A CONTRIBUTION TO THE KNOWLEDGE OF BIOLOGY OF *PAGELLUS ERYTHRINUS* L. IN THE MIDDLE ADRIATIC (1)

by L. RIJAVEC and S. ZUPANOVIC

INTRODUCTION

The biology of this species in the Adriatic sea is very bad investigated. We find the first particulars about its research in works of SYRSKI (1876), GRAEFFE (1888), D'ANCONA (1949), ZEI (1940), ZEI and ZUPANOVIC (1961) and ZUPANOVIC (1961). Further contribution on knowledge of biology of *Pagellus erythrinus* in the Adriatic are the results of authors.

I. — EXPERIMENTAL PART OF WORK.

For the whole working time with depth trawl net we have been tended that our catch would be as much as possible standardized because of comparison of data. The haul with net have bee lasting exactly for one hour. By the less quantities of catch we have analysed all cought specimens but by the larger ones we have taken representative sample. To the analysed specimens there were measured body length, body weight, then, determinated sex and stadium of sexual maturity, then were taken scales and otholits and was analysed the content of stomach.

II. — RESULTS OF INVESTIGATION.

A) Zoogeografic distribution.

The distribution of *Pagellus erythrinus* in the Middle Adriatic is represented on the figure 1. From the data of figure 1 follows that the isobat of 100 *meter is the limit* for the distribution of this species. All along the Adriatic sea we don't find it over 100 m of depth and so we found *Pagellus erythrinus* as typical fish of the sublitoral zone.

The distribution of this species shows that the substratum doesn't act any important part as the factor on the extension of the species. From the quantitative distribution related to the substratum follows that the number of specimens, in the unit of effort (one hour) of hauling the depth trawl net, is very considerable so in clayey and argiliferous bottoms as in sandy ones. By the distribution of this species in the chanels region of Middle Adriatic the « hydrografic facies » represents probably more important factor that the edafic one. The correlation between the catch and the variation of hydrografic factors of the milleu would confirm this (ZUPANOVIC, 1961).

(1) More detailed analyse of the research of the biology of *Pagellus erythrinus* will be printed in the *Acta Adriatica* of the Institut of Oceanography and Fisheries in Split under the title of « Dynamics of Population of *Pagellus erythrinus* L. in the Chanels of the Middle Adriatic. »

B) Biometric analyse.

1°) *Length as the peculiarity of the population.*

The body length has been measured by 4589 specimens. We used maximal length i.e. the distance from the top of mandibola to the end of gathered tail fins. All specimens were

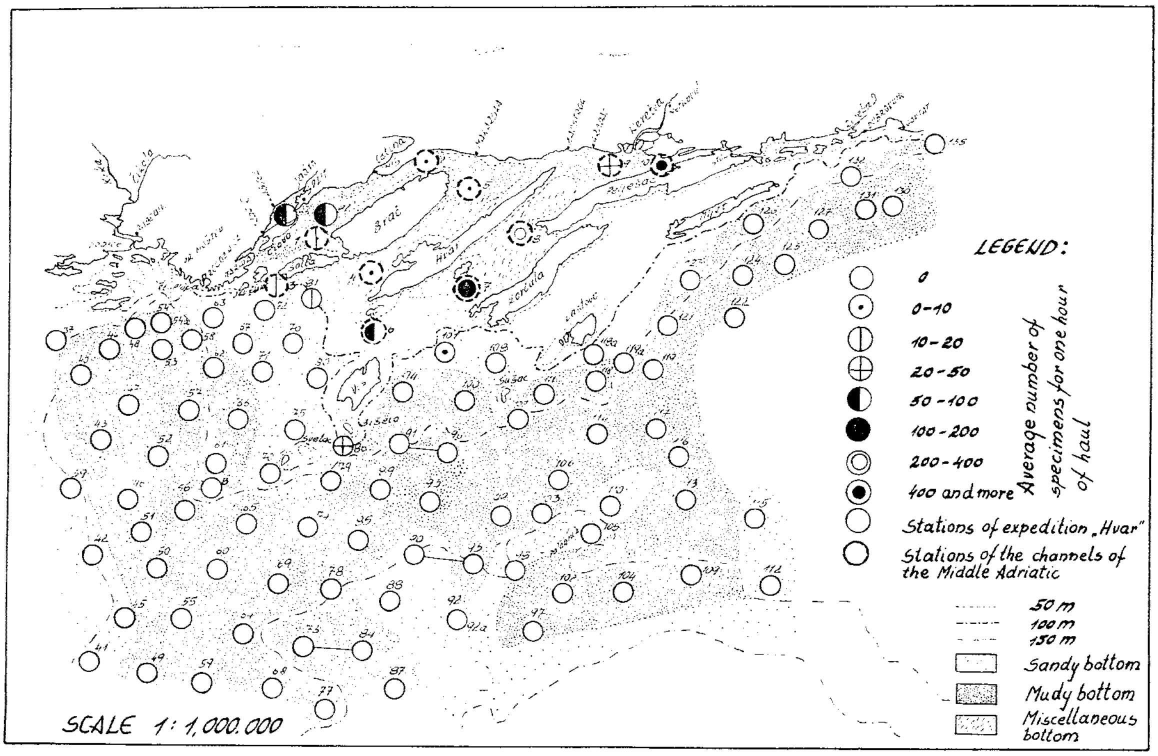

FIG. 1. — *The distribution of* Pagellus erythrinus L. *in the Middle Adriatic.*

Station	N° of specimens	N° of analysed specimens	average length cm
1	184	184	14,14
2	22	22	8,00
3	178	178	17,67
4	80	80	16,23
5	94	93	14,05
6	1 133	666	13,93
7	1 896	1 065	13,93
8	3 812	1 207	14,96
9	554	501	16,16
10	3 733	593	15,12

TABLE I

measured in millimeters. We arranged so measured specimens in the length interval from 4,0 to 28,0 cm. Average body length was 14,76 ± 1,26 cm. If we compare average body length on the particular stations (tabl. 1), we'll get considerable heterogeneousness (see also fig. 1).

Analysing data of table I we can see that doesn't exist any order in the distribution of average body lengths related to the location of stations. So, we have the most minimal value of the average body length (8,00 cm) on the station 2, which lies near the shore and where it was reached the least number of cought specimens, while is the maximal average value (17,67 cm) represented on the station 3 which is rather distant from the cost. On the contrary we have on the stations 6 and 7 which are far from the shore, small value of average body length (13,93 cm) but on the station 10, which is the nearest station to the cost, and where we had the maximal catch the value of average body length is much larger (15,12 cm). This irregularity in the values of average body lengths we could explaine in some way with season migrations inside the population in the area of the Middledalmatian chanels.

2°) *Length and the sexual dimorphism.*

Determination of sex and measuring of body length was carried out by 2636 specimens. The analysed females are on the average less than males. Analyse of the frequency of lengths for both sexes have given folloving results :

1) to the body length of 130 mm predominate nearly 100 p. 100 females,

2) at the body length from 140 to 160 mm falls the number of females and grows the number of males,

3) at the body length 160 mm it starts prevailing males, until they achieve at 230 mm 100 p. 100 value.

Between the third and the fourth years of life i.e. about 170 mm of body length, by this species, comes namely to the inversion of the sex and so we have by larger specimens only males.

3°) *Relation length - weight.*

Because of inversion of sex by *Pagellus erythrinus* it was analysed both sexes together. We have analysed 192 specimens. Specimens have been weighted with precision of one gramm. Analysed individuals were arranged in classes with interval of one cm. The average value of weight was calculated for each class separatly. So got equation sounds :

$$y = 0{,}134 \times {}^{2{,}981}$$

The obtained curve of relative growth shows us two points of inflexion :

1) first point of inflexion between 110 and 120 mm would correspond with the moment of first sexual maturity of females (the least find female individual with mature gonad in the chanels of Middle Adriatic has measured 121 mm of body length);

2) second point of inflexion is found between 160 and 170 mm and this one would coincide with inversion of sexes, which is the « normal » case by this species over 170 mm of body length.

C) Biology.

1°) *Age.*

Age was determinated by means of scales. Scales were taken under the side line from two spots, near the head and near the tail. On determination of age we used the method LARRANETA recomended (1963). It was analysed 311 specimens, from this 125 males, 179 females and 7 hermaphrodits. In table 2 they are showed absolute and relative values of analysed specimens in single age groups upon sexes and together.

If we analyse the data from table 2 we can see that in the begining prevail females (up to 3d year), then relation equalizes and more and more prevail males, which by the age of 6 years completely predominate. Inversion of sexes, which apears in third and fourth year, shows us the specimens of hermaphrodits just in these age groups.

Age group	Males	Females	Hermaphrodits	Total
I	2	3	-	5
II	33	99	-	132
III	52	64	5	121
IV	31	12	2	45
V	6	1	-	7
VI	1	-	-	1
	125	179	7	311

TABLE 2

Relative values (%)

Age group	Males	Females	Hermaphrodits
I	40,00	60,00	—
II	25,00	75,00	—
III	42,98	52,89	4,13
IV	68,89	26,67	4,44
V	87,71	14,29	—
VI	100,00	—	—

2⁰) *Growth.*

In table 3 they are given the spans of body lengths for each age group and average values of body lengths of all analysed specimens for each sex separetly and without regard to the sex.

Age group	Span of lengths cm	Average lengths			
		males	females	hermaphrodits	total
I	11,5-14,3	13,20	13,40	-	13,30
II	12,6-18,0	15,15	15,36	-	15,20
III	14,6-20,1	17,86	17,18	17,58	17,49
IV	18,3-24,2	21,02	21,15	22,95	21,20
V	22,2-25,6	24,42	24,10	-	24,21
VI		26,70+	-	-	26,70

+ only one specimen

TABLE 3

On determination of the growth rate we have used von Bertalanffy equation of growth, which modified according to BEVERTON and HOLT (1957) sounds :

$$l_t = L_\infty (1 - e^{-K(t - t_0)})$$

where they are given three constants :

L_∞ = the limit value of body length i.e. the theoretical maximal length which could fish reach in its life.

K = coeficient of growth or mathematical said is that rate which give us the estimate of the slope of the theoretical curve. The bigger is K, steeper is the slope, and the curve quicker approaches to the asimptotic value, that means fish quicker grows.

t_0 = hyptetical value of time. Time t is independent variable, while l_t is dependent variable of length in given time i.e. the average body length of all specimens in given age group. As usualy *e* is the basis of natural logarithm.

In our analyse we got for K value 0,20 and for L_∞ 37, 88 cm that means that *Pagellus erythrinus* grows in the chanels of the Middle Adriatic quite slowly but reaches for that considerable length.

3°) *Mortality.*

Mortality of the fish is very important factor in fisheries biology but its estimate is in the same time the most problematic. On calculating mortality we usualy suppose that the population is uniform distributed over given area, uniform exploited and that isn't undervent to migrations. These suppositions are very rarely satisfied. Arisen faults we avoid in such manner we calculate total mortality coeficient Z on different manners and then we take the average value of all obtained results as real value.

From our material is it possible calculate only total mortality coeficient Z ($-$ dN/Ndt $= F + M$), where are summed up both mortalities i.e. fishing mortality (F) and natural mortality (M).

For estimating of total mortality coeficient we have needed frequences of age groups from table 3. This method is the most frequently applied and it is rather sure if the data are known from several seasons trhough which we can follow single age groups. Unfortunately, we dispose only with data from one season, so we can compare only frequences of age groups from one year.

The value of Z in our analyse amounts 1,50, that means from whole population remains only 22 p. 100 of the population alive. This high value of total mortality (if its survay is correct) goes on count on intensive exploitation respectively high fishing mortality.).

D) Nutrition.

It was analysed 156 specimens of stomach content. Because of relative small number of analysed examples it hasn't done any precise analyse related to the sex and largeness of specimens, to time of the catch and similary. By 63 examples the stomach has been empty, while by the rest 93 ones the quantitative and qualitative analyse has showed the following feature :

Kind of food	Relative appearance in the sample (p. 100)
1. Pisces	23,65
2. Policheta	22,58
3. Crustacea	22,58
4. Cephalopoda	20,43
5. Gastropoda	4,30
6. Detritus	2,15
7. The rest	4,30

From the up mentioned data follows that *Pagellus erythrinus* mainly feeds on Policheta and Crustacea but on fish only exceptionaly. The same is valid for Cephalopoda.

Institut for Marine Biology. Kotor.
Institut of Oceanography and Fisheries. Split.

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