



Annandale's collection of freshwater fishes from Inle Lake, Myanmar, housed in the Kyoto University Museum

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Received: 18 November 2020 / Revised: 09 February 2021 / Accepted: 16 February 2021
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Thomas Nelson Annandale (1876–1924) was an English anthropologist and zoologist who served as the superintendent of the Indian Museum from 1907 until the time of his death (Dover 1924; Kemp 1925). His focus was initially on anthropology, but after he moved to India in 1904, he began studying the aquatic biota in Asian lakes. His research areas covered the Sea of Galilee in Israel, Hamun Lake in Iran, Chilika Lake and Loktak Lake in India, Inle Lake in Myanmar, Songkhla Lake in Thailand, Lake Tai in China, and Lake Biwa in Japan. His works provide important discoveries about the fauna and the origin of the lakes he researched (e.g., Annandale 1918b, 1922). In 1915, Annandale stayed in Japan for about two months, and in order to carry out his research of Lake Biwa (Annandale 1916, 1922), he spent a great deal of time on the Otsu Hydrobiological Station (OHS), Kyoto University (one of the parent organizations of the current Center for Ecological Research, Kyoto University). Later, in 1917, Annandale studied Inle Lake, which is an ancient lake in Myanmar. The biota of Inle Lake was first fully explored by Annandale, where he discovered and described seven endemic species and subspecies (Annandale 1918b).

Inle Lake has a unique geological history and rich biodiversity (Abell et al. 2008; UNDP 2015; Kano et al. 2016), and several new species have been described in the surrounding areas, even in recent years (e.g., Roberts 2007; Nishikawa et al. 2014). In the last few decades, populations of native fishes in Inle Lake have decreased due to

environmental deterioration caused by water pollution and the introduction of exotic species (Toke et al. 2013; Kano et al. 2016). The specimens collected before recent environmental changes have important value for understanding the original environment. Most of the specimens collected by Annandale are housed at the Zoological Survey of India (Annandale 1918b; Menon and Yazdani 1968).

Recently, at the Kyoto University Museum (KUM), we found a total of 12 bottles containing 33 individuals of 12 freshwater fish species collected from Inle Lake by Annandale, which had originally been donated by him to OHS approximately 100 years ago. Here, we report a list of these specimens with the latest scientific names. Specimens of two species of catfish collected by Annandale in India, which are presumed to have been donated at the same time, were also found and are included in this report. The scientific names are given following Kano et al. (2016) and Fricke et al. (2020). Photographs of all specimens, the labels, the original bottles, and 3D data of the selected specimen (*Cyprinus intha*) are registered in the ffish.asia (<https://ffish.asia>) biodiversity database on freshwater fish and freshwater organisms in Asia (Watanabe et al. 2010; Kano et al. 2013). The ID of “InleAnnandale” was tagged to these data (<https://ffish.asia/InleAnnandale>).

The specimens that had originally been deposited in the fish collections of OHS were transferred to KUM in 2001 (Kai 2015). The specimens have been stored by species in 12 bottles. Details of the specimens are as follows: Cyprinidae, 22 individuals of 7 species; Nemacheilidae, 7 individuals of 2 species; Cobitidae, 2 individuals of 1 species; Channidae, 1 individual of 1 species; and Notopteridae, 1 individual of 1 species (Fig. 1; Table 1). Although the original label and OHS label of *Barbus stedmanensis* Annandale 1918b [unneeded replacement name for *Barbus compressus* Boulenger 1893; valid as *Systemus compressiformis* (Cockerell 1913)] remain with the FAKU-P225 bottle, the specimen could not be found and has probably been lost.

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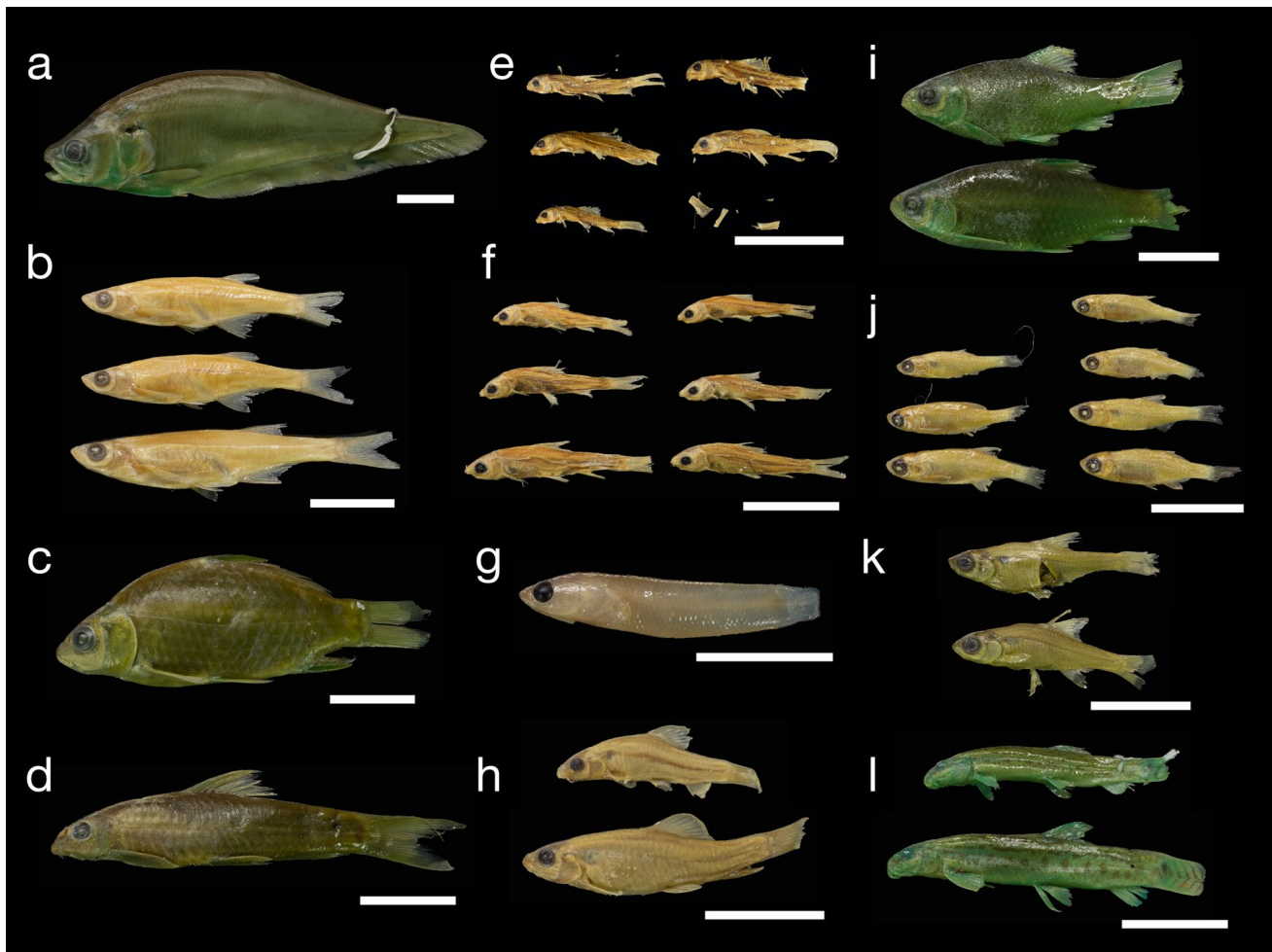


Fig. 1 Specimens of freshwater fishes in Inle Lake that were donated to the Otsu Hydrobiological Station by Dr. N. Annandale and are housed in the Kyoto University Museum. **a** *Notopterus notopterus* (Pallas 1769) (FAKU-P225), **b** *Inlecypris auropurpureus* (Annandale 1918b) (FAKU-P1163), **c** *Cyprinus intha* Annandale 1918b (FAKU-P1165), **d** *Garra graveleyi* (Annandale 1919) (FAKU-P1166), **e** *Physoschistura brunneana* (Annandale 1918b) (FAKU-P1168), **f**

Gymnostomus horai (Bănărescu 1986) (FAKU-P1169), **g** *Channa harcourtbutleri* (Annandale 1918b) (FAKU-P1170), **h** *Petruichthys brevis* (Boulenger 1893) (FAKU-P1171), **i** *Systemus* sp. cf. *rubripinnis* (FAKU-P1172), **j** *Microrasbora rubescens* Annandale 1918b (FAKU-P1173), **k** *Sawbwa resplendens* Annandale 1918b (FAKU-P1174), **l** *Lepidocephalichthys bermorei* (Blyth 1860) (FAKU-P1175). Scale bar 20 mm

Of these 13 species, six species, *Ophiocephalus harcourtbutleri* (valid as *Channa harcourtbutleri*), *Cyprinus carpio intha* (valid as *Cyprinus intha*), *Barilius auropurpureus* (valid as *Inlecypris auropurpureus*), *Microrasbora rubescens*, *Nemachilus brunneanus* (valid as *Physoschistura brunneana*), and *Sawbwa resplendens* were originally described by Annandale (1918b). Of these, for the four species, *I. auropurpureus*, *P. brunneana*, *Ch. harcourtbutleri*, and *M. rubescens*, the KUM specimens may be a part of their paratypes, since Annandale only designated the holotypes in the original description (Annandale 1918b; Kottelat 1990; ICZN 1999: Art. 72; Fricke et al. 2020). For *Cy. c. intha*, Menon and Yazdani (1968) treated two lots of specimens [ZSI F 9366/1 from Inle Lake (11 individuals) and F 9367/1 from He-Ho plain (9 individuals)] as syntypes of

this subspecies, since no types were explicitly designated in Annandale (1918b). One specimen of *Cy. intha* maintained at KUM could be considered as one of the syntypes, because the letters “Co-type” are written on the label and the specimen ledger (ICZN 1999: Arts. 72.4, 73.2). This specimen was labeled with the specimen number before donation, and although the second digit is blurred and illegible, the other letters match the specimen number of the syntype ZSI F 9367/1, and the collection site is the same as ZSI F 9367/1 (He-Ho).

Physoschistura brunneana was originally described by Annandale (1918b), but Hora (1929) pointed out that Annandale (1918b) had confused it with a closely related species, *Physoschistura rivulicola* (Hora 1929), which occurs sympatrically with *P. brunneana* and was described

Table 1 List of specimens of freshwater fishes in Inle Lake that were donated to the Otsu Hydrobiological Station by Dr. N. Annandale and are housed in the Kyoto University Museum

Specimen ID (FAKU/OHS/original)	Number of individuals	Family	Species	Species on original label	Locality
–/–/Ex. F 9415/1	0	Cyprinidae	<i>Systomus compressiformis</i> (Cockerell 1913)	<i>Barbus stedmanensis</i> (Boulenger)	Fort Stedman, Inle Lake, S. Shan States
FAKU-P225/P225/–	1	Notopteridae	<i>Notopterus notopterus</i> (Pallas 1769)	<i>Notopterus kapirat</i> (Pallas)	Inle Lake, S. Shan States
FAKU-P1163/P1163/–	3	Cyprinidae	<i>Inlecyprius auropurpureus</i> (Annandale 1918b)	<i>Barilius auropurpureus</i> Annandale	Inle Lake, S. Shan States
FAKU-P1164/P1164/–	1	Sisoridae	<i>Pseudecheneis sulcata</i> (McClelland 1842)	<i>Pseudecheneis sulcatus</i> McClell	India
FAKU-P1165/P1165/Ex. F 9367/1	1	Cyprinidae	<i>Cyprinus intha</i> Annandale 1918b	<i>Cyprinus carpio intha</i> Annandale	He-Ho, S. Shan States
FAKU-P1166/P1166/Ex. F 9423/1	1	Cyprinidae	<i>Garra gravelyi</i> (Annandale 1919)	<i>Discognathus lamta</i> (Ham. Buch.)	Fort Stedman, Inle Lake, S. Shan States
FAKU-P1167/P1167/–	1	Sisoridae	<i>Glyptothorax striatus</i> (McClelland 1842)	<i>Glyptosternum striatum</i> McClell	India
FAKU-P1168/P1168/–	5	Nemacheilidae	<i>Physoschistura brunneana</i> (Annandale 1918b)	<i>Nemachilus brunneanus</i> Annandale	Yawnghwe, S. Shan States
FAKU-P1169/P1169/Ex. F 9383/1	6	Cyprinidae	<i>Gymnostomus horai</i> (Bănărescu 1986)	<i>Cirrhina latia</i> (Ham. Buch.)	Yawnghwe, S. Shan States
FAKU-P1170/P1170/–	1	Channidae	<i>Channa harcourtbutleri</i> (Annandale 1918b)	<i>Ophiocephalus harcourtbutleri</i> Annandale	He-Ho, S. Shan States
FAKU-P1171/P1171/–	2	Nemacheilidae	<i>Petruichthys brevis</i> (Boulenger 1893)	<i>Nemachilus brevis</i> Boulenger	Inle Lake, S. Shan States
FAKU-P1172/P1172/Ex. F 9379/1	2	Cyprinidae	<i>Systomus</i> sp. cf. <i>rubripinnis</i>	<i>Barbus sarana caudimarginatus</i> Blyth	Yawnghwe, S. Shan States
FAKU-P1173/P1173/Ex. F 9419/1	7	Cyprinidae	<i>Microrasbora rubescens</i> Annandale 1918b	<i>Microrasbora rubescens</i> Annandale	Inle Lake, S. Shan States
FAKU-P1174/P1174/Ex. F 9427/1	2	Cyprinidae	<i>Sawbwa resplendens</i> Annandale 1918b	<i>Sawbwa resplendens</i> Annandale	Fort Stedman and Lin Kin, middle of Inle Lake, S. Shan States
FAKU-P1175/P1175/Ex. F 9388/1	2	Cobitidae	<i>Lepidocephalichthys berdmorei</i> (Blyth 1860)	<i>Lepidocephalus berdmorei</i> (Blyth)	Small stream about 1 mile from edge of Inle Lake, S. Shan States

later. So, the present specimens of “*P. brunneana*” could contain two species; however, the specimens unfortunately dried up and could not be identified by morphological examination (Fig. 1e).

The specimen of *Garra gravelyi* (Annandale 1919) was labeled as *Discognathus lamta* (Hamilton 1822). Specimens of this species collected from Inle Lake and He-Ho plain were tentatively identified as *D. lamta* in Annandale (1918b). Then, in the following year, the tentative *D. lamta* specimens were compared with several related species, including *D. lamta* from distant site in Shan States and India, and were then formally described by Annandale (1919) as *Discognathus gravelyi*. It is assumed that these specimens were donated before the publication of Annandale (1919), because the specimen of this species was labeled as *D. lamta* (Table 1; also see below).

Two sisorid catfish species, *Pseudecheneis sulcata* (McClelland 1842) and *Glyptothorax striatus* (McClelland

1842), were not obtained from Inle Lake but were also donated by Annandale. The only information on these two specimens is their scientific names and their locality, “India” (Table 1). These two species are known to be distributed in Bangladesh and India, respectively (Ng 2006; Ng and Lalramliana 2013).

The labels and ledger of the specimens donated by Annandale contain the scientific name, local name, collector name, and locality (Electronic supplementary materials Table S1), but they do not contain the date of collection. In addition, there is a description in the ledger indicating that it was donated by Annandale, but there is no record of when it was donated. The survey of Inle Lake was carried out from February to March in 1917, and the reports were published in 1918 (Annandale 1918a, 1918b). Because the specimens deposited in KUM contain those probably used by Annandale (1918b) (at least *Cy. intha*), it can be deduced that they were collected by Annandale in 1917. In addition,

these specimens are inferred to have been donated by 1919, because *G. gravelyi*, which was described in 1919, was labeled as *D. lamta* in the original ledger. Since Annandale could not make his second visit to Japan after 1915 (Ueno 1925), the specimens would have been donated by sea mail. There is no record that Annandale shipped the specimens from India to Japan. However, such shipping of specimens was possible at that time, because there is a record that Annandale shipped his collection of Lake Biwa specimens from Kobe, Japan, to India in 1915 (Annandale 1916).

Specimens of shellfish and sponge collected from Inle Lake were also donated by Annandale to OHS in the same period and are respectively preserved in dry conditions and in ethanol. Their image data are also registered in the ffish.asia and can be referred to from the “InleInvAnnandale” tag (<https://ffish.asia/InleInvAnnandale>).

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10228-021-00806-5>.

Acknowledgements We are grateful to Dr. N. Morimoto and Mr. S. Tanaka (Kyoto University) for conducting CT imaging. Our survey of fish specimens from Inle Lake was in cooperation with Dr. P. Musikasinthorn (Kasetsart University, Thailand); the Forest Department, Ministry of Natural Resources and Environmental Conservation, Myanmar; the Forest Resource Environment Development and Conservation Association, Myanmar (FREDA); and Mr. Nyi Nyi Lwin (Green Leaf, Myanmar). This work was supported by a JSPS KAKENHI Grant (JP19J23130 to YF and JP20HP8020 to YK) and Kurita Water and Environment Foundation Research Grant (17B028, 18K013, 19K008) to YF.

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