A METHOD FOR DISTINGUISHING THE SEX OF THE OIL-SARDINE, *SARDINELLA LONGICEPS* VAL. IN THE FIELD*

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Sex studies form an important part of fishery biological investigations and as such easy methods of distinguishing the sexes of commercially important fishes will lighten the work of determining their sex. Well-known examples of conspicuous secondary sexual characters are found in some of the cyprinids and cyprinodonts (Norman, 1957) and such characters help us to distinguish the sexes of those fishes easily. In many teleosts the genital and urinary pores open on a more or less prominent papilla. Among the clupeoids, O'Connell (1955) makes mention of a median muscular ridge in *Sardinops cærulea*, extending from the rectal portion of the intestine and bearing the genital and urinary pores. He terms this ridge, as urogenital papilla. There is no indication of the sex of the fish in which such a papilla has been observed. Determination of the sex in clupeoid fishes have almost always been done by dissection and examination of the gonads. But, while studying the sex composition and maturity of the oil-sardine, *Sardinella longiceps*, the presence of a muscular papilla bearing the genital and urinary pores has been observed in the male and a membranous one in the female. On the basis of those characters the fish can be sorted out into the two sexes without actual dissection.

Orientation of the Genital and Urinary Pores in the Oil-Sardine

In the oil-sardine the anus, genital pore, urinary pore as well as the posterior opening of the gas bladder to the exterior are situated in a common subcutaneous pit which may be termed the 'cloaca'.[1] In the male (Fig. 1 *a*, and Fig. 2 *a*) the vas deferens from each testis passes backwards and joins the other to form a common duct which opens on a muscular pear-shaped papilla immediately behind the anal opening. The urinary pore is also situated on this papilla at its distal end. The common urinary duct appears to be

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[1] The presence of a typical cloaca in teleosts is doubted by many workers. However, the term 'Kloake' has been used by Maier and Scheuring (1923) in the case of the herring.

FIG. 1

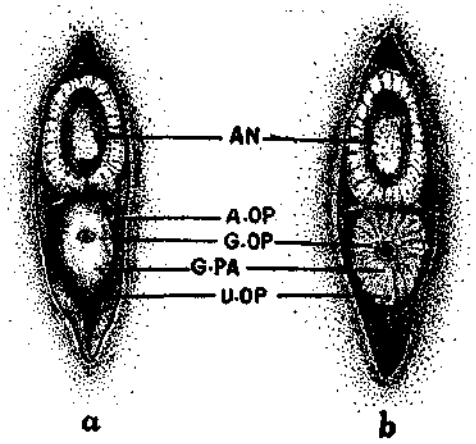

FIG. 2

FIGS. 1–2. Fig. 1. Photographs of the anal region of: (*a*) the male and (*b*) the female oil-sardine 164 and 163 mm. in total length respectively. *ca.* × 22. Fig. 2. Semi-diagrammatic representation of the anal region of: (*a*) The male and (*b*) the female oil-sardine (each 140 mm. in total length). *ca.* × 30. AN, anus; A.OP, opening of the gas bladder; G.OP, genital pore; G.PA, genital papilla; U.OP, urinary pore.

independent of the genital duct. In juveniles the papilla is comparatively less prominent and the pores on the papilla are inconspicuous, whereas in the adults in advanced stages of maturity and in spent and recovering ones, the papilla and the pores are very prominent. In the female (Fig. 1 *b*, and Fig. 2 *b*) the oviducts unite distally and the common duct passes into a membraneous papilla situated behind the anus and this papilla communicates with the cloaca by the genital opening. The urinary duct also opens into the cloaca by a small pore which is behind the genital opening, on the membranous papilla. In spent as well as in spent-recovering females the papilla is found in the form of a small flaccid but protuberant tube tapering posteriorly, with the genital opening situated anteriorly and the urinary pore at the tip. On the basis of the above differences the oil-sardine has been sorted out into males and females with a high degree of accuracy. The average error in sorting by this method reckoned for all the 19 samples examined (comprising 1,133 fishes) is about 1·2%. The observations have been spread over a period of six months from June–December 1958.

As may be seen from Table I, the specimens examined ranged in length from 127–188 mm. and they have been mostly in maturity stages I–V, along with small numbers of spent and spent-recovering specimens in

TABLE I

Showing details of regarding size range, maturity, etc., of the fish examined

Sample No.	No. of specimens in the sample	Size range and (mode) in mm.	Maturity range[2]	No. of specimens wrongly identified	Remarks
1	25	142–162 (150)	II–V	2	
2	102	137–165 (145)	II–V	1	
3	100	137–159 (155)	II–V	1	
4	102	137–166 (150)	II–V	..	
5	100	142–185 (155)	III–V	..	
6	100	144–188 (155)	II–V	..	
7	101	138–182 (165)	I–II	1	In samples 8, 10, 14, 15, 17 and 19 spent specimens recovering into stage I maturity have been observed in varying numbers
8	51	158–183 (160 & 170)	I	..	
9	6	135–154 (140)	I–II	..	
10	50	161–184 (170)	I	..	
11	50	127–176 (135 & 150)	I	5	
12	100	160–182 (170)	I	..	
13	10	130–175 (140)	I	..	
14	20	158–181 (170)	I	..	
15	25	168–170 (170)	I	..	
16	52	131–170 (140)	I	3	
17	18	163–180 (170)	I	..	
18	111	127–151 (140)	I	1	
19	10	169–181	I	..	
	1133	127–188	I–V	14	Average error is about 1·2%

[2] Determination of the maturity stages has been based on the key adopted by the International Council for the Exploration of the Sea, as reproduced by Lovern, J. A. and H. Wood, 1937.

stage I. It is found that the present method is not quite reliable for distinguishing the sexes of juvenile oil-sardine below 130 mm. in total length. It may be remembered that in such specimens where the gonads are in the early stage of maturity, dissection and microscopical examination are required to distinguish the sexes. In specimens between 130 mm. and 140 mm. this method could be applied more or less satisfactorily; but it takes comparatively more time for sorting out the sexes correctly. As a rule, this character is quite reliable for sorting the maturing oil-sardine of 140 mm. length and above as also spent fish and spent-recovering specimens. No oil-sardine has been observed during the present study beyond stage I of maturity in the recovering condition. In addition to its usefulness in distinguishing the sexes, the structure of the external genitalia of the oil-sardine throws light on the spent and recovering condition of the fish. In a specimen maturing for the first time with the gonads in maturity stage I, the length of the gonads is seen to be less than half that of the body cavity and the genital papilla less conspicuous and it is inside a more or less closed cloacal chamber; whereas in a spent-recovering fish in stage I, the gonad is distinctly more than half the length of the body cavity and the muscular papilla in the male and the membranous tapering tube in the female are very prominently seen inside a widely gaping cloaca.

The secondary sexual characters noted in the oil-sardine become more prominent as the fish advance in maturity and reach maximum development by the time they are fully mature. Even after the discharge of the genital products, the above characters continue to be conspicuous for some time. Hence the presence of the highly prominent papilla in the male and the corresponding membranous structure in the female oil-sardine enables us to distinguish a recovering fish in maturity stage I from a fish of the same stage maturing for the first time.

Finally it is relevant to point out here the presence of the above mentioned muscular papillæ associated with the genital and urinary pores in the case of other sardines like *Sardinella gibbosa*, *S. fimbriata*, *S. albella* and *S. sirm*, examined for comparative information. *Kowala coval* popularly known as the white sardine also show this character.

An attempt by individual workers in sorting out the sexes of the above and allied fishes like *Hilsa* spp. etc., on the basis of this character to assess its utility for sex composition studies seems worthwhile in view of the success of this method in the case of *Sardinella longiceps*.