

ON THE LITTLE KNOWN FISH, *CHIROCENTRUS NUDUS*
SWAINSON FROM THE INDIAN SEAS, AND ITS COMPARISON
WITH *CHIROCENTRUS DORAB* (FORSKAL)*

By G. LUTHER

Central Marine Fisheries Research Institute

INTRODUCTION

Chirocentrus nudus Swainson (1839) is based on the brief description and drawing of 'Wallah' (Telugu name) from the Visakhapatnam coast, India by Russell (1803). Bleeker (1852) described a new species, *Chirocentrus hypselosoma* with *C. nudus* Swainson as its synonym. Günther (1868), Day (1878) and Weber and de Beaufort (1913) considered *C. hypselosoma* synonymous to *C. dorab* (Forskål). A detailed study made by Hardenberg (1930) to re-establish the two species, although indicated that *C. hypselosoma* is distinct from *C. dorab* by the constant statistical differences found in different characters, did not show any absolute difference in any character between the two species. However, it has been pointed out by him, as also by Bleeker, that *C. dorab* is the more slender of the two species. Subsequent authors, viz., Fowler (1941), Smith (1949), Suvatti (1950), Deraniyagala (1952) Munro (1955) and Robert *et al.* (1963) considered *C. nudus* to have priority over *C. hypselosoma*. But Misra (1959) considered the genus *Chirocentrus* to be monotypic consisting of *C. dorab* and Marshall (1964) believed that the genus *Chirocentrus* consisted of 'probably only one species'.

In spite of the fact that the two species of *Chirocentrus* are distinct and both species occur together in the commercial catches in India, the occurrence of *C. nudus* is little known. This may be due to the overlap of the several morphometric and meristic characters so far considered diagnostic of the species. In view of this, a detailed study of morphological and morphometric characters, and meristic counts of the two species was made, from which three characters were found useful to distinctly separate the two species. One of the three characters is helpful in the visual separation of the two species by the colouration of the dorsal fin, the major portion of which is black in *C. dorab*, and white in *C. nudus*. This character was employed for the initial separation of the two species. Details of analyses of these characters are given in this paper.

C. nudus forms an important component in the drift-gill net catches in the Palk Bay and the Gulf of Mannar around Rameswaram Island. Out of a total number of 8,537 specimens examined at random of both the species of *Chirocentrus*, *C. nudus* formed 80% in the total.

MATERIAL AND METHODS

Material for this study was collected and examined from fish landing places along the Palk Bay and the Gulf of Mannar at Dhanushkodi, Rameswaram,

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Thangachimadam, Kundugal Point, Pamban, Mandapam, Keelakarai, Tuticorin, Panaikulam, Sethubhavachattram, Mallipattanam, and from Madras. A photograph of *C. nudus* from Bombay was also examined.

50 specimens of *C. nudus* ranging in size from 169 to 562 mm. standard length and 50 specimens of *C. dorab* ranging in size from 168 to 566 mm. standard length preserved in 5% formalin were used for laboratory study other than for vertebral counts. An effort was made to examine one specimen for each centimetre interval in the size range. The material included juveniles and adults of both sexes. For observations on the colouration of dorsal fin in fresh fish, as many as 6,794 specimens of *C. nudus* measuring 169-750 mm. standard length and 1,743 specimens of *C. dorab* measuring 168-630 mm. standard length, which included the usual size range in the commercial catches by drift-gill nets, were examined in the field.

The measurements taken are defined below :

Fork length : Distance from tip of lower jaw to the fork of caudal fin.

Standard length : Distance from tip of snout to midbase of caudal fin.

Depth of body : Depth at base of pelvic fin.

Depth at orbit : Depth at the front border of eye.

Head length : Distance from tip of snout to end of operculum.

Eye diameter : Horizontal diameter of eye.

Snout length : Distance from tip of snout to front border of eye.

Dorsal caudal peduncle length : Distance from the base of the last dorsal ray to the midbase of the caudal fin.

Depth of caudal peduncle : The least distance, dorsoventrally, of caudal peduncle.

Predorsal length : Distance from tip of snout to anterior base of dorsal fin.

Pectoral fin length : Distance from base to tip of pectoral fin.

Caudal fin length : Distance from midbase to the tip of the upper lobe of caudal fin.

The number of gill rakers of the upper and lower limbs of the right outermost arch was counted separately. The gill rakers broken off within the series, indicated by stumps and scars, were included in the count.

The body proportions are expressed in thousandths of standard length.

COMPARISON OF *C. DORAB* AND *C. NUDUS*

KEY TO SPECIES

1. *In fresh specimens, dorsal fin black excepting for a thin arched whitish area, narrow anteriorly and wider posteriorly, along the basal portion of the fin. On preservation in formalin, the whitish area along the basal portion of fin widens and turns light yellow, the black pigment on the last 3-6 rays tends to fade out in sizes below 410 mm. S. L. Pectoral fin 11.6 - 13.1%, and depth at orbit 8.4 - 9.5% in standard length. End of maxilla does not reach pre-opercular margin. C. dorab. (Pl. I, Fig. 1).*

2. Dorsal fin whitish with a tinge of yellow (the latter becoming intense on preservation) excepting for a dark streak on its front border over the first three unbranched rays and over the posterior border of the last ray. Pectoral fin 14.8 - 17.8%, and depth at orbit 10.3 - 11.9% in standard length. End of maxilla surpasses preopercular margin in sizes beyond 210 mm. standard length. . . . *C. nudus*. (Pl. I, Fig. 2)

BODY PROPORTIONS

The range, mean, standard deviation and standard error for the body proportions of ten morphometric characters for both the species are given in Table I and are represented graphically in Fig. 1. The percentage occurrence of each species within the overlapping ratios of the ten body proportions are given in Table II.

TABLE I
Biometric data for ten morphometric characters in *C. dorab* and *C. nudus*

S. No.	Character (Ratios expressed in thousandths of standard length)	N	Range of ratio	Mean ratio	Standard deviation	Standard error
1.	Depth of body					
	<i>C. dorab</i>	50	131-162	145.42	6.9606	0.9844
	<i>C. nudus</i>	50	151-201	172.66	8.763	1.2393
2.	Depth at orbit					
	<i>C. dorab</i>	50	84-95	90.92	2.5671	0.3630
	<i>C. nudus</i>	50	103-119	109.70	2.9816	0.4217
3.	Head length					
	<i>C. dorab</i>	50	160-184	170.06	5.0774	0.7180
	<i>C. nudus</i>	50	174-199	184.52	4.9809	0.7044
4.	Snout length					
	<i>C. dorab</i>	50	49-59	53.54	2.2472	0.3178
	<i>C. nudus</i>	50	50-61	54.62	2.4576	0.3476
5.	Eye diameter					
	<i>C. dorab</i>	50	30-39	33.78	2.3366	0.3304
	<i>C. nudus</i>	50	32-43	37.06	2.8460	0.4025
6.	Pectoral fin length					
	<i>C. dorab</i>	50	116-131	124.88	3.4453	0.4872
	<i>C. nudus</i>	50	148-178	164.00	6.7616	0.9562
7.	Predorsal length					
	<i>C. dorab</i>	50	668-720	691.86	11.209	1.5852
	<i>C. nudus</i>	50	661-704	685.06	10.265	1.4517
8.	Dorsal caudal peduncle length					
	<i>C. dorab</i>	50	203-246	225.18	9.8625	1.3948
	<i>C. nudus</i>	50	219-254	234.92	8.369	1.1836
9.	Depth of caudal peduncle					
	<i>C. dorab</i>	50	65-79	72.68	2.7166	0.3842
	<i>C. nudus</i>	50	76-91	83.32	3.178	0.4494
10.	Caudal fin length					
	<i>C. dorab</i>	42	191-237	213.97	10.961	1.6913
	<i>C. nudus</i>	41	226-266	243.00	10.314	1.6108

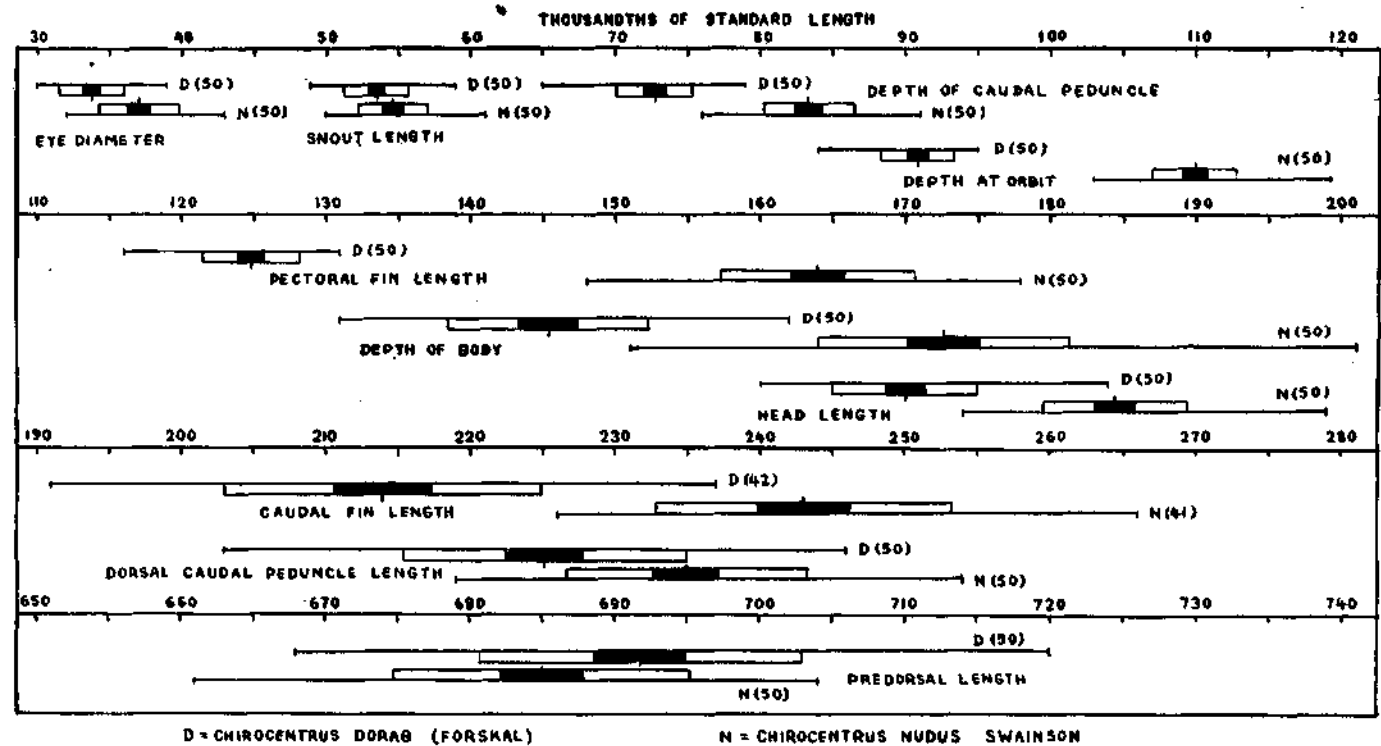


FIG. 1. Graphic representation of variations in 10 morphometric characters of *C. dorab* and *C. nudus*. (The horizontal line represents the total range; the short vertical line the mean; the solid rectangle two standard errors on each side of the mean, and the hollow rectangle one standard deviation on each side of the mean.) The number of specimens in each sample is given in parenthesis.

It could be seen that there is no overlap between species in the proportions of pectoral fin length and of the depth at orbit. Based on these two important characters the author refers the figure of *C. dorab* by Devanesen and Chidambaram (1953) to *C. nudus*.

TABLE II

Range of overlapping ratios of morphometric characters and the percentage occurrence of *C. dorab* and *C. nudus* within the ratios

S. No.	Characters (Ratios expressed in thousandths of standard length)	Ratio of overlap	Percentage occurrence within the overlapping ratio			
			<i>C. dorab</i>		<i>C. nudus</i>	
			N	Percentage	N	Percentage
1.	Depth of body ..	151-162	50	24.00	50	8.00
2.	Depth at orbit ..	nil	50	nil	50	nil
3.	Head length ..	174-184	50	18.00	50	56.00
4.	Snout length ..	50-59	50	94.00	50	98.00
5.	Eye diameter ..	32-39	50	92.00	50	80.00
6.	Pectoral fin length ..	nil	50	nil	50	nil
7.	Predorsal length ..	668-704	50	92.00	50	94.00
8.	Dorsal caudal peduncle length	219-246	50	68.00	50	92.00
9.	Depth of caudal peduncle	76-79	50	12.00	50	10.00
10.	Caudal fin length ..	226-237	42	11.90	41	29.27

COLOURATION

Body: *C. dorab*—In fresh specimens, the prominent coloured band on back is constituted by separate bands of green, grey with a tinge of blue and violet, and sea-blue with a tinge of green extending in line to the upper angle of operculum. Further down is a narrow reddish-yellow band followed by the silvery area. *C. nudus*—In fresh specimens, the prominent coloured band on back is constituted by separate bands of blue, grey, and blue not extending in line to the upper angle of operculum. Further down is a narrow reddish-yellow band followed by the silvery area. Subsequent to rigor mortis the back turns dark grey and grey in *C. dorab* and *C. nudus* respectively. On preservation, the sides of body, chin and the adipose tissue over eye develop yellow colour in both the species. The back turns dark grey in *C. dorab* and grey in *C. nudus* descending in a diffused manner to the midlateral region. **Dorsal fin:** As mentioned in the key for both the species. **Pelvic fin:** Hyaline, but turns light yellow on preservation in both species. **Anal fin:** *C. dorab*—Hyaline, but in specimens above 40 cm. standard length dark patches are present in the anterior portion of the fin. These dark patches extend further backwards in larger specimens. On preservation the fin turns light yellow. *C. nudus*—Hyaline, but turns yellow on preservation. **Pectoral fin:** Blackish, but on preservation the lower half of the fin turns yellow in both the species. **Caudal fin:** Dark grey with darker margin in both the species. On preservation it turns light yellow except for the margin.

MERISTIC COUNTS

The frequency distribution of the various meristic counts in the two species are given below together with the results of statistical analyses of same by X^2 test, and their levels of probability (Table III). The formula employed for the purpose was that given by Fisher (1950, p. 87) :

$$X^2 = \frac{I}{p \cdot q} \left\{ S(ap) - n\bar{p} \right\}$$

TABLE III

Chi-square values for ten meristic characters of C. dorab and C. nudus, and the levels of their probability

No.	Character	X^2 value	Degrees of freedom	Value of P
1.	Dorsal fin rays	7.65	3	Between .05 and .10 (non-significant)
2.	Anal fin rays	10.48	4	Between .02 and .05
3.	Pectoral fin rays	32.97	1	Less than .01
4.	Pelvic fin rays	4.17	1	Between .02 and .05
5.	Gill rakers in upper limb	29.85	2	Less than .01
6.	Gill rakers in lower limb	6.70	3	Between .05 and .10 (non-significant)
7.	Gill rakers in both limbs	19.54	5	Less than .01
8.	Precaudal vertebrae	22.31	2	Less than .01
9.	Caudal vertebrae	42.16	2	Less than .01
10.	Total number of vertebrae	32.26	3	Less than .01

Dorsal fin

In both species 4-5 unbranched rays and 12-14 branched rays are present, the total range of all rays being 16-19. The frequency of occurrence of the latter is given below :

Number of dorsal fin rays	16	17	18	19
<i>C. dorab</i>	1	17	29	3
<i>C. nudus</i>	4	27	18	1

Anal fin

In *C. dorab* 3-4 unbranched rays and 26-32 branched rays and in *C. nudus* 4-5 branched and 27-32 unbranched rays are present, the total range of all rays being 29-36 for *C. dorab* and 31-37 for *C. nudus*. Their frequency of occurrence is given below :

Number of anal fin rays	29	30	31	32	33	34	35	36	37
<i>C. dorab</i>	1	..	2	9	18	15	3	2	..
<i>C. nudus</i>	..	..	1	4	10	21	7	6	1

Pectoral fin

In both the species there is a single unbranched ray, stouter in *C. dorab* than in *C. nudus*. The branched rays varied from 12 to 14 in *C. dorab* and 13 to 14 in *C. nudus*, the total range of all rays being 13-15 for *C. dorab* and 14-15 for *C. nudus*. Their frequency of occurrence is given below :

Number of pectoral fin rays	13	14	15
<i>C. dorab</i>	8	39	3
<i>C. nudus</i>	..	20	30

Pelvic fin

In *C. dorab* there is one unbranched ray ; the number of branched rays varied between 6 (92%) and 7 (8%) in the 50 specimens examined. In *C. nudus* all the 50 specimens had one unbranched and 6 branched rays.

Bleeker (1872) and Hardenberg (1930) gave the pelvic fin ray count as 1+6 for both the species but Robert *et al.* (1963) report 6-7 rays for both the species.

Gill rakers

The frequency of occurrence of the gill rakers in the upper and lower limbs and also the total from both limbs of the outer arch for both species are given below :

Number of gill rakers	Upper limb					Lower limb								
	1	2	3	4	5	10	11	12	13	14	15	16	17	18
<i>C. dorab</i>	1	7	31	11	..	1	1	6	13	11	14	4	..	..
<i>C. nudus</i>	..	1	11	24	14	..	..	2	9	11	19	6	2	1

Number of gill rakers	Total number of rakers from both the limbs of arch											
	12	13	14	15	16	17	18	19	20	21	22	23
<i>C. dorab</i>	2	..	3	5	10	12	9	5	4	..	..	..
<i>C. nudus</i>	..	..	..	2	7	5	7	17	3	6	2	1

Vertebrae

For this study 24 specimens of *C. dorab* ranging in fork length between 223-530 mm., and 22 specimens of *C. nudus* ranging in fork length between 180-520 mm. collected from fish landing centres around Rameswaram Island were examined. Skeletons were prepared from fresh fish after immersion for a while in steaming water. Separate counts of the caudal and precaudal vertebrae were made. The first caudal vertebrae is one with a long haemal spine. The urostyle was

included in the vertebral count. The frequency of occurrence of the vertebrae in the two regions separately and together is given below :

Number of vertebrae	Precaudal vertebrae				Caudal vertebrae					Total number of vertebrae						
	42	43	44	45	27	28	29	30	31	69	70	71	72	73	74	75
<i>C. dorab</i>	..	3	8	13	..	..	12	11	1	..	..	..	1	4	14	5
<i>C. nudus</i>	12	5	5	..	6	15	1	..	..	2	12	4	4	..	..	..

The X^2 values indicate statistically significant differences, at 5% probability level, in the frequency distribution for all the meristic counts excepting the dorsal fin rays and the gill rakers in lower limb. The non-significance noted for the latter is important since Smith (1961) separated the two species of *Chirocentrus* based on this character.

DISCUSSION AND CONCLUSIONS

Bleeker (1872) found it rather difficult to distinguish the two species of *Chirocentrus* as he wrote in his Atlas : ' Sur deux individus d'une longueur de 442" ces differences se traduisent comme suit.' Later authors, however, have separated the two species by the ratio of depth in body length (Smith, 1949 ; Munro, 1955 ; Robert *et al.* 1963) ; by the extension of end of maxilla in relation to the preopercular margin, and the relative length of the gill rakers to gill filaments (Deraniyagala, 1952) ; by the relative proportion of the head to body (Munro, 1955 ; Scott, 1959) ; and by the number of gill rakers in the lower limb of the outer gill arch (Smith, 1961).

The present study which includes specimens over a wide size range indicates that the body proportions and counts mentioned by the above authors overlap in both the species. Similar results have been obtained by Hardenberg (1930). The non-significance noted in the X^2 distribution of gill rakers in the lower limb of outer arch (Table III) rules out the possibility of separating the two species based on this character. Therefore the characters used by earlier authors to distinguish the two species of *Chirocentrus* appear to be based on a small size range, probably of large fish, and on small samples. The results of the present study show that *C. dorab* and *C. nudus* could be distinguished by the relative proportion of pectoral fin length and depth at orbit in standard length, and the colour of dorsal fin irrespective of the size of fish within the limits given in this study.

SUMMARY

The occurrence of a second species, *C. nudus* Swainson, along with *C. dorab* (Forskål), in the Indian Seas has been re-established by the present study. Out of several morphological, morphometric and meristic characters analysed to distinguish the two species, three characters, viz., the relative proportion of pectoral fin length and depth at orbit in standard length, and the colour of dorsal fin have been found to be most reliable.

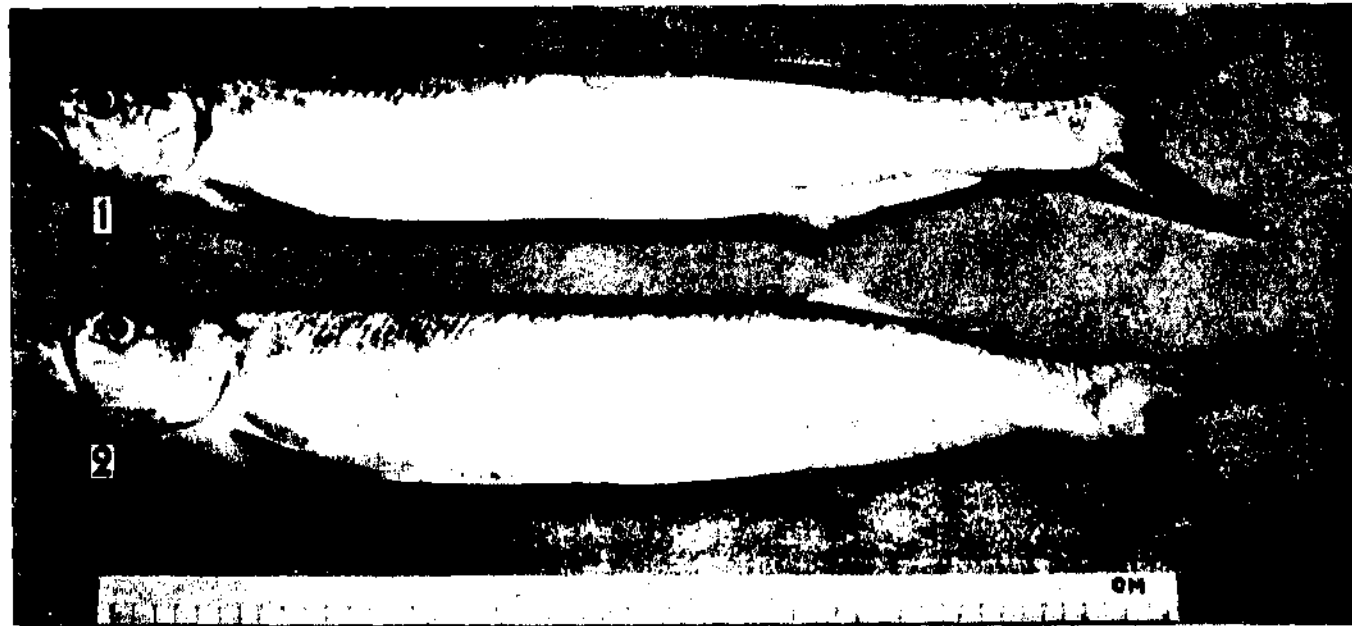


FIG. 1. *Chirocentrus dorab* (Forskål). FIG. 2. *Chirocentrus nudus* Swainson.

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