



## Revision of *Flagellotrema* Ozaki, 1936 (Digenea, Gyliachenidae Fukui, 1929), including the description of two species from acanthuroid fishes from the Great Barrier Reef, Queensland, Australia

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### Abstract

The taxonomy of the Gyliachenidae Fukui, 1929 (Digenea) has been confounded historically by 2 main factors: difficulty in specimen preparation and varying opinion as to the consistency of morphological characters, such as the morphology of the oesophagus and the position of the ovary. Distinction between *Flagellotrema* Ozaki, 1936 and *Gyliachen* Nicoll, 1915 has been blurred by overlap in the diagnoses of these genera. Here we provide a diagnosis for *Flagellotrema*, definitively separating it from *Gyliachen*. We define *Flagellotrema* as possessing an oesophagus with at least 1 loop, an intertesticular ovary, and a cilia-like lining of the genital atrium, and also by the position of the genital pore definitively posterior to the intestinal bifurcation. We redescribe the type-species, *Flagellotrema convolutum* Ozaki, 1936 from *Prionurus scalprum* (Acanthuridae) from Japanese waters, based on our examination of type material and the literature, and describe 2 new cryptic species from acanthuroid fishes of the Great Barrier Reef, Australia. *Flagellotrema amphitrite* n. sp. is described from *Prionurus maculatus* from Heron Island, Great Barrier Reef, Australia and *Flagellotrema reburrus* is described from *Siganus punctatus* (Siganidae) from the same location. We also record *F. reburrus* from 3 other species of *Siganus*, *S. corallinus*, *S. doliatus* and *S. vulpinus* from Heron and Lizard Islands, Australia. Distinction between *F. amphitrite* and *F. reburrus* is difficult, and is based on the combination of morphometric data and sequence data from ITS2 and 28S (D1–D3) rDNA and ND1 mtDNA genes. We provide a taxonomic key to species of *Flagellotrema* and discuss the taxonomy and biogeography of the group. The description of 2 new species from acan-

thuroid fishes on the Great Barrier Reef, Australia, expands the geographic range of *Flagellotrema* from Japan to the greater western Pacific Ocean.

**Key words:** *Flagellotrema amphitrite* n. sp., *Flagellotrema reburrus* n. sp., *Flagellotrema* Ozaki, 1936, Gyliachenidae, Digenea, *Prionurus*, Acanthuridae, *Siganus*, Siganidae, Great Barrier Reef, Australia, Indo-West Pacific, taxonomic key

## Introduction

*Flagellotrema* Ozaki, 1936 was proposed for a new species of gyliachenid from the intestine of *Prionurus scalprum* Valenciennes, 1835 (Acanthuridae) from Japanese waters (Ozaki 1936); Ozaki (1933) had previously proposed *Telotrema caudatum* Ozaki, 1933 from the same host in the same waters. This new species was distinguished from *T. caudatum* by its smaller body size and differently shaped excretory papilla (Ozaki 1936). Ozaki concluded that these characters warranted a new genus of gyliachenid, and designated the new species, within the genus *Flagellotrema*, as *F. convolutum* Ozaki, 1936. The genus was diagnosed, by Ozaki (1936), by the presence of an intertesticular ovary, in contrast to the pretesticular position in species of *Gyliachen* Nicoll, 1915 and *Paragyliachen* Yamaguti, 1934, and the presence of a small excretory papilla. Yamaguti (1970) described 2 new species of *Flagellotrema*, *F. centropygis* Yamaguti, 1970 and *F. potteri* Yamaguti, 1970, and proposed the new combination of *Ichthyotrema chaetodontis* Manter & Pritchard, 1962 as *F. chaetodontis* (Manter & Pritchard, 1962). In their major review of the Gyliachenidae, Nahhas & Wetzel (1995) recognised all 4 species within *Flagellotrema*, and according to their key, diagnosed *Flagellotrema* as having an intertesticular or post-testicular ovary. These 3 latter species are clearly distinguished from the type-species, *F. convolutum*, by the possession of a large oesophageal bulb, which is larger than the pharynx, and have since been transferred by us to a new genus, *Hadrobolbus* Hall & Cribb, 2005 (see Hall & Cribb 2005a).

The key presented by Nahhas & Wetzel (1995), and the diagnosis of *Flagellotrema*, to which which it alludes, highlights a fundamental problem in the taxonomy of the Gyliachenidae. The overlapping diagnoses of genera make the placement of new species difficult. *Flagellotrema* and *Gyliachen* are each currently defined by the variable topography of the ovary, which may be variously pre-, inter- or post-testicular. The taxonomy of the Gyliachenidae is challenging and is hindered by two key factors:

1. Difficulties with specimen preparation.

Gyliachenids are notoriously difficult to prepare for microscopy; the worms are cylindrical, or conical, and this low surface area to volume ratio hampers penetration of ethanol and clearing agents. Frequently, specimens are incompletely dehydrated and cleared. Some workers have flattened specimens to overcome these problems, however, flattening often results in distortion of the internal morphology, particularly of the reproductive system. Additionally, flattening specimens can obscure gross morphological features, such as the excretory papilla. The presence of the papilla on many of the species is, in itself, an obstacle to specimen preparation; the preparation of dorsoventral wholemounts is often impossible to achieve without fracture of the papilla or posterior half of the body. Further, the specimens are heavily pigmented, often red-orange or yellow in life, and are richly invested with glands. The large number of pigment cells in the parenchyma (Ozaki 1937) and profuse glands surrounding the oesophagus and terminal genitalia presents obstacles for staining; stain uptake by the parenchyma and gland cells is intense and often obscures visibility of internal morphology. We have detailed previously a protocol which results in the preparation of good quality wholemounts and which has ameliorated many of the problems outlined above (Hall & Cribb 2000). Where practical, we prepare parallel sets of laterally and dorsoventrally mounted specimens, and recommend this approach to other workers.

2. An absence of consensus regarding the significance of morphological characters, especially the structure of the oesophagus.

The structure of the oesophagus of some species of gyliachenids can be difficult to interpret, largely because of the difficulties in preparing specimens. The oesophagus is often entirely surrounded by dense