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Fishes of the East Tiaoxi River in Zhejiang Province, China

Jun Nakajima*,, Tatsuro Sato*, Yuichi Kano*, Liangliang Huang***, Jyun-ichi Kitamura****, Jianhua Li*** and Yukihiro Shimatani***

We conducted fish sampling at 90 sites in the East Tiaoxi River, Yangtze River basin, China. Seventy-seven species belonging to 19 families were recorded, and photographs of live specimens are provided for all species. Three exotic species were recorded: *Cirrhinus cirrhosus*, *C. molitorella*, *Gambusia affinis*. The top 3 species-rich families were Cyprinidae (46 %), Cobitidae (5 %) and Gobiidae (5 %). The species composition in the East Tiaoxi River is similar to that of the Yangtze River Basin; however, the East Tiaoxi River has quite a diverse fish fauna for a small river system.

Introduction

The Yangtze River basin is known to support a diverse freshwater fish fauna, and this river basin is very important in terms of formative history of the East Asian freshwater fish fauna (Fu et al., 2003; Yu et al., 2005). The Yangtze River and its lakes were listed in the "Global 200" by World Wildlife Fund and are priority ecoregions for conservation (Olson & Dinerstein, 2002). The East Tiaoxi River is one of the largest rivers flowing into Taihu Lake, China, and it connects to the Yangtze River in the lowest reaches via a number of small rivers and creeks (Chen et al., 2009a). The East Tiaoxi River is treated as the Taihu Lake sub-basin section of the Yangtze River Basin, and the fish fauna is said to be closely related to that of the Yangtze River (Fu et al., 2003). Although there has been fragmentary information on the fish fauna of the East Tiaoxi River (Mao et al., 1991; Kano et al., 2011; Sato et al., 2011; Li et al., 2012), these studies have some taxonomic problems and the fish fauna of the East Tiaoxi River remains to be completely elucidated.

The East Tiaoxi River and Taihu Lake are situated near Shanghai, one of the major cities of the world. Both the river and the lake are economically and socially essential as water supply for Shanghai and neighbouring cities. The environment of the river has been drastically altered in recent years by the rapid economic development of Shanghai (Chen et al., 2009a; Sato et al.,

* Faculty of Engineering, Kyushu University, Motooka 744, Nishi-ku, Fukuoka 819-0395, Japan. E-mail: oikawamaru@gmail.com
** Fukuoka Institute of Health and Environmental Sciences, Mukaizano 39, Dazaifu, Fukuoka, 818-0135 Japan.
*** Key Laboratory of Yangtze River Water Environment, Ministry of Education, Tongji University, Shanghai 200092, China.
**** Mie Prefectural Museum, Koumei-cho 147-2, Tsu, Mie 514-0006, Japan.

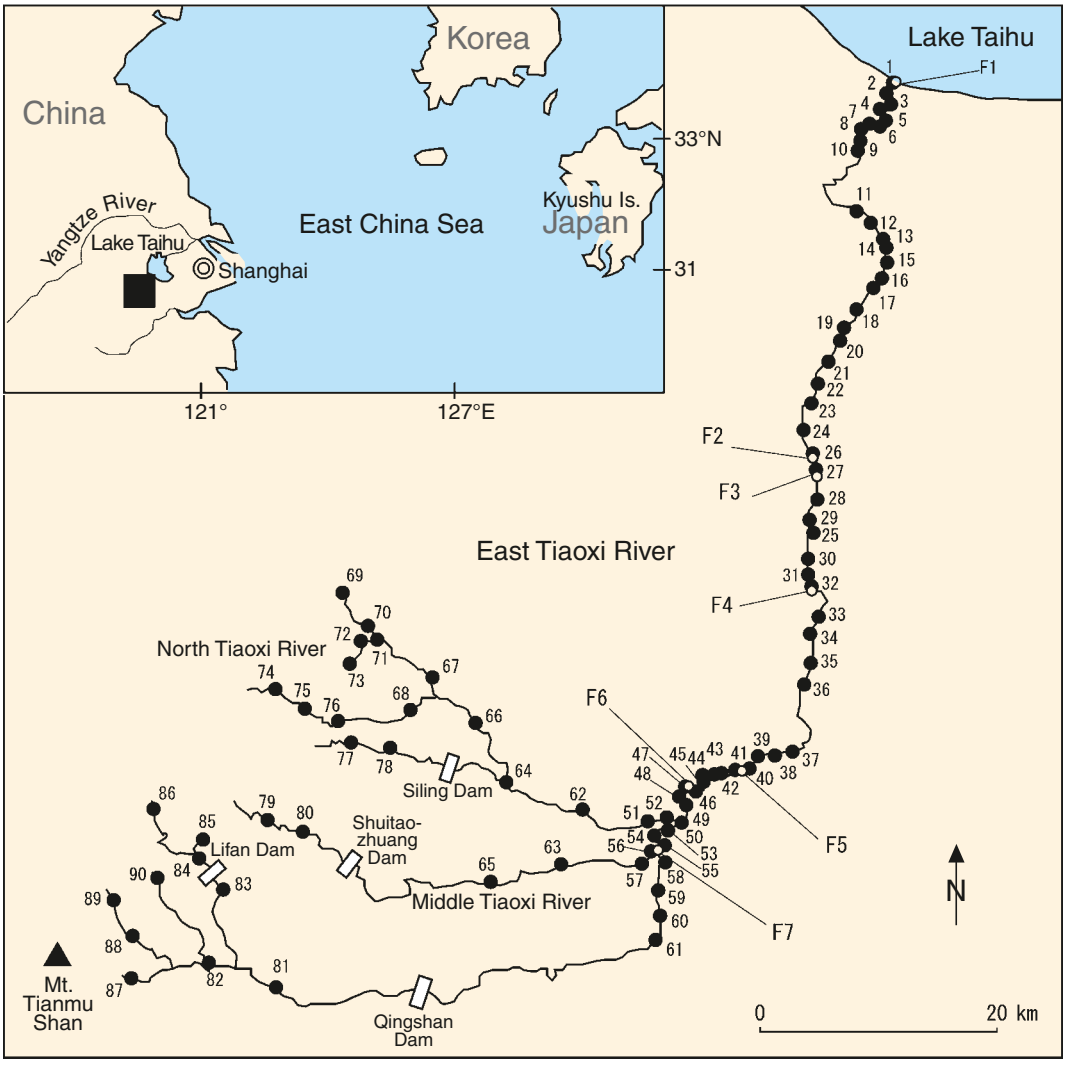

Fig. 1. Map of the study area, showing the 90 sampling sites (●), the 7 sites where data were obtained from fishermen's catches (○), and 4 dams in the East Tiaoxi River system, China.

2010; Kano et al., 2011). Therefore, up to date and accurate information regarding the fish fauna is required immediately for effective conservation strategies. The primary aim of this study is to present the current fish fauna of the East Tiaoxi River on the bases of our field survey.

Materials and methods

The East Tiaoxi River flows into Taihu Lake, Zhejiang province, China (Fig. 1). The main river has a length of 151 km, a drainage area is 2265 km^2, and the highest mountain in its drainage is Mt. Tianmu Shan (1271 m asl) (Chen et al., 2009a; Sato et al., 2010). This river is located in the subtropical zone, and average annual precipitation is about 1460 mm (Chen et al., 2009a). The river system has 4 high dams: Siling Dam (since 1966, 9.2 million tons), Shuitaozhuang Dam (since 2002, 28.9

Fig. 2. Landscapes of the East Tiaoxi River. **a,** braided reach (station 1); **b,** braided reach (station 27); **c,** pool-riffle reach (station 65); **d,** step-pool reach (station 74).

million tons), Qingshan Dam (since 1964, 213.0 million tons), and Lifan Dam (since 1973, 20.4 million tons) in the upper reaches (Fig. 1). The East Tiaoxi River is mainly composed by three types of streams: braided reach (Fig. 2a,b), pool-riffle reach (Fig. 2c), and step-pool reach (Fig. 2d), categorized by Bission & Montgomery (1996). Figure 3 shows the altitudinal gradient of the East Tiaoxi River and 2 main branch rivers. Approximately 100 km up the river from the mouth is categorized as braided reach, from 100 km to 130 km is categorized as pool-riffle reach, and over 130 km up river from the mouth is categorized as step-pool reach.

Sampling was conducted in October and November 2009 and May 2010, and a total of 90 sites in the East Tiaoxi River system were covered (Figs. 1–3). Sampling was conducted either by wading in shallow reaches (28 sites) or by the use of a small boat in the deeper reaches (62 sites). In the shallow reaches with riffle-pool structures, sampling was conducted in 3 main habitat types: riffle, glide, and pool. Electrofishing was conducted in each habitat along a 15 m × 2 m stretch of the river by using a backpack electrofisher (LR-24; Smith-Root Inc., Vancouver), with at least 2 netters present to capture the stunned fishes. In the deeper reaches, fishes were captured from the boat with a locally purchased electrofisher (Weibociliji; Caifu, unknown city) typically used by the local fishermen around the East Tiaoxi River and the Taihu Lake. The boat was driven at a slow speed (approximately 10 $m \cdot min^{-1}$) along the river shore for 50 m, and fish individuals within 2 m of the boat were captured. In addition, we observed the catch in local fishermen's nets at 7 sites on the river.

After sampling, each captured fish was identified to species level. Most of the individuals were released at the site of capture, but some were fixed in 10 % formalin for identification, after being anesthetized using eugenol solution. Iden-

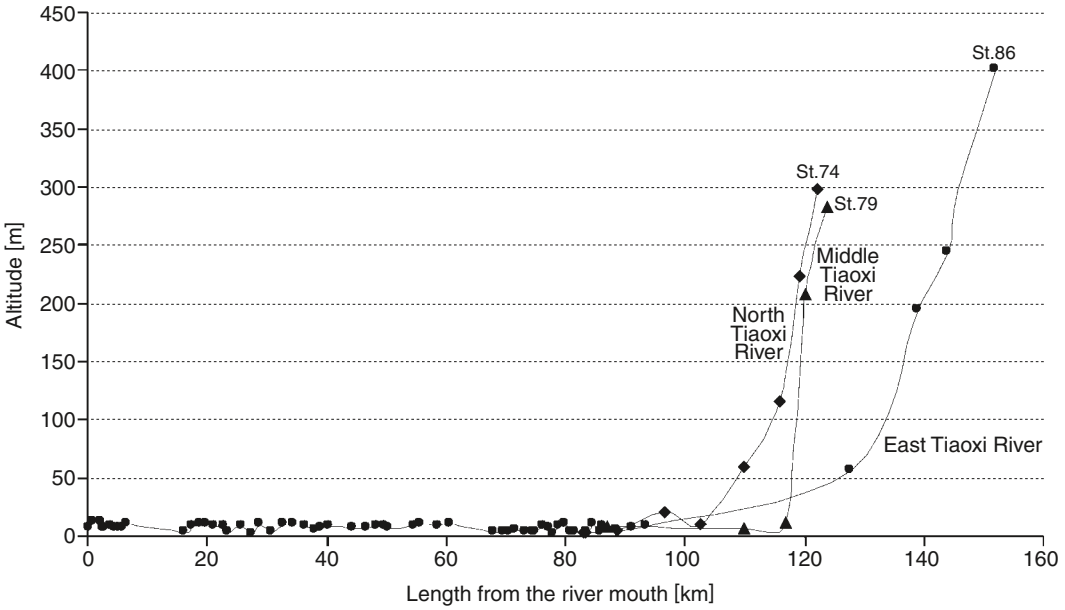

Fig. 3. Relationships between length from river mouth and altitude of the East Tiaoxi River and two main tributaries.

tifications were mainly based on the papers published by Cheng & Zheng (1987), Mao et al. (1991), Chen (1998), Chu et al. (1999), Yue (2000), Yuan et al. (2006) and Wu (2008). In addition, we referred to a number of current taxonomical papers. All fixed specimens are preserved in the Key Laboratory of Yangtze River Water Environment, Ministry of Education, Tongji University, Shanghai, China.

Results

Seventy-seven species from 19 families were recorded in the East Tiaoxi River during our survey (Table 1; Figs. 4–9). The top 4 species-rich families were Cyprinidae (46 %), Cobitidae (5 %), Gobiidae (5 %), and Bagridae (4 %). We have discussed the taxonomy of a number of species below.

Coilia ectenes Jordan & Seale, 1905
(Fig. 4a)

Remarks on taxonomy. Although *Coilia nasus* Temminck & Schlegel, 1846, is similar to this species, Takita (1978) stated that these 2 species are distinguishable according to anal fin rays and the number of scutes and vertebrae.

Rhodeus fangi (Miao, 1934)
(Fig. 4b)

Remarks on taxonomy. The scientific name of *Rhodeus fangi* has often been mistakenly replaced by *R. sinensis* Günther, 1868, in the Chinese literature (e. g., Cheng & Zheng, 1987; Mao et al., 1991). However, the figures and morphological data in these works agree more with *R. fangi*. The true *R. fangi* has a vivid blue line from the predorsal part of body to the caudal fin base.

Rhodeus sinensis Günther, 1868
(Fig. 4c)

Remarks on taxonomy. *Rhodeus sinensis* has been treated as *R. lighti* (Wu, 1931) by most Chinese authors (e. g. Cheng & Zheng, 1987; Mao et al., 1991; Chen, 1998). However, Akai & Arai (1997) treated *R. lighti* as a synonym of *R. sinensis*.

Tanakia chii (Miao, 1934)
(Fig. 4e)

Remarks on taxonomy. Although much of the Chinese literature places this species in the genus *Paracheilognathus* (Cheng & Zheng, 1987; Mao et al., 1991; Chen, 1998), genetic and morphological data show that it belongs to the genus *Tanakia*

Table 1. Fish species collected from the East Tiaoxi River by our survey, number of collecting sites (CS) and altitude. Asterisks (*) indicate presence in fishermen's catches.

fig.	family current name	CS	Average altitude (range)
	Engraulidae		
4a	*Coilia ectenes*	4	7 (7)
	Cyprinidae		
4b	*Rhodeus fangi*	23	9 (4–45)
4c	*Rhodeus sinensis*	30	8 (2–45)
4d	*Rhodeus ocellatus*	14	15 (4–59)
4e	*Tanakia chii*	5	7 (3–12)
4f	*Acheilognathus gracilis*	6	9 (7–11)
4g	*Acheilognathus imberbis*	23	6 (2–10)
4h	*Acheilognathus macropterus*	13	6 (3–10)
4i	*Acheilognathus tonkinensis*	17	7 (3–11)
4j	*Acheilognathus barbatulus*	4	4 (3–5)
4k	*Acheilognathus chankaensis*	1	12
4l	*Culter alburnus*	13	9 (7–12)
4m	*Chanodichthys erythropterus*	2	8 (4–12)
4n	*Chanodichthys dabryi*	3	7 (4–9)
5a	*Chanodichthys mongolicus*	1*	–
5b	*Hemiculter leucisculus*	24	7 (3–12)
5c	*Hemiculter bleekeri*	10	9 (4–12)
5d	*Sinibrama wui*	1	8
5e	*Megalobrama amblycephala*	3	10 (9–11)
5f	*Cyprinus carpio*	3	6 (2–11)
5g	*Carassius auratus*	30	8 (3–45)
5h,i	*Acrossocheilus fasciatus*	7	220 (85–299)
5j	*Cirrhinus cirrhosus*	2	8 (7–8)
5k	*Cirrhinus molitorella*	1*	–
5l	*Ctenopharyngodon idella*	1	4
5m	*Xenocypris argentea*	2	7 (7)
5n	*Xenocypris microlepis*	–*	–
6a	*Pseudobrama simoni*	7	8 (4–11)
6b	*Hypophthalmichthys molitrix*	1*	–
6c	*Hemibarbus maculatus*	2	8 (5–10)
6d	*Paracanthobrama guichenoti*	1*	–
6e	*Pseudorasbora parva*	28	20 (3–223)
6f	*Sarcocheilichthys sinensis*	2	6 (4–7)
	Cyprinidae		
6g	*Sarcocheilichthys parvus*	1	12
6h	*Sarcocheilichthys kiangsiensis*	5	8 (4–12)
6i	*Sarcocheilichthys nigripinnis*	5	9 (4–12)
6j	*Squalidus argentatus*	1	12
6k	*Squalidus wolterstorffi*	1	21
6l	*Abbottina rivularis*	9	8 (4–21)
6m	*Microphysogobio fukiensis*	9	7 (3–21)
6n	*Microphysogobio kiatingensis*	3	22 (9–45)
7a	*Huigobio chenhsiensis*	3	27 (10–59)
7b	*Aphyocypris chinensis*	2	28 (10–45)
7c	*Opsariichthys bidens*	13	47 (4–183)
7d	*Zacco platypus*	16	113 (5–283)
7e	*Rhynchocypris oxycephalus*	14	215 (45–401)
	Cobitidae		
7f	*Cobitis sinensis*	2	71 (57–85)
7g	*Cobitis dolichorhynchus*	3	8 (4–12)
7h	*Cobitis laterimaculata*	7	158 (12–283)
7i	*Misgurnus anguillicaudatus*	14	87 (4–223)
7j	*Paramisgurnus dabryanus*	2	11 (10–11)
	Botiidae		
7k	*Leptobotia tchangi*	3	26 (10–57)
	Balitoridae		
7l	*Vanmanenia pingchowensis*	10	231 (85–401)
7m	*Vanmanenia stenosoma*	9	92 (10–208)
	Amblycipitidae		
7n	*Liobagrus styani*	5	192 (85–299)
	Siluridae		
8a	*Silurus asotus*	1	7
	Bagridae		
8b	*Tachysurus nitidus*	1	9
8c	*Tachysurus taeniatus*	9	118 (10–283)
8d	*Tachysurus tenuis*	1	5
8e	*Tachysurus fulvidraco*	7	7 (3–11)
	Osmeridae		
8f	*Protosalanx chinensis*	1	12
8g	*Neosalanx tangkahkeii*	1	12
	Adrianichthidae		
8h	*Oryzias sinensis*	5	14 (3–45)
	Hemiramphidae		
8i	*Hyporhamphus intermedius*	6	8 (5–12)
	Poeciliidae		
8j	*Gambusia affinis*	11	5 (2–10)
	Synbranchidae		
8k	*Monopterus albus*	3	84 (7–223)
	Mastacembelidae		
8l	*Sinobdella sinensis*	20	8 (4–21)
	Sinipercidae		
8m	*Siniperca chuatsi*	1	4
	Odontobutidae		
8n	*Micropercops cinctus*	3	4 (4–5)
9a	*Odontobutis potamophila*	22	71 (3–298)
	Gobiidae		
9b	*Rhinogobius guirinus*	30	26 (3–243)
9c	*Rhinogobius cliffordpopei*	6	129 (10–243)
9d	*Rhinogobius multimaculatus*	11	126 (10–298)
9e	*Rhinogobius* sp. 1	20	172 (10–401)
9f	*Rhinogobius* sp. 2	7	77 (10–138)
	Osphronemidae		
9g	*Macropodus ocellatus*	3	7 (4–11)
	Channidae		
9h	*Channa argus*	1*	–

Fig. 4. Fishes of the East Tiaoxi River. **a,** *Coilia ectenes*; **b,** *Rhodeus fangi*; **c,** *R. sinensis*; **d,** *R. ocellatus*; **e,** *Tanakia chii*; **f,** *Acheilognathus gracilis*; **g,** *A. imberbis*; **h,** *A. macropterus*; **i,** *A. tonkinensis*; **j,** *A. barbatulus*; **k,** *A. chankaensis*; **l,** *Culter alburnus*; **m,** *Chanodichthys erythropterus*; **n,** *C. dabryi*.

Fig. 5. Fishes of the East Tiaoxi River. **a,** *Chanodichthys mongolicus*; **b,** *Hemiculter leucisculus*; **c,** *H. bleekeri*; **d,** *Sinibrama wui*; **e,** *Megalobrama amblycephala*; **f,** *Cyprinus carpio*; **g,** *Carassius auratus*; **h,** *Acrossocheilus fasciatus* (adult male); **i,** *A. fasciatus* (adult female); **j,** *Cirrhinus cirrhosus*; **k,** *C. molitorella*; **l,** *Ctenopharyngodon idella*; **m,** *Xenocypris argentea*; **n,** *X. microlepis*.

(Arai & Akai, 1988; Okazaki et al., 2001; Chang et al., 2009).

***Acheilognathus imberbis* Günther, 1868**
(Fig. 4g)

Remarks on taxonomy. Although many Chinese works place this species in the genus *Paracheilognathus* (Cheng & Zheng, 1987; Mao et al., 1991; Chen, 1998), genetic and morphological data show that it belongs to the genus *Acheilognathus* (Arai & Akai, 1988; Okazaki et al., 2001).

***Acheilognathus macropterus* (Bleeker, 1871)**
(Fig. 4h)

Remarks on taxonomy. The genus *Acanthorhodeus* is currently considered a synonym of *Acheilognathus,* based on morphological characters and phylogenetic relationships (Arai & Akai, 1988; Okazaki et al., 2001; Nelson, 2006). However Bogutsukaya et al. (2008) retain *Acanthorhodeus* as a distinct genus because of morphological differences between the type-species of *Acanthorhodus* and *Acheilognathus*.

***Acheilognathus tonkinensis* (Vaillant, 1892)**
(Fig. 4i)

Remarks on taxonomy. *Acheilognathus tonkinensis* was originally described from the Red River drainage in the northern part of Vietnam. Although the morphological features fitted into the description of *A. tonkinensis* by Chen (1998), the taxonomic status of this species warrants further research. The color of the marginal band on the anal fin in the male is white.

***Acheilognathus chankaensis* (Dybowski, 1872)**
(Fig. 4k)

Remarks on taxonomy. *Acheilognathus chankaensis* was originally described from Lake Khanka in Russia. Although the morphological features of our specimens matched the description of *A. chankaensis* by Chen (1998), the taxonomic status of this species requires further research. The color of the marginal band on the anal fin in the male is black.

***Culter alburnus* Basilewsky, 1855**
(Fig. 4l)

Remarks on taxonomy. This species has been mistakenly treated as *Culter erythropterus* or *Chanodoichthys erythropterus* in a number of Chinese studies (e.g., Mao et al., 1991; Chen, 1998). The problems associated with this taxonomical mistake have already been explained by Kottelat (2001) and Bogutskaya et al. (2008). *C. alburnus* is the species called "hun boyu" in China. This species has a long abdominal keel from the pectoral to the anal fins, and the lower part of the anal and caudal fins of living adults is red.

***Chanodichthys erythropterus* (Basilewsky, 1855)**
(Fig. 4m)

Remarks on taxonomy. This species has been mistakenly reported as *Culter alburnus* in some Chinese works (e.g., Chen, 1998). Bogutskaya et al. (2008) demonstrated that *Erythroculter ilishaeformis* Bleeker, 1871, is a synonym of *C. erythropterus*. This species has an abdominal keel from the pelvic to the anal fins.

***Sinibrama wui* (Rendahl, 1932)**
(Fig. 5d)

Remarks on taxonomy. Although Mao et al. (1991) recorded *Sinibrama macrops* (Günther, 1868) in the East and West Tiaoxi Rivers, our specimens were all identified as *S. wui* by following Xie et al. (2003a, 2003b) and Zhang et al. (2004).

***Cyprinus carpio* Linnaeus, 1758**
(Fig. 5f)

Remarks on taxonomy. The systematics of the Asian *Cyprinus* is very confusing (Kottelat, 2001). Genetic data show that Asian *"Cyprinus carpio"* includes several different species (Mabuchi et al., 2005).

***Carassius auratus* (Linnaeus, 1758)**
(Fig. 5g)

Remarks on taxonomy. Although Mao et al. (1991) recorded *C. auratus gibelio* (Bloch, 1782) in the East and West Tiaoxi Rivers, the taxonomic status of the species is not clear (Kottelat & Freyhof, 2007; Bogutskaya, 2008; Takada et al., 2010). *Carassius gibelio* is apparently restricted to Europe.

***Cirrhinus cirrhosus* (Bloch, 1795)**
(Fig. 5j)

Remarks on taxonomy. This species is native to the Ganges and Brahmaputra rivers of the Indian

Subcontinent (Roberts, 1997). Several individual were caught at two sites; therefore, we predict that this exotic species is breeding naturally in the East Tiaoxi River.

***Cirrhinus molitorella* (Valenciennes, 1844)**
(Fig. 5k)

Remarks on taxonomy. This species is native to the Minjiang River, Pearl River, Red River, Mekong River, and Hainan Islands (Roberts, 1997; Yue, 2000) and it may be an exotic species in the East Tiaoxi River system. This species differs from all other species of the genus in having discrete marks on each scale (Roberts, 1997).

***Zacco platypus* (Temminck & Schlegel, 1846)**
(Fig. 7e)

Remarks on taxonomy. This species was originally described on the basis of Japanese specimens. There are large genetic differences between Japanese and Chinese populations (Chen et al., 2009b). The nuptial color of the male appear different in the Japanese populations

Rhynchocypris oxycephalus
(Sauvage & Dabry de Thiersant, 1874)
(Fig. 7c)

Remarks on taxonomy. Mao et al. (1991) recorded *Phoxinus lagowskii variegates* in the East and West Tiaoxi Rivers, but the species distributed around the Yangtze River Basin has been identified as *Phoxinus oxycephalus* by Chen (1998). Most Asian species originally classified as *Phoxinus* in fact belong to *Rhynchocypris* (Sakai et al., 2006).

***Cobitis sinensis* Sauvage & Dabry de Thiersant, 1874**
(Fig. 7f)

Remarks on taxonomy. The reported morphological characters of this species are confusing (Kim et al., 1999; Son & Kim, 2002; Chen & Chen, 2005a). However Kim et al. (2003) stated that the type specimens of *C. sinensis* have a series of vertical blotches in the fourth Gambetta's zone and males have an elongated lamina circularis. Therefore, we identified our specimens as *C. sinensis*.

***Cobitis dolichorhynchus* Nichols, 1918**
(Fig. 7g)

Remarks on taxonomy. We captured some *Cobitis* specimens with a roundish lamina circularis in the males. The morphological characters were similar to those of *C. dolichorhynchus*, as described by Nichols (1943). However, the taxonomic status of this species requires further research.

***Cobitis laterimaculata* Yan & Zheng, 1984**
(Fig. 7h)

Remarks on taxonomy. Son & He (2001) transferred this species to the genus *Niwaella*, and Chen & Chen (2005b) supported this decision from the viewpoint of morphology. However, some phylogenetic classifications suggest that this species is related to *Cobitis* rather than *Niwaella* (Tang et al., 2006, 2008; Šlechtová et al., 2008). Therefore we retain this species in the genus *Cobitis*.

***Vanmanenia pingchowensis* (Fang, 1935)**
(Fig. 7l)

Remarks on taxonomy. The taxonomy of the genus *Vanmanenia* is still unclear. We tentatively identified our specimens by following Yue (2000).

***Liobagrus styani* Regan, 1908**
(Fig. 7n)

Remarks on taxonomy. Although Mao et al. (1991) recorded *Liobagrus mariginatus* (Wu, 1930) in the East and West Tiaoxi Rivers, our specimens were all identified as *L. styani* by following Cheng & Zheng (1987) and Chu et al. (1999).

Tachysurus nitidus
(Sauvage & Dabry de Thiersant, 1874)
(Fig. 8b)

Remarks on taxonomy. Cheng et al. (2009) redescribed *Pseudobagrus (= Tachysurus) fui* (Miao, 1934) from the Yangtze River drainage. Although this species resemble *T. nitidus* in form, our specimens are all identified as *T. nitidus* following Cheng et al. (2009).

***Tachysurus fulvidraco* (Richardson, 1846)**
(Fig. 8e)

Remarks on taxonomy. Ng & Kottelat (2007) reported that *T. fulvidraco* consists of at least two

Fig. 6. Fishes of the East Tiaoxi River. **a,** *Pseudobrama simoni*; **b,** *Hypophthalmichthys molitrix*; **c,** *Hemibarbus maculatus*; **d,** *Paracanthobrama guichenoti*; **e,** *Pseudorasbora parva*; **f,** *Sarcocheilichthys sinensis*; **g,** *S. parvus*; **h,** *S. kiangsiensis*; **i,** *S. nigripinnis*; **j,** *Squalidus argentatus*; **k,** *S. wolterstorffi*; **l,** *Abbottina rivularis*; **m,** *Microphysogobio fukiensis*; **n,** *M. kiatingensis*.

Fig. 7. Fishes of the East Tiaoxi River. **a,** *Huigobio chenhsiensis*; **b,** *Aphyocypris chinensis*; **c,** *Rhynchocypris oxycephalus*; **d,** *Opsariichthys bidens*; **e,** *Zacco platypus*; **f,** *Cobitis sinensis*; **g,** *C. dolichorhynchus*; **h,** *C. laterimaculata*; **i,** *Misgurnus anguillicaudatus*; **j,** *Paramisgurnus dabryanus*; **k,** *Leptobotia tchangi*; **l,** *Vanmanenia pingchowensis*; **m,** *V. stenosoma*; **n,** *Liobagrus styani*.

species. Our specimens are all identified as *T. fulvidraco* following Ng & Kottelat (2009).

***Oryzias sinensis* Chen, Uwa & Chu, 1989**
(Fig. 8h)

Remarks on taxonomy. The species was previously recorded as *Oryzias latipes* in south-western China; however, it is actually *Oryzias sinensis*. The genus *Oryzias* was revised by Parenti (2008).

***Monopterus albus* (Zuiew, 1793)**
(Fig. 8k)

Remarks on taxonomy. Genetic data suggest that *Monopterus albus* of Eastern Asia includes three highly diversified clades (Matsumoto et al., 2010).

***Sinobdella sinensis* (Bleeker, 1870)**
(Fig. 8l)

Remarks on taxonomy. This species has been treated as *Mastacembelus aculeatus* (Bloch, 1786) in most Chinese literatures (e. g. Cheng & Zheng, 1987; Mao et al., 1991). However, Kottelat & Lim (1994) highlighted problems with the classification and created the new genus name *Sinobdella*.

***Siniperca chuatsi* (Basilewsky, 1855)**
(Fig. 8m)

Remarks on taxonomy. Genus *Siniperca* has sometimes been places in Centropomidae or Percichthyidae; however, it needs further taxonomic study (Nelson, 2006).

***Micropercops cinctus* (Dabry de Thiersant, 1872)**
(Fig. 8n)

Remarks on taxonomy. *Micropercops swinhonis* (Günther, 1873) is a synonym of *Micropercops cinctus* (Bogutsukaya et al., 2008).

***Macropodus ocellatus* Cantor, 1842**
(Fig. 9g)

Remarks on taxonomy. Some Chinese studies have misidentified this species as *Macropodus chinensis* (Bloch, 1790) (e. g., Cheng & Zheng, 1987; Mao et al., 1991). However, *M. chinensis* was treated as a synonym of the *Macropodus opercularis* (Linnaeus, 1758), and the *Macropodus* species distributed in the Yangtze River basin have been identified as *M. ocellatus* (Freyhof & Herder, 2002; Winstanley & Clements, 2008).

***Rhinogobius* sp. 1**
(Fig. 9e)

Remarks on taxonomy. Although Li et al. (2012) misidentifies this species as *Rhinogobius lentiginis* (Wu & Zheng, 1985), this is an undescribed species (I.-S. Chen, pers. comm.).

***Rhinogobius* sp. 2**
(Fig. 9f)

Remarks on taxonomy. This is an undescribed species (I.-S. Chen, pers. comm.).

Discussion

Although Mao et al. (1991) have previously reported the fish fauna of the East and West Tiaoxi Rivers, the result were mixed and the fish fauna of each river has remained ambiguous. To the best of our knowledge, this is the first comprehensive report of the fish fauna in the East Tiaoxi River Basin.

We recorded 74 native species in the East Tiaoxi River Basin, and there are 361 native species in the Yangtze River (Fu et al., 2003). The length and drainage area of the East Tiaoxi River are only 151 km and 2265 km^2, respectively; in contrast, the main Yangtze River has a length of 6300 km and its drainage area is 1 175 000 km^2. The data presented here show that the East Tiaoxi River has quite a diverse fish fauna for such a small river basin. It is known that the variability of the physical environment and the habitat contributes to species richness (Allan, 1995). In fact, the East Tiaoxi River Basin has various types of streams, including braided reach (Fig. 2a,b), pool-riffle reach (Fig. 2c), and step-pool reach (Fig. 2d). Therefore, we suggest that the reasons for high fish diversity in the East Tiaoxi River include its variability of the physical environment and the habitat associated with the diversity of reach types.

The East Tiaoxi River is treated as the Taihu Lake sub-basin section of the Yangtze River Basin, and the fish fauna is closely related to that found in the Yangtze River (Fu et al., 2003). Fu et al. (2003) stated that Cyprinidae (54 %), Cobitidae (17 %), and Bagridae (6 %) are the most species-rich families in the Yangtze River basin. In the East Tiaoxi River, we found the top three species-rich families are Cyprinidae (46 %), Cobitidae (5 %), and Gobiidae (5 %). Although the river

scale of the East Tiaoxi River is very smaller than that of the Yangtze River, the fish species composition is very similar.

The main fish fauna of the East Tiaoxi River is basically common to that of the rivers in the temperate regions of East Asia and includes the species *Cyprinus carpio*, *Carassius auratus*, *Abbottina rivularis*, *Pseudorasbora parva*, *Zacco platypus*, *Apyocypris chinensis*, *Rhynchocypris oxycephalus*, and *Silurus asotus*, and the genera *Coilia*, *Rhodeus*, *Tanakia*, *Acheilognathus*, *Hemibarbus*, *Sarcocheilichthys*, *Squalidus*, *Neosalanx*, *Cobitis*, *Liobagrus*, *Tachysurus*, *Oryzias*, *Odontobutis*, and *Rhinogobius*. These are the main taxa that compose a significant part of fish fauna of the temperate regions of East Asia, especially the Korean Peninsula and the northern part of Kyushu Island, Japan (Kim & Park, 2002; Nakajima et al., 2006). In contrast, *Acrossocheilus fasciatus*, two *Vanmanenia* species and *Sinobdella sinensis* are distributed in the East Tiaoxi River. No related species are known from the Korean Peninsula and Kyushu Island, and they belong to families more speciose in subtropical/tropical Asia (Berra, 2001; Yue, 2000). In summary, the fish fauna of the East Tiaoxi River is based on the common East Asian fishes, with the addition of some Southeast Asian fishes. To explain the formation of this fish fauna, we need more detailed information about the geological history of this river system.

In our field survey, the East Tiaoxi River demonstrated a diverse fish fauna and river environment. However Sato et al. (2010) and Kano et al. (2011) have stated that there is a risk of human impact on the aquatic organisms that inhabit this river. In particular, seven species *(Sinibrama wui*, *Sarcocheilichthys parvus*, *Squalidus argentatus*, *Squalidus wolterstorffi*, *Leptobotia tchangi*, *Tachysurus tenuis* and *Siniperca chuatsi)* were only found in a very limited area in the river, and the number of individuals was much lower than that recorded for other species during our field survey. The life history of these species needs to be urgently described to identify and conserve their critical habitats.

In addition, we recorded the presence of 3 exotic species: *Cirrhinus cirrhosus*, *C. molitorella*, and *Gambusia affinis*. These species are native to South Asia, South China, and North America, respectively. These species are not ichthyophagous, and the impacts on the native fish fauna are unclear. However, *G. affinis* competes with *Oryzias latipes*, and *O. latipes* has lost its habitat in Japan (Onikura et al., 2008). The status of these exotic species in the East Tiaoxi River Basin needs to be monitored.

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Fig. 8. Fishes of the East Tiaoxi River. **a,** *Silurus asotus*; **b,** *Tachysurus nitidus*; **c**, *T. taeniatus*; **d**, *T. tenuis*; **e**, *T. fulvidraco*; **f,** *Protosalanx chinensis*; **g,** *Neosalanx tangkahkeii*; **h,** *Oryzias sinensis*; **i,** *Hyporhamphus intermedius*; **j,** *Gambusia affinis*; **k,** *Monopterus albus*; **l,** *Sinobdella sinensis*; **m,** *Siniperca chuatsi*; **n,** *Micropercops cinctus*.

Fig. 9. Fishes of the East Tiaoxi River. **a,** *Odontobutis potamophila*; **b,** *Rhinogobius guirinus*; **c,** *R. cliffordpopei*; **d,** *R. multimaculatus*; **e,** *R.* sp. 1; **f,** *R.* sp. 2; **g,** *Macropodus ocellatus*; **h,** *Channa argus*.

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