# **Research Advances**

# First Report of Osteoglossiform Fish *Huashia* from the Cretaceous of Eastern Liaoning, China



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### Objective

The Mesozoic strata in eastern Liaoning and southern Jilin are relatively well developed. Liu et al. (1963) studied Lycoptera in North China, and they mentioned the fossils of south Jilin, but they were not included in the study due to the lack of specimens and poor preservation. Ma and Sun (1988) studied fish fossils from the Sankeyushu section in Tonghua, Jilin, and laid the foundation for the study of fish fossils in this area. Later, paleontologists came to eastern Liaoning and southern Jilin to investigate fish fossils; Su (1992) collected and studied fish fossils in the Suzihe Basin (Nanzamu, Xinmin Manchu Autonomous County) in eastern Liaoning. The research level in eastern Liaoning and southern Jilin is also very low, but the composition of fossil faunas is different, and they are very important for fish evolution and zoogeographic significance. We have carried out fossil fish surveys in eastern Liaoning and discovered fossils of the freshwater fish Huashia in the Xiaowenzhigou area.

Huashia fossils are distributed in Zhejiang (NIMRF, 2015a), Gansu (NIMRF, 2012), Ningxia (NIMRF, 2015b), Jilin and other regions in China (Ma and Sun, 1988). In western Liaoning, Huashia only appears in the Jiufotang Formation (Fm.) in Binggou Village, Jianchang County. Species of Huashia are unique to East Asia in the Late Mesozoic (Zhang, 2002). Huashia is different from Lycoptera in its stage of development and evolution, because its dentofacial structure tends to be teleost-like, the parasphenoid bone is toothless, and the notochord perforation is small. Huashia is a member of the later fish group of the Jehol Biota (Ma and Sun, 1988). Therefore, the Huashia fossils of eastern Liaoning are of great significance for studying the migration and evolution of Jehol biota. At the same time, the large number of beds with Huashia are significantly higher than the concentration of Lycoptera, which can be used as an important basis for Mesozoic stratigraphic division and comparison.

# **Geological Setting**

The fossils were discovered in Wenzhigou Village, Hualai Town, Huanren County, Benxi City, Liaoning Province, China (GPS: 125°8'13"E, 41°28'43"N, Fig. 1). The studied area is mainly composed of Mesozoic and Pre -Mesozoic granite intrusions and sedimentary caprocks; the strata are composed of Pre-Paleozoic, Paleozoic, Mesozoic and Cenozoic beds. The fossiliferous horizons are part of the Cretaceous Lishugou Fm. More than 50 fossil specimens, including the arthropod Yanjiestheria (Li and Wu, 2021) and the fish fossils were found in a section of beds comprising a yellow-green tuff siltstone, yellowgreen silt mudstone, and dark gray siltstone within the Lishugou Fm. There are nine specimens of Huashia come from yellow-green tuff siltstone in our collection and those relatively well preserved are illustrated in this paper (Fig. 2). Fossils are stored in Liaoning Provincial Institute of Geological Exploration Co., Ltd. (LN-HR), Dalian, China.

## Results

#### Order **Osteoglossiformes** Suborder **Huashioidei** Zhang, 1990 Family **Huashiidae** Chang and Chou, 1977 Genus *Huashia* Chang and Chou, 1977

Species *Huashia* sp.

**Material**: Nine specimens, of which five are illustrated (Fig. 2). Their catalog numbers are LN-HR-022S10 (Fig. 2a), LN-HR-022S08 (Fig. 2b), LN-HR-022S01 (Fig. 2c), and LN-HR-022S06 (Fig. 2d), and LN-HR-022S05 (Fig. 2e): Lishugou Fm. of Albian Stage (Early Cretaceous).

**Description:** All specimens are incomplete. In some, the dorsal and caudal fins are poorly preserved (Fig. 2a); others preserve only the head and part of the trunk (Figs. 2b, d). Some have only caudal peduncle and caudal fins (Fig. 2c). One specimen preserves only the trunk and ventral fins (Fig. 2e). The body of the fish is spindle-shaped with a total length of about 6–7 cm. Length and depth of skull are 1.2–1.5 cm. Length of skull almost

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Fig. 1. Fossil collection location (a) and simplified geological map of the Huanren area (b).

equals to depth of body. The body length is about 4.5 times the body depth, and 1.5 times the depth of caudal peduncle. The parietal bone is poorly preserved but large and with a foramen temporale. Snout length is about 0.7 cm, maxilla and teeth is not clear, and the dental sclerite is large. The opercular is large and oval. Vertebral ossification is complete, with a large notochord perforation in the center (Fig. 2e). There are 18-20 pairs of ribs (Fig. 2e). There are some 30+ vertebrae in all but the number of tail vertebrae is unknown. The dorsal fins are not preserved, and the anal and ventral fins are poorly preserved. The caudal fins have large bifurcations and shallow splits, with 16 bifurcated fin rays (Fig. 2c). The pectoral fins are large and low, with 6 pairs of ribs to the caudal fin and 8 fin rays (Fig. 2d). The eyes are large, with a diameter about 1/3 of the skull length, and the supraorbital is faintly visible (Fig. 2a).

The characteristics of these fish fossils are broadly consistent with the characteristics of *Huashia* discovered in Sankeyushu section of Tonghua, Jilin reported by Ma and Sun (1988). We consider that the fish fossils from the Lishugou Fm. in the Wenzhigou area should be assigned to the genus *Huashia*. As the fossils have not yet been not prepared, some details cannot be observed and, as such, they are not identified to species level.

#### Conclusions

The discovery of *Huashia* in the Cretaceous Lishugou Fm. from eastern Liaoning not only expands the

distribution of the Jehol biota, but also supports the hypothesis that some organisms of that biota migrated from western Liaoning to the Korean Peninsula and Japan (Chang et al., 2003) through eastern Liaoning in the late Early Cretaceous. The fish fauna gradually evolved during migration; Lycoptera tends to disappear, whereas Huashia appears in large numbers. The deposition period of the Huashia-bearing layer in the Lishugou Fm. is also proven to be later than that of the Yixian Fm. and Jiufotang Fm. in western Liaoning, and we speculate that the sedimentary age of the Lishugou Fm. is similar to that of Shahai Fm. in western Liaoning. If this hypothesis is correct, then as the Jehol biota migrated eastwards, other elements, such as Ephemeropsis, birds, and dinosaurs, should also appear in eastern Liaoning. Therefore, we suggest that further paleontological investigation of the Lishugou Fm. for evidence of the Jehol Biota is needed.

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Fig. 2. Photographs of *Huashia* sp. fossils from the Lishugou Formation in the Wenzhigou area of eastern Liaoning Province. (a) LN-HR-022S10 showing articulated skeleton except tail; (b) LN-HR-022S08 showing head to anterior vrtebrae only; (c) LN-HR-022S01 showing tail and caudal vertebrae; (d) LN-HR-022S06 showing head to mid-body; (e) LN-HR-022S05 showing pectoral fin and mid-body vertebrae.

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