

# ANNALES

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*Annali di Studi istriani e mediterraneei*  
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## VSEBINA / INDICE GENERALE / CONTENTS 2022(1)

SREDOZEMSKI MORSKI PSI  
*SQUALI MEDITERRANEI*  
MEDITERRANEAN SHARKS

**Farid HEMIDA, Christian REYNAUD & Christian CAPAPÉ**

Observations on Thresher Shark, *Alopias vulpinus* (Chondrichthyes: Alopiidae) from the Coast of Algeria (Southwestern Mediterranean Sea) ..... 1  
*Opazovanja morskih lisic, Alopias vulpinus (Chondrichthyes: Alopiidae) ob alžirski obali (jugozahodno Sredozemsko morje)*

**Elif ÖZGÜR ÖZBEK & Hakan KABASAKAL**

Notes on Smoothback Angel Shark, *Squatina oculata* (Squatiniiformes: Squatinidae) caught in the Gulf of Antalya ..... 9  
*Zapis o pegastih sklatih, Squatina oculata (Squatiniiformes: Squatinidae), ujetih v Antalijskem zalivu*

**Alessandro PAGANO & Alessandro DE MADDALENA**

Underwater Observations of the Rare Angular Roughshark *Oxynotus centrina* (Chondrichthyes: Squalidae) in the Waters of Santa Tecla (Sicily, Italy) ..... 17  
*Podvodna opazovanja redkega morskega prašiča, Oxynotus centrina (Chondrichthyes: Squalidae) v vodah Sante Tecele (Sicilija, Italija)*

**Deniz ERGÜDEN, Deniz AYAS & Hakan KABASAKAL**

Morphometric Measurements of Three Young Carcharhinid Species from Northeastern Levant (Mediterranean Sea) ..... 25  
*Morfometrične meritve mladičev treh vrst morskih psov iz družine Carcharhinidae iz severnovzhodnega Levanta (Sredozemsko morje)*

**Hakan KABASAKAL**

Projections on the Future of Deep-Sea Sharks in the Sea of Marmara, Where Deep Zones Are Threatened by Deoxygenation: a Review ..... 35  
*Napovedi o prihodnosti globomorskih morskih psov v Marmarskem morju, ogroženem zaradi pomanjkanja kisika: pregled*

BIOINVAZIJA  
*BIOINVASIONE*  
*BIOINVASION*

**Alan DEIDUN, Bruno ZAVA & Maria CORSINI-FOKA**

Distribution Extension of *Lutjanus argentimaculatus* (Lutjanidae) and *Psenes pellucidus* (Nomeidae) to the Waters of Malta, Central Mediterranean Sea ..... 49  
*Širjenje areala vrst Lutjanus argentimaculatus (Lutjanidae) in Psenes pellucidus (Nomeidae) v malteške vode (osrednje Sredozemsko morje)*

**Sami M. IBRAHIM, Abdulrazziq A. ABDULRAZIQ, Abdulghani ABDULGHANI, Sara A.A. AL MABRUK, David SALVATORI, Bruno ZAVA, Maria CORSINI-FOKA & Alan DEIDUN**

First Record of *Enchelycore anatina* (Muraenidae) from Libyan Waters and an Additional Record from Southern Italy (Western Ionian Sea) ..... 59  
*Prvi zapis o pojavljanju kavljazobe murene Enchelycore anatina (Muraenidae) iz libijskih voda in dodatni zapis za južno Italijo (zahodno Jonsko morje)*

**Rasha Ali HENEISH & Samir Ibrahim RIZKALLA**

Morphometric and Meristic Characteristics of a New Record of Bluespot Mullet *Crenimugil seheli* (Pisces: Mugilidae) in Egyptian Mediterranean waters ..... 67  
*Novi zapis o pojavljanju vrste Crenimugil seheli (Pisces: Mugilidae) v egiptovskih sredozemskih vodah in njene morfometrične in meristične značilnosti*

**Yana SOLIMAN, Adib SAAD, Vienna HAMMOUD & Christian CAPAPÉ**

Heavy Metal Concentrations in Tissues of *Siganus rivulatus* (Siganidae) from the Syrian Coast (Eastern Mediterranean Sea) ..... 75  
*Vsebnost težkih kovin v tkivih marmoriranega morskega kunca Siganus rivulatus (Siganidae) iz sirske obale (vzhodno Sredozemsko morje)*

IHTIOLOGIJA  
 ITTIOLOGIA  
 ICHTHYOLOGY

**Jihade ALAHYENE, Brahim CHIAHOU, Hammou EL HABOUZ & Abdelbasset BEN-BANI**

Length Based Growth Estimation of the Blue Shark *Prionace glauca* from the Moroccan Central Atlantic Coast ..... 85  
*Dolžinsko-masni odnos in ocena rasti pri sinjem morskem psu (Prionace glauca) iz osrednje atlantske obale Maroka*

**Okan AKYOL, Altan LÖK & Funda ERDEM**

Occurrence of *Cubiceps gracilis* (Nomeidae) in the Eastern Mediterranean Sea ..... 101  
*Pojavljanje klateža, Cubiceps gracilis (Nomeidae), v vzhodnem Sredozemskem morju*

**Farid HEMIDA, Boualem BRAHMI, Christian REYNAUD & Christian CAPAPÉ**

Occurrence of the Rare Driftfish *Cubiceps gracilis* (Nomeidae) from the Algerian Coast (Southwestern Mediterranean Sea) ..... 107  
*Pojavljanje redkega klazeža Cubiceps gracilis (Nomeidae) z alžirske obale (jugozahodno Sredozemsko morje)*

**Deniz ERGÜDEN & Cemal TURAN**

A Rare Occurrence of *Carapus acus* (Carapidae) in the Eastern Mediterranean, Turkey ..... 113  
*Redko pojavljanje strmorinca Carapus acus (Carapidae) v vzhodnem Sredozemskem morju (Turčija)*

**Laith JAWAD, Murat ŞIRIN, Miloslav PETRTÝL, Ahmet ÖKTENER, Murat ÇELİK & Audai QASIM**

Skeletal Abnormalities in Four Fish Species Collected from the Sea of Marmara, Turkey ..... 119  
*Skeletne anomalije pri štirih vrstah rib iz Marmarskega morja (Turčija)*

RAZMNOŽEVALNA EKOLOGIJA  
 ECOLOGIA RIPRODUTTIVA  
 REPRODUCTIVE ECOLOGY

**Amaria Latefa BOUZIANI, Khaled RAHMANI, Samira AIT DARNA, Alae Eddine BELMAHI, Sihem ABID KACHOUR & Mohamed BOUDERBALA**

Gonadal Histology in *Diplodus vulgaris* from the West Algerian Coast ..... 137  
*Histologija gonad pri navadnem šparu (Diplodus vulgaris) iz zahodne alžirske obale*

**Cheikhna Yero GANDEGA, Nassima EL OMRANI, Rezan O. RASHEED, Mohammed RAMDANI & Roger FLOWER**

The Growth and Reproduction of Two Sparidae, *Pagrus caeruleostictus* and *Pagellus bellottii* in Northern Mauritanian Waters (Eastern Tropical Atlantic) ..... 143  
*Rast in razmnoževanje dveh vrst pagrov, Pagrus caeruleostictus in Pagellus bellottii v severnih mavretanskih vodah (vzhodni tropski Atlantik)*

**Nassima EL OMRANI, Hammou EL HABOUZ, Abdellah BOUHAIMI, Jaouad ABOU OUALID, Abdellatif MOUKRIM, Jamila GOUZOU, Mohammed RAMDANI, Roger FLOWER & Abdelbasset BEN-BANI**

The Reproductive Biology of the Pouting *Trisopterus luscus* from the Atlantic Coast of Morocco ..... 155  
*Reproduktivna biologija francoskega moliča (Trisopterus luscus) iz atlantske obale Maroka*

**Mourad CHÉRIF, Rimel BENMESSAOUD & Christian CAPAPÉ**

Growth Patterns and Age Structure of *Mullus surmuletus* (Mullidae) from the Northern Coast of Tunisia (Central Mediterranean Sea) ..... 173  
*Rastni parametri in starostna struktura progastih bradačev Mullus surmuletus (Mullidae) iz severne tunizijske obale (osrednje Sredozemsko morje)*

FLORA  
 FLORA  
 FLORA

**Martina ORLANDO-BONACA, Erik LIPEJ, Romina BONACA & Leon Lojze ZAMUDA**

Improvement of the Ecological Status of the *Cymodocea nodosa* Meadow near the Port of Koper ..... 185  
*Izboljšanje ekološkega stanja morskega travnika kolenčaste cimodoceje (Cymodocea nodosa) v bližini kopskega pristanišča*

FAVNA  
 FAVNA  
 FAVNA

**Manja ROGELJA, Martin VODOPIVEC & Alenka MALEJ**

*Cestum veneris* Lesueur, 1813 (Ctenophora) – a Rare Guest in the Northern Adriatic Sea ..... 197  
*Cestum veneris Lesueur, 1813 (Ctenophora) – redek gost v severnem Jadranu*

**Adla KAHRIĆ, Dalila DELIĆ & Dejan KULIJER**

*Notospermus annulatus* (Nemertea: Lineidae), a New Record for Bosnia and Herzegovina ..... 205  
*Notospermus annulatus (Nemertea: Lineidae), prvi zapis o pojavljanju za Bosno in Hercegovino*

**Andrea LOMBARDO & Giuliana MARLETTA**

Report of an Interesting *Trapania* (Gastropoda: Nudibranchia: Goniodorididae) Specimen from Central Eastern Sicily ..... 211  
*Zapis o zanimivem primerku iz rodu Trapania (Gastropoda: Nudibranchia: Goniodorididae) iz osrednje vzhodne Sicilije*

**Abdelkarim DERBALI & Othman JARBOUI**

Stock Assessment, Cartography and Sexuality of the Wedge Clam *Donax trunculus* in the Gulf of Gabes (Tunisia) ..... 217  
*Ocena staleža, kartografija in spolnost klinaste školjke Donax trunculus v gabeškem zalivu (Tunizija)*

**Abdelkarim DERBALI, Aymen HADJ TAIEB & Othman JARBOUI**

Length-Weight Relationships and Density of Bivalve Species in the Shellfish Production Area of Zarzis (Tunisia, Central Mediterranean Sea) ..... 229  
*Dolžinsko-masni odnos in gostota školjk na gojišču školjk v predelu Zarsisa (Tunizija, osrednje Sredozemsko morje)*

**Toni KOREN**

The Diversity of Moths (Lepidoptera: Heterocera) of Significant Landscape Donji Kamenjak and Medulin Archipelago, Istria, Croatia ..... 237  
*Raznolikost nočnih metuljev (Lepidoptera: Heterocera) Pomembne pokrajine Donji Kamenjak in Medulinski arhipelag, Istra, Hrvaška*

## OCENE IN POROČILA

RECENSIONI E RELAZIONI

REVIEWS AND REPORTS

**Ines Mandić Mulec & Nives Ogrinc**

Recenzija knjige: Mikrobna biogeokemija vod ..... 263

Kazalo k slikam na ovitku ..... 265

*Index to images on the cover* ..... 265



OBSERVATIONS ON THE THRESHER SHARK, *ALOPIAS VULPINUS*  
(CHONDRICHTHYES: ALOPIIDAE) FROM THE COAST OF ALGERIA  
(SOUTHWESTERN MEDITERRANEAN SEA)

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ABSTRACT

*Between 1996 and 2002, 194 specimens of thresher shark, *Alopias vulpinus*, were sampled from the Algerian coast. Males (102 specimens) did not significantly outnumber females (92 specimens). The collected specimens ranged between 49 and 249 cm in standard length and weighed between 14 and 150 kg. Since 2002, captures of *A. vulpinus* have remained relatively rare throughout the Algerian coast and this phenomenon could indicate a decline of the species' occurrence in this area and probably in the entire Mediterranean.*

**Key words:** *Alopiidae, *Alopias vulpinus*, Maghrebin shore, growth parameters, migrations*

OSSERVAZIONI SULLO SQUALO VOLPE, *ALOPIAS VULPINUS* (CHONDRICHTHYES:  
ALOPIIDAE) DALLA COSTA DELL'ALGERIA (MEDITERRANEO SUD-OCCIDENTALE)

SINTESI

*Tra il 1996 e il 2002, 194 esemplari di squalo volpe, *Alopias vulpinus*, sono stati catturati lungo la costa algerina. I maschi (102 esemplari) non erano significativamente più numerosi delle femmine (92 esemplari). Gli esemplari catturati variavano tra i 49 e i 249 cm di lunghezza standard e pesavano tra i 14 e i 150 kg. Dal 2002, le catture di *A. vulpinus* sono rimaste relativamente rare lungo tutta la costa algerina e questo fenomeno potrebbe indicare un declino della presenza della specie in quest'area e probabilmente in tutto il Mediterraneo.*

**Parole chiave:** *Alopiidae, *Alopias vulpinus*, costa magrebina, parametri di crescita, migrazioni*

## INTRODUCTION

The thresher shark, *Alopias vulpinus* (Bonnaterre, 1788) is an oceanic and coastal species widely distributed in warm oceans and seas (Compagno, 1984). It is recorded in the eastern Atlantic from Norway and the British Isles southward to temperate and tropical Atlantic (Quéro, 1984). The species is known throughout the Mediterranean Sea, but appears to be more abundant in the western than in the eastern basin (Capapé, 1989). *A. vulpinus* occurs off the Maghreb shore, from Morocco (Lloris & Rucabado, 1998), Algeria (Refes et al., 2010) to Tunisia (Rafrafi-Nouira et al., 2019). Rare occurrences of *A. vulpinus* were also reported from the Marmara and Black Seas (Kabasakal, 1998, 2007).

Regular investigations conducted in collaboration with experienced fishermen have allowed the observation of several specimens of *A. vulpinus* and improved the knowledge of the species. The main purpose of the present paper is to study some biological parameters recorded about the species in order to model its linear growth.

## MATERIAL AND METHODS

Observations were carried out from 1996 to 2002 in the great fish market of Algiers (Fig. 1). The captures of *A. vulpinus* occurred throughout both west and east regions of the Algerian coast (Fig. 2). A total of 194 specimens were examined, standard length (SL) or precaudal fin length (PRC) was measured to the nearest centimetre from the tip of the snout to the beginning of caudal fin (Compagno, 1984). Additionally, their eviscerated weights were recorded to the nearest kilogram. Statistical differences were established using a  $\chi^2$  test. The test for normality of the sample was performed using the Shapiro-Wilk test, with  $p < 0.05$ .

Estimation of growth parameters, such as  $SL_{\infty}$  and  $K$ , is based on size structure analysis performed by the FISAT logistic model. The data related to collection periods were separated into seasons allowing for size frequency polygons based on monthly samples, with size intervals of 13 cm. The mean sizes of males and females were compared using MANOVA test.



**Fig. 1:** Specimen of *Alopias vulpinus* examined at the fish market of Algiers (Algeria).  
**Sl. 1:** Primerek morske lisice na ribji tržnici v Algiersu (Alžirija).

**Tab. 1: Mean standard lengths (SL) according to sex for *Alopias vulpinus* caught in the eastern and western regions of Algerian coast.**

**Tab. 1: Povprečna standardna dolžina (SL) morskih lisic, ujetih vzdolž zahodne in vzhodne regije alžirske obale, glede na spol.**

Sex	Males		Females	
Region	Eastern	Western	Eastern	Western
Mean SL (cm)	118.80	117.94	118.60	133.62
N of specimens	51	51	56	56

Tests for significance ( $p < 0.05$ ) were performed using ANOVA, and statistical differences were established using a  $\chi^2$  test (Schwartz, 1983). The relation between SL and EW was used as a complement following Froese et al. (2011). This relation,  $EW = aSL^b$ , was converted into its linear regression expressed in decimal logarithmic coordinates, and correlations were assessed by least-squares regression as:  $\log EW = \log a + b \log SL$ . Significance of constant b differences was assessed against the hypothesis of isometric growth if  $b = 3$ , positive allometry if  $b > 3$ , negative allometry if  $b < 3$  (Pauly, 1983). In the relationship EW versus SL, comparisons of curves for sexes were carried out using ANCOVA. ANOVA and ANCOVA were performed using the STAT VIEW 5.0 logistic model.

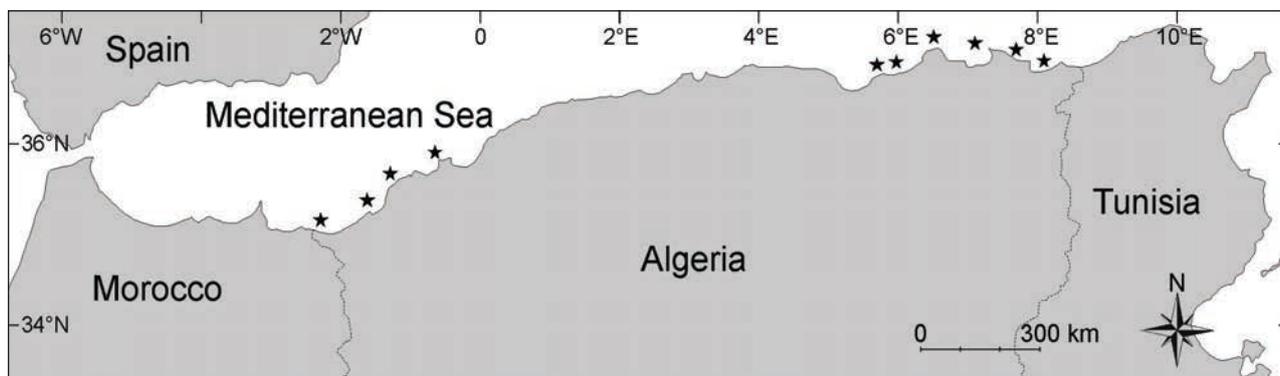
**RESULTS AND DISCUSSION**

Concerning the collected *A. vulpinus*, the Shapiro-Wilk normality was  $W = 0.95$  with  $p < 0.011$ , which suggests that the present sample came from a normally distributed population. Of the 194 specimens sampled, 102 were males and 92 females, and thus

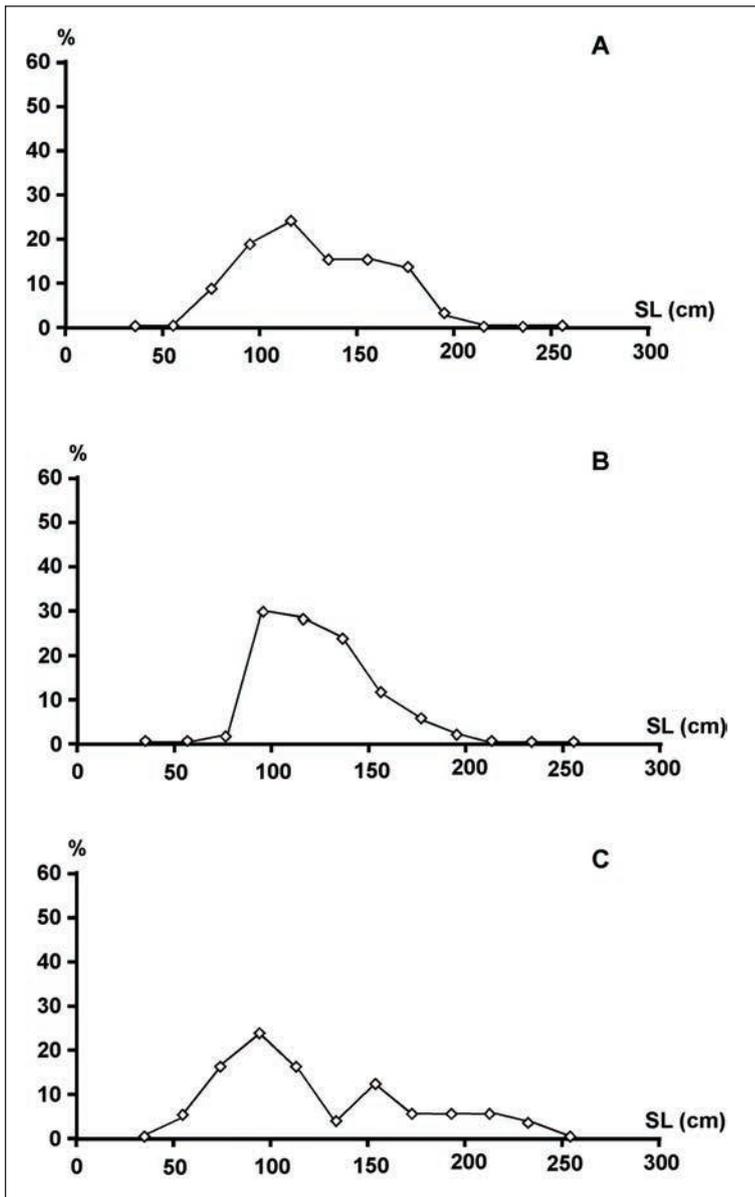
the former did not significantly outnumber the latter ( $\chi^2 c = 0.51 < \chi^2 t = 3.84$ ;  $df = 1$ ). Similar patterns were observed for the eastern region (56 females, 51 males): females did not significantly outnumber males ( $\chi^2 c = 0.91 < \chi^2 c = 3.84$ ;  $df = 1$ ); conversely, in the western region males outnumbered females (36 females, 51 males) but the difference was not significant ( $\chi^2 c = 1.41 < \chi^2 t = 3.84$ ;  $df = 1$ ).

Standard lengths ranged from 49 to 207 cm and from 63 to 229 cm, in males and females, respectively. The eviscerated weights ranged from 5 to 165 kg, and from 4 to 180 kg in males and females, respectively. Standard lengths of the sampled males and females allowed for calculating mean sizes according to sex and region (Tab. 1). When compared by MANOVA test, it appeared that mean sizes of males and females according to the region were not significantly different, with  $1.77 < F < 2.21$ , and  $0.16 < p < 0.18$ .

Size frequency polygons during the period 1996–2002, expressed in percentages, were considered for three seasons (Fig. 3). According to the region, size frequency polygons yielded five apparent modes displaying the values presented in Fig. 4. They also exhibited five apparent modes displaying the fol-



**Fig. 2: Map of the Algerian coast indicating the capture sites of *Alopias vulpinus* (stars).  
Sl. 2: Zemljevid alžirske obale z označenimi lokalitetami ulova morskih lisic (zvezdice).**



**Fig. 3:** Size frequency polygons according to seasons reported for *Alopias vulpinus* caught off the Algerian coast. **A. Autumn, n = 58. B. Winter, n = 69. C. Spring, n = 54.**  
**Sl. 3:** Velikostna porazdelitev poligonov za morske lisice, ujete ob alžirski obali, glede na sezono. **A. Jesen, n = 58. B. Zima, n = 69. C. Pomlad, n = 54.**

lowing values: 75, 95, 115, 155, and 215 cm (with 95 and 115 repeated twice). The mode 185 was a hidden mode, overlapping other modes more apparent. Additionally, it appeared that the modes moved onto the right side. The minimum SL observed (SL = 49 cm) was less than those recorded by Fischer et al. (1987) and Van Grevelinghe (1999), who noted them to be between 114 and 150 cm.

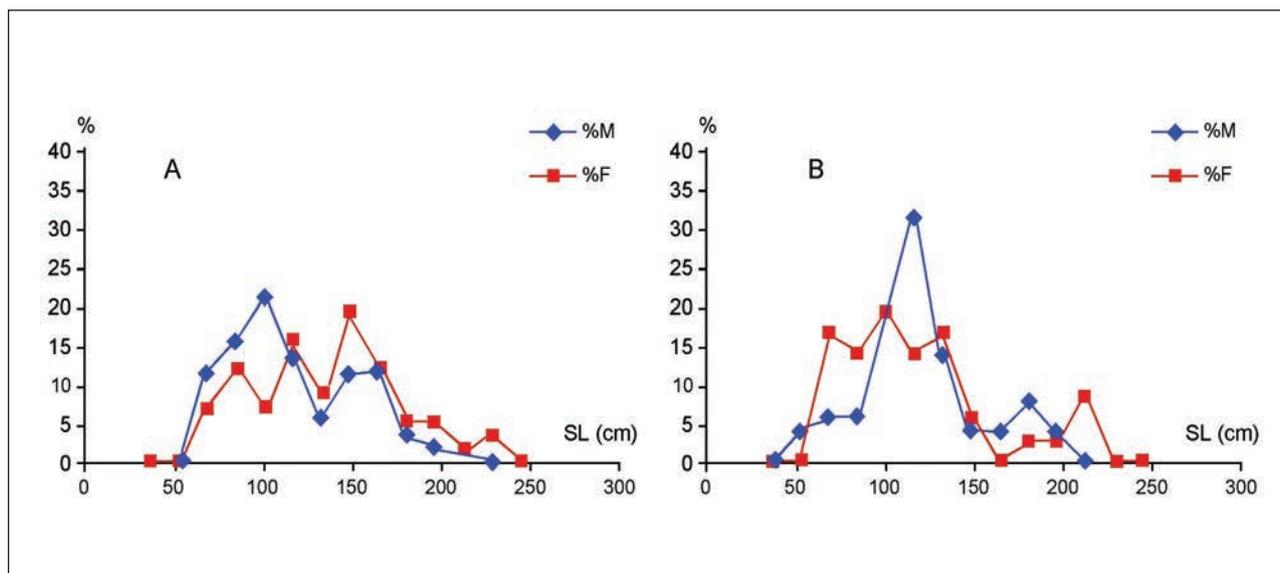
The modal values were grouped following the Petersen method (see Pauly & Moreau, 1997). Age group I comprised specimens from 75 to 115 cm SL, age group II those reaching up to 155 cm SL. Age group III and IV included specimens with an SL over 185 cm and under 215 cm, respectively.

Standard length-at-age data pairs provided by the Petersen method for these four age groups were performed by the FISAT II logistic-model calculating the parameters of the Von Bertalanffy growth equation (see Gayanilo Jr et al., 1985); the equation applied was  $SL = 267.66 [1 - e^{-0.38(t + 0.22)}]$ . The value of  $SL_{\infty}$  of 267.66 cm was considerably higher than the observed value of 229 cm, and slightly higher than the SL maximum /0.95 (241.05 cm); such results seem to reflect the reality quite accurately (Goldman et al., 2019).

From the fourth year onward, the growth in females is more important than the growth in males. Males reach the size at first sexual maturity in the third year, females in the fifth year (Compagno, 1984; Goldman et al., 2019).

The relationship between total length (TL) and total mass (TM) did not show significant differences between males and females ( $F = 0.55, p = 0.46, df = 1$ ). Therefore, males and females were included in the same relationship plotted in Fig. 5 according to the following formula:  $\log EW = -4.72 + 3.01 * \log SL$ ;  $r = 0.97$ ;  $n = 62$ . *A. vulpinus* displayed an isometric growth, probably because the species found in this region favourable conditions to grow and reproduce. Additionally, the asymptotic eviscerated weight expressed from the relation  $EW = a W = a SL^b$  was:  $W\% = 366.13 \text{ kg}$ .

The studied sample provided an opportunity to present some biological data concerning *A. vulpinus*, a species poorly known in the Mediterranean Sea (Louisy, 2002; Quéro et al., 2003). Routine monitoring carried out in the fish markets on the Algerian coast showed a relative abundance of this large shark, which is generally appreciated by local consumers. *A. vulpinus* is not targeted in the area but holds an interesting economic value, and such a pattern explains its occurrence in local fish markets. However, since the studied

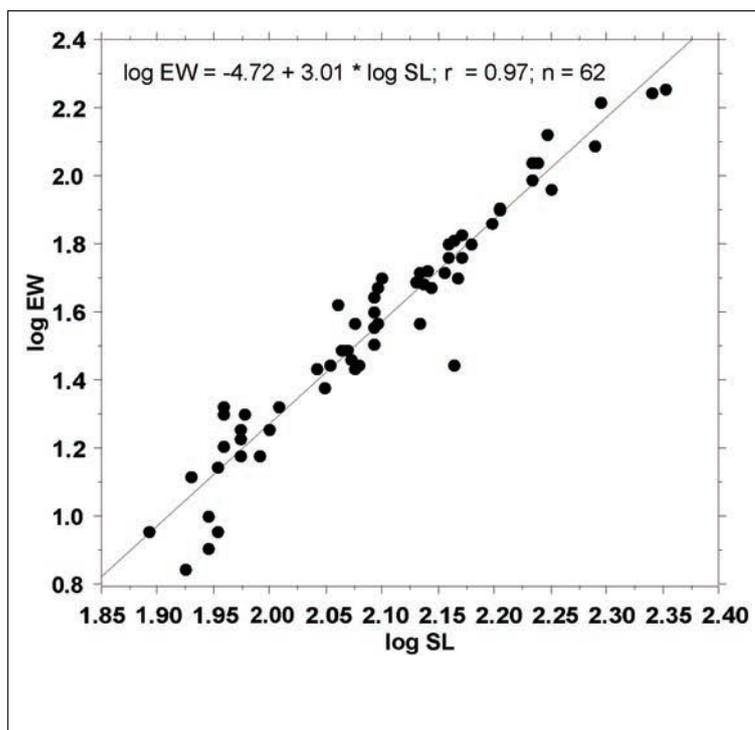


**Fig. 4:** Size frequency polygons reported for *Alopias vulpinus* caught off the Algerian coast. A. Eastern region, males = 51, females = 56. B. Western region, males = 51, females = 56.

**Sl. 4:** Velikostna porazdelitev poligonov za morske lisice, ujetje ob alžirski obali. A. vzhodna regija, samci = 51, samice = 56. B. Zahodna regija, samci = 51, samice = 56.

period, 1996–2002, captures of *A. vulpinus* have been less abundant and, according to information provided by experienced fishermen, the species has completely disappeared. Such a phenomenon is probably due to over-fishing, as corroborated by the opinion of Ferretti et al. (2008) who noted a constant decrease of large sharks in the Mediterranean Sea. *A. vulpinus* and other sharks species display *K*-selected characteristics and are object of a drastic decline; their populations are inferred to have reduced by 30–49% over the last seven decades and are assessed to date as VU A2bd (Goldman et al., 2009).

Conversely, recent observations carried out by Rafrafi-Nouira et al. (2019) reported captures of several specimens from the northern Tunisian coast. They showed that the species has not totally disappeared from the Maghreb shore, therefore its absence could be explained by migrations into eastern regions, as *A. vulpinus*, like other large shark species, is prone to such large movements (Compagno, 1984; Quéro, 1984). Management of the fishing effort should be conducted to preserve the occurrence of the species in the



**Fig. 5:** Eviscerated weight (EW) versus standard length (SL) relationship expressed in logarithmic co-ordinates for *Alopias vulpinus* caught off the Algerian coast.

**Sl. 5:** Odnos med maso brez drobovja (EW) in standardno dolžino telesa (SL) pri morskih lisicah, ujetih vzdolž alžirske obale, izražen v logaritamskih koordinatah.

Mediterranean Sea. Such opinion is seconded by Ayas *et al.* (2020) for *A. vulpinus* in Turkish Mediterranean waters. They noted that fishery management should be taken into consideration to halt the drastic decline of the species that has been recorded in this area, despite the fact that

recently some specimens have been captured and among them a pregnant female carrying developed embryos. The sample used in the present study provides information on growth parameters and could be used further to assess the real status of this species in the Mediterranean Sea.

OPAZOVANJA MORSKIH LISIC, *ALOPIAS VULPINUS* (CHONDRICHTHYES: ALOPIIDAE)  
OB ALŽIRSKI OBALI (JUGOZAHODNO SREDOZEMSKO MORJE)

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POVZETEK

Med leti 1996 in 2002 je bilo ob obali Alžirije ujetih 194 primerkov morske lisice, *Alopias vulpinus*. Samcev (102 primerka) ni bilo znatno več od samic (92 primerkov). Primerki so merili med 49 and 249 cm standardne dolžine in so tehtali med 14 in 150 kg. Od leta 2002 so postali ulovi morskih lisic razmeroma redki vzdolž celotne alžirske obale, kar bi lahko odražalo upad populacije na obravnavanem predelu in verjetno tudi na nivoju celotnega Sredozemskega morja.

**Ključne besede:** Alopidae, *Alopias vulpinus*, magrebska obala, rastni parametri, migracije

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