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On the identity of *Culter oxycephalus* (Teleostei, Cypriniforms, Xenocyprididae), with notes on the validity of eight cultrin fish species from East Asia

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Abstract

The identification problems of cultrin fish species from East Asia are discussed. *Culter oxycephalus* Bleeker, 1871 is found to be a senior synonym of *Culter oxycephaloides* Kreyenberg & Pappenheim, 1908 and is redescribed. *Culter abramoides* Dybowski, 1872 is a senior synonym of *Erythroculter dabryi shinkainensis* Yi & Zhu, 1959. Examination of three specimens identified as *Erythroculter recurviceps* and *Culter oxycephalus* by John Treadwell Nichols was found to be in error. Based on the data obtained during the field survey and coupled with known literature and the latest taxonomic development of relevant taxa, there are five and six cultrin fishes in Lake Dongting and Lake Xingkai, respectively, namely the Bream-shaped Culter *Chanodichthys abramoides*, Dabry's Culter *Chanodichthys dabryi*, Topmouth Culter *Chanodichthys erthropterus*, Mongolian Culter *Chanodichthys mongolicus*, Sharphead Culter *Chanodichthys oxycephalus*, Predatory Culter *Culter alburnus* and *Culter compressocorpus*. This study clarifies the interrelationships between *Chanodichthys oxycephalus* and *Chanodichthys oxycephaloides*, and taxonomically explains the absence of records of the Sharphead Culter for more than half a century. We also report six cultrin fishes distributing in the Heilong-Jiang basin of China: *Chanodichthys abramoides*, *Ch. dabryi*, *Ch. erythropterus*, *Ch. mongolicus*, *Culter alburnus* and *C. compressocorpus*.

Key words

Taxonomy; Morphological character; Species and distribution; *Culter*; *Chanodichthys*

Introduction

Cultrin fishes of the genus *Chanodichthys* and *Culter* belong to the family Xenocyprididae (Cypriniformes) (Fricke *et al.* 2024), and constitute an important part of this endemic carp family of East Asia (Chen *et al.,* 2022a). Both genera are widely distributed in Russia, Korea Peninsula, Vietnam, and throughout China, except the Tibetan Plateau (Xiong *et al.*, 2019). Most species of this group are common fishes in rivers and lakes and have an important economic value (Peng *et al.*, 2009; Wang *et al.*, 2017). The vast majority of the cultrin fishes of the Xenocyprididae belongs to East Asian taxa with a relatively short evolutionary history (about 12 Myr), and the phylogenetic relationships among them are still unclear (Chen *et al.*, 1998).

Previous studies on cultrin fishes are numerous, but mainly focused on the taxonomy of the genera *Chanodichthys* and *Culter*, e.g., Bleeker (1871b); Berg (1934); Smith (1938); Myer (1940); Yi and Zhu (1959); Bănărescu (1967a); Li (1992); Luo (1994); Luo and Yue (1996); as well as studies on basic biology and population dynamics, e.g., Chen (1959); Yang *et al.* (2009); Duan *et al.* (2015); Hu *et al.* (2015); Wang *et al.* (2016); Wang *et al.* (2017); Lin *et al.* (2021). Phylogenetic studies of the traditional subfamily Cultrinae suggest that the current classification system of this subfamily may be inaccurate (Wang, 2007; Tang *et al.,* 2013; Chen *et al.*, 2022a).

Previous studies on the genera *Chanodichthys* Bleeker, 1860 and *Culter* Basilewsky, 1855, such as Huang *et al.* (2005); Feng *et al.* (2008); Feng *et al.* (2009); Peng *et al.* (2009), have mainly focused on a few species, such as Dabry's Culter (*Chanodichthys dabryi*), Mongolian Culter (*Chanodichthys mongolicus*), Topmouth Culter (*Chanodichthys erthropterus*), and Predatory Culter (*Culter alburnus*). Other cultrin fish species have received less attention, and the related studies basically remained at the population level (Liu and Yang, 2014; Xu *et al.,* 2014; Zhang *et al.*, 2014; Yang *et al.,* 2016; Xiang *et al.*, 2021), examples are studies on Hainan Culter, Shinkai Dabry's Culter and Sharphead Culter. Especially for the Sharphead Culter (*Chanodichthys oxycephalus*), relevant records are scarce after Bleeker's (1871a) original description. The available records can be divided into two parts, one consists of generalized summaries of historical literature, such as Sauvage and Dabry de Thiersant (1874); Nichols (1943); Wu (1964); Zhang and Zhao (2016); and the other part consists of ecological surveys that lack a taxonomic scrutiny, such as Zhang (2007); Tang *et al.* (2011); Tang *et al.* (2015); Yang *et al.* (2022). During this period there have been published some taxonomic studies involving the Sharphead Culter with different conclusions, such as Bogutskaya and Naseka (2004); Zhang *et al.* (2008); Kottelat (2013) and Wang *et al.* (2019).

Recent studies on cultrin fishes, e.g., Kottelat (2013) and Chen *et al.* (2022b) suggest that the genus *Culter* Bleeker, 1860, consists of two species, *Culter alburnus* Basilewsky, 1855 and *Culter compressocorpus* Yi & Zhu, 1959 (authors also seen as Yih & Chu) (Fricke *et al.* 2024). All other species formerly included in the genus *Culter* should be placed in the genus *Chanodichthys* Basilewsky, 1855.

To investigate the problem of the validity of several cultrin fish species, we collected fishes in various waters of the Yangtze River (= Chang-Jiang in Chinese) basin. We collected 103 specimens provisionally identified as *Chanodichthys oxycephalus* and / or *Chanodichthys oxycephaloides*. We also reviewed the curated specimens (71 ind.) from other basins (Heilong-Jiang, Lake Xingkai) to clarify the relationship between *Chanodichthys oxycephalus* and *Ch. oxycephaloides*, and we tried to give a taxonomically rational explanation for the lack of official records of the Sharphead Culter for more than 60 years. This study once again revealed and emphasized the importance of reviewing type specimens and consulting the literature with the original descriptions.

Material and methods

Specimen sampling and preservation

Specimens utilised for this study were sampled in accordance with the Chinese

84 Laboratory Animal Welfare and Ethics animal welfare laws (GB / T 35892–2018). After being anaesthetised, all captured individuals were fixed by immersion in ethanol or formalin. Specimens were collected using gill nets, trap nets and electrofishing. Caught specimens of cultrin fishes were stored in 10% formalin for morphological examination. The voucher specimens are deposited in the collection of the Museum of Aquatic Organisms at the Institute of Hydrobiology (IHB), Chinese Academy of Sciences (CAS).

Morphological analysis

Measurements were taken point to point (schematic picture see **Fig. 1**) with a digital caliper connected directly to a data-recording computer and data recorded to the nearest 0.1 mm. Measurements were taken on the left side of specimens whenever possible, following methods used by Kottelat (2001) and Song *et al.* (2018). The head length and measurements of other parts of the body are given as percentages of standard length (SL). Measurements of parts of the head are given as proportions of the head length (HL) (**Tables 1, 2**). The counts of vertebrae were taken from radiographs of Micro-CT or X-rays. The specimens examined in this study are deposited in the collections of: **AMNH** American Museum of Natural History, New York; **IBTS** Taxonomy Research Group, Research Centres in Biology Field, University of Bucharest, Tr. Savulescu, Bucharest, Romania; **IHB** Institute of Hydrobiology, Wuhan, China; **MCZ** Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; **MHNL** Muséum d'histoire naturelle de Lyon, Lyon; **MNHN** Muséum National d'Histoire Naturelle, Paris; **ZIN** Zoological Institute of the Russian Academy of Sciences, St. Petersburg; **ZMB** Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science, Berlin; **ZMFMIB** Zoologial Museum, Fan Memorial Institute of Biology, Tsinghua University, Beijing, China (now in **ASIZB**).

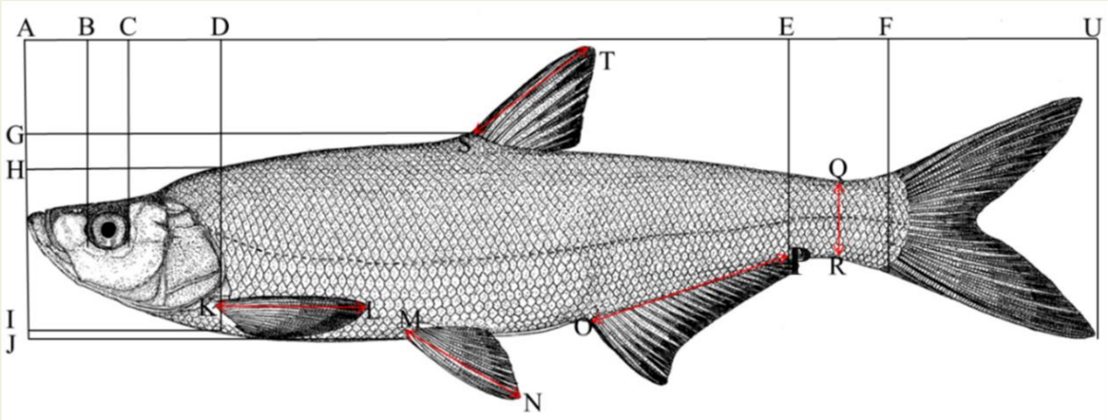

Fig. 1 Schematic picture of a cultrin fish (Illustrated by Zhi-Xian Sun). A-F: Standard length (SL: mm); A-U: Total length; A-B: Snout length; B-C: Eye diameter; A-D: Head length; H-I: Head depth; G-J: Body depth; E-F: Caudal peduncle length; Q-R: Caudal peduncle depth; K-L: Pectoral length; M-N: Pelvic length; O-P: Anal length; S-T: Dorsal length.

Table 1. Morphometry of *Chanodichthys oxycephalus*. Measurements are in percentage of standard length, except for standard length (SL). SD: standard deviation; r: Pearson's correlation coefficient; p: significance; linear regression parameters calculated from measurements.

Measurements	N	Min	Max	Mean	SD	slope (b)	intercept (a)	r (SL)	p
SL (mm)	30	66.71	236.74	136.88	52.43				
Snout length	30	4.67	17.55	10.38	3.89	13.36	-1.75	0.99	<0.01
Eye diameter	30	4.41	10.88	7.33	1.92	26.91	-60.39	0.99	<0.01
Head length	30	17.00	59.69	36.43	13.33	3.91	-5.62	0.99	<0.01
Eye depth	30	1.38	9.45	4.86	2.29	22.31	28.51	0.97	<0.01

Eye-Head depth	30	7.11	24.02	13.26	4.88	10.60	-3.66	0.99	<0.01
Head depth	30	9.82	32.65	18.66	7.05	7.40	-1.30	1.00	<0.01
Body depth	30	15.19	69.94	35.65	16.04	3.24	21.45	0.99	<0.01
Caudal peduncle length	30	8.96	26.66	15.86	5.23	9.49	-13.63	0.95	<0.01
Caudal peduncle depth	30	6.03	25.84	12.45	6.08	8.39	32.43	0.97	<0.01
Pectoral length	30	11.47	47.74	23.02	10.50	4.82	25.94	0.96	<0.01
Pectoral height	30	2.99	12.64	6.74	3.09	16.07	28.54	0.95	<0.01
Pectoral-Body depth	30	12.98	57.13	28.92	12.88	4.00	21.19	0.98	<0.01
Pelvic length	30	8.82	42.46	20.59	9.64	5.33	27.19	0.98	<0.01
Anal length	30	8.68	29.44	16.88	6.73	7.72	6.66	0.99	<0.01
Dorsal length	30	13.87	41.09	28.21	8.87	5.57	-20.17	0.94	<0.01
Mouth depth	30	3.57	11.26	5.48	2.28	18.35	36.40	0.80	<0.01
Mouth width	30	4.05	15.07	8.59	3.32	15.67	2.34	0.99	<0.01
Head width	30	6.49	24.23	13.27	5.36	9.69	8.27	0.99	<0.01

Body width	30	5.49	28.19	13.24	6.61	7.76	34.19	0.98	<0.01

Table 2. Morphometric measurements for four cultrin fishes: *Chanodichthys abramoides*, *C. dabryi, C. erthropterus* and *C. mongolicus*.

Character	*C. abramoides* (n = 21)		*C. dabryi* (n = 23)		*C. erthropterus* (n = 14)		*C. mongolicus* (n = 13)	
	Range	Mean ±SD	Range	Mean ±SD	Range	Mean ±SD	Range	Mean ±SD
SL (mm)	149.81-270.94	208.63±30.87	73.7-193.48	140.45±34.97	114.22-226.5	148.1±32.01	111.37-282.26	156.59±42.81
Morphometric data								
% of SL								
Body depth	0.26-0.31	0.28±0.02	0.21-0.28	0.24±0.02	0.19-0.24	0.21±0.01	0.22-0.26	0.23±0.01
Body width	0.08-0.1	0.09±0	0.09-0.12	0.1±0.01	0.07-0.09	0.08±0.01	0.08-0.11	0.1±0.01
Caudal peduncle length	0.11-0.14	0.12±0.01	0.08-0.14	0.12±0.02	0.12-0.17	0.14±0.01	0.12-0.16	0.13±0.01
Caudal peduncle depth	0.08-0.11	0.1±0.01	0.08-0.11	0.09±0.01	0.08-0.09	0.08±0	0.08-0.1	0.09±0.01
Pectoral length	0.18-0.22	0.2±0.01	0.18-0.21	0.19±0.01	0.17-0.22	0.19±0.02	0.13-0.19	0.16±0.02
Pectoral position	0.76-0.91	0.84±0.05	0.81-0.95	0.88±0.04	0.77-0.95	0.87±0.05	0.77-0.91	0.84±0.04
Pelvic length	0.16-0.2	0.17±0.01	0.16-0.19	0.17±0.01	0.14-0.18	0.16±0.01	0.12-0.18	0.14±0.01
Anal length	0.22-0.27	0.25±0.02	0.1-0.14	0.12±0.01	0.07-0.15	0.12±0.02	0.08-0.12	0.1±0.01
Dorsal length	0.18-0.23	0.21±0.02	0.14-0.24	0.2±0.02	0.15-0.21	0.18±0.02	0.17-0.23	0.19±0.02
Head length	0.25-0.3	0.27±0.01	0.24-0.27	0.26±0.01	0.23-0.26	0.24±0.01	0.24-0.27	0.26±0.01
% of HL								
Head depth	0.67-0.84	0.8±0.05	0.53-0.64	0.58±0.03	0.52-0.65	0.58±0.03	0.51-0.6	0.55±0.03

Head width	0.34-0.42	0.38±0.02	0.35-0.45	0.39±0.02	0.34-0.42	0.37±0.03	0.37-0.47	0.41±0.03
Snout length	0.26-0.33	0.3±0.02	0.23-0.32	0.28±0.02	0.27-0.33	0.3±0.02	0.26-0.33	0.3±0.02
Eye diameter	0.16-0.36	0.19±0.05	0.18-0.27	0.22±0.03	0.19-0.3	0.23±0.03	0.15-0.25	0.2±0.02
Eye position	0.36-1.96	0.55±0.41	0.16-0.43	0.33±0.05	0.31-0.45	0.39±0.04	0.3-0.42	0.36±0.04
Mouth depth	0.3-0.55	0.35±0.06	0.26-0.4	0.32±0.04	0.26-0.53	0.33±0.07	0.28-0.41	0.33±0.03
Mouth width	0.64-0.88	0.73±0.07	0.52-0.75	0.61±0.05	0.56-0.69	0.62±0.04	0.56-0.66	0.61±0.03
Aspect ratio								
Body aspect ratio	0.29-0.34	0.32±0.02	0.35-0.44	0.39±0.03	0.33-0.42	0.38±0.03	0.35-0.47	0.41±0.04
Caudal peduncle aspect ratio	1.06-1.53	1.26±0.14	0.89-1.59	1.25±0.19	1.46-1.97	1.69±0.16	1.12-1.93	1.45±0.21
Head aspect ratio	0.41-0.55	0.47±0.03	0.58-0.74	0.67±0.04	0.59-0.71	0.64±0.04	0.68-0.79	0.74±0.04
Meristic counts								
Lateral-line scales	64-69	68±0.5	64-70	67±0.7	80-92	85±0.6	69-77	70±0.7
Scale rows above lateral line	12-13	12±0.5	13-14	13±0.5	18-20	19±0.4	13-16	15±0.5
Scale rows below lateral line	8-9	8±0.5	6-7	6±0.5	7-8	7±0.4	6-7	6±0.5
Circumpedun cular scales	20-23	22±0.5	20-22	21±0.5	24-26	25±0.4	22-24	22±0.5

Photographic examination of relevant specimens

Some of specimens utilised by Yi and Zhu (1959), by Bănărescu (1972) and by Luo (1994) in the published taxonomic revisions of the genus *Culter* Basilewsky, 1855, were collected from Lake Dongting, Lake Xingkai and some other waters. These specimens were not extensively examined by Chinese workers when they revised the species of this genus. Because we could not access all those specimens, we inspected photographs of some critical species, including the holotypes of *Culter abramoides* Dybowski, 1872, *C. dabryi* Bleeker, 1871, *C. oxycephalus* Bleeker, 1871, *C. oxycephaloides* Kreyenberg & Pappenheim, 1908 and *Erythroculter dabryi shinkainensis* Yi & Zhu, 1959. We further examined some topotypical specimens.

Culter oxycephalus Bleeker, 1871

Culter oxycephalus was described by Bleeker in 1871 on the basis of a single specimen (SL 290 mm) collected in January 1868 from Yang-tse-kiang (i.e., Yangtze River) by Dabry de Thiersant, a French consular official in China (Luo, 2005; MNHN, 2022). According to Israeli (1989), the consulate where Dabry de Thiersant served during that period was located in Hankau (Hankou), so it is hypothesized that the type locality of *Culter oxycephalus* would be in the Hankou District, Wuhan City, middle Chang-Jiang River mainstream. In this study, we examined the type specimen of the Sharphead Culter (MNHN 0000-5050) by photographs, the lateral-line scales and circumpeduncular scales could not be counted, probably due to the poor preservation quality of the specimen (**Fig. 2a**).

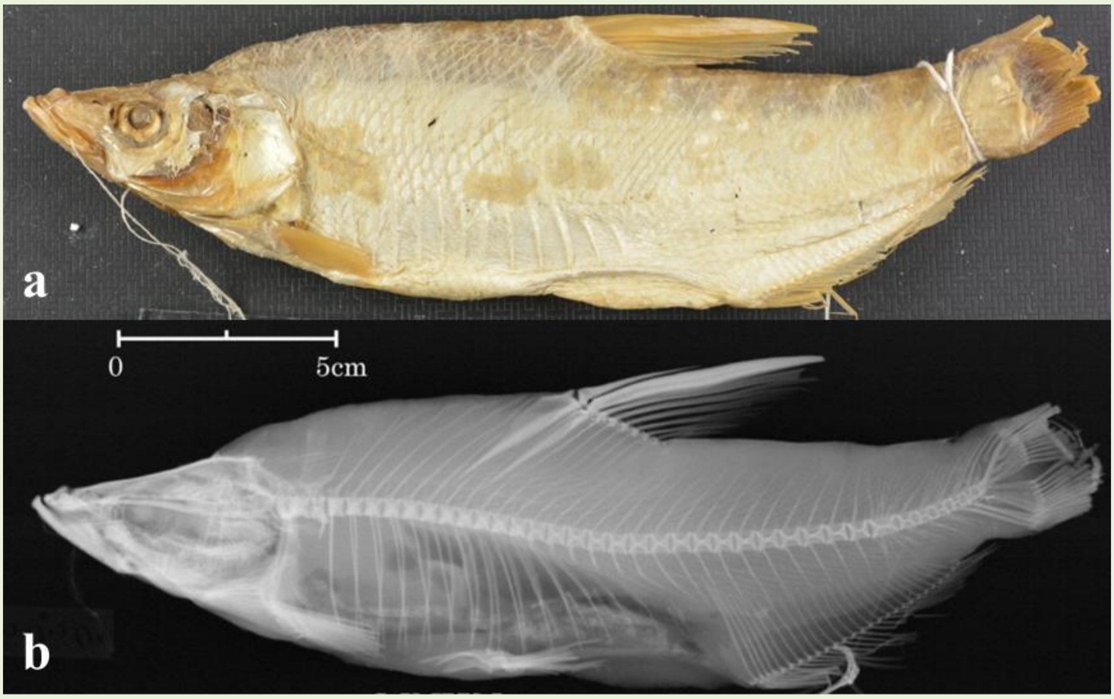

Fig. 2 Lateral view (a) and X-ray (b) of *Culter oxycephalus* Bleeker, 1871 (MNHN 0000-5050), holotype.

Comparing with the type specimen of *C. oxycephaloides* (ZMB 16686, **Fig. 5**), it was found that except for the lateral-line scales and circumpeduncular scales, all other characters (such as the number of anal fin rays and vertebrae) were in agreement with that of *C. oxycephalus*. Therefore, it seems likely that *C. oxycephalus* Bleeker, 1871 is a senior synonym of *Culter oxycephaloides* Kreyenberg & Pappenheim, 1908. Comparing the original descriptions, Kreyenberg and Pappenheim (1908) concluded that the lateral-line scales of *C. oxycephalus* differed significantly from those of *C. oxycephaloides*, and that the differences in other characteristics such as body length / body height or caudal peduncle length / caudal peduncle height were not significant. The large difference in the number of lateral-line scales prompted this study to revisit the original descriptions of these two fishes. The low number of lateral-line scales (65) in Bleeker's (1871a) description and figure (see **Fig. 3**) has led to two hypotheses: (1) the research environment at that time was not concerned with the feature of scales. Wu (1964) already argued that there were inconsistencies in Bleeker's account. (2) the original descriptions were not sufficiently accurate. Yi *et al.* (2011) stated that Bleeker's (1871a) original description looked for evidence from the erroneous scales in Basilewsky's (1855) supplementary illustration. The errors in the accompanying drawings can be seen in several details in the plates, e.g., (a) some fishes with distinct lateral-line scales do not even reflect the lateral line, as in Tab II, *Acanthorhodeus macropterus* [= *Acheilognathus macropterus* (Bleeker, 1871)] or are not clearly defined, as in Tab IV, *Sarcochilichthys sinensis* Bleeker, 1871; (b) the number of lateral lines is clearly wrong in some fishes, e.g., *Hemibarbus dissimilis* (= *Paracanthobrama guichenoti* Bleeker, 1864) in Tab VI, where the number of lateral line is not obvious and incorrect. Furthermore, the scales of cultrin fishes are inherently prone to shedding, which, together with the abnormal condition of a teratological specimen, may result in a low lateral-line scale count.

Fig. 3 A copy of Bleeker's (1871) illustration of the holotype of *Culter oxycephalus*

Berg (1949) incorrectly treated *Culter abramoides* Dybowski, 1872 (type ZMB 7933) from Lake Khanka (i.e., Lake Xingkai / Chanka), Ussuri River, southeastern Russia, as a senior synonym of *Erythroculter oxycephalus* (Bleeker 1871). According to Berg's (1949) description, he did not review the holotype of *Culter oxycephalus* Bleeker, 1871 (nor were the dates correct). Yi and Zhu (1959) assigned the Sharphead Culter to the genus *Culter*, based on the description of the ventral keel by Berg (1909). However, the holotype was not examined, and specimens were assumed that harvested from Lake Xingkai of Ussuri River basin based on the erroneous number of lateral-line scales (65). *Culter abramoides* Dybowski, 1872 was hence synonymized as Sharphead Culter and the outline drawing was provided (**Fig. 4a**), then the distribution of Sharphead Culter was confirmed in Lake Xingkai and Chang-Jiang. In the book "Chinese fishes of Cyprinidae", the fish was supplemented with scales and fins (**Fig. 4b**) (Wu, 1964). Li (1992) agreed with Berg (1909) that the names and type species of the genera *Culter* and *Erythroculter* Berg, 1909, as used by Yi and Wu (1964), were inaccurately recognized, but that statement did not attract more ichthyologists' attention. Luo (1994) considered *Chanodichthys* Bleeker, 1860 to be a junior synonym of *Culter* Basilewsky, 1855 and merged both genera. He also followed Smith's (1938) view to include the species of *Erythoculter* in the genus *Cultrichthys* Smith, 1938; "Fauna Sinica" agreed with this view, while retaining Wu's (1964) figure (**Fig. 4c**) (Chen *et al.*, 1998). Subsequently, most Chinese scholars have used this figure without validation, and the name has appeared in various local ichthyological records, e.g., Ren (1981); Zhang (1995); Guo *et al.* (2021). Bogutskaya and Naseka (1997) considered both *Culter oxycephalus* Bleeker, 1871 and *Culter abramoides* Dybowski, 1872 to be senior synonyms of *Chanodichthys dabryi* (Bleeker, 1871), and a similar point was made by Bănărescu (1967a) and Dyldin *et al.* (2023). Recent studies, e.g., Kottelat (2013) and Chen *et al.* (2022b) suggest that the genus *Cultrichthys* should be restored to *Culter* and only two species are recognized, *Culter alburnus* Basilewsky, 1855 and *Culter compressocorpus* Yi and Zhu, 1959. All other species formerly aligned with the genus *Culter* now belong to the genus *Chanodichthys*, including the fish of our concern: *Chanodichthys oxycephalus*.

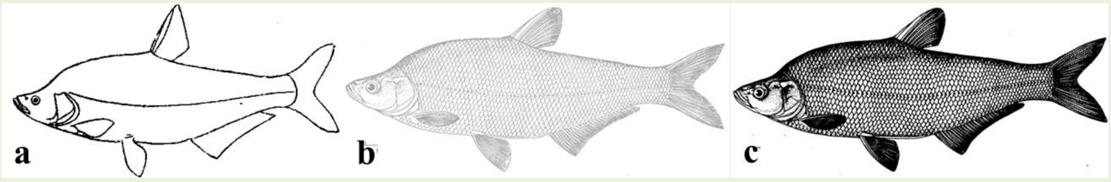

Fig. 4 A copy of Yi and Zhu' (1959) (a), Yi and Wu' (1964) (b) and Chen *et al.*'s (1998) (c) illustrations of *Chanodichthys oxycephalus* (formerly *Culter o.*)

In this study, we examined the holotype (ZMB 7933) of *Culter abramoides* (**Fig. 6**), which has a number of lateral-line scales of 65-66, protruding mandible, significantly longer lower jaw than the upper jaw, dorsal fin sclerotized spine that is approximately equal to head length, and pectoral fin that ends close to or beyond the base of the ventral fin. Except for the characteristics such as the number of lateral-line scales, all the other characteristics of *Culter abramoides* are not consistent with the current concept of *Chanodichthys oxycephalus*. Therefore, this study concludes that the two are not the same species. Three voucher specimens of Sharphead Culter from "Fauna Sinica", taken from Lake Liangzi, Hubei Province and Lake Xiaoxingkai, Heilongjiang Province, were also examined, and showed characteristics diagnostic for *Chanodichthys dabryi* (Bleeker, 1871) and *Chanodichthys abramoides* (Dybowski, 1872), respectively.

Comparison of the holotype characters of *Culter abramoides* Dybowski, 1872

(ZMB 7933, see **Fig. 6**) and *Culter dabryi* Bleeker, 1871 (MNHN 0000-5078, see **Fig. 7**) showed that they were different and should be treated as different species. At the same time, the holotype of *Erythroculter dabryi shinkainensis* Yi and Zhu, 1959 (IHB 58-1558, see **Fig. 8**) was examined, and it was found that shared the following characteristics with *Chanodichthys abramoides*: (1) snout length / head length; (2) relative position of the dorsal and ventral fins; and (3) number of anal fin rays and vertebrae. Therefore, the present study considers *Erythroculter dabryi shinkainensis* Yi and Zhu, 1959 a synonym of *Chanodichthys abramoides* (Dybowski, 1872). Recent studies such as Bogutskaya and Naseka (2004); Bogutskaya *et al.* (2008) and Kottelat (2013) also support the view of the present study. *Erythroculter dabryi shinkainensis* was described as a subspecies of *Chanodichthys dabryi* (Bleeker, 1871) (then in *Erythroculter*, Yi and Zhu, 1959), but the degree of dorsal elevation of the posterior part of the head varies with development, and although the snout length / interorbital distance and body coloration of the two are almost the same, there are some slight differences, such as the anterior end of the upper jaw protruding (vs. no protrusion), the interorbital distance is slightly smaller than the snout length (vs. slightly larger than that), the ventral fins reaching to the beginning of the anal fins (vs. almost reaching to the anus), and the body coloration silvery (vs. dorsal grey-black, abdominal silvery-white), so there are many differences in the geometrical morphological analyses (Zhang *et al.*, 2008). Based on these characteristics, Shinkai Dabry's Culter is considered a synonym of the Bream-shaped Culter *Chanodichthys abramoides*, which is clearly different from Dabry's Culter. Therefore, according to the principle of nomenclatural priority, *Chanodichthys abramoides* (Dybowski, 1872) is the senior synonym of *Erythroculter dabryi shinkainensis* Yi & Zhu, 1959, and *Chanodichthys dabryi* (Bleeker, 1871) is a different valid species.

Culter oxycephaloides Kreyenberg & Pappenheim, 1908

Kreyenberg and Pappenheim (1908) collected one cultrin fish with a relatively pointed head (SL 172 mm) during surveys in Tungtingsee (i.e., Lake Dongting) and considered a new undescribed species. Without examining the holotype of the Sharphead Culter, and only by comparing with its original description, it was concluded that there were morphological differences such as more lateral-line scales (85 vs. 65), more slender body shape (vs. relatively stubby), and more elongated caudal peduncle (vs. relatively stubby) (**Fig. 5**).

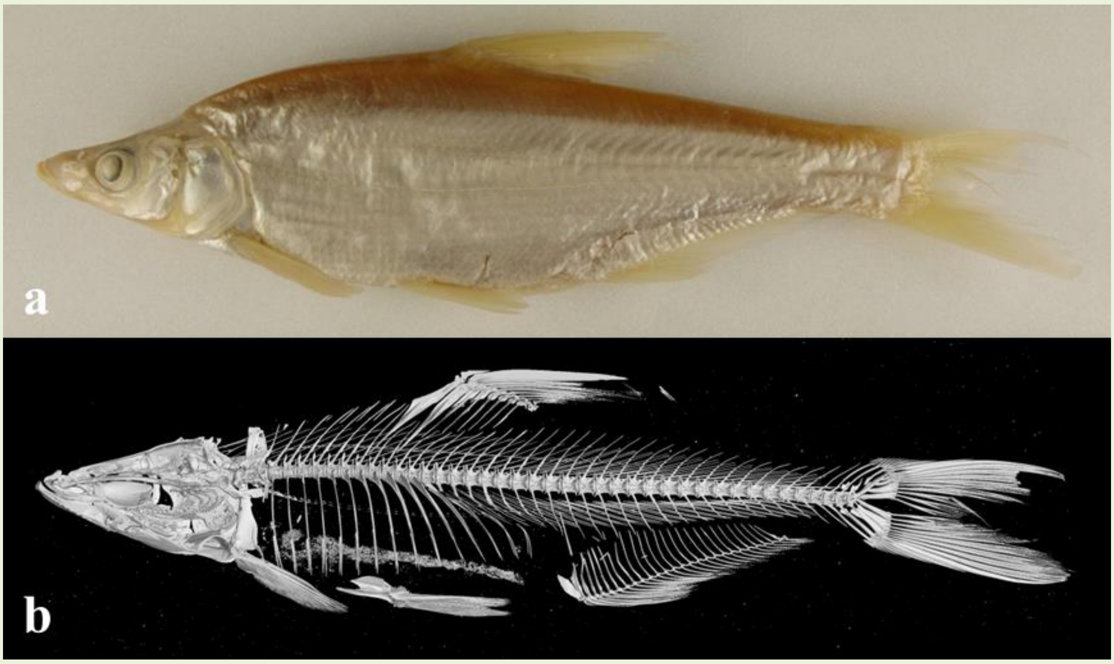

Fig. 5 Lateral view (a) and X-ray (b) of *Culter oxycephaloides* Kreyenberg & Pappenheim, 1908 (ZMB 16686), holotype.

As previously analysed, the original description of the lateral-line scales of *Culter oxycephalus* in Bleeker (1871a) may have been problematic. Yi and Zhu (1959) also provided a sketch of *Culter oxycephaloides* without reviewing the holotype, followed by Yi and Wu (1964); Chen *et al.* (1998) expanded on it. *Culter oxycephalus* is redescribed hereinafter, and *Culter oxycephaloides* is recognized as a junior synonym of *Chanodichthys oxycephalus*.

Culter abramoides Dybowski, 1872

Culter abramoides was described by Dybowski in 1872 on the basis of a single specimen (ZMB 7933, TL 310 mm) collected in 1869 from Ussuri River, Lake Xingkai. Bogutskaya and Naseka (1996) merged *Culter abramoides* Dybowski, 1872 into

Chanodichthys dabryi (Bleeker, 1871). But, as we noted above, both species are valid.

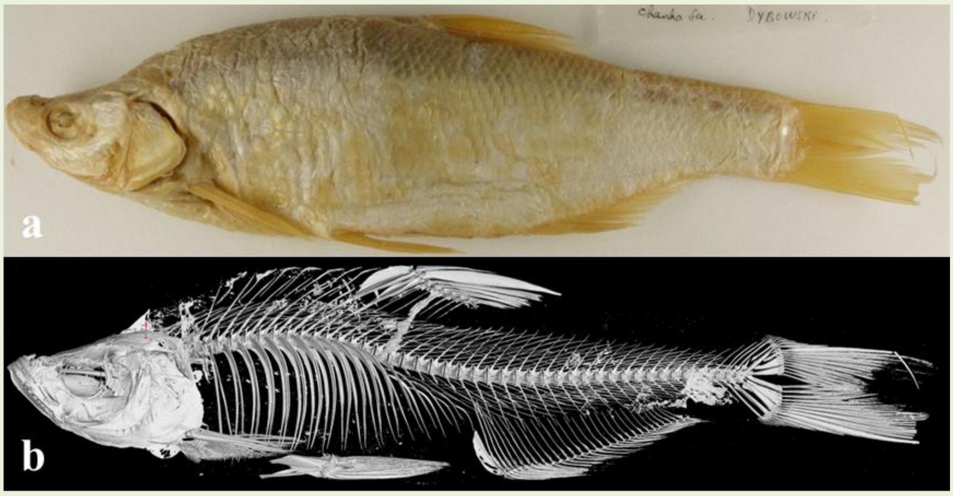

Fig. 6 Lateral view (a) and X-rayed photograph (b) in *Culter abramoides* Dybowski, 1872 (ZMB 7933), holotype.

Culter dabryi Bleeker, 1871

Culter dabryi was also described by Bleeker in 1871 based on a single specimen (MNHN 0000-5078, SL 270 mm) collected in 1868 by Dabry de Thiersant, from Yang-tse-kiang. In accordance with recent taxonomic advances, *Culter dabryi* was formally renamed as *Chanodichthys dabryi* (Bleeker, 1871).

Fig. 7 Lateral view (a) and X-ray (b) of *Culter dabryi* Bleeker, 1871 (MNHN 0000-5078), holotype.

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Erythroculter dabryi shinkainensis Yi and Zhu, 1959

Yi and Zhu (1959) collected 11 and 21 fish from Lake Daxingkai in 1957 and 1958, respectively, i.e., *Erythroculter dabryi shinkainensis* (**Fig. 8**), and the traits of lateral-line scales, gill rakers, and anal fin rays were similar to those of *Culter dabryi*. The difference in body size is remarkable, with extremely bulbous dorsum behind the head and very high body. Body height equals or exceeds head length. The pectoral fins end beyond the base of the ventral fins, and the ventral fins end at the beginning of the anal fins. The caudal peduncle is long. The swim bladder chambers are especially enlarged. As already shown above, *Erythroculter dabryi shinkainensis* should be treated as a junior synonym of *Chanodichthys abramoides* (Dybowski, 1872).

Fig. 8 *Erythroculter dabryi shinkainensis* Syntype IHB 58-1558

Culter hypselonotus Bleeker, 1871

Culter hypselonotus was also described by Bleeker in 1871 on the basis of a single specimen (SL 210 mm) collected from Yang-tse-kiang in 1868 by Dabry de Thiersant. The holotype of *Culter hypselonotus* could not be found (personal communication with MNHN and MHNL). However, based on Bleeker's original description and figure (see **Fig. 9**), the main identifying characters are diagnostic for *Chanodichthys dabryi*, and the present study concludes that the holotype of *Culter hypselonotus* is a specimen of *Chanodichthys dabryi* (Bleeker 1871). This view is in agreement with Bogutskaya *et al.* (1996) and Kottelat (2001).

Fig. 9 A copy of Bleeker's (1871) illustration for *Culter hypselonotus*

Culter pekinensis Basilewsky, 1855

In 1849, the 13th mission from Tsarist Russia came to China. Among them were some enthusiastic museum specimen collectors, such as Stephano Basilewsky, the mission's physician, who collected fish specimens around Beijing. *Culter pekinensis* was described by Basilewsky in 1855 based on a single specimen taken from streams draining to the Gulf of Tschili (today Bohai Bay) from Pekin (i.e., Beijing). The North Canal is the only one of the five major water systems in Beijing that originates in Beijing, so the type locality of this species should be the North Canal. According to Basilewsky's (1855) original description of *Culter pekinensis*, its abdomen (the part in front of the ventral fins) protrudes (abdomen non-compressed, see **Fig. 11b**), which, together with other identifying characters, is believed in this study to diagnose the genus *Chanodichthys*. Kottelat (2006, 2013) considered that it may be a synonym of *Chanodichthys mongolicus* (Basilewsky 1855). Important characteristics are the anterior dorsal fin elevation (anterius elevato = raised in front) and the silvery-gray body / fins (Pinnae albeseentes = whitish fins) in the original text (Basilewsky, 1855). Furthermore, only *C. dabryi*, a common economic fish in Beijing (Wang, 1984; Zhang and Zhao, 2013), was not mentioned. Therefore, this species may be a synonym of *Culter dabryi*. The name *pekinensis* has, evidently priority over *dabryi*. Yet the identification of the first named is not sure (and the locality could be in error), while

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the second is based on a still existing holotype, therefore the name in usage must be retained. The holotype was searched for at the curatorial site, the Russian Academy of Sciences, and may have been lost (pers. comm.), so its validity is open to question and its taxonomic status is provisionally retained here, a synonym of *Chanodichthys mongolicus* (Basilewsky, 1855).

Culter exiquus Basilewsky, 1855

Culter exiquus was originally described by Basilewsky in 1855 on the basis of specimens taken from near Beijing. Bleeker (1871a, b; 1873) considered *Culter exiquus* (he spelled *C. exiguus*) together with *C. pekinensis* to be valid species of the genus *Pseudoculter* Bleeker, 1860. Based on the original descriptions of two species of the genus (*Culter pekinensis* and *Culter exiquus*), they have a non-compressed protruding abdomen (see **Fig. 11b**). In combination with other identifying characters, the present study suggests that both names should be in *Chanodichthys*. This is in agreement with Kottelat's (2013) and Zhang and Zhao's (2016) conclusions. *Exiquus* means small and the specimen may be a juvenile of some cultrin fish. Given the close resemblance to *C. pekinensis* (as already noted by Bleeker), the name could be a synonym of *Chanodichthys mongolicus* (Basilewsky, 1855). The holotype was also searched at the curatorial site, the Russian Academy of Sciences, but it could not be found (pers. comm.), so its validity remains in dispute, and, for the time being, its taxonomic status has to be considered as a Nomen Dubium.

Culter kashinensis Shaw, 1930

Culter kashinensis was originally described by Tsen-Hwang Shaw (i.e., Zhenhuang Shou) in 1930 on the basis of a single specimen taken from Jiaxing City, Zhejiang Province (Shaw, 1930). The species was recorded by Nichols (1943) without comparison. Berg (1949) believed that this species was closely related to *Culter alburnus*. According to its original description and accompanying drawing (see **Fig. 10**), *Culter kashinensis* has angular abdominal ribs extending forward to the base of the pectoral fins (see **Fig. 11a**), mouth terminal, large eye diameter (head length / eye diameter 4.7), small interorbital distance (head length / interorbital distance 3.8), pectoral fins terminating close to the base of the ventral fins, 21 branched anal fin rays, and according to the original author "with some features close to *Erythroculter mongolicus* or *Culter recurviceps*". This is in agreement with Yi and Zhu (1959). It is hypothesized that may be a hybrid of *Chanodichthys mongolicus*, *Chanodichthys recurviceps* or *Culter alburnus* in the present study, and similar circumstances occur in *Leptocephalus mongolicus* Basilewsky, 1855 (Bănărescu, 1967a; 1972). The fish has not been reported since 1930. The holotype ZMFMIB 5120 was attempted to locate at the curatorial site, now ASIZB, but the type was not found (pers. comm.), so its validity is open to question and its taxonomic status is provisionally retained here.

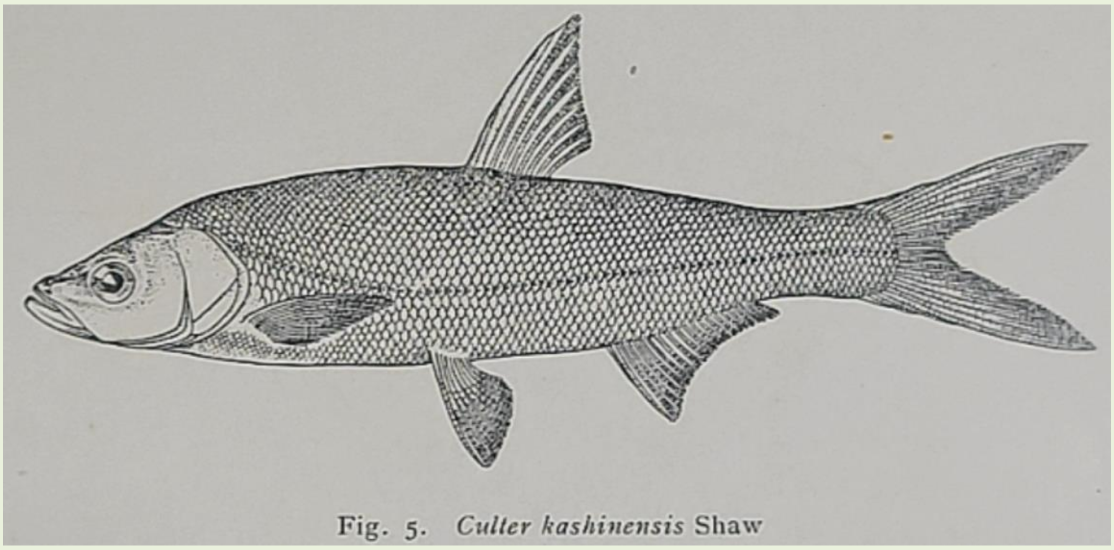

Fig. 10 A copy of Shaw' (1930) illustration of the holotype of *C. kashinensis*.

Results

Redescription of *Chanodichthys oxycephalus* (Bleeker, 1871)

Holotype: *Culter oxycephalus* Bleeker 1871:74, Pl. 5 [Memoire sur les Cyprinoïdes de Chine], China, Chang-Jiang. Appeared first as name only in Bleeker 1870:252, [Mededeeling omtrent eenige nieuwe vischsoorten van China]. Also appeared in Bleeker 1871:87 [Sur les espèces du genre *Culter* Basil.].

Synonym: *Culter oxycephaloides* Kreyenberg & Pappenheim 1908:104 [Ein Beitrag zur Kenntnis der Fische der Jangtze und seiner Zuflüsse] Tungtingsee, southeast central China. Also appeared as new in Kreyenberg 1910:19 [Ein Beitrag zur Kenntniss der Fische der Yangtze und seiner Zuflüsse].

Culter oxycephaloides Kreyenberg & Pappenheim, 1908 Sitz. Ges. Nat. Freunde Berl (4): 104 (Lake Dongting); Yunlin Luo, 1994, Acta Hydrobiologica Sinica 18 (1); 47.

Erythroculter oxycephaloides: Nichols, 1928, Bull. Am. Mus. Nat. Hist. 58: 30 (Lake Dongting); Bolu Yi, Zhirong Zhu, 1959, Acta Hydrobiologica Sinica (2): 87 (Lake Liangzi, Hubei); Bolu Yi, Qingjiang Wu, 1964, Fauna of Cyprinidae China: 103 (Lake Liangzi, Yunxian, Mudong, Hechuan, Hunan).

Culter (*Erythroculter*) *oxycephaloides*: Kimura, 1934, J. Shanghai Sci. Inst. (3) 1: 107 (Chongqing).

Specimens examined

MNHN 0000-5050, 1 holotype, 290mm SL, China: Chang-Jiang (photograph examination); ZMB 16686, 172mm SL, China: Lake Dongting (photograph examination).

IHB 201807055611–5614, 8 specimens, 65.9–122.4 mm SL; China: Hunan Province: Menggu Village, Xiangyin County (28°48'4.88"N, 112°53'28.42"E); collected by X. Chen, C. An, Z. Wang, W. Shao, 5 July 2018. IHB 201805055611–5614, 3 specimens, 65.9–122.4 mm SL; China: Hunan Province: Chenglingji, Yueyang City, Lake Dongting (29°26'9.73"N, 113°08'43.87"E); collected by X. Chen, T. Nguyen Dinh, L. Zhang, 10 May 2018. IHB 201807165611–5614, 4 specimens, 65.9–122.4 mm SL; China: Hunan Province: Hongqihu, Yueyang City, Lake Dongting (29°13'56.86"N, 112°57'11.99"E); collected by X. Chen, L. Cao, L. Qiu, 16 June 2018.

Diagnosis

Chanodichthys oxycephalus is distinct from all other congeneric species, except *C. dabryi* and *C. abramoides*, in having sub-superior and oblique mouth and unbranched anal fin rays 26-29. It differs from these two species in having a red lower lobe of caudal fin, a long and pointed head, and pored scales 73-85.

Description

Morphometric data for type specimens given in **Table 1**. General body appearance

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of holotype shown in **Fig. 2a**. Body elongate, laterally compressed, dorsal bulge behind head, arcuate, abdomen with ventral ribs from ventral fin to anus (**Fig. 11b**), caudal peduncle high. Head small, pointed, laterally compressed, head length less than body height. Snout pointed, snout longer than eye diameter. Mouth sub-superior, slit, mandible slightly longer than maxilla, end of maxilla reaching below nostrils. Eyes large, situated on anterior half of head. The interocular space is wide and slightly convex, and the interorbital distance is larger than eye diameter. The nostrils are located near the anterior margin of the eye, with the lower margins above the upper margin of the eye. Gill aperture broad, extending forward approximately below posterior margin of eye; gill cover membrane united to isthmus; isthmus narrow. Scales medium to large. Lateral line straight, approximately centered on the side of the body, slightly curved anteriorly, straight posteriorly, reaching to the base of the caudal fin.

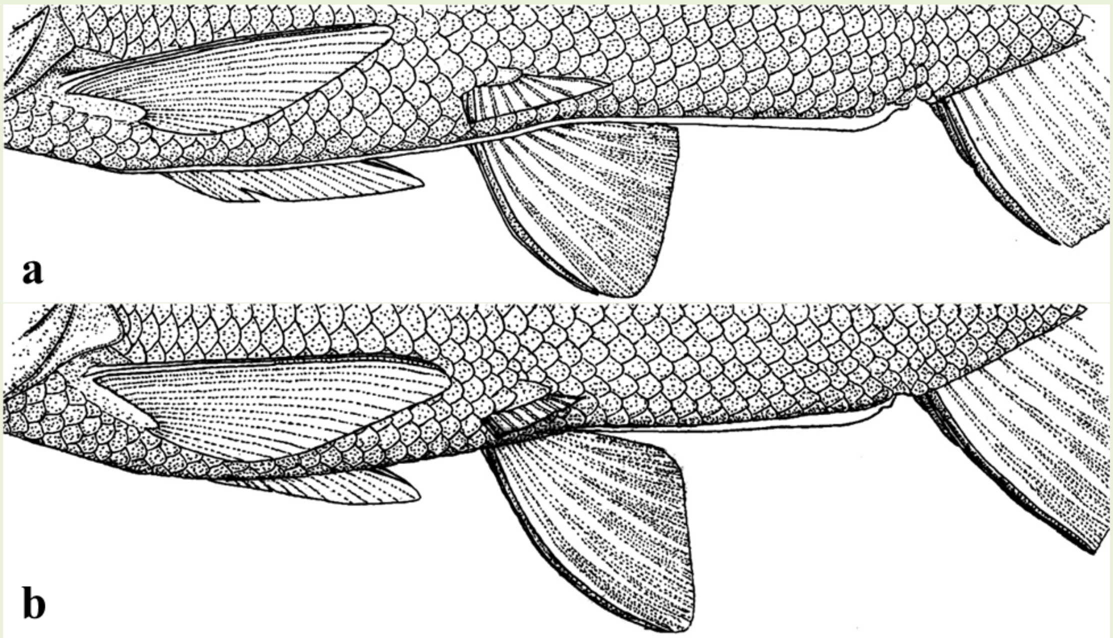

Fig. 11 Figure of the keel of a cultrin fish species: entire keel (a); half keel (b). (Illustrated by Zhi-Xian Sun)**.**

Dorsal fin located posteriorly above base of ventral fin, outer margin oblique, terminal unbranched fin smooth and stiffly spined, length of spines shorter than head length. Anal fin located posteriorly below base of dorsal fin, outer margin concave, distance from beginning to base of ventral fin much smaller than to base of caudal fin.

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Pectoral fins are short, pointed, and do not reach the beginning of the ventral fin. Ventral fin located anteriorly and inferiorly to dorsal fin, shorter than pectoral fin. The caudal fin is deeply forked and the upper and lower lobes are pointed at ends.

First gill arch lateral gill rakers 19-22. Gill rakers medium-long, densely arranged. Hypopharyngeal bones narrow, hooked, forearms longer than hindarms, without conspicuous antennal projections. Pharyngeal teeth subconical, pointed and slightly hooked at the end. Swim bladder 3-chambered, middle chamber largest, posterior chamber finely pointed. Intestine short, curved anteriorly and posteriorly, length of intestine shorter than body length. Peritoneum grayish white.

Lateral line complete and almost straight, extending along mid-lateral of body, with 73 (7) or 75 (7) pored scales; scale rows above and below lateral lines 5 and 3; circumpeduncular scales 21 (7) or 22 (7) and pre-dorsal mid-line scales 13 (14). Body covered with moderately-sized scales. Vertebral counts 4+41 (see **Fig. 2b**).

Colouration

In freshly-collected specimens, head and dorsum of body grey black, underside and abdomen silver white; back and lateral head peppered with dark spots. Back darker and belly lighter. Fins silver white, with orange-red anal and lower lobe of the caudal fin.

In formalin-stored specimens, ground colour slightly faded; body dorsally greyish and ventrally greyish-white and the back of the head becoming yellowish-brown. Dorsal, pectoral, and pelvic fins light greyish, anal fin and lower lobe of the caudal fin orange-red with black distal margin.

Sexual dimorphism

No sexual dimorphism was observed in the specimens examined.

Geographical distribution and habitat

C. oxycephalus is confined to the Chang-Jiang basin in Sichuan, Hubei, Hunan, Jiangxi, Anhui and Jiangsu provinces, southern China. Specimens examined in this study were collected from the Lake Dongting in Yueyang and Yuanjiang City. *C. oxycephalus* usually occurs in turbid rapid-flowing water with mixed substrate including boulders, gravel and pebbles. Coexisting fishes include *Chanodichthys* *erythropterus*, *Chanodichthys dabryi*, *Chanodichthys mongolicus, Tachysurus eupogon*, *Siniperca scherzeri*, *Coilia brachygnathus* and *Channa asiatica.*

In the past, ichthyologists identified the species based on a single specimen or even mutilated or teratological specimens, and the original descriptions were sketchy, often establishing new species with minor trait differences. Since the type specimens (including topotypes) cannot always be reexamined, and the original records are often plausible, or the lack of diagrams, the problem of confusion cannot always be resolved.

A review of specimens of species such as *C. oxycephalus* and *C. oxycephaloides* in this study revealed that Sharphead Culter described in "Fauna Sinica" is actually 'neither fish nor fowl' and is a combination of features spliced from several species (including *C. oxycephaloides*, *C. abramoides* and *C. dabryi*). This is the reason why there is no official record of Sharphead Culter since 1959. Topmouth Culter, Mongolian Culter and Predatory Culter can be the dominant and economically important fishes in many waters (Yi and Wu, 1964), and all these fishes belong to the mid-lower Chang-Jiang fluvio-lacustrine ecosystem. The true Sharphead Culter is only found in Chang-Jiang Basin and its subsidiary water bodies.

Discussion

Culter from Lake Dongting

Richardson (1846) described *Leuciscus recurviceps* Richardson, 1846 (= *Chanodichthys recurviceps* (Richardson 1846) based solely on an illustration from Canton (i.e., Guangzhou) by Reeves (Whitehead, 1970) (**Fig. 12**). This species was the first described cultrin fish and is now known to occur in the Pearl River and on Hainan Island (Chen *et al.*, 1998; Yang *et al.*, 2016; Xiang *et al.*, 2021)

Nichols (1928, 1943) recorded a batch of cultrin fishes taken by Clifford Pope in 1921 from the Huping of Lake Dongting (today Yueyang City, Hunan Province) and identified these as *Erythroculter dabryi*, *E. erythropterus*, *E. mongolicus*, *E. oxycephalus*, *E. recurviceps*, *E. oxycephaloides*. By examining the specimens stored in AMNH and MCZ (**Fig. 13**), this study found errors in some of the identifications: '*E.*

recurviceps' MCZ 32640, AMNH 10842, 10850 should be *Chanodichthys erythropterus*; '*E. recurviceps*' AMNH 12166 should be *Chanodichthys mongolicus*; '*E. oxycephaloides*' AMNH 10871, 10875 should be *Chanodichthys oxycephalus*; '*E. oxycephalus*' AMNH 15243 should be *Pseudobrama simoni*.

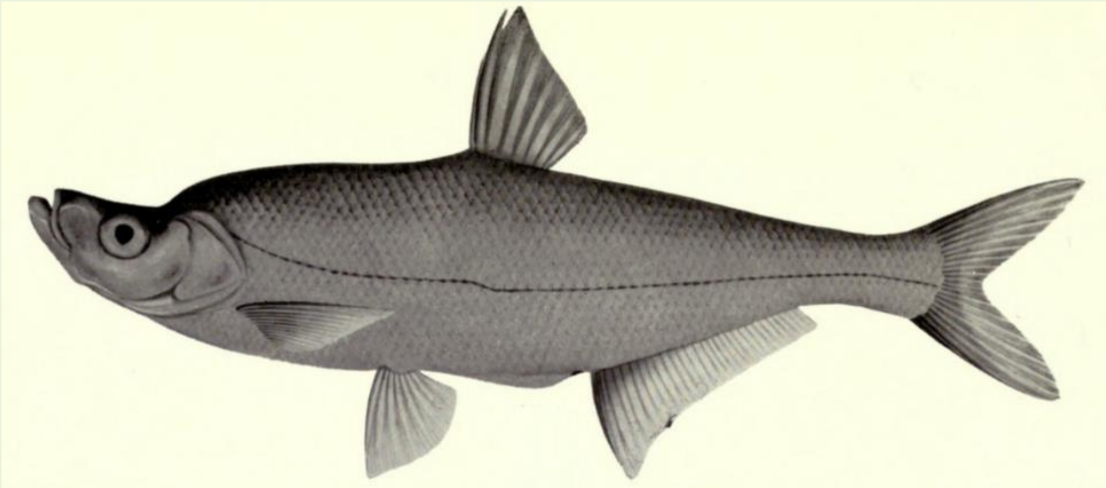

Fig. 12 A copy of Richardson's (1846) illustration of *Culter recurviceps*.

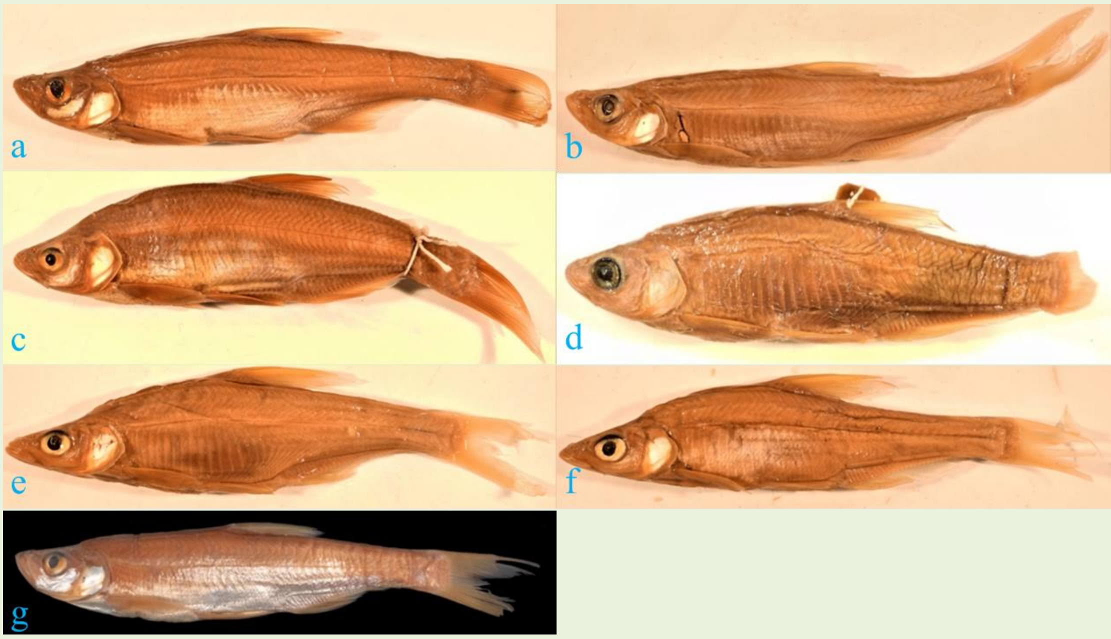

Fig. 13 Cultrin fish specimens from Lake Dongting collected by Clifford Pope (a: '*Erythroculter recurviceps*' AMNH 10842; b: '*E. recurviceps*' AMNH 10850; c: '*E. recurviceps*' AMNH 12166; d: '*E. oxycephalus*' AMNH 15243; e: *E. oxycephaloides* AMNH 10871; f: *E. oxycephaloides* AMNH 10875; g: '*E. recurviceps*' MCZ 32640).

Chen *et al.* (2022b) concluded that six species of cultrin fishes should be present in Lake Dongting based on field sampling and historical records from 2012-2019, while *Cultrichthys erythropterus* (sensu Chen *et al.* 1998) was the misidentification of *Culter alburnus*. As explained above, *Culter*, as here delimited, includes two species: *C. alburnus* and *C. compressocorpus*. All other species currently placed in *Culter* by Chinese authors should be referred to the genus *Chanodichthys*. According to the present study, five species should be present in Lake Dongting: *Chanodichthys dabryi* (Bleeker, 1871), *Ch. erythropterus* (Basilewsky, 1855), *Ch. mongolicus* (Basilewsky, 1855), *Ch. oxycephalus* (Bleeker, 1871) and *Culter alburnus* (Basilewsky, 1855). In addition to Lake Dongting, *Culter oxycephalus* also occurs in Lake Honghu, middle reach of Chang-Jiang (unpublished data) and the lower Chang-Jiang mainstream at the Nanjing City section (Wang, 2022). Based on the present study, it is suggested that previous records of specimens from the upper Chang-Jiang and Heilong-Jiang could be a misidentification of *Chanodichthys dabryi*, a view also supported by Bănărescu (1967a, b). Thus, the distribution area of *Chanodichthys oxycephalus* is restricted to the mid-lower Chang-Jiang mainstream and its subsidiary water bodies.

Culter from Lake Xingkai

Previous studies on Lake Xingkai are more numerous and mainly carried out by Chinese and Russian researchers, such as Berg (1909); Yi and Zhu (1959); Wu (1964); Naseka and Bogutskaya (2004); Bohlen *et al.* (2006) and Svirsky and Barabanshchikov (2010). Dybowski (1872) described four new species of *Culter* in Lake Xingkai as *Culter abramoides* Dybowski, 1872 (= *Chanodichthys abramoides*), *C. sieboldii* [= *Chanodichthys erythropterus*], *C. rutilus* [= *Chanodichthys mongolicus*], *C. lucidus* [= *Hemiculter lucidus* (Dybowski, 1872)]. Yi and Zhu (1959) described *Erythroculter dabryi shinkainensis* and *Culter compressocorpus*, based on a batch of specimens from Lake Xingkai, while a batch of cultrin fishes from the first Songhua-Jiang in the middle Heilong-Jiang was described as *Erythroculter ilishaeformis sungarinensis* Yi & Zhu, 1959, which was later resolved by Luo (1994) as a synonym of *Chanodichthys* *erythropterus*. Bogutskaya and Naseka (1997) concluded that four species of cultrin fishes should be present in Lake Xingkai based on field sampling, namely *Chanodichthys dabryi* (Bleeker, 1871), *Ch. erythropterus* (Basilewsky, 1855), *Ch. mongolicus* (Basilewsky, 1855) and *Culter alburnus* (Basilewsky, 1855). Bogutskaya *et al.* (2008) considered two more species from Lake Xingkai, namely also *Chanodichthys abramoides* (Dybowski, 1872) and *Chanodichthys oxycephalus* (Bleeker, 1871). Turanov *et al.* (2019) explored the phylogenetic relationships of these fishes from Lake Xingkai with the help of DNA. They used *Ch. erythropterus*, *Ch. mongolicus*, *Ch. oxycephalus* and *Culter alburnus*. Based on the specimens' and photographic examinations' result during this study, it is suggested that six cultrin fish species could be present in Lake Xingkai, namely *Chanodichthy abramoides*, *Ch. dabryi*, *Ch. erythropterus*, *Ch. mongolicus*, *Culter alburnus* and *C. compressocorpus*.

Zhao (2022) recorded 7 cultrin fish species from the Heilong-Jiang basin in China. Based on the results of our study, Shinkai Dabry's Culter (*Erythroculter dabryi shinkainensis*) in the Handbook may represent *Chanodichthys abramoides*, based on the longer pectoral fin reaching the base of the pelvic fin, sub-superior mouth, 64-68 pored scales. The Sharphead Culter *Chanodichthys oxycephalus* is not distributed in Heilong-Jiang Basin, Zhao's (2022) displayed species may represent *Chanodichthys dabryi* based on the larger eye diameter, lesser lateral scales, grey caudal and the distal margin of the anal fin. Thus, there are six cultrin fishes distributing in the Heilong-Jiang basin of China, i.e., *Chanodichthys abramoides*, *Ch. dabryi*, *Ch. erythropterus*, *Ch. mongolicus*, *Culter alburnus* and *C. compressocorpus*.

Reviews on differences between morphological and molecular analysis

Zhang *et al.* (2008) showed that *Culter* spp. can be divided by morphological methods into four separate species groups: (1) *C. alburnus* + *C. recurviceps*; (2) *C. dabryi dabryi* + *C. oxycephalus* + *C. dabryi shinkainensis*; (3) *C. oxycephaloides*; (4) *C. mongolicus mongolicus* + *C. mongolicus elongatus* + *C. mongolicus qionghaiensis*. We have reexamined the specimens of '*Culter oxycephalus*' used by Zhang *et al.* (2008)

housed in the Museum of Aquatic Biology (IHB-CAS) and all of them were found to be *Chanodichthys dabryi* based on significantly different characteristics.

The phylogenies from Wang *et al.* (2019) using Cytb and COI as molecular markers indicated that '*Culter oxycephalus*' and '*Culter oxycephaloides*' have a very small genetic distance and therefore always clustered together and cannot be effectively separated.

Kreyenberg & Pappenheim's uncritical original description of *Culter oxycephaloides* and the incorrect morphological description and drawing in "Fauna Sinica" since 1998, are hypothesized to have contributed to the longstanding confusion about the relationship between *Ch. oxycephalus* and *Ch. oxycephaloides* in the studies of Zhang *et al.* (2008) and Wang *et al.* (2019).

Taxonomic implication of type specimens and original literature

Kreyenberg and Pappenheim (1908) failed to review types and consult the original literature, leading to the creation of '*Culter oxycephaloides*', and to more than a century of misunderstanding. Similarly, due to the scientific conditions at that time, Yi and Zhu (1959) could not compare the holotypes of *Culter oxycephalus* with those of *Culter oxycephaloides*, and incorrectly recognized *Culter abramoides* as a synonym of *Culter oxycephalus* by the number of lateral-line scales.

Therefore, in order to avoid the recurrence of such confusion, ichthyologists should identify fish species based on complete specimens, with original descriptions documented in as much detail as possible, and with as much knowledge as possible of the fish's life-history cycle (including habitat, habits, coloration, etc.). Ichthyologists need to understand that fish exhibit different traits at different growth periods and in different sexes to avoid misidentifying species based on minor trait differences. At the same time, the exchange of literature and specimens should be strengthened so that the same fishes will not be categorized into different groups, or different species will not be treated as a single species. The number of species with synonyms will be suppressed, as well as the phenomenon of mistakenly categorizing different species into one species.

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Even if problems are found later, they can be rechecked by obtaining name-bearing type specimens, voucher specimens, original records, accompanying drawings, or topotypes.

Comparative material

Abramis pekinensis **ZIN** 5637 (3), Syntypes, Rivers leading to Tschili Bay, China.

Culter abramoides **ZMB** 7933 (1), Syntype, Ussuri River and Lake Khanka, southeastern Russia.

Culter alburnus **ZIN** 5585 (1), Lectotype, Rivers draining to the Gulf of Tschili, China.

Culter aokii **FMNH** 59110 (1), Lectotype, Lake Candidius (Jitsugetsutan), Taiwan, China.

Culter brevicauda **BMNH** 1865.10.29.29 (1). Lectotype; **BMNH** 1865.10.29.30-31 (2), 1865.10.29.32 (1). Paralectotypes: Taiwan, China.

Culter compressocorpus **IHB** 58-1572~1575 (6); Dongbei-0520~0523, Syntypes, Lake Xiaoxingkai & Lake Jingpo, China.

Culter dabryi **MNHN** 5078 (1), Holotype, Chang-Jiang, China.

Culter lucidus **ZMB** 7935 (2), Lectotype, Lake Khanka, southeastern Russia.

Culter mongolicus **ZIN** 2950-51 (2). Lectotype and paralectotype: Mongolia and Manchura, northern China.

Culter recurvirostris **MNHN** 1884-0078 (1), Holotype, Near Hanoi, northern Vietnam.

Culter rutilus **ZMB** 7934 (1), Syntype, Ussuri River and Lake Khanka, southeastern Russia.

Culter sieboldii **ZMB** 7932 (1), Syntype, Middle Amur River, Ussuri River, Sungari River, and Lake Khanka, China.

Erythroculter dabryi shinkainensis **IHB** 58-1548~1567 (21), Syntypes, Lake Daxingkai, Heilong-Jiang, China.

Erythroculter hypselonotus daovantieni **IBTS** 625 (1), Holotype, Boi River, northern Vietnam.

Erythroculter ilishaeformis **MNHN** 0000-5055 (1), Syntype, Chang-Jiang, China.

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