

The significance of the Middle Pleistocene freshwater fishes from the Nogami Formation in Kyushu, Japan based on the study of phylogeny and paleobiogeography of the genus *Nipponocypris*

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Many well preserved freshwater fish fossils have been found from the Middle Pleistocene Nogami Formation, which is a lacustrine diatomaceous bed in Kusu Basin, Oita Prefecture in the northern part of Kyushu, Japan. Six species, five genera and six families have been recognized. These are *Oncorhynchus masou* subsp. of Salmonidae, *Hemibarbus barbus x labeo*, *Zacco* cf. *Z. temminckii* (= *Nipponocypris* sp.) and *Acheilognathus* sp. of Cyprinidae and *Rhinogobius brunneus* and *R. similis* of Gobiidae.

These fossils are important to study about the origin and history of the Recent freshwater fish fauna of Japan and East Asia, because many well preserved specimens allow us to accomplish the phylogenetic and paleobiogeographical studies of each species based on the comparison with Recent ones. In the present study, we conducted the phylogenetic and paleobiogeographical studies of Recent opsariichthins and the fossils from the Middle Pleistocene Nogami Formation in Oita Prefecture, Northern Kyushu, Japan.

The opsariichthin group is one of the common Asian endemic cyprinid fishes, which is distributed in China, Southeastern Asia, Korea, eastern Russia, Taiwan and Japan, and consists of following five genera: *Zacco*, *Opsariichthys*, *Parazacco*, *Candidia*, and *Nipponocypris*. Fossils of opsariichthins have been found from the Pleistocene Nogami Formation of Kusu Basin in Oita, the Miocene deposits in Ishikawa Prefecture, Japan, the Lower Eocene Buxin Formation in China and others.

The fossil opsariichthin from the Nogami Formation is assigned to the genus *Nipponocypris* because of eight supraneurals, the posterior margin of the opercle concave and 42-44 vertebrae. The genus consists of following three species: *Nipponocypris temminckii*, *N. sieboldii* and *N. koreanus*.

The result of the cladistic analysis of Recent and fossil opsariichthins suggest that the fossil opsariichthin from the Nogami Formation is the sister species of *Nipponocypris temminckii*. It indicates the possibility that the ancestor of *N. temminckii* appeared at latest the Middle Pleistocene time. The existence of this fossil and *N. temminckii* distributed in the western part of Japan and the southern part of Korean Peninsula suggest that *N. temminckii* probably derived in Japan and migrated to Korean Peninsula after the Middle Pleistocene. This is significant to understand the origin and speciation of other Japanese freshwater fishes having the same distribution pattern like *Coreoperca kawamebari*.

Keywords: Cyprinid fishes, Pleistocene, Nogami Formation, freshwater fishes, *Nipponocypris*, opsariichthins