

Pioneer studies on some microscopic organisms: an unknown aspect of species diversity in paddy fields

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Introduction

A vast species diversity nurtured in the paddy field area has been recognized by many people in Japan. Kiritani (2010) listed 5,668 species of organisms associated with rice paddy ecosystems in Japan. This is more than triple the number of the reported species from Lake Biwa, the largest and oldest lake in Japan (cf. Timoshkin et al. 2010)

Kiritani's list, however, seems to be wanting in many taxonomic groups, especially microscopic ones. For instance, none of Gastrotricha and Xanthophyceae is listed, although these classes clearly include members of any paddy field community.

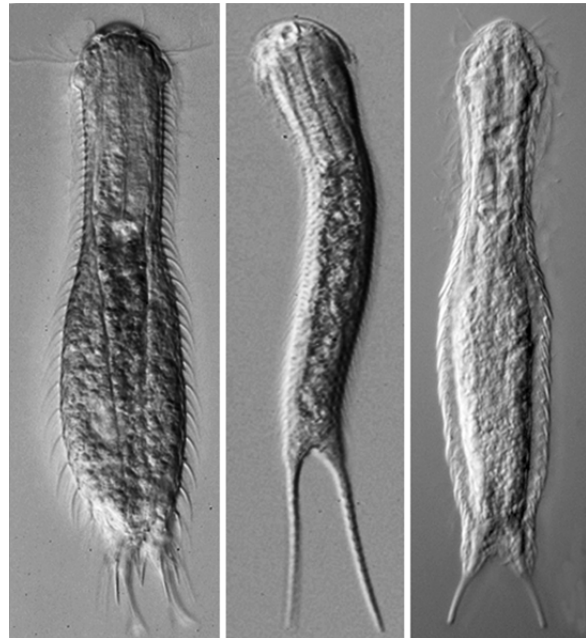
We have attempted to reveal the species diversity of microscopic organisms in paddy fields in Shiga Prefecture, an area largely correspond to the Lake Biwa catchment. Here we present a primary report on species diversity of Chaetonotida (Gastrotricha, Gastrotrichia) and diatoms (Bacillariophyceae, Heterokontophyta) in paddy fields in Shiga.

Paddy fields as a home of diverse Chaetonotida

Chaetonotid gastrotrichs are among of the smallest metazoans, with a body length of usually 100-200 μm . Thirty-two species have been reported from Japan, but none species appears on Kiritani's list. Yamazaki et al. (2004a, b) found some Chaetonotida in a paddy field in Aichi Prefecture in Central Japan, but they were only identified to the order level.

T. Suzuki, one of the present authors, studied Chaetonotida in twelve paddy fields located in Otsu City, Shiga Prefecture, from May to June, 2009. Samples were collected from plants hanging from levees, water near the plants, and bottom sediment with decomposing rice straw.

In total, 43 species of Chaetonotida including unidentified ones were found. This exceeds the total number of species so far reported from Japan. In addition, at least five of them are probably new species, which are now undergoing carefully examined prior to



Examples of undescribed species of
Chaetonotida found in paddy fields

formal description.

Why such a common taxonomic group in rice paddies has been nearly completely neglected until now may be ascribed to unsuitable sampling methodology. Because Chaetonotida belong to the microbenthos, they are usually rare in plankton samples. Furthermore, they are also rare in benthos samples because of being too small to remain in a sieve. It is possible to obtain a good number, however, by washing plants or sediment, or collecting water from just above the surface of plants or sediment. Our finding suggests that new sampling methodology, especially focusing around the interface between water and substratum, will enhance awareness of new and unexpected aspects of the species diversity of paddy fields.

Diatom: a potential indicator of paddy field environment

Diatoms are the most common microalgae, responsible for about 25% of the earth's photosynthesis. They are also known for their high species diversity ($>2 \times 10^4$

species) and for being excellent environmental indicators. They are also very common in paddy fields, but their taxonomy and their potential as environmental indicators there have been little studied. While only 45 species appeared in Kiritani (2010), more than 200 species have been already reported from the paddy fields in past literature. For instance, Ohtsuka & Fujita (2001) reported 92 species from a parcel of paddy field.

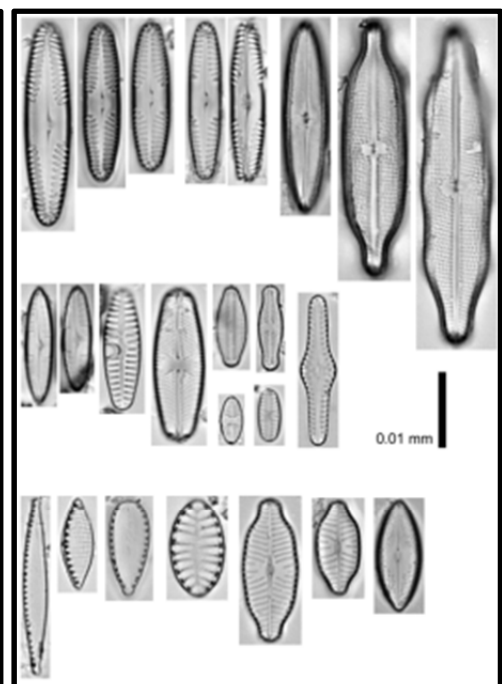
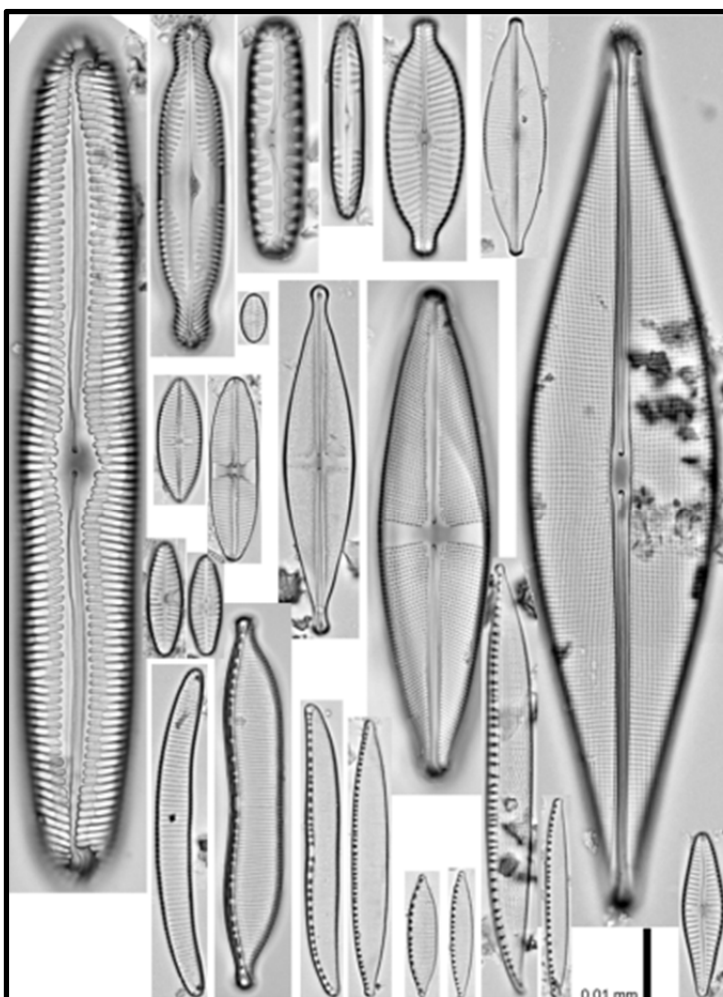
T. Ohtsuka, one of the present authors, studied diatoms in 65 paddy fields across Shiga Prefecture in May and June, 2009. Although examinations have not been completed, more than 250 species of diatom including unidentified ones have already been found in these samples.

Some remarkable diatom species uncommon in natural wetlands were observed in paddy fields. Many of them were common in paddies with herbicide application, while they were relatively rare in herbicide-free paddies. Diatom species composition, therefore, can indicate the herbicide use.

In addition, we found that some larger diatom species (e.g., *Craticula*, *Stauroneis*, and *Pinnularia* spp.) were often more abundant in non-tilled paddies than in adjacent tilled ones. Although the generality and mechanism for this pattern are still unclear, it also demonstrates how the diatom assemblage may serve as an indicator of a sound paddy-field environment.

Literature cited

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Diatoms of a non-tilled paddy field (right) and those of a tilled one (left) in the same region. Note that larger diatoms are more abundant in the former paddy than the latter.