

สารบัญ และเพลงก่ตอน

Diversity of halophilic cyanobacteria in saline areas in some regions of Thailand

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The halophilic cyanobacteria are a group of cyanobacteria that can grow in high salt concentration biotopes. They can tolerate this situation because they can maintain the level of osmotic pressure between their cells and their environment. The objectives of this research concern the biodiversity and distribution of halophilic cyanobacteria including some physical and chemical characteristic of their habitats. A preliminary study in the northeastern parts of Thailand in March 2007 found 3 divisions, i.e., Cyanophytes, Chlorophytes and Chrysophytes. Dominant species are in the Division Cyanophytes and are *Chroococcus* sp., *Osillatoria* spp., and *Phormidium* sp., and include the diatom, *Amphora* sp. Cultures of these algae are in progress.

Genetic diversity and phylogenetic relationships of hot spring cyanobacteria

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Short and long tandemly repeated repetitive sequences (STRR and LTRR) of 11 hot spring cyanobacteria were studied. Cyanobacterial isolates were selected from culture collections maintained at the Applied Algal Research Laboratory CMU representing different morphogenera or morphospecies. DNA fingerprinting was obtained following PCR reaction using primers specific to tandemly repeated repetitive sequences. Two primers, STRR 1A and STRR 1B, specific to short tandem repeats, were successfully used to generate fingerprints, while primers specific to long tandem repeats were not. Fingerprints from both primers generated congruent trees with two main clusters. However, clusters were not in agreement with taxonomic groups; only three strains in the genus *Synechococcus* formed a subgroup together within Cluster I. Further analysis of sequences of *cpc*-IGS and rDNA-ITS of these strains will be conducted to confirm relationships within this group of cyanobacteria.

Research and development of algal products for restoration of soil and sustainable production of agricultural products

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Algae, the microorganism group that produces extracellular polysaccharide substances (EPSs), play a significant role in soil aggregation, soil structure and stabilization. Therefore, algae either as living biomass or secreted in EPSs form can be used as soil biofertilizer/conditioners to improve soil structure and increase soil organic matter. Twenty-eight blue-green algal strains from the Algal Culture Collection at MIRCEN, TISTR, were studied for their growth and polysaccharide production. The experimental results indicated that all 28 algal strains produced variable amounts of total polysaccharide. Among these, 4 algal strains that had high total polysaccharide contents with rapid growth, namely *Nostoc* sp. TISTR 8290, *Nostoc muscorum* TISTR 9054, *Nostoc muscorum* TISTR 8871, and *Nostoc* sp. TISTR 8873, were selected. These 4 algal strains had total polysaccharide contents of 124.86 ± 2.74 , 120.10 ± 2.56 , 117.94 ± 1.65 , and 114.92 ± 2.00 milligrams per gram of dry algae, respectively. Living biomasses produced by these 4 algal strains were 29.07 ± 1.13 , 14.63 ± 1.39 , 16.06 ± 1.61 , and 33.08 ± 1.56 grams per litre, respectively. Further study on the effectiveness of *Nostoc muscorum* TISTR 9054 for the improvement of plant growth (*Oryza sativa* L. Pathumthani 1) and soil properties (Din Lumduan) was conducted in a pot experiment. Height of rice seedlings grown in soil mixed with algae (10:1, w/w) for 35 days of cultivation was 35.88 ± 0.67 cm which was significantly different ($p=0.02$) to shoot height of rice seedlings in the control (32.82 ± 0.87 cm). Analytical results for organic matter (OM) content and water holding capacity (WHC) showed that %OM in soil mixed with algae increased from 9.60% to 199.97% while %WHC also increased from 132.74% to 235.18%. This indicated that soil properties could be improved by the addition of algae.

Characterization of soil conditioners from algae

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The efficiency of soil conditioners from algae was studied by comparison between the addition of algal biomass (AB) and extracellular polysaccharide (EPS) to two types of soil, i.e., 1) paddy soil of Thung Gula Ronghai in Roi Et province, and 2) garden soil of Lam Takhong Research Station in Nakhon Ratchasima province. Four *Nostoc* strains (TISTR 8290, 8871, 8873, and 9054) which had been previously screened and selected as potential strains based on their rapid growth and high EPS production were applied. The experiments were conducted using a Completely Randomized Experimental Design (CRD) with 3 replicates for each treatment. Plastic boxes (13x13x4.5 cm) containing 250 g of soil were used. For the AB model, 10 g of fresh AB were spread over the soil surface and kept under cool-white fluorescent lamps at a light intensity of 60 $\mu\text{E}/\text{m}^2/\text{s}$. In the case of the EPS model, 32 ml of EPS were spread over the soil surface and kept in the dark. All test boxes were covered with plastic lids to control soil moisture and were incubated at $28\pm 1^\circ\text{C}$ for 2 months. Findings indicated that *Nostoc muscorum* TISTR 9054 delivered the best results in either soil with the addition of AB or EPS. These results showed statistically significant differences ($p\leq 0.05$) to the control group in terms of organic compounds, microbial activity, soil bulk density and soil bulk porosity of Lam Takhong soil and organic compounds and microbial activity of Thung Gula Ronghai soil. The stability of soil against water action is in the process of analysis.

Screening for herbicide-production by microalgal strains

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The purpose of this study was to screen algal strains for effective production of herbicidal compounds. The crude extracts of three algal strains, *Anabaena* sp. TISTR 8077, *Hapalosiphon fontinalis* TISTR 8225 and *Oscillatoria* sp. TISTR 8245, were assayed for their inhibition effects on the growth of rice seedlings (*Oryza sativa* L., Pathumthani 1) at the MIRCEN laboratory, TISTR. The highest efficiency was found for the crude extract of *Hapalosiphon fontinalis* TISTR 8225 at concentrations of 0.15-12.0 g DW L⁻¹ (80% MeOH) which exhibited inhibition effects on the shoots and roots of rice seedlings at 24-35% and 56-82%, respectively. The phytotoxicity of the crude extracts of all algal strains to root growth was greater than that to shoot growth and the inhibition effect was dependent on the concentration. The lowest EC₅₀ (50% effective concentration) obtained from crude extracts of *Hapalosiphon fontinalis* TISTR 8225 on shoots and roots were 17.2 and 2.6 g DW L⁻¹, respectively. The results indicated that crude extracts of *Hapalosiphon fontinalis* TISTR 8225 using MeOH at 40°C in the dark (R² = 0.9004) could greatly inhibit the growth of roots. Furthermore, SEM and TEM observations showed that the external layers and the cells of root tips were destroyed. It is suggested that the crude extract of *Hapalosiphon fontinalis* TISTR 8225 could be used as a substance for developing natural herbicides, particularly for the inhibition of root growth of some grasses.

A comparative study on morphology of the Agarophyte, *Gracilaria salicornia* (C. Agardh) Dawson, occurring along the North Coast of the Gulf of Thailand

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Specimens of *G. salicornia* were randomly collected from 11 sites in five provinces at Chonburi (Ko Sichang, Ang-Sila, Sri Racha harbour, Samaesan), Rayong (Ban phe), Trat (Laem sok, Laem Thien, Ao cho), Prachuap Kiri Khan (Ta Monglai, Wanakon beach) and Chumporn (Thung Wua Laen beach), during low tide in the dry and monsoon seasons. The collected samples were preserved in formalin solution. Specimens were also dried on herbarium sheets. Changes in morphology of the specimens were examined with reference to different habitats. Collected specimens showed variation in external features in relation to season and habitat and could be divided into two groups. Group I fronds were cylindrical, constricted and with articulated branches. These characters were found in specimens from Ko Sichang (Ø 0.90-1.95 mm) and Ang-Sila (Ø 0.80-1.90 mm). In Group II, fronds were succulent forming slightly articulated branches or constricted articulated branches as above. These characters were found in specimens from Sri Racha harbor (Ø 2.20-3.85 mm), Samaesan (Ø 1.30-2.85 mm), Ban phe (Ø 1.20- 3.20 mm), Laem Sok (Ø 1.80-3.35 mm), Laem Thien (Ø 2.25-3.80 mm), Ao Cho (Ø 1.50-3.85 mm), Ta Monglai (Ø 2.05-3.75 mm), Wanakon beach (Ø 0.95-3.75 mm), and Thung Wua Laen beach (Ø 1.80-3.70 mm). Group I showed no significant difference in segment diameter ($p = 0.05$) among specimens, while Group II showed variation in morphology with habitat. There were no significant differences in segment diameter with season except for plants collected from Ang-Sila, Ban phe, Wanakon beach and Thung Wua Laen beach.

Yield, composition and antimicrobial activity of polysaccharide extracted from brown seaweed by hot water extraction

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Seven species of brown seaweed, namely *Colpomenia sinuosa*, *Hydroclathrus clathratus*, *Sargassum polycystum*, *Turbinaria conoides*, *Dictyota dichotoma*, *Padina australis* and *Padina minor*, were collected from Chonburi, Rayong and Chumporn provinces. Samples collected were dried at room temperature and extracted in distilled water at 100 °C for 2 hrs. Yield of the extracts had maximum values of 2.98% in *P. australis* and 2.86% in *S. polycystum* collected from Rayong province. The lowest yield of 1.4% was obtained from *D. dichotoma* collected from Chumporn province. Total carbohydrate contents were highest in the extracts of *P. minor* (56.31%) and *P. australis* (51.54%) while the lowest value of 32.17% was obtained from *T. conoides*. The highest sulfate content was 18.38% obtained from the extract of *H. clathratus* while the lowest contents were 4.93% and 4.92% in *P. australis* and *S. polycystum*, respectively, collected from Chonburi province. Components of monosugar in the extracts were analyzed by the TLC technique using glucose, galactose, fucose, mannose and fructose as standard references. The TLC analysis showed fructose sugar as an essential component in all extract polymers. The antibacterial activity of the extracts was screened using the bacterial species, *Vibrio parahaemolyticus* and *V. haveyi*. *Padina australis* collected from Rayong showed inhibition to *V. parahaemolyticus* at all concentrations of 100, 250, 500 ppm. The most effective inhibition (1.52 ± 0.13 mm) was obtained from the extract concentration of 500 ppm while inhibition at concentrations of 100 and 250 ppm were 1.07 ± 0.16 mm and 1.30 ± 0.05 mm, respectively.

Population structure of *Padina australis* Hauck (Dictyotales, Phaeophyta) in two locations in Phuket Province, Thailand

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The genus *Padina*, a brown alga (Phaeophyta), has a worldwide distribution in tropical and subtropical climate zones. Because of the broad distribution of this genus, we posed the question: How does *Padina* increase the number of individuals and what factors support its reproduction? The purpose of this project is to study the population structure of *Padina australis* Hauck in two locations on Koh Phuket. The hypothesis includes the idea that characteristic patterns of growth, reproductive cell formation and recruitment in the natural habitats will determine the distribution of particular phases of the life history, the numbers of each phase and the annual cycle of growth, maturation, death and then recruitment of new individuals. The two populations at the contrasting habitats of Sirinart National Park (SNP) and Tang Khen Bay (TKB), undoubtedly show similarities and differences over the year of study. Thirty samples have been collected at 20 meter intervals from the shoreline in the intertidal zones. The length, radius, maturity phase, quantity of reproductive cells and quantity of released reproductive cells were recorded for each individual. The recruitment study was carried out on hard substrata *in situ*. Three permanent plots 0.25 m² were studied every 20 meters. Intraspecific competition was calculated from percentage of recruitment at the two sites. The research started in September 2005 and it will be finished in August 2006. The results showed significant differences in population distribution, reproductive potential and recruitment success ($P \leq 0.5$). The factor that differentially influenced *P. australis* populations at the two sites was mainly wave currents which had a strong influence on *P. australis* at SNP.

Seasonal variation in distribution, density, and life stage of *Halimeda macroloba* Decaisne at Tangkhen Bay, Phuket Province, Thailand

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The genus *Halimeda*, a green alga (Chlorophyta), is widely distributed in tropical and sub-tropical marine environments. *Halimeda macroloba* Decaisne has several calcified segments, an erect and flat thallus and a massive bulbous holdfast for attachment to sandy bottoms. This bulbous holdfast may adhere to fine particles of loose substrate. The purpose of this project is to investigate the seasonal variation in distribution, density, and life stage of *Halimeda macroloba* Decaisne at Tangkhen Bay, Phuket Province, Thailand. To study distribution and population density, data has been collected every month for a year using sixty 0.25 m² quadrats placed along three transect lines. Twenty-one 0.25 m² permanent plots have been used to monitor life stage and life span of *H. macroloba*. The data set from this study will reveal the seasonal variation of *H. macroloba* population and what might cause such variation. The results so far of this study showed that the highest density was found in September 2006, at 38.13 thalli per m², while the lowest was found in October 2006, at 2.33 thalli per m². The seven-month dataset showed variation in density of *H. macroloba* in each substrate and month. The density of each life stage of *H. macroloba* varied with time of sampling ($P < 0.05$). Newly recruited plants were found only in December 2006, at 0.14 thalli per m², while fertile plants were not found in this study. However, it does not show that there was no sexual reproduction in this population. Physical parameter analysis could explain the seasonal variation in the abundance of *H. macroloba*.

Biodiversity of freshwater bryozoans and biological monitoring trials of water quality in the Songkram River

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Since 2001 much progress has been made towards understanding freshwater bryozoans in Thailand. A team of scientists and students at Kasetsart University has now identified 20 species in Thai waters, including 6 described for the first time, bringing the total number of species worldwide to 86. The objective of this BRT project in Northeastern Thailand was to study bryozoans in the Songkhram River watershed, an area known for its high biological diversity. This included a series of trials to monitor water quality with local bryozoan species. We made trips to the area during June-July 2006 and January-February 2007. For the biological monitoring component, we grew colonies of *Hislopia malayensis* on plastic panels and deployed them at 10 established sites in the Songkhram River for at least one week. For the surveying component, we searched intensively for bryozoans in the river as well as in a number of ponds and lakes within the watershed. Results of this project included: (1) Verification of 11 bryozoan species occurring at 15 river and lake sites, including 3 species not reported elsewhere in Thailand, with much new information about the ecology of all species; (2) Results from biomonitoring trials were uneven. In general, growth and survival were much higher during the rainy season, suggesting that water quality during the dry season may not be as excellent as we had assumed.

Species diversity of calanoid copepods at the Surin Islands National Park, Phang-Nga Province

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The species diversity of calanoid copepods at the Surin Islands National Park, Phang-Nga Province, was investigated in January 2006. Zooplankton samples from 9 stations were collected by horizontally towed nets with 330 μm mesh size. A total of 27 species in 16 genera and 11 families were reported. Among them, 8 species in 6 genera were very common. Seven species in five genera in this study are first records for Thai waters of the Andaman sea: *Calanopia elliptica* Dana, *C. minor* A. Scott, *Candacia curta* (Dana), *C. pachydactyla* (Dana), *Eucalanus crassus* Giesbrecht, *Paracalanus aculeatus* Giesbrecht and *Undinula vulgaris* (Dana).

Communities of cyclopoid copepods in two wetlands: Bueng Boraphet, Nakhon Sawan Province and Bueng Khong Long, Nong Khai Province

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An investigation of cyclopoid copepods in two wetlands was carried out in 3 seasons, the rainy, cool and hot seasons, during August 2002 to April 2004. The cyclopoid copepod communities of Bueng Boraphet, Nakhon Sawan Province, comprised the following 6 species: *Eucyclops serrulatus* (Fischer), *Mesocyclops aspericornis* (Daday), *M. thermocyclopoides* Harada, *Microcyclops* sp., *Thermocyclops crassus* (Fischer) and *T. decipiens* (Kiefer). In the first year (August 2002-April 2003), average maximum and minimum abundances of 41±31 and 31±33 individuals/litre were recorded in the cool and rainy seasons, respectively. In the second year (August 2003-April 2004), average maximum and minimum abundances of 152±171 and 31±52 individuals/litre were recorded in the rainy and hot seasons, respectively. In Bueng Khong Long, 5 species were identified and two (*Ectocyclops polyspinosus* Harada and *Mesocyclops pehpeiensis* Hu) are new to Thailand. The others recorded from this wetland were *M. aspericornis*, *M. thermocyclopoides* and *Microcyclops* sp. In the first year, average maximum and minimum abundances of 57±66 and 39±40 individuals/litre were found in the hot and rainy seasons, respectively. In the second year, average maximum and minimum abundances of 160±126 and 111±77 individuals/litre were found in the rainy and cool seasons, respectively. However, the biodiversity and abundance in both wetlands during the first and second years and within the same season were not significantly different ($p>0.05$). Most of the taxa recorded are circumtropical species. In addition, the physico-chemical characteristics of water in these wetlands were suitable for natural living animals and fisheries.

Species diversity of ostracods in Srisaket Province

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A survey of species diversity of ostracods from Srisaket Province was conducted in winter (December 2006) and summer (April 2007). Samples were collected from temporary ponds, rice fields, reservoirs, canals, lakes and rivers using a 60 µm mesh plankton net. In each location, water quality parameters, including pH, water temperature, and conductivity, were measured. Nitrate and Phosphate concentrations were measured by a Hach model DR/2400 Portable Spectrophotometer. Geographic position (altitude) was measured by a Sportrak GPS Receiver. Specimens were preserved in 70% alcohol and identified under compound and stereo microscopes. Images of identified species were taken using a Leo 1450VP scanning electron microscope. 25 species of ostracod were identified: *Stenocypris* cf. *distincta*, *Stenocypris derupta*, *Dolerocypris* sp., *Chrissia* sp., *Strandesia kraepelini*, *Strandesia wierzejskii*, *Strandesia weberi*, *Strandesia lineata*, *Strandesia* cf. *wollterecki*, *Strandesia sexpunctata*, *Strandesia calapanensis*, *Strandesia richardi*, *Strandesia* sp. 1, *Strandesia* sp. 2, *Strandesia* sp. 3, *Cypridopsis aculeata*, *Cypridopsis* sp., *Pseudocyprretta* sp. 1, *Pseudocyprretta* sp. 2, *Pseudocyprretta* sp. 3, *Physocyprria* sp. 1, *Physocyprria* sp. 2, *Physocyprria* sp. 3, *Cyprretta* sp. and *Hemicyprria* sp.

Zooplankton dynamics in Kung Krabaen-Bay, Chanthaburi Province

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A study on zooplankton dynamics was conducted in Kung Krabaen Bay, Chanthaburi Province. Zooplankton comprised 15 phyla and 40 groups, which were divided into 22 groups of holoplankton and 18 groups of meroplankton. The average density ranged from $7.69 \times 10^5 - 1.76 \times 10^7$ ind. 100 m^{-3} . Copepods dominated and contributed 49.92% of total zooplankton density. Crustacean nauplii, Gastropod larvae, Bivalvia larvae and Larvaceans were also found in abundance. Densities of Cladocera and Rotifera were related to seasonal variation. These groups were found in abundance during the southwest monsoon season or rainy season because they live mainly in fresh water and brackish water. The total density of zooplankton showed a higher density in the northeast monsoon season than in the southwest monsoon season. The zooplankton communities in the bay had greater similarity than those near the mouth of the bay as well as near the mangrove forest. However, the density of crustacean larvae varied significantly ($p=0.05$) in relation to the transparency of the water column. Biological factors such as chlorophyll_a positively influenced the population densities of Hydromedusae. Furthermore, the presence of predaceous zooplankton such as arrow worms, Hydromedusae and fish larvae would probably affect the density of Copepods and larvae of Mollusks, Polychaetes and Crustaceans. Brachyuran larval density was high near the mangrove forest in September and November 2004 because these were the breeding and egg laying seasons of mud crabs and blue swimming crabs. Therefore, it is necessary to reduce crab harvesting during this period to preserve and conserve natural crab stocks.

The zooplankton community in Pak Panang Mangrove Creeks, Nakhon Si Thammarat Province

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Zooplankton composition and abundance were studied in Pak Panang mangrove creeks, Nakhon si Thammarat province during 2006. Sample collections were conducted in 2 mangrove creeks in mangrove forest of 16 and 20 years of age. Total zooplankton density occurred in the ranges of 2.75×10^4 to 4.64×10^7 inds/100 m³. Zooplankton communities were dominated by copepod nauplii, copepods, barnacle nauplii, gastropod larvae, bivalve larvae, mysid shrimps and lucifers. Mysid shrimps were the most frequent inhabitants throughout the study period. Peak densities of mysids were 3.92×10^5 inds/100m³ in July and 1.10×10^5 inds/100m³ in September in the 16-year-old and 20-year-old forests, respectively. The economically important Grapsid crab showed a maximum zoea density of 7.20×10^4 inds/100m³ in November. Pearson correlation coefficients indicated a negative relationship between the abundance of copepod nauplii and the amount of dissolved oxygen but a positive one between the abundance of mysids and transparency depth.