Kasetsart J. (Nat. Sci.) 32 : 339 - 346 (1998)

Diversity of Blue-Green Algae and Green Algae in the Deciduous Dipterocarp Forest at Huai Kha Khang Wildlife Sanctuary

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ABSTRACT

Study on diversity of blue-green algae and green algae was carried out in Deciduous Dipterocarp Forest at Huai Kha Khang Wildlife Sanctuary. Samples were collected from nine spots in representative plot of 100x100 square meter during rainy, winter and summer. They were divided into two parts and the first part was immediately observed under microscope to study the morphological characteristics while the second portion was enriched with NS III medium and incubated for approximately one month prior to microscopic observation. Based on information obtained 18 genera of blue-green algae and 31 genera of green algae were identified. Distribution of blue-green algal genera was varied in different seasons, i.e. 18 in rainy season, 9 in winter and 14 in summer. Similar pattern was also noticed among green algae, i.e. 27 genera in rainy, 13 genera in winter and 13 genera in summer. Predominant blue-green algae were *Oscillatoria* and *Lyngbya*, while green algae were *Chlorella* and *Ulothrix*.

Key words : blue-green algae, green algae, Deciduous Dipterocarp Forest, Huai Kha Khang

INTRODUCTION

Huay Kha Khang Wildlife Sanctuary is one of the most undisturbed natural forest in Thailand. It is an important watershed for several waterways. In 1991, Huay Kha Khang Wildlife Sanctuary was declared as World Heritage by UNESCO for its richness in plant and animal species (Assavachaicharn, 1992).

Variations in geographic topography and climates from tropical to sub-tropical, has led to the diversity of living organisms in this region. Although, biodiversity has been carried out in this area, past studies were concentrated mainly on plant and animal species (Prayoonsith, 1992). Therefore, to complete the information, studies on distribution of microorganisms, including micro-algae in this important reserve were carried out.

Micro-algae live in various habitats, namely water, soil, surfaces of rock, tree bark, etc. Different in living environments results in variation of micro-algal species (Smith, 1950). In addition seasonal change is another important factor contributing to micro-algal diversity due to variation in temperature and moisture. The main objectives of this research were to study and report the distribution of micro-

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algal species in Huay Kha Khang Wildlife Sanctuary and collect the species that may have the commercial applications.

MATERIALS AND METHODS

1. Sampling Sites

This research project was a part of an integrated program on studies of all living organisms in Huay Kha Khang Wildlife Sanctuary, Uhtai Thani Province, therefore a representative plot of 100 × 100 square meter in natural Deciduous Dipterocarp Forest. Samples were collected in 9 spots of various ecological habitats, *i.e.* soil, rock surface, tree bark and small basins and waterways.

2. Sample collections

Samples were collected from sampling plot in winter, summer and rainy seasons. Each sample was divided into two parts. The first portion was studied under light microscope at site for natural morphological characteristics and species distribution. The second portion was enriched with NS III medium (Payer, 1971) to obtain half strength concentration. After incubation under natural light in the laboratory for 1 month, algal species were revealed under high resolution phase contrast microscope.

3. Identification of micro-algal species

Identification of micro-algal species was carried out based mainly on morphological characteristics, such as cell structure and size, cell organization, number and position of flagella. Some biochemical properties, such as pigments and food storage, were also employed (Round, 1973).

4. Classification of micro-algae

Classification of micro-algae taxa was carried out to genera level based on procedures of Smith (1950); Desikachary (1959); Randhawa (1959); Ramanathan (1964); Bold and Wynne (1978) and Prescott (1978).

RESULTS AND DISCUSSION

Studies on diversity of micro-algae in Deciduous Dipterocarp Forest at Huay Kha Khang Wildlife Sanctuary revealed 18 genera of blue-green algae (Figure 1) and 31 genera of green algae (Figure 2). Seasonal changes affected number of micro-algae of both groups. In rainy season all 18 genera of blue-green algae and 27 general of green algae were observed. In winter, the species of blue-green algae and green algae detected were minimal at 9 and 13 genera, respectively. While in summer where occasional rainfalls were noticed, 14 genera of blue-green algae and 13 genera of algae were observed. Regarding species variations, *Oscillatoria* and *Lyngbya* were widely distributed in all seasons, where *Phormidium* came next. For the remainder, blue-green algae that found only in rainy season were *Calothrix, Cylindrospermum, Homoeothrix,* and *Microcoleus,* where *Chroococcus, Gloeocapsa, Merismopedia, Plectonema,* and *Stigonema* were found in rainy and summer seasons (Table 1). Among green algae, *Chlorella* and *Ulothrix* were abundant and common in every season, follow by *Chlamydomonas. Ankistrodesmus, Euastridium, Geminella, Kirchneriella, Micrasterias, Mougeotia, Mougeotiopsis, Netrium, Pediastrum, Protoderma, Spirogyra, Staurastrum, Stichococcus* and *Stigeoclonium* were found only in rainy season. Species that encountered in some season were *Chlorococcum, Hormidium* and *Leptosira* in summer; *Cosmarium, Cylindrocystis, Haematococcus, Tetmemorus* in rainy and winter; *Chlamydomonas* and *Stichococcus* in rainy and summer; and *Trochiscia* in winter and summer (Table 2)

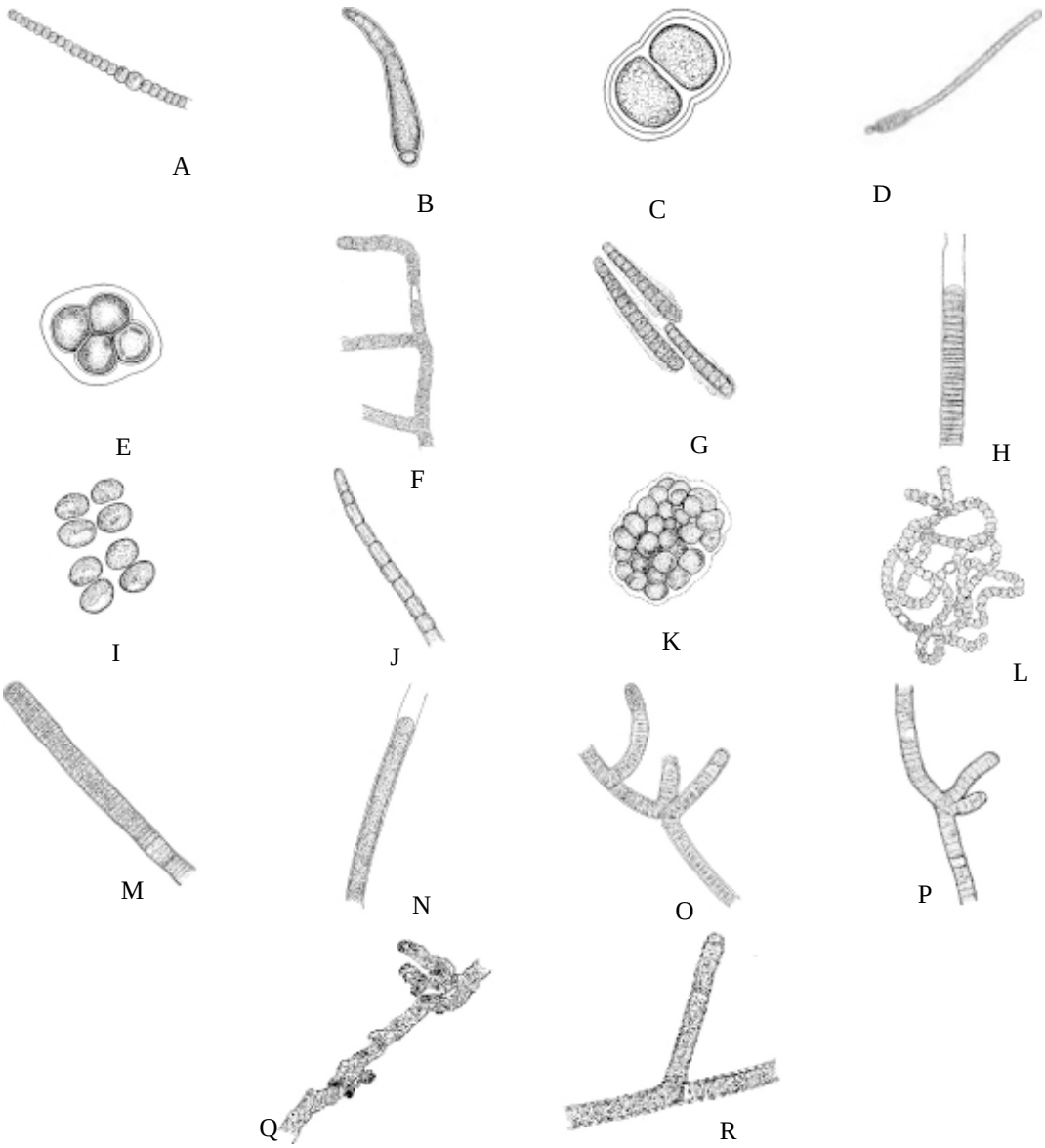

Figure 1 Illustration of blue-green algae found in Deciduous Dipterocarp Forest at Huay Kha Khang Wildlife Sanctuary, Uthai Thani Province.

(A) Anabaena sp. (B) *Calothrix* sp. (C) *Chroococcus* sp.
(D) *Cylindrospermum* sp. (E) *Gloecapsa* sp. (F) *Hapalosiphon* sp.
(G) *Homoeothrix* sp. (H) *Lyngbya* sp. (I) *Merismopedia* sp.
(J) *Microcoleus* sp. (K) *Myxosarcina* sp. (L) *Nostoc* sp.
(M) *Oscillatoria* sp. (N) *Phormidium* sp. (O) *Plectonema* sp.
(P) *Scytonema* sp. (Q) *Stigonema* sp. (R) *Tolypothrix* sp.

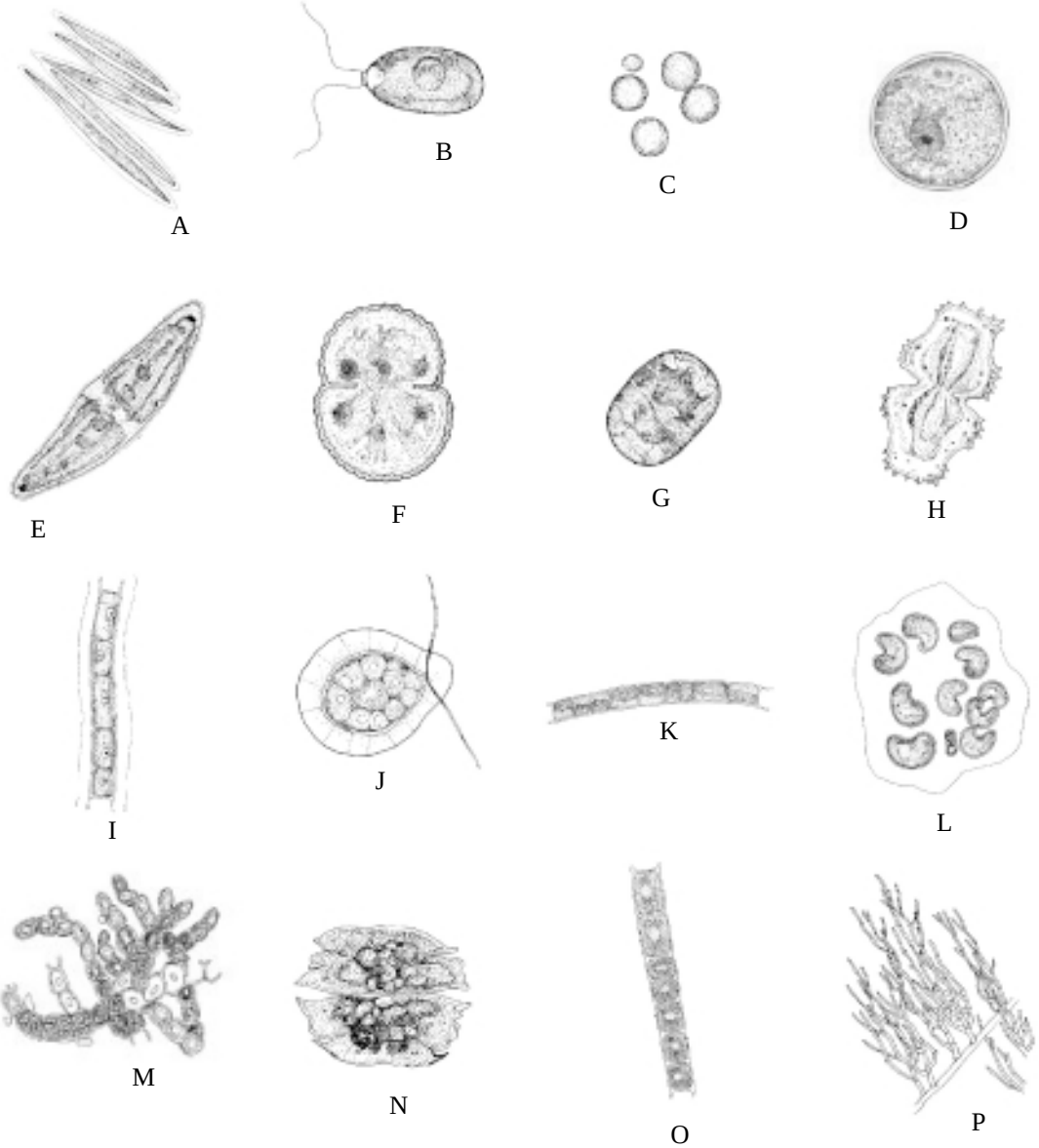

Figure 2 Illustration of green algae found in Deciduous Dipterocarp Forest at Huay Kha Khang Wildlife Sanctuary, Uthai Thani Province.

(A) *Ankistrodesmus* sp. (B) *Chlamydomonas* sp. (C) *Chlorella* sp.
(D) *Chlorococcum* sp. (E) *Closterium* sp. (F) *Cosmarium* sp.
(G) *Cylindrocystis* sp. (H) *Euastridium* sp. (I) *Geminella* sp.
(J) *Haematococcus* sp. (K) *Hormidium* sp. (L) *Kirchneriella* sp.
(M) *Leptosira* sp. (N) *Micrasterias* sp. (O) *Microspora* sp
(P) *Microthamnion* sp.

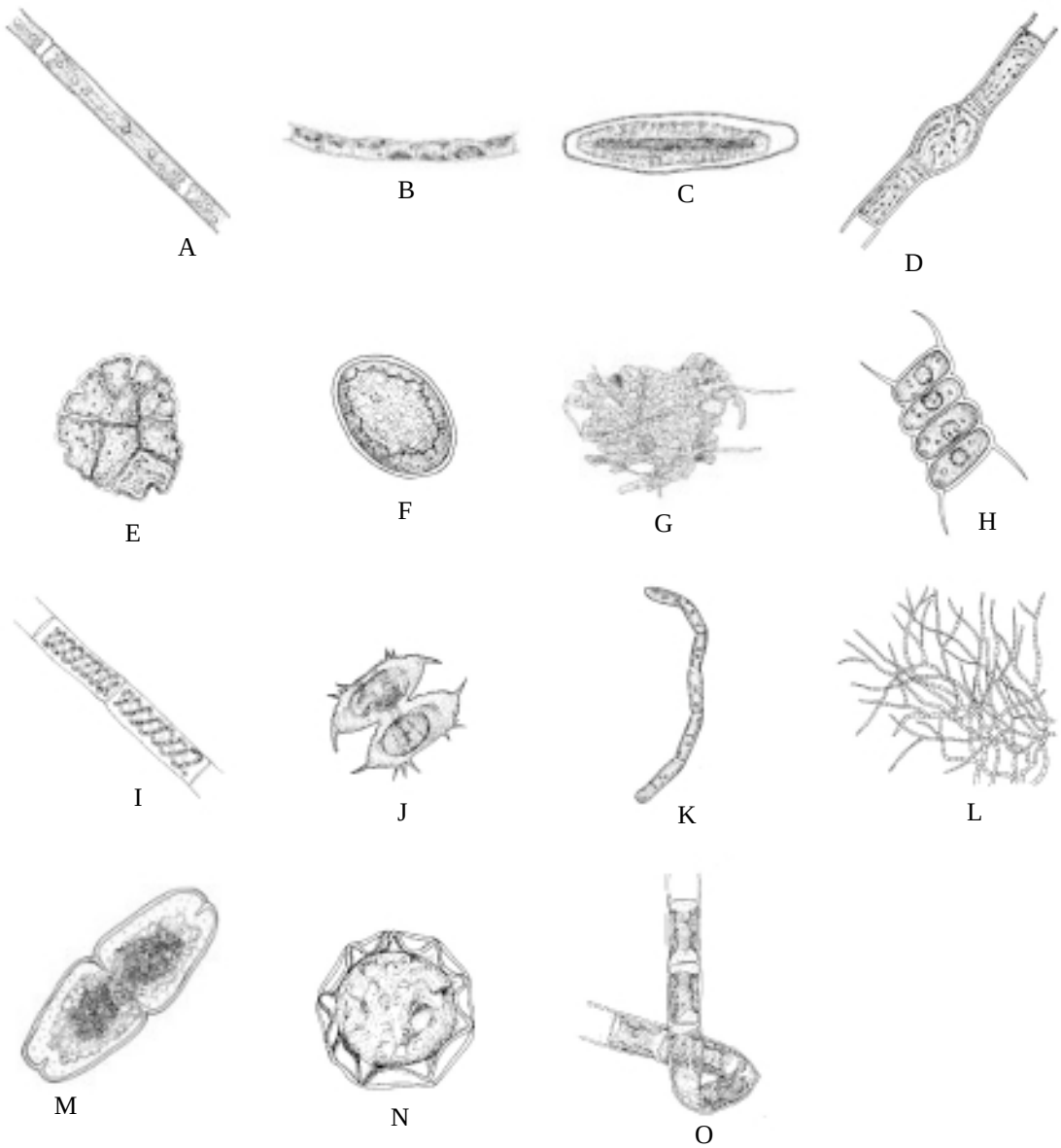

Figure 3 Illustration of green algae found in Deciduous Dipterocarp Forest at Huay Kha Khang Wildlife Sanctuary, Uthai Thani Province (continued).

(A) *Mougeotia* sp. (B) *Mougeotiopsis* sp. (C) *Netrium* sp.
(D) *Oedogonium* sp. (E) *Pediastrum* sp. (F) *Protococcus* sp.
(G) *Protoderma* sp. (H) *Scenedesmus* sp. (I) *Spirogyra* sp.
(J) *Staurastrum* sp. (K) *Stichococcus* sp. (L) *Stigeoclonium* sp.
(M) *Tetmemorus* sp. (N) *Trochiscia* sp. (O) *Ulothrix* sp.

Table 1 Distribution of blue-green algae found in different seasons at deciduous dipterocarp forest of Huay KhaKhang Wildlife Sanctuary, Uthai-thani Province.

Genus	Spot 1			Spot 2			Spot 3			Spot 4			Spot 5			Spot 6			Spot 7			Spot 8			Spot 9		
	R	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*
Anabaena	-	-	-	-	-	-	+	-	-	-	+	+	+	+	+	+	+	+	+	-	+	-	-	-	-	-	-
Calothrix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Chroococcus	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-
Cylindrospermum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Gloeocapsa	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-
Hapalosiphon	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	+	+	-	+	-	-	-	-	-	-
Homoeothrix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Lyngbya	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	-	-	+
Merismopedia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	+
Microcoleus	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myxosarcina	+	-	-	+	-	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Nostoc	-	-	+	+	-	+	-	-	+	-	+	+	+	-	+	+	+	+	-	+	-	-	-	-	-	-	-
Oscillatoria	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+
Phormidium	-	-	-	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+	+	-	-	-	+	+	-	+	+
Plectonema	-	-	+	+	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scytonema	+	+	+	+	+	+	+	-	+	+	+	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-
Stigonema	-	-	-	+	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypothrix	+	-	-	+	+	-	+	+	+	-	-	+	+	+	-	+	-	-	-	+	-	-	-	-	-	+	+

\+ - found

\- - not found

R - Rainy, W - Winter, S - Summer

Each species of micro-algae grows and adapts to different environmental conditions. In nature season changes are the main factors contributing to variations in temperature, moisture and light which play major roles on micro-algal growth. Under unfavorable conditions some micro-algae may develop into more tolerant life-forms. For example, an isolate of *Haematococcus* sp. found in this reserve, its cell undergoes several changes by removal of flagella, enlarging cell size, change to spherical cell shape and accumulate large amounts of red carotenoid pigment. On another hand, *Anabaena* sp. produces achinete to survive in detrimental environmental conditions. *Oscillatoria* sp. and *Lyngbya* sp. undergo fragmentation of filaments into hormogone. All of these life-forms will develop to vegetative cells when seasonal changes allowed optimal temperature and moisture.

Concerning habitat of blue-green algae, *Microcoleus*, grew well in moist soil, while *Calothrix*, *Cylindrospermum* and *Homoeothrix*, preferred complete water surroundings. *Chroococcus*, *Hapalosiphon* and *Merismopedia* were found both in water and moist soil. *Stigonema*

Table 2 Distribution of green algae found in different seasons at deciduous dipterocarp forest of Huay KhaKhang Wildlife Sanctuary, Uthai-thani Province.

Genus	Spot 1			Spot 2			Spot 3			Spot 4			Spot 5			Spot 6			Spot 7			Spot 8			Spot 9		
	R	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*	*R*	*W*	*S*
Ankistrodesmus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Chlamydomonas	-	-	-	-	-	+	-	-	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-	+	+	-	-
Chlorella	-	-	-	+	-	-	+	-	-	-	-	-	+	+	-	-	-	-	+	-	-	+	+	+	+	-	-
Chlorococcum	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Closterium	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	+	+	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	-	+	+	-	-	-	-	+	+	-
Cylindrocystis	+	-	-	+	+	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euastridium	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Geminella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Haematococcus	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	-	-	+	-	-	-	-	-	-	-
Hormidium	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Kirchneriella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Leptosira	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Micrasterias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Microspora	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	+	+	+	-	-	-	-	-	-
Microthamnion	-	+	-	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mougeotia	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mougeotiopsis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Netrium	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Oedogonium	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+	+	-	+	+	-	-	-	-	-
Pediastrum	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Protococcus	+	+	+	-	+	+	-	-	-	-	+	-	+	+	+	-	-	-	-	-	+	-	-	-	-	-	-
Protoderma	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scenedesmus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	+	+	+	+	+	+
Spirogyra	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Staurastrum	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Stichococcus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Stigeoclonium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Tetmemorus	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Trochiscia	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-	-	-
Ulothrix	-	+	+	-	-	-	+	-	-	-	+	-	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-

\+ - found

\- - not found

R - Rainy, W - Winter, S - Summer

and *Myxosarcina* were detected on tree bark and rock surface. Many blue-green algae were located in various habitat including water body, soil and rock surfaces and tree bark, such as *Anabaena, Gloeocapsa, Lyngbya, Nostoc, Oscillatoria, Phormidium, Plectonema, Scytonema* and *Tolypothrix.*

For green algae, *Protoderma* was found on tree bark and wood surface while *Chlorococcum* was located on soil surface. Most green algae, namely *Ankistrodesmus, Euastridium, Geminella, Kirchneriella, Leptosira. Micrasterias, Mougeotia, Mougeotiopsis, Netrium, Pediastrum, Scenedesmus, Spirogyra, Staurastrum* and Stigeoclonium were detected in small basins. The remainder algae were found in various habitat, for example *Chlamydomonas, Chlorella,Closterium, Cosmarium, Cylindrocystis, Haematococcus, Hormidium, Microspora, Microthamnion, Oedogonium, Protococcus, Stichococcus, Stigeoclonium, Tetmemorus, Trochiscia* and *Ulothrix.*

ACKNOWLEDGEMENT

The authors would like to thank the Department of Microbiology, Kasetsart University and Thailand Institute of Scientific and Technological Research for providing research facilities for this study. Financial support from Kasetsart University Research and Development Institute was also acknowledged.

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Received date : 2/03/98
Accepted date : 12/05/98