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# 主論文の要約

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## 学 位 論 文 題 目

Comparative morphology and phylogenetic relationships of the family  
Polynemidae (Pisces: Perciformes)

（ ツバメコノシロ科魚類の比較形態学および系統類縁関係に関する  
研究 ）

The family Polynemidae (sensu Nelson, 2006), known as threadfins, is classified into the perciform suborder Percoidei, and comprises eight valid genera and about 50 species (e.g., Feltes, 2003; Motomura, 2004; Nelson et al., 2016). This family is characterized by the diagnostic features such as the body elongated to deep and compressed, the adipose eyelid covering the eye, and the pectoral fins divided into an upper part with 12 to 19 rays joined by membrane and a lower part with three to 16 separate filament-like rays (see Motomura, 2004; Nelson, 2006).

Polynemidae has been variously classified by many ichthyologists. For example, Nelson (1984) recognized that Polynemidae includes seven genera. Feltes (1993) described a new genus *Parapolynemus*, and redefined the family including seven genera with synonyms of *Polistonemus* under *Polynemus*. More recently, Motomura (2004) recognized eight genera, *Eleutheronema*, *Filimanus*, *Galeoides*, *Leptomelanosoma*, *Parapolynemus*, *Pentanemus*, *Polydactylus* and *Polynemus*, and several authors have

followed this definition. Many authors showed various candidates of the sister group of Polynemidae; then, Kang et al. (2017) confirmed the monophyly of the family Polynemidae by 19 synapomorphies, and showed the evidences to support the sister relationship of Polynemidae and Sciaenidae. However, phylogenetic relationships providing the basis of the classification have not been reconstructed in the Polynemidae.

The goals of the present study are: (1) to show the monophyly of this family and the sister relationship of Polynemidae and Sciaenidae; (2) to describe its osteological and myological characters; (3) to reconstruct its phylogenetic relationships based on morphological characters; and (4) to discuss the classification of Polynemidae.

### **Materials and systematic methodology**

25 polynemid species in eight genera, and 86 acanthomorph species in 8 orders and 63 families were selected as study materials and comparative materials (of them, 11 sciaenid species were used as outgroup in phylogenetic analysis), respectively.

Anatomical examinations were made on specimens stained in alcian blue and alizarin Red-S, and dissected under stereo-microscope utilized in the preparation of drawings.

In order to reconstruct phylogenetic relationships of Polynemidae, the cladistic approach formulated by Hennig (1966) was adopted. The outgroup comparison was used to determine the character polarity (Watrous and Wheeler, 1981; Wiley, 1981).

### **Monophyly of the family Polynemidae**

Kang et al. (2017) concluded that the monophyly of the family Polynemidae was strongly supported by 19 synpomorphies of Polynemidae such as the tooth plate present on the ectopterygoid, the metapterygoid and quadrate interdigitated medially, an unnamed bone present on the cephalic sensory canal extending from the supratemporal, the third actinost not supporting pectoral-fin rays, a rod-like process extending from the

ventral margin of the coracoid, and the adductor mandibulae section 1 comprised the lateral and medial elements. In addition to the 19 synapomorphies, a single new synapomorphy was found in this study: levator arcus palatini divided into two subsections, anterior and posterior subsections. Thus, this study recognizes 20 synapomorphies supporting the monophyly of Polynemidae.

### **Sister relationship of Polynemidae and Sciaenidae**

Kang et al. (2017) proposed the sister relationship of Polynemidae and Sciaenidae supported by six synapomorphies including two rare (metapterygoid and quadrate interdigitated medially, and anterior extension of nasal canal present), two rather rare and two common derived characters. This study sustains this conclusion, and use Sciaenidae as the outgroup in the phylogenetic analysis.

### **Phylogenetic relationships of Polynemidae**

Phylogenetic relationships of the family Polynemidae were reconstructed by characters in 64 transformation series. Four most parsimonious trees of Polynemidae were obtained after the phylogenetic analysis. The tree length was 153, consistency index 0.49 and rescaled consistency index 0.35. In this study, the strict consensus tree was constructed on the basis of four parsimonious trees and adopted as the relationships of Polynemidae. The monophyly of each of *Filimanus* and *Polynemus* was retained, and *Pentanemus* and *Parapolynemus* were monotypic. Therefore, the validity of each of these genera was supported in this study. In contract, *Eleutheronema*, *Leptomelanosoma* and *Galeoides* were nested within *Polydactylus*.

### **Classification**

The validity of genera *Filimanus*, *Pentanemus*, *Parapolynemus* and *Polynemus* is supported in this study. However, the genus *Polydactylus* was assumed to be a

non-monophyletic group in the four most parsimonious trees, because *Eleutheronema*, *Leptomelanosoma* and *Galeoides* are nested within *Polydactylus*. To avoid to recognize the cladistically invalid genus, this study propose a newly-defined genus including species of *Polydactylus*, *Eleutheronema*, *Leptomelanosoma* and *Galeoides*. Accordingly, the latter three genera are synonymized under *Polydactylus* having priority over them.

This study redefined Polynemidae as a family including five genera. The new classification of Polynemidae is summarized as follow:

Family Polynemidae

*Filimanus* Myers, 1936

*Parapolynemus* Feltes, 1993

*Pentanemus* Günther, 1860

*Polydactylus* Lacepède, 1803 (synonyms: *Galeoides* Günther, 1860, *Eleutheronema* Bleeker, 1862 and *Leptomelanosoma* Motomura and Iwatsuki, 2001)

*Polynemus* Linnaeus, 1758 (synonym: *Polistonemus* Gill, 1861)

## Literature Cited

- Feltes, R.M. (1993) *Parapolynemus*, a new genus for the polynemid fish previously known as *Polynemus verekeri*. *Copeia*, 1993, 207–215.
- Feltes, R.M. (2003) Polynemidae. In: K.E. Carpenter (ed.), *The living marine resources of the Western Central Atlantic. Vol. 3: Bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals. FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication. No 5*. FAO, Rome, pp. 1578–1582.
- Hennig, W. (1966) *Phylogenetic systematics*. University of Illinois Press, Urbana, 263

pp.

Kang, S.H., Imamura, H. & Kawai, T. (2017) Morphological evidence supporting the monophyly of the family Polynemidae (Teleostei: Perciformes) and its sister relationship with Sciaenidae. *Ichthyol. Res.*,  
<https://dx.doi.org/10.1007/s10228-017-0591-6>.

Motomura, H. (2004) *Threadfin of the world. FAO species catalogue for fishery purposes*. No. 3. FAO, Rome, 117 pp.

Nelson, J.S. (1984) *Fishes of the world. 2nd edition*. John Wiley & Sons, New York, xv+475 pp.

Nelson, J.S. (2006) *Fishes of the world. 4th edition*. John Wiley & Sons, New York, xix+601 pp.

Nelson, J.S., Grande T.C. & Wilson M.V.H. (2016) *Fishes of the world, 5th edition*. John Wiley & Sons, Hoboken, xvi+707 pp.

Watrous, L.E. & Wheeler, Q.D. (1981) The out-group comparison method of character analysis. *Syst. Zool.*, 30, 1–11.

Wiley, E.O. (1981) *Phylogenetic: the theory and practice of phylogenetic systematic*. John Wiley and Sons, New York, xv+439 pp.