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## ANALYSIS OF THE VERTEBRAL NUMBER IN GILT SARDINE *SARDINELLA AURITA* VALENCIENNES, 1847 AND ALLIS-SHAD *ALOSA FALLAX NILOTICA* (LACÈPEDE, 1803) FROM THE EASTERN CENTRAL ADRIATIC

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### ABSTRACT

Samples of the gilt sardine catches with a total of 50 individuals from the channel area (Hvar Channel) and open waters (Palagruža Island) of the central Adriatic were analysed with respect to their number of vertebrae. The vertebral number in gilt sardines ranged from 47 to 49. Modal value of 48 vertebrae was observed in all the samples of gilt sardine catches. Samples of the allis shad catches with a total of 76 individuals from the inshore waters (Saldun and Marina Bays) and offshore waters (Jabuka Island) were also analysed with respect to their number of vertebrae. The vertebral number of allis shad ranged from 54 to 57. Modal value of 57 vertebrae was observed in all the samples of the allis shad catches. There was no significant difference between the mean values of vertebrae for both species. It could be concluded that the tested gilt sardine and allis shad samples from the investigated regions belonged to the same populations as regards their number of vertebrae, respectively.

**Key words:** *Sardinella aurita*, *Alosa fallax nilotica*, vertebral number, eastern central Adriatic

## ANALISI DEL NUMERO DI VERTEBRE DI ALACCIA *SARDINELLA AURITA* (VALENCIENNES, 1847) E CHEPPIA *ALOSA FALLAX NILOTICA* (LACÈPEDE, 1803) IN ADRIATICO CENTRO-ORIENTALE

### SINTESI

È stato analizzato il numero di vertebre di campioni di pescate di alaccia, per un totale di 50 individui, provenienti dall'area del canale (canale di Lesina) e dal mare aperto (isola di Pelagosa). Il numero di vertebre dell'alaccia è variato da 47 a 49. Il valore modale di 48 vertebre è stato riscontrato in tutti i campioni di pescate di alaccie. È stato inoltre analizzato il numero di vertebre di campioni di pescate di cheppia, per un totale di 76 individui, provenienti da acque vicine alla riva (baie di Saldun e Marina) e da acque al largo (isola di Jabuka). Il numero di vertebre della cheppia è variato da 54 a 57. Il valore modale di 57 vertebre è stato riscontrato in tutti i campioni di pescate di cheppie. Non è stata registrata alcuna differenza significativa tra i valori medi delle vertebre di entrambe le specie. L'autore conclude che, visto il numero di vertebre registrato, i campioni di alaccia e cheppia analizzati appartengono rispettivamente alle stesse popolazioni.

**Parole chiave:** *Sardinella aurita*, *Alosa fallax nilotica*, numero di vertebre, Adriatico centro-orientale

INTRODUCTION

The differences between the length distribution of gilt sardine *Sardinella aurita* Valenciennes, 1847 and allis-shad *Alosa fallax nilotica* (Lacèpede, 1803) taken from the inshore and offshore waters of the central Adriatic (Kačić, 1975; Morović, 1958) indicated a possibility of heterogeneous gilt sardine and allis-shad populations existence.

The number of vertebrae is a meristic character previously used at population identification (Piccinetti, 1971; Krajnović-Ozretić & Žikić, 1978; Sinovčić, 1982; Đulčić *et al.*, 1994). The same meristic character was applied in this work.

Various experiments have shown that the vertebral number is genetically fixed with narrow limits, and that minor aberrations are due to the influence of different environmental factors, especially temperature in the so-called sensitive time (Lindsay, 1954; Blaxter, 1957), which is different for each species. However, it is apparent that the statistic different number of vertebrae represents an independent population (Larrañeta, 1958).

The purpose of the present study is to analyse the number of vertebrae in gilt sardine and allis-shad from the inshore and offshore waters of the central Adriatic, since there are no precise data on the vertebral number of gilt sardine and allis-shad from the eastern Adriatic.

MATERIAL AND METHODS

Samples of the gilt sardine catches were taken from the channel area (Hvar Channel) and open waters (the region of Palagruža Island), while those of allis shad were obtained from the inshore (Saldun and Marina Bay) and open waters (the region of Jabuka Island) in the central Adriatic (Fig. 1). Six representative samples of catches with a total of 50 individuals of the gilt sardine and 76 individuals of the allis shad were taken during 1997. The number of individuals varied from 7 to 15 for the gilt sardine, and from 9 to 13 for the allis shad in some samples of the catches.

Fish were preserved in 4% formaldehyde and, after dissection, air-dried for one to two days. The vertebrae were counted by lens, from occipital condyle (not counted) to urostyle (included), as recommended by FAO Fisheries Division.

The samples were also analysed statistically. Mean numbers of vertebrae, standard deviation and standard errors of arithmetic means were calculated. Analyses of variance and Fisher's F test were also applied to determine the significant differences between variances. Obtained F values were compared to those of the limited values F, at a 5% significance level.

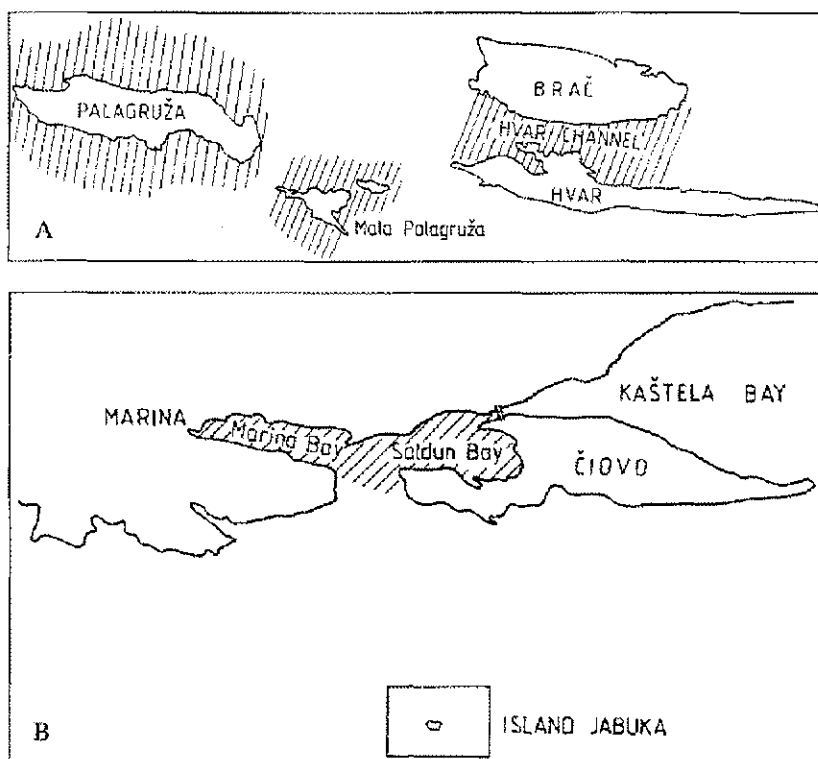


Fig. 1: Location of sampling stations of the gilt sardine (A) and allis shad (B) in the eastern central Adriatic. Sl. 1: Lokacije vzorčič za veliko sardelo (A) in čepo (B) v vzhodnem srednjem Jadranu.

## RESULTS AND DISCUSSION

Total length of the gilt sardines from the Hvar Channel used in the analysis of the vertebral number varied from 197 to 279 mm (mean value =  $248 \pm 0.44$ ), and from 156 to 224 mm (mean value =  $183 \pm 0.39$ ) of those from open waters. Total length of allis shad from Saldun and Marina Bays varied from 137 to 425 mm (mean value =  $289 \pm 0.77$ ), and from 186 to 386 mm (mean value =  $267 \pm 0.59$ ) for those from Jabuka Island.

The total vertebral number of gilt sardine from the channel area and open waters of the central Adriatic ranged from 47 to 49 (mean value =  $48.22 \pm 0.67$ , SE = 0.08, coefficient of variability = 1.39). The vertebral number in gilt sardines from the Hvar Channel ranged from 47 to 49 ( $48.20 \pm 0.84$ , SE = 0.07, coefficient of variability = 1.74), and from 48 to 49 (mean value =  $48.25 \pm 0.50$ , SE = 0.06, coefficient of variability = 1.04) in those from Palagruža Island. There was no significant difference between mean values ( $t = 0.11$ ,  $P > 0.05$ ), so it can be concluded that there are no statistically significant differences in the vertebral number in gilt sardines from the channel area in relation to those from the open waters. There were no such differences between vertebral numbers in gilt sardines from the catch samples within the same regions. It could be concluded that the tested gilt sardine samples from both regions belonged to the same population as regards their number of vertebrae. Modal value of 48 vertebrae was observed in all samples of the gilt sardine catches. Besides that modal class, the class 48 showed the highest frequency and the class 49 appeared rarely just in the channel area. Similar vertebral number means in gilt sardines have been ob-

served by several authors (Fage, 1920; Navarro, 1927, 1932; Quignard & Kartas, 1974) for the Almeira region, Algerian coastal waters, Canarian archipelago and Tunisian waters. Navarro (1948) and Oliver & Navarro (1952) reported the widest ranges of vertebrae (45-52 and 45-50) for Balearic Islands.

The total vertebral number in allis shad from the inshore and offshore waters of the central Adriatic ranged from 54 to 57 (mean value =  $56.10 \pm 0.99$ , SE = 0.11, coefficient of variability = 1.76). The vertebral number of allis shad from Saldun and Marina Bays ranged from 55 to 57 (mean value =  $56.25 \pm 0.94$ , SE = 0.06, coefficient of variability = 1.67) and from 54 to 57 (mean value =  $56.14 \pm 1.27$ , SE = 0.13, coefficient of variability = 2.25) for those from Jabuka island. There was no significant difference between mean values ( $t = 0.18$ ,  $P > 0.05$ ), so it can be concluded that there are no statistically significant differences in the vertebral number of allis shad from inshore waters in relation to the allis shad from offshore waters. There were no such differences between vertebral numbers of allis shad from the catch samples within the same regions. It could be concluded that the tested allis shad samples from both regions belonged to the same population as regards their number of vertebrae. Modal value of 57 vertebrae was observed in all samples of the allis shad catches. There are no data about the vertebral number of allis shad from the Adriatic Sea, but there are some data from freshwaters. Vuković (1961) reported the number of vertebrae for Skadar Lake (47-60), Bačinska Lakes (48-60) and River Neretva Estuary (53-60). Ivanović (1973) noted that the total number of allis shad from the Skadar Lake ranged from 55 to 60.

ANALIZA ŠTEVILA VRETENC V VELIKIH SARDELAH *SARDINELLA AURITA*  
VALENCIENNES, 1847 IN ČEPAH *ALOSA FALLAX NILOTICA* (LACÈPEDE, 1803)  
IZ VZHODNEGA SREDNJEGA JADRANA

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POVZETEK

Avtor je ugotavljal število vretenc v velikih sardele in čepah, ujetih v vzhodnem srednjem Jadranu. Pri analizi 50 primerkov velike sardele iz Hvarskega kanala in odprtega morja (iz okolice Palagruže) se je število vretenc gibalo med 47 in 49, medtem ko je bilo modalno število pri vseh primerkih 48 vretenc. Pri analizi 76 primerkov čep iz obalnih voda (zalivov Saldun in Marina) in odprtega morja (iz okolice Jabuke) pa se je število vretenc gibalo med 54 in 57; modalno število pri vseh primerkih je bilo 57 vretenc. Avtor ni ugotovil nobene pomembne razlike med srednjimi vrednostmi pri obeh vrstah. Zatorej je bilo mogoče napraviti sklep, da so glede na število vretenc preučevani primerki velike sardele in čepe iz zgoraj omenjenih raziskanih območij pripadali istim populacijam.

**Ključne besede:** *Sardinella aurita*, *Alosa fallax nilotica*, število vretenc, vzhodni srednji Jadran

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