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Phylogenetic systematics of the family Sillaginidae (Percomorpha: order Perciformes)

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Abstract

The phylogenetic relationships of the family Sillaginidae are inferred based on morphological characters. The Sillaginidae is revealed as being a monophyletic group supported by 16 synapomorphies such as shortened segments on the first soft ray of pelvic fin and the adductor mandibulae section A2 covering section A1 laterally. The characters recognized in 24 transformation series were used for the phylogenetic analysis to reconstruct the interrelationships of the family. Twelve equally most parsimonious trees were obtained in the analysis. A strict consensus tree from the 12 trees was adopted as representing the phylogenetic relationships of the family Sillaginidae. Although reversals and character changes to other derived conditions are recognized, it is inferred that five characters additionally support the monophyly of the Sillaginidae. The family Sillaginidae is redefined based on the synapomorphies supporting its monophyly for the first time. In the new classification proposed, the Sillaginidae comprises the following five genera: *Sillago*, *Sillaginopsis*, *Sillaginodes*, *Sillaginopodys*, and *Sillaginops* gen. nov. A key to identification of the genera of Sillaginidae is provided. The family Sillaginidae contains two groups having different evolutionary trends in the reconstructed phylogeny of the family. The first group, including *Sillaginopsis*, *Sillaginodes*, *Sillaginopodys*, and *Sillaginops* gen. nov., has a trend towards reducing the swimbladder; and the second group, including only *Sillago*, has a trend towards further refining the swimbladder.

Key words: Phylogeny, Sillaginidae, Monophyly, Evolutionary trend, *Sillaginopsis*, *Sillaginodes*, *Sillaginopodys*, *Sillaginops*, new genus

Introduction

The family Sillaginidae Richardson, 1846, commonly known as sand whitings or sand borers (McKay, 1992), belongs to the perciform suborder Percoidei (e.g., Greenwood *et al*., 1966; Johnson, 1993; Nelson, 2006). According to McKay (1992), Nelson (2006), Kaga *et al*. (2010), and Gao *et al*. (2011), the family consists of three genera and about 33 species. Sillaginids inhabit shallow marine waters, estuaries, and rarely into freshwaters of the Indo-West Pacific (McKay, 1992; Nelson, 2006). Several members are important inshore fishery and recreational sport fishing species, including *Sillaginodes* and *Sillago* (*Parasillago*) *japonica* (McKay, 1992; Konishi & Nakabo, 2007).

Golani *et al*. (2011) rehabilitated *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829, from the synonym of *S. sihama* (Forsskål, 1775), and the species *S. sihama* was restricted to the southern Red Sea. However, the status of *S. erythraea* and *S. sihama* is still uncertain.

The family Sillaginidae is characterized by the following characters: body elongated; mouth small; two dorsal fins with little or no interspace, the first dorsal fin bearing 10–13 spines, the second dorsal with one slender spine and 16–27 soft rays; the anal fin with two small spines and 14–26 soft rays; three supraneural bones; swimbladder absent or vestigial to highly complex with various extensions; and 32–44 vertebrae (Nelson, 2006).

The systematic position of the family Sillaginidae is still uncertain, although Springer and Orrell (2004) showed the close relationships with Rhyacichthyidae and Percidae by the phylogenetic analysis based on dorsal gill-arch muscles and skeleton.

The Sillaginidae has been variously classified by previous ichthyologists. Gill (1861) recognized two genera, including *Sillago* Cuvier, 1817 and *Sillaginopsis* Gill, 1861, but subsequently, Gill (1862) added a new genus *Sillaginodes*. Bleeker (1874) followed Gill (1862) in recognizing the three genera. In contrast, Boulenger (1901) recognized only *Sillago*. Fowler (1933) recognized two subgenera (*Sillago* and *Sillaginopodys*) in the genus *Sillago*. McKay (1985) divided the genus *Sillago* into three subgenera based on morphology of the swimbladder: the subgenus *Sillaginopodys* Fowler, 1933 with a reduced swimbladder, the subgenus *Sillago* Cuvier, 1817 with two posterior extensions of the swimbladder, and the subgenus *Parasillago* McKay, 1985 with one simple posterior extension and duct-like process. Recently *Sillago* (*Parasillago*) *indica* McKay, Dutt & Sujatha, 1985 was reassigned to the subgenus *Sillago* from the observation of the swimbladder by Kaga & Ho (2012). However, some researchers have not supported McKay's subgenera (e.g., Nelson, 2006).

Fowler (1933) separated the Sillaginidae into two subfamilies, Sillaginae (including *Sillago* and *Sillaginodes*) and Sillaginopsinae (including *Sillaginopsis*). However, recent authors have not recognized Fowler's subfamilies (e.g., McKay, 1985, 1992; Nelson, 2006).

Such taxonomic disagreements of the composition of the Sillaginidae have arisen because of the lack of understanding of its phylogenetic relationships, which can provide the basis for classification.