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ON THE VERTEBRAL NUMBER OF ANCHOVY *ENGRAULIS ENCRASICOLUS* (L.), IN THE CENTRAL ADRIATIC

O BROJU KRALJEŠAKA BRGLJUNA, *ENGRAULIS ENCRASICOLUS* (L.) U SREDNJEM JADRANU

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Twelve samples of anchovy catches with a total of 1295 individuals from the most inshore coastal waters (Kaštela Bay) and the open ones (the region of Vis and Biševo Islands) of the Central Adriatic were analysed with respect to their number of vertebrae.

The vertebral number of anchovy ranged from 44 to 47. The mode of 46 vertebrae was observed in almost all the examined samples.

Total mean value of anchovy vertebral number from both regions was 45.7436.

INTRODUCTION

The differences between the length distribution of anchovy taken from the most inshore coastal waters (Kaštela Bay) and the open ones (the region of Vis and Biševo Islands) of the Central Adriatic and, moreover, relative permanency of that value in the same regions (Sinovčić, 1978) pointed to the possibility of heterogeneous anchovy population existence.

The number of vertebrae is a meristic character previously used at engraulid population identification. The same meristic character was applied in this work, too.

It was found by experiments that the vertebral number is genetically fixed within narrow limits, and that minor aberrations are due to the influences of different environmental factors, especially temperature in the so called sensitive time (Gabriel, 1944; Lindsay, 1954; Blaxter, 1957) which is different for each species. However, it is apparent that statistic different number of vertebrae represents an independent population (Laraña eta, 1958).

The purpose of the present study is to analyse the number of vertebrae in anchovy from inshore coastal waters (Kaštela Bay) and open waters (the region of Vis and Biševo Islands) of the Central Adriatic since there are no

data on the vertebral number of anchovy from the eastern Adriatic, and those from its western part are very poor (Fage, 1920, Lo Giudice, 1922 and Piccinetti, 1971).

MATERIAL AND METHODS

Samples of anchovy catches were taken from the coastal zone (Kaštela Bay) and open waters (the region of Vis and Biševo Islands) of the Central Adriatic.

Twelve representative samples of catches with a total of 1295 individuals caught in the period of their intensive spawning during three fishing seasons, from 1978 to 1980, were used.

The number of individuals varied from 67 to 151 in some samples of the catches.

Total length of anchovy from the Kaštela Bay used in the analysis of the vertebral number varied from 11.3 to 15.6 cm, and their means from 13.0 to 14.0 cm. The anchovy from the region of Vis and Biševo Islands showed variations in total length from 15.1 to 18.3 cm, and means from 16.5 to 16.9 cm.

Fish were preserved in 4% formaldehid and after dissection they were air dried 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 deviations and standard errors of arithmetic means were calculated. Analyses of variance and Fisher's F test were also applied to determine the significant differences among variances. Obtained F values were compared to those of the limited values F, at a 5% significance level.

RESULTS AND DISCUSSION

The total vertebral number of anchovy from the coastal and open waters of the Central Adriatic ranged from 44 to 47 vertebrae (Fig. 1). The vertebral number of anchovy from the Kaštela Bay ranged from 44 to 47 vertebrae (Fig. 2), and that from the region of Vis and Biševo Islands from 45 to 47 vertebrae (Fig. 3).

Modal walue of 46 vertebrae was observed in all the samples of anchovy catches with the exception of that from July 1980 where the mode was 45. Besides the modal class, the class 45 showed the highest frequency. The class 47 was poorly represented, and the class 44 appeared rarely just in the Kaštela Bay anchovy.

Anchovy from the north-west part of the Adriatic (Fage, 1920) and that from the north and west coasts of Mediterranean occurred to have the same results in the vertebral number fluctuation range and similar frequency polygons. It seems that such a distribution of the vertebral number and its range are relatively constant and may be applied at identification of their population.

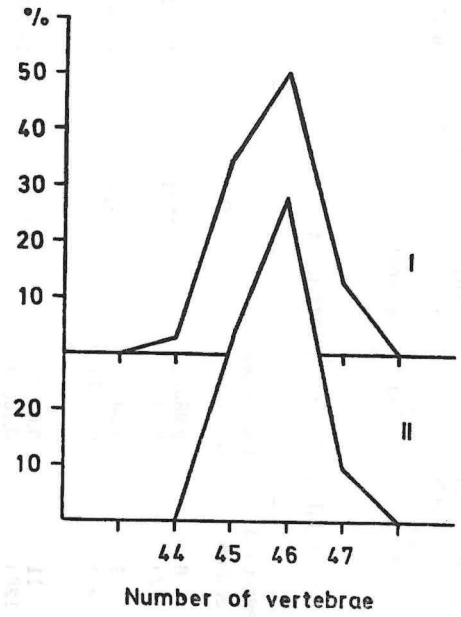

Fig. 1. Vertebrae polygons of the anchovy samples from Kaštela Bay (I) and Vis and Biševo Islands region (II) in 1978, 1979 and 1980

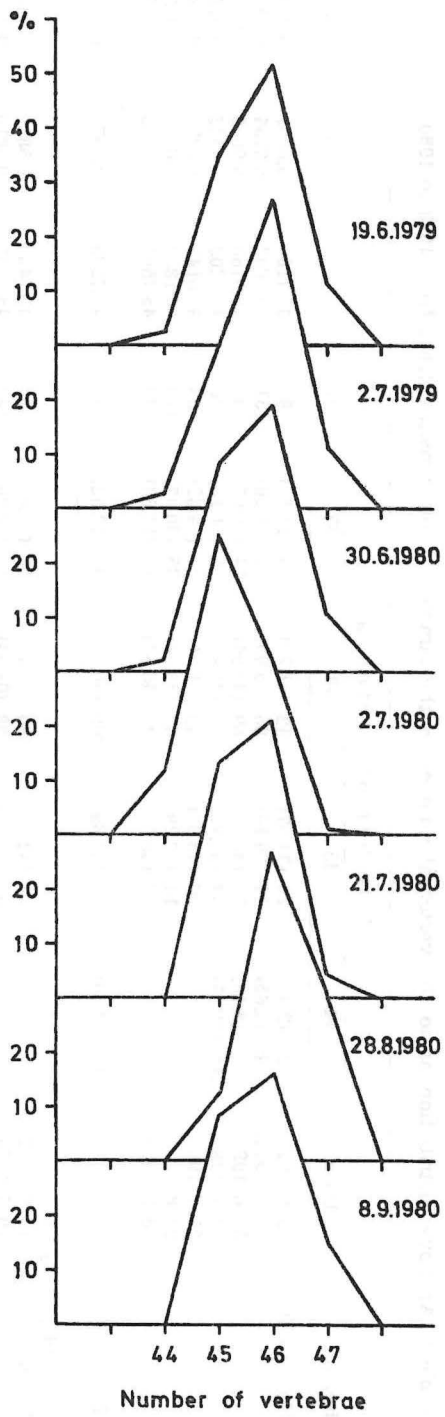

Fig. 2. Vertebrae polygons of the anchovy samples from the Kaštela Bay in 1979 and 1980

Table 1. Anchovy distribution as to the vertebral number in the samples of commercial catches from 1978 to 1980

Region	Date	Number of vertebrae 44	45	46	47	n	x	s	s_x
Kaštela Bay	19. 6. 1979.	2 (2.47)	28 (34.57)	42 (51.85)	9 (11.11)	81	45.7160	0.6891	0.0766
	2. 7. 1979.	4 (2,65)	44 (29.14)	86 (56.95)	27 (11.26)	151	45.7682	0.6754	0.0550
	30. 6. 1980.	3 (2.16)	53 (38.13)	69 (49.64)	14 (10.07)	139	45.6763	0.6808	0.0577
	2. 7. 1980.	10 (11.63)	48 (55.81)	27 (31.40)	1 (1.16)	86	45.2209	0.6542	0.0705
	21. 7. 1980.		36 (43.37)	43 (51.81)	4 (4.82)	83	45.6145	0.5773	0.0634
	28. 8. 1980.		14 (12.39)	64 (56.64)	35 (30.97)	113	46.1858	0.6317	0.0594
	8. 9. 1980.		32 (39.02)	38 (46.34)	12 (14.63)	82	45.7561	0.6949	0.0767
Total		19 (2.59)	255 (34.69)	369 (50.20)	92 (12.52)	735	45.7265	0.7076	0.0261
Vis and Biševo Islands	15. 6. 1978.		44 (32.84)	80 (59.70)	10 (7.46)	134	45.7463	0.5819	0.0503
	16. 7. 1978.		43 (30.07)	88 (61.54)	12 (8.39)	143	45.7832	0.5810	0.0486
	12. 8. 1978.		46 (32.17)	82 (57.34)	15 (10.49)	143	45.7832	0.6161	0.0515
	9. 7. 1979.		30 (41.10)	37 (50.68)	6 (8.22)	73	45.6712	0.6205	0.0726
	24. 8. 1979.		20 (29.85)	38 (56.72)	9 (13.43)	67	45.8358	0.6371	0.0778
Total			183 (32.68)	325 (58.04)	52 (9.28)	560	45.7661	0.6041	0.0255

Table 2. The variance analyses of the vertebral number of anchovy commercial catches from 1978 to 1980

Region	Source of variation	Sum of Squares	Degrees of freedom	Mean square (variance)	F	$\bar{x}$
Kaštela Bay	between samples	0.48437	6	0.08072	0.1834	45.7265
	within samples	320.47248	728	0.44020		
Vis and Biševo Islands	between samples	0.01484	4	0.00371	0.0101	45.7661
	within samples	203.23619	555	0.36619		
Total	between samples	0.49921	11	0.04538	0.1112	45.7436
	within samples	523.70867	1283	0.40819		

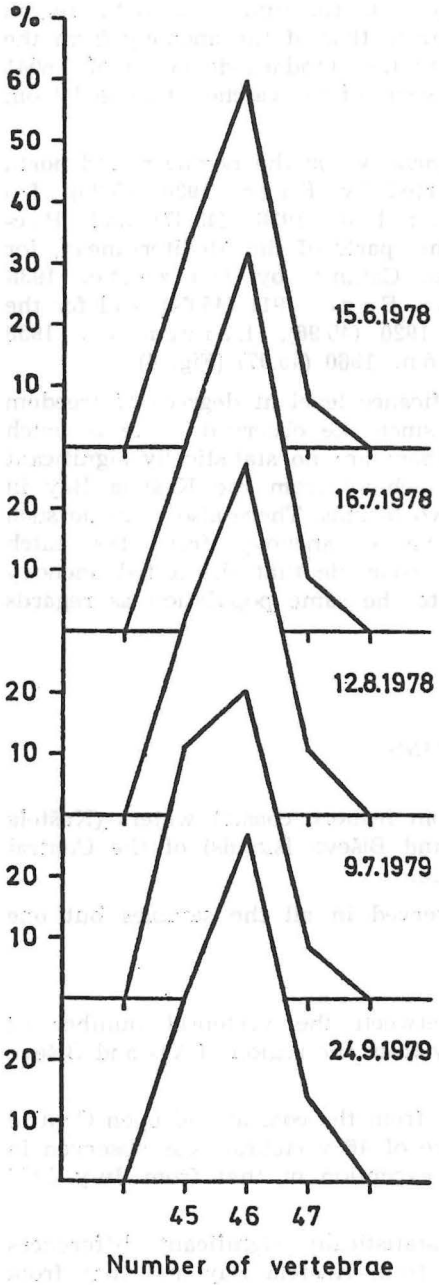

Fig. 3. Vertebrae polygons of the anchovy samples from the Vis and Biševo Islands region in 1978 and 1979

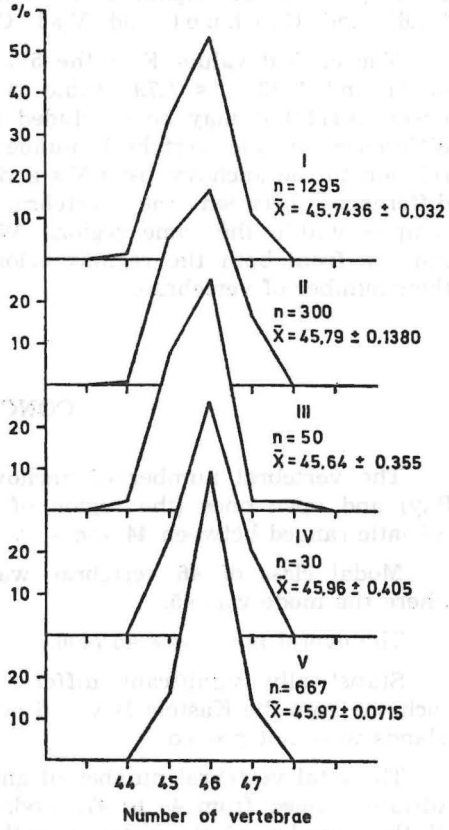

Fig. 4. Vertebrae polygons of the anchovy from the Central Adriatic (I — Sinovčić), Gulf of Catania (II — Dulzetto, 1938), Gulf of Lion (III — Fage, 1911), Almeria (IV — Fage, 1920) and from Málaga (V — Crehuet and Val-Cordón, 1960).

The overall mean of the vertebral number of anchovy from the Kaštela Bay was 45.7265 with the standard deviation of 0.7076 and the standard error of 0.0261. The overall mean of the anchovy vertebral number from the region of Vis and Biševo Islands was very similar to that of the anchovy from the Kaštela Bay and amounted to 45.7661, with the standard deviation of 0.6041 and the standard error of 0.0255 while in some of the catches it ranged from 45.6712 to 45.8358 (Table 1).

Similar vertebral number means of anchovy for the northern and north-western part of the Adriatic were reported by Fage, 1920 (45.20), Lo Giudice, 1921—1922 (quoted by Dulzetto, 1938) (45.37) and Piccinetti, 1971 (45.16—45.39), and for some parts of the Mediterranean, for instance, for the anchovy of the Gulf of Catania, by Dulzetto, 1938 (45.79), for the anchovy of the Gulf of Lion, Fage, 1911 (45.64), and for the anchovy from the Spain coast Fage, 1920 (45.96), Larrañeta, 1958 (45.67) and Crehuet and Val-Cordón, 1960 (45.97) (Fig. 4).

The critical values F at the 5% significance level at degrees of freedom of 11 and 1283 was 1.79 (Table 2) and since the observed value is much lower (0.1112) it may be concluded that there are no statistically significant differences in the vertebral number of anchovy from the Kaštela Bay in relation to the anchovy from Vis and Biševo Islands. There also were no such differences between the vertebral number of anchovy from the catch samples within the same regions. We can conclude that the tested anchovy samples from both the regions belonged to the same population as regards their number of vertebrae.

CONCLUSIONS

The vertebral number of anchovy from inshore coastal waters (Kaštela Bay) and open ones (the region of Vis and Biševo Islands) of the Central Adriatic ranged between 44 and 47 vertebrae.

Modal class of 46 vertebrae was observed in all the samples but one where the mode was 45.

The overal mean was 45.7436.

Statistically significant differences between the vertebral number of anchovy from the Kaštela Bay and anchovy from the region of Vis and Biševo Islands were not proved.

The total vertebral number of anchovy from the coastal and open Central Adriatic ranged from 44 to 47. Modal value of 46 vertebrae was observed in all the samples of the catches, with the exception of that from July 1980 with modal value of 45 vertebrae.

It was found that there were no statistically significant differences between the retebral number of anchovy from Kaštela Bay and that from Vis and Biševo Islands. There also were no such differences between the vertebral number of anchovy in the same regions what could point to the homogeneity of the anchovy population in this part of the Adriatic.

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KRATAK SADRŽAJ

Broj kralješaka je fenotipska karakteristika koja se upotrebljava kod identifikacije populacije ribe. U tu svrhu analiziran je broj kralješaka brgljuna *Engraulis encrasicolus* (L.) iz reprezentativnih uzoraka komercijalnih lovina obalnog (Kaštelanski zaljev) i otvorenog srednjeg Jadrana (područje otoka Visa i Biševa).

Upotrebljeno je ukupno 1295 primjeraka brgljuna sabranih tijekom tri sezone ribolova, od 1978. do 1980. uključivo, u vrijeme njegova intenzivna mriješćenja.

Kralješci su brojani pomoću lupe, od okcipitalnog kondila (koji nije ulazio u zbir) do urostila uključivo.

Uzorci su analizirani statistički. Izračunate su srednje vrijednosti broja kralješaka, standardne devijacije i standardne pogreške aritmetičkih sredina broja kralješaka. Upotrebljen je i F test da bi se odredila značajnost razlika između varijanci.

U cjelini, broj kralješaka brgljuna obalnog i otvorenog srednjeg Jadrana kretao se između 44 i 47. Modalna vrijednost od 46 kralješaka opažena je kod svih uzoraka lovina osim onog iz srpnja 1980. sa modalnom vrijednošću od 45 kralješaka.

Utvrđeno je da nije bilo statistički značajnih razlika između broja kralješaka brgljuna s područja Kaštelanskog zaljeva u odnosu na onog s područja otoka Visa i Biševa. Takvih razlika nije bilo ni između broja kralješaka brgljuna unutar istih područja, što bi moglo ukazati na homogenost populacije brgljuna u ovom dijelu srednjeg Jadrana.