Freshwater Phytoplankton in Thailand I: Euglenophyceae

Ladda Wongrat[1], Prachit Wongrat[1], Suneerat Ruangsomboon[2]

[1]Department of Fishery Biology, Faculty of Fisheries, Kasetsart University, Bangkok 10900, Thailand.
[2]Department of Fishery Science, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang, Bangkok, Thailand.

Abstract

This article is a part of a series of diversity study on freshwater phytoplankton of Thailand. The study based upon examinations of 248 plankton samples collected from various types of water bodies in the central and eastern parts of the country, during 1998 and 2003. A list of one hundred and six species, thirty-three varieties, and two forms of euglenoids is provided. Many of the taxa encountered are well known cosmopolitan forms. A further illustrated and brief taxonomic description of the first record taxa is also given. This includes fifty species, twenty-one varieties, and two forms. This study provides baseline data for future diversity and ecological studies of freshwater phytoplankton in Thailand.

Key words : Euglenophyceae, diversity study, freshwater phytoplankton, tropical region, Thailand.

Introduction

Thailand is one of the tropical countries who has a great diversity of flora and fauna. Its tropical ecosystems supports a rich and diverse flora and fauna which have high levels of endemisms. Many species and habitats have been destroyed due to deforestation, extensive land development for agriculture, industries and tourisms. The destruction has increasingly been informed but can not be measured due to lack o knowledge of biological resources, especially the impact of human activities.

The current policy of biodiversity conservation of Thailand originates from the Convention on Biological Diversity which was signed by 157 governments at the Earth Summit in Rio in June 1992, entered into force at the end of 1993. Thereafter, biodiversity is a major issue on the global agenda. The Biodiversity Convention provides a framework, which will enable each government to decide for itself how best to conserve its own diversity. Recognizing this issue, the Program for Biodiversity Research and Training (BRT) was established in 1994 in order to promote research on and conservation and sustainable use of biological resources.

The study on diversity of euglenoids is a subproject (Chlorophyta and Chromophyta) of the main project "Diversity of freshwater plankton in Thailand". We work in collaboration with researchers of Khon Kaen University, and Prince of Sonkhla University. Other three subprojects on plankton diversity are : Cyanophyta, Rotifera, and Crustaceans (Copepoda and Cladocera).

The identification were mainly based on morphological characters observed under light microscopy. The main classification and identification keys used are: Gojdics, 1953; Huber-Pestalozzi, 1955; Prowse, 1958; Weik, 1967; Yamagishi, 1975, 1987, 1992.

Materials and Methods

The euglenoids recorded in this report were collected from various types of freshwater bodies, i.e. reservoirs, man-made lake, rivers, canals, ponds, ditches, rice and fields. The sampling sites or provinces are located in the central part of Thailand (12°N to 14° 56′ and 99°E to 100° 54′ E). All of them are characterized as lowland area (Fig. 1). Eighteen provinces are as follow:

C1- Nakhon Sawan
C2-Uthai Thani
C3-Chai Nat
C4-Lop Buri
C5-Sing Buri
C6-Ang Thong
C7-Suphan Buri
C8-Phra Nakhon Si Ayuthaya
C9-Bangkok
C10-Nonthaburi
C11-Pathum Thani
C12-Nakhon Pathom
C13-Saraburi
C14-Samut Prakan
C15-Samut Songkhram
C16-Samut Sakorn
C17-Ratchaburi
C18-Phetchaburi
C19-Nakorn Nayok
E1-Chachoengsao
E2-Chon Buri
E3-Rayong
E4-Chanthaburi
E5-Trat
E6-Prachin Buri
E7-Sa Keaw

Most samples were taken form the surface of the water bodies by horizontal towing method with plankton nets of 20 and 40 mesh sizes. However, at some stations with deep water, vertical towing method was employed as well. Phytoplankton samples were fixed in 4% formaldehyde, after live species identification was already made. All samples are kept at the Natural Science Museum of Fisheries, Kasetsart University. Some physical and chemical properties of water (i.e. temperature, DO, pH, conductivity and salinity) were also carried out. This study was made during December, 1998 to November, 1999 and December, 1999 to November 2000.

This paper is the first attempt to identify euglenoids from freshwater bodies in Thailand.

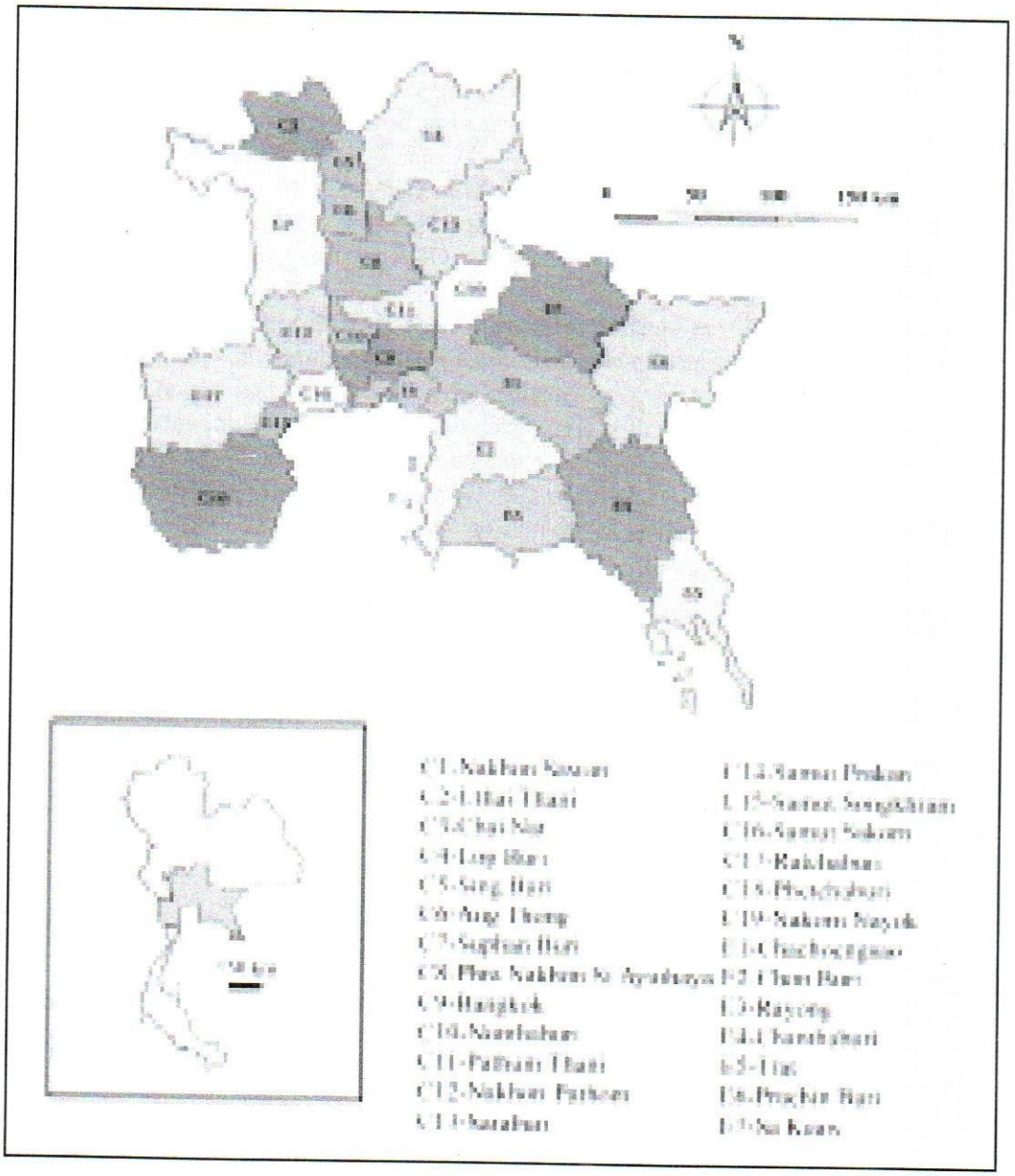


Fig. 1 Study area

Results

The euglenoids of various types of freshwater bodies in the central part of Thailand was studied based on samples collected during December 1998 to November 1999 and December 1999-November 2000. One hundred and nine species, 32 varieties, and 2 forms belong to order Euglenales, Family Euglenaceae were identified using light microscope. Average water chemical and physical characteristics of the selected sites were water temperature 17.3-36.2 °C, turbidity1.08-625.0 NTU, dissolved oxygen 0.14-19.9 mg L^{-1}, pH 5.10-10.54, conductivity 0.083-19.5 mS cm^{-1}, salinity 0.1-.15 ppt.

***Table 1** List of euglenoids found in the central and eastern parts of Thailand*

Scientific Names	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Class Euglenophyceae																										
Order Euglenales																										
Family Euglenaceae																										
Euglena acus Ehrenberg 1838	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	X	X	X	X
E. acus Ehrenberg var. *longa* Johnson 1944	-	X	-	-	-	-	-	-	-	-	-	-	X	X	-	X	X	X	X	X	X	-	X	-	X	X
E. gracilis Klebs 1883	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X
E. limnophila Lemmermann 1898	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. mangini Lefèvre 1933	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. oxyuris Schmarda 1846	-	-	-	X	X	-	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X
E. oxyuris var. *charkowiensis* (Swirenko) Chu 1946	-	X	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. polymorpha Dangeard 1902	-	X	-	X	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X
E. proxima Dangeard 1902	X	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
E. sanguinea Ehrenberg 1830	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	X	X	-	-	-	-	-	-
E. sciotensis Lackey 1939	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
E. spirogyra Ehrenberg 1838	-	-	-	X	-	X	-	-	X	X	X	X	X	X	-	-	X	X	-	X	X	X	X	-	-	X
E. viridis Ehrenberg 1830	-	-	-	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lepocinclis acicularis France 1938	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
L. acuta Prescott 1949	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X	X	X	X	X	-	-	-	-	X
L. constricta Matvienko 1938	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
L. fusiformis (Carter) Lemmermann 1901	-	-	-	-	X	-	-	-	X	X	X	X	X	X	X	X	X	–	X	X	X	X	-	-	-	X
L. glabra Drezepolski 1925	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
L. marssonii Lemmermann 1905	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	-	-	-	X

Scientific Names	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Lepocinclis ovum (Ehrenberg) Lemmermann 1901	X	X	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-
L. reeuwykiana Conrad var. *kriegeri* Conrad 1934	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
L. salina Fritsch 1914	-	-	X	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
L. texta (Dujardin) Lemmermann var. *mamillata* (Da Cunha) Conrad	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	-	X	X	-	-	-	X
L. wangi Chu 1936	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
Phacus acuminatus Stokes 1885	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	X
P. acutus Pochmann 1942	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X
P. agilis Skuja 1926	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
P. anacoelus Stokes 1885	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	X	-	-
P. angulatus Pochmann 1942	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
P. caudatus Hübner 1886	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	X	-	-	-
P. contortus Bourrelly 1952	X	-	-	-	X	-	-	-	X	X	-	X	X	X	-	-	X	X	X	X	X	-	X	-	-	X
P. curvicauda Swirenko 1915	X	X	X	X	X	-	X	-	X	X	X	X	X	X	-	-	X	X	-	X	X	-	X	-	-	-
P. glaber (Deflandre) Pochmann 1942	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	-	-	-	-	-	-	-
P. helikoides Pochmann 1942	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	X	X
P. horridus Pochmann 1942	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
P. lefevrei Bourrelly 1952	-	-	-	-	-	-	X	-	X	X	-	X	X	X	-	X	X	X	-	-	X	-	X	-	-	X
P. longicauda (Ehrenberg) Dujardin 1841	X	X	X	X	X	X	X	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X
P. longicauda (Ehrenberg) Dujardin var. *madagassica* (Pochmann) Huber-Pestalozzi	-	-	-	-	X	-	-	-	X	X	X	X	X	-	-	X	-	-	X	X	X	-	X	-	-	-

Scientific Names	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Phacus longicauda (Ehrenberg) Dujardin var. *major* Swirenko 1915	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-
P. meson Pochmann 1942	-	X	-	X	X	-	-	-	X	X	-	-	X	-	-	X	-	-	X	X	-	X	-	-	X	X
P. mirabilis Pochmann 1942	-	-	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. myersi Skvortzow 1919	-	-	-	-	X	-	-	-	X	X	X	X	-	-	-	X	X	X	-	-	X	-	-	-	-	-
P. nordstedii Lemmermann 1904	-	-	-	-	-	-	-	-	X	X	-	X	X	X	-	-	-	X	X	X	X	-	-	-	-	-
P. onyx Pochmann 1942	X	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-	-	X	-	-	X
P. orbicularis Hübner 1886	-	-	X	-	-	-	-	-	X	X	-	X	X	X	X	X	-	X	X	X	X	-	X	X	X	X
P. pleuronectes (O.F. Müller) Dujardin 1841	X	X	-	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X	X	-	X	X	-	X	X
P. pseudonordstedtii Pochmann 1942	-	X	X	X	X	X	X	-	X	-	X	X	X	-	-	X	X	-	-	-	-	-	-	-	-	X
P. raciborskii Drezepolski 1925	-	X	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	-	X	-	X	-	-	-	-	-
P. ranula Pochmann 1942	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	X	-	-	-	-	X
P. suecicus Lemmermann 1913	-	-	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
P. swirenkoi Skvortzow 1928	-	-	-	-	X	X	-	-	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
P. tortus (Lemmermann) Skvortzow 1928	-	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	X	-
P. triqueter (Ehrenberg) Dujardin 1841	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	X
P. tripteris Dujardin 1841	-	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Strombomonas ampullaeformis Huber-Pestalozzi	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. australica (Playfair) Deflandre 1930	X	X	X	-	-	-	-	-	X	X	X	X	-	X	-	-	-	-	X	X	X	-	X	-	-	X
S. cuneata (Playfair) Deflandre 1930	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. deflandrei (Roll) Deflandre 1930	-	X	-	X	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	-	X	-	X	-	-	X
S. fluviatilis (Lemmermann) Deflandre 1930	X	X	X	-	X	X	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	-	X

Scientific Names

	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Strombomonas fluviatilis (Lemmermann) Deflandre var. *curvata* Lemmermann	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. giardiana (Playfair) Deflandre 1930	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	-	-	-
S. gibberosa (Playfair) Deflandre 1930	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	-	X
S. longicauda (Swirenko) Deflandre 1930	-	X	X	X	X	-	-	-	X	X	X	X	X	-	-	X	X	X	X	X	-	-	-	-	-	X
S. napiformis (Playfair) Deflandre 1930	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
S. rotunda (Playfair) Deflandre 1930	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. schauninslandii (Lemmermann) Deflandre 1930	X	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	-	X
S. triquetra (Playfair) Delflandre 1930	-	-	-	-	-	-	-	-	X	X	-	X	X	X	-	X	X	X	-	-	-	-	-	-	-	-
S. urceolata Stokes	-	-	-	X	-	-	-	-	X	X	X	X	X	-	-	X	X	X	-	-	X	-	-	-	-	-
S. verrucosa (Daday) Deflandre 1930	X	X	X	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	-	-	X	-	X	-
S. verrucosa (Daday) Deflandre var. *zmiewika* (Swirenko) Deflandre 1930	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trachelomonas abrupta (Swirenko) Deflandre 1887	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. acanthostoma (Stokes) Deflandre 1887	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
T. armata (Ehrenberg) Stein 1955	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
T. armata (Ehrenberg) Stein var. *longa* Deflandre 1930	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	-	X	-
T. armata (Ehrenberg) Stein var. *longispina* (Playfair) Deflandre 1926	X	-	-	X	X	X	-	-	-	X	X	X	X	X	X	-	X	X	X	-	-	-	X	-	-	-
T. armata (Ehrenberg) Stein var. *steinii* Lemmermann 1906	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. armata (Ehrenberg) Stein fa. *coronata* Deflandre 1926	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Scientific Names	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Trachelomonas armata (Ehrenberg) Stein fa. *pseudolongispina* Deflandre 1926	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. australica var. *invaginata* Conrad	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	X	-	X	-	X	-	-	-	-	-
T. bacillifera Playfair var. *globulosa* Playfair	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. bacillifera Playfair var. *minima* Playfair 1915	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. bernardinensis Vischer emend Deflandre 1912	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
T. crebea Kellicott emend Deflandre 1926	X	X	X	X	X	-	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X
T. crebea Kellicott emend Deflandre var. *brevicollaris* Prescott	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
T. crebea Kellicott emend Deflandre var. *spinosa* Balech	-	-	X	-	-	-	-	-	X	X	X	X	X	-	-	X	X	-	-	-	-	-	-	-	-	-
T. crispa Balech	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. curta Cunha emend Deflandre	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. dangeardiana Deflandre var. *glabra* (Playfair) Deflandre 1926	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
T. dubia Swirenko var. *ornata* Szabados	-	-	-	-	-	-	X	-	X	X	-	X	X	X	-	X	X	X	X	X	X	-	X	-	-	X
T. dybowski Drezepolski	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. euchlora (Egrenberg) Lemmermann var. *cylindrical* (Ehrenberg) Lemmermann	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
T. globularis (Awerinzeff) Lemmermann	-	-	-	-	-	-	X	-	X	X	-	X	-	X	-	-	-	-	X	-	X	-	-	-	-	-
T. globularis (Awerinzeff) Lemmermann var. *crenulatocollis* Szabados	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. globularis (Awerinzeff) Lemmermann var. *gigas* Drezepolski	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

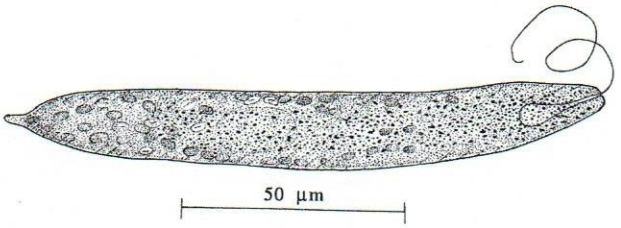
Scientific Names

	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Trachelomonas hispida (Perty) Stein 1883	X	-	X	-	-	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-
T. hispida (Perty) Stein var. *coronata* Lemmermann ex Deflandre 1926	-	X	-	X	X	X	-	-	X	X	X	X	X	X	-	-	X	X	X	X	X	-	-	-	-	X
T. hispida (Perty) Stein var. *duplex* Deflandre 1926	-	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-	X	X	-	-	X	-	-	-	-
T. horrida Palmer 1905	X	-	-	-	-	-	X	-	-	X	X	X	-	X	-	-	-	X	X	-	-	-	-	-	-	-
T. hungarica Szabados var. *banatica* Szabados	-	X	X	-	X	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
T. intermedia Dangeard 1902	-	-	-	-	-	X	-	-	X	-	X	-	X	-	-	-	X	X	X	-	X	-	X	-	-	X
T. intermedia Dangeard var. *spinifera* (Popova) Popova 1966	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. kelloggii Skvortzow	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. lacustris Drezepolski 1925	X	X	X	-	X	X	-	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X	-	-	-	-
T. lismorensis Playfair var. *mirabilis* Playfair	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
T. megalantha var. *crenulatocollis* Bourelly 1952	X	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
T. mirabilis Swirenko var. *affinis* Skvortzow 1925	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-
T. oblonga Lemmermann var. angusta Huber-Pestalozzi	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X
T. oblonga Lemmermann var. *truncata* Lemmermann 1955	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. planctonica Swirenko	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. planctonica Swirenko var. *oblonga* Drezepolski 1952	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
T. playfairi Deflandre var. *oviformis* Hortobagyi 1955	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
T. pseudobulla Swirenko 1914	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
T. pulcherrima Playfair 1916	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	-	-	X
T. raciborskii Woloszynska var. *nova* Drezepolski	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Scientific Names	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)	(E1)	(E2)	(E3)	(E4)	(E5)	(E6)	(E7)
Trachelomonas robusta Swirenko emend Deflandre	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. rotunda Swirenko emend Deflandre 1927	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. scabra Playfair 1915	-	-	-	-	-	X	-	-	X	X	X	X	X	X	-	-	X	X	X	X	X	-	-	-	X	X
T. scabra Playfair var. *pygmaea* Playfair 1952	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T. speciosa Deflandre 1926	-	-	-	-	-	-	X	-	X	-	X	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-
T. spectabilis Deflandre 1926	-	-	-	-	-	-	X	-	X	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-	-	-
T. splendida Playfair	X	-	-	-	-	X	-	-	-	-	-	-	X	-	-	X	X	X	X	-	-	X	X	-	-	X
T. superba Swirenko emend Deflandre 1926	-	X	X	-	X	-	-	-	X	X	X	X	X	X	-	-	X	X	X	X	X	-	X	-	-	-
T. sydneyensis Playfair 1916	-	X	-	-	X	X	-	-	X	X	-	-	X	-	-	-	X	-	X	X	-	-	-	-	X	-
T. volvocina Ehrenberg 1833	X	X	X	X	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
T. volzii Lemmermann var. *cylindrica* Playfair 1915	-	-	X	-	-	-	-	-	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X
T. woycickii Kockzara	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-	-	-

In this study, 56 species, 21 varieties, and 2 forms are new records of Thailand. They are *Euglena* 7 species, *Lepocinclis* 6 species, 2 varieties, *Phacus* 13 species, 2 varieties, *Strombomonas* 8 species, 1 variety, and *Trachelomonas* 22 species, 16 varieties, 2 forms. Their characteristics and local distributions are as follows;

Class Euglenophyceae
Order Euglenales
Family Euglenaceae



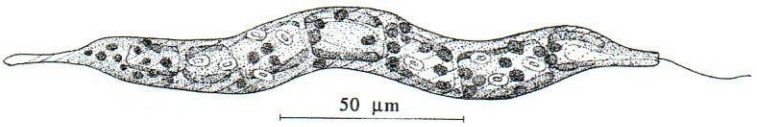
***Euglena Chlorophoenicea* Schmarda 1846 Pl. 1, Fig. 1**

M. Gojdics, 1953, pp. 93-94, pl. 9, figs. 2a-c.

Cell cylindrical, slightly tapered anteriorly; posteriorly it ends in a short point that is commonly retracted to a blunt rounded end; pellicle prominent striae; and covered by a large number of orange-red haematochrome granules of unequal sizes; chloroplasts numerous, ovoid; paramylum many, ovoid with depressed centers; flagellum one fifth to one half as long as the cell; eye spot large and crimson color; movement quite metabolic, corkscrew-like twisting; cells 15-20 µm in diameter, 100-125 µm long.

The Thai specimens were smaller than those reported by Gojdics (103.5x17.25 µm). This species cause surface bloom in fish ponds.

Local Distribution C9, C17



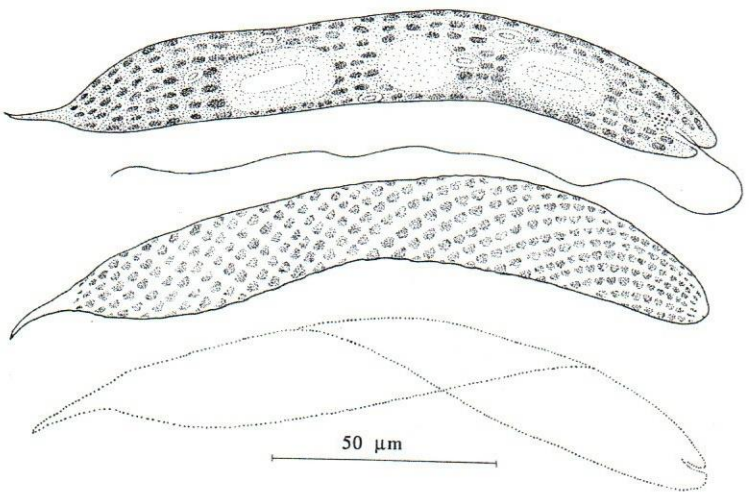
***Euglena convoluta* Korshikov 1941 Pl. 1, fig. 2**

G.W. Prescott, 1962, p. 391, pl. 86, figs. 7-9, 14.

Cells slightly metabolic, elongate-fusiform, spirally twisted or curved; abruptly narrowed anteriorly and truncate posteriorly, narrowing mor gradually to form a long cauda; pellicle finely and spirally striated; prarmylon bodies of two sorts: large concave of trough-shaped plates and small disc-like rings; Cells 10-12 µm in diameter, 120-145 µm long.

This large species was rarely found in samples of several provinecs in the central part and most localities in the east part of the country.

Local Distribution C9, C12, C17, C18, C19, E1, E2, E3, E6, E7



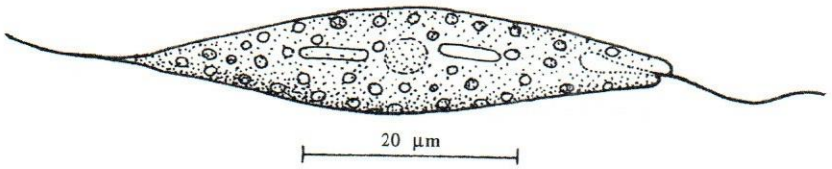
***Euglena fusca* (Klebs) Lemmermann 1910 Pl. 1, fig. 3**

G. Huber- Pestalozzi, 1955, pp. 32, 64, pl. 7, fig. 41.

Cell long, flat, with sides nearly parallel, but often twisted, ending posteriorly in a sharp tail-piece; rounded at the anterior end; brown pellicle with spiral rows of hemisphaerical to squarish excrescence, rows often incomplete or absent; paramylon two large links, usually one anterior and one posterior to the nucleus, and occasionally several smaller ones as well; chloroplasts perietal, ovoid, numerous; movement weakly metabolic by a slow forward rotating movement, able to contract to about ¾ of cell; cells 15-20 µm wide, 150-230 µm long.

This species is very close to *E. spirogyra*, but it differs from the latter species in brown color, much greater size, and shape of the chloroplast.

Local Distribution C14, E1



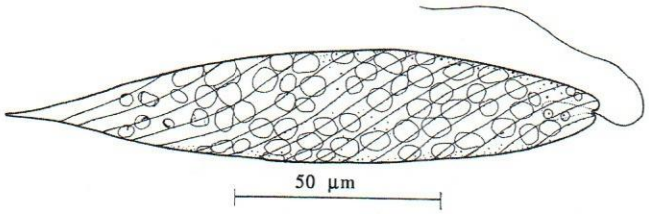
***Euglena limnophila* Lemmermann 1898 Pl. 1, Fig. 4**

M. Gojdics, 1953, p. 103, pl. 11, fig. 6.

Cell spindle-shaped, rounded anteriorly, ending in a long straight, or curved spine; pellicle striated; chloroplasts numerous disc-shaped, irregular arranged; pyrenoid none; paramylon one or two rodlike bodies; when there is only one, it is usually posterior to the nucleus, when there are two, one is usually anterior, and the other posterior to the nucleus, or in some cases there may be one on either side of it; cells very slightly metabolic; cells 8-9 µm wide, 75-80 µm long.

This species was very rarely observed in this study.

Local Distribution C8



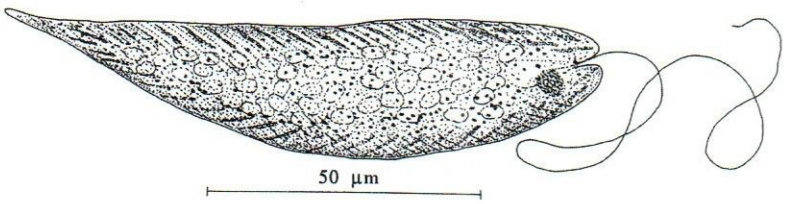
***Euglena mangini* Lefevre 1933 Pl. 1, Fig. 5**

M. Gojdics, 1953, p. 89, pl.7, Fig. 5.

Cells fusiform, ending abruptly in a fine straight rigid tail; pellicle thick, yellowish, with widely spaced striae; chloroplasts numerous discoid; paramylon ovoid grains, numerous distributed in the whole cell; slightly metabolic movement; cells 17-19 µm wide, 95-100 µm long.

This is Indo-China species, and commonly observed in the central part of the country from various localities.

Local Distribution C1-C19



***Euglena sanguinea* Ehrenberg 1838 Pl. 1, Fig. 6**

G. Huber- Pestalozzi, 1955, pp. 90-92, pl. 15, fig. 70.

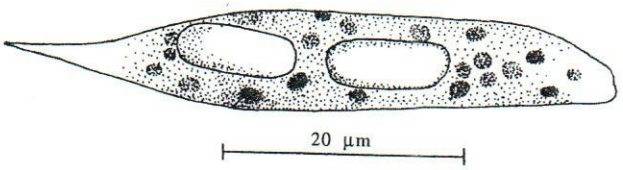
G.W. Prescott, 1962, p. 394, pl. 86, figs. 1-2.

M. Gojdics, 1953, pp. 154-155, pl. 31, fig. 3.

Cells broadly spindle-shaped, rounded anteriorly, gradually tapering to a point posteriorly; pellicle conspicuously striated, almost parallel to the long axis; cells brick-red with haematochrome granules that may form a network under the pellicle when cells are in strong light, at which time the other cell contents are difficult to see, or they may migrate to the center in dimmer light; chloroplasts very numerous, elongate, spindles radially arranged, that give the posterior part a very streaky appearance, not all chloroplasts have pyrenoids; paramylum sphaerical or ovoid; cells markedly metabolic before the cover slip is applied, after which it slows down considerably, then swims rather actively; cells 23-30 µm in diameter, 50-77 µm long.

This species forms water bloom in fish ponds which are rich in organic matter. The color produced is a dense brick-red, localized at the water surface.

Local Distribution C9, C12, C17, C19, E1



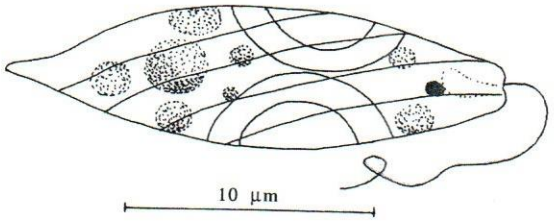
***Euglena sciotensis* Lackey 1939 Pl. 1, Fig. 7**

T. Yamagishi, 1992, p. 27, pl. 8, figs. 3-5.

Cells nearly cylindrical; slightly enlarged in the posterior half, then tapers abruptly to a sharp point; obliquely truncate in the anterior end; pellicle without visible striae; chloroplasts large discoid, parietally placed, and no pyrenoid; cells slightly metabolic; cells 5-8 µm in diameter, 35-45 µm long.

Collected from swamps and drainage channels. It was rarely observed in the study area.

Local Distribution C8, C19



***Lepocinclis acicularis* France Pl. 2, Fig. 1**

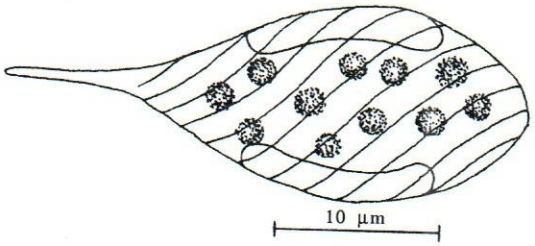
G. Huber- Pestalozzi, 1955, p. 147, pl. 28, fig. 141.

T. Yamagishi, 1992. P. 28, pl. 9, figs. 1-3.

Cells fusiform, anterior ends narrowed and truncate; posterior ends narrowed and produced into a short straight cauda; lateral side slightly swelled; periplasts obliquely spirally striated; paramylon bodies two, ring-like plate; cells 6-9 µm in diameter, 21-22 µm long with the cauda.

Collected from drainage channels and padi swamps.

Local Distribution C19, E7



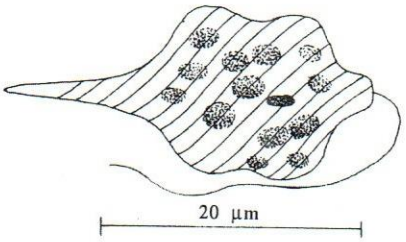
***L. acuta* Prescott Pl. 2, Fig. 2**

G. W. Precott, 1962, p. 405, pl. 89, figs. 8,9.

Cells ovoid-pyriform, tapering posteriorly to a long, sharply pointed caudus, slightly narrowed anteriorly and rounded at the apex; pellicle spirally striated downward to the right; paramylon two curved plates, one on either side of the cell; chloroplasts several ovoid discs; cells 10-12 µm in diameter, 28-32µm long.

This cosmopolitan species was widely distributed in this study.

Local Distribution C9, C10, C11, C12, C13, C14, C17, C18, C19, E1, E2, E7



***Lepocinclis constricta* Matvienko Pl. 2, Fig. 3**

T. Yamagishi and Y. Kanetsuna, 1987, p. 63. pl. 1, figs. 1-2.

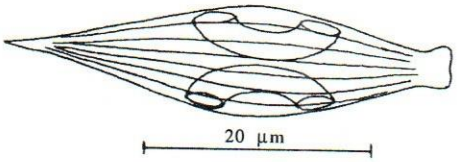
Cells gourd-shaped, broad fusiform to longitudinal hexagon with clear constriction at center of lateral sides; anterior ends narrowly projected and truncate, slightly bilobed; posterior end broadly rounded with a thin, long, straight cauda; pellicle spirally striated; paramylon bodies numerous, globose to ovoid; cells 14-18 µm in diameter, 26-33 µm long including cauda.

This species was rarely observed in drainage channels and found only in two provinces.

Local Distribution C19, E7

***Trachelomonas raciborskii* Woloszynska var. *nova* Drezelopski 1925 Pl. 8, Fig. 12**

T. Mizuno, 1969, p. 19, pl. 5, fig. 12.



***Lepocinclis marssonnii* Lemmermann 1905 Pl. 2, Fig. 4**

Synonym: *Lepocinclis capitata* Playfair

Lepocinclis marssonii var. *lata* Roll

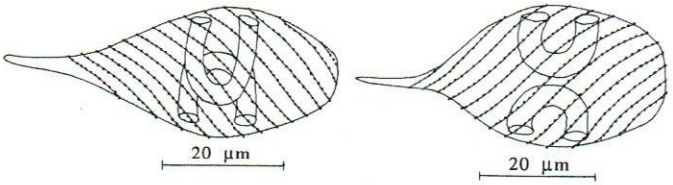
G. Huber-Pestalozzi, 1955, pp. 137, 140, pl. 26, fig. 119.

G.A. Prowse, 1958, p. 155, figs. 2w-x.

Cells cylindric-fusiform; anterior ends narrowly protruded and truncate, more or less bipapillately elevated; posterior end gradually narrowed and projected into a long straight cauda; pellicle longitudinally, closely striated; paramylon bodies two, ring-like plate; cells 10-12 µm in diameter, 33-60 µm long.

They were observed in a few water bodies in many provinces in the central part of Thailand. Tropical species.

Local Distribution C2, C3, C9, C10, C11, C12, C13, C14, C16, C17, C18, C19, E2, E3,E7



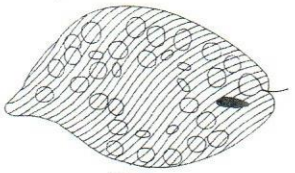
***Lepocinclis reeuwykiana* Conrad var. *kriegeri* Conrad 1934 Pl. 2, Fig. 5**

T. Yamagishi, 1992, p. 34, pl. 10, figs. 24-26.

Cells long, fusiform; anterior ends narrowly protruded and truncate, slightly bipapillate, without constriction below the end, 2.2-3 µm (Yamagishi, 1992; about 2.5-3.5 µm broad); posterior end gradually narrowed and projected into a long, nearly straight cauda; pellicle spirally striated; paramylon bodies two, ring-like plates; cells 10-16 um in diameter, 50-60 µm long with the cauda.

This species was mostly found in the central part of the country.

Local Distribution C1, C17, C18, C19, E3



***Lepocinclis texta* (Dujardin) Lemmermann var. *mamillata* (Da Cunha) Conrad 1934 Pl. 2, Fig. 6**

Synonym : *Euglena texta* (Dujardin) HØbner

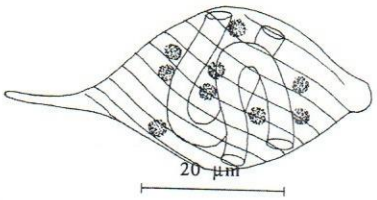
G. A. Prowse, 1958, p. 151, fig. 2a.

G. Huber-Pestalozzi, 1955, p. 144, pl. 27, fig. 129.

Cell broadly oval, tapering to a very short, blunt, tail at the posterior end; anterior end rounded; pellicle spirally striated, running to the right; paramylum one large central disc, and numerous, scattered small and ovoid granules; chloroplasts numerous, discoid, parietal; eye spot large, crimson; cells 40 µm in diameter; 60 µm long.

This species is similar to *L. salina*; but bigger than from the latter species in length. It was one of common species in the study area.

Local Distribution C9, C10, C11, C12, C13, C14, C16, C17, C18, E2, E3, E7



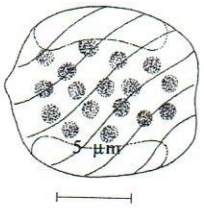
***Lepocinclis wangi* Chu 1936 Pl. 2, Fig. 7**

T. Yamagishi, 1992, p. 36, pl. 11, figs. 7-9.

Cell fusiform; anterior ends conically narrowed and rounded, shallowly, and prominently bilobed at the dorsal furrow, one side produced into a beak-like process; posterior end gradually narrowed into a long, straight cauda; pellicle spirally striated; paramylum bodies two, ring-like plate; cells 19-28 µm in diameter, 47-56 µm long.

This is a rare species and observed in a few water bodies.

Local Distribution C19, E6



***Phacus agilis* Skuja 1926 Pl. 3, Fig. 1**

Synonym : *Phacus parvula* Klebs

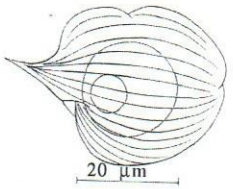
G.A. Prowse, 1958, p. 165, fig. 33.

G. Huber-Pestalozzi, 1955, pp. 171, 189, pl. 36, fig. 215.

Cell bean-like, ellipsoid to broad ellipsoid with canaliculate inside; anterior ends truncately rounded, sometimes slightly concaved; posterior end truncately rounded with a small papilla; pellicle roughly obliquely striated; paramylum bodies two, long, parietal; cells 11 µm wide, 12.5 µm long.

This species was commonly observed in drainage channels and small water bodies.

Local Distribution C1, C4, C9, C10, C14, C17, E1



***Phacus anacoelus* Stokes 1888 Pl. 3, Fig. 2**

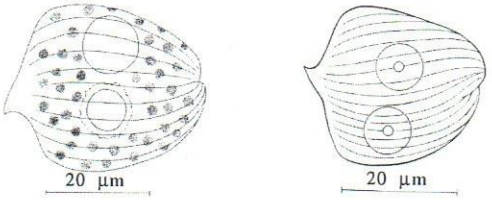
G. W. Prescott, 1962, pp. 397, pl. 87, fig. 3.

G. Huber-Pestalozzi, 1955, p. 174, 214, pl. 46, fig. 285.

Cells broadly ovoid, narrowed abruptly posteriorly to form a short cauda which turns to the left (as seen in ventral view); paramylon bodies 1-2 circular plates; lateral margins of cells with 2-3 creases or folds, the membrane convex between the indentations; pellicle longitudinal striae; cells 60-65 µm wide, 80-111 µm long.

This medium sized species occurred in various types of habitat in some provinces.

Local Distribution C1, C5, C9, C10, C11, C12, C13, C14, C16, C18, C19, E2, E5



***Phacus angulatus* Pochmann 1942 Pl. 3, Fig. 3 a,b**

Synonym : *Phacus alata* var. *indica* Skvortzow

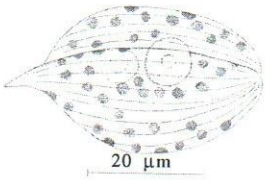
G. Huber-Pestalozzi, 1955, pp. 176, 207, pl. 44, fig. 266.

T. Yamagishi, 1992, p. 37, pl. 13, figs. 15-17.

Cells ovoid to broad triangular; anterior end narrowly rounded and shallowly bilobed; posterior end abruptly, asymmetrically rounded, with a cauda; cauda short, blunt and usually slightly curved; one lateral margin nearly straight and other roundly swelled; pellicle longitudinally striated; paramylon bodies two, circular plated; cells 34-35 µm wide, 39-40 µm long.

This species was rare; observed species were slightly bigger than those reported by Huber-Pestalozzi.

Local Distribution C2, C7, C9, C19



***Phacus contortus* Bourrelly 1952 Pl. 3, Fig. 4**

G. Huber-Pestalozzi, 1955, p. 204, pl. 42, fig. 260A.

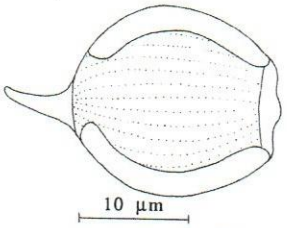
K.L. Weik, 1967, p. 128, fig. 26.

T. Yamagishi, 1992, p. 39, pl. 14, figs. 4-8.

Cells ovoid to triangular ovoid, usually broadest at posterior end; dorsal surface roundly curved; ventral surface concave, with a blunt, longitudinal flange; anterior ends rounded; posterior ends broadly rounded, with a cauda, sligtly hollowed at both sides of the cauda; caudae narrow and curved; pellicle longitudinally striated; paramylon bodies two, circular plate; cells 28 µm wide, 40 µm long.

They were observed in many provinces in the central and the eastern parts.

Local Distribution C1, C5, C9, C10, C12, C13, C14, C16, C17, C18, E1, E2, E4, E7



***Phacus glaber* (Deflandre) Pochmann 1942 Pl. 3, Fig. 5**

Synonym : *Phacus hispidula* fa. *glabra* Deflandre

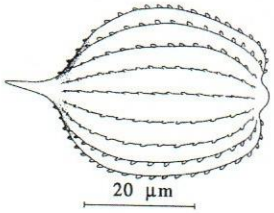
G.A. Prowse, 1958, p. 173, fig. 4d.

G. Huber-Pestalozzi, 1955, pp. 179, 238, pl. 55, fig. 340.

This species is similar to *P. suecicus*, but pellicle is smooth, cells subglobal with short cauda, anterior end with a papilla; cells 19 µm wide, 26 µm long.

They were observed in many provinces studied.

Local Distribution C9, C10, C11, C12, C13, C14, C16, C17, C18, C19



***Phacus horridus* Pochmann 1942 Pl. 3, Fig. 6**

Synonym : *Phacus hispidulus* bei Playfair

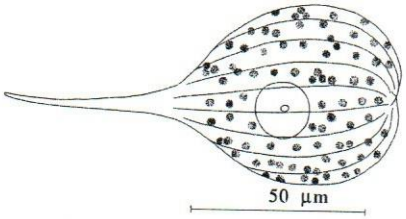
G.A. Prowse, 1958, pp. 173-174, fig. 4e.

G. Huber-Pestalozzi, 1955, pp. 179-239, pl. 55, fig. 343.

Cells compressed ovoid to subsphaerical in front view; anterior ends narrowed, truncate or slightly retuse, with a prominent median papilla; posterior ends broadly rounded, with a relatively long, sharp, slightly reflect cauda; lateral sides broadly rounded; pellicle longitudinally striated with row of down-curved hooks; paramylon bodies two, parietal dish-like plate, lying along the lateral margins; cells 33 µm wide, 48 µm long.

This species was very rare in Thai waters. It was observed only one locality in this study. It is very similar to *P. suecicus* except there are down-curved hooks longitudinal striae.

Local Distribution C9, E6



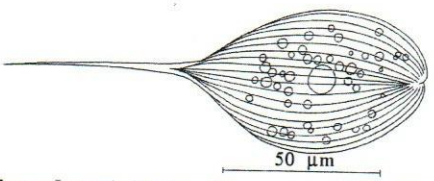
***Phacus longicauda* (Ehrenberg) Dujardin var. *madagassica* (Pochmann) Huber-Pestalozzi 1955 Pl. 3, Fig. 7**

G. Huber-Pestalozzi, 1955, pp. 223-224, pl. 50, fig. 304.

Cells broad obovoid; anterior ends broadly rounded, shallowly bilobed; posterior ends narrowed and tapering into a cauda; caudae very long approximately 1 ½ of cell, usually curved, transversely striated periplasts; paramylon bodies a single, ring like plate; cells 190 µm long.

This variety differs from the typical form by having transverse striation between pellicle striations, very long straight cauda.

Local Distribution C5, C9, C10, C11, C12, C13, C16, C19, E1, E2, E4



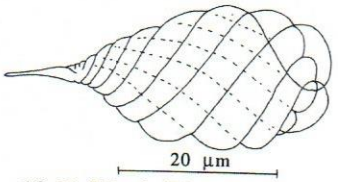
***Phacus longicauda* (Ehrenberg) Dujardin var. *major* Swirenko 1915 Pl. 3, Fig. 8**

G. Huber-Pestalozzi, 1955, p. 223, pl. 49, fig. 302b.

Cells broad ovoid, slightly asymmetrical of two lateral sides, posterior ends narrowed long, nearly straight or slightly curved cauda, anterior ends broadly rounded, periplasts longitudinally striated, paramylon bodies a single plate in the middle of the cell; 55-56 µm wide, 170 µm long including cauda, cauda 46 µm long.

This variety differs from the typical form by its greater width, and less commonly found than the type.

Local Distribution C1, C7, C9, C11, C12, E1, E6



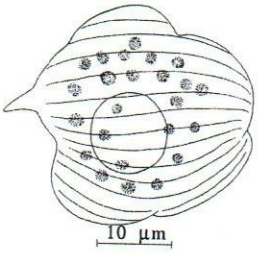
***Phacus mirabilis* Pochmann 1942 Pl. 4, Fig. 1**

G. Huber-Pestalozzi, 1955, p. 234, pl. 54, fig. 329.

Cells ovoid and twisted, anterior ends rounded, width of cell narrower at about ½ of body length and tapering into a long twisted hyaline cauda; keeled and spiral pellicle and terminating at the base of cauda; cells 17 µm wide, 32 µm long excluding cauda, cauda 13 µm long.

This rare and small species occurred only in three provinces in the central part of the country.

Local Distribution C5, C6, C9



***Phacus myersi* Skvortzow 1928 Pl. 4, Fig. 2**

Synonym : *Phacus curvicauda* Swirenko var. *undulata* Skvortzow

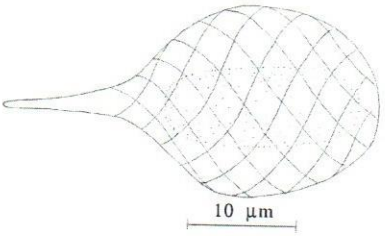
G. Huber-Pestalozzi, 1955, p. 214, pl. 47, fig. 286.

G.A. Prowse, 1958, pp. 170-171, figs. 3j,o.

Cell rounded, trapezium shaped, broadest near the posterior end, bearing a short thick, obliquely inclined tail; cell narrower toward anterior ends, sometimes rounded truncate; both sides distinctly notched; periplasts longitudinally striated; paramylum 1-2 large central discs or rings; cells 30 µm wide, 35 µm long excluding cauda, cauda 4-5 µm long.

This small species was observed in many provinces in the central part of Thailand.

Local Distribution C9, C10, C11, C12, C16, C17, C18, E2



***Phacus nordstedii* Lemmermann 1904 Pl. 4, Fig. 3**

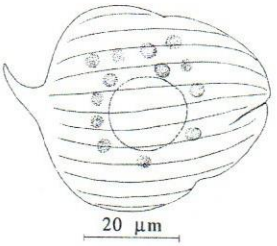
G. Huber-Pestalozzi, 1955, p. 230, pl. 53, fig. 320.

G.W. Prescott, 1962, p. 401, pl. 88, fig.1.

Cell napiform (globular at the top and tapering off abruptly) with a long straight sharply pointed caudus; broadly rounded anteriorly; pellicle forming an envelope widely separated from an elliptical protoplast, the pellicle spirally striated; paramylon bodies not observed; chloroplast numerous ovoid indistince discs; cells 18.5 µm wide, 36 µm long.

This small species was observed in many provinces in the central part, but only two provinces in the eastern part.

Local Distribution C9, C10, C12, C13, C14, C16, C17, C18, C19, E1, E2



***Phacus onyx* Pochmann 1942 Pl. 4, Fig. 4**

Synonym : *Phacus swirenkoi* Skvortzow

G. Huber-Pestalozzi, 1955b, p. 216, pl. 47, fig. 289.

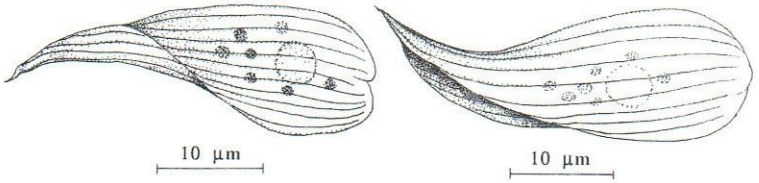
G.A. Prowse, 1958, p. 171, 216, figs. 31, a1, b1.

Cell round, trapezoidal, broadest, and somewhat abrupt at the posterior end, with a stout sharp tail, curved upwards from the dorsal surface and elightly to one side, anterior end rounded; one or both sides notched, pellicle longitudinally striae; paramylon one large central disc or ring, rarely two smaller ones; chloroplasts parietal, discoid, numerous; cells 35-37 µm wide, 50-55 µm long excluding cauda, cauda 14-17 µm long.

This species is close to *P. myersi*, from which it differs by the much larger size, the very stout outstanding tail piece.

This medium species occurred in many provinces in the central part, but only two provinces in the eastern part.

Local Distribution C1, C9, C10, C11, C12, C14, C15, C16, C17, C18. E4, E7



***Phacus raciborskii* Drezepolski 1925 Pl. 4, Fig. 5 a,b**

G. Huber-Pestalozzi, 1955, pp. 175, 208, pl. 44, fig. 269.

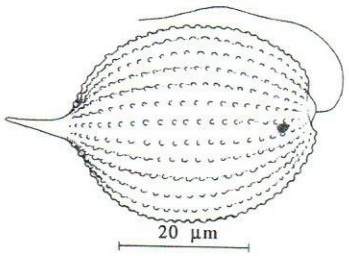
G.A. Prowse, 1958, p. 168, figs. 3u, y.

Cells elongate-ovate in outline, vary variable shape; the cell body is made up of two wings folded back towards the dorsal surface, and tapering-posteriorly to a sharp pointed, often curved tail, the whole cell being markedly twisted throughout its length; from the ventral face the cell may display a long twisted keel, and from the dorsal side a similar hollow groove; striations of pellicle following the curves of the wings longitudinally. Paramylum usually one, occasionally two hollow disc; chloroplasts parietal, discoid, numerous; cells 18 µm wide, 45 µm long.

Cell 45 µm long and 18 µm wide. This species is so characteristic especially in the living state that anyone who has seen it could not confuse it with any other species.

This medium sized species occurred both in freshwater and brackishwater in the central part of the country.

Local Distribution C_2, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}, C_{16}, C_{19}



***Phacus suecicus* Lemmermann 1904 Pl.. 4, Fig. 6**

Synonym : *Phacus moniliata* var. *suecica* Lemmermann

Phacus hispidula (Eichw.) Lemmermann var. *suecica* Lemmermann

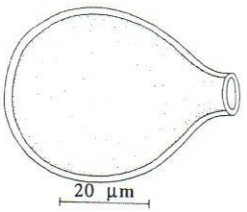
G.A. Prowse, 1958, p. 173, figs. 4n-p.

G. Huber-Pestalozzi, 1955, pp. 179, 237, pl. 55, fig. 338.

Cells broadly ovoid to suborbicular, terminating in a stout, sharp-pointed tail at the posterior end, truncate or slightly retuse at the anterior end, with a central papilla through which the flagellum passes; pellicle longitudinally rows of small wart-like excrescences, or verrucae, number of rows variable; parietal paramylum two large lateral curved discs; chloroplasts numerous small circular discs; cells 15-23 µm wide, 25-36 µm long.

This small species was rare and occasionally found in some provinces. This species is similar to *P. horridus*, but *P. suecicus* has granules along longitudinal striae.

Local Distribution C9, C10, C11, C18



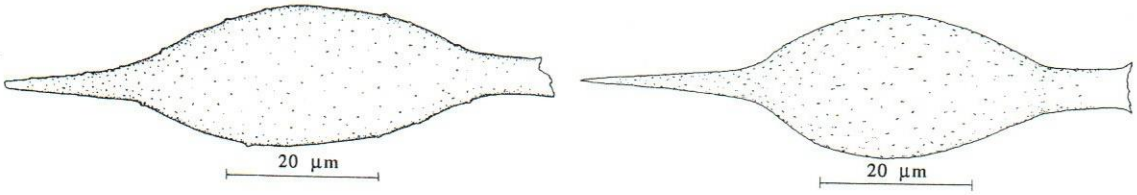
***Strombomonas ampullaeformis* Huber-Pestalozzi 1955 Pl. 5, Fig. 1**

G. Huber-Pestalozzi, 1955, pl. 72, figs. 695 A, C.

Lorica subglobose to broad ellipsoid, anterior end conically narrow into short cylindrical collar, truncated mouth, posterior end round, wall smooth; lorica 48.4 µm in diameter, 65.6 µm long.

This cosmopolitan species was found in several provinces studied.

Local Distribution C1, C7, C9, C10, C12, C14, C16



***Strombomonas australica* (Playfair) Deflandre 1930 Pl. 5, Fig. 2 a,b**

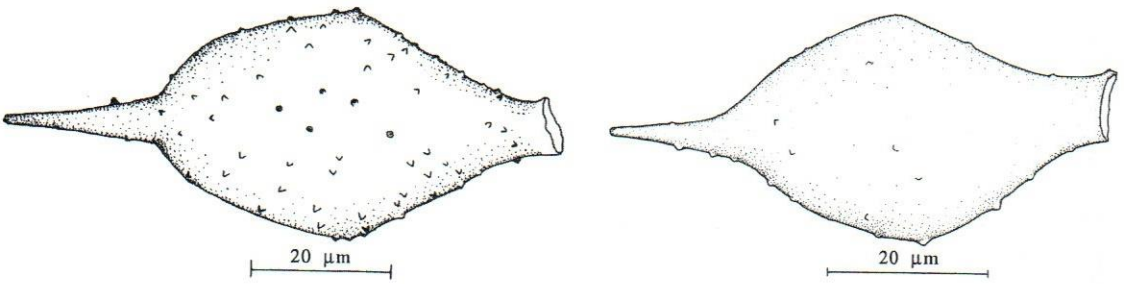
G. Huber-Pestalozzi, 1955, pp. 365, 378, pl. 78, fig. 813.

G.A. Prowse, 1958, p. 186, figs. 5m-p.

Lorica hyaline to clear yellow, rough to almost smooth circular in cross section, elongate fusiform in outline, tapering to a long, sharp cauda at the posterior end, and terminating in a long cylindrical neck, usually tooth at anterior end; lorica 17-20 µm in diameter, 40-66 µm long excluding cauda, cauda 8-13 µm long.

This cosmopolitan species presented in many types of water habitats, in both areas studied.

Local Distribution C1, C2, C3, C9, C10, C11, C12, C14, C19, E1, E2, E4, E7



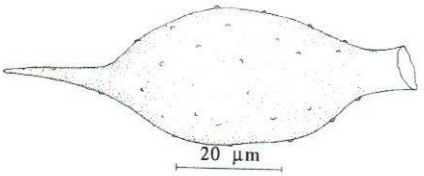
***Strombomonas cuneata* (Playfair) Deflandre 1930 Pl. 5, Fig. 3 a,b**

G. Huber-Pestalozzi, 1955, p. 381, pl. 79, fig. 826.

Lorica subrhomboid, with almost square lateral sides; anterior end narrowed into a cylindrical collar with a slightly flared mouth; posterior end conically produced into a long, straight cauda, lorica irregularly rough and with scattered granules; lorica 35-51 µm in diameter, 78-123 µm long excluding cauda, cauda 17-23 µm long.

This species was rare in Thai samples. They were found in a few water bodies.

Local Distribution C1, C7



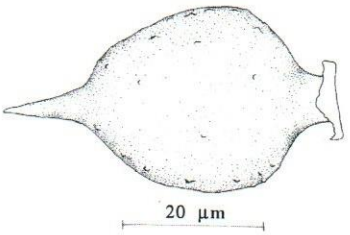
***Strombomonas fluviatilis* (Lemermann) Deflandre var. *curvata* Lemmermann 1913 Pl. 5, Fig. 4**

G. Huber-Pestalozzi, 1955, p. 379, pl. 78, fig. 816.

Lorica fusiform, anterior ends narrowed with a cylindrical collar; slightly oblique, not toothed mouth; posterior end tapered into a curved sharp cauda; lorica rough with scattered irregular verrucae; wall with minute pores, hyaline to clear brown; lorica 30 µm wide, 97 µm long excluding cauda, cauda 25 µm long.

This variety differs from the type in having long, and curved; tail and big size. It was found in most provinces of the central and the eastern parts of the country.

Local Distribution C1, C5, C7, C10, C11, C12, C14, C15, C16, C17, E1, E2, E3, E4



***Strombomonas napiformis* (Playfair) Deflandre 1930 Pl. 6, Fig. 1**

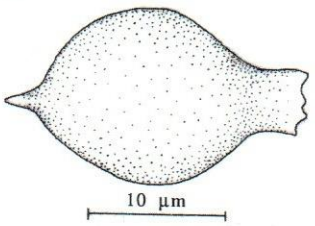
Synonym : *Trachelomonas napiformis* Playfair

T. Yamagishi, 1992, p. 54, pl. 20, figs. 3-4.

Lorica ovoid; anterior end broadly rounded with a collar; collars broad cylindric sometimes with a slightly flared mouth; posterior ends conically narrowed with a short straight cauda; lorica smooth or slightly rough; lorica 18-22 µm in diameter, 32-42 µm long without cauda, cauda 5-6 µm long.

This species differs from other species in having a distinct flared mouth. It was rarely found in the area studied.

Local Distribution C1, C7, E9, E2



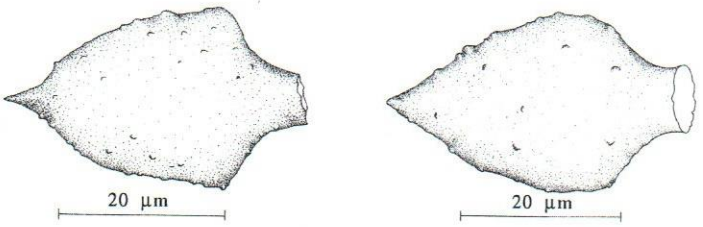
***Strombomonas rotunda* (Palmer) Deflandre 1930 Pl. 6, Fig. 2**

T. Yamagishi, 1992, p. 55, pl. 20, figs. 11-13.

Lorica ovoid to broad ovoid; anterior end broadly rounded, with a broad cylindric slightly flared collar; posterior end rounded with a slender cauda; lorica smooth or slightly rough; lorica 16 µm in diameter, lorica 25 µm long with the cauda and the collar.

A small species was rarely observed in some water bodies of several provinces.

Local Distribution C1, C9, C10, C11, C12, C14, C17



***Strombomonas triquetra* (Playfair) Deflandre 1930 Pl. 6, Fig. 3 a,b**

Synonym : *Trachelomonas triquetra* Playfair

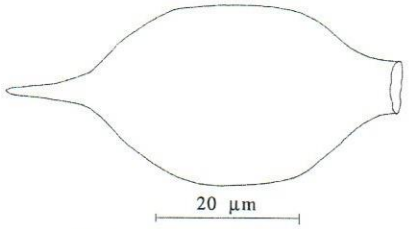
G. Huber-Pestalozzi, 1955, pp. 388-389, pl. 81, fig. 846.

T. Yamagishi, 1992, p. 56, pl. 21, figs. 14-17.

Lorica nearly pentagonal in lateral view, nearly triangular in apical view, anterior end truncately rounded, broader than the posterior end, with a short, cylindric collar having an irregular, slight obliqued, sometimes slightly flared mouth; posterior end conically narrowed into a short cauda; lorica minutely punctate and with irregularly scattered low granules; lorica 20-25 µm in diameter, 38-45 µm long with the cauda and the collar.

This species was widely distributed in the studied area.

Local Distribution C1-C19



***Strombomonas urceolata* Stokes 1888 Pl. 6, Fig. 4**

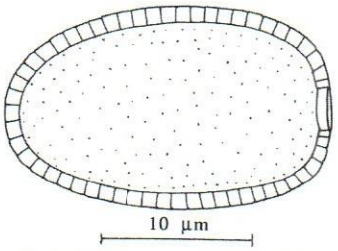
Synonym : *Trachelomonas urceolata* Stokes

G. Huber-Pestalozzi, 1995, p. 375, pl. 78, fig. 804.

Lorica vase-shaped, anterior end broadly rounded, with a broad short cylindrical collar having nearly smooth, and not flared mouth, the width of mouth approximately equal to the width of collar; posterior end conically narrowed into a short and sharp cauda. Lorica smooth without granules; lorica 22-28 µm wide, 44-57 µm long.

This cosmopolitan species was observed in some water bodies of many provinces.

Local Distribution C4, C9, C10, C11, C12, C13, C14, C16, C17, C18, E2



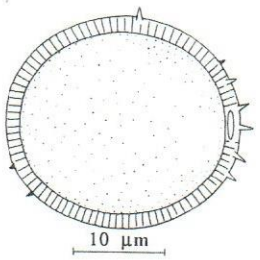
***Trachelomonas abrupta* (Swirenko) Deflandre 1926 Pl. 7, Fig. 1**

G. Huber-Pestalozzi, 1955, p. 320, pl. 69, figs. 628a-d.

Lorica cylindric, anterior and posterior ends slightly truncated rounded, lateral sides nearly straight and parallel, flagellum aperture without a collar; lorica densely punctate; lorica 28 µm in diameter, 31 µm long.

This small species scarcely distributed in some water bodies in several provinces.

Local Distribution C2, C9, C10, C13, C14, C16



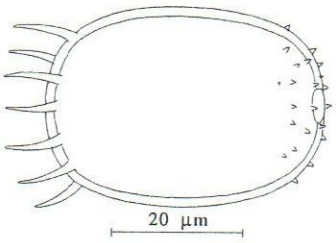
***Trachelomonas acanthostoma* (Stokes) Deflandre 1926 Pl. 7, Fig. 2**

G.W. Prescott, 1962, pp. 410-411, pl. 83, fig. 33.

Lorica subglobose or ovoid; wall densely punctate, sometimes with minute spiny projections around the flagellum aperture which has a low collar; lorica 28 µm in diameter, 31 µm long.

This species was scarcely observed in a few water bodies.

Local Distribution C5, C6, C9, C10, C13



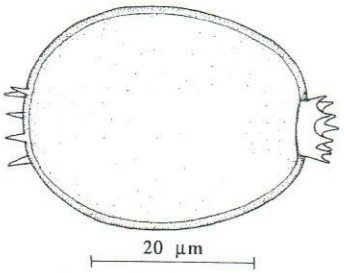
***Trachelomonas armata* (Ehrenberg) Stein var. *longa* Delfandre 1926 Pl. 7, Fig. 3**

G. Huber-Pestalozzi, 1955, p. 310, pl. 67, fig. 591.

Lorica cylindrical; anterior and posterior ends rounded; lateral sides nearly straight and parellel; flagellum aperture without a collar, sometimes with small spines around the opening; wall rather thick with very fine and small pores; anterior end beset with short spines, and long spines at the posterior end; lorica 41-43 µm long, 29-31 µm in diameter.

This medium species was generally found in all provinces in the central part of Thailand. It is similar to var. *steinii* but its lorica shape is cylindrical.

Local Distribution C1-C19



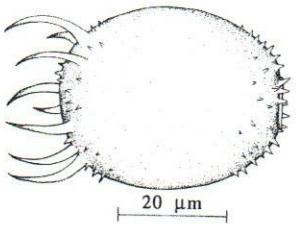
***Trachelomonas armata* (Ehrenberg) Stein fa. *coronata* Deflandre 1926 Pl. 7, Fig. 4**

T. Yamagishi, 1992, p. 58, pl. 22, figs. 15-16.

Lorica broad ellipsoid; anterior end slightly narrowed and rounded; posterior end broadly rounded; flagellum aperture with a low collar encircling by the short spines around the mouth; wall punctate and roughly beset with short spines at the anterior end and stout long spines at the posterior end ; lorica 34 µm in diameter, 44 µm long.

This characteristic species has spines around mouth openning. They were scarcely found in several provinces.

Local Distribution C1, C6, C7, C9, C11, C12, C17



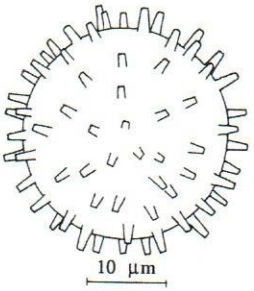
***Trachelomonas armata* (Ehrenberg) Stein fa. *pseudolongispina* Deflandre 1926 Pl. 7, Fig. 5**

G. Huber-Pestalozzi, 1955, p. 310, pl, 67, fig. 592.

Lorica broad ellipsoid; anterior end slightly narrower than the posterior end which is broadly rounded; flagellum aperture without a collar, anterior region with short, sharp spines, posterior end with very stout and cuvred-long spines, small sharp spines are widely distributed in the posterior region; lorica 42 µm in diameter, 51 µm long.

This fairly big form was found in some water bodies of several provinces.

Local Distribution C1, C6, C7, C9, C11, C16



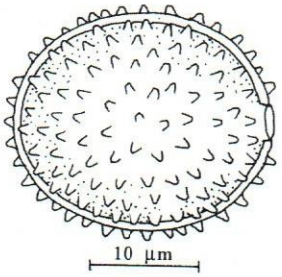
***Trachelomonas bacillifera* Playfair var. *globulosa* Playfair 1915 Pl. 7, Fig. 6**

G. Huber-Pestalozzi, 1955, pp. 302-303, pl. 65, fig. 554.

Lorica sphaerical; flagellum aperture without a collar; wall densely covered with many, blunt short spines; lorica 32 µm in diameter.

This round and small variety was rarely found in a few provinces.

Local Distribution C1, C6, C7



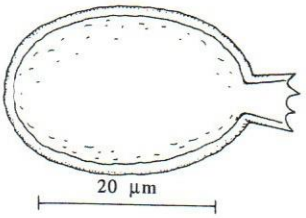
***Trachelomonas bacillifera* var. *minima* Pl. 7, Fig. 7**

T. Yamagishi, 1987, p. 44, pl. 8, fig. 9, pl. 10, fig. 8.

Lorica ellipsoid; anterior end posterior ends rounded; lateral sides broadly rounded; flagellum aperture without a collar; wall densely covered with many blunt, short spines

This species is very close to *T. khannae* reported in Bung Boraphet by Yamagishi (1987), but it differs from *T. khannae* in having larger lorica and blunt short spines; lorica 21-22 m in diameter, 25-26 m long.

Local Distribution C1, C2, C6, C7



***Trachelomonas bernardinensis* Vischer emend Deflandre 1927 Pl. 7, Fig. 8**

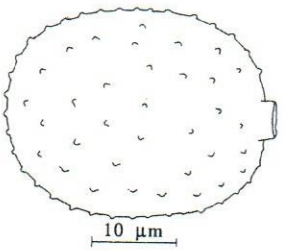
T. Yamagishi and M. Hirano, 1973, p. 74, pl. 4, fig.3.

T. Yamagishi, 1992, p. 60, pl. 22, figs. 22-23.

Lorica long ellipsoid to broad fusiform; anterior end narrowed; posterior end narrowed with a short blunt cauda-like projection; lateral sides swelled; flagellum aperture with a broad cylindric collar having a slightly flared mouth; wall minutely scrobiculated; lorica 23 m in diameter, 35 m long.

This rare species was found only two provinces in the central part of Thailand.

Local Distribution C1, C6, E2



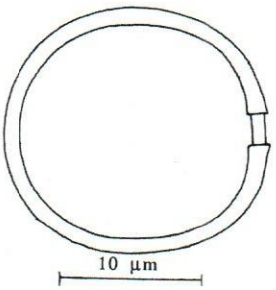
***Trachelomonas crebea* Kellicott emend Deflandre var. *brevicollaris* Prescott 1949 Pl. 7, Fig. 9**

G.W. Prescott, 1962, p. 412, pl. 84, fig. 17.

Lorica broad-ellipsoid to subglobose, anterior and posterior ends broadly rounded; flagellum aperture with a short cylindrical collar having a smooth mouth; wall irregularly rough with low verrucae, anterior end with small punctae; lorica 25 µm in diameter, 43 µm long.

This variety differs from the type by having small pores on lorica. It was more quently found in the central part than the eastern part.

Local Distribution C1, C3, C7, C9, C10, C11, C12, C13, E1



***Trachelomonas curta* Cunha emend Deflandre 1913 Pl. 7, Fig. 10**

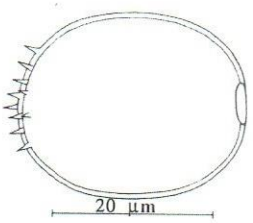
G. Huber-Pestalozzi, 1955, p. 269, pl. 59, fig. 425.

T. Yamagishi and M. Hirano, 1973, p. 75, pl. 4, fig. 10.

Lorica globose and compressed; flagellum aperture without a collar; wall smooth; lorica 16-16.5 µm in diameter, 36-37 µm long; collar 3-3.5 µm high, 1.5-2 µm in diameter.

This small species occurred in a few provinces.

Local Distribution C7, C9, C12



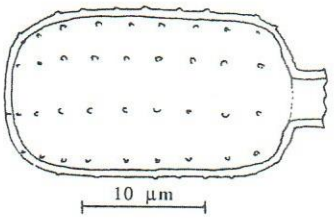
***Trachelomonas dangeardina* Deflandre var. *glabra* (Playfair) Deflandre 1926 Pl.7, Fig. 11**

G. Huber-Pestalozzi, 1955, pp. 311-312, pl. 68, fig. 596.

Lorica broad ellipsoid to ovoid; anterior end rounded, flagellum aperture without a collar; posterior end rounded and beset with short sharp spines; wall smooth; lorica 28 µm in diameter, 35 µm long.

This cosmopolitan species occurred in several provinces.

Local Distribution C1, C7, C9, C10, C12, C13, C14, C19, E1, E3



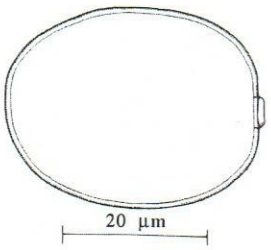
***Trachelomonas dubia* Swirenko var. *ornata* Szabados 1939 Pl. 7, Fig. 12**

G. Huber-Pestalozzi, 1955, p. 335, pl. 42, pl. 72, fig. 700.

Lorica cylindrical; anterior end and posterior ends slightly rounded; flagellum aperture with a collar; collar cylindrical with a slightly toothed mouth; wall with rows of pores; lorica 11-13 µm in diameter, 22-26 µm long.

A cosmopolitan and small species was observed in many provinces.

Local Distribution C7, C9, C10, C12, C13, C14, C16, C17, C18, C19, E1, E2, E4, E7



***Trachelomonas dybowskii* Drezepolski 1925 Pl. 8, Fig. 1**

Synonym : *T. intermedia* Dangeard var. *levis* Playfair

G. W. Prescott, 1962, pp. 412, pls. 83-84, fig. 6.

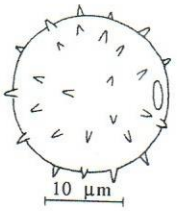
Lorica broad ellipsoid to subglobose; anterior and posterior ends broadly rounded; flagellum aperture without a collar, but usually surrounded by a thickening of the wall; lateral sides slightly swelled at midregion; wall smooth; lorica 22-33 µm in diameter, 23-43 µm long.

This small species was rarely observed in some water bodies in five provinces of the central part of the country.

Lorica broad fusiform; anterior and posterior ends narrowly rounded; lateral sides swelled; flagellum aperture with a cylindric collar with a circle of stout spines around the mouth; wall covered with many short, stout spines; lorica 24 µm in diameter, 36 µm long.

This species was rarely found in some provinces studied.

Local Distribution C1, C3, C9, C11, C13, C19, E1, E6



***Trachelomonas euchlora* (Ehrenberg) Lemmermann var. cylindrica (Ehrenberg) Lemmermann 1913 Pl. 8, Fig. 2**

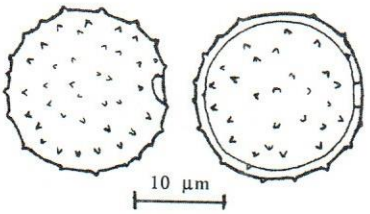
Synonym : *Trachelomonas cylindrica* Ehrenberg

G. Huber-Pestalozzi, 1955, pp. 331-332, pl. 71, fig. 682.

Lorica globose; flagellum aperture without a collar; wall covered with widely scattered short spine; lorica 8-9 µm in diameter, 23-27 µm long.

This variety differs from the type in smaller size and slimmer shape of lorica. It is one of the rare species in the studied area.

Local Distribution C5, E2



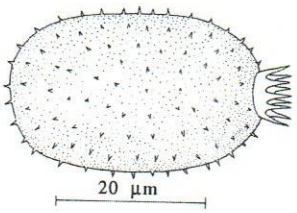
***Trachelomonas globularis* (Awerinzeff) Lemmermann var. *crenulatocollis* Szabados 1939 Pl. 8, Fig. 3 a,b**

G. Huber-Pestalozzi, 1955, p. 57, pl. 57, fig. 381.

Lorica compressed, circular in top view; broad ellipsoid in lateral view; flagellum aperture without a collar, but with a thickening wall a a ring; wall with short sharp spines; lorica 25-26 µm in diameter, 27 µm long.

This variety differs from the type in having collar and long spines distributed on lorica. It was scarcely observed in three provinces in the central part of the country.

Local Distribution C1, C9, C12



***Trachelomonas hispida* (Perty) Stein var. *coronata* Lemmermann ex Deflandre 1926 Pl. 8, Fig. 4**

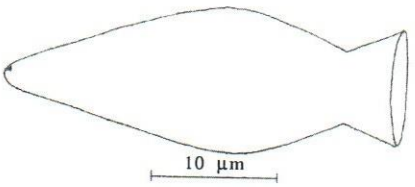
G. Huber-Pestalozzi, 1955, p. 295, pl. 64, fig. 525.

G.W. Prescott, 1962, p. 414, pl. 83, figs. 30.

Lorica cylindric ovoid; anterior and posterior ends rounded; lateral sides nearly straight and parallel; flagellum aperture without a collar and encircling by long spines around the mouth; wall finely punctate and beset with sparsely disposed minute spines; lorica 20 µm in diameter, 29-32 µm long.

This variety differs from other varieties in having a ring of spines around collar openning. It was commonly found in the studied area.

Local Distribution C2, C4, C5, C6, C9, C10, C11, C12, C13, C14, C17, C18, C19, E1, E2, E7



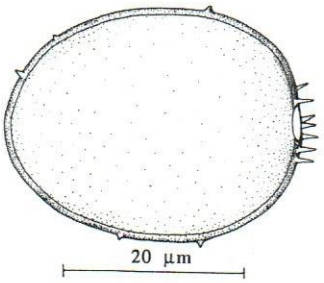
Trachelomonas hungarica **Szabados var.** ***banatica*** **Szabadoz 1939 Pl. 8, Fig. 5**

G. Huber-Pestalozzi, 1955, p. 331, pl. 71, fig. 680.

Lorica-narrow vase-like shaped; yellow-green; anterior end with a broad cylindric flared collar; posterior end narrowed and rounded; wall smooth; lorica 12 µm in diameter, 32 µm long.

The Thai specimen is slimmer than the type, and having large collar openning compared to width of posterior end of lorica. It was occasionally observed in several provinces in the central part, but only occurred in one province in the eastern part.

Local Distribution C2, C3, C5, C6, C8, C10, E7



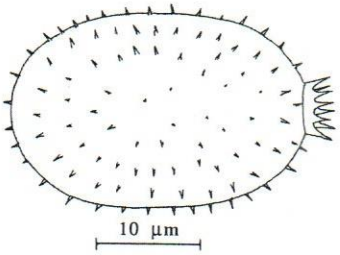
Trachelomonas intermedia **Dangeard var.** ***spinifera*** **(Popova) Popova 1966 Pl. 8, Fig. 6**

T. Yamagishi, 1992, p. 64, pl. 23, figs. 31-33.

Lorica broad ellipsoid; anterior and posterior ends broadly rounded; flagellum aperture without a collar; wall densely punctate and with sparsely distributed blunt, short spines; lorica 32.5 µm in diameter, 40 µm long.

This cosmopolitan species was rarely found in some water bodies of some provinces.

Local Distribution C1, C7, C9, C12, C17



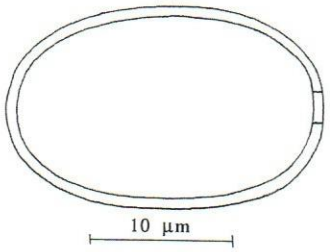
Trachelomonas mirabilis **Swirenko var.** ***affinis*** **Skvortzow 1925 Pl. 8, Fig. 7**

T. Yamagishi, 1995, pp. 65-66, pl. 24, figs. 4-5.

Lorica broad fusiform; anterior and posterior ends narrowly rounded; lateral sides swelled; flagellum aperture with a cylindric collar with a circle of stout spines around the mouth; wall covered with many short, stout spines; lorica 24 µm in diameter, 36 µm long.

This species was rarely found in some provinces studied.

Local Distribution C1, C3, C9, C11, C13, C19, E1, E6



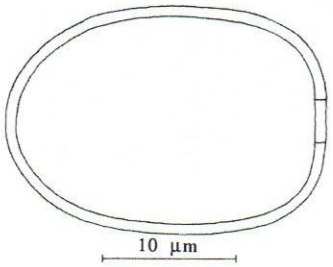
***Trachelomonas oblonga* Lemmermann var. *angusta* Huber-Pestalozzi 1900 Pl. 8, Fig. 8**

G. Huber-Pestalozzi, 1955, p. 279, pl. 61, fig. 459.

Lorica squared-shaped with rounded corners; anterior and posterior ends broadly rounded; flagellum opening without a collar; wall smooth; lorica 24 µm in diameter, 27-28 µm long.

This variety differs from var. *truncata* in shapes of anterior and posterior ends of lorica. Anterior end is round and wider than that of posterior end.

Local Distribution C1, C9, C17, C18, E2, E7



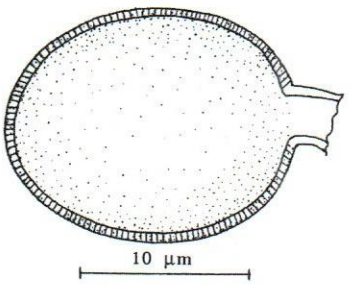
***Trachelomonas oblonga* Lemmermann var. *truncata* Lemmermann 1913 Pl. 8, Fig. 9**

T. Yamagishi, 1995, p. 66, pl. 24, figs. 6-7.

Lorica cylindrical; anterior and posterior ends truncately rounded; lateral sides nearly straight and parallel; flagellum aperture without a collar; wall smooth; lorica 26-27 µm in diameter, 30 µm long.

This variety has truncated end both anterior and posterior ends of lorica. It was common in many provinces in the central part of the country.

Local Distribution C1, C7, C9, C10, C12, C13, C14, C17



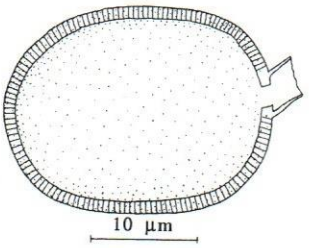
***Trachelomonas playfairii* Deflandre var. *oviformis* Hortobagyi 1947 Pl. 8, Fig. 10**

T. Yamagishi, 1992, p. 68, pl. 24, figs. 27-30.

Lorica ellipsoid to long ovoid; anterior end rounded; posterior end slightly narrowed and rounded; lateral sides swelled; flagellum aperture with a curved, cylindric collar having a slightly irregular mouth; wall smooth; lorica 17 µm in diameter, 21 µm long; collar 4.5-5 µm wide, 3.5-4 µm high.

This small species was found in some provinces in the central part of the country.

Local Distribution C1, C5, C11, C13, C19



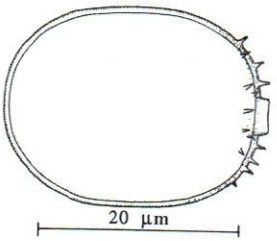
***Trachelomonas pseudobulla* Swirenko 1914 Pl. 8, Fig. 11**

T. Yamagishi, 1992, pp. 68-69, pl. 25, figs. 1-4.

Lorica broad ellipsoid to ovoid; anterior end slightly narrowly rounded; posterior end rounded; flagellum aperture with a collar; collar cylindric, base broader than the aperture, and having an irregular slightly oblique mouth; wall smooth or finely punctate; lorica 23.8 µm in diameter, 31.6 µm long; collar 4.2 µm wide, 3.9 µm high.

This variety was occasionally found in some provinces.

Local Distribution C7, C9, C10, C13, C14, C16, E1



***Trachelomonas raciborskii* Wołoszynska var. *nova* Drezelopski 1925 Pl. 8, Fig. 12**

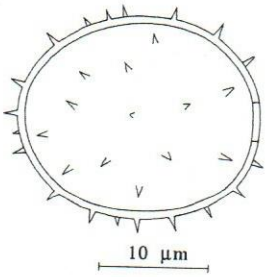
T. Mizuno, 1969, p. 19, pl. 5, fig. 12.

Lorica broadly cylindric; anterior end slightly truncated and having short spine sparsely distributed; posterior end broadly rounded; lateral sides not swelled, nearly parallel; flagellum aperture with a short cylindrical collar having a smooth mouth; wall smooth; lorica 24 µm in diameter, 31 µm long; collar 1 µm wide, 1 µm high.

This medium size variety occurred in a few aquatic habitats.

Local Distribution C1, C5, C7, C15

Leedale, G.F. 1967. Euglenoid flagellates. Prentice-Hall, Inc., New Jersey. 242 p.



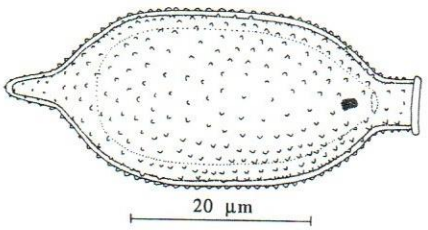
***Trachelomonas robusta* Swirenko emend Deflandre 1914 Pl. 8, Fig. 13**

G. Huber-Pestalozzi, 1955, p. 305, pl. 66, fig. 568.

Lorica subglobose to broad ovoid; anterior and posterior ends rounded; lateral sides broadly rounded; flagellum aperture with a short collar; wall covered with short spines; lorica 24 µm in diameter, 27 µm long; collar 0.9 µm high, base 4.2 µm, mouth 4.7 µm.

This spiny species was rarely found in some provinces in the central part of the country.

Local Distribution C1, C5, C9, C10, C13



Trachelomonas splendida **Playfair 1915 Pl. 8, Fig. 14**

G. Huber-Pestalozzi, 1955, p. 353, pl. 75, fig. 764.

Lorica cylindrical, nearly long pentagonal; anteriorly truncately and slightly rounded; posterior slight rounded and produced into a short cylindrical cauda; flagellum aperture with a high collar having a smooth mouth; wall evenly beset with short spines; lorica 20 µm in diameter, 40 µm long; collar 5 µm wide, 6 µm high.

This large sized species has a large eye-spot and very long flagellum. It was more frequently found in the central part than the eastern part.

Local Distribution C1, C6, C13, C16, C17, C18, C19, E3, E4, E7

Discussion

Many aquatic habitats of the central part of Thailand are shallow, mesotrophic, or eutrophic. The euglenoid flora of the central part of Thailand appears to be rich because most of the habitats are culturally influenced. In this study, 47 species, 22 varieties, and 2 forms are new records for Thailand (Yamagishi, 1987; Wongrat, 1995; Charubhun and Charubhun, 1998)

Others occurs predominantly in nutrient rich waters (*E. sanguinea*, and *E. chlorophoenicea*), especially in organic matter, such as fish ponds, drainage channels, etc.

The conclusion of the present findings is that future investigations should be focused on water bodies which are not or only slightly influenced culturally. Therefore, there is a real need for sampling in other types of localities in other part of the country.

Acknowledgement

This work was supported by TRF/BIOTEC Special Program for Biodiversity Research and Training grant BRT 143002.

References

Charubhun, B. and Charubhun, N. 1998. Freshwater protozoa in Thailand. Pp. 92-102. In : Watanabe, M. and Kaya, K. (eds.). Advances in microalgal and protozoal studies in Asia. The First International Symposium on "Asian Network on Microbial Researches", Tsuchiura, Japan, March 23-24, 1997.

Gojdics, M. 1953. The genus *Euglena*. The University of Wisconsin Press, Madison, U.S.A. 268 p.

Huber-Pestalozzi, G. 1955. Euglenophyta. Die Binnengewasser. Das Phytolankton des Susswasswes 16(4). E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1135 p.

Hirano, M. 1967. Freshwater algae collected by the joint Thai-Japanese Biological Expedition to Southeast Asia 1961-62. Nature and Life in Southeast Asia. V. 71p. 16 Pls.

Hirano, M. 1975, Phytoplankton from Lake Boraphet in the central plain of Thailand. *Contr. Biol. Lab. Kyoto Univ.*, 24(4):187-203, 7 Pls.

Kudo, R.R. 1966. Protozoology, 5 th ed. Charles C. Thomas, Springfield. 1174 p.

Mizuno, T. 1969. Illustrations of the freshwater plankton of Japan. Hoikusha Publishing Co., Ltd. 351 p.

Prescott, G.W. 1962. Algae of the western Great Lakes area. Wm. C. Brown Company Publishers, Iowa. 977 p.

Prowse, G.A. 1958. The Eugleninae of Malaya. Garden's Bull., 16:136-204.

Weik, K.L. 1967. A revision of the genus *Phacus* Dujardin in Illinois. Southern Illinois University, U.S.A. 237 p.

Wongrat, L. 1995. Freshwater algae in Thailand. Pp. 96-291. *In*: Lewmanomont, K., L. Wongrat, and C. Supanwanid. Algae in Thailand. Office of Environmetnal Policy and Planning, Bangkok, Thailand.

Yamagishi, T. 1987. The Euglenophyceae from Lake Boraphet in the Central Plain of Thailand. College of Agriculture and Veterinary Medicine, Nihon University. 23:39-51.

Yamagishi, T. 1992. Plankton Algae in Taiwan (Formosa) Uchida Rokakuho, Tokyo. 252 p.

Yamagishi, T. and Hirano, M. 1973. Some freshwater algae from Cambodia. *Contr. Biol. Lab. Kyoto Univ.*, 24(2):61-86, 8 pls.

Yamgishi, T. And Kanetsuna, Y. 1987. The planktonic Chlorophyceae from Lake Boraphet (the Central Plain, Thailand). General Education Review, College of Agriculture and Veterinary Medicine, Nihon University. Vol. 23, Pp. 19-38.