

## ***Thorea siamensis* sp. nov. (Thoreaceae: Rhodophyta) from Thailand**

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**ABSTRACT.**— *Thorea siamensis* sp. nov. is described from specimens collected at UTM 0453312, 1617355 (N, E), Tambol Huay Kha Yeng, Amphur Thong Pha Phum, Kanchanaburi Province, South-Western Thailand.

**KEY WORDS:** freshwater Rhodophyta, Thailand, *Thorea siamensis*

### **INTRODUCTION**

The freshwater algae genus *Thorea* (Thoreaceae, Rhodophyta) have a worldwide distribution, but tend to be more common in tropical and subtropical regions and in those temperate regions with warm waters. From the Asian Pacific regions, *T. gaudichaudii* was described as a new species from Guam Island in Marianas Islands (Agardh, 1824), then, reported from Okinawa Island in Japan (Yamada, 1949) and Gagil-Tamil Island in Caroline Islands (Lobban et al., 1990). *Thorea okadai* was described as a new species from Kyusyu Island in Japan (Yamada, 1949) and *T. hispida* (as *T. ramosissima*) reported from China (Yamada, 1949). *T. prowsei* and *T. clavata* were described from Pahang and Selangor States, respectively, in Peninsula

Malaysia (Rantasabapathy and Seto, 1981). Seto (1985) reviewed the taxonomy and distribution of the taxa of Thoreaceae in the Western Pacific regions. In this manuscript *T. siamensis* sp. nov. is described from Thailand as a new species.

### **MATERIALS AND METHODS**

#### **Environments and water quality**

From each sampling site the water temperature, velocity, pH, DO, BOD, hardness, conductivity and level of nutrients (nitrate nitrogen, nitrite nitrogen, orthophosphate phosphorus and silica) were characterised according to selected procedures from APHA et al. (1998). An extensive survey of the many streams in Thong Pha Phum in the Kanchanaburi province, South Western Thailand was carried out.

#### **Specimens**

Specimens of freshwater red algae were collected from rocks and submerged aquatic

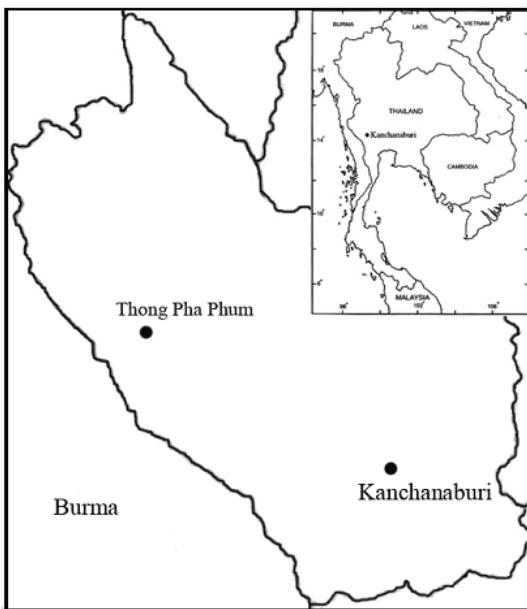
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**FIGURE 1.** A map of Thailand showing the location of Kanchanaburi Province and within, Thong Pha Phum District.

plants. The specimens were divided into three parts and preserved viz: (1) in Lugol's solution, (2) in 70% (v/v) alcohol, and (3) as dry specimens.

Specimens examined: specimens from Thong Pha Phum, Kanchanaburi Province, Thailand (Fig. 1), by Traichaiyaporn *et al.* [no. 9 (29<sup>th</sup> November, 2003) and no. 12 (12<sup>nd</sup> January, 2004), (CMU)] and Tarn Thip, Krabi Province, Thailand, by Nualcharoen *et al.*

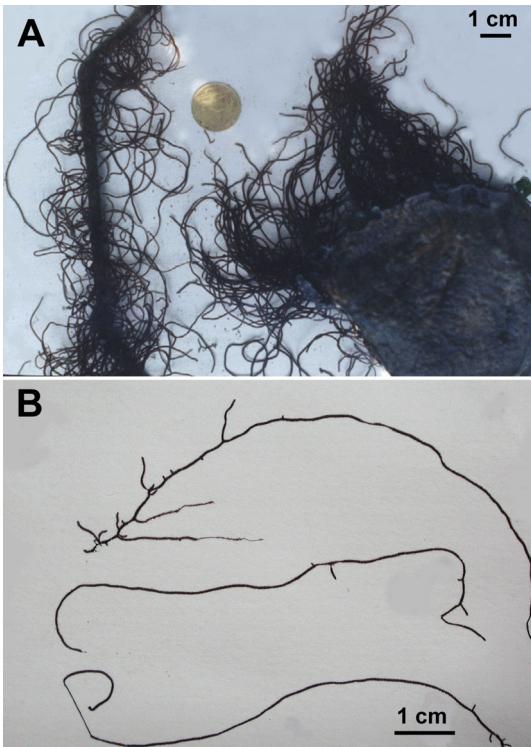
The identification of freshwater red algae was carried out with reference to the following published books and references (Agardh, 1824; Rantasabapathy and Seto, 1981; Seto, 1985; Yamada, 1949; Kumano, 2002). Photographs were taken using a compound light microscope, and then the sizes of both vegetative and reproductive parts were measured.

## SYSTEMATICS

*Thorea siamensis* Kumano and Traichaiyaporn, sp. nov.  
Figure 2-5

Thallus dioecius, parvulus, 8-15 cm longus, ca. 800  $\mu\text{m}$  in diametro, hepaticus vel porphyreus, potius gracilis, cespitosus, valde gelatinosus in thallo juveniliore vix vel sparsim ramificans, in thallo vetustiore saepe ramificans. Pars medullosa ca. 250  $\mu\text{m}$  lata. Fila assimilativa e parte basali et parte piliformi constantia; pars piliformis et non claviformis, raro ramosa; 200-250  $\mu\text{m}$  longa, puerisque ex 10-18 cellulis constantia. Cellulae intercalaribus cylindricae, 7.4-15.2  $\mu\text{m}$  longae, 2.2-5.7  $\mu\text{m}$  in diametro; cellulae apice rotundatae, 7.4-15.2  $\mu\text{m}$  longae, 2.2-3.7  $\mu\text{m}$  in diametro. Spermatangia ellipsoidalia, 4-5  $\mu\text{m}$  diametro, 8-10  $\mu\text{m}$  longa, 3-9 fasciculate, terminalia vel subterminalia on parte basali filii assimilativo brevibus oriundis. Carpogonia basi tumida leviter, 3-4  $\mu\text{m}$  diametro, 4.5  $\mu\text{m}$  longa; trichogynes rectaevel plus minusve curvae, elongatae-filiformes. ca. 2  $\mu\text{m}$  diametro, 70-150  $\mu\text{m}$  longae. Carposporophyllum indefitum; fila gonimoblastrum retantia in strato corticali. Carposporangia solitaria vel fasciculate ex parte basali filii assimilativo oriundis, ovalia, obovata vel pyriformia, 16-19  $\mu\text{m}$  longae, 8-9  $\mu\text{m}$  in diametro (Figs 2-5).

Plants dioecious, violet brown, small, sparsely branched, rather slender, mucilaginous, about 800  $\mu\text{m}$  in diameter, 8-15 cm long. Medulla about 250  $\mu\text{m}$  in diameter. Assimilatory filaments consisting of basal portion and unbranched, non-clavate hair portion, 200-250  $\mu\text{m}$  long, consisting of 10-18 cells. Apical cells 2.2-



**FIGURE 2.** *Thorea siamensis* sp. nov. A. Plant attached on an aquatic plant and rock. B. Whole plant (dry specimens)

3.7  $\mu\text{m}$  in diameter, 7.4-15.2  $\mu\text{m}$  in length with rounded apices, intercalary cells cylindrical 2.2-5.7  $\mu\text{m}$  in diameter, 7.4-15.2  $\mu\text{m}$  in length. Spermatangia ellipsoidal, 4-5  $\mu\text{m}$  in diameter, 8-10  $\mu\text{m}$  long, 3-9 in clusters, terminal or sub-terminal on short assimilatory filaments near the base of cortical layers. Carpogonia issued laterally on cells of basal portion of assimilatory filaments. Basal portion of carpogonium slightly swollen. Carpogonia are 3-4  $\mu\text{m}$  in diameter at the base, 4-5  $\mu\text{m}$  long, trichogyne straight or more or less curved, elongate-filiform, about 2  $\mu\text{m}$  in diameter, 70-150  $\mu\text{m}$  long. Carposporophyte with defused gonimoblast filaments consisting of cylindrical cells. Carposporangia solitary, terminal or sub-terminal on gonimoblast

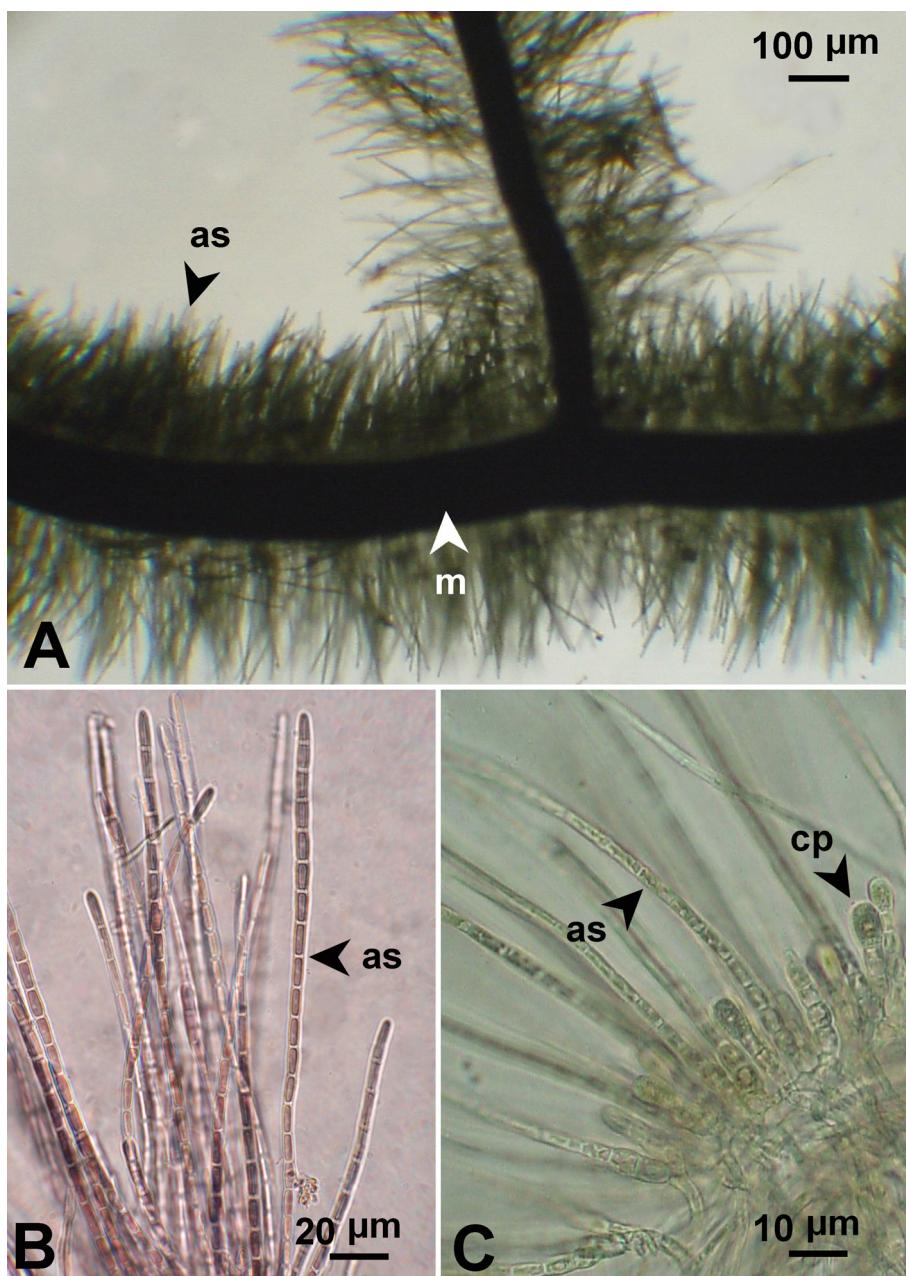
filaments, club-shaped or obovoid, 8-9  $\mu\text{m}$  in diameter, 16-19  $\mu\text{m}$  long (Figs 2-5).

**Holotype specimen.**- Thong Pha Phum, Kanchanaburi, South Western Thailand by Traichaiyaporn *et al.* no. 9, 29, November, 2003, deposited in the Herbarium of the Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand (CMU).

**Other specimen examined.**- Thong Pha Phum, Kanchanaburi, South Western Thailand by Traichaiyaporn *et al.* no. 12, 12 January, 2004, deposited in the Herbarium of the Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand (CMU).

**Habitat.**- *Thorea siamensis* was found growing in a small stream, attached on plants and rocks, in half-shaded places in a crystal, shallow, big stream, 20-40 cm depth, 2.50-3.50 m wide, running through tropical mixed deciduous forests at an altitude of about 205 m, UTM 0453312, 1617355 (N, E), at Tambol Huay Kha Yeng, Amphur Thong Pha Phum, Kanchanaburi Province, South Western Thailand.

The stream bed consisted of stones, gravel and sand, with a light intensity of low to medium. Physico-chemical water quality recorded in November 2003 and January 2004 were as follows: crystal water color, depth 10-40 cm, water velocity 0.09-0.31 m/sec, water temperature 23.7-24.9 °C, pH 7.45-7.50, conductivity 344.0-347.0  $\mu\text{S}/\text{cm}$ , hardness 66.3-152.8 mg/l as  $\text{CaCO}_3$ , nitrate nitrogen ND-1.200 mg/l, nitrite nitrogen ND-0.006 mg/l, orthophosphate phosphorus 0.090-0.200 mg/l and silica 9.120-9.248 mg/l.



**FIGURE 3.** *Thorea siamensis* sp. nov. A. Thallus with medulla portion (m) and assimilatory filaments (as). B. Assimilatory filaments. C. Assimilatory filaments and carposporangia (cp).

**Distribution.**– *Thorea siamensis* occurs in Thong Pha Phum, Kanchanaburi Province and Tarn Thip, Krabi Province in Thailand.

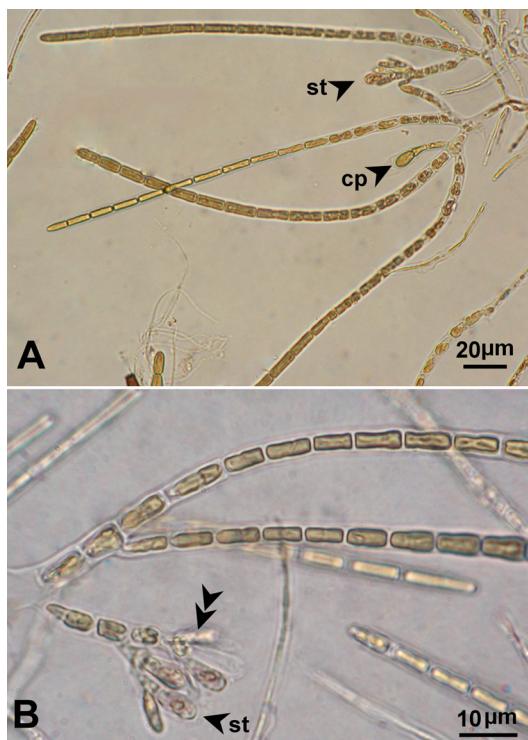
## DISCUSSION

**Effective criteria:** The length and shape of the assimilatory filaments, the shape of the carpogonia and the shape and size of the carposporangia are the main criteria that distinguished *T. siamensis* from the Asian-Pacific taxa from other species within this genus.

**Shape of assimilatory filament:** Only *T. clavata* has the clavate type of assimilatory filaments, while all other taxa have non-clavate assimilatory filaments.

**Shape of carpogonia:** *Thorea hispida* and *T. okadae* have a spherical type of carpogonia, whilst *T. gaudichaudii*, *T. clavata* and *T. siamensis* have an ovoid type of carpogonia.

**Shapes of carposporangia:** According to the observed shapes of the carposporangia, the taxa of *Thorea* can be grouped into two types: 1) a spherical type of carposporangia: (diameter/ length ratio 1.2-1.6) including *T. hispida* and *T. okadae*, 2) an ovoid type of carposporangia (diameter/ length ratio 1.7-1.9) including *T. gaudichaudii*, and *T. siamensis*. As mentioned here, two taxa, *T. siamensis* and *T. gaudichaudii* have the same spherical type of carposporangia. However, the sizes of the carposporangia are recognized as the criteria to distinguish between both taxa (see below).



**FIGURE 4.** *Thorea siamensis* sp. nov. A. Carposporangia (cp) and spermatangia (st). B. Spermatangia and naked spermatangium (double arrow head).

**Sizes of carposporangia:** Carposporangia of *T. gaudichaudii* are 11.4  $\mu\text{m}$  (9.8-12.0  $\mu\text{m}$ ) in diameter, 19.8  $\mu\text{m}$  (17.7-21.5  $\mu\text{m}$ ) in length, while those of *T. siamensis* are 7.5  $\mu\text{m}$  (7.0-8.0  $\mu\text{m}$ ) in diameter, 15.5  $\mu\text{m}$  (15.2-15.8  $\mu\text{m}$ ) in length. The size of the carposporangia is thus an effective criterion to distinguish *T. siamensis* from *T. gaudichaudii*.

Thus, the specimens from the Asian Pacific region are classified as follows:



**FIGURE 5.** *Thorea siamensis* sp. nov. carpogonium (cg) with trichogyne (tg).

- 1a Assimilatory filaments clavate.....  
.....*T. clavata*
- 1b Assimilatory filaments non-clavate.....2
- 2a Base of carpogonia spherical.....3
- 2b Base of carpogonia ovoid.....4
- 3a Assimilatory filaments long....*T. hispida*
- 3b Assimilatory filaments short...*T. okadae*
- 4a Carposporangia large, 11.4  $\mu\text{m}$  (9.8-12.0  $\mu\text{m}$ ) in diameter....*T. gaudichaudii*
- 4b Carposporangia small, 7.5  $\mu\text{m}$  (7.0-8.0  $\mu\text{m}$ ) in diameter....*T. siamensis* sp. nov.

**Distribution of the Asian-Pacific taxa:**  
Taxa of *Thorea* from the Asian Pacific region might be grouped in accordance with the latitudes of their habitats.

1) Temperate taxa: *Thorea hispida* is cosmopolitan and widely distributed in the Eurasian continent as well as, in the tropics, within the Americas and the Asian Pacific regions. Within Europe it was reported from three locations each in the United Kingdom and Croatia, and also in France (Type locality). From the Asian Pacific regions it

was reported from Honshu Island in Japan at about 36° N, from Niangzi Guan in China at about 38° N, *T. okadae* from Honshu Island at about 35° N, and in Kyushu Island in Japan at about 32-33° N. *Thorea okadae* is endemic to Japan, distributed in River Sendai at Ebino, Yoshimatu, Miyazaki, at Hishikari (type locality) and at Suzunose, Kagoshima in Japan.

2) Subtropical-tropical taxa: *Thorea gaudichaudii* is restricted from subtropical to tropical regions and has been reported from three localities in Japan at about 26° N latitude, River Mahlac, River Ylig, Spring Dobo in Guam Island in and Marianas Islands at about 13° N and 9° N, respectively, and from the Philippines (without reported latitude).

3) Tropical taxa: *Thorea clavata* is restricted to Malaysia and Thailand, distributed from Kanchanaburi Province in Thailand at about 16° N and Selangor State in Malaysia at about 3° N. *Thorea prowsei* is endemic to Malaysia, from the River

Gombak near Kuala Lumpur, Pahang State in Malaysia at about 3° N. *Thorea siamensis* is endemic to Thailand, found from two localities, Thong Pha Phum, Kanchanaburi Province at about 16° N, and Tarn Thip, Krabi Province (without reported latitude)

It is interesting that *T. siamensis* is found at the same locality in Thailand together with *T. clavata*, originally described from the River Gombak near Kuala Lumpur in Peninsula Malaysia. In other words, *T. siamensis* and *T. clavata* are found growing in two different streams located at a distance of about 200 m in the same locality in Thailand.

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