina (*Romolini & Soca) Kreutz – Endemico (MX, OX, OY, RY, SY come *Ophrys holosericea s.l.*).
46. *Ophrys holosericea* subsp. *apulica* (O. Danesch & E. Danesch) Buttler – Endemico (CY, DY, EY, GX, NH, OX, OY).
47. *Ophrys holosericea* (Burm. f.) Greuter subsp. *dinarica* (Kranjcev & P. Delforge) Kreutz– Appennino-Balcanico (HY, MX, MY, OX, OY, RX, RY, RZ). Sono state ricondotte al taxon in esame tutte le segnalazioni di *Ophrys scolopax*. Secondo Faurholdt (2009) l'entità deve considerarsi una varietà di *O. fuciflora* (*holosericea*). La specie nel Molise raggiunge il suo limite meridionale di distribuzione geografica. Recentemente Delforge (2015) ha descritto per l'Abruzzo *Ophrys personata* cui, a suo avviso, andrebbero riferite tutte le segnalazioni italiane di *Ophrys holosericea* subsp. *dinarica*. Ciononostante, poiché nella Regione *O. dinarica* forma numerosi ibridi che andrebbero rinominati, in attesa di nuovi studi e ricerche, in tale sede si continua a utilizzare la vecchia denominazione.
48. *Ophrys holosericea* subsp. *gracilis* (Büel, O. Danesch & E. Danesch) Büel, O. Danesch & E. Danesch – Endemico. (MH, MX, MY, OX, OY, RY, RZ, SX)
49. *Ophrys holosericea* subsp. *pinguis* (Romolini & Soca) Kreutz – Endemico (RY). **Specie nuova per la regione.** Stazione di rinvenimento: Isernia. Le descrizioni di *O. appennina* e O. *pinguis* portano all'esclusione dalla flora molisana di *O. holosericea* subsp. *holosericea* (Burm. f.) Greuter con cui le due entità sono da porre in sinonimia. Tuttavia la presenza in natura di piante con caratteristiche intermedie di difficile classificazione e il fatto che le differenze morfologiche tra le due specie sono minime dovrebbero condurre a una revisione tassonomica e altri studi e ricerche. Inoltre come sottolineano Romolini & Souche (2012) il taxon è sintopico con altre specie appartenenti allo stesso gruppo. Ciò porta alla formazione di vari ibridi, accresce le difficoltà di classificazione e pone seri dubbi sul rango tassonomico in quanto rende inspiegabili i meccanismi di isolamento riproduttivo da cui il taxon si è generato.
50. *Ophrys holosericea* subsp. *tetraloniae* (W.P. Teschner) Kreutz – Appennino-Balcanico (DY, FY, HH, MH, MX, OX, RY, SX). Non segnalata per il Molise da Rossi (2002) e in GIROS (2016). Ad avviso di Hertel & Presser (2009) il taxon è presente sulle montagne dell'Italia centrale. Delforge (2016) lo segnala per il Veneto mentre, a suo avviso, tutte le sue menzioni per le altre regioni italiane devono essere assegnate a specie diverse.
51. *Ophrys incubacea* Bianca subsp. *brutia* (P. Delforge) Kreutz– Endemico (MX, OX, OY, PX).
52. *Ophrys incubacea* Bianca subsp. *incubacea* – Stenomediterraneo (CY, EY, FY, HX, OX, OY, RZ).
53. *Ophrys insectifera* L. – Europeo (CX, CY, DY, EY, FY, HX, MX, OX, OY, SX).
54. *Ophrys lacaitae* Lojac. – Appennino-Balcanico (CY, EY, FY, MH, NZ, MX, NH, OX, OY).
55. *Ophrys lutea* subsp. *lutea* Cav. – Stenomediterraneo (CY, EX, EY, FY, HX, MM, NH, OX, OY, PX, PY, RX, RZ).
56. *Ophrys molisana* P. Delforge – Endemico (NZ). Sono state ricondotte al taxon le segnalazioni di *Ophrys illyrica* S. Hertel & K. Hertel e quelle delle entità osservate nei pressi di Montenero (IS) che secondo Tandé (2012) sono attribuibili a *O. araneola* o a *O. ausonia*.
57. *Ophrys passionis* subsp. *majellensis* (Helga & Herm. Daiss) Romolini & Soca. – Endemico (DH, FY, MX, OX, OY*)*.
58. *Ophrys passionis* subsp. *passionis* Sennen ex Devillers-Tersch. & Devillers (sin. *O. garganica* O. Danesch & E. Danesch) – Mediterraneo-Occidentale (AZ, CY, EY, FY, HX, LZ, MM, OX, OY, PY, RX).
59. *Ophrys promontorii* O. Danesch & E. Danesch – Endemico (MX, OX, RY). Non segnalata per il Molise in GIROS (2016).
60. *Ophrys sphegodes* subsp. *minipassionis* (Romolini & Soca) Biagioli & Grünanger – Endemico (LY, MX, OX, OY).
61. *Ophrys sphegodes* subsp. *sphegodes* Mill. – Eurimediterraneo (CY, DX, DY, EY, FY, HX, OX, PX, RX). Romolini & Souche (2012) e GIROS (2016) segnalano per il Molise *Ophrys classica*, un'entità controversa che secondo Hertel & Presser (2006) rientrerebbe nella variabilità di *Ophrys sphegodes*.

62. *Ophrys tenthredinifera* subsp. *neglecta* (Parl.) E.G. Camus – Stenomediterraneo (CY, EY, FY, NZ, OX, OY, PY, RX, RZ, SX).
63. *Orchis anthropophora* (L.) All. - Mediterraneo-Atlantico (CY, DY, EY, FY, HX, NH, OX, OY, PY, RX, RZ, RY).
64. *Orchis italica* Poir. – Stenomediterraneo (CX, CY DX, DY, EY, HX, MY, OX, OY, PX, PY, RX, RY, SY).
65. *Orchis mascula* L. (*s.l.*) – Europeo-Caucasico (CY, EY, FX, FY, HX, NH, OX, OY, PY, RX, SY). Vari ricercatori (BX, LY, OY, RY) segnalano per la Regione *Orchis mascula* subsp. *speciosa* (Mutel) Hegi (sin. *O. mascula* [L.] L. subsp. *signifera* [Vest.] Soó), un taxon che ad avviso di Gulli & Tosi (in GIROS 2016) è di dubbio valore tassonomico mentre Perazza & Lorenz (2013) sostengono che è esclusivo della catena alpina centro-orientale. Lo scrivente, tenendo conto di quanto espresso da altri studiosi e non riuscendo ad accertare a quale sottospecie vanno riferite le segnalazioni di *Orchis mascula s.l.* ha ritenuto opportuno riunire il tutto nell'ambito di un unico taxon.
66. *Orchis pallens* L. – Europeo-Caucasico (AX, CY, EY,FY, OY).
67. *Orchis pauciflora* Ten. – Stenomediterraneo (CY, EY, FY, HX, NH, OX, OY, PY, RX, SY).
68. *Orchis provincialis* Balb. ex Lam. – Stenomediterraneo (CY, DY, EY, FY, HX, OX, OY, PY, RX).
69. *Orchis purpurea* Huds. – Eurasiatico (CY, DX, DY, EY, FX, FY, GZ, HX, NH, OX, OY, PX, PY, RX).
70. *Orchis simia* Lam. – Eurimediterraneo (CX, CY, EY, FY, OX, OY, PZ, RY).
71. *Platanthera bifolia* subsp. *bifolia*. (L.) Rchb. – Paleotemperato (CX, AX, CY, EY, FX, FY, OX, OY, PY, RX).
72. *Platanthera chlorantha* (Custer) Rchb. – Eurosiberiano (CY, EX, EY, FX, FY, HX, NH, OX, OY)
73. *Pseudorchis albida* (L.) A. Löve & D. Löve – Artico-Alpino (CY, EY, FY, NH, NZ, OX, OY).
74. *Serapias bergonii* E. G. Camus – Stenomediterraneo (DY, FY, MH, OX). Non segnalata per il Molise in GIROS (2016).
75. *Serapias cordigera* L. – Stenomediterraneo (CY, EY, FY, OX, OY).
76. *Serapias lingua* L. – Stenomediterraneo (CY, DH, DY, EY, FY, LZ, MY, OX OY, RY, RZ).
77. *Serapias parviflora* Parl. – Stenomediterraneo (CY, DY, EY, FY, OX, OY, RX, RY).
78. *Serapias vomeracea* (Burm.f.) Briq. subsp. *vomeracea* – Eurimediterraneo (CY, DH, EY, FY, OX, PX, PY, RX, RZ). Non segnalata per il Molise in GIROS (2016).
79. *Serapias vomeracea* subsp. *longipetala* (Ten.) (Baumann & Künkele) – Mediterraneo-Orientale (OY, RY). Secondo Rossi (2002) le due denominazioni sono da considerarsi sinonimi e pertanto si riferiscono allo stesso taxon. Secondo Delforge (2016), all'interno dell'areale di diffusione non s'incontrano mai popolazioni pure comprendenti un'unica sottospecie tra le due riportate. Lorenz (in GIROS 2016), a sua volta sostiene che all'interno dell'areale, singole piante possono essere attribuite sia a una sia all'altra tra le due sottospecie e di conseguenza alcuni studiosi considerano la subsp. *longipetala*, una varietà abbassando il suo rango tassonomico.
80. *Spiranthes spiralis* (L.) Chevall. – Europeo-Caucasico (CX, CY, FY, OX, OY, PY, RX, RZ).

Ibridi

1. *Anacamptis* x*alata* (Fleury) H. Kretzschmar, Eccarius & H. Dietr (*A. laxiflora* x *A. morio*) (MY, OX, PZ, RY).
2. *Anacamptis* x*gennarii* (Fleury) H. Kretzschmar, Eccarius & H. Dietr (*A. morio* x *A. papilionacea*) (OX).
3. *Dactylorhiza* x*serbica* Fleischm. (*D. incarnata* x *D. saccifera*). **Ibrido nuovo per la Regione**. Stazione di rinvenimento: Montenero Val Cocchiara.
4. *Ophrys appennina* x *O. dinarica* (OX, RY, SX).
5. *Ophrys appennina* x *O. lacaitae* (HX, MX, OX, RY).
6. *Ophrys appennina* x *O. tetraloniae* (HX, MX, OX, RY).
7. *Ophrys dinarica* x *O. gracilis* (OX, RY).
8. *Ophrys dinarica* x *O. lacaitae* (SX). **Ibrido nuovo per il Molise.**
9. *Ophrys dinarica* x *O. sphegodes* (OX, RY Come *O. aranifera* x *O. dinarica*).
10. *Ophrys gracilis* x *O. lacaitae* (OX, PZ, RY, SX).
11. *Ophrys gracilis* x *O. sphegodes* (MY, OX, SX).
12. *Ophrys lacaitae* x *O. tetraloniae* (OX, RY).
13. *Ophrys* x*bilineata* Barla (*O. bertolonii* x *O. sphegodes* subsp. *sphegodes*) (RY come *O. aranifera* x *O. romolinii)*. Ibrido nuovo per il Molise. Stazione di rinvenimento: Montenero Val Cocchiara.
14. *Ophrys* x*couloniana* P. Delforge (*O. bertolonii* x *O. promontorii*). (OX, RY).
15. *Ophrys* x*capracottae* Romolini & Soca (*O. brutia* x *O. dinarica*). (NX).
16. *Ophrys* ×*impresciae* Soca (*O. dinarica* x *O. pinguis* (RY). **Ibrido nuovo per il Molise.** Stazione di rinvenimento: Rionero Sannitico.
17. *Ophrys* x*lyrata* H. Fleischm. (*O. bertolonii* x *O. incubacea*) (EY, FF come O. *romolinii* x *O. incubacea* (RX, RZ).
18. *Ophrys* x*piconei* Soca (*O. bertolonii* x *O. dinarica*) (MY, OX).
19. *Ophrys* x*terrae-laboris* W.Rossi & F.Minutillo (*O. promontorii* x *O. sphegodes*) (LY, OX).
20. *Orchis* x*bivonae* Tod. (*O. antropophora* x *O. italica*) (GX, OX).
21. *Orchis* x*colemanii* Cortesi (*O. mascula* x *O. pauciflora*) (CY, OX).
22. Orchis xpenzigiana Camus (O. mascula x O. provincialis) (LY, OX).
23. *Serapias* ×*intermedia* Forestier *(S. lingua* x *S. vomeracea*. (RY). **Ibrido nuovo per il Molise.** Stazione di rinvenimento: Forli del Sannio, Isernia.

24. *Serapias* ×*ruggieroi* Medagli & Turco *(S. parviflora* x *S. vomeracea*) (RY). **Ibrido nuovo per il Molise.** Stazione di rinvenimento: Isernia.

L'elenco floristico sopra riportato è costituito da 80 entità distinte tra specie e sottospecie. Tale numero, facendo riferimento agli elenchi pubblicati in Peruzzi (2010) e GIROS (2016), costituisce il 3,27 % della flora regionale e il 35 % delle *Orchidaceae* presenti nel territorio nazionale. Risulta nuova per la flora molisana: *Ophrys holosericea* subsp. *pinguis*.

All'insieme delle specie e sottospecie si aggiungono 24 ibridi, dei quali sette mai segnalati in precedenza e di conseguenza l'ammontare complessivo dei taxa riportati è di 104. Pezzetta (2015b) per la regione segnalava 78 entità, la lista attuale ne riporta 80 con un incremento di due unità.

La Regione Molise con la legge regionale 23-02-1999 tutela le seguenti specie di *Orchidaceae* comprese nell'elenco, cioè ne vieta la raccolta, la distruzione e il danneggiamento: *Epipactis palustris*, *Corallorhiza trifida*, *Dactylorhiza incarnata, Epipactis muelleri*, *Epipactis persica*, *Epipogium aphyllum*, *Ophrys apulica*, *Ophrys crabronifera*, *O. insectifera*, *O. lacaitae*, *O. lutea*, *O. tenthredinifera, Orchis laxiflora*, *Orchis palustris*, *Orchis simia*, *Nigritella widderi* e *Serapias parviflora*.

Facendo riferimento a Lucchese (1995) le specie più diffuse nella Regione, in ordine decrescente sono le seguenti: *Orchis purpurea*, *Epipactis helleborine*, *Anacamptis pyramidalis*, *Dactylorhiza maculata* s, l., *Gymnadenia conopsea*, *Cephalanthera damasonium*, *Neottia nidus-avis*, *Orchis italica*, *Ophrys apifera* ed a seguire tutte le altre.

Come si è potuto notare, la presenza in Regione di diverse entità riportate nell'elenco non trova unanime consenso ed in certi casi lo status tassonomico è messo in discussione. Ciò è la conseguenza dei problemi tassonomici non ancora risolti che portano a dare valutazioni diverse ad alcuni taxa critici e dei diversi punti di vista e criteri di classificazione adottati dai ricercatori. La tendenza in atto è in generale orientata verso la descrizione di nuovi taxa tenendo conto di sottili caratteri morfologici che portano alla riduzione dell'intervallo di variabilità dei caratteri stessi per ogni singolo taxon. Tale metodo di classificazione sistematica ha qualche limite. Uno di essi è costituito dal fatto che riducendo l'intervallo di variabilità, la discriminazione dei caratteri in alcuni casi può diventare molto difficile se non impossibile. Un altro limite è dovuto al fatto che spesso tra una specie e un'altra molto simile certi caratteri sfumano e non acquistano connotazioni precise. Alla luce di queste considerazioni, per non cadere nell'effettiva impossibilità di riuscire a classificare un individuo e raccogliere più consenso sul suo rango tassonomico, si ritiene opportuno adottare criteri di classificazione sistematica più attendibili scegliendo meglio i caratteri diagnostici e accettare una definizione di specie ampiamente condivisa che considera i caratteri morfologici ed altri aspetti. Fino a quando non si arriverà a un unico e valido criterio di classificazione, i risultati delle ricerche saranno sempre molto opinabili e non forniranno mai notizie chiare riguardanti l'effettiva consistenza numerica sulla flora di un territorio.

Tab. 1: Generi delle Orchidaceae molisane e numero di specie.
Tab. 1: Rodovi kukavičevk v deželi Molize in število vrst.

Genere	Numero specie
Anacamptis	6
Barlia	1
Cephalanthera	3
Coeloglossum	1
Corallorhiza	1
Dactylorhiza	6
Epipactis	9
Epipogium	1
Gymnadenia	1
Himantoglossum	2
Limodorum	1
Listera	1
Neotinea	4
Neottia	1
Nigritella	1
Ophrys	24
Orchis	8
Platanthera	3
Pseudorchis	1
Serapias	6
Spiranthes	1

Dalla Tabella 1 emerge che le varie entità di *Orchidaceae* si ripartiscono in 21 generi e di questi il più rappresentato è il genere *Ophrys* con 24 taxa. Seguono i generi: *Epipactis* con 9; *Orchis* con 8*; Dactylorhiza*, *Anacamptis* e *Serapias* con 6 taxa e poi tutti gli altri con valori inferiori.

Com'è visibile in Tabella 2, il valore di densità di *Orchidaceae* per 100 kmq di superficie regionale (1,81) colloca la regione al primo posto su scala nazionale. Seguono la Liguria (1,59), la Valle d'Aosta (1,53), il Friuli Venezia Giulia e la Basilicata (0,91), l'Abruzzo (0,9), l'Umbria (0,84), le Marche (0,75), la Campania (0,59), la Calabria (0,58), ecc.

La Tabella 3 evidenzia che nel Molise la famiglia delle *Orchidaceae* incide con il 3,28 % sulla flora regionale.

Tab. 2: Densità (D) regionale delle Orchidacee in 100 Kmq di superficie.
Tab. 2: Gostota (D) kukavičevk na 100 km² površine po posameznih deželah.

Regione	Orchidacee presenti N	Superfice regionale S	Densità specie Orchidacee D D = (N/S) x 100
Valle d'Aosta	50	3262	1,53
Piemonte	76	25408	0,3
Lombardia	68	23844	0,28
Trentino Alto Adige	67	13619	0,41
Veneto	75	18264	0,44
Friuli Venezia Giulia	72	7845	0,91
Liguria	86	5410	1,59
Emilia Romagna	81	22451	0,36
Toscana	96	22994	0,42
Marche	73	9694	0,75
Umbria	71	8456	0,84
Lazio	97	17203	0,56
Abruzzo	98	10794	0,9
Molise	80	4438	1,81
Campania	81	13595	0,59
Puglia	102	19345	0,53
Basilicata	91	9992	0,91
Calabria	88	15082	0,58
Sicilia	77	25711	0,3
Sardegna	65	24090	0,27

Tab. 3: Incidenza delle Orchidacee sulle flore regionali.
Tab. 3: Pojavljanje kukavičevk v regionalnih florah posameznih dežel.

Regione	Orchidacee presenti N	Totale specie piante superiori presenti T	% Orchidacee N x 100 /T
Valle d'Aosta	50	2190	2,28
Piemonte	76	3630	2,09
Lombardia	68	3332	2,04
Trentino Alto Adige	67	3043	2,2
Veneto	75	3587	2,09
Friuli Venezia Giulia	72	3347	2,15
Liguria	86	3324	2,58
Emilia Romagna	81	2821	2,87
Toscana	96	3541	2,71
Marche	73	2713	2,69
Umbria	71	2396	2,88
Lazio	97	3431	2,83
Abruzzo	98	3409	2,87
Molise	80	2440	3,28
Campania	81	3102	2,61
Puglia	102	2352	4,34
Basilicata	91	2694	3,37
Calabria	88	2787	3,16
Sicilia	77	3106	2,48
Sardegna	65	2620	2,48

Tale valore percentuale colloca la Regione al terzo posto dopo la Puglia (4,34%) e Basilicata (3,37%). Seguono Calabria con 3,16 %, l'Umbria con 2,88%, Abruzzo ed Emilia Romagna con 2,87%, Lazio con 2,83%, Toscana con 2,71% e le altre Regioni con valori inferiori.

Come visto, nella regione diversi taxa sono al limite latitudinale del loro areale di distribuzione nella penisola italiana e, talvolta, in Europa. Infatti raggiungono il limite meridionale di distribuzione geografica : *Dactylorhiza maculata* subsp. *fuchsii*, *Nigritella rubra* subsp. *widderi, Ophrys holosericea* subsp. *dinarica* e *O. holosericea* subsp. *tetraloniae*. Raggiunge il limite settentrionale *Himantoglossum hircinum*.

Com'è ben visibile nella Tabella 4, le *Orchidaceae* presenti in Molise appartengono a 19 diversi corotipi, un dato confermativo che anche per tale famiglia l'ambito in esame rappresenta un crocevia di correnti migratorie con diversa origine e distribuzione geografica.

Lo spettro corologico (visibile in Tab. 4 e Fig. 1) mostra la prevalenza del contingente mediterraneo (37,5 %) con 30 taxa. Seguono il contingente eurasiatico (23,75 %) con 18, quello endemico (16,25%) con 11, l'europeo con 10 (12,5 %) e infine i contingenti mediterraneo-atlantico e nordico (6,25%) con quattro.

La consistenza numerica delle specie appartenenti ad alcuni corotipi è passibile di variazioni temporali con

Tab. 4: Corotipi delle Orchidacee molisane.
Tab. 4: Horotipi kukavičevk v deželi Molize.

Elementi geografici	Numero taxa	%
Endemico e Subendemico	**13**	**16,25**
Endemico	12	
Subendemico	1	
Mediterraneo	**30**	**37,5**
Eurimediterraneo	13	
Stenomediterraneo	15	
Mediterraneo-Occidentale	1	
Mediterraneo-Orientale	1	
Eurasiatico	**19**	**23,75**
Eurasiatico s.s.	7	
Europeo-Caucasico	6	
Eurosiberiano	3	
Paleotemperato	3	
Nordico	**4**	**5**
Artico-Alpino	1	
Circumboreale	3	
Europeo	**10**	**12,5**
Europeo s.s.	3	
Centro-Europeo	2	
Appennino-Balcanico	4	
Sud-Est-Europeo	1	
Mediterraneo-Atlantico	**4**	**6,25**
Subatlantico	1	
Mediterraneo-Atlantico s.s.	3	
Totale	**80**	**100**

il procedere delle conoscenze botaniche. Infatti, in un recente volume sulle orchidee della Croazia, Kranjčev (2005) segnala la presenza nella Dalmazia continentale e/o nelle sue isole di *Ophrys holosericea* subsp. *gracilis* e *O. sphegodes* subsp. *brutia*. Se saranno confermate, il loro areale si estenderebbe e anziché essere considerate endemiche italiane rientrerebbero nel corotipo Appennino-Balcanico.

I contingenti mediterraneo, eurasiatico ed europeo sono rappresentati da quattro diversi corotipi ciascuno mentre i contingenti endemico, nordico e mediterraneo-atlantico da due. Facendo riferimento a Poldini (1991) e tenendo conto delle loro caratteristiche termiche, i corotipi sono stati riuniti nei seguenti tre gruppi:

- gruppo macrotermico comprendente le specie appartenenti ai corotipi stenomediterraneo, eurimediterraneo, sud-est-europeo, appennino-balcanico, mediterraneo-occidentale, mediterraneo-orientale ed endemico;[1]
- gruppo mesotermico comprendente le specie appartenenti ai corotipi euroasiatico *s.s.*, europeo-caucasico, centro-europeo, paleotemperato, mediterraneo-atlantico ed europeo *s.s.*;[2]
- gruppo microtermico comprendente le specie appartenenti ai corotipi artico-alpino, circumboreale, eurosiberiano, subatlantico e subendemico.

Al primo gruppo appartengono 47 taxa, al secondo gruppo 28 mentre al terzo nove taxa. Questi dati dimostrano che le orchidacee in Molise sono maggiormente diffuse negli ambienti caldi, sono presenti in una rilevante proporzione anche negli ambiti temperati e non mancano in quelli più freschi. In particolare: le entità euromediterranee sono tipiche di ambienti aperti e delle schiarite di bosco; quelle stenomediterranee prediligono gli ambienti aridi; le entità nordiche, europee, subendemiche, eurosiberiane, europeo-caucasiche ed euroasiatiche *s.s*. sono a loro volta tipiche degli ambienti temperati e temperato-freschi (boschi, pascoli montani e ambienti umidi).

Il 16.25% delle orchidacee è costituito da entità endemiche e subendemiche, che contribuiscono a fornire alla flora regionale una forte connotazione territoriale. Una di tali specie porta il nome di *Ophrys molisana* poiché il suo *locus classicus* è sito nel territorio regionale e in questo momento, non si conoscono stazioni della stessa in altre regioni.

In base alle caratteristiche del loro areale, i vari endemismi possono essere cosi distinti:

- Endemismi peninsulari, diffusi in modo più o meno continuo nelle regioni italiane: *Ophrys appennina* e *O. holosericea* subsp. *gracilis;*
- Endemismi dell'Italia centrale: *Ophrys molisana*, *O. argolica* subsp. *crabronifera*, *O. holosericea* subsp. *pinguis* e *Ophrys sphegodes* subsp. *minipassionis*
- Endemismi esclusivi dell'Italia centro-meridionale: *Epipactis meridionalis*, *Ophrys fusca* subsp. *lucana, O. holosericea* subsp. *apulica*, *O. incubacea* subsp. *brutia* e *O. promontorii*.

CONCLUSIONI

Gli ambiti regionali più ricchi di orchidee sono: il Matese, la Riserva Naturale Regionale-Oasi WWF

1 Nel gruppo macrotermico sono state inserite le entità appennino-balcaniche che appartengono al genere *Ophrys* e prediligono ambienti caldi e soleggiati.
2 Nel gruppo mesotermico è stato inserito *Epipactis meridionalis*.

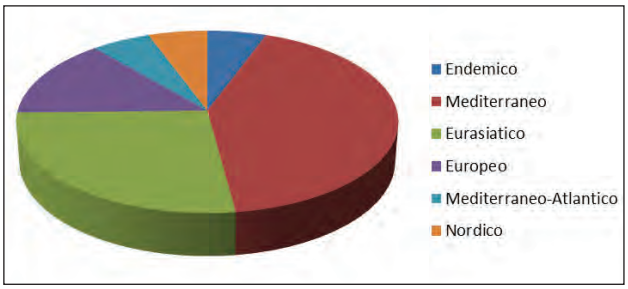

Fig. 1: Ripartizione dei vari contingenti floristici.
Sl. 1: Delež vrst glede na fitogeografsko opredelitev.

Guardiaregia-Campochiaro, la riserva MAB Collemeluccio-Montedimezzo, la Zona di Protezione Speciale Lago di Gualdalfiera, il territorio dei comuni di San Pietro Avellana e Pescopennataro, le Mainarde, l'area tra Capracotta e Isernia e i territori attorno ai passi del Macerone e Rionero Sannitico.

L'elenco floristico riportato dimostra l'importanza del patrimonio orchidologico del Molise e le considerazioni su di esso ripropongono il tema della corretta definizione e caratterizzazione dei singoli taxa. Per questo motivo non si riuscirà mai a stabilire con certezza il numero di specie effettivamente presenti. Ciò è anche impossibile perché varia di continuo anche la flora. Importante, come detto, è la corretta definizione e caratterizzazione dei singoli taxa. Come ci ricorda Popper la scienza non è un sistema di asserzioni certe, o stabilite in modo definitivo, e non è neppure un sistema che avanza costantemente verso uno stato definitivo: non può mai pretendere di aver raggiunto la verità e neppure di essere un sostituto della verità, come la probabilità. Sebbene non possa mai raggiungere né la verità né la probabilità, lo sforzo per ottenere la conoscenza e la ricerca della verità, sono ancora i motivi più forti della ricerca scientifica.

RINGRAZIAMENTI

Per le informazioni fornite si ringraziano: il personale del Museo di Storia Naturale di Trieste, Giampiero Ciaschetti, Severino Costalonga, Angela Damiano, Paolo Grünanger, Michele Marinelli, Carlo Meo, Ivan Serafini del Centro Studi Alto Vastese e Rémy Souche.

KUKAVIČEVKE DEŽELE MOLIZE: SISTEMATSKA DOPOLNILA IN NOV SEZNAM VRST

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POVZETEK

Dežela Molize se nahaja ob jadranski obali italijanskega polotoka in pokriva 4438 km² površine. Meji na dežele Abruci, Kampanijo, Lacij in Apulijo. Dežela je zelo bogata po pestrosti semenovk, saj so do konca leta 2010 ugotovili prisotnost 2440 vrst. Nadaljnje floristične raziskave so še dodatno dopolnile regionalno floro. Med novimi odkritimi vrstami so bile tudi kukavičevke. Na podlagi recentnih taksonomskih revizij in novih odkritih ali novo opisanih taksonov je potrebno preveriti njihovo število na območju dežele. Pričujoči prispevek tako predstavlja nov seznam vrst, podvrst in križancev iz družine kukavičevk. V nekaterih primerih avtor razpravlja o taksonomskem statusu nekaterih vrst. Opravil je tudi horološko analizo, ki nakazuje prevladovanje sredozemskih elementov.

Ključne besede: Molize, Orchidaceae, regionalni seznam vrst, floristični elementi

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short scientific article
received: 2017-05-04

DOI 10.19233/ASHN.2017.04

FIRST RECORD OF *CONCHODERMA AURITUM* (CIRRIPEDIA: LEPADIDAE) ON *ZIPHIUS CAVIROSTRIS* (CETACEA: ZIPHIIDAE) IN GREECE

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ABSTRACT

*The carcass of an adult, male, Cuvier's beaked whale (*Ziphius cavirostris*, Ziphiidae) was found floating close to the coasts of Corfu Island, Greece, in July 2016. Many tens of copepods of the genus* Pennella *had infested the whale. Barnacles identified as* Conchoderma auritum *(Cirripedia, Lepadidae) and green algae were attached to the base of both teeth. We took standard measurements of the barnacles and found a mean capitulum length of 12.88 mm (sd = 6.26 mm, n = 13). Although this barnacle has been reported on several marine mammals and has a cosmopolitan distribution, this is the first report of the species in the Eastern Mediterranean Sea.*

Key words: rabbit-ear barnacle, parasite, *Pennella*, Cuvier's beaked whale, cetacean, Mediterranean

PRIMO RITROVAMENTO DI *CONCHODERMA AURITUM* (CIRRIPEDIA: LEPADIDAE) SU *ZIPHIUS CAVIROSTRIS* (CETACEA: ZIPHIIDAE) IN GRECIA

SINTESI

*La carcassa di un maschio adulto di zifio (*Ziphius cavirostris*, Ziphiidae) è stata trovata galleggiante vicino alle coste dell'isola greca di Corfù nel luglio 2016. Decine di copepodi del genere* Pennella *avevano infestato la balena. Cirripedi identificati come* Conchoderma auritum *(Cirripedia, Lepadidae) e alghe verdi sono stati trovati fissati alla base di entrambi i denti. Gli autori hanno preso le misure standard dei cirripedi e stabilito una lunghezza, media del capitulum pari a 12,88 mm (sd = 6,26 mm, n = 13). Anche se questa specie di cirripedi è già stata trovata su diversi mammiferi marini e ha una distribuzione cosmopolita, questa è il primo ritrovamento della specie nel Mediterraneo orientale.*

Parole chiave: cirripedi, parassiti, *Pennella*, zifio, cetacei, Mediterraneo

INTRODUCTION

Several species of cetaceans are known to host sessile and stalked barnacles (Crustacea: Cirripedia) (Fertl & Newman, 2008). Stalked barnacles of the genus *Conchoderma* can be considered generalists, since they occur on both living organisms and inanimate objects, such as ship hulls (Davidson *et al.*, 2009). Species of this genus have a highly reduced shell plate armature, which is correlated with an epibiotic mode of life (Anderson, 1993). The rabbit-ear barnacle *Conchoderma auritum* (Linnaeus, 1767) is one of the twenty living species of barnacles that use marine mammals as hosts (Newman & Ross, 1976). It is known to settle on slowly moving marine mammals (Aznar *et al.*, 2005) and requires hard surfaces for attachment (Clarke, 1966). It can be found attached on exposed and unprotected teeth or even on malformed parts of the jaw (such as a bone injury) (Clarke, 1966; Elorriaga-Verplancken *et al.*, 2015). It is considered as epizoic and commensal since it is hitch-hiking on whales (Ralls & Mesnick, 2008).

Worldwide, *C. auritum* has been recorded on the teeth of seventeen toothed whales (*e.g.*, Clarke, 1966; Mignucci-Giannoni *et al.*, 1998; Elorriaga-Verplancken *et al.*, 2015). It has also been found, less frequently, on damaged baleen plates in four mysticete species (Clarke, 1966; Ólafsdóttir & Shinn, 2013).

The Cuvier's beaked whale *Ziphius cavirostris* Cuvier, 1823 is characterized by a nearly cosmopolitan distribution, avoiding only high latitudes and polar waters (Heyning, 1989). It is the only ziphiid species that regularly occurs throughout the Mediterranean Sea (Podestà *et al.*, 2016), with a local population likely small and isolated from that of the Atlantic (Dalebout *et al.*, 2005). From 1990 until the date of the stranding reported herein, at least 126 Cuvier's beaked whale strandings had been recorded along the Greek coasts (Frantzis, 2009; Frantzis, *unpublished data*).

In this short note, we report the first record of *C. auritum* in the Eastern Mediterranean basin.

MATERIAL AND METHODS

On 12 July 2016, a carcass of a Cuvier's beaked whale was found floating close to the coast of Santa Barbara beach (Fig. 1), SW Corfu Island, Greece (39°24′42″N, 019°59′14″E). Several photographs were taken (Fig. 2), but no necropsy was conducted. Green algae (Chlorophyta) and barnacles that were found attached to the base of both teeth (Fig. 3a) were collected, preserved in 70% ethanol for further analysis and deposited at the Pelagos Cetacean Research Institute in Athens, Greece.

We identified all the barnacles collected from both teeth following Darwin (1852, p. 141, pl. III, fig. 4). Apart from the order level (Buckeridge & Newman, 2006), the classification of the barnacles followed Martin and Davis' (2001) scheme to family level. We also took the following measurements to the nearest 0.01 mm with a digital Vernier caliper: capitulum length (CL), total length (TL, without "ears") and scutum maximal length and width (SL & SW, respectively). Specifically for SL and SW, we measured these without removing the scutum.

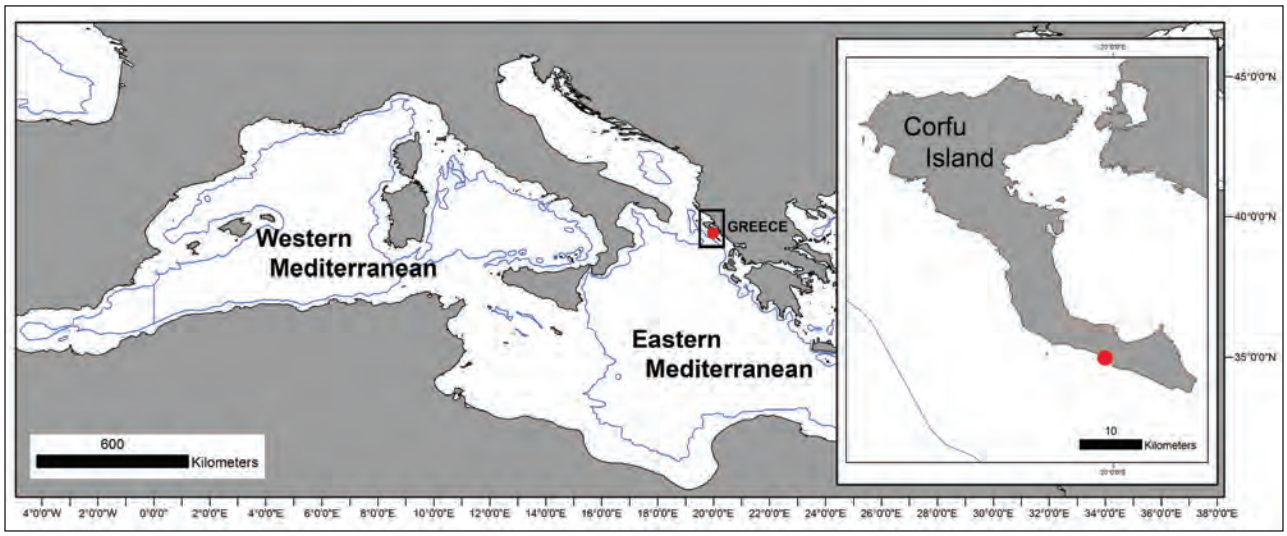

Fig. 1: Map of the Mediterranean Sea and Corfu Island (magnification) showing the stranding position in Santa Barbara Beach (red dot). The 1000 m contour appears as a blue line in both maps.
Sl. 1: Zemljevid Sredozemskega morja in otoka Krfa (povečano) z označeno lokaliteto, kjer je naplavilo kita na plaži Sv. Barbare (rdeča pika). Kontura, ki označuje 1000 m, je označena z modro črto.

RESULTS

The stranded whale was a recently dead male with erupted teeth (Fig. 3a) and a total length of 5.15 m. Based on several of the available photographs, it seemed emaciated, although no definitive conclusion can be drawn as the photographs were taken while the whale was in the water.

Many *Pennella* sp. copepods had infested the whale. At least one hundred of them were counted on the available photographs, which only showed the right side of the whale's body. These copepods were spread all over the head, body and tail-stock (Fig. 2).

The barnacles were in two large clusters attached to both teeth. All ten barnacles found on the right tooth and three out of six from the left tooth were collected.

The species was readily identified as the rabbit-ear barnacle *Conchoderma auritum* by the obvious ear-like appendages (tubes) on the capitulum, and the small bilobed scutum (Darwin, 1852; Fig. 3b & 3c). The chlorophytes were not identified to species level. The barnacle species' classification is the following:

Phylum ARTHROPODA
Infraclass CIRRIPEDIA Burmeister, 1834
Order LEPADIFORMES Buckeridge & Newman, 2006
Family LEPADIDAE Darwin, 1852
Genus *Conchoderma* von Olfers, 1814
Conchoderma auritum (Linnaeus, 1767)

The mean ($\bar{x}$), standard deviation (s), minimum and maximum (*min-max*) values (in mm) of CL, TL, SL and SW for all sampled barnacles (n=13) were, respectively:

CL: $\bar{x}$ = 12.88, s = 6.26, *min-max* = 2.04-25.08
TL: $\bar{x}$ = 13.92, s = 6.90, *min-max* = 4.17-50.40
SL: $\bar{x}$ = 4.39, s = 1.83, *min-max* = 1.28-7.45
SW: $\bar{x}$ = 1.96, s = 0.85, *min-max* = 0.51-3.40

DISCUSSION

Today, the barnacle genus *Conchoderma* is represented by three living species according to Chan *et al.*, (2009). *Conchoderma virgatum* Spengler, 1789 and *C. auritum* are present in the Mediterranean Sea (Koukouras & Matsa, 1998). The rabbit-ear barnacle *C. auritum* had only been reported from the western Mediterranean basin (Koukouras & Matsa, 1998) before our observation, and it is somewhat surprising that no other reports were available for the eastern Mediterranean basin, since the species has a cosmopolitan distribution (Chan *et al.*, 2009). Throughout the cetacean fauna of the Mediterranean Sea, it was reported to have been found on a Cuvier's beaked whale stranded in Algiers (Monod, 1938 in Clarke, 1966) and on the left mandible of a striped dolphin *Stenella coeruleoalba* (Meyen, 1833) that stranded in Sicily (Sampieri) in 1991 (Insacco *et al.*, 2014; G. Insacco, *personal communication*, 2016). The latter, recorded at the Strait of Sicily, was the easternmost record of the species in the Mediterranean Sea.

Fig. 2: Body parts of the Cuvier's beaked whale stranded in Santa Barbara Beach, Corfu Island, Greece, on 12 July 2016. More than 35 specimens of the parasitic copepod *Pennella balaenoptera* ***are visible in the photograph of the head area.***
Sl. 2: Telesni deli Cuvierjevega kljunatega kita, ki ga je naplavilo na plaži Sv. Barbare na Krfu 12 julija 2016. Več kot 35 primerkov zajedalskega raka ceponožca *Pennella balaenoptera* ***je vidno na fotografiji glave.***

The barnacles we found on the teeth of the stranded whale were in two clusters, one on each tooth. The presence of the rabbit-ear barnacle in clusters is probably facilitating cross-fertilization, since this species is hermaphrodite (Ruppert *et al.*, 2004). According to Rasmussen (1980), the rabbit-ear barnacle reaches sexual maturity at a scutum length of 7 mm. If these growth measurements taken at sea water temperatures of 16 - 19 °C were also valid for the hotter Eastern Mediterranean basin, only one of the specimens we sampled was sexually mature. Similarly, all barnacles would have been attached on the whale for much less than 150 days, according to the same author.

There are only three known records of rabbit-ear barnacles on Cuvier's beaked whales: from the Galápagos Islands (Palacios *et al.*, 1994), the Caribbean (Mignucci-Giannoni *et al.*, 1998), and the western Mediterranean basin (Monod, 1938 in Clarke, 1966), with the first record considered doubtful by the authors. In the first two cases, as in the current study, the whale was a male with a total length exceeding 5 m, and the barnacles were only attached to its teeth.

Apart from the rabbit-ear barnacles that we found on the whale, there was a large number of parasitic copepods spread along the body. They were determined as *Pennella balaenoptera* Koren & Danielssen, 1817, since this is the only species of the genus that uses marine

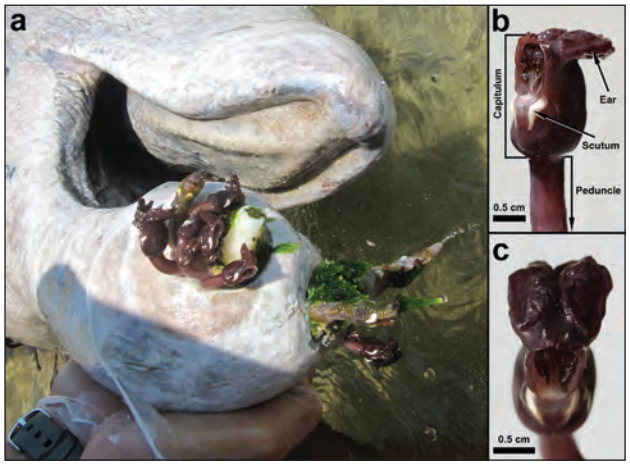

Fig. 3: a) Close view of the whale's jaws with the rabbit-ear barnacles** Conchoderma auritum **and green algae attached to the teeth; b) and c) upper part of a rabbit-ear barnacle specimen. Scale bar = 0.5 cm.
Sl. 3: a) Bližinski posnetek kitove čeljusti z raki vitičnjaki** Conchoderma auritum **in zelenimi algami, pritrjenimi na zobeh; b) in c) zgornji del raka vitičnjaka. Merilo = 0,5 cm.

mammals as hosts (Hogans, 1987). The heavy infestation by parasitic copepods in this case might not have been independent from the presence of the rabbit-ear barnacle. However, no physical connection between the two parasites could be observed from the available photographs, as in other reported cases of fish infestation by *Pennella* sp. and *Conchoderma* sp. (e.g., Pradeep *et al*., 2016). Infestation of cetaceans by *P. balaenoptera* can be a signal of an extended period of weakness (Aznar *et al*., 2005), while a heavy infestation can cause substantial depletion of lymphoid tissue, resulting in ineffective immune responses (Cornaglia *et al*., 2000). Moreover, an extensive epizootic crustacean infestation might be associated with the immunosuppressive effects of a viral infection (cetacean morbillivirus, CeMV) and abnormally heavy loads of polychlorinated biphenyls (Aznar *et al*., 2005). Although CeMV is rarely reported in Cuvier's beaked whales (Jacob *et al*., 2016), parasitosis of *P. balaenoptera* can be seen as an indicator of cetacean health (Vecchione & Aznar, 2014).

The available evidence suggests that the Cuvier's beaked whale studied here was probably weakened and unable to feed. The infestation with the copepods and the settlement of the barnacles was likely the result of the whale's gradual debilitation that eventually led to its death.

ACKNOWLEDGEMENTS

The authors thank Hercules, Marilena and Theofanis Dimitriadis for sending the whale's photographs and the samples of barnacles and algae. They are also grateful to Asst. Prof. Teresa Paula Gonçalves Cruz (Department of Biology, University of Évora, Portugal) for her advice on barnacle measurements. Ultimately, they thank Miss Heather Margaret Vance for her helpful comments to improve the manuscript.

PRVI ZAPIS O POJAVLJANJU RAKA VITIČNJAKA VRSTE *CONCHODERMA AURITUM* (CIRRIPEDIA: LEPADIDAE) NA CUVIERJEVEM KLJUNATEM KITU *ZIPHIUS CAVIROSTRIS* (CETACEA: ZIPHIIDAE) V GRČIJI

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POVZETEK

*Truplo odraslega samca Cuvierjevega kljunatega kita (*Ziphius cavirostris*, Ziphiidae) je julija 2016 naplavilo blizu obale otoka Krfa (Grčija). Na kitu se je zaredilo nekaj deset ceponožcev iz rodu* Pennella*, medtem ko so bili na bazi zob pritrjeni raki vitičnjaki* Conchoderma auritum *(Cirripedia, Lepadidae) in zelene alge. Avtorji so opravili standardne meritve na rakih vitičnjakih in izmerili povprečno dolžino glavičastega dela (capitulum), ki je meril 12,88 mm (sd = 6,26 mm, n = 13). Čeprav so o tem raku vitičnjaku že poročali, da je bil najden na mnogih morskih sesalcih in je tudi sicer kozmopolit, gre za prvi zapis o pojavljanju te vrste v vzhodnem Sredozemskem morju.*

Ključne besede: rak vitičnjak, zajedalec, *Pennella*, Cuvierjev kljunati kit, kiti, Sredozemsko morje

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IHTIOLOGIJA

ITTIOLOGIA

ICHTHYOLOGY

short scientific article
received: 2016-12-21

DOI 10.19233/ASHN.2017.05

FIRST CONFIRMED RECORD OF WEDGE SOLE *DICOLOGLOSSA CUNEATA* (SOLEIDAE) FROM THE TUNISIAN COAST (CENTRAL MEDITERRANEAN)

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ABSTRACT

This paper reports the first record of two specimens of wedge sole Dicologlossa cuneata *(Moreau, 1881) from the Tunisian coast. This record confirms the occurrence of the species off the Maghreb shore, but do not suggest a successful establishment of a viable population in this region. Its rarity in Tunisian waters is probably due to the fact that, locally, the species has no economic value.*

Key words: morphometric measurements, meristic counts, distribution, Maghreb shore, central Mediterranean Sea

PRIMO RITROVAMENTO CONFERMATO DI SOGLIOLA CUNEATA *DICOLOGLOSSA CUNEATA* (SOLEIDAE) LUNGO LA COSTA TUNISINA (MEDITERRANEO CENTRALE)

SINTESI

L'articolo riporta il primo ritrovamento di due esemplari della sogliola cuneata Dicologlossa cuneata *(Moreau, 1881) lungo la costa tunisina. Il ritrovamento conferma la presenza della specie al largo della costa di Maghreb, ma non indica un avvenuto insediamento di una popolazione vitale nell'area. La rarità della specie in acque tunisine è probabilmente dovuta al fatto che, localmente, la specie non ha alcun valore economico.*

Parole chiave: misurazioni morfometriche, conte meristiche, distribuzione, costa di Maghreb, mare Mediterraneo centrale

INTRODUCTION

The wedge sole *Dicologlossa cuneata* (Moreau, 1881) is reported in the eastern Atlantic, from the Bay of Biscay (Lagardère, 1980), and continuously southwards to the coast of South Africa (Smith & Heemstra, 1986). It is a well-known fish species in the Mediterranean Sea (Quéro *et al*., 1986) and as one of the main target species off the Spanish coast (Jiménez *et al*., 1998; García-Isarch *et al*., 2006). It is currently vulnerable to depletion from overfishing in this area (Munroe & Nielsen, 2010). Quéro *et al*. (1986), however, did not report the occurrence of *D. cuneata* in the Mediterranean coast of France or in Italian marine waters.

Dicologlosssa cuneata is also known in the eastern Mediterranean, from Greece (Papaconstantinou, 2014) to Turkey (Bilecenoglu *et al*., 2014), and has recently reached as far as the Levantine Basin (Ali *et al*., 2015). *D. cuneata* occurs in southern Mediterranean regions, such as the Maghreb shore from Morocco (Lloris & Rucabado, 1998) to Algeria, where it appears to be a common catch (Rousset & Marinaro, 1983; Boufersaoui & Bedda, 2011). Conversely, the species is not recorded off the Tunisian coast (Bradaï, 2000; Bradaï *et al*., 2004). The surveys regularly conducted throughout the latter area offered us the opportunity to collect two specimens of *D. cuneata*, which are the subject of the present paper. Following Bello *et al*. (2014), the purpose of the paper is therefore to describe both records of *D. cuneata*, as well as commenting on and discussing the species occurrence in the area concerned and in the wider Mediterranean.

MATERIAL AND METHODS

On 4th December 2016, two specimens of *Dicologlossa cuneata* were caught by 16-mm mesh trawl nets on sandy-muddy bottoms, at a depth of approximately 50 m, in the north-western area of the Gulf of Tunis at 37°11′ N and 10°21′ E (Fig. 1). Both specimens were measured to the nearest millimetre and weighed to the nearest gram. The biometric examination of the specimens followed the methodologies by Quéro *et al*. (2003), Louisy (2002), Bello *et al*. (2014) and Ali *et al*. (2015). The weight, morphometric measurements, and meristic counts were summarized in Table 1. The morphometric measurements were provided in absolute values [mm], as well as relative values, expressed as percentages of total length (TL) and standard length (SL). The specimens were preserved in 10% buffered formalin and deposited in the Ichthyological Collection of the Institut des Sciences et Technologies de la Mer de La Goulette (Tunisia) under catalogue numbers INSTM Dic-cun 01 and INSTM Dic-cun 02 (Fig. 2A). The first specimen was photographed using X-rays to allow the counting of the vertebrae (Fig. 2B).

RESULTS AND DISCUSSION

Both specimens were identified as *Dicologlossa cuneata* by the following combination of characters:

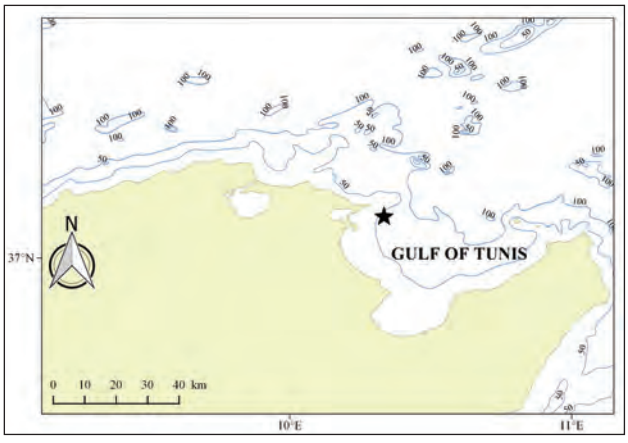

Fig. 1: Map of the north-eastern coast of Tunisia showing the Gulf of Tunis and the capture site of the two specimens of *Dicologlossa cuneata* ***(marked by the black star).***
Sl. 1: Zemljevid severovzhodne obale Tunizije s tuniškim zalivom in lokaliteto, kjer sta bila ujeta dva primerka vrste *Dicologlossa cuneata* ***(označena s črno zvezdico).***

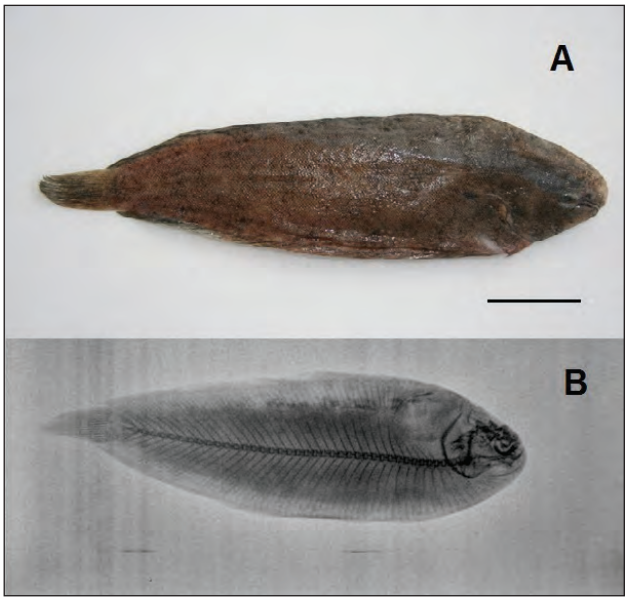

Fig. 2: A. *Dicologlossa cuneata****, specimen INSTM Dic-cun 01, caught in the Gulf of Tunis, scale bar = 20 mm. B. X-ray photograph of the same specimen.***
Sl. 2: A. Primerek vrste *Dicologlossa cuneata****, INSTM Dic-cun 01, ujet v tuniškem zalivu. Merilo = 20 mm. B. Rentgenska fotografija primerka.***

Tab. 1: Absolute and relative biometric data recorded in the two specimens of** Dicologlossa cuneata **caught in the Gulf of Tunis.
Tab. 1: Absolutni in relativni biometrični podatki za primerka vrste** Dicologlossa cuneata**, ujetih v tunizijskih vodah.

Specimen reference	INSTM Dic-cun 01			INSTM Dic-cun 02		
Morphometric measurements	mm	TL%	SL%	mm	TL%	SL%
Total length	173.0	100.0	113.8	164.0	100.0	116.3
Standard length	152.0	87.9	100.0	141.0	86.0	100.0
Body depth	52.3	30.2	34.4	51.0	31.1	36.2
Interorbital space	7.2	4.2	4.7	7.2	4.4	5.1
Pre-pelvic length	29.1	16.8	19.2	30.2	18.4	21.4
Pre-anal length	49.5	28.6	28.6	48.2	29.4	34.2
Dorsal fin length	151.0	87.3	99.3	126.0	76.8	89.4
Dorsal fin base	146.0	84.4	96.1	121.0	73.8	85.8
Dorsal fin height	9.1	5.3	6.0	8.9	5.4	6.3
Anal fin length	125.6	72.6	82.6	114.0	69.5	80.9
Anal fin base	124.0	71.7	81.6	107.0	65.2	75.9
Anal fin height	9.0	5.2	5.9	8.7	5.3	6.2
Meristic counts						
Dorsal fin soft rays	81			82		
Pelvic fin soft rays E/B	7/7			7/7		
Anal fin soft rays	67			67		
Pectoral fin soft rays E/B	7/7			7/7		
Lateral line scales E/B	131/127			131/127		
Supratemporal lateral line scales E/B	0/23			0/23		
Caudal fin soft rays	16			16		
Total vertebrae	44			-		
Total weight (gram)	36.7			103.0		

body oval, tapering backward, snout prominent and rounded, ctenoid scales on the eyed side, cycloid scales on the blindside, mouth curved, lateral line with 125 scales on the eyed side, supra-temporal branch of lateral line forming an angular S-shape (Fig. 3A), pectoral fin on the eyed side with 8 soft rays, somewhat shorter on the blind side with 7 soft rays, dorsal fin with 81-82 soft rays and anal fin with 67 soft rays, both fins joined to the caudal fin, anterior nostril on the blind side not enlarged (Fig. 3B). Brown on the eyed side with a dark blotch on pectoral fin, blind side whitish.

The morphology, colour, morphometric measurements and meristic counts observed in the two specimens were in total agreement with Quéro *et al.* (1986, 2003), Louisy (2002) and Ali *et al.* (2015), and therefore confirmed the presence of *Dicologlossa cuneata* in Tunisian waters, thus increasing the number of fish species previously reported in this area (Ben Amor *et al.*, 2016; Bradaï *et al.*, 2004; Ounifi–Ben Amor *et al.*, 2016). Also, since Munroe & Nielsen (2010) did not include the Tunisian waters among the native regions of *D. cuneata,* the present findings constitute the first confirmed records of *D. cuneata* in Tunisian waters.

D. cuneata is reported continually throughout the eastern coast of the Atlantic, from the Bay of Biscay to southern Africa, where it appears as rather abundant, especially in areas surrounding the Strait of Gibraltar, such as south-western Spain (Jiménez *et al.*, 1998; García-Isarch et *al.*, 2006). The species is unknown in northern Mediterranean areas (Quéro *et al.*, 1986), but frequently captured in areas of the southern Mediterranean, such as the Maghreb shore, both Moroccan (Lloris & Rucabado, 1998) and Algerian coasts (Rousset & Marinaro, 1983). The species has migrated toward eastern Mediterranean

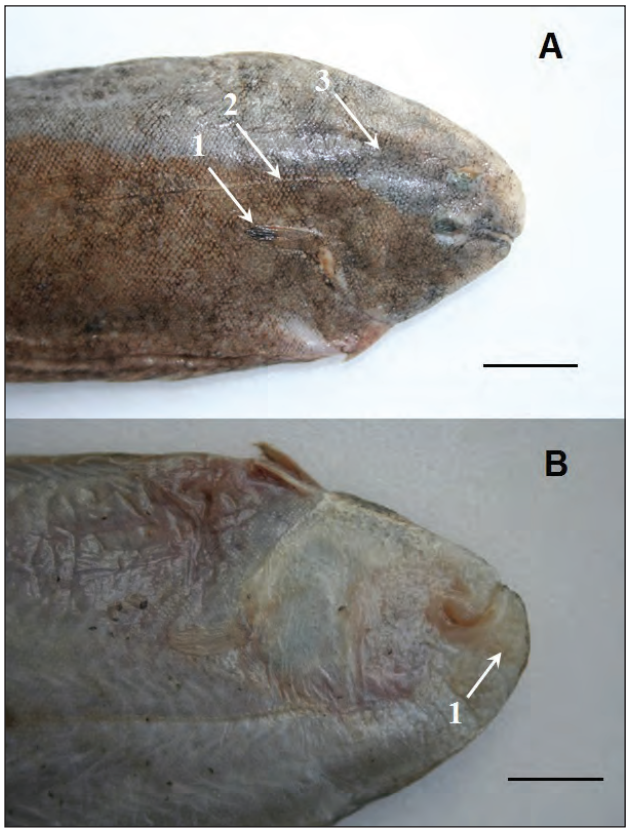

Fig. 3: *Dicologlossa cuneata*, ***specimen INSTM Dic-cun 01. A: Eyed side with arrows indicating black notch on pectoral fin (1), lateral line (2), supra-temporal branch of lateral line forming an angular S-shape (3), scale bar = 20 mm. B: Blind side with arrow indicating anterior nostril (1), scale bar = 20 mm.***
Sl. 3: Primerek vrste *Dicologlossa cuneata*, ***INSTM Dic-cun 01. A: Okata stran telesa. Puščica označuje zajedo (1), pobočnico (2), supra-temporalni del pobočnice v obliki ukrivljene črke S (3), merilo = 20 mm. B: Slepa stran telesa s puščico, ki označuje sprednjo nosnico. (1), merilo = 20 mm.***

areas, presently as far as the Levantine Basin (Ali *et al.*, 2015). The hypotheses of the eastern Atlantic as the source of the Mediterranean *D. cuneata,* and of the species being a Herculean migrant (*sensu* Quignard & Tomasini, 2000) still await confirmation, but cannot be ruled out completely. The scarcity of *D. cuneata* records in Tunisian waters can probably be ascribed to the fact that the species is not as targeted as its cognate species, the common sole *Solea vulgaris* (Quensel, 1806). Recent information given by experienced fishermen could indicate that *D. cuneata* is growing more abundant in the Tunisian fish market, but for that possibility to be taken into serious consideration, the presence of a viable population in the area needs to be supported by further data.

PRVI ZABELEŽEN PRIMER POJAVLJANJA MORSKEGA LISTA VRSTE *DICOLOGLOSSA CUNEATA* (SOLEIDAE) IZ TUNIZIJSKE OBALE (OSREDNJE SREDOZEMSKO MORJE)

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POVZETEK

Avtorji poročajo o prvem zapisu o pojavljanju vrste morskega lista Dicologlossa cuneata *(Moreau, 1881), ujetega ob tunizijski obali. Ta zapis dokazuje, da se vrsta pojavlja v vodah vzdolž magrebske obale, čeprav za zdaj ni možno sklepati o naselitvi viabilne populacije v regiji. Verjetno je potrebno redkost te vrste pripisati dejstvu, da nima ekonomskega pomena.*

Ključne besede: morfometrične meritve, meristična štetja, razširjenost, magrebska obala, vzhodno Sredozemsko morje

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short scientific article
received: 2016-12-09

DOI 10.19233/ASHN.2017.06

A CASE OF HERMAPHRODITISM IN THE COMMON EAGLE RAY *MYLIOBATIS AQUILA* (CHONDRICHTHYES: MYLIOBATIDAE), REPORTED FROM THE TUNISIAN COAST (CENTRAL MEDITERRANEAN)

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ABSTRACT

A common eagle ray Myliobatis aquila *(Linnaeus, 1758) exhibiting abnormal male and female traits on the left side of the genital apparatus was captured off the north-eastern Tunisian coast. As the specimen could not be considered a functioning adult male and/or female, it was classified as an abnormal hermaphrodite. This is the latest of the 16 hermaphrodite batoid specimens known to date.*

Key words: Chondrichthyes, *Myliobatis aquila*, abnormal hermaphrodite, north-eastern Tunisian coast

CASO DI ERMAFRODITISMO NELL'AQUILA DI MARE *MYLIOBATIS AQUILA* (CHONDRICHTHYES: MYLIOBATIDAE) DALLA COSTA TUNISINA (MEDITERRANEO CENTRALE)

Sintesi

Un'aquila di mare Myliobatis aquila *(Linnaeus, 1758), con tratti anormali maschili e femminili sul lato sinistro dell'apparato genitale, è stata catturata al largo della costa nord-orientale della Tunisia. Poiché l'esemplare non può essere considerato né femmina né maschio adulto funzionale, è stato classificato come ermafrodito anormale. Questo è l'ultimo dei 16 esemplari ermafroditi batoidi conosciuti fino ad oggi.*

Parole chiave: Chondrichthyes, *Myliobatis aquila*, ermafrodito anormale, costa tunisina nord-orientale

INTRODUCTION

The common eagle ray *Myliobatis aquila* (Linnaeus, 1758) is distributed over the eastern Atlantic from northern regions to Southern Africa, the frequency of its capture varying by areas (McEachran & Capapé, 1984). The species is also reported in the Mediterranean Sea; it is considered common off the southern coast of France (Capapé *et al*., 2006) and in southern areas, especially off the Maghreb shore (Rafrafi-Nouira, 2016).

M. aquila occurs throughout the Tunisian coast (Bradai *et al*., 2004) and has also been recorded in brackish areas, such as the Lagoon of Bizerte (El Kamel *et al*., 2009). In the wake of a collaboration with experienced local fishermen, some common eagle rays were collected, among them a specimen with a visible asymmetry in the size of the claspers. This specimen was delivered to our laboratory, where it was thoroughly dissected and examined. This paper presents, describes and comments on our observations.

MATERIAL AND METHODS

On 27 November, the specimen was captured by means of a 1000 m long longline with 0.8 m long snoods spaced at 5 m intervals, each carrying 13 hooks baited with common cuttlefish, *Sepia officinalis* Linnaeus, 1758. The capture occurred off Ras Jebel (Fig. 1), in north-eastern Tunisia, at 37° 14′ 08 04″ N and 10° 10′ 53 71″ E, at a depth of 20 m, on sandy-muddy bottom. The specimen had the tail cut off by the fishermen after the capture to avoid sting injury, however, its weight was recorded to the nearest gram and its morphometric measurements to the nearest millimetre, all of which are included in Table 1 with percentages of disc width (% DW). The specimen was preserved in 10% buffered formalin and deposited in the Ichthyological Collection of the Faculté des Sciences of Bizerte (Tunisia) under the catalogue number FSB-Myl-aqui-04.

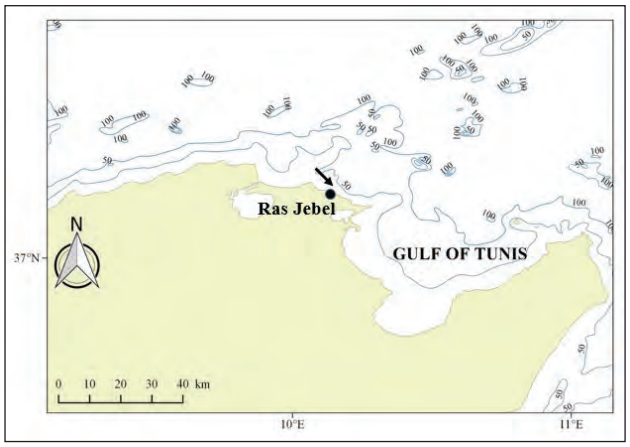

Fig. 1: Map of northern Tunisia indicating the capture site (black arrow) of the abnormal hermaphrodite *Myliobatis aquila* ***(FSB-Myl-aqui-04).***
Sl. 1: Zemljevid severne Tunizije z označeno lokaliteto ulova (črna puščica) abnormalnega hermafrodita morskega goloba (FSB-Myl-aqui-04).

RESULTS AND DISCUSSION

The specimen was identified as a *Myliobatis aquila* based on a suite of characteristics described by Capapé & Quignard (1974), McEachran & Capapé (1984) and El Kamel *et al.* (2009).

The present *Myliobatis aquila* reached 430 mm in DW. Its size allowed us to consider it as a mature specimen, as size at maturity for this species in Tunisian waters ranges between 360 and 410 mm in DW (see

Tab. 1: Morphometric measurements in mm with percentages of disc width (% DW) and weight in grams, recorded in the abnormal hermaphrodite *Myliobatis aquila* ***(FSB-Myl-aqui-04).***
Tab. 1: Morfometrične meritve v mm in delež širine diska (% DW) ter masa v gramih pri abnormalnem hermafroditskem primerku vrste *Myliobatis aquila* ***(FSB-Myl-aqui-04).***

Reference	**FSB-Myl-aqui-04**	
Morphometric measurements	**in mm**	**% DW**
Total length	-	-
Disc length	200	46.5
Disc width	430	100.0
Maximum snout width	80	18.6
Snout length	56	13.0
Mouth width	44	10.2
First gill slit	9	2.0
Fifth gill slit	9	2.0
Distance between first gill slits	65	15.1
Distance between fifth gill slits	34	7.9
Pectoral fin anterior margin	204	47.4
Pectoral fin posterior margin	180	41.8
Pectoral fin inner margin	22	5.1
Pelvic fin anterior margin	54	12.5
Pelvic fin posterior margin	42	9.7
Pelvic fin inner margin	16	3.7
Span of pelvic fins	52	12.0
Right clasper	68	15.8
Left clasper	82	19.0
Total weight (in grams)	**1029.8**	

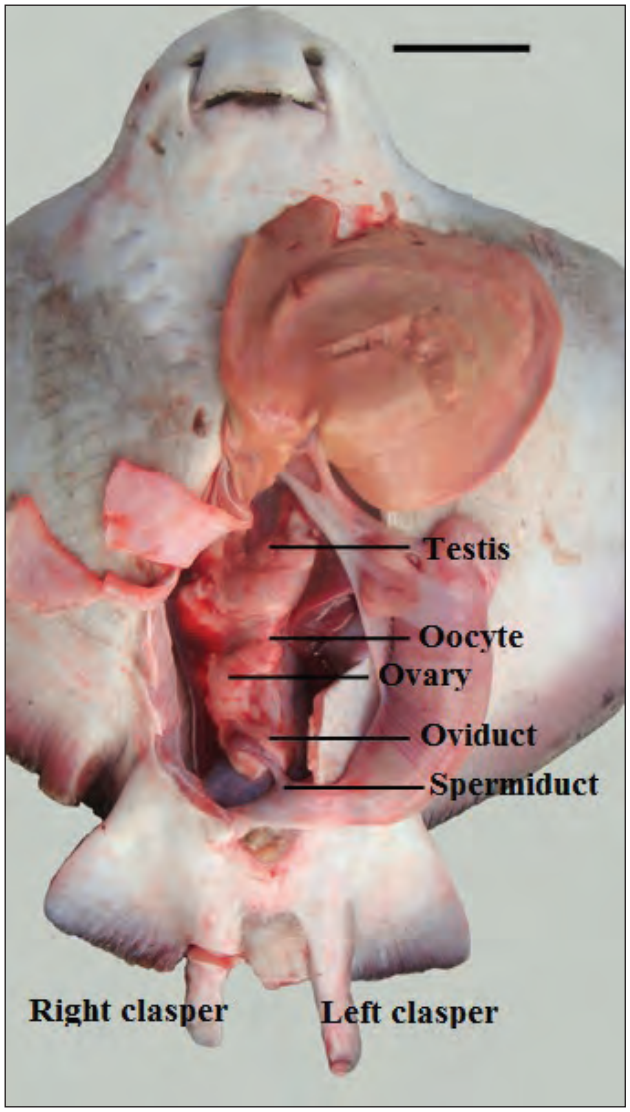

Fig. 2: Dissection of the abdominal cavity of the abnormal hermaphrodite *Myliobatis aquila* ***(FSB-Myl-aqui-04) showing the male and female reproductive organs on the left side of the genital apparatus.***
Sl. 2: Trebušna votlina abnormalnega hermafrodita morskega goloba (FSB-Myl-aqui-04) z moškimi in ženskimi razmnoževalnimi organi na levi strani genitalnega aparata.

Capapé & Quignard, 1974). Conversely, both orbitary surfaces were smooth and missing the horns, the morphological trait only recorded in adult males (Capapé & Quignard, 1974).

A thorough examination of the abdominal cavity revealed a normally developed testis on the right side of the genital apparatus with externally visible spermatocysts (Fig. 2); however, the seminal vesicle contained no sperm and the spermiduct was slightly convoluted. Con-

Tab. 2: Consistency of different morphological traits observed on both sides of the genital apparatus in the abnormal hermaphrodite *Myliobatis aquila* ***(FSB-Myl-aqui-04) with the three stages of development in normal specimens: the juvenile, sub-adult and adult, following Capapé*** *et al.* ***(2007).***
Tab. 2: Značilni morfološki znaki na obeh straneh razmnoževalnega aparata pri abnormalnemu hermafroditskem primerku morskega goloba *Myliobatis aquila* ***(FSB-Myl-aqui-04) in opredelitev treh razvojnih stadijev pri normalnih primerkih: mladič, mladostni primerek, odrasli primerek (po Capapé*** *et al.,* ***2007).***

Morphological characters of the present specimen	Morphological stages following Capapé *et al.* (2007)
Size (DW,mm)	Adult
Orbit	Juvenile
Right testis	Adult
Right spermiduct	Sub-adult
Left testis	Adult
Left spermiduct	Juvenile
Left ovary	Adult
Left oviduct	Juvenile

versely, on the left side, both a testis and an ovary were present. Although the left testis appeared normal, the respective spermiduct was inconspicuously developed and thread-like. The ovary exhibited yolked oocytes, undersized in comparison with mature oocytes ready to be ovulated (Capapé *et al.*, 2007), no oviducal gland was visible and the oviduct was thread-like.

As per Atz (1964) and Iglésias (2005), there exist two types of hermaphrodites in chondrichthyans: normal or true hermaphrodites, and abnormal or pseudo hermaphrodites (see Irvine *et al*., 2002). It appears that normal or true hermaphrodites can – reaching sexual maturity – assume the functions of both the male and the female, while all other cases of hermaphroditism should be defined as abnormal or pseudo-hermaphroditism. In Table 2, we compared the morphology of different traits observed on both sides of the present specimen in order to assess their consistency with the three stages of development in normal specimens: the juvenile, subadult and adult (Capapé *et al*., 2007). Based on the two types of morphology present in the specimen, the *M. aquila* under study could not be considered as a functioning adult male and/or female, but as an abnormal or pseudohermaphrodite specimen. It increases the number of cases of hermaphroditism recorded to date for the batoid species to 16, with 15 previously reported by Capapé *et al.* (2012).

Although Iglesias *et al.* (2005) noted that hermaphroditism is a normal condition in the reproduction of the longhead catshark *Apristurus longicephalus* Nakaya, 1975, the batoid species, to our knowledge, does not display a similar pattern. The causes of hermaphroditism in chondrichthyans remain obscure; however, Atz (1964) suggested they may involve endogenous, hormonal or genetic factors as in other vertebrate species. The impact of unfavourable environmental conditions and pollutants, which induce stress in the wild, cannot be ruled out completely either (Sfakianakis *et al.*, 2004), but that has not been clearly assessed yet (Capapé *et al.*, 2012).

PRIMER HERMAFRODITIZMA PRI NAVADNEM MORSKEM GOLOBU *MYLIOBATIS AQUILA* (CHONDRICHTHYES: MYLIOBATIDAE) OB TUNIZIJSKI OBALI (OSREDNJE SREDOZEMSKO MORJE)

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POVZETEK

Ob severovzhodni tunizijski obali je bil ujet primerek navadnega morskega goloba Myliobatis aquila *(Linnaeus, 1758), pri katerem so bili vidni deli ženskega in moškega spolnega aparata. Primerek je bil opredeljen kot abnormalni hermafrodit, saj ni funkcioniral ne kot odrasel moški ali ženski primerek. Gre za zadnji primer izmed 16 znanih za morske skate.*

Ključne besede: Chondrichthyes, *Myliobatis aquila*, abnormalni hermafrodit, severovzhodna tunizijska obala

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SREDOZEMSKI MORSKI PSI

SQUALI MEDITERRANEI

MEDITERRANEAN SHARKS

original scientific article
received: 2017-01-31

DOI 10.19233/ASHN.2017.07

NOTES ON HISTORICAL AND CONTEMPORARY CATCHES OF LAMNIFORM SHARKS IN TURKISH WATERS

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ABSTRACT

On 22 December 2016, one bigeye thresher shark, Alopias superciliosus*, a female, and two shortfin mako sharks,* Isurus oxyrinchus*, a male and a female, were incidentally captured by a commercial pelagic swordfish long-liner operating in the open waters of the Bay of Antalya (southern Turkey). A huge female of* I. oxyrinchus*, caught by a purse-seiner off the Kuşadası coast in the early 2000s, is currently displayed as a taxidermy specimen at the Kuşadası Fish Market. Available data suggest that new-born, juvenile and adult lamniform sharks are incidentally killed by commercial fisheries in the Levantine Basin, which creates a substantial threat to the survival of the lamniform and other species of large sharks in the region.*

Key words: Lamniforms, large sharks, Levantine, conservation, fisheries, bycatch

NOTE SULLE CATTURE STORICHE E CONTEMPORANEE DEGLI SQUALI LAMNIFORMI IN ACQUE TURCHE

SINTESI

Il 22 dicembre 2016, una femmina di squalo volpe occhiogrosso, Alopias superciliosus*, e un maschio e una femmina di squalo mako,* Isurus oxyrinchus*, sono stati accidentalmente catturati con un palamito commerciale per pesce pelagico nelle acque della baia di Antalya (Turchia meridionale). Una femmina enorme di* I. oxyrinchus*, catturata con una rete da circuizione al largo della costa di Kuşadası nei primi anni 2000, è ora esposta come esemplare tassidermizzato al mercato del pesce di Kuşadası. I dati disponibili suggeriscono che individui sia giovani che adulti di squali lamniformi vengono accidentalmente uccisi nel bacino levantino dalla pesca commerciale, che crea una minaccia sostanziale per la sopravvivenza dei lamniformi e di altre specie di grossi squali nella regione.*

Parole chiave: Lamniformi, grandi squali, bacino levantino, conservazione, pesca, cattura accessoria.

INTRODUCTION

The Lamniformes are a small group of sharks with 15 living species worldwide (Compagno, 2002), 9 of them occurring in the Mediterranean Sea (Serena, 2005). Except for one species, the small-sized crocodile shark, *Pseudocarcharias kamoharai* (Matsubara, 1936), all other living lamniform sharks are medium-sized to gigantic species, inhabiting varied habitats, from coastal to open oceanic waters, and ranging from bottom-dwellers to high-speed tachypelagic predators (Compagno, 2002).

Although the early reports on the occurrence of lamniform sharks in Turkish waters date back to the early 20th century (*e.g.* Deveciyan, 1926), the study of the biology and distribution of individual lamniform species only began in the late 1990s (*e.g.* Kabasakal, 1998). In the most recent checklist of marine fish in Turkey, Bilecenoğlu *et al*. (2014) reported on the occurrence of 8 species of lamniform sharks in Turkish waters: *Carcharias taurus* Rafinesque, 1810; *Odontaspis ferox* (Risso, 1810); *Carcharodon carcharias* (Linnaeus, 1758); *Isurus oxyrinchus* Rafinesque, 1810; *Lamna nasus* (Bonnaterre, 1788); *Cetorhinus maximus* (Gunnerus, 1765); *Alopias superciliosus* Lowe, 1841; and *A. vulpinus* (Bonnaterre, 1788). Before this ichthyological inventory, Kabasakal (2011) reported the occurrence of the same lamniform species in the first shark-specific inventory study of Turkish waters.

In the present article, the author reports on the historical and recent captures of several lamniform sharks landed by commercial fishermen operating in different zones of Turkish seas.

MATERIAL AND METHODS

On 22 December 2016, one bigeye thresher shark, *A. superciliosus*, a female, and two shortfin mako sharks, *I. oxyrinchus*, a male and a female, were incidentally captured by a commercial pelagic swordfish long-liner operating in the open waters of the Bay of Antalya (Fig. 1). A huge female of *I. oxyrinchus* had been caught by a purse-seiner off the Kuşadası coast (Fig. 1) in the early 2000s, and is currently displayed as a taxidermy specimen at the Kuşadası Fish Market. Since the taxidermy shortfin mako shark was dried in a curved position without prior measurement of its body, the total length (TL) and the precaudal length (PCL) of this specimen were determined based on its photograph, by means of Klonk Image Measurement software with reference to the size of a known object located in the same plane as the taxidermy shortfin mako. The length of the bottom border of a poster frame (70 cm) seen just behind the taxidermy

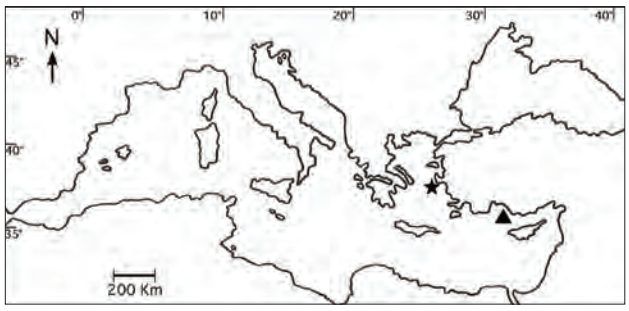

Fig. 1: Capture sites of *Alopias superciliosus* ***(▲) and*** *Isurus oxyrinchus* ***(▲ - fresh specimens; ★ - taxidermy specimen) in Turkish waters.***
Sl. 1: Lokalitete ulova primerkov vrst *Alopias superciliosus* ***(▲) in*** *Isurus oxyrinchus* ***(▲ - sveži primerki; ★ - nagačen primerek) v turških vodah.***

Fig. 2: *Alopias superciliosus* ***and*** *Isurus oxyrinchus* ***specimens caught in the Bay of Antalya (Photo: IRS archives).***
Sl. 2: Primerki vrst *Alopias superciliosus* ***in*** *Isurus oxyrinchus****, ujeti v Antalijskem zalivu (Foto: arhiv IRS).***

Tab. 1: Selected measurements of examined specimens of *Alopias superciliosus* ***and*** *Isurus oxyrinchus* ***caught in Turkish waters.***
Tab. 1: Izbrane meritve preiskanih primerkov vrst *Alopias superciliosus* ***in*** *Isurus oxyrinchus****, ujetih v turških vodah.***

***Alopias superciliosus* Lowe, 1841 - ♀**		
Measurement	**Value (cm)**	**% of TL**
Total Length (TL)	342.4	---
Precaudal fin length	240.5	70.2
Prebranchial length	34.6	10.1
Preorbital length	14.7	4.2
Prepectoral fin length	38.6	11.2
Preoral length	15.1	4.4
Interorbital space	9.4	2.7
Eye length	6.9	2.01
Eye height	5.1	1.4
Pectoral fin anterior margin	46.4	13.5
***Isurus oxyrinchus* Rafinesque, 1810 - ♀ - fresh specimen**		
Measurement	**Value (cm)**	**% of TL**
Total Length (TL)	71.2	---
Precaudal fin length	57.9	81.3
Prebranchial length	24.2	17.2
Preorbital length	8.8	6.26
Prepectoral fin length	31.5	22.4
Prenarial length	4.7	3.3
Eye length	1.8	2.5
Pectoral fin anterior margin	13	18.2

shortfin mako shark was used as a reference to estimate the animal's TL and PCL. Based on the resultant TL and PCL measures, the size of the fresh specimen was calculated, taking into account the 3.8% to 15% shrinkage parameter for frozen shortfin mako shark (Celona *et al*., 2004). Fresh specimens of *A. superciliosus* and *I. oxyrinchus* were measured and photographed by volunteer field observers of the Ichthyological Research Society (IRS). The total length and several biometrical measurements of the examined specimens were taken on site, using a measuring tape, and recorded to the nearest 0.1 cm, following Compagno (2002). The photographs and measurements of the specimens were delivered to the IRS for further analysis and are preserved in its archives.

RESULTS AND DISCUSSION

Species identification of *A. superciliosus* and *I. oxyrinchus* were based on the following descriptive characters (Compagno, 2002):

***Alopias superciliosus* Lowe, 1841**

Head nearly flat between the eyes, with a deep horizontal groove on either side of the nape above the gills; eyes large, reaching the dorsal surface of the head; 24 teeth on the upper and 22 on the lower jaw; first dorsal fin base closer to pelvic bases than to pectoral bases (Fig. 2).

***Isurus oxyrinchus* Rafinesque, 1810**

A spindle-shaped, moderately slender fusiform body with an acutely pointed snout and relatively small eyes (Figs. 2 & 3); U-shaped ventral mouth with the lower anterior teeth strongly protruding and horizontal on jaw, cusps of teeth with non-serrated cutting edges and flexed tips; 25 teeth on the upper and 28 teeth on the lower jaws; anterior length of pectoral fin shorter than head length (Tab. 1); apex of the first dorsal fin somewhat rounded; brilliant to greyish-blue colouration dorsally and white ventrally, tip of snout with dark to black blotch ventrally (Figs. 2 & 3).

Fig. 3: Head view of** Isurus oxyrinchus **caught in the Bay of Antalya. (Photo: IRS archives).
Sl. 3: Glava maka** Isurus oxyrinchus**, ujetega v Antalijskem zalivu (Foto: arhiv IRS).

The descriptive characters of the examined lamniform species coincided well with those described in Compagno (2002) and Serena (2005). Moreover, the morphometric measurements of the examined species also matched the ones reported for several lamniform species previously caught in Turkish waters (Kabasakal & Karhan, 2008; Kabasakal & Kabasakal, 2013; Tunçer & Kabasakal, 2016), with negligible differences.

In two embalmed bigeye thresher sharks (TL 310 and 450 cm) caught in Dodecanese waters (southern Aegean Sea), the prepectoral length, as reported by Corsini-Foka and Sioulas (2008), was 11.1% and 14.5% of total length, respectively, while in the present specimen it amounted to 11.2% of TL (Tab. 1). Kabasakal and Karhan (2008) examined the head of an *A. superciliosus* caught in the Sea of Marmara, and reported its interorbital space- and eye height-to-total length ratios as 25.8% and 13.04%, respectively (in the examined specimen, 27.1% and 14.7%, respectively; Tab. 1).

Previous captures of two young shortfin mako sharks (TL 74.7 and 123.6 cm) in northeastern Aegean Sea provided the opportunity to compare the biometric measurements of a young *I. oxyrinchus* caught off the Turkish coast (Kabasakal & Kabasakal, 2013; Tunçer & Kabasakal, 2016). The precaudal length-, prepectoral length- and pectoral anterior length-to-TL ratios in the examined specimens of young shortfin mako sharks stood at 81.31% to 82.99%, 27.04% to 27.1% and 15.93% to 16.06%, respectively (Kabasakal & Kabasakal, 2013; Tunçer & Kabasakal, 2016). In the latter fresh sample, the precaudal length-, prepectoral length- and pectoral anterior length-to-TL ratios were about 81.3%, 22.4% and 18.3% (Tab. 1). According to Compagno (2002), the pectoral anterior length-to-TL ratio in *I. oxyrinchus* is between 16% and 22%.

The precaudal length (PCL) and total length (TL) of the taxidermy female shortfin mako shark (Fig. 4) were estimated to be 260.41 cm and 288.07 cm, respectively. Based on the 3.8% to 15% shrinkage in frozen specimens for *I. oxyrinchus* (Celona *et al*., 2004), the adjusted estimates of PCL and TL of the taxidermy shortfin mako shark amounted to 299.01 cm and 331.28 cm, indicating a huge specimen while it was alive. Compagno (2002) considered an estimated maximum total length of about 408 cm for *I. oxyrinchus*. Since the female *I. oxyrinchus*, according to Compagno (2002), matures at about 275 to 293 cm TL, the adjusted size estimates indicate that the taxidermy shortfin mako shark was a mature female. The occurrence of newborns and huge specimens of *I. oxyrinchus* in the Aegean Sea off the Turkish coast is well documented by historical and contemporary records of shortfin mako sharks in the mentioned region (Kabasakal & De Maddalena, 2011; Kabasakal, 2015; Tunçer & Kabasakal, 2016).

The first record of *A. superciliosus* in Turkish waters was reported by Mater (2005), based on a specimen (TL 350 cm) caught in the Gökova Bay (SE Aegean Sea) on 23 May 2005. Subsequently to the Gökova specimen, several bigeye thresher sharks were recorded in different regions of Turkish waters (Kabasakal & Karhan, 2008; Kabasakal *et al*., 2011). On 25 February 2007, a bigeye thresher shark (TL 450 cm) was captured off the Silivri coast, which extended the Mediterranean distribution of *A. superciliosus* into Marmaric waters (Kabasakal & Karhan, 2008). Although the occurrence of *A. superciliosus* in Turkish waters is based on fairly recent records, Corsini-Foka and Sioulas (2008) pointed out that specimens of *A. superciliosus* had been captured in Dodecanese waters (SE Aegean Sea) at least since 1952. Corsini-Foka and

Fig. 4: Taxidermy specimen of** Isurus oxyrinchus **captured in the central Aegean Sea off the Turkish coast. (Photo: IRS archives).
Sl. 4: Nagačen primerek maka** Isurus oxyrinchus**, ujetega v osrednjem Egejskem morju ob turški obali (Foto: arhiv IRS).

Sioulas (2008) examined two old embalmed specimens captured in Dodecanese waters and displayed at the collection of the Hydrobiological Station of Rhodes, and concluded that they were misidentified for a long time as *A. vulpinus*, since they belong to the species *A. superciliosus*. According to Clo *et al*. (2008), a bigeye thresher shark was captured off the Marmaris coast, Turkey (SE Aegean Sea) in April 2004, and two neonates were recorded in Israeli waters (eastern Mediterranean) in 1996. Therefore, it is necessary to examine the historical records of *Alopias* specimens with precise dates of capture, preserved in scientific or fisheries collections, to clarify whether the first record of the occurrence of *A. superciliosus* in Turkish waters could be dated before 2005.

Evidence of the decline of large predatory sharks in the Mediterranean Sea has been provided by Ferretti *et al*. (2008). In a recent review of large sharks caught by commercial fishermen in Turkish waters, Kabasakal *et al*. (2017) emphasized that the low numbers of *A. superciliosus* and *I. oxyrinchus* captures were mostly related to pelagic fishing vessels. According to the authors, the *A. superciliosus* and *I. oxyrinchus* specimens represented 2.5% and 5.6% of the total large shark catch (n=394) in Turkish waters between 1990 and 2015.

Evidence linking commercial fisheries and lamniform shark catch both in Turkish waters and in the entire Mediterranean Sea has been provided by several studies (*e.g.* Damalas & Megalofonou, 2012; De Maddalena & Heim, 2012; Kabasakal, 2007, 2015, 2016). According to Serena (2005), *A. superciliosus* and *I. oxyrinchus* are caught as bycatch in pelagic longline fisheries, mainly tuna longliners, throughout the Mediterranean Sea. Regarding the conservation status in the Mediterranean, *A. superciliosus* is an endangered (A2bd) and *I. oxyrinchus* a critically endangered (A2bd) shark species (Dulvy *et al*., 2016). The fishery-dependent nature of the surveys (*e.g.* Kabasakal, 2007, 2015, 2016; Kabasakal *et al*., 2017) did not allow for the mentioned region to be sampled homogeneously in time and space, and studies like the present one can only provide anecdotal evidence on the occurrence of large pelagic sharks. This leaves significant gaps in our understanding of the status of large pelagic sharks in Turkish waters.

The results of previous studies have demonstrated that the catches of large pelagic sharks, including the Lamniformes, in the Levantine Basin are characterized by much larger specimens than those in other areas of the Mediterranean Sea (*e.g.* Kabasakal, 2007, 2015, 2016; Kabasakal & De Maddalena, 2011; Megalofonou *et al*., 2005). Recent captures of new-born and juvenile specimens of several lamniform sharks, such as *C. carcharias*, *I. oxyrinchus* and *A. vulpinus*, have also sug-

gested the possibility of breeding or nursery grounds of the mentioned species in the region (Kabasakal, 2015, 2016). For the moment, no speculation can be made on the status of breeding populations of the Lamniformes in the region. However, available data suggest that newborns, juveniles and adults of lamniform species are incidentally killed by commercial fisheries in the Levantine Basin, which creates a remarkable threat to the survival of the Lamniformes, as well as other large sharks in the region.

ACKNOWLEDGMENTS

The author wishes to thank the following person who kindly provided support in the field surveys of lamniform shark research and photographs of the examined specimens: Mr. Berg G. İpek, angler, and Mr. Nesimi Ozan Veryeri, Underwater Research Association (SAD). Special thanks go to my wife Özgür and my son Derin, for their endless love and patience.

ZAPISI O HISTORIČNIH IN SODOBNIH ULOVIH MORSKIH VOLKOV (LAMNIFORMES) V TURŠKIH VODAH

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POVZETEK

*Dvaindvajsetega decembra 2016 so bili v odprtih vodah zaliva Antalya (južna Turčija) naključno ujeti samica velikooke morske lisice (*Alopias superciliosus*) in samec ter samica atlantskega maka* (Isurus oxyrinchus) *v ribiške mreže za lov mečaric. Nagačen preparat izredno velike samice maka, ki so jo ujeli blizu obale Kuşadası okoli leta 2000, pa je trenutno razstavljen v ribji tržnici Kuşadası. Razpoložljivi podatki kažejo, da se skotenci, mladostni in odrasli primerki lamniformnih morskih psov naključno ujamejo v mreže komercialnih ribičev levantskega bazena, kar povzroča veliko nevarnost za preživetje te skupine morskih psov in drugih velikih vrst v regiji.*

Ključne besede: morski volkovi in sorodstvo, veliki morski psi, levantski bazen, varstvo narave, ribištvo, prilov

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short scientific article
received: 2017-01-23

DOI 10.19233/ASHN.2017.08

RECORD OF DICEPHALOUS EMBRYO IN LONGNOSE SPURDOG *SQUALUS BLAINVILLEI* (CHONDRICHTHYES: SQUALIDAE) FROM THE SYRIAN COAST (EASTERN MEDITERRANEAN)

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ABSTRACT

This paper reports the first record of a dicephalous specimen of Squalus blainvillei *(Risso, 1810) from the Syrian coast and the second known to date for this species – a female embryo of longnose spurdog, reaching 200 mm in total length, probably a near-term embryo despite the presence of an external yolk sac. The causes of this abnormality are discussed and commented.*

Key words: Chondrichthyes, Squalidae, *Squalus blainvillei*, viviparous aplacental species, conjoined twins, Eastern Mediterranean

RITROVAMENTO DI UN EMBRIONE DICEFALO DI SPINAROLO BRUNO *SQUALUS BLAINVILLEI* (CHONDRICHTHYES: SQUALIDAE) LUNGO LA COSTA SIRIANA (MEDITERRANEO ORIENTALE)

SINTESI

L'articolo riporta il primo ritrovamento di un esemplare dicefalo di Squalus blainvillei *(Risso, 1810) lungo la costa siriana, ossia il secondo a oggi segnalato per questa specie. Si tratta di un embrione femminile di spinarolo bruno, della lunghezza totale di 200 mm, probabilmente in fase embrionale terminale nonostante la presenza di un sacco vitellino esterno. Le cause di quest'anomalia vengono discusse e commentate.*

Parole chiave: Chondrichthyes, Squalidae, *Squalus blainvillei*, specie aplacentali vivipare, gemelli siamesi, Mediterraneo orientale

INTRODUCTION

Following Dawson (1964, 1966, 1971) and Dawson & Heal (1971), Ribeiro-Prado *et al.* (2008) noted that three categories of abnormalities could be distinguished in fish species: colour (full or partial albinism), genital apparatus (total, semi or pseudo hermaphrodism) and morphological deformities (teratological cases, also called 'monstrosities' by the authors), with the latter being the most frequently reported category in elasmobranch species. To date, two lists summarizing the abnormalities recorded in elasmobranch species have been compiled, one including all elasmobranch species (Saïdi *et al.*, 2006) and the other only skates and rays (Ribeiro-Prado *et al.*, 2008).

Different abnormalities were listed for sharks – most commonly, snout deformities, skeletal deformities and abnormal and/or missing fins –, however, of the 33 cases reported only two concerned dicephalic embryos (Saïdi *et al.*, 2006), also known in literature as two-headed or dicephalous sharks (see Sans-Coma *et al.*, 2017). According to Bondeson (2001), the term dicephalous applies to conjoined specimens with totally separated heads on a single body, while the term diprosopus refers to a single body and head, with only parts of the latter duplicated (Sans-Coma *et al.*, 2017).

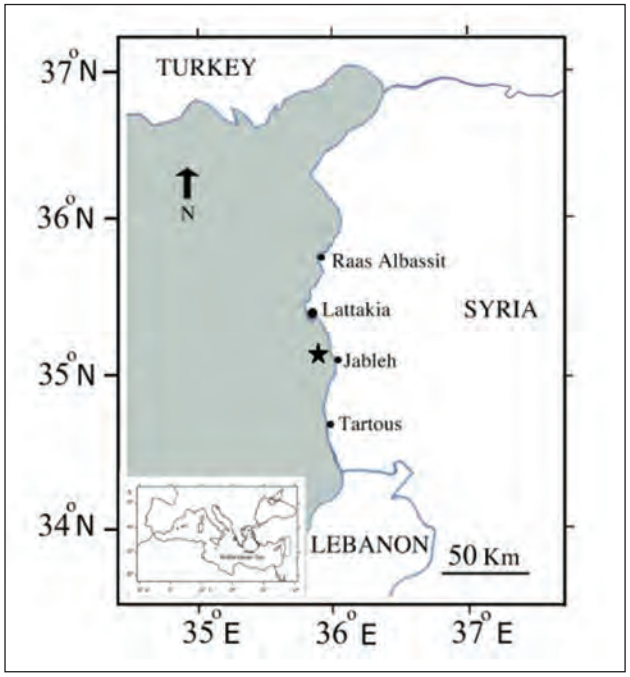

Fig. 1: Map of the Mediterranean showing Syria, and map of the Syrian coast indicating the capture site of the dicephalous *Squalus blainvillei* ***(black star).***
Sl. 1: Zemljevid Sredozemskega morja in Sirije z označeno lokaliteto vzdolž sirske obale, kjer je bil ujet dvoglavi primerek vrste *Squalus blainvillei* ***(črna zvezdica).***

Generally, such deformities are only observed in embryos, as these do not survive after laying or hatching in the wild (Galván-Magaña *et al.*, 2011). The aim of this paper is to report a new record – a two-headed embryo removed from a normal adult female of a longnose spurdog *Squalus blainvillei* (Risso, 1826) caught off the Syrian coast – and to complete the Sans-Coma *et al.*'s review (2017) concerning the dicephalous sharks known to date.

MATERIAL AND METHODS

On 13 February 2013, a shark carrying a dicephalous embryo was captured off the Syrian coast, by trawl net, on sandy bottom, at a depth of about 50 m. The capture site was located 5 km off the beach of Jablah, a Syrian coastal town, at 35º 44´ E, 35º 24´ N (Fig. 1). Due to the rarity of the abnormal specimen, it was impossible for us to recover it from the fishermen, so unfortunately, it is not preserved in an ichthyological collection. Our study is thus mainly based on photographs (see Figs. 2 and 3).

RESULTS AND DISCUSSION

The adult shark was identified following McEachran & Branstetter (1984) and Louisy (2002), based on a combination of morphological characters, such as: origin of first dorsal spine on a vertical with inner pectoral corner, dorsal surface without white spots, anterior nasal flap with a small, but distinct lobe. McEachran & Branstetter (1984) and Louisy (2002) noted that *Squalus blainvillei* could be distinguished from its close relative species, spurdog *S. acanthias* Linnaeus, 1758, by the presence of white spots and the lack of lobe in the nasal flap in the latter.

The respective dicephalous specimen was a female embryo measuring 200 mm in total length (TL), with

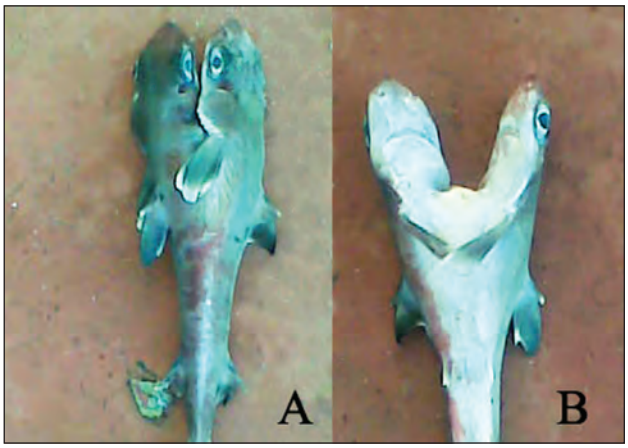

Fig. 2: Dicephalous *Squalus blainvillei* ***captured off the Syrian coast. A. dorsal surface, B. ventral surface.***
Sl. 2: Dvoglavi primerek vrste *Squalus blainvillei,* ***ujet ob sirski obali. A. hrbtna stran, B. trebušna stran.***

a single body, normal fins and two heads originating anteriorly to the gills. Each head exhibited a mouth, two eyes, two spiracles and two gill openings. The body of the embryo was supported by two well-developed vertebral columns and ended with a single caudal fin (Figs. 2A and 2B). The size of the specimen corresponded to that of near-term embryos; for instance, Quignard (1971) reported that size at birth for the *S. blainvillei* from the Tunisian coast occurred between 210 and 240 mm TL, Capapé *et al*. (2000) reported it between 224 and 255 mm TL for the Languedocian coast, southern France, and Kousteni & Megalofonou (2011) between 180 and 229 mm TL for the eastern Mediterranean. A large external yolk sac appears in Fig. 3, characteristic of viviparous aplacental shark species generally resorbed in an internal vitelline vesical in near-term embryos (see Capapé & Reynaud, 2011). This yolk sac is unique to the dicephalous embryo and could explain its large size.

Following Sans-Coma *et al*. (2017), it is the second record of a dicephalous specimen of *Squalus blainvillei* known to date, the first being the specimen found by Lozano Cabo (1945) off the Spanish Mediterranean coast. Therefore, three cases of dicephaly were found in viviparous aplacental shark species and only one in an oviparous shark species, Atlantic saw tail cat shark *Galeus atlanticus* (Vaillant, 1888), which, following Sans-Coma *et al*. (2017), suggests that dicephaly is more common in viviparous placental shark species. To this regard, Galván-Magaña *et al*. (2011) stated that *Prionace glauca* could register the highest number of two-headed embryos due to the fact it is one of the most fecund sharks in the world, its litter reaching up to 50 specimens. The abnormality is assumed to begin during the embryonic development. In viviparous aplacental sharks, the embryos are free in the mother's uteri conversely, while in viviparous placental sharks, each embryo is confined to a restricted chamber and attached to the uterine wall by an umbilical stalk, with such conditions presumably facilitating an abnormal development during gestation.

Ehemann *et al*. (2016) noted that two-headed shark embryos were more common in the wild than in captivity, and stated that such abnormalities might be caused by overfishing. Additionally, Galván-Magaña *et al*. (2011) noted that scientists frequently reported these anomalies, and that two-headed sharks had become more prevalent. However, unfavourable environmental conditions such as large exposure to pollutants, play an important role in the occurrence of abnormalities in elasmobranchs and Ribeiro-Prado *et al*. (2008) explain why they are more frequently observed in oviparous than viviparous species: the former develop their eggs in the wild, whereas in the latter, the embryos are protected by the mother during their embryonic development. Similar patterns have been reported in our study area, abnormalities were described in two skates species, thornback ray *Raja clavata* Linnaeus, 1758, and longnosed skate *Dipturus oxyrhinchus* (Linnaeus, 1758), by Capapé *et al*. (2015a, b).

Fig. 3: Dicephalous** Squalus blainvillei **captured off the Syrian coast, with the arrow indicating the yolk sac.
Sl.. 3: Dvoglavi primerek vrste** Squalus blainvillei, **ujet ob sirski obali. Zvezdica označuje rumenjakovo vrečo.

Abnormalities in elasmobranch species in the wild are the consequence of different and various parameters, including viruses, pollutants, and especially genetic factors. In complete agreement with Ehemann *et al*. (2016) and Sans-Coma *et al*. (2017), we can say it remains difficult to conduct a research about the birth defects affecting sharks, dicephaly in particular, as two-headed specimens are still rare and probably unable to survive in the wild.

DVOGLAVI RJAVI TRNEŽ *SQUALUS BLAINVILLEI* (CHONDRICHTHYES: SQUALIDAE) IZ SIRSKE OBALE (VZHODNO SREDOZEMSKO MORJE)

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POVZETEK

Avtorja poročata o prvem primeru pojavljanja dvoglavega primerka vrste Squalus blainvillei *(Risso, 1810) iz sirske obale in o drugem znanem dozdaj za to vrsto. Zarodek samice rjavega trneža, ki je meril 200 mm v dolžino, je bil v sklepni fazi, čeprav je še vedno imel zunanjo rumenjakovo vrečo. Avtorja nadalje razpravljata o tej anomaliji.*

Ključne besede: Chondrichthyes, Squalidae, *Squalus blainvillei*, živorodna aplacentalna vrsta, siamska dvojčka, vzhodno Sredozemsko morje

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CAMBIAMENTI RECENTI NELLA BIODIVERSITÀ MEDITERRANEA

RECENT CHANGES IN THE MEDITERRANEAN BIODIVERSITY

short scientific article
received: 2017-04-10

DOI 10.19233/ASHN.2017.09

ABUNDANT RECORDS OF RED-EYE ROUND HERRING *ETRUMEUS GOLANII* (OSTEICHTHYES: CLUPEIDAE) FROM THE TUNISIAN COAST (CENTRAL MEDITERRANEAN)

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ABSTRACT

This paper reports an additional record of red-eye round herring Etrumeus golanii *DiBattista, Randall & Bowen, 2012 from the Tunisian coast. The studied specimen was singled out from a 640 kg haul of* E. golanii *caught off the northern Tunisian coast. The abundant catch suggests that an important and viable population has successfully established in this region. Nevertheless, further studies are needed to demonstrate that such an ichthyological event was not fortuitous.*

Key words: *Etrumeus golanii,* morphometric measurements, meristic counts, Lessepsian migration, central Mediterranean, Tunisia

NUMEROSI RITROVAMENTI DI *ETRUMEUS GOLANII* (OSTEICHTHYES: CLUPEIDAE) LUNGO LA COSTA TUNISINA (MEDITERRANEO CENTRALE)

SINTESI

L'articolo riporta un ritrovamento aggiuntivo dell'aringa rotonda dagli occhi rossi, Etrumeus golanii *DiBattista, Randall & Bowen, 2012, catturata lungo la costa tunisina. Il campione studiato è stato prelevato da una retata di 640 kg di* E. golanii, *prelevata al largo della costa tunisina settentrionale. Le recenti abbondanti catture di questa specie suggeriscono che una popolazione vitale si sia stabilita con successo in questa regione. Tuttavia, ulteriori studi sono necessari per dimostrare che tale evento ittiologico non sia stato solamente fortuito.*

Parole chiave: *Etrumeus golanii*, misure morfometriche, conteggi meristici, migrazione lessepsiana, Mediterraneo centrale, Tunisia

INTRODUCTION

The red-eye round herring *Etrumeus golanii* DiBattista, Randall & Bowen, 2012 is a Lessepsian migrant (*sensu* Por, 1978), common in the Red Sea (Golani, 2005), which passed through the Suez Canal into the Mediterranean, where it was first recorded in Haifa Bay (Whitehead, 1963). The species has invaded the eastern Mediterranean, where it appears to be successfully established (Golani *et al*., 2002). Furthermore, it has migrated towards western areas and has been recorded in the central Mediterranean, off the Island of Lampedusa (Falautano *et al*., 2006), and southwards in the Gulf of Gabès, Tunisia (Boussellaa *et al*., 2016).

In March 2017, in the course of routine monitoring of Tunisian waters, now a decade long practice, and concomitantly, in the wake of a collaboration with experienced fishermen familiar with these fishing grounds, we were informed of a haul of fish caught during a trawling survey that took place off the northern Tunisian coast. The present paper offers a short description of a specimen from this catch, its morphometric and meristic measurements, and some comments about the real status of the species in the area.

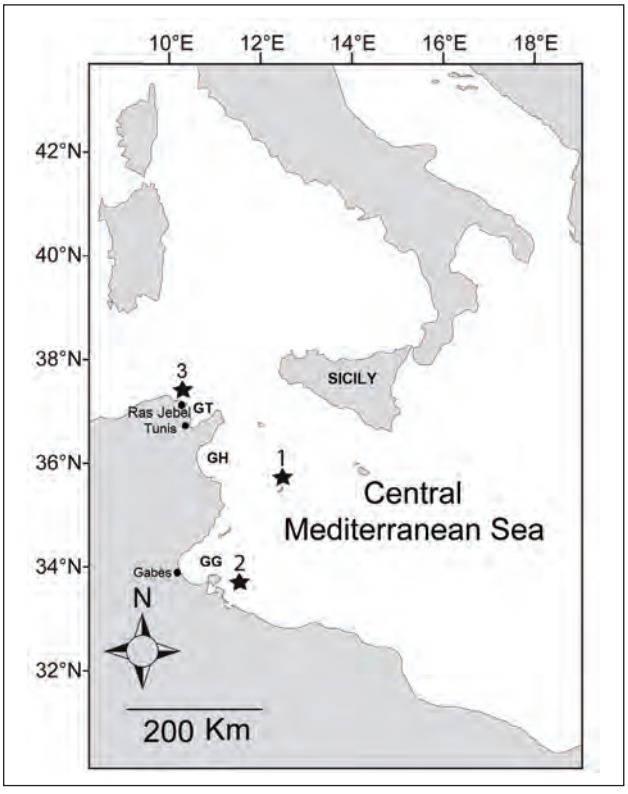

Fig. 1: Map of the central Mediterranean Sea, indicating (black stars) the capture sites of *Etrumeus golanii*. ***1. Island of Lampedusa (Falautano et al., 2006). 2. Gulf of Gabès (Boussellaa et al., 2016). 3. Northern Tunisia, off Ras Jebel. GT: Gulf of Tunis, GH: Gulf of Hammamet. GG: Gulf of Gabès.***
Sl. 1: Zemljevid osrednjega Sredozemskega morja z oznako lokalitete (črna zvezdica), kjer so ujeli vrsto *Etrumeus golanii*. ***1. otok Lampedusa (Falautano et al., 2006). 2. Gabeški zaliv (Boussellaa et al., 2016). 3. severna Tunizija, blizu Ras Jebel. GT: tuniški zaliv, GH: Zaliv Hammamet. GG: Gabeški zaliv.***

MATERIAL AND METHODS

On 31st March 2017, a school of *Etrumeus golanii* was captured by pelagic trawl at an approximate depth of 60-70 m, off the city of Ras Jebel in northern Tunisia (37°13′22.89″ N and 10°22′20.68″ E) (Fig. 1), and a specimen was singled out for examination. Its total weight was recorded to the nearest gram and its morphometric measurements to the nearest millimetre, with percentages of standard length (% SL) and meristic counts (Tab. 1). The specimen was preserved in 10%

Tab. 1: Absolute and relative biometric and meristic data recorded in the specimen of *Etrumeus golanii*, ***specimen FSB-Etr-gol-01, caught in northern Tunisia, off Ras Jebel.***
Tab. 1: Absolutni in relativni biometrični in meristični podatki pri primerku vrste *Etrumeus golanii*, ***FSB--Etr-gol-01, ujetem v vodah blizu Ras Jebel v severni Tuniziji.***

Reference	**FSB-Etr-gol-01**	
Morphometric measurements	**mm**	**%SL**
Total length	222.0	118.0
Fork length	200.0	106.3
Standard length (SL)	188.0	100.0
Body depth	41.2	21.9
Head length	44.3	23.5
Eye diameter	13.0	6.9
Dorsal fin base length	31.6	16.8
Anal fin base length	11.0	5.8
Predorsal length	82.5	43.8
Pelvic fin length	14.0	7.4
Meristic counts		
Dorsal finrays	19	
Anal finrays	9	
Pectoral finrays	16	
Pelvic finrays	9	
Masses (g)		
Total body weight	109.3	

Fig. 2: *Etrumeus golanii****, specimen FSB-Etr-gol-01, captured in northern Tunisia, off Ras Jebel, with scale bar = 40 mm.***
Sl. 2: Primerek vrste Etrumeus golanii, FSB-Etr-gol-01, ujet ob severni obali Tunizije, blizu lokalitete Ras Jebel, z merilom = 40 mm.

Fig. 3: Haul of *Etrumeus golanii* ***in tanks testifying to the abundance of the catch of this species in the northern Tunisian coast.***
Sl. 3: Ulov vrste *Etrumeus golanii* ***v prostorih za skladiščenje, ki potrjuje masiven ulov vrste ob severni tunizijski obali.***

buffered formalin and deposited in the Ichthyological Collection of the Faculté des Sciences of Bizerte (Tunisia) under the catalogue number FSB-Etr-gol-01 (Fig. 2).

RESULTS AND DISCUSSION

Further to information provided by fishermen, the present specimen was singled out from a catch of several *Etrumeus golanii* (Fig. 3). Previously, the fishermen used to identify and sell this species in some Tunisian fish markets as European anchovy *Engraulis encrasicolus* (Linnaeus, 1758), but they noticed some morphological differences between the two species and requested our help in identifying the catch. The specimen singled out was identified as *E. golanii* based on a set of morphological characteristics: body elongated and cylindrical in its anterior part, large head, eye covered with adipose eyelid, dorsal fin origin before midpoint, pelvic fin behind dorsal fin base, a single W-shaped pelvic scute at the base of the pelvic fins, lack of a series of scutes along the belly, scales very deciduous, easily detached, colour dark blue, silver on the flanks and belly.

The description, colour, morphometric measurements, meristic counts and %SL are in complete agreement with previous findings by Golani *et al.* (2002), Falautano *et al.* (2006), DiBattista *et al.* (2012) and Boussellaa *et al.* (2016). They confirm the presence of *E. golanii* in the Tunisian waters and this record marks the northernmost extension of the species off the Tunisian coast, and its westernmost extension in the Mediterranean Sea. The studied specimen measured 222 mm in total length (TL) and weighed 109.3 g; it was a medium-sized *E. golanii*; for instance, Golani *et al.* (2002) reported that the species' TL, based on the specimens observed, generally ranges between 150 and 280 mm TL.

Falautano *et al.* (2006) recorded a single specimen in the waters around the Island of Lampedusa, and Boussellaa *et al.* (2016) reported a capture of 7 specimens from the Gulf of Gabès. The catch made in northern Tunisia was quantitatively more important, and according to the statistical landing quantities of the National Tunisian Fisheries, 640 kg of *E. golanii* were collected by different pelagic trawls over a period of several days (Azzouz, personal communication, 2017). This is the first time for such a large quantity of this species to be reported in the Mediterranean. It is an important ichthyological event indicating that the living conditions in this part of the Mediterranean Sea are favourable to the development of this species, thus allowing and accounting for the rapid spread of its population throughout the area since its first record (Whitehead, 1963). *E. golanii* is a pelagic fish prone to large migrations, which is why such an abundant catch could be considered fortuitous, especially since Falautano *et al.* (2006) and Boussellaa *et al.* (2016) stated that the species was not frequent in this area. However, such an important school of fish could also indicate that the species was more abundant in the area even at the time of previous studies, but overlooked, or that its population has grown since. Or was this, nevertheless, just a fortuitous catch? Such a hypothesis cannot be totally ruled out even if a successful establishment of *E. golanii* in some areas of the Mediterranean region seems definite and permanent (Golani *et al.*, 2002).

ŠTEVILNE NAJDBE VRSTE *ETRUMEUS GOLANII* (OSTEICHTHYES: CLUPEIDAE) OB TUNIZIJSKI OBALI (OSREDNJE SREDOZEMLJE)

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POVZETEK

Avtorji poročajo o novih podatkih o pojavljanju vrste Etrumeus golanii *DiBattista, Randall & Bowen, 2012 ob obali Tunizije. Raziskani primerek izvira iz 640 kg težkega ulova rib* E. golanii *iz voda ob severni tunizijski obali. Zajeten ulov nakazuje, da se je v danem okolju vrsta ustalila. Vseeno pa so potrebne nadaljnje raziskave, ki bodo potrdile, da ne gre za osamljen pojav.*

Ključne besede: *Etrumeus golanii,* morfometrične meritve, meristična štetja, lesepske selivke, osrednje Sredozemlje, Tunizija

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short scientific article
received: 2016-10-07

DOI 10.19233/ASHN.2017.10

ON THE OCCURRENCE OF THE SMALLSCALE CODLET, *BREGMACEROS NECTABANUS* (BREGMACEROTIDAE), OFF THE URLA COAST IN IZMIR BAY (AEGEAN SEA, EASTERN MEDITERRANEAN)

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ABSTRACT

The paper reports a new record of the smallscale codlet, Bregmaceros nectabanus*, previously misidentified as* B. atlanticus *in the Turkish Aegean Sea. The specimen, measuring 95 mm in TL, was captured off the Urla coast in Izmir Bay and is one of the largest specimens recorded to date in the Mediterranean. It also constitutes the northernmost extension range of this species in the Aegean Sea. Given the rebuttal of the occurrence of* B. atlanticus *in the Mediterranean,* B. nectabanus *is evidently a Lessepsian migrant.*

Key words: *Bregmaceros nectabanus,* new record, extension range, Izmir Bay, Aegean Sea

PRESENZA DI *BREGMACEROS NECTABANUS* (BREGMACEROTIDAE) AL LARGO DELLA COSTA DI URLA NELLA BAIA DI SMIRNE (MAR EGEO, MEDITERRANEO ORIENTALE)

SINTESI

L'articolo riporta un nuovo ritrovamento di Bregmaceros nectabanus*, in precedenza erroneamente identificato come* B. atlanticus *nel mar Egeo turco. L'esemplare, 95 mm di TL, è stato catturato al largo della costa di Urla nella baia di Smirne, ed è uno dei più grandi avvistati fino ad oggi nel mare Mediterraneo. Si tratta del ritrovamento più settentrionale di questa specie ittica nel mar Egeo. Data la confutazione della presenza di* B. atlanticus *nel Mediterraneo,* B. nectabanus *è evidentemente un migrante lessepsiano.*

Parole chiave: *Bregmaceros nectabanus*, nuovo record, estensione, baia di Smirne, mar Egeo

INTRODUCTION

It has been suggested that previous reports of *Bregmaceros atlanticus* Goode & Bean, 1886 as a monotypic species in the Mediterranean Sea were likely misidentifications of *Bregmaceros nectabanus* Whitley, 1941 (Harold & Golani, 2016). The authors mentioned three species belonging to the genus *Bregmaceros* (*B. nectabanus, B. arabicus* D'Ancona & Cavinato, 1965, and *B. mcclellandi* Thompson, 1840) as possibly occurring in the Red Sea. *B. nectebanus* is distinguished from *B. atlanticus* and its congeneric species by a distally fimbriate opercular spine, nearly unpigmented abdomen and the presence of a thin dorsolateral longitudinal stripe below the second dorsal fin (Harold & Golani, 2016).

B. nectabanus is distributed in the eastern Atlantic from Morocco to Namibia and South Africa, including the Mediterranean (as *B. atlanticus*); the western Atlantic and the southeast Caribbean; the Indian Ocean and the tropical western Pacific as far as Fiji (Iwamoto, 2015).

In the Mediterranean Sea, a single specimen of *B. nectabanus* (as *B. atlanticus*) had been mentioned previously from the Strait of Sicily (D'Ancona & Cavinato, 1965), however, Cohen (1986) and Torii *et al*. (2003) implied that this record was questionable. Since then, the occurrence of *B. nectabanus* in the Mediterranean had not been reported until 2002. Yılmaz *et al*. (2004) identified two specimens of *B. nectabanus* in the stomach of a lizardfish, *Saurida undosquamis,* caught in the Gulf of Antalya, southern Turkey, and Goren & Galil (2006) reported one specimen from off Palmahim near Ashdod, Israel. These records are shown in Table 1 and Figure 2. This paper provides all successive records of *B. nectabanus* in the eastern Mediterranean with an additional record from Izmir Bay, NE Aegean Sea.

MATERIAL AND METHODS

On 9th September 2014, one specimen of *B. nectabanus,* 95 mm TL (Fig. 1) was captured by a commercial trammel net targeting shrimp (40-mm mesh size) near the coastal waters of Urla, Izmir Bay (Coordinates: 38°23'N-26°46'E) at a depth of 20 m (Fig. 2). The specimen was fixed with a 5% formaldehyde solution and deposited in the fish collection of the Fisheries Faculty, Ege University (ESFM-PIS/2014-009).

RESULTS AND DISCUSSION

The specimen was measured to the nearest millimetre and weighed to the nearest decigram (Tab. 2); brief description of the specimen: body fusiform, elongated, the colour is silver-grey on the belly, with dense pigmentation entirely along the dorsum and a distinctive thin brown dorsolateral longitudinal stripe below the second dorsal fin. All the determined measurements and

Tab. 1: Capture records of *Bregmaceros nectabanus* ***in the Eastern Mediterranean since 2004. *As*** *Bregmaceros* ***sp. Tab. 1: Lokalitete, kjer so bili ujeti primerki vrste*** *Bregmaceros nectabanus* ***v vzhodnem Sredozemskem morju od leta 2004. *Označeno kot*** *Bregmaceros* ***sp.***

Location	Coordinates Lat. N - Lon. E	Depth (m)	Record Date	Number collected	Size (mm)	References
Gulf of Antalya, Turkey	?	30	12 Oct. 2002	2	30-34 TL	Yılmaz *et al.* (2004)
Off Palmahim, Israel	31°05'- 34°03'	35	20 Sept. 2004	1	46.5 SL	Goren & Galil (2008)
Kuşadası Bay, Turkey	?	150	04 Feb. 2005	1	39 TL	Filiz *et al.* (2007)
Off Palmahim, Israel	31°05'- 34°03'	35	26 May 2006	3	47-62 SL	Goren & Galil (2008)
Off Iskenderun, Turkey	35°57'- 35°59'	120	15 Dec. 2010	5	70.7-102 TL	Turan *et al*. (2011)
Izmir Bay, Turkey	38°28'- 26°47'	50	01 Dec. 2011	1	66 TL	Aydın & Akyol (2013)
Gulf of Seronikos, Greece	37°50'- 23°29'	90	31 July 2014	1	53 TL	Dogrammatzi & Karachle (2015)
Gulf of Seronikos, Greece	37°50'- 23°20'	98	02 Aug. 2014	7	54-64 TL	Dogrammatzi & Karachle (2015)
Rashid, Egyptian Med.	?	29	? Sept. 2014	1*	76 TL	Rizkalla & Akel (2015)
Izmir Bay, Turkey	38°23'- 26°46'	20	09 Sept. 2014	1	95 TL	This study

Fig. 1: *Bregmaceros nectabanus* ***captured in the Izmir Bay, NE Aegean Sea in September 2014 (ref. ESFM-PIS/2014-009) (Photo: O. Akyol)***
Sl. 1: Primerek vrste *Bregmaceros nectabanus* ***ujet v izmirskem zalivu, v severovzhodnem Egejskem morju v septembru 2014 (ref. ESFM-PIS/2014-009) (Foto: O. Akyol)***

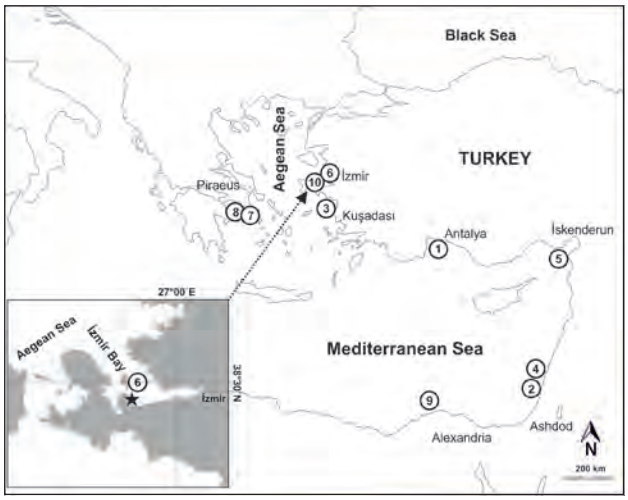

Fig. 2: Capture sites of *Bregmaceros nectabanus* ***specimens in the eastern Mediterranean between 2004 and 2015: 1. Gulf of Antalya (Yılmaz*** *et al.*, ***2004), 2. Off Palmahim (Goren & Galil, 2008), 3. Kuşadası Bay, SE Aegean Sea (Filiz*** *et al.*, ***2007), 4. Off Palmahim (Goren & Galil, 2008), 5. Off Iskenderun (Turan*** *et al.*, ***2011), 6. Izmir Bay, NE Aegean Sea (Aydın & Akyol, 2013), 7-8. Gulf of Seranikos (Dogrammatzi & Karachle, 2015), 9. Off Rashid (Rizkalla & Akel, 2015), 10. Izmir Bay, NE Aegean Sea (this study).***
Sl. 2: Lokalitete, na katerih so bili ujeti primerki vrste *Bregmaceros nectabanus* ***v vzhodnem Sredozemskem morju, med leti 2004 in 2015: 1. Antalijski zaliv (Yılmaz*** *et al.*, ***2004), 2. pri Palmahimu (Goren & Galil, 2008), 3. zaliv Kuşadası Bay, JV Egejsko morje (Filiz*** *et al.*, ***2007), 4. pri Palmahimu (Goren & Galil, 2008), 5. pri Iskenderunu (Turan*** *et al.*, ***2011), 6. izmirski zaliv, SV Egejsko morje (Aydın & Akyol, 2013), 7-8. Zaliv Seranikos (Dogrammatzi & Karachle, 2015), 9. pri Rashidu (Rizkalla & Akel, 2015), 10. izmirski zaliv, SV Egejsko morje (pričujoče delo).***

colour patterns are in accordance with the descriptions by Harold & Golani (2016), and Froese & Pauly (2016).

Although there existed fossil records of the genus *Bregmaceros* (Agiadi & Karakitsios, 2012) with no mention of *B. nectabanus,* Goren & Galil (2008) hypothesized on three probabilities of *B. nectabanus* (as *B. atlanticus*) presence in the Mediterranean: (a) they were part of a small native population, (b) they were introduced via the Suez Canal from the Red Sea, (c) they were transported with ballast water of ships as larvae or post larvae. The authors assumed that the presence of the Israeli specimens 25 km from the port of Ashdod in the direction of the prevailing coastal current suggested a possible introduction to the area through a frequent discharge of ballast water. Goren *et al.* (2009) also noted that they could have been carried as vectors into the Mediterranean in early life cycle stages via ship ballast water as they were not native to the Red Sea either. Eventually, the most recent study proved that *B. nectabanus* is a Lessepsian migrant and had been previously misidentified as *B. atlanticus* (Harold & Golani, 2016). These latest findings notwithstanding, a review of captures of *B. nectabanus* (see Fig. 2) during the past decade and more has shown that the species is also likely to have been introduced in the Eastern Mediterranean via ship ballast water, as it occurs near large ship harbours.

Tab. 2. Morphometric measurements in mm and as percentages of total length (%TL), and counts recorded in *Bregmaceros nectabanus* ***(for both ref. ESFM-PIS/2014-009 and ref. ESFM-PIS/2011-006), captured from the Urla coast, Izmir Bay. *This study, **Aydın & Akyol (2013), ***SL is converted to TL.***
Tab. 2: Morfometrične meritve v mm in v deležu celotne dolžine (%TL) ter meristični podatki pri primerkih vrste *Bregmaceros nectabanus* ***(za primerke z ref. ESFM-PIS/2014-009 in ref. ESFM-PIS/2011-006), ujetih na obalah Urle, izmirski zaliv. *Pričujoče delo, **Aydın & Akyol (2013), ***SL je bila preračunana v TL.***

Reference	**ESFM-PIS/2014-009***		**ESFM-PIS/2011-006****	
Measurements	**Size (mm)**	**Proportion %**	**Size (mm)**	**Proportion %**
Total length (TL)	95.0		66.0	
Standard length (SL)	83.0	87.4 TL	60.0	90.9 TL***
Maximum body depth	15.0	15.8 TL	10.0	15.2 TL
Predorsal fin length	34.0	35.8 TL	23.0	34.8 TL
Prepectoral fin length	15.0	15.8 TL	10.0	15.2 TL
Pre-anal fin length	34.0	35.8 TL	23.0	34.8 TL
Pre-ventral length	10.0	10.5 TL	-	-
Head length (HL)	14.0	14.7 TL	10.4	15.8 TL
Eye diameter	4.4	31.4 HL	3.0	28.8 HL
Preorbitary length	3.0	21.4 HL	2.0	19.2 HL
Interorbital length	5.0	35.7 HL	-	-
Counts				
Dorsal fin rays	48		48	
Anal fin rays	49		49	
Pectoral fin rays	16		16	
Caudal fin rays	13		-	
Total body weight (gr)	5.6		-	

POJAVLJANJE VRSTE *BREGMACEROS NECTABANUS* (BREGMACEROTIDAE), V VODAH BLIZU URLE V IZMIRSKEMU ZALIVU (EGEJSKO MORJE, VZHODNO SREDOZEMLJE)

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POVZETEK

Avtorja poročata o novem zapisu o pojavljanju ribje vrste, Bregmaceros nectabanus*, ki so jo predhodno pogosto napačno določevali kot vrsto* B. atlanticus *v turškem delu Egejskega morja. Petindevetdeset mm dolg primerek je bil ujet pri Urli v Izmirskemu zalivu in je eden izmed največjih do sedaj ujetih sredozemskih primerkov. Ta zapis tudi potrjuje širjenje areala te vrste v najbolj severne predele Egejskega morja. Glede na dejstvo, da se vrsta* B. atlanticus *v Sredozemskem morju ne pojavlja, je* B. nectabanus *očitno lesepska selivka.*

Ključne besede: *Bregmaceros nectabanus,* nova najdba, širjenje areala, izmirski zaliv, Egejsko morje

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OCENE IN POROČILA

RECENSIONI E RELAZIONI

REVIEWS AND REPORTS

NACIONALNI INŠTITUT ZA BIOLOGIJO
MORSKA BIOLOŠKA POSTAJA

NA MORSKI BIOLOŠKI POSTAJI OBELEŽILI DAN BIOTSKE RAZNOVRSTNOSTI

Mednarodni dan biotske raznovrstnosti so letos na Nacionalnem inštitutu za biologijo obeležili s srečanjem, ki je potekalo 22. maja v dvorani Morske biološke postaje v Piranu.

Srečanja se je udeležilo več kot 60 predstavnikov iz različnih slovenskih ustanov, ki so povezane z raziskavami ali ohranjanjem biotske raznovrstnosti. Med njimi so bili na primer ugledni predstavniki z Univerze v Ljubljani in Univerze na Primorskem, gosti z Ministrstva za okolje in prostor, naravovarstveniki z Zavoda za varstvo narave in Krajinskega parka Strunjan, predstavniki iz podjetij Luke Koper in Okolje Piran, ravnateljica piranskega Akvarija, gostje iz Prirodoslovnega Muzeja Slovenije ter sodelavci z ljubljanskega dela Nacionalnega inštituta za biologijo in Morske biološke postaje.

Uvodnemu nagovoru direktorice Nacionalnega inštituta za biologijo prof. dr. Tamare Lah Turnšek je sledila dobrodošlica vodje Morske biološke postaje Piran doc. dr. Andreje Ramšak.

Serijo predavanj je nato z uvodnim predavanjem otvoril dr. Peter Skoberne z Ministrstva za okolje in prostor, ki je razpravljal o razlogih za obeleževanje mednarodnega dneva biotske raznovrstnosti in kritično razmišljal o stanju varovanja in raziskovanja biotske raznovrstnosti v Sloveniji.

Sledila je predstavitev knjige *Biogenic formations in the Slovenian sea,* katere uvod je predstavila prof. dr. Tamara Lah Turnšek, bolj podrobno pa je monografijo predstavil prof. dr. Lovrenc Lipej, ki je tudi soavtor knjige skupaj z dr. Martino Orlando-Bonaca in dr. Borutom Mavričem. Monografija obravnavava apnenčaste tvorbe, ki jih ustvarjajo morski organizmi in so znane pod strokovnim imenom biogene formacije. Te so lahko velike od nekaj pičlih kvadratnih decimetrov do orjaških tvorb s skoraj 10.000 m^2. Novejša spoznanja kažejo, da gre za zelo bogata okolja po številu vrst bentoških organizmov, še posebej pa je to značilno za veliki biogeni formaciji pred rtom Ronek in pred Debelim rtičem. Izpostavljen je bil tudi pomen biogenih formacij iz vidika biotske pestrosti, saj s svojo prisotnostjo omogočajo življenjski prostor za mnoga živa bitja in s tem dvigujejo stopnjo biodiverzitete v danem okolju. Predavanje so dopolnjevale tudi izvirne sheme in fotografije. Izdajo monografije je s finančno podporo omogočil tuniški center za zavarovana območja RAC/SPA (Regional Activity Center for Specialy Protected Areas).

Tematiko življenjskih okolij je v svojem prispevku nadaljeval mag. Robert Turk z Zavoda za varstvo narave, ki je razpravljal o stanju raziskanosti habitatov v slovenskem morju. Dotaknil se je tudi problematike deleža zavarovanih območij, ki namesto načrtovanih 10 % znaša le 0,5 %.

Sl. 1: Uvodni nagovor direktorice Nacionalnega inštituta za biologijo prof. dr. Tamare Lah Turnšek (foto: Vladimir Bernetič).

V nadaljevanju je imel predavanje dr. Borut Mavrič, ki je predstavil *Arkonavte – iskalce izgubljenega zaklada*. Če so bajeslovni Argonavti iskali zlato runo, pa naj bi Arkonavti iskali naravne zaklade morja. Arkonavti plujejo na Noetovi ladji Arki, ki simbolizira slovensko morje. Tako kot je Noe na ladjo spravil po dva predstavnika vsake vrste živih bitij, tako nekako naj bi bilo stanje v slovenskem morju, kjer na majhnem območju najdemo ogromno število vrst, ki pa niso zelo številčne. V okviru predavanja je dr. Mavrič zbranim predstavil raziskave skupine za biodiverziteto iz Morske biološke postaje Piran s poudarkom na različna področja raziskav, s katerimi se le ta ukvarja.

Sledilo je predavanje vodje oddelka za raziskave organizmov in ekosistemov na Nacionalnem Inštitutu za Biologijo, doc. dr. Mete Virant-Doberlet. Predstavila je pet obrazov biodiverzitete, ki simbolizirajo raziskave različnih vidikov biodiverzitete, s katerimi se ukvarjajo raziskovalci njene skupine. Te se navezujejo na oglašanja škržatov, raziskovanja ptičjih združb, spremljanja različnih domorodnih in tujerodnih vrst sladkovodnih rakov, popisovanja redkih vrst hroščev ter inventarizacije jamskih okolij. Predavanje je popestrila tudi z zanimivimi fotografijami in zvočnimi posnetki različnih vrst škržatov. Dr. Meta Virant-Doberlet je v posebni predstavitvi predstavila tudi novi projekt, ki so ga pridobili na oddelku iz serije LIFE o raziskovanju biodiverzitete, avtorja dr. Davorina Tometa, ki na posrečen način prikaže izbor čudovitih in tehnično popolnih fotografij o slovenski pokrajini in biodiverziteti ob spremljavi znanega Griegovega *Jutra*.

Zadnji prispevek je bila predstavitev večkrat nagrajenega dokumentarnega filma Cirila Mlinarja Cica iz Prirodoslovnega muzeja Slovenije v angleškem jeziku z

naslovom »Lovci na močerile« (»*Proteus hunters*«). Film nas seznani s preučevanjem človeških ribic v Sloveniji. Za konec sta nekaj svojih misli o pomenu biodiverzitete

Sl. 2: Dr. Peter Skoberne z Ministrstva za okolje in prostor je razpravljal o razlogih za obeleževanje mednarodnega dneva biotske raznovrstnosti in kritično razmišljal o stanju varovanja in raziskovanja biotske raznovrstnosti v Sloveniji (foto: Vladimir Bernetič).

in njenem varovanju strnila tudi akademik prof. dr. Matija Gogala in prof. dr. Mihael J. Toman. Celoten dogodek je povezovala govornica dr. Martina Orlando-Bonaca. Poseben pečat k dogodku pa so prispevali tudi pevci Biološkega okteta, ki so že tako zanimiv program popestrili še z venčkom slovenskih pesmi in tako pričarali prav posebno vzdušje.

Sledila je še manjša pogostitev, kjer so zbrani izmenjali mnenja in razpravljali o pomenu biodiverzitete. Srečanje strokovnjakov, ki se na tak ali drugačen način ukvarjajo s proučevanjem biotske raznovrstnosti je zelo pomembno, saj je možno na ta način spoznati vse vidike raziskovanja, ki jih Nacionalni inštitut za biologijo, kot eden izmed največjih slovenskih raziskovalnih inštitutov na področju naravoslovja, izvaja v Sloveniji.

Vnovič se je potrdilo dejstvo, da so raziskave biodiverzitete še vedno izjemno pomembne ali skoraj esencialne in v mnogočem ključne za razumevanje osnovnih ekoloških in bioloških procesov.

Domen Trkov
Morska biološka postaja Piran,
Nacionalni inštitut za biologijo

NAVODILA AVTORJEM

1. Revija ANNALES (*Anali za istrske in mediteranske študije* Series historia naturalis) objavlja **izvirne znanstvene** in **pregledne članke** z naravoslovnimi vsebinami, ki obravnavajo posebnosti različnih podpodročij sredozemskega naravoslovja: morska biologija in ekologija, ihtiologija, geologija s paleontologijo, krasoslovje, oljkarstvo, biodiverziteta Slovenije, varstvo narave, onesnaževanje in varstvo okolja, fizična geografija Istre in Mediterana idr. Vključujejo pa tudi **krajše** znanstvene prispevke o zaključenih raziskovanjih., ki se nanašajo na omenjeno področje.

2. Sprejemamo članke v angleškem, slovenskem in italijanskem jeziku. Avtorji morajo zagotoviti jezikovno neoporečnost besedil, uredništvo pa ima pravico članke dodatno jezikovno lektorirati.

3. Članki naj obsegajo do 48.000 znakov brez presledkov oz. 2 avtorski poli besedila. Članek je mogoče oddati na e-naslov annales@mbss.org (zaželjeno) ali na elektronskem nosilcu (CD) po pošti na naslov uredništva.

Avtor ob oddaji članka zagotavlja, da članek še ni bil objavljen in se obvezuje, da ga ne bo objavil drugje.

4. Naslovna stran članka naj vsebuje naslov članka, ime in priimek avtorja (avtorjev), ime in naslov inštitucije, kjer je (so) avtor(ji) zaposlen(i) oz. domači naslov in naslovom elektronske pošte (samo prvi oz. korespondenčni avtor).

5. Članek mora vsebovati **povzetek** in **izvleček.** Izvleček je krajši (cca. 10 vrstic) od povzetka (cca. 30 vrstic).

V *izvlečku* na kratko opišemo namen, metode dela in rezultate. Izvleček naj ne vsebuje komentarjev in priporočil.

Povzetek vsebuje opis namena in metod dela ter povzame analizo oziroma interpretacijo rezultatov. V povzetku ne sme biti ničesar, česar glavno besedilo ne vsebuje. V povzetku se avtor ne sklicuje na slike, tabele in reference, ki so v članku.

6. Avtorji naj pod izvleček članka pripišejo ustrezne **ključne besede** (največ 6). Zaželjeni so tudi angleški (ali slovenski) prevodi izvlečka, povzetka, ključnih besed, podnapisov k slikovnemu in tabelarnemu gradivu. V nasprotnem primeru bo za prevode poskrbelo uredništvo.

7. Glavni del besedila naj vključuje sledeča poglavja: Uvod, Material in metode, Rezultati, Razprava ali Rezultati in razprava, Zaključki (ali Sklepi), Zahvala (če avtor želi), Literatura. Dele besedila je možno oblikovati v podpoglavja (npr. Pregled dosedanjih objav v Uvodu, Opis območja raziskav v Material in metode). Podpisi k slikam so priloženi posebej za poglavjem Literatura.

8. Tabele avtor priravi posebej na ločenih straneh v programu Word, tako kot rokopis, jih zaporedno oštevilči in opremi z naslovom – kratkim opisom. V glavnem delu besedila se sklicuje na tabele tako, da jih na ustreznem mestu označi z npr. "(Tab. 1)".

9. Slikovno gradivo (grafi, zemljevidi, fotografije, table) avtor posreduje v ločenih datotekah (jpeg, tiff) z najmanj 300 dpi resolucije pri želeni velikosti. Največja velikost slikovnega gradiva je 17x20 cm. Vsa potrebna dovoljenja za objavo slikovnega gradiva (v skladu z Zakonom o avtorski in sorodnih pravicah) priskrbi avtor sam in jih predloži uredništvu pred objavo članka. Slike je potrebno tudi podnasloviti in zaporedno oštevilčiti (glej točko 7). V glavnem delu besedila se avtor sklicuje na slike tako, da jih na ustreznem mestu označi z npr. "(Sl. 1)".

10. Bibliografske opombe, s čimer mislimo na **citat** – torej sklicevanje na druge publikacije, sestavljajo naslednji podatki v oklepaju: *avtor* in *leto izida*; npr. (Novak, 2007). Če sta dva avtorja, se izpišeta oba (Novak & Kranjc, 2001), če so trije ali več pa se izpiše samo prvi, ki mu sledi okrajšava *et al*. (Novak *et al*., 1999). Več citatov je med seboj ločenih s podpičjem in si sledijo kronološko - z naraščajočo letnico izdaje, npr. (Novak *et al*., 1999; Adamič, 2001; Kranjc & Zupan, 2007). Osebno informacijo (ustno, pisno) izpišemo prav tako v oklepaju z navedbo kratice imena in priimka posredovalca informacije, za vejico pa dodamo "osebno sporočilo", npr. (J. Novak, *osebno sporočilo*).

11. Celotni **bibliografski podatki** so navedeni v poglavju Literatura v abecednem vrstnem redu. Pri tem avtor navede izključno dela, ki jih je v članku citiral. Če ima isti avtor več bibliografskih podatkov, se najprej kronološko izpišejo tisti, kjer je edini avtor, sledijo dela v soavtorstavu še z enim avtorjem in dela v soavtorstvu z več avtorji. Imena revij, v katerih so izšla citirana dela, se izpišejo okrajašano (splošno priznane okrajšave revij). Članki, ki še niso bili publicirani, se lahko citirajo le, če so bili dokončno sprejeti v tisk, pri čemer se na koncu bibliografskega podatka doda beseda "v tisku". Člankov, ki so šele bili poslani v recenzijo, se ne sme citirati.

Primeri navajanje različnih tipov bibliografskih podatkov:

članki v revijah:

Klock, J.-H., A. Wieland, R. Seifert & W. Michaelis (2007): Extracellular polymeric substances (EPS) from cyanobacterial mats: characterisation and isolation method optimisation. Mar. Biol., 152, 1077-1085.

Knjige in druge neserijske publikacije (poročila, diplomska dela, doktorske disertacije):

Wheeler, A. (1969): The fishes of the British Isles and North-West Europe. McMillan, London, 613 p.

Poglavje v knjigi:
McEachran, J. D. & C. Capapé (1984): Myliobatidae. In: Whitehead, P. J. P., M. L. Bauchot, J.-C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-eastern Atlantic and the Mediterranean, Vol. 1. Unesco, Paris, pp. 205-209.

12. Drugo: latinski izrazi kot npr. *in vivo*, *in situ*, *e.g.*, *i.e.*, ter rodovna (*Myliobatis* sp.) in vrstna (*Myliobatis aquila*) imena se izpišejo v fontu italic. Kadarkoli je možno, se uporabljajo enote iz sistema SI (Système international d'unités).

13. Prvi odtis člankov uredništvo pošlje avtorjem v **korekturo.** Avtorji so dolžni popravljeno gradivo vrniti v enem tednu. Besedilo popravljamo s korekturnimi znamenji, ki jih najdemo na koncu Slovenskega pravopisa (2001), Ljubljana, ZRC SAZU, 24–25.

Širjenje obsega besedila ob korekturah ni dovoljeno. Druge korekture opravi uredništvo.

14. Za dodatna pojasnila v zvezi z objavo člankov je uredništvo na voljo.

UREDNIŠTVO

ISTRUZIONI PER GLI AUTORI

1. La rivista ANNALES (*Annali per gli studi istriani e mediterranei*, Series historia naturalis) pubblica **articoli scientifici originali** e **compendii** dai contenuti scientifici relativi ai vari settori della storia naturale e pertinenti l'area geografica del Mediterraneo: biologia marina, ecologia, ittiologia, geologia, paleontologia, carsologia, olivicoltura, biodiversità della Slovenia, tutela della natura, inquinamento e tutela dell'ambiente, geografia fisica dell'Istria e del Mediterraneo ecc. La rivista pubblica anche articoli scientifici **brevi** relativi a ricerche concluse pertinenti a tali settori.

2. La Redazione accetta articoli in lingua inglese, slovena e italiana. Gli autori devono garantire l'ineccepibilità linguistica dei testi, la Redazione si riserva il diritto di una revisione linguistica.

3. Gli articoli devono essere di lunghezza non superiore alle 48.000 battute senza spazi, ovvero 2 fogli d'autore. Possono venir recapitati all'indirizzo di posta elettronica annales@mbss.org (preferibilmente) oppure su supporto elettronico (CD) per posta ordinaria all'indirizzo della Redazione.

L'autore garantirà l'originalità dell'articolo e si impegnerà a non pubblicarlo altrove.

4. Ogni articolo deve essere corredato da: **titolo**, nome e cognome dell'autore (autori), denominazione ed indirizzo dell'ente di appartenenza o, in alternativa, l'indirizzo di casa, nonché l'indirizzo di posta elettronica (solo del primo autore o dell'autore di corrispondenza).

5. I contributi devono essere corredati da un **riassunto** e da una **sintesi**. Quest'ultima sarà più breve (cca. 10 righe) del riassunto (cca 30 righe).

Nella *sintesi* si descriveranno brevemente lo scopo, i metodi e i risultati delle ricerche. La sintesi non deve contenere commenti e segnalazioni.

Il *riassunto* riporterà in maniera sintetica lo scopo, i metodi delle ricerche e l'analisi ossia l'interpretazione dei risultati. Il riassunto non deve riferirsi alle tabelle, figure e alla bibliografia contenuta nell'articolo.

6. Gli autori sono tenuti ad indicare le **parole chiave** adeguate (massimo 6). Sono auspicabili anche le traduzioni in inglese (o sloveno) della sintesi, del riassunto, delle parole chiave, delle didascalie e delle tabelle. In caso contrario, vi provvederà la Redazione.

7. Il testo principale deve essere strutturato nei seguenti capitoli: Introduzione, Materiali e metodi, Risultati, Discussione o Risultati e discussione, Conclusioni, Ringraziamenti (se necessari), Bibliografia. Il testo può essere strutturato in sottocapitoli (ad es. sottocapitolo Rassegna delle pubblicazioni nell'Introduzione; sottocapitolo Descrizione dell'area di ricerca nel capitolo Materiali e metodi). Le didascalie devono essere presentate separatamente, a seguito del capitolo Bibliografia.

8. Le tabelle saranno preparate in forma elettronica come il manoscritto (formato Word) e allegate in fogli separati alla fine del testo. Gli autori sono pregati di contrassegnare ogni tabella con un numero e il titolo ossia una breve descrizione. Nel testo la tabella viene richiamata come segue: (Tab. 1).

9. Il materiale grafico (grafici, carte geografiche, fotografie, tavole) va preparato in formato elettronico (jpeg o tiff) e consegnato in file separati, con una definizione di 300 dpi alla grandezza desiderata, purché non ecceda i 17x20 cm. Prima della pubblicazione, l'autore provvederà a fornire alla Redazione tutte le autorizzazioni richieste per la riproduzione del materiale grafico (in virtù della Legge sui diritti d'autore). Tutto il materiale grafico deve essere accompagnato da didascalie (vedi punto 7) e numerato.. Nel testo i grafici vengono richiamati come segue: (ad es. Fig. 1).

10. I riferimenti bibliografici (citazioni) richiamano un'altra pubblicazione (articolo). La nota bibliografica, riportata nel testo, deve contenere i seguenti dati tra parentesi: *cognome dell'autore*, *anno di pubblicazione*, ad es. (Novak, 2007). Se gli autori sono due, verranno indicati entrambi (Novak & Kranjc, 2001), nel caso di tre o più autori verrà indicato soltanto il primo, seguito dall'abbreviazione *et al.* (Novak *et al.,* 1999). Vari riferimenti bibliografici in una stessa nota vanno divisi dal punto e virgola e segnalati in ordine cronologico, ad. es. (Novak *et al.*, 1999; Adamič, 2001; Kranjc & Zupan, 2007). La testimonianza (orale, scritta) verrà indicata tra parentesi con l'abbreviazione del nome e con il cognome di chi l'ha trasmessa, seguiti dalla virgola e la dicitura "informazione personale", ad es. (J. Novak, *informazione personale*).

11. La bibliografia completa va inserita in ordine alfabetico nel capitolo Bibliografia. L'autore indicherà esclusivamente i lavori e le edizioni citati nell'articolo. Se si citano più lavori dello stesso autore, verranno indicati prima in ordine cronologico i lavori in cui l'autore appare solo, poi quelli in cui l'autore compare assieme ad un secondo coautore, seguiti infine da quelli in cui egli compare tra più coautori. I nomi delle riviste in cui sono pubblicati i lavori citati saranno indicati nella forma abbreviata (abbreviazioni ufficialmente riconosciute). Gli articoli inediti si possono citare soltanto se sono in corso di pubblicazione, facendo loro seguire la dicitura "in corso di pubblicazione". Gli articoli, non ancora recensiti non possono essere citati.

Esempio di lavoro bibliografico:

Articoli in riviste:

Klock, J.-H., A. Wieland, R. Seifert & W. Michaelis (2007): Extracellular polymeric substances (EPS) from cyanobacterial mats: characterisation and isolation method optimisation. Mar. Biol., 152, 1077-1085.

Libri ed altre pubblicazioni non periodiche (relazioni, tesi di laurea, dissertazioni di dottorato):

Wheeler, A. (1969): The fishes of the British Isles and North-West Europe. McMillan, London, 613 p.

Capitoli di libro:

McEachran, J. D. & C. Capapé (1984): Myliobatidae. In: Whitehead, P. J. P., M. L. Bauchot, J.-C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-eastern Atlantic and the Mediterranean, Vol. 1. Unesco, Paris, pp. 205-209.

12. Altro: Le espressioni latine come ad es. *in vivo*, *in situ*, *e.g.*, *i.e.*, i nomi dei generi famiglie (*Myliobatis* sp.) e delle specie (*Myliobatis aquila*) si scrivono con il carattere italic. Quando possibile saranno utilizzate le unità del sistema SI (*Système international d'unités*).

13. Gli autori ricevono le **prime bozze** di stampa per la revisione. Le bozze corrette vanno quindi rispedite entro una settimana alla Redazione. In questa fase, i testi corretti con segni adeguati (indicazioni in merito si trovano alla fine della pubblicazione "Slovenski pravopis" (2001), Ljubljana, ZRC SAZU, 24-25, non possono essere più ampliati. La revisione delle bozze è svolta dalla Redazione.

14. La Redazione rimane a disposizione per eventuali chiarimenti.

LA REDAZIONE

INSTRUCTIONS TO AUTHORS

1. The journal ANNALES (*Annals for Istrian and Mediterranean Studies,* Series historia naturalis) publishes **original scientific** and **review articles** in the field of natural studies related to the specifics of various subfields of Mediterranean natural studies: marine biology and ecology, ichthyology, geology with paleontology, karst studies, olive growing, biodiversity of Slovenia, nature protection, pollution and environmental protection, physical geography of Istria and the Mediterranean, etc. It also publishes **short** scientific papers on completed research projects related to the above-mentioned subfields.

2. The articles submitted can be written in the English, Slovene or Italian language. The authors should ensure that their contributions meet acceptable standards of language, while the editorial board has the right to have them language edited.

3. The articles should be no longer than 48,000 characters (spaces excluded) or 32 typewritten double-spaced pages. They can be submitted via e-mail annales@mbss.org (preferably) or regular mail, with the electronic data carrier (CD) sent to the address of the editorial board.

Submission of the article implies that it reports original unpublished work and that it will not be published elsewhere.

4. The **title page** should include the title of the article, the name and surname of the author(s), their affiliation (institutional name and address) or home address, and e-mail address (of the first author or the corresponding author only).

5. The article should contain the **summary** and the **abstract,** with the former (c. 30 lines) being longer than the latter (c. 10 lines).

The *abstract* contains a brief description of the aim of the article, methods of work and results. It should contain no comments and recommendations.

The *summary* contains the description of the aim of the article and methods of work and a brief analysis or interpretation of results. It can contain only the information that appears in the text as well. It should contain no reference to figures, table and citations published in the main text.

6. Beneath the abstract, the author(s) should supply appropriate **keywords** (max 6) and, if possible, the English (or Slovene) translation of the abstract, summary, keywords, and captions to figures and tables. If unprovided, the translation will be provided by the editorial board.

7. The **main text** should include the following chapters: Introduction, Material and Methods, Results, Discussion or Results and Discussion, Conclusion, Acknowledgement (not obligatory), References. Individual parts of the text can form a sub-chapter (e.g. Survey of Previous Studies under Introduction; Description of Research Area under Material and Methods). Captions to figures should appear on a separate page beneath References.

8. Each **table** should be submitted on a separate page in Word programme (just like the main text). It should be numbered consecutively and supplied with the title – brief description. When referring to the tables in the main text, use the following style: (Tab. 1).

9. Illustrative matter (diagrams, maps, photographs, plates) should be submitted as separate files (in jpeg or tiff format) and saved at a minimum resolution of 300 dpi per size preferred, with the maximum possible publication size being 17x20 cm. Prior to publication, the author(s) should obtain all necessary authorizations (as stipulated by the Copyright and Related Rights Act) for the publication of the illustrative matter and submit them to the editorial board. All figures should be captioned and numbered consecutively (cf. Item 7). When referring to the figures in the main text, use the following style: (Fig. 1).

10. **Bibliographic notes** or **citations** – i.e. references to other articles or publications – should contain the following data: *author* and *year of publication,* e.g. (Novak, 2007). If there are two authors, include both surnames (Novak & Kranjc, 2001); if there are more than two authors, include the surname of the first author followed by a comma and the abbreviation *et al.* (Novak *et al.*, 1999). If there is more than one reference, separate them by a semicolon and list them in ascending chronological order, e.g. (Novak *et al.*, 1999; Adamič, 2001; Kranjc & Zupan, 2007). When citing information obtained through personal communication (oral, written), provide the initial letter of the name and full surname of the informant followed by a comma and the phrase *personal communication,* e.g. (J. Novak, *personal communication*).

11. The entire list of **bibliographic data** should be published under References in alphabetical order. The author(s) should list only the works cited in the article. If you are listing several works by the same author with some of them written in co-authorship, first list those written by the author him/herself, then those written in co-authorship with another author, and finally those written in co-authorship with more than one author, with the entries listed in chronological order. The names of journals in which the works cited were published should be abbreviated (cf. list of official journal abbreviations). Unpublished articles can be cited only if they have been

approved for publication, which should be indicated by adding the phrase *in press* to the end of the relevant bibliography entry.

Some examples of how to cite different types of bibliographical data:

Articles published in serial publications:

Klock, J.-H., A. Wieland, R. Seifert & W. Michaelis (2007): Extracellular polymeric substances (EPS) from cyanobacterial mats: characterisation and isolation method optimisation. Mar. Biol., 152, 1077-1085.

Books and other non-serial publications (reports, diploma theses, doctoral dissertation):

Wheeler, A. (1969): The fishes of the British Isles and North-West Europe. McMillan, London, 613 p.

Chapters published in a book:

McEachran, J. D. & C. Capapé (1984): Myliobatidae. In: Whitehead, P. J. P., M. L. Bauchot, J.-C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-eastern Atlantic and the Mediterranean, Vol. 1. Unesco, Paris, pp. 205-209.

12. Miscellaneous: Latin phrases such as *in vivo*, *in situ*, *e.g.*, *i.e.*, and names of genera (*Myliobatis* sp.) and species (*Myliobatis aquila*) should be written in italics. Whenever possible, use the SI units (Système international d'unités).

13. The authors are sent the **first page proofs**. They should be returned to the editorial board within a week. When reading the proofs, the authors should use the correction signs listed at the end of the book Slovenski pravopis (2001), Ljubljana, ZRC SAZU, 24–25.

It is not allowed to lengthen the text during proof-reading. Second proof-reading is done by the editorial board.

14. For additional information regarding article publication contact the editorial board.

EDITORIAL BOARD

KAZALO K SLIKAM NA OVITKU

SLIKA NA NASLOVNICI:
Bertolonijevo mačje uho (*Ophrys bertolonii*) je redkejša vrsta kukavičevke, ki jo najdemo vzdolž jadranske obale na Balkanskem in Apeninskem polotoku. V Sloveniji je vrsta bila zabeležena dvakrat v okolici vasi Podpeč na kraškem robu. (Foto: I. Paušič)
Sl. 1: V sredozemskem okolju je veliko vrst mačjih ušes. Mednje spada tudi Tommasinijevo mačje uho (*Ophrys tommasini*), za katerega pa še ni povsem jasno, ali raste tudi v Sloveniji. (Foto: I. Paušič)
Sl. 2: Serap (*Serapias lingua*) je stenomediteranska vrsta kukavičevk, v Sloveniji je ne srečamo. (Foto: I. Paušič)
Sl. 3: Dvolistni vimenjak (*Platanthera bifolia*) se pojavlja na travnikih in jasah v bližini svetlih gozdov. (Foto: I. Paušič)
Sl. 4: Splavka (*Limodorum abortivum*) je ena izmed najlepših sredozemskih kukavičevk. Je zajedavska; njeni listi imajo malo klorofila. (Foto: I. Paušič)
Sl. 5: Navadna močvirnica (*Epipactis palustris)* raste na poplavljenih in vlažnih travnikih in mokriščih. Je uvrščena na Rdeči seznam ogroženih rastlin s statusom ranljive vrste (V). (Foto: I. Paušič)
Sl. 6: Čmrljeliko mačje uho (*Ophrys holosericea*) je zelo variabilno in nastopa v različnih barvnih vzorcih, znanih pa je tudi veliko podvrst. (Foto: I. Paušič)

INDEX TO IMAGES ON THE COVER

FRONT COVER:
Bertoloni's bee orchid (*Ophrys bertolonii*) is a rare orchid species found along the Adriatic coasts of the Balkan and Apennine peninsulas. In Slovenia, it has only been recorded twice in the surroundings of the village Podpeč on the karst edge. (Photo: I. Paušič)
Fig. 1: The Mediterranean is home to many bee orchid species, including Tommasini's bee orchid (*Ophrys tommasini*). It is still to be established beyond doubt whether the latter also grows in Slovenia. (Photo: I. Paušič)
Fig. 2: The tongue orchid (*Serapias lingua*) is a steno-Mediterranean orchid species, not yet recorded in Slovenia. (Photo: I. Paušič)
Fig. 3: The lesser butterfly orchid (*Platanthera bifolia*) inhabits meadows and clearings close to light forests. (Photo: I. Paušič)
Fig. 4: The violet limodore (*Limodorum abortivum*) is one of the most beautiful orchids of the Mediterranean. It is a parasitic plant; its leaves only contain a small amount of chlorophyll. (Photo: I. Paušič)
Fig. 5: The marsh helleborine (*Epipactis palustris)* grows on submerged and wet meadows and other types of wetlands. It is recorded on the Red List of Threatened Species as a vulnerable species (VU). (Photo: I. Paušič)
Fig. 6: The bumblebee orchid (*Ophrys holosericea*) is famed for its variety. Featuring a number of subspecies, it can be found in many different colour patterns. (Photo: I. Paušič)