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SEX REVERSAL IN THE DAGERAAD *CHRYSOBLEPHUS CRISTICEPS* (PISCES, SPARIDAE)

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Abstract – This paper reports protogynous hermaphroditism in the dageraad *Chrysoblephus cristiceps*. Mass-length relationships indicate growth changes in male and female fish. Seasonal maturity in dageraad, and hermaphroditism in South African sparid fish are discussed. A regulatory measure for the conservation of dageraad is proposed.

Introduction

The occurrence of natural sex reversal in South African sparid fish was first recorded by Lucks (1970) in west coast steenbras *Lithognathus aureti* and Penrith (1972) in roman *Chrysoblephus laticeps*. Mehl (1974) in a study on the white steenbras *Lithognathus lithognathus* found this sparid to be permanently hermaphroditic. He postulated that it was a rudimentary hermaphrodite with only one of the two sexes functioning throughout the individual's life span and concluded that it could be a transitionary stage towards eventual gonochorism. *Chrysoblephus laticeps* was shown to be a case of protogynous hermaphroditism while *Lithognathus aureti* proved to be protandrous hermaphroditic.

Penrith (1972) stated that although he did not have large fish in his samples, the data available suggested that sexual reversal in all probability took place. During a study of two submerged reefs in the inshore waters of the Tsitsikama Coastal National Park this supposition was confirmed.

The reefs currently being studied are known locally as Middelbank and Rheeder se Knol. Due to environmental factors presently being investigated *Chrysoblephus cristiceps* are seldom taken at Middelbank although the depth of the reef is approximately the same (10–15 fathoms). Almost exclusively the data on which this report is based came from Rheeder se Knol, situated six km east of the Storms River Mouth.

Material and Methods

Samples were collected by hand-line fishing from an 5,5 m vessel. Fish were mass measured to the nearest milligram and measured for total and caudal lengths to the nearest millimeter. Macroscopic examination of the gonads was conducted after dissection. Gonads were re-

corded on a 1 to 7 maturity index scale : 1 being inactive, 6 being ripe and running and 7 being spent. There appeared to be no external sexual dimorphism in *Chrysoblephus cristiceps,* During the macroscopic examination of the gonads individuals of ten were found in a transformation stage i.e. with the male gonad developing and the female gonad degenerating. These fish were recorded according to the dominating gonad. The records included in the analyses number 510 fish and the majority were collected during 1973 and 1974.

The standard exponential relationship between fish mass and length were calculated. This is expressed by the function:

$$W = aL^b$$

where L = length in millimeters
a = intercept of the y axis
W = mass in milligrams
b = exponent

Logarithmic transformations yield a linear relationship from which a and b can be calculated by the method of least-squares.

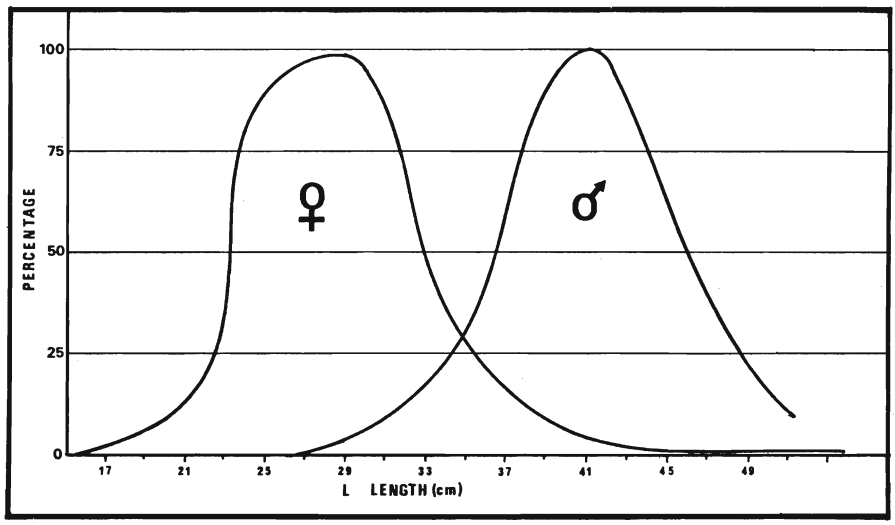

Fig. 1. Size composition of a Dageraad population as obtained from hand-line catches in Tsitsikama Coastal National Park.

Results

(i) By plotting the relative frequency of the size groups it is clearly seen that sex reversal is taking place (Fig. 1). The majority seem to undergo this sex change during the lengths 33–37 cm (caudal length), although there are some of both sexes between 29 and 41 cm due to differential growth rates. The mode of the female individuals in the population, peaks at 26–30 cm whereas the male individuals in the populations peak at 39–43 centimeter. The conclusion is that *Chrysoblephus cristiceps* is protogynous hermaphroditic.

(ii) The mass-length relationships were calculated:

$$W = 0{,}0324\ L^{2{,}877}$$

$$W = 0{,}0052\ L^{3{,}358}$$

It can be seen from Fig. 2 that in the smaller female fish this relationship is curvi-linear whereas in the larger, male fish, this relationship is linear i.e. growth changes between sexes.

(iii) By grouping all the maturity index data by month, as inactive (maturity indices 1 and 2) and active (maturity indices 3 to 7), the relative proportion of active to inactive indicates a peak activity in November and a minimum in July–August, suggesting a spawning period in October to December (Fig. 3).

Discussion

Chan (1970) reviewed the phenomenon of sex reversal found in vertebrates and concluded that sexuality in these animals may be classified into two main groups i.e. gonochorism and hermaphroditism. He notes that in the sparids there exists a diversified expression of sexuality and hermaphroditism. The basic structure of the gonads of sparids are reported to consist of a paired ovotestes fused posteriorly while the cavities of the two lobes form a common duct. Internally each lobe consists of ovarium lamellae, where ovarium follicles develop and mature. Posteriorly on the ventro-lateral part of each lobe, testicular tissues are visible as two bands adjacent to the lumen of the gonad with connective tissue separating male and female zones.

Macroscopically the development of the testicular part were seen to develop on the ventrolateral portion of the gonads in *Chrysoblephus cristiceps* as well as the roman *Chrysoblephus laticeps* and another sparid, the red steenbras *Petrus rupestris*. This latter species was reported by Penrith (1972) to be bisexual or gonochoristic. The evolution of hermaphroditism is extremely scanty but it is obvious that simultaneous hermaphroditism would be a disadvantage due to the possibility of self-fertilization and inbreeding. However, protogynous hermaphrodites could provide a mechanism as good as gonochorists.

Penrith (1972) presents an intriguing theory for the presence of pro-

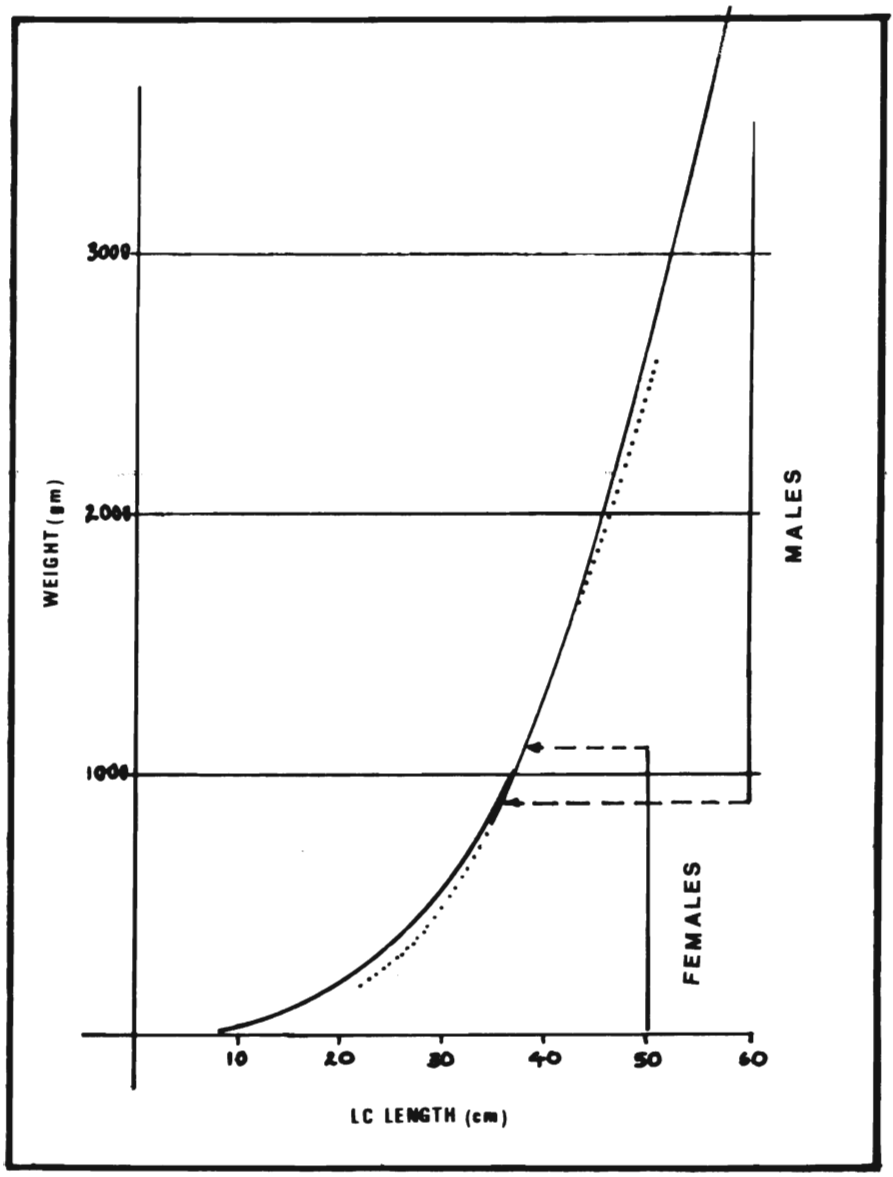

Fig. 2. Mass-length relationships for *Chrysoblephus cristiceps* ♂♂ and ♀♀.

togynous hermaphroditism in *Chrysoblephus laticeps*. He believes that this fish with its large heavy head, flabby body, and soft slightly concave caudal fin, becomes hydrodynamically a poorer swimmer as it increases in size. The advantage of sex reversal being that the younger reproductive sector of the population could avoid their natural predators, while the larger slower males would have the potential of fertilizing several

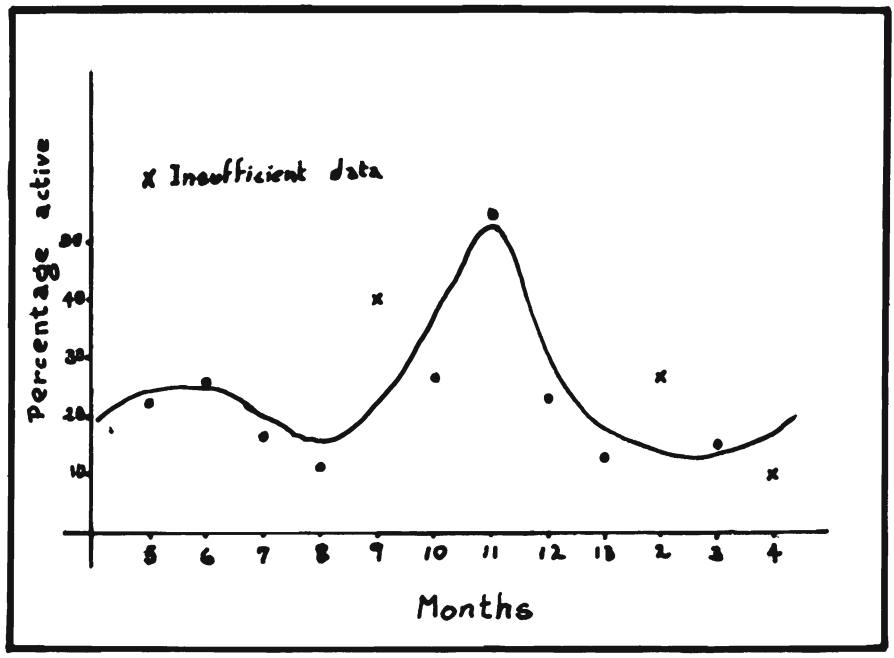

Fig. 3. Monthly relative frequency of maturity indices 3 to 7 fish in the population.

females. In this way survival of the species under natural conditions is guaranteed. *Chrysoblephus cristiceps* is similar in body dimensions to *Chrysoblephus laticeps* and is therefore also prone to becoming a poorer swimmer as it increases with size and age.

Dageraad were relatively abundant along the south coast between Cape Point and Algoa Bay but their numbers and size in catches have decreased rapidly during recent times. F. Spalmer *(pers. comm.)* noted that at Arniston this change has been most dramatic, whereas the fishermen caught many, large dageraad they now return with fewer and smaller fish.

The Tsitsikama coast is treacherous and the population of dageraad have not been exposed to the same pressure of exploitation as other areas along the coast. It is suggested that the reason for good catches still to be obtained at Tsitsikama, is due to the protection these fish are afforded in the Park. At present the conservation of this species is based on a minimum length size of 20 centimeters. It is proposed that due to the protogynous hermaphroditic nature of dageraad that a regulatory measure be imposed on the maximum size and that all fish over 40 cm (LC) should be released when caught. (A similar regulation exists in the case of the lobsters along the northwestern shore of America).

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