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Specific Characters of Three Sparid Fishes Referred to the Genus *Chrysophrys* in the Indo-Pacific

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Abstract The four species of sea-bream referred to the genus *Chrysophrys* in the Indo-Pacific area have been treated in the state of a confusion as to their generic and specific characters. In the present study dealing with the three species, *C. unicolor* from West Australia, *C. auratus* from New Zealand and *C. major* from Japan totalling 137 specimens, it was clarified that the three species are distinct from each other: They are distinguished by the length of head and the distance from the tip of snout to the origin of the first dorsal. The skull of these species also showed a clear specific difference especially in the following features: the growth stages when the frontals fuse; the portion and shape of the thickening of the supraoccipital.

Introduction

The fishes referred to the genus *Chrysophrys* are widely distributed in the tropical and subtropical waters in the Indo-Pacific, commercially fished by trawling, bottom long-line and other gear, and usually highly valued in these waters. The accurate identification of the species in the genus, thus, is needed not only in ichthyological research but also for the rational exploitation of the species.

It was pointed out by Whitley (1931) that *Chrysophrys major* Temminck and Schlegel from Japan, *C. auratus* (Bloch and Schneider) from New Zealand, *C. unicolor* Quoy and Gaimard from West Australia and *C. guttulatus* (Cuvier and Valenciennes) from East Australia will be referred to one genus, which is distinguished from other sparid genera of the Indian and Pacific Oceans on the basis of the differences in the shape of teeth and coloration. Fowler (1933) regarded *C. unicolor* and *C. guttulatus* as synonymous of *C. auratus*, believing the genus *Chrysophrys* in Australian waters represented by single species, namely *auratus* (Bloch and Schneider). He also united *C. auratus* with *C. major* of Japan claiming the latter as a geographical variety. The present status, as derived by a number of studies conducted, is that *C. major* at any rate is very close to *C. auratus*. The present study was attempted to clarify the specificity of these two forms in conjunction with another subtropical species *C. unicolor*, which is also closely related to the formers, under a critical study of morphometry and meristic counts on the specimens totalling 137 collected in the three waters where respective species is distributed. Also, osteological anatomy of the species was attempted to substantiate the studies on external characters.

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Material and methods

The materials examined in the present study are shown in Table 1. The specimens of *C. major* were measured in fresh condition, but others from West Australia and New Zealand were measured after two or three months preservation in frozen condition.

Jordan & Fesler (1893), Fowler (1933 and 1936), Smith (1938) and Akazaki (1962) adopted external several characters for the comparison of these species. In the present work, the characters that are not easily affected or destroyed by freezing were chosen with due consideration for specific comparison.

As the characters which are used commonly and can be measured after defrosting, the following 13 external body parts were selected for measurement and counting: 1) body length (B.L.), 2) body height (B.H.), 3) head length (H.L.), 4) snout length (S.L.), 5) eye diameter (E.D.), 6) number of dorsal fin rays, 7) number of anal fin rays, 8) number of pectoral fin rays, 9) number of pored scales on the lateral line (L.l.), 10) number of scales in oblique series, counted from the origin of dorsal fin as well as the number of scales from the origin of anal fin to lateral line (l.tr.), 11) number of gill rakers, counted on the upper and lower gill arch of the left side, the gill raker on the joint of the upper and lower gill arches included in the count of the latter, 12) number of rows of cheek scales, counted from the lower edge of the eye to the posterior edge of the preoperculum, 13) number of canines on the upper and lower jaws. In addition the following characters were also examined: 1) distance from the tip of snout to the origin of dorsal fin, 2) distance from the tip of snout to the end of dorsal fin base, 3) distance from the tip of snout to the upper insertion of pectoral fin, 4) distance from the tip of snout to the origin of anal fin, 5) distance from the tip of snout to the end of anal fin base, 6) distance from the tip of snout to the outer insertion of pelvic fin. The methods of measurement were taken from Matsubara (1963, p. 60). Together with these, the skull, especially on the frontal bone, and vertebrae were also examined.

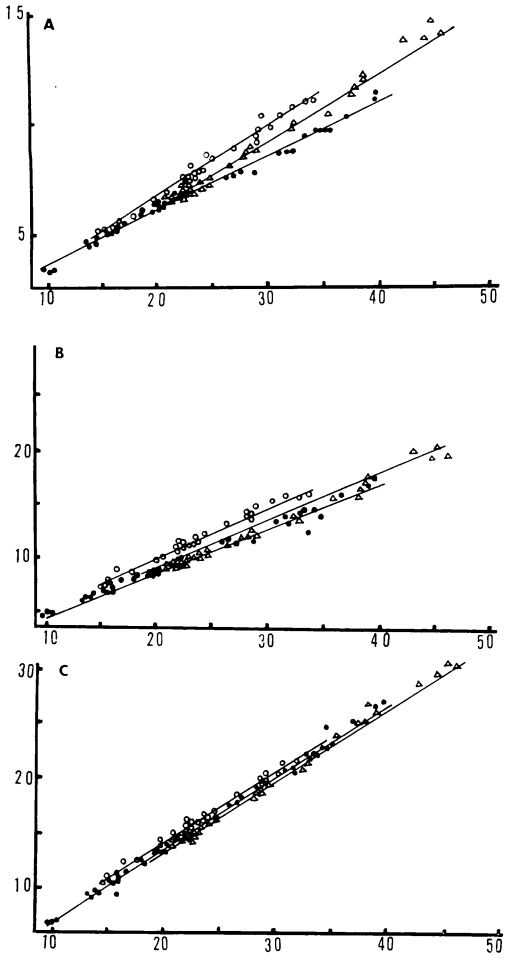
Results

1. Coloration.

The ground color in the three species is generally reddish pink on the dorsal side and silvery white on the belly, and a few series of bluish green spots, almost as large as scales, run longitudinally on both sides of the body, and these spots fade to whitish as soon as the fish is defrosted. In *C. auratus*, of about 200 mm in body length, a few vertical reddish bands appear, resembling those of the young of *C. major*; the membrane of the dorsal fin of *C. auratus* is brownish with a few translucent blotches. Distal margin of the caudal fin is

Table 1. Record of collection of three sparid species studied.

Species	Locality	Station	Date	No. of samples examined	Range and mean of body length (mm)
Chrysophrys major	Shimoda, Japan		July 23rd '66–Aug. 11th '67	80	75–322 (288)
C. unicolor	West Australia	25°30′– 26°00′S. 112°30′–113°00′E.	June 4th '67	27	149–337 (246)
		Near Shark Bay	Feb. '64		
C. auratus	Northwest New Zealand	37°30′– 37°40′S. 174°40′–174°50′E.	Sept. 11th '67	30	204–462 (338)
		38°50′– 39°00′S. 174°30′–174°40′E.	Oct. 2nd '67		



characteristically black in all the three species.

2. External characters.

The results of morphometrical measurements and meristic counts are shown in Table 2. As shown in the table, it may be noted that these species are closely related to one another with respect to all those characters which are customarily used for the separation of these species. Also, the distance from the tip of snout to the origin of anal fin (Fig. 1–C) does not show specificity of these fishes; the distance from the tip of snout to the origin of the dorsal fin (Fig. 1–B) appears to show though slightly a specific difference. The head length as shown in Fig. 1–A is believed to be specifically differentiated in the fishes measuring 25 cm and larger in body length. The morphometrical and meristic characters, as presented above, are therefore may not be highly evaluated as specific characters for the identification of these species dealt with. The length of dorsal and anal spines, which were claimed by Akazaki (1962) to show the specific differences between

Fig. 1. Relation between the body length (abscissa) and three body parts (A. Head length; B. Distance from the tip of snout to the origin of dorsal fin; C. Distance from the tip of snout to the origin of anal fin) in three species of *Chrysophrys*: dots, *C. major*; circles, *C. unicolor*; triangles, *C. auratus*. All the measurement are given in cm.

Table 2. Morphometry and meristic characters of three species of *Chrysophrys*: figures show the range and in parentheses the mean. See text for the methods of measurement and counting.

	C. major	*C. unicolor*	*C. auratus*
B.L./H.L.	3.00–3.28 (3.14)	2.75–3.09 (2.95)	3.05–3.38 (3.23)
B.L./B.H.	2.18–2.68 (2.39)	2.03–2.30 (2.14)	2.16–2.50 (2.29)
H.L./S.L.	2.34–3.10 (2.59)	2.10–2.52 (2.32)	2.19–2.59 (2.41)
S.L./E.D.	1.13–1.82 (1.41)	1.38–1.85 (1.65)	1.37–2.06 (1.62)
H.L./E.D.	3.14–4.11 (3.56)	3.17–4.15 (3.83)	3.37–4.86 (3.89)
D	XII, 10	XII, 10	XII, 9–10
A	III, 8	III, 8	III, 8– 9
P	15–16	15–16	15–16
L.l.	54–60 (55)	52–58 (54)	52–59 (54)
L.tr.	6–8/14–16	8–10/16–18	9–12/16–18
No. of rows of cheek scales	5	5	5
No. of gill rakers	6–8+10–11	6–8+9–12	7–8+9–10
Canine	4/6	4/6	4/6
Length of pedicel and premaxillary ramus	equal	equal	equal

Table 3. Comparison of osteological characters in three species of *Chrysophrys*.

Species	Stage	Interorbital region	Nape and occiput	Frontals	Supraoccipital	Haemal spines
C. major	Adult	Slightly gibbous.	Nape gibbous or not.	Fused; with a few small holes in pair on smooth surface. Gibbous anteriorly.	Base swelled into a "bump".	Middle of some spines globose.*
	Young	Not gibbous.	Not gibbous.	Separated up to 200 mm in body length. With a few small holes in pair and longitudinal grooves. Concave anteriorly.	*Ditto.*	Normal, with no globose spine.
C. unicolor	Adult	Slightly gibbous.	Occiput gibbous or not.	Fused; with a few small holes in pair on smooth surface. Gibbous anteriorly.	Thickened toward dorsal edge.	Middle part of 6th–8th spines globose.
	Young	Not gibbous.	Not gibbous.	Separated up to 170 mm in body length. With a few small holes in pair and longitudinal grooves. Concave anteriorly.	*Ditto.*	Middle part of 6th–8th spines globose above 160 mm in body length.
C. auratus	Adult	Slightly gibbous.	Occiput gibbous or not.	Fused; with a few small holes in pair on smooth surface. Gibbous anteriorly.	*Ditto.*	Middle part of 6th–8th spines globose.
	Young	Not gibbous.	Not gibbous.	Separated or fused up to 200–250 mm in body length. With a few small holes in pair and longitudinal grooves. Concave anteriorly.	*Ditto.*	Middle part of 6th–8th spines globose above 200 mm in body length.

* Personal communication from Prof. Takashi Hibiya, The University of Tokyo.

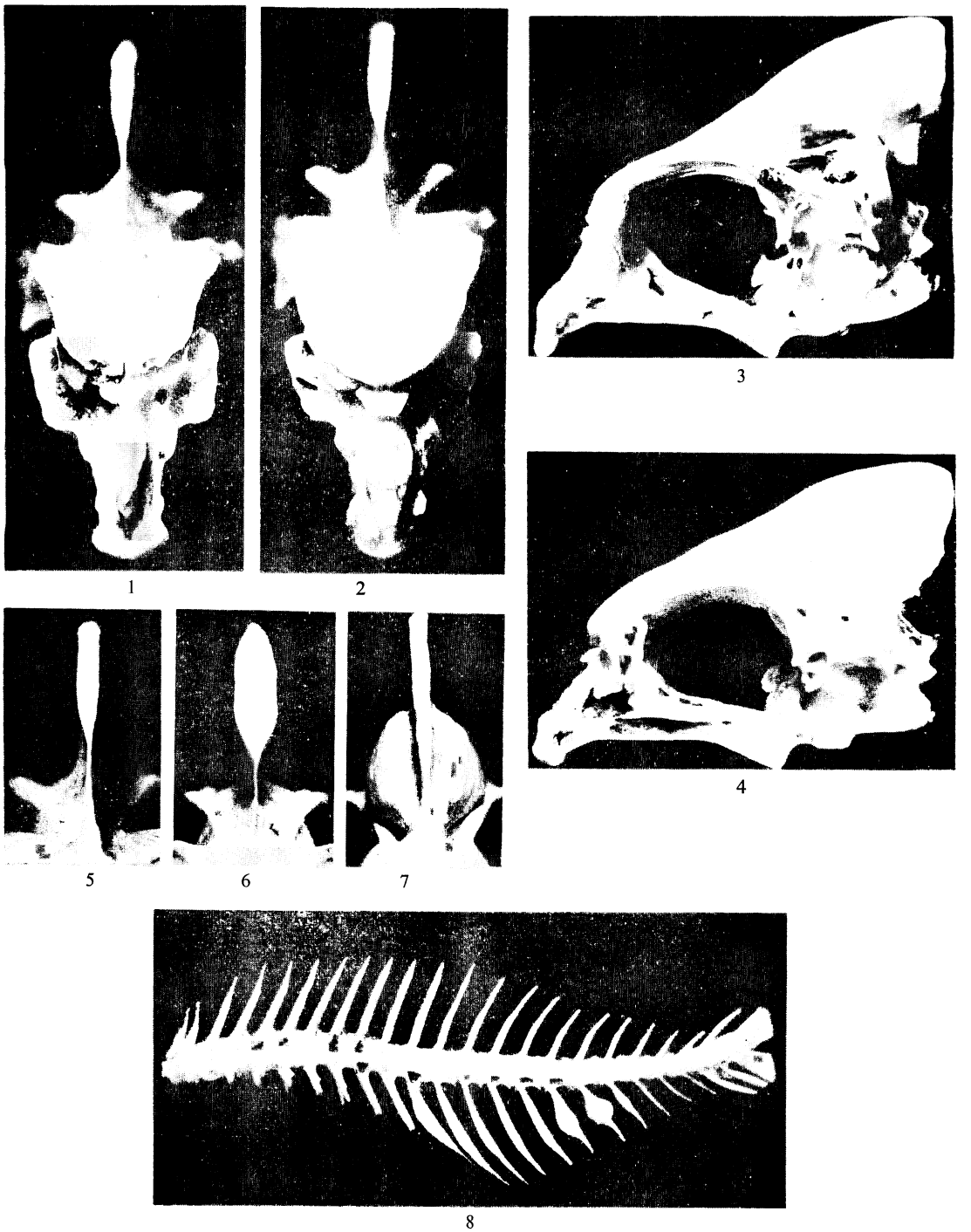


Fig. 2. Skulls and vertebral bones in three species of *Chrysophrys*. 1. Dorsal view of skull of *C. auratus* (255 mm in body length); 2. The same (398 mm); 3. Lateral view of the same (255 mm); 4. The same (398 mm); 5. Dorsal view of supraoccipital of the same (398 mm); 6. The same of *C. unicolor* (228 mm); 7. The same of *C. major* (289 mm); 8. Vertebral bones of *C. unicolor* (289 mm).

C. major and *C. auratus*, were not dealt with in the present study due to the fact that those spines in some specimens were mutilated by refrigeration or other causes exposing their unsuitability for the study.

3. Internal characters.

The external characters are considered not always satisfactory to discriminate these species from each other, however, internal organs such as skull and vertebrae warranted to show specificity when studied in details. These features are shown in Table 3 and Figure 2.

Skull:—The frontals, as far as the young stage is concerned, are not well differentiated among three species: the bones are separated by a fissure (Fig. 2–1), and its anterior portion is only slightly concave (Fig. 2–3); there are a few small holes in pair, and bear longitudinal small grooves anteriorly. With the growth of fish, though retaining small holes in pair, the frontals are "fused" with each other and become gibbous with smooth surface (Figs. 2–2 and 4). The occurence of the change from the separated to "fused" condition of the frontals is seen in different stages of growth among three species, 170 mm (body length) in *C. unicolor*, 200 mm in *C. major* and 200–250 mm in *C. auratus*.

The supraoccipital is highly differentiated in *C. major* (Fig. 2–7) where the lower or ventral part is swelled into a "bumpy" growth especially in adult fishes, while, in *C. unicolor* and *C. auratus* such swelling does not develope at all, but, the dorsal edge of the bone is thickened though its shape is different between the two species (compare 5 and 6 in Fig. 2). Also, the growth of the thickening of dorsal edge of the supraoccipital starts in different stages of fish, 170 mm (body length) in *C. unicolor* and 200 mm in *C. auratus*, the size corresponding to that for the fusion of the frontals in the respective species.

The dimension of the premaxillary and the angle of the premaxillary pedicel and premaxillary ramus meet are nearly equal among the three species studied.

Vertabrae:—The middle part of 6th to 8th caudal haemal spines is globular (Fig. 2–8) in the two species (*C. unicolor* and *C. auratus*), which, however, shows neither relationship with external appearance of the occiput nor with sexes. In *C. major*, in which the globes also develope and more often in larger females of full grown stage (personal communication from Professor Takashi Hibiya of The University of Tokyo), but not in the young, nor in the adult specimens the authors studied. This globular growth on the spines was noticed in specimens around 160 mm and larger (body length) in *C. unicolor* and over 200 mm in *C. auratus*.

Discussion

Recently Akazaki (1962), working on *Pagrus pagrus* (Linné) from Europe, *Pagrus auratus* (Bloch and Schneider) from Australia and *Pagrus major* (Temminck and Schlegel) from Japan, stated that all these three species should be placed under the genus *Pagrus*. Also, he considered that *P. auratus* and *P. major* are separable in the gibbousness of the nape and a few other characters such as the length of the first dorsal and anal spine as well as the suborbital width, but claiming the relation of the two forms as geographical varieties though retaining his statement tentative. The same author, further, suggested that *P. unicolor* of West Australia, *P. guttulatus* of East Australia and *P. auratus* of New Zealand could be treated as a single species.

The present authors (1969) separated the genus *Chrysophrys* from *Pagrus* in the osteological characters, and the rejection of the genus *Chrysophrys* can not be accepted according to our studies. It has been expressed by a number of researchers that three species from Australia and New Zealand (*C. unicolor*, *C. guttulatus* and *C. auratus*) can be represented by a single species, *C. auratus*, and *C. major* was recognized merely as a variety in *C. auratus* complex.

The present study, dealing with three out of four species of *Chrysophrys* in the Indo-Pacific, is believed to have demonstrated the

specific characters of each form, and the osteological characters especially presented a solid and stable evidence.

Marked differences were found in the supraoccipital, which may be treated as one of the stable characters for comparison of the species studied here.

The swelling at the base of supraoccipital of *C. major* has been reported by a number of researchers such as Jordan and Thompson (1912), Tomiyama (1931), Hotta (1961) and others; while the thickening of dorsal edge of supraoccipital of *Pagrosomus auratus* (=*C. auratus*) has been reported by Jordan and Thompson (1912), who interpreted that the thickening of supraoccipital is evidently due to hyperostosis with age, but it was found in the present study that the thickening of supraoccipital even in the specimens of considerably small size. Therefore, it is apparent that the thickening in this bone is not merely due to hyperostosis with age, but rather a specific character.

Considering the above fact, the differences between *C. major* and the other two, *C. unicolor* and *C. auratus* is not a mere geographical variation, because significant differences are existing in some of the stable characters. Therefore, the authors consider that each of these forms can be ranked as separate species.

According to Whitley (1931) the sparid fishes referred to the genus *Chrysophrys* are represented by four species in the waters of Japan, Australia and New Zealand, but it is anticipated that other species in the genus may be found in the intervening seas between the two regions when the extentive collection of the fishes will be attempted covering the whole area.

Literature cited

Akazaki, M. 1962. Studies on the spariform fishes.—Anatomy, phylogeny, ecology and taxonomy. (Mimeograph in Japanese with English note). Misaki Mar. Biol. Inst. Kyoto Univ. Spec. Rep., 1: 1–368, figs. 1–58.

Fowler, H. W. 1933. Fishes of Philippines and adjacent seas. Bull. U.S. Nat. Mus., 100 (12): 1–465, figs. 1–32.

Fowler, H. W. 1936. The marine fishes of West Africa. Amer. Mus. Nat. Hist., 12(2): 607–1493, figs. 276–567.

Hotta, H. 1961. Comparative study of the axial skeleton of Japanese teleostei. (in Japanese). Nippon Gyogaku Shinkokai.: 1–146, figs. 1–205.

Jordan, D. S. and P. Fesler. 1893. A review of the sparoid fihses of America and Europe. Rept. Comm. 1889 to 1891, Part 17: 421–544, pls. 28–62.

Jordan, D. S. and W. F. Thompson. 1912. A review of the Sparidae and related families of perch like fishes found in the waters of Japan. Proc. U. S. Nat. Mus., 41 (1875): 521–601.

Matsubara, K. 1955. Fish, morphology and hierarchy. (in Japanese). Ishizaki Shoten, Tokyo. Part 1–3: 1–1605, pls. 1–135.

Smith, J. L. B. 1938. The South African fishes of the families Sparidae and Denticidae. Trans. Roy. Soc. South Africa, 26(3): 225–305.

Tomiyama, I. 1931. Comparative studies on the opisthotic bone of Sparidae. Jour. Fac. Sci. Imp. Univ. Tokyo, Sec. 4, 2(4): 309–317, figs. 1–9.

Whitley, G. P. 1931. New names for Australian fishes. Aust. Zool., 6(4): 310–334. pls. 25–27.

Yasuda, F. and Mizuguchi, K. 1969. A study on the osteological characters of six sparid fishes referred to the genera *Chrysophrys* and *Pagrus*. Jpn. J. Ichthy., 16(1): 31–34, fig. 1.

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インド・太平洋産マダイ属3種の種の特徴について

安田富士郎・水口憲哉. マダイ属に属する4種，日本産の *Chrysophrys major*，西部オーストラリヤ産の *C. unicolor*，東部オーストラリヤ産の *C. guttulatus* 及びニュージーランド産の *C. auratus* については従来多くの研究者によりその近似性が論じられてきた．本報告は *C. major*, *C. unicolor* 及び *C. auratus* の3種について外部及び内部形態を比較検討したが，外部形態では多くの形質は差が小さく，体長に対する頭長を除いては，種の決定の助けとなる明瞭な差は見られなかった．しかし，頭骨の比較において，オーストラリヤ及びニュージーランド産の *C. unicolor* と *C. auratus* では上後頭骨の背縁が肥厚するのに対し，日本産の *C. major* では基部が著しく肥厚することが判明し，前二者とは明瞭な区別が行なえた．また，*C. unicolor* と *C. auratus* では，少くとも成魚においては頭長と上後頭骨背縁の肥厚部の形態に差異のあることがわかった．

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