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New data on *Trachipterus trachypterus Gmelin, 1789 and Zu cristatus (Bonelli, 1820)* (Pisces: Trachipteridae) from the Mediterranean Sea

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In this paper we report data on four juvenile individuals of T. trachypterus and one adult of Z. cristatus, from the Strait of Messina and southern Tyrrhenian Sea, respectively (Mediterranean Sea). Information on morphometric and meristic characters are provided together with some biological data such as prey and age estimation. Only stomachs of T. trachypterus contained prey: copepods, amphypods and pelagic snails. The analisys of growth patterns in vertebrae of Z. cristatus allowed to estimate an age of 4 years for this individual. We also combined our data together with information from bibliographic sources and estimated the relationships between total length and standard length, as well as total length and body mass, for these two species.

Key words: Lampriformes; morphometric; length-mass relationship; prey; age; Mediterranean Sea

INTRODUCTION

Trachipteridae family includes three genera: *Trachipterus*, *Desmodema* and *Zu*, consisting of 10 species which are distributed worldwide throughout the pelagic marine environment (FROESE & PAULY, 2021) Species belonging to Trachipteridae are rare, although sometimes they are accidentally caught by pelagic fisheries (GARCIA-BARCELONA *et al.,* 2014; BORME & VOLTINA 2006; ANGULO, 2017; FALSONE *et al.,* 2017) or can be found stranded on the coast (BERDAR *et al.,* 1977; CAVALLARO *et al.,* 2021). Adult ribbonfishes usually occur in the mesopelagic zone (HEEMSTRA & KANNEMEYER, 1986; BIANCO *et al.,* 2006; BORME & VOLTOLINA, 2006), but juvenile specimens are often found also in upper water layers (BINI, 1970). These species are characterized by a long-compressed ribbon or ribbon-shaped body (BINI, 1970; TORTONESE, 1970;

OLNEY *et al.,* 1993), short head and narrow mouth with upper jaw highly protrusible (HEEMSTRA & KANNEMEYER, 1986; OLNEY *et al.,* 1993). They are characterized by a high dorsal fin extended for almost the full dorsal length, whereas the pectoral fins are small. Pelvic fins are extended in juveniles, rudimentary or absent in adults (HEEMESTRA & KANNEMEYER, 1984) and anal fin is absent. It was observed that these species usually assume a vertically oriented posture in the water column, with head up and swimming using the dorsal fin rays as a propulsion mechanism (NISHIMURA & HIROSAKI 1964; HEEMESTRA & KANNEMEYER, 1984; BORME & VOLTOLINA, 2006; MARTIN, 2015). Members of Trachipteridae are poorly known and available information regarding their taxonomy, distribution, occurrence, biology and ecology are limited.

In this paper we discuss about two species of Trachipteridae: *Trachipterus trachypterus* Gmelin, 1789 and *Zu cristatus* (Bonelli, 1820).

Trachipterus trachypterus

The Mediterranean dealfish *T. trachypterus* occurs in tropical and subtropical waters including the Mediterranean Sea (PALMER, 1986). Its vertical distribution extends up to mesopelagic environment, at a maximum depth of about 900 m (BINI, 1970). In Mediterranean waters this species is sporadically found stranded on the coasts or floating almost dead at surface (BINI, 1970; BORME & VOLTOLINA, 2006; LIPEJ *et al.,* 2018). Most records were located in the Strait of Messina (BINI, 1970; COSTA, 1991; CAVALLARO *et al.,* 2021) and Adriatic Sea (JARDAS, 1980; DULCIC, 1996; BORME & VOLTOLINA, 2006), referring of several juvenile individuals. Adults are sometimes caught by longlines, as observed by GARIBALDI (2015) in the Ligurian Sea and MYTILINEOU *et al*., (2013) in Ionian Sea. Other catches of large individuals are reported by bottom-trawl in Tyrrhenian Sea by PSOMADAKIS *et al.,* (2007). Spawning occurs throughout the year (BINI, 1970). In the Strait of Messina eggs and larvae of this species can be found from November to May, moreover, juvenile and adult specimens are recorded on the beaches from March to May (COSTA, 1991).

Zu cristatus

The scalloped ribbon fish *Z. cristatus* is a teleost which usually lives in mesopelagic and bathypelagic waters (BINI, 1970; FROESE & PAULY, 2020). It has a cosmopolitan distribution in tropical and temperate waters of Mediterranean Sea, Atlantic, Indian and Pacific Oceans (FROESE & PAULY, 2020). Despite its wide geographical distribution, this fish is considered quite rare and it is only occasionally reported. With regards to the Mediterranean basin, these records include juvenile stages collected by hand-nets (METAXA, 1833; JARDAS, 1980; BIANCO *et al.,* 2006), casting net (BRADAI & EL OUAER, 2012) beach seine (DULČIĆ *et al.,* 2014) or stranded (DULČIĆ *et al.,* 2014) as well as adults usually caught by several fishing gears: longlines (TORTONESE, 1958; GARCIA BARCELONA *et al.,* 2016; FALSONE *et al.,* 2017), bottom trawls (IBANEZ & GALLEGO, 1974; ROIG & DEMESTRE, 1982; PSOMADAKIS *et al.,* 2007), trammel net (POSTEL, 1955), surrounding nets (ROIG & DEMESTRE, 1982), rod fishing (SPERONE & GIGLIO, 2015). On the basis of these records, juveniles/small individuals are more frequently found near surface, while the adults seem to descend towards deep waters. According to some authors (SANZO, 1918; SPARTA, 1956; DULČIĆ 2002; BINI, 1970) eggs and larval stages can be mainly found during late spring and summer, from May to September. The existence of reproductive areas around the Strait of Messina and in the eastern-central Adriatic Sea can be inferred by the occurrence for these larval stages.

Aim of this paper we report is the catch of a four individuals of *T. trachypterus* and one of *Z. cristatus*, providing information on morphometric and meristic characters together with some biological data (sex, prey, maturity stage and age; this last one only for *Z. cristatus*). We also joined our data with information from bibliographic sources for the estimation of the relationships between total length and standard length as well as total length and body mass, for these species.

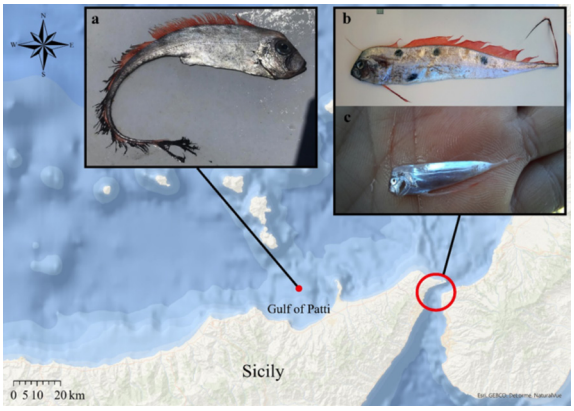

Fig. 1. Catch location of the individuals of Zu cristatus (a = individual found on 28 July 2020) and Trachipterus trachypterus (a = individual caught on 20 February 2021 ; b = specimen stranded on 10 April 2021) collected in the southern Tyrrhenian Sea and the Strait of Messina, respectively.

MATERIAL AND METHODS

On 28th July 2020 a specimen of *Z. cristatus* (Fig. 1) was caught off the Gulf of Patti in the southern Tyrrhenian Sea (western Mediterranean Sea), by a fishing vessel targeting red shrimps and using a bottom trawl net. In the next year, four young specimens of *T. trachypterus* were collected in the Strait of Messina (Fig. 1) between February and April 2021. The first *T. trachypterus* was caught on 07th February 2021 by a recreational fisherman, whereas the other three were found stranded on the coast in the same area, on 20th February, 09th and 10th April, respectively. These individuals were identified through the taxonomic features reported by PALMER (1986).

In laboratory, each specimen was photographed (Fig. 1) and examined, recording morphometric data to the nearest 0.1 mm, mass to the nearest 0.01 g and meristic features. Stomach was removed in order to improve current knowledge on the feeding behavior of these species.

Furthermore, additional analyses were performed for the adult *Z. cristatus*. The sex was determined only in this large individual. This specimen was dissected and the gonads were observed in order to record the information on sex and sexual maturity (maturity stage according to the scale proposed by HOLDEN & RAITT (1974). A portion of vertebral column was extracted from the body and vertebrae were used for age determination, following the methodology reported by CASTRIOTA *et al.* (2014). Overall 8 vertebrae were isolated, immersed in hot water and cleaned from fleshy parts, also removing neural and haemal spines. Then, they were stained with alizarin red in a solution of NaOH and glycerine for about 2 hours. Each vertebra was washed, dried and observed at a stereomicroscope under reflected light in order to observe the growth pattern. It was assumed that the sum of one opaque ring and one hyaline ring corresponds to one year of growth, according to the usual growth pattern observed in most Mediterranean fish.

Finally, we used size and body mass data to estimate the relationships between total length and standard length as well as total length and body mass. To do this, we integrated our information with available data from previous published records regarding these species.

The relationship between total and standard length (*TL* and *SL*, respectively) was calculated as follows:

$$TL = m*SL + q$$

where *m* is the slope and *q* is the y-intercept.

Then, length-body mass relationship was calculated according to the following function:

$$M = a * TL^b$$

where *M* is the body mass, *TL* is the standard length of the fish, and *a* is the value of the intercept of the regression line when the function is log-transformed and *b* the regression coefficient, i.e. the slope of the log-transformed relation (LE CREN, 1951; FROESE, 2006; FROESE *et al.,* 2011).

RESULTS AND DISCUSSION

Morphometric data and proportions of the collected specimens are presented in Table 1.

The individuals of *T. trachypterus* were all young specimens, ranging between 32.4 to 520.3 mm TL in size, and from 0.1759 to 81.26 g in body mass. As shown by our data the body proportions in this species changes during the growth. Indeed, early juveniles (the specimens

Table 1. Morphometric data recorded on the individuals of Trachipterus trachypterus and Zu cristatus collected in the Strait of Messina and Southern Tyrrhenian Sea, respectively.

	Trachipterus trachypterus					***Zu cristatus***
Date	07/02/2021	20/02/2021	09/04/2021	10/04/2021		28/07/2020
Morphometric data (mm)						
Total length (TL)	63.8	520.3	36.5	32.4		998.7
Standard length (SL)	45.2 (70.84% TL)	372 (71.5% TL)	31 (84.9% TL)	27.3 (84.3% TL)		862.3 (86.3% TL)
Caudal length	18.6 (29.1% TL)	148.3 (28.5% TL)	5.5 (15.1% TL)	5.5 17.0% TL)		136.4 (13.7% TL)
Head length (HL)	9.9 (15.5% TL)	49 (9.4% TL)	7.5 (20.5% TL)	6.5 (20.1% TL)		145.0 (14.5% TL)
Maximum head depth	11.8 (18.5% TL)	52.2 (10.0% TL)	8.7 (23.8% TL)	7.9 (24.4% TL)		152.7 (15.3% TL)
Upper jaw length	4.2 (42.4% HL)	17.9 (36.5% HL)	3.1 (41.3% HL)	2.6 (40.0% HL)		64.3 (44.3% HL)
Maximum upper jaw depth	1.8 (18.1% HL)	10.5 (21.4% HL)	1.2 (16.0% HL)	1.2 (18.5% HL)		32.0 (22.1% HL)
Lower jaw length	4.6 (46.4% HL)	23.9 (48.8% HL)	3.5 (46.7% HL)	3.4 (52.3% HL)		76.3 (52.6% HL)
Preorbital length	2.4 (24.2% HL)	15.8 (32.2% HL)	1.65 (22.0% HL)	1.65 (25.4% HL)		35.0 (24.1% HL)
Eye – operculum distance	4.8 (48.5% HL)	18.5 (37.8% HL)	3.5 (46.7% HL)	2.5 (38.5% HL)		59.0 (40.7% HL)
Eye horizontal diameter	2.7 (27.27% HL)	14.7 (30.0% HL)	2.35 (31.3% HL)	2.35 (36.2% HL)		51.0 (86.3% HL)
Eye vertical diameter	3.5 (35.3% HL)	14.7 (30.0% HL)	2.5 (33.3% HL)	2.4 (36.9% HL)		48.0 (4.8% HL)
Operculum - tail distance	35.3 (55.3% TL)	323 (62.1% TL)	23.5 (64.4% TL)	20.8 (64.2% TL)		717.3 (71.8% TL)
Predorsal length	3.3 (5.2% TL)	23.6 (4.5% TL)	2.1 (5.7 % TL)	1.8 (5.5% TL)		62.0 (71.8% TL)
Prepectoral length	10 (15.7% TL)	47.1 (9.1% TL)	6.8 (18.6% TL)	6.2 (19.1% TL)		125.0 (71.8% TL)
Preanal length	-	-	-	-		367.0 (71.8% TL)
Preventral length	10.2 (15.9% TL)	52.8 (10.1% TL)	8.3 (22.7% TL)	7.3 (22.5% TL)		134.0 (71.8% TL)
Pectoral fin length	6 (9.4% TL)	19.9 (3.8% TL)	2 (5.5% TL)	-		59.5 (71.8% TL)
Pelvic fin length	20.1 (31.5% TL)	62.8 (12.1% TL)	14.8 (40.5% TL)	16.7 (51.5% TL)		-
Dorsal fin base	43.6 (68.3% TL)	345 (66.3% TL)	28 (76.7% TL)	24 (74.1% TL)		782.0 (78.3% TL)
Pelvic fin base	0.5 (0.8% TL)	5 (1.0% TL)	14 (38.4% TL)	1.1 (3.4% TL)		11.1 (1.1% TL)
Pectoral fin base	0.3 (0.4% TL)	4.6 (0.9% TL)	0.5 (1.4% TL)	0.4 (1.2% TL)		13.4 (1.3% TL)
Maximum trunk height after the operculum	10.5 (16.4% TL)	68.2 (13.1% TL)	9 (24.7% TL)	7.4 (22.8% TL)		17.0 (1.7% TL)
Minimum trunk height at caudal peduncle	0.7 (1.0% TL)	5.5 (1.1% TL)	0.75 (2.1% TL)	0.65 (2.0% TL)		7.6 (0.8% TL)

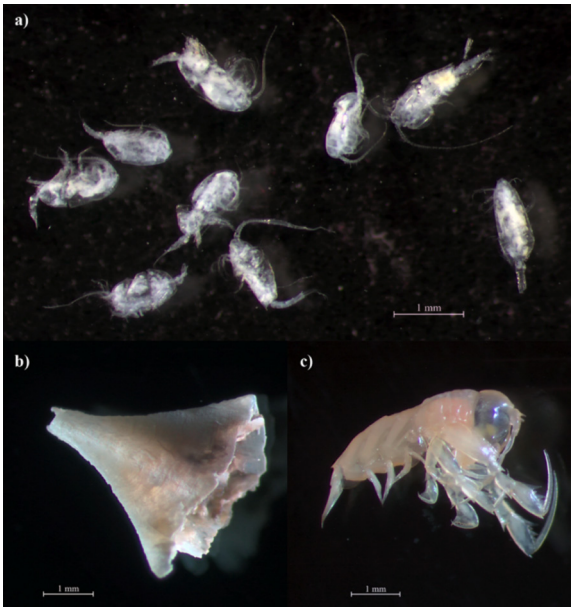

Fig. 2. Some prey items found in the stomach content of T. trachypterus : a) Copepods; b) Phrosina semilunata; c) Clio pyramidata.

found on April 2021) have a shorter body in comparison with the others, becoming the body shape more tapered during the development. This aspect was also underlined by JARDAS (1980), that observed considerable morphological changes during the ontogenetic development of this species. Moreover, changes in general body shape, fin length and number and pigmentation patterns can be detected (MARTIN, 2015). According to MARTIN (2015), specimens belonging to the genus *Trachipterus* retain their juvenile characters up to about 600 mm SL.

The following meristic characters were recorded in the largest specimen: 5+161 dorsal fin rays, 10 pectoral fin rays, 1+7 pelvic fin rays, 3+9 gillrakers on the first gill arch (epibranchial + ceratobranchial), 8 caudal fin elements, 3 black spots on flanks over lateral line and 1 on the abdomen.

All these individuals were found in the Strait of Messina, where occasionally this species has been previously recorded (BERDAR, 1977; COSTA, 1991; CAVALLARO *et al.,* 2021). The occurrence of juvenile individuals in this area has been reported during an extended period, between March and May, demonstrating that the recruitment of this species coincides with late winter and spring. Furthermore, the finding of juveniles of different sizes in the reported period may indicate different reproduction events within these months. According to the information provided by the fisherman that caught the individual of 520.3 mm TL, there was a shoal of several specimens swimming at surface, confirming the observation of juvenile individuals is more common than adults due to a probable habitat shift towards deep waters during ontogenetic development.

The largest individual was an immature male (stage I of Holden-Raitt maturity scale; gonadal mass = 0.0383 g).

The analysis of stomach content revealed that *T. trachypterus* feeds mainly on copepods at smaller sizes. Indeed, the three smaller individuals had only copepods (Fig. 2) in the stomach contents, and in particular they ingested 62, 133 and 51 prey items, respectively. Differently, the largest individual preyed mainly on amphypods (1 *Phronima sedentaria*, 1 *Phrosina semilunata* and 16 *Hyperioides longipes*), although also the mollusc *Clio pyramidata* was also found. Also, the previous study of BORME & VALTOLINA (2006) reported that a juvenile individual had several copepods (n=79; 87.8% of total prey) in its stomach, although some other food categories were identified (e.g., cladocerans, isopods, decapods, fish).

The unique individual of *Z. cristatus* measured 998.7 mm TL and weighed 1548 g. It was caught at an average depth of about 600 m. The catch of adult individuals belonging to this species usually occurs at deep waters. The maximum depth recorded for this species in Mediterranean waters is about 2000 m, according to the information reported by TIRALONGO *et al.* (2019).

According to our meristic counts, 5+115 dorsal fin rays, 11 pectoral fin rays, 3+9 gillrakers on the first gill arch (epibranchial + ceratobranchial), 9+3 caudal fin elements (upper + lower lobes). It was impossible to count the pelvic fin rays because they were broken. This specimen was a female, with gonads in regression status (stage V of Holden-Raitt maturity scale; gonadal mass = 98 g). This information could support the hypothesis that reproduction occurs also in early summer period in the south-

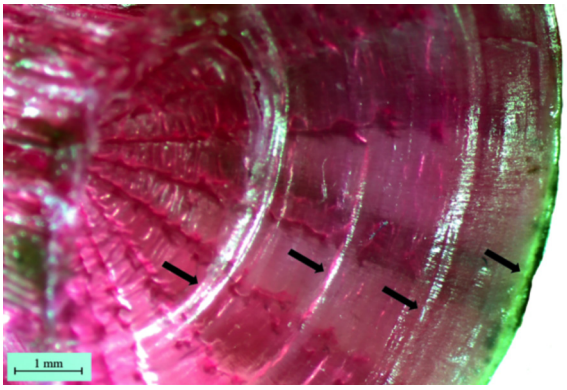

Fig. 3. Image of the growth patterns in a vertebra of Zu cristatus, indicating the annual rings.

Fig. 4. Isopod parasite found in the buccal cavity of Zu cristatus.

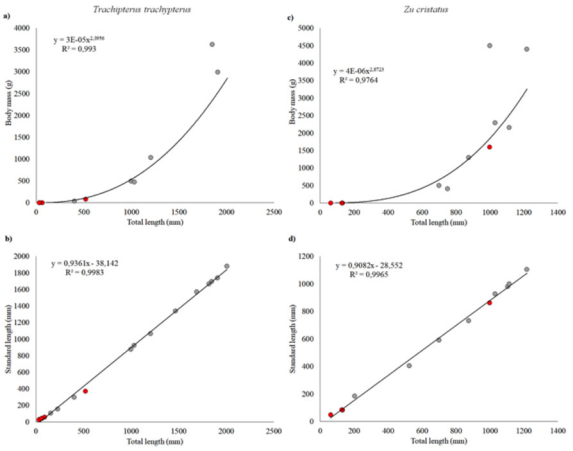

Fig. 5. The size-mass and TL-SL relationships for *T. trachypterus* and *Z. cristatus*. The red dots indicate the data collected in the present study. The grey dots refer to data reported in previous papers (*Trachipterus trachypterus*: PEQUEÑO,1991; BORME & VOLTINA 2006; CORTES *et al.,* 1995; FARIAS *et al.,* 2010; LIPEJ *et al.,* 2018; MYTILINEOU *et al.,* 2013; MACALI *et al.,* 2020; *Zu cristatus*: TORTONESE,1958; IBAÑEZ, 1974; ECKMAYER, 1982; ROIG & DEMESTRE,1982; Scott, 1984; Heemstra e Kannemeyer, 1984; Bianco et al., 2006; Psomadakis et al., 2007; DULCIC *et al.,* 2014; FALSONE *et al.,* 2017; ANGULO & SANCHEZ., 2017; MOHAN *et al.,* 2011; FITCH., 1964; GARCIA–BARCELONA *et al.,* 2014; ZENETOS *et al.,* 2015). Moreover, a single record was collected from data obtained by a social network.

ern Tyrrhenian Sea.The stomach was empty, but some parasites were found (they were delivered to another research group for further analyses). Another isopod parasite was found in the buccal cavity (Fig. 4).

The analysis of growth patterns in the vertebrae of *Z. cristatus* indicated that this fish was 4 years old (Fig.3). The age estimation in these fish is not simple because of the presence of several rings in the structure of vertebrae; however, some of them may be laid down in the same year. During our readings it was evident that annual growth patterns can be distinguished by the presence of marked growth rings (Fig. 3). This indicates that it is possible to overestimate the age of this species. Recently, FALSONE *et al.* (2017) estimated an age of 11 years on a specimen of 876 mm TL. For this reason, it would be useful to collect and analyse more samples in order to clarify these aspects and achieve a reliable estimation of the life duration of this fish.

In Fig. 5 the size-mass and TL-SL relationships for both *T. trachypterus* and *Z. cristatus* are reported. The values of the regression coefficient *b* suggested that they follow a negative allometric growth. The estimation of TL-SL relationships for both species provided reliable equations because data fitted well the regression line. These equations may be useful for the reconstruction of sizes or weight of these species, considering that these animals are quite delicate and sometimes they are found in bad conditions.

The information collected in this paper improve the knowledge on these poorly known species, although more data are needed to better understand their biology and ecology in Mediterranean waters.

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REFERENCES

ANGULO, A., & M. I. LOPEZ-SANCHEZ. 2017. New records of lampriform fishes (Teleostei: Lampriformes) from the Pacific coast of lower Central America, with comments on the diversity, taxonomy and distribution of the Lampriformes in the eastern Pacific Ocean. Zootaxa, 4236(3) : 573-591.

BERDAR, A. 1977. Contributo alla conoscenza dei pesci spiaggiati lungo in litorale siciliano dello Stretto di Messina.

BIANCO, P. G., V. ZUPO & V. KETMAIER. 2006. Occurrence of the scalloped ribbonfish *Zu cristatus* (Lampridiformes) in coastal waters of the central Tyrrhenian Sea, Italy. J. Fish Biol., 68(A) : 150-155.

BINI, G. 1970. Atlante dei pesci delle coste Italiane. Vol. 3. Osteitti. Mondo Sommerso ed., pp. 183-186.

BORME, D. & F. VOLTOLINA. 2006. On the occurrence of ribbon fish *Trachipterus trachypterus* (Gmelin, 1789) in the Gulf of Trieste (northern Adriatic Sea). Annales Ser. Hist. Nat.,16 (2): 181-188.

BRADAI, M. N. & A. EL OUAER. 2012. New record of the scalloped ribbon fish, *Zu cristatus* (Osteichthyes: Trachipteridae) in Tunisian waters (central Mediterranean). Mar. Biodivers. Rec., 5.

CAU, A. 1980. Second note on the bathyal ichthyofauna of the seas around southern Sardinia. Quaderni della Civica Stazione Idrobiologia di Milano 8 :39– 44.

CAVALLARO M., G. AMMENDOLIA, I. RAO VILLARI A. & P. BATTAGLIA 2021. Variazioni pluriennali del fenomeno dello spiaggiamento di specie ittiche nello Stretto di Messina, con particolare attenzione alle specie mesopelagiche. Annales Ser. Hist. Nat., 31 (1).

CASTRIOTA, L., FALAUTANO, M. BATTAGLIA, P., A. ODDO & F. ANDALORO. 2014. New biological data on *Fistularia commersonii* in the central Mediterranean Sea. Cybium, 38(1): 15-21.

CORTES, N., M. ARRIAZA & C. OYARZUN. 1995. Nuevos registros de *Trachipterus trachypterus* (Gmelin, 1789) para el Pacífico suroriental, con una revisión de ejemplares congenéricos de Chile (Osteichthyes, Trachipteridae). Rev. Biol. Mar., 30(2): 265-273.

DULČIĆ, J. 1996. First record of ribbon fish larva, *Trachipterus trachypterus*, from the eastern Adriatic. Cybium, 20(1): 101-102.

DULČIĆ, J. 2002. First record of scalloped ribbon fish, *Zu cristatus* (Pisces: Trachipteridae), eggs in the Adriatic Sea. J. Plankton Res., 24(11): 1245-1246.

DULČIĆ, J., B. DRAGIČEVIĆ, M. PAVIČIĆ, Z. IKICA, A. JOKSIMOVIĆ & O. MARKOVIĆ. 2014. Additional records of non-indigenous, rare and less known fishes in the eastern Adriatic/ nuove segnalazioni di pesci non indigeni, rari e meno conosciuti nell'adriatico orientale. Annales Ser. Hist. Nat., 24(1): 17-22.

ECKMAYER, W. J. 1982. First Gulf of Mexico Record of *Zu cristatus* (Bonnelli)(Pisces: Trachypteridae). Gulf Mex. Sci., 5(2): 5.

FALSONE, F., M. L. GERACI, D. SCANELLA, C. O. R., OKPALA, G. B. GIUSTO, M. BOSCH-BELMAR, S. GANCITANO & G. BONO. 2017. Occurrnce of two rare species from order. Lampriformes: Crestfish *Lophotus lacepede* (Giorna, 1809) and scalloped ribbonfish *Zu cristatus* (Bonelli, 1819) in the northern coast of Sicily, Italy. Acta Adriat., 58(1): 137-144.

FARIAS, I., T. MOURA, I. FIGUEIREDO, A. R. VIEIRA, B. SERRA-PEREIRA & L. SERRANO GORDO.2010. Northernmost occurrence of the ribbonfish *Trachipterus trachypterus* (Gmelin, 1789) in the NE Atlantic : the Portuguese continental shelf. J. Appl. Ichthyol., 26(1): 143-144.

FITCH, J. E. 1964. The ribbon fishes (family Trachipteridae) of the Eastern Pacific Ocean, with a description of a new species. Calif. Fish Game, 50(4): 228-240.

FROESE R. 2006. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. J. Appl. Ichthyol., 22: 241–253.

FROESE R., A.C. TSIKLIRAS, K.I. STERGIOU. 2011. Editorial note on weight–length relations of fishes. Acta Ichthyol. Piscat., 41: 261–263.

FROESE, R. & D. PAULY. 2020. (Editors). FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2020).

FROESE, R. & D. PAULY. 2021. (Editors). FishBase. *Trachipteridae Swainson*, 1839. Accessed through: World Register of Marine Species at: http://www.marinespecies.org/aphia.php?p=taxdetails&id=125483 on 2021-05-13

GARCIA-BARCELONA, S., R. GARCIA-CANCELA, M. J. CAYUELA, A. DE CARLOS, R., BAÑON, D. MACIAS & J. C. BAEZ. 2016. Descripción de dos ejemplares de *Zu cristatus* (Bonelli, 1820) capturados accidentalmente con unpalangre semipelágico en el Mediterráneo occidental. Arx. Misc. Zool., 14 : 91-98.

GARIBALDI, F. 2015. By-catch in the mesopelagic swordfish longline fishery in the Ligurian Sea (Western Mediterranean). Collect. Vol. Sci. Pap. ICCAT, 71(3):1495-1498.

HOLDEN, M. J. & D. F. S. RAITT. 1974. Manual of fisheries science. Part 2 - methods of resources investigation and their application. FAO Fish. Tech. Pap., 115:1–214.

HEEMSTRA, P. C. & S.X. KANNEMEYER. 1984. The families Trachipteridae and Radiicephalidae (Pisces, Lampriformes) and a new species of *Zu* from South Africa. Ann. S. Afr. Mus., 94: 13–39.

HEEMSTRA, P. C. & S.X. KANNEMEYER. 1986. Trachipteridae. In: Smiths sea fishes. M. M. Smith, P. C. Heemstra (Editors). Springer-Verlag, Berlin, Germany, pp. 399–402

JARDAS I. 1980. Contribution a` la connaissance des Trachipte`res dans la mer Adriatique. 1. *Trachipterus trachypterus* (Gmelin, 1789). Acta Adriat., 21: 3–17.

IBAÑEZ, M., & GALLEGO, L. 1974. A new record of a *Zu cristatus* (Trachipteridae Pisces) off the coast of Blanes (Spain). Vie et Milieu, 523-526.

LE CREN E.D. 1951 The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J. Anim. Ecol., 20: 201–219.

LIPEJ, L., D. TRKOV & B. MAVRIČ. 2018. Occurrence of ribbon fish (*Trachipterus trachypterus*) In Slovenian waters (Northern Adriatic Sea). Annales Ser. Hist. Nat., 28(2) : 129-134.

MACALI, A., A. SEMENOV, F. PALADINI DE MENDOZA, A. DINOI, E. BERGAMI & F. TIRALONGO. 2020. Relative influence of environmental factors on biodiversity and behavioural traits of a rare mesopelagic fish, *Trachipterus trachypterus* (Gmelin, 1789), in a continental shelf front of the Mediterranean Sea. J. Mar. Sci. Eng., 8(8): 581.

MARTIN, JENNIFER M. 2015. «Phylogeny, Ontogeny and Distribution of the Ribbonfishes (Lampridiformes: Trachipteridae)». Dissertations, Theses, and Masters Projects. Paper 1539616922. https://dx.doi.org/doi:10.25773/v5-fe3a-yf15

METAXA, T. 1833. Memorie Zoologico Mediche. Roma, 90 pp.

MYTILINEOU, C., A. ANASTASOPOULOU, G. CHRISTIDES, P. BEKAS, C. J. SMITH, K. N. PAPADOPOULOU, E. LEFKADITOU & S. KAVADAS. 2013. New records of rare deep-water fish species in the Eastern Ionian Sea (Mediterranean Sea). J. Nat. Hist., 47(25-28): 1645-1662.

MOHAN, S., SELVANIDHI, S., & RAJAPACKIAM, S. 2011. First record of scalloped ribbonfish *Zu cristatus* (Bonelli, 1819) at Chennai. Mar. Fish. Infor. Serv., 207: 37-37.

NISHIMURA S. 1964. Additional information on the biology of the dealfish *Trachipterus ishikawai* Jordan & Snyder. Bull. Jap. Sea Reg. Fish. Res. Lab, 13: 127-129.

OLNEY, J.E., G.D. JOHNSON & C.C. BALDWIN.1993. Phylogeny of lampridiform fishes. Bull. Mar. Sci., 52: 137–169.

PALMER, G. 1986. Trachipteridae. In : Whitehead, P. J. P., Bauchot, M. L., Hureau, J. C., Nielsen, J., & Tortonese, E. (eds). Fishes of the north-eastern Atlantic and the Mediterranean. vol. 2., pp. 729-732

PEQUEÑO, G. 1991. Nuevos registros de *Trachipterus trachipterus* (Gmelin, 1789) frente a Valdivia (Osteichthyes, Trachipteridae). Bol. Soc. Biol. Concepc., 62: 119-122.

POSTEL, E. 1955. Capture d'un trachyptère *Trachypterus cristatus* Bonelli en baie de Tunis. Bull. SOS, 51: 69–70.

PSOMADAKIS, P. N., M. BOTTARO & M. VACCHI. 2007. On two large specimens of *Zu cristatus* (Trachipteridae) from the Gulf of Genoa

(NW Mediterranean). Cybium, 31(4): 480-482.

ROIG, A. & M. DEMESTRE 1982. Sobre la captura de dos *Zu cristatus* (Bonelli, 1820) en aguas del litoral catalán (Pisces, Trachipterigidae). Misc. Zool., 6: 152-154.

SANZO, L. 1918. Uova e larve di *Trachypterus cristatus* Bp. Mem. R. Com. Talassogr. Ital., Venezia, 64: 1-16.

SCOTT, E. O. G. 1984. Observations on some Tasmanian fishes: Part XXX. In Pap. Proc. R. Soc. Tasman., 118: 187-222.

SPARTA, A. 1956. Trachipteridae. Fauna e flora del Golfo di Napoli. Monografia Stazione Zoologica di Napoli, 38: 266–275.

SPERONE, E.,GIGLIO G. 2015. On the occurrence of *Ranzania laevis* and *Zu cristatus* in Calabria (Southern Tyrrhenian Sea). In : ZENETOS A., AKEL E.H.KH., APOSTOLIDIS C., BILECENOGLU M., BITAR G., BUCHET V., CHALARI N., CORSINI-FOKA M., CROCETTA F., DOGRAMMATZI A., DRAKULIĆ M., FANELLI G., GIGLIO G., IMSIRIDOU A., KAPIRIS K., PKARACHLE P.K., KAVADAS S., KONDYLATOS G., LEFKADITOU E., LIPEJ L., MAVRIČ B., MINOS G., MOUSSA R., PANCUCCI-PAPADOPOULOU M.A., PRATO E., RENDA W., RÍOS N., RIZKALLA S.I., RUSSO F., SERVONNAT M., SIAPATIS A., SPERONE E., THEODOROU J.A., TIRALONGO F. & TZOVENIS I. 2015. New Mediterranean Biodiversity Records. Med. Mar. Sci., 16 (1): 266-284.

TORTONESE, E. 1970. Osteichthyes (pesci ossei). Parte prima. Calderini (Editors), Bologna, Italy.

TORTONESE, E. 1958. Cattura di *Trachypterus cristatus* Bon. e note sui Trachypteridae del Mar Ligure. Doriana, 11(89): 1-5.

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Novi podaci o maču srebrnjaku *Trachipterus trachypterus* Gmelin, 1789. i srporibi srebrnici *Zu cristatus* (Bonelli, 1820) (Pisces: Trachipteridae) iz Sredozemnog mora

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SAŽETAK

U ovom radu objavljujemo podatke o četiri juvenilne jedinke *T. trachypterus* i jednoj zreloj jedinki. *Z. cristatus*, iz Mesinskog tjesnaca, odnosno južnog Tirenskog mora (Sredozemno more). Podaci o morfometrijskim i merističkim značajkama daju se zajedno s nekim biološkim podacima kao što su plijen i procjena starosti. Samo želuci *T. trachypterus* sadržavali su plijen: kopepode, amfipode i pelagične puževe.

Samo želuci *T. trachypterus* sadržavali su plijen: kopepode, amfipode i pelagične puževe. Analiza obrazaca rasta u kralješcima *Z. cristatus* omogućila je procjenu starosti ove jedinke od 4 godine. Također smo spojili naše podatke zajedno s informacijama iz bibliografskih izvora i procijenili odnose između ukupne duljine i standardne duljine, kao i ukupne duljine i tjelesne mase za ove dvije vrste.

Ključne riječi: Lampriformes; morfometrija; odnos duljine i mase; plijen; dob; Sredozemno more