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The fecundity of damsel fish (*Chromis chromis*) in the eastern middle Adriatic

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The fecundity of damsel fish, Chromis chromis, *was studied from 283 specimens. There was no significant correlation between the size of the eggs and the size of the fish. Fecundity ranged from 6 050 to 73 688 mature ova. Fecundity increased exponentially with fish length and age. The correlation between fecundity and age was slightly better than that between fecundity and length.*

INTRODUCTION

Knowledge of fish fecundity is useful in determing racial and environmental differences, in investigating population dynamics of fish species and for fish culture purposes. The relationship between a species length and its fecundity has been used principally as a rapid means of predicting the fecundity of fish stocks when their lengths are known. Typically, fecundity increases as length increases until a state of senility sets in.

The damsel fish, *Chromis chromis* (Linnaeus, 1758), are small fish found in shoals in mid-water above or near rocky reefs or above sea-grass (*Posidonia*) meadows at depths ranging from 3 to 35 m. They occur in the Mediterranean and from Portugal southwards to Angola (QUIGNARD and PRAS, 1986). GRUBIŠIĆ (1982) reported that the spawning season of damsel fish in the Adriatic occurred between May and August.

Although damsel fish (*Chromis chromis*) are widely distributed in the Mediterranean Sea, nothing has been published on the fecundity of this species.

As a contribution to the knowledge of the biology of damsel fish in the eastern middle Adriatic, this study presents information on the fecundity of the species in relation to length and age.

MATERIALS AND METHODS

The present study is based on samples of damsel fish taken in the eastern middle Adriatic near islands Trstenik and Pržnjak (Fig. 1) during May and June 1993.

Subsample of 283 mature females were collected for fecundity studies. All specimens were preserved in 4% formalin after capture. Total length in cm was recorded. The body weight was measured to the nearest 0.1 g.

A gonad maturity stage was assigned to each specimen using the sexual development classification and criteria proposed by NIKOLSKY (1976). The ovaries from each fish were carefully removed, weighed to the nearest 0.01 g, and placed in a bottle containing modified Gilson's fluid (SIMPSON, 1951). This solution not only preserves the eggs, but also breaks

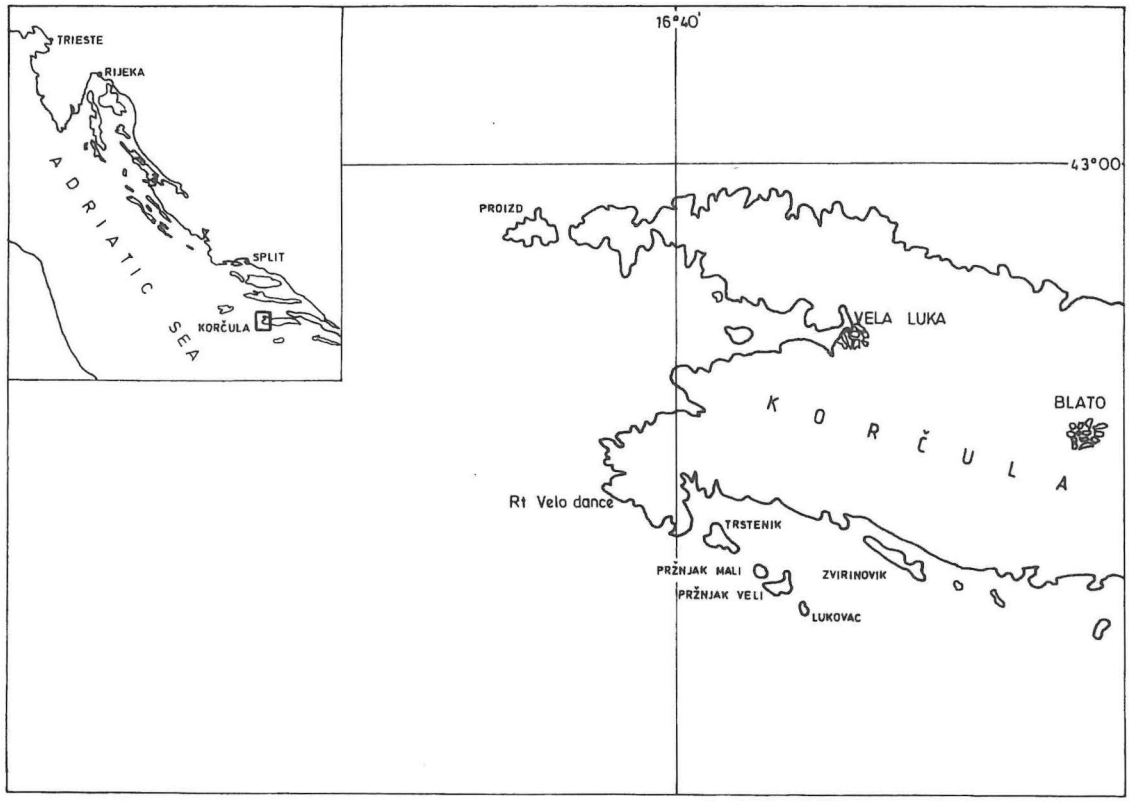

Fig. 1.

down the intraovarian connective tissues after several weeks without damage to the ova. Eggs left in Gilson's fluid for more than 2 or 3 months were in poor condition and had to be discarded.

After two month preservation, the ovaries were washed thoroughly in cold water and after that eggs were separated into the size ranges > 0.8, 0.5 - 0.8 and 0.35 - 0.5 mm. Oocyte diameters were measured using a binocular microscope fitted with an eyepiece micrometer.

Fecundity was determined for both maturing gonads by relating the number of eggs in a subsample to the whole gonad. Gravimetric determinations were made by weighing the same ovaries and their sample sections to the nearest milligram on a Mettler balance. This method involved the weight of a known number of mature ova and proportionally computing the total number of eggs in both ovaries was calculated by using the following formula:

$$\text{fecundity} = \frac{Wt}{Ws} \times N$$

where N = number of eggs in the sample, Wt = weight of the ovary and Ws = weight of the sample.

Since the analysis of variance tests showed insignificant difference in the weight or number of counted ova from the left and right ovaries we used either ovary for measurements and counts ($F = 2.76$, $P > 0.05$; $F = 3.53$, $P > 0.05$).

Scales were removed from damsel fish, while they were in fresh condition. Scale samples for aging were taken from the left side of the body, along the midline and below the origin of the dorsal fin.

RESULTS

Damsel fish mature at 6.8 - 7.2 cm TL as they approach age 2^0.

Gonad development was obvious at 5.8 - 6.5 cm, as most specimens entered the early

developmental stage. The ripe ovaries occupy the greatest part of the body cavity and have an orrange colour. Two ovaries are almost equal in length and size, but, at spawning they show some differences. Data were obtained from 283 female damsel fish sampled immediately before spawning. The total length of the females ranged from 5.5 to 13.5 cm (average 8.6 cm) and their ages from 2 to 9 . The total number of eggs per female ranged 100 to 110 350 (average 45 400) and the mean oocyte diameter ranged from 0.42 to 0.83 mm. All oocytes smaller than 0.5 mm in diameter were classified as immature. No positive correlation between mean diameter of mature oocytes and length or weight was found for damsel fish.

Fecundity is here defined as the total number of ova, with diameter larger than 0.5 mm, that mature in both ovaries in one season. The estimates ranged from 7 080 eggs for a 6.8 cm fish to 74 800 eggs for a 13.5 cm specimen; most of the fish were in the range 8.0 - 12.0 cm and fecundity estimates generally ranged between 11 680 and 44 740 ova (on the average 22 840).

There was considerable variation in fecundity of individuals. The range in age and length of individuals in the sample suggested that it would be desirable to examine in detail these variables and their relationship to fecundity. Various equations were examined in order to choose the one best fitting the data: length or age - fecundity. For this choice, the criterion of the smaller mean square error (MSE) between observed and calculated fecundity was used, combined with the possibility of interpreting the equation biologically. Two of these are polynomials (first and second degree) and the third is a power function. The power function was finally chosen, despite not having the lowest MSE, because the fecundity estimated for the younger damsel fish using linear regression led to negative fecundity, having no biological meaning and the loss in terms of MSE was not regarded as significant.

Regression analysis indicated that the total length or age could be used to predict fecundity of damsel fish, but age proved to be slightly better related to fecundity (r = 0.9761) than length (r = 0.9732) (Fig. 2 and Fig. 3).

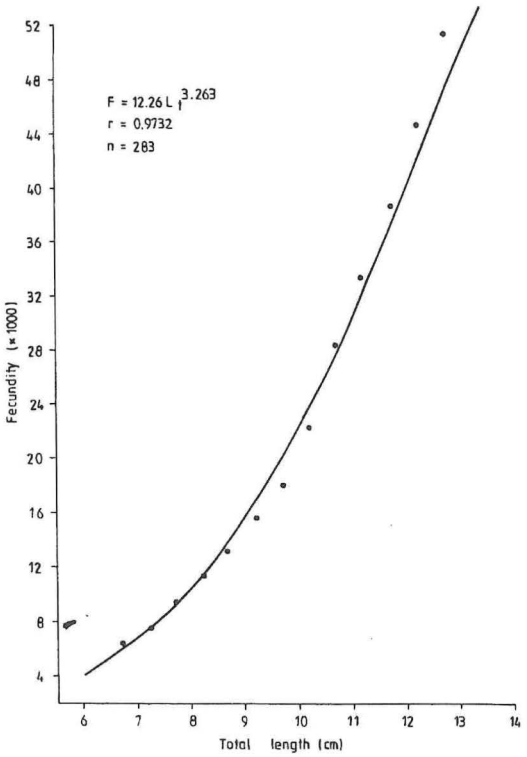

Fig. 2.

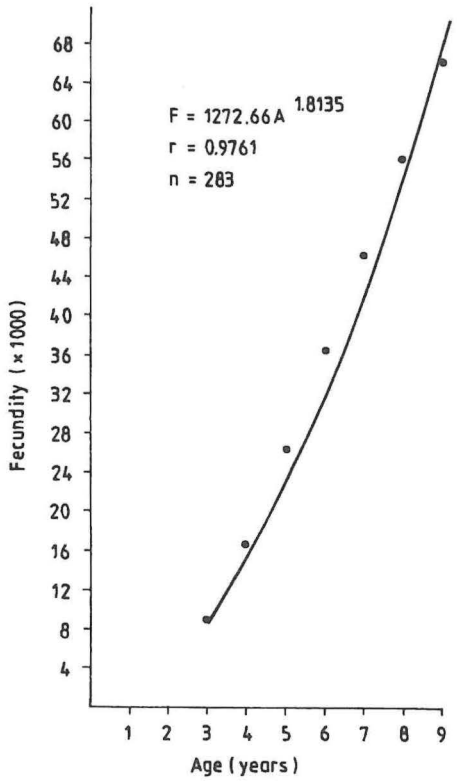

Fig. 3.

Combinations of two independent variables, length and age improved predictability only slightly, therefore, separate equations were derived by using length and age on fecundity. Regression analysis showed that fecundity estimation increased with length and age, according to the equations:

$$\log F = 3.26 \log TL + 1.09$$
$$r = 0.9732 \qquad n = 283$$

$$\log F = 1.81 \log A + 3.11$$
$$r = 0.9761 \qquad n = 283$$

where TL is the total length in cm, A the age in years and r the correlation coefficient.

The smallest and largest mature females (6.8 and 13.5 cm) gave minimum and maximum fecundities of 6 050 - 9 335 and 68 440 - 73 670 respectively, which do not differ from the measured number of eggs.

DISCUSSION

The accurate determination of the fecundity of a fish is time consuming and in damsel fish the problem is especially complicated by the necessity to classify eggs on the basis of their maturity. The best approach is to decide which ova are to be considered mature and determine only their numbers through gravimetric-volumetric estimates or actual counts. If estimates are to be made, checks on their accuracy through actual counts of selected specimens should be conducted.

As has been found for other fish species (BAGENAL, 1978), the present study confirms that the absolute fecundity of damsel fish increases with increasing length and age, suggesting that it would be suitable to examine in detail these variables and their relationship to fecundity. The small difference of the correlation coefficient between the fecundity vs. length or age, shows that fecundity can be expressed in terms of length as well as age. Generally, an exponential relationship exists between fecundity and the above parameters, although, in some other fish, the relationship has been found to be linear (TSIMENIDIS and PAPACONSTANTINOU, 1985).

The fecundity of damsel fish taken in the eastern middle Adriatic was found to vary at a rate proportional to the length at a power of about 3.3 . This value of the exponent is generally in the range of the values 3 to 5 reported by RAITT (1933) for North Sea haddock, by BOTROS (1962) for Baltic cod, by MAY (1967) for cod of eastern Newfoundland, while values between 4 and 5 have been reported by POWLES (1953) for the Gulf of St. Lawrence cod and by HODDER (1963) for Grand bank haddock. ISMEN (1995) reported the values between 2.20 and 3.36 for whiting *Merlangius merlangus euxinus* from the Turkish Black Sea coast.

Comparisons of the correlation coefficients of the relationships of fecundity to length and age separately indicate that fecundity is slightly better correlated with age than with length. LEHMAN (1953) noted that for the Hudson river shad data, the correlation between fecundity and age was better (r = 0.98) than for fecundity and length. These results might be a peculiarity of these two species. However, length measurements are usually more easily and more accurately obtained during field sampling than age and with the rather insignificant difference between the correlation coefficients. MAY (1967) reviewed the results of fecundity work on several species (cod, herring, long rough dab, hake), which showed that for most practical purposes, variation in fecundity is satisfactorily explained in terms of length alone. Fecundity in whiting from western and eastern Turkish Black Sea (ISMEN, 1995) and North Sea, Minch, Iceland and Northwest Atlantic (HISLOP and HALL, 1974) was found to be related more to body length than to age.

REFERENCES

BAGENAL, T. B. 1978. Aspects of fish fecundity. *In* S. D. GERKING (Editor), Ecology of Freshwater Fish Production. Blackwell Scientific Publication, Oxford, 75 - 101 pp.

BOTROS, G. A. 1962. Die fruchtbarkeit des dorsches (*Gadus morhua* L.) in der westlichen Ostsee und Westnorweigische Gewassern. Kiel. Meeresforch., 18: 67 - 70.

GRUBIŠIĆ, F. 1982. Ribe, rakovi i školjke Jadrana. ITRO Naprijed, Zagreb, GRO Liburnija, Rijeka, 240 pp.

HISLOP, J. R. G. and W. B. HALL. 1974. The fecundity of whiting, *Merlangius merlangus* (L.) in the North Sea, the Minch and at Iceland. J. cons. Int. Explor. Mer. 36 e : 42 - 49.

HODDER, V. M. 1963. Fecundity of Grand Bank haddock. J. Fish. Res. Bd. Canada, 20: 1465 - 1487.

ISMEN, A. 1995. Fecundity of whiting, *Merlangius merlangus euxinus* (L.) on the Turkish Black Sea coast. Fisheries Research, 22: 309 - 318.

LEHMAN, B. A. 1953. Fecundity of Hudson River shad. U. S. Fish and Wildlife Serv., Res. Rept., 33: 1 - 8.

MAY, A. W. 1967. Fecundity of Atlantic cod. J. Fish. Res. Bd. Canada, 24: 1531 - 1551.

NIKOLSKY, G. V. 1976. The ecology of fishes. Academic Press. New York - London, 352 pt.

POWLES, P. M. 1953. Studies on reproduction and feeding of Atlantic cod (*Gadus callaris* L.) in the southwestern Gulf of St Lawrence. J. Fish. Res. Bd. Canada, 15: 1383 - 1402.

QUIGNARD, J. P. and A. PRAS. 1986. *Pomacentridae. In*: P. J. P. WHITEHEAD, M. L. BAUCHOT, J. C. HUREAU, J. NIELSEN and E. TORTONESE (Editors). Fishes of the North-eastern Atlantic and Mediterranen. Vol. II. UNESCO, UK, pp. 916 - 918.

RAITT, D. S. 1933. The fecundity of the haddock. Fish. Bd. Scot. Sci. Invest., 1: 1 - 40.

SIMPSON, A. C. 1951. The fecundity of the haddock. Fish. Invest., Ser. 2, 17: 1- 27.

TSIMENIDIS, N. and C. PAPACONSTANTINOU. 1985. A preliminary study of the fecundity of the hake (*Merluccius merluccius* L., 1758) in the Greak Seas. Inv. Pesq. 49: 55 - 59.

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Fekunditet crnelja (*Chromis chromis* L.) u istočnom srednjem Jadranu

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KRATKI SADRŽAJ

Fekunditet crnelja (*Chromis chromis* L.) je ispitan na 283 jedinke. Nije utvrđena značajna korelacija izmedu veličine jaja i veličine ribe. Fekunditet se kretao u rasponu od 6 050 do 73 688 zrelih jaja crnelja. Fekunditet je rastao eksponencijalno s dužinom i starošću ribe. Korelacija između fekunditeta i starosti nešto je bolja od korelacije između fekunditeta i dužine.