The Influence of Environmental Factors on the Distribution on Macroalgae, Kai, *Cladophora* spp., *Microspora* spp. and *Rhizoclonium* spp. at Nan River, Tha Wang Pha District, Nan Province

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Abstract

Exploring the influence of environmental factors on the distribution and Growth on *Cladophora* spp., *Microspora* spp. and *Rhizoclonium* spp. at Nan River were carried out from 3 sampling sites during November 2015 to March 2016, the samples were collected by monthly. The results showed that the high abundance of macroalgae were found during January to March 2016. The most distribution of algae can be found at site NongBao was *Cladophora spp*. 64-80% of square meter area. The physico-chemical parameters were recorded that related to algae growth in this study were air temperature 25.0 – 34.0 °C, water temperature23.5 – 28.5 °C, water depth0.2 – 0.8 m., velocity0.33 – 0.80 ms^{-1}, turbidity10 – 33 NTU, pH7.90 – 8.21, DO 7.0 – 8.8 mgL^{-1}, BOD0.4 – 2.0 mgL^{-1}, conductivity226.2 – 272.8 μscm^{-1}, TDS225.1 – 245.5 mgL^{-1}, NO_3^--N0.1 – 0.7 mgL^{-1}, NH_4^+-N 0.12 – 0.23 mgL^{-1} and orthophosphate 0.01 – 0.18 mgL^{-1}. The most factor that influenced the distribution of diatoms and macroalgae was the physical factors such as water velocity and turbiditymore than Chemical factor as DO, BOD and Nutrients.

Keywords: Macroalgae, Kai, Tha Wang Pha District, Nan Province

1. Introduction

Kai is the famous river weed of northern and northeastern of Thailand. Kai is composed by three main macroalgae as *Cladophora*spp., *Microspora*spp. and *Rhizoclonium*spp (Kunpradid*et al*., 2004). This organism is remarkable as the dominant river macroalgae in the Nan River and its tributaries. These riverweed is an economically and ecologically important algae due to people used as the traditional food for fresh and preserved consumption in Thung Chang, Pua, Muang and Tha Wang Pha Districts (Peerapornpisal et al. 2002). The kai have long been used as a source of food by local people because of their testy and it's contain high nutrition. Therefore, the demand of fresh kai is increasing day by day but the growth of kai is limited cause the fresh of kai are depend on the season, beginning of winter until late winter. Hence this study are aim to explore the factors that influence to distribution and growth of the kai, *Cladophora* spp., *Microspora* spp. and *Rhizoclonium* spp. at Nan River .The highest distribution sites of Nan River were selected as a study sites. The result of this study will be used for the kai conservation and sustainable consumption in this area and also transfer to the other area that have a similar kai production. In addition, the relationship between the growing of kai and physical-chemical data could be used for the future aspect such as the cultivation and optimum field harvest.

2. Research Objective

To explore the environmental factors that influence to distribution and growth of the kai, *Cladophora* spp., *Microspora* spp. and *Rhizoclonium* spp. at Nan River

3. Research Methodology

3.1 The three sampling sites for Kai harvesting in the Nan river of Thawangpha District were selected. The sample were collected monthly from November 2015 to March 2016. The sampling site were showed in figure 1

Figure 1. Map of sampling site in Tha Wang Pha, Nan province, Thailand

3.2 In each sampling site, the harvest area where the water depth is less than one metre and suitable substrata extend over a distance of 100 metres. The most appropriate substrata types were also investigated at all sites sampling where the river bed is predominantly rock, cobble,

3.3 At each site, 10 samples as the 1 m. x 1 m include the 25 small quadrant (20 cm. x 20 cm.) (Picture 2). Quadrant is collected, one at a time, at intervals of about 10 m. Each 10 m x 5 m sampling site will be measured by the length of 10 m along the river and the width of 5 m across the river. Random tables will be used for the selection of 10 numbers of 1 m^2 from selected areas. In each 1 m^2, macroalgal quadrants will be used for sampling collection. One person will set up the quadrat, a second person will use the metal under water viewer tank to clarify the viewing of macroalgae without disturbing the water current. The number of small quadrats will be randomize from 25 numbers. In each small quadrate, some unknown genus will be pre-identified by genus level. The pre-identified and the coving estimated were done under the underwater viewer tank. (Peerapornpisal*et. al.*, 1998). The calculation of percent covering will record in each sampling site.

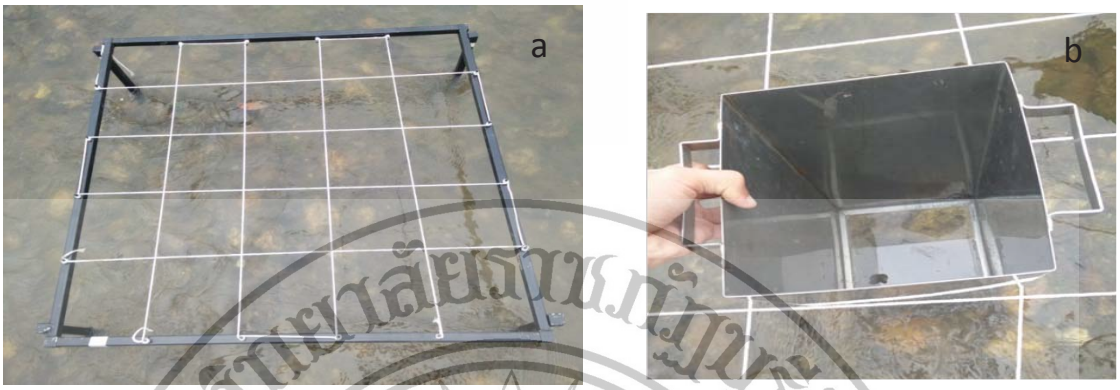

Figure 2. a (Quadrate b (Under Water Viewer Tank

3.4 The sample the kai were separated collect in each species of Kai. The fresh sample were scrape and then transferred to a plastic container and labeled with the name of the site, a location code, the date of sampling and sample–replicate number. Each genus of macroalgae will be marked on the field data sheet in terms of percentage of substrate coverage. Each genus in the small quadrates will be scraped and cut from the substrate (e.g. cobble, soil, macrophytes and artificial substrates). The fresh samples will be preserved in 2% glutaladehyde solution and put into ice box at low temperature (5-10 ˚c).

3.5 The Physical and Chemical properties of water were also investigate in each sites. The temperature(°C) the depth) m(, The velocity) ms^{-1} (, Turbidity) NTU (, Dissolved (mgL^{-1}) and Biochemical Oxygen Demand (mgL^{-1}) ,pH , the Conductivity)μscm^{-1}) and Total Dissolved Solid) mgL^{-1}(were measured in the field. The Nutrient as the Nitrate-Nitrogen, Ammonia-Nitrogen and Soluble Reactive Phosphorus were measuringin the laboratory.

3.6 In term to evaluate the environmental factor that influenced to distribution and growth of macroalgae. The raw data of the cell counts were input to the Multivariate Statistical Package R Studio version 3.1 with Vegan package to perform by using Principal Components Analysis (PCA).

3.7 The name of the sampling sites, a location code, the date of sampling, sample-replicate number, collector's name and substratum type are also noted in the field notebook, as is any information about the site that could be influencing the presence or abundance of different types of Kai.

4. Research Results

The study on the distribution of kai, in harvest season of Nan River, Thawang Pha District shown that the highest genus of Kai was *Caldophora* spp. The common river weed in Northern Thailand. The highest abundance of Kai were found from January to February 2016. The most abundance site were Ban Noung Bao (Site 3) due to the most substratum are cobble and gravel with percentage ratio as 10 – 80 % covered. The most influenced environmental factor to the growth of Kai was physical factor including water velocity and depth of the water. The velocity of water value flowing faster than 0.8 mater per second and the depth value more than 0.6 metres may impact and inhibit the growth of Kai. In addition, the turbidity was also as a main

factor that influence to the growth of kai. Nevertheless, the other physical and chemical properties such as air and water temperature, Nutrient were unclear impact to the distribution of Kai because of they were stable and slightly change throughout the study period.

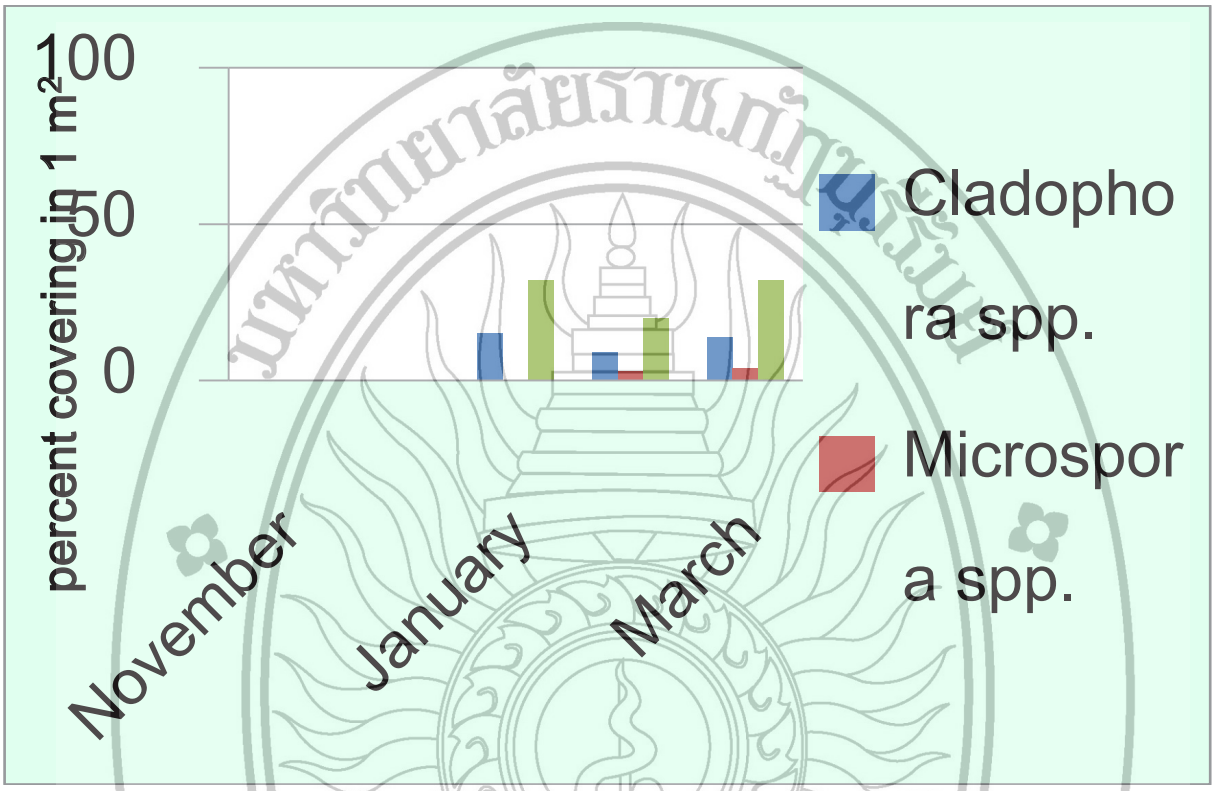

Figure 3. The distribution of Macroalgae in Nan River at sampling site 1 Ban Aham, Thawang Pha District

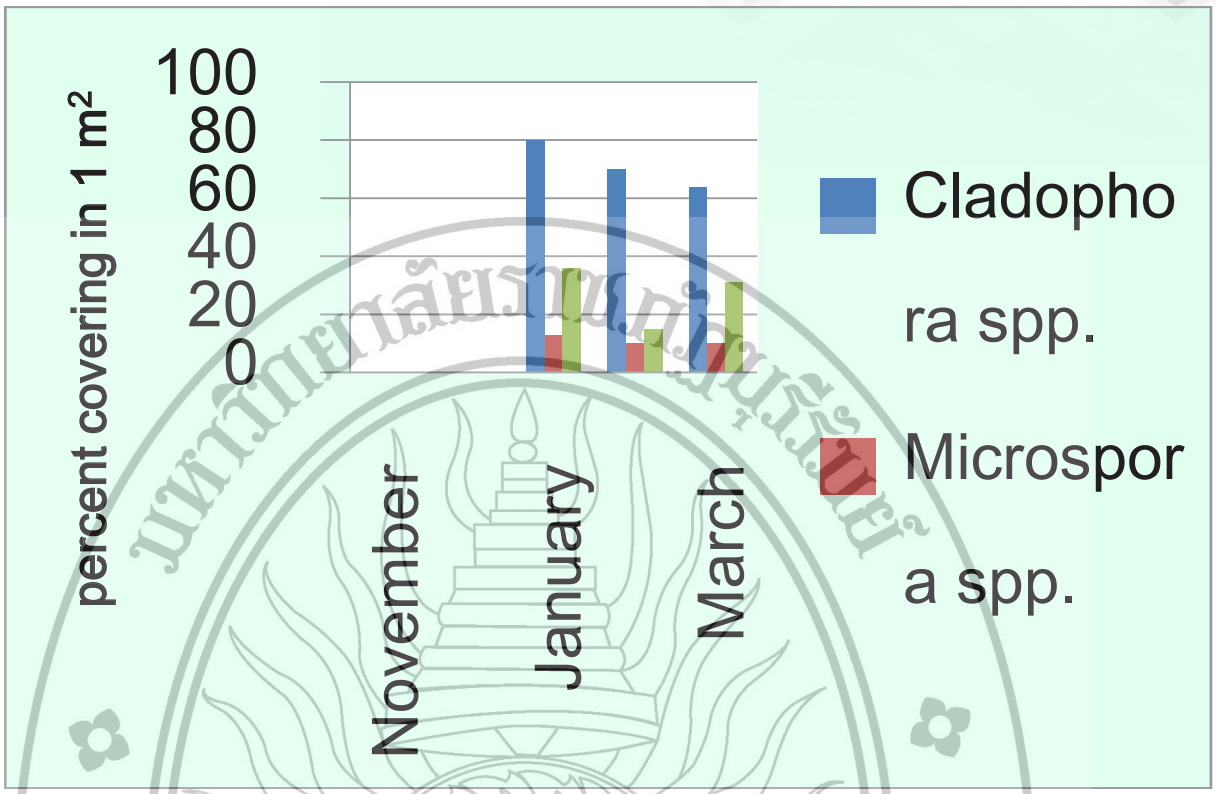

Figure 4. The distribution of Macroalgae in Nan river at sampling site 2 Ban Nong Bua, Tha Wang Pha District

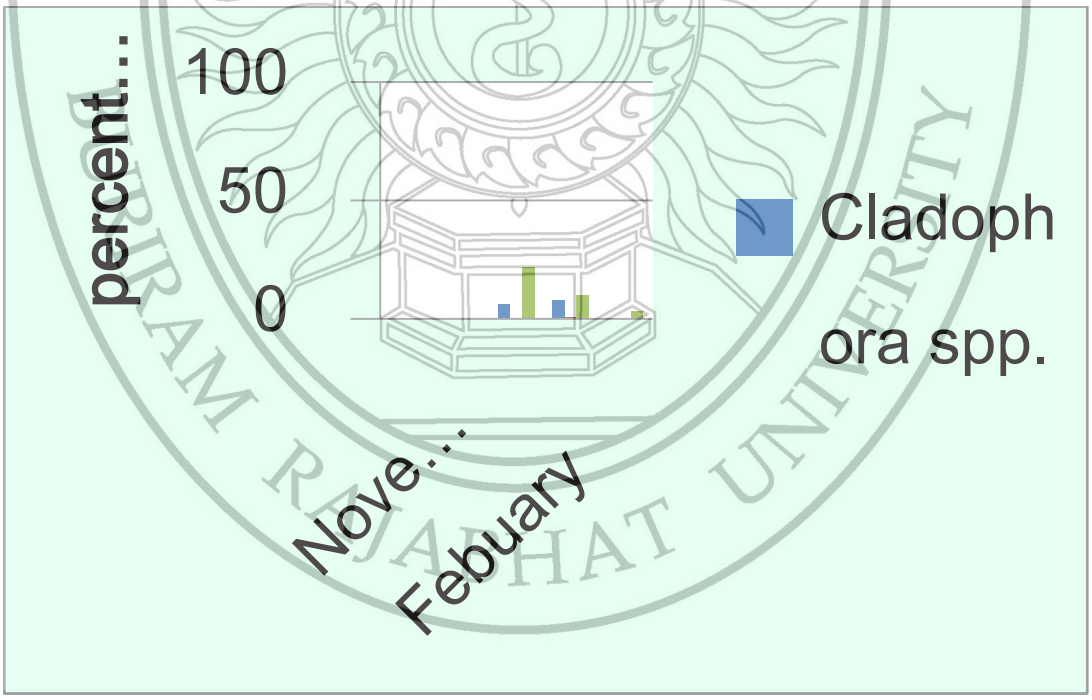

Figure 5. The distribution of Macroalgae in Nan river at sampling site 3 Ban Don Chai, Thawang Pha District

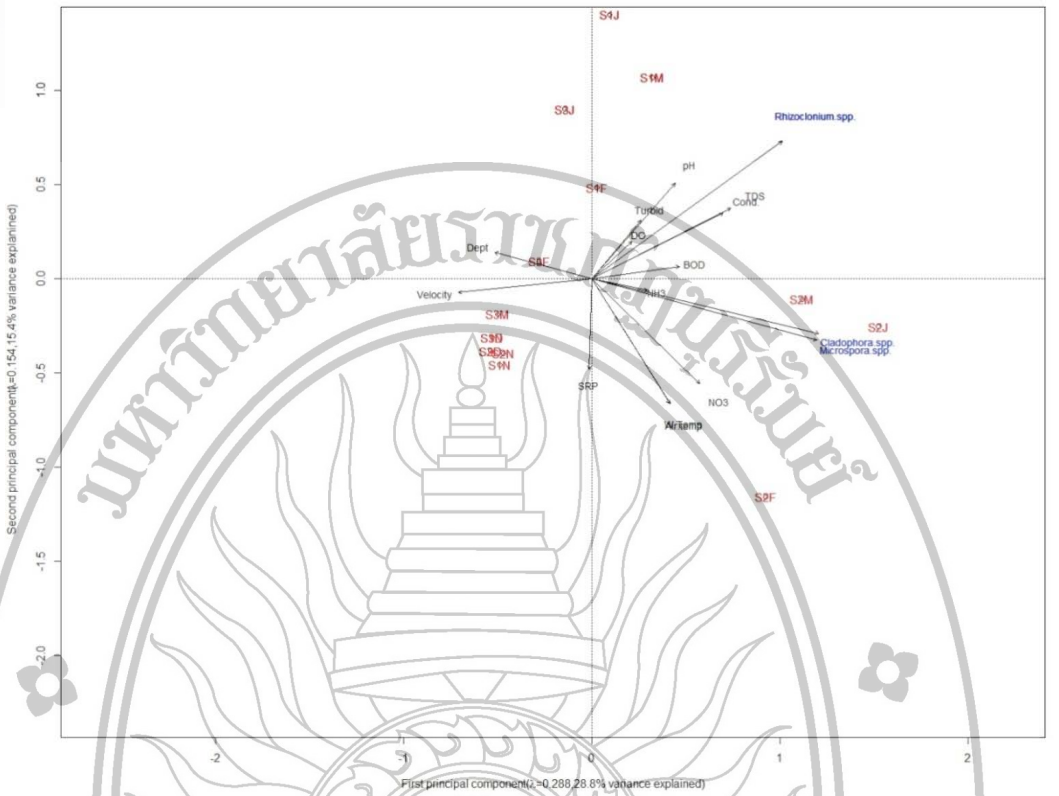

Figure 6. The PCA analysis of distribution of Macroalgae and Physical and Chemical Properties in Nan river at three sampling site, ThawangPha District, Nan Province.

Table 1
The substratum characteristics of three sampling sites of Nan River Thawang Pha District, Nan from November 2015 – March 2016

Sampling Sites	November	December	January	February	March
Site 1	Cobble50 % Mud,Clay30% Sand20 %	Cobble50 % Mud,Clay30 % Sand20 %	Cobble50 % Mud,Clay30 % Sand20 %	Cobble50 % Sand20 % Mud,Clay15 % gravel5 %	Cobble50 % Sand20% Mud,Clay15 % gravel5 %
Site2	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%
Site3	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Cobble50% Sand20 % gravel15 % Mud,Clay15 %	Cobble50% Sand20 % gravel15 % Mud,Clay15 %

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Site2	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%	Cobble70 % Sand15 % gravel13 % Bed Cobble2%
Site3	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Sand50 % Mud,Clay20 % Cobble15% gravel15 %	Cobble50% Sand20 % gravel15 % Mud,Clay15 %	Cobble50% Sand20 % gravel15 % Mud,Clay15 %

6. Discussions

According to the results, from the slightly different water body properties in the Nan Rivers, the clear changes were shown in terms of physical and chemical properties but the other group that impacted the river was the presence of benthic algae (Whitton and Kelly, 1995). The distribution of macroalgae and benthic diatoms decreased from the first site to the last site but the number of organisms increased from the upper part of the river to the lower part of the river. This characteristic revealed that the running water received the allochthonous from an externals source (Hynes, 1970) (Figure 3, 4 and 5).

In term of PCA analysis, the first major factor that influenced the distribution of diatoms and macroalgae was the physical factors such as water velocity and turbidity. The water velocity impacted the benthic algae, especially macroalgae (Nozaki, 2001). *Microsporafloccosa*, *M. pachyderma* and *Cladophoraglomerata* in Division Chlorophyta and *Nostochopsishansgirg* in Cyanophyta, the dominant species in Nan Rivers were found only in running water (Kunpradid, 2006). Another impact of velocity was the forming of macroalgae. The flowing areas of the Ping and Nan Rivers found a larger presence of thallus and colonies than the non-flowing areas, such as *Cladophora* spp. and*Microspora*spp. As the results of this the group of Cyanobacteriawere absence.

Another physical factor that influences the distribution of the Kai were turbidity. In the rainy season, the diversity and number of macroalgae were significantly decreased. The PCA analyses result shown that the relationship between the turbidity and the distribution of Kai werenegative correlated, (Figure 6) The disturbance of turbidity was reviewed by Wong *et al.* (1997) and it was found that *Cladophora* spp. and *Microspora*spp. decreased in high turbidity, even when there were appropriate nutrients for growth. The effect from the high turbidity was a lower light intensity to the water. In high turbidity water, the light had a reduced ability to penetrate the water body and prevented the autotrophic organism from growing (Caduto, 1990).

The last factor that influence to the macroalgae distribution is the substrate (Table 1). The Macroalgae could be growth differentially on different substrates, such as *Cladophora* spp. and *Microspora* spp. which could grow well only on the surface of cobble or gravel. The macroalgae also could be count in term of quantity of them exactly. However, we could not use dry weight to estimate every species of macroalgae, which was similar to the report of Round (1973) who mentioned that the quantitative analysis of macroalgae in the exact number may be difficult.

7. Conclusion

The study on influence of environmental factors on the distribution of Kai, river macroalgaeas *Cladophora* spp., *Microspora* spp. and *Rhizoclonium* spp. at Nan River were carried out from three sampling sites during November 2015 to March 2016, The physico-chemical parameters were investigated included the air temperature, water temperature, water depth, velocity, turbidity, pH, DO, BOD, conductivity, TDS and the nutrients as NO_3^--N, NH_4^+-N and soluble reactive phosphorus.The most factor that influenced the distribution of diatoms and macroalgae was the physical factors such as water velocity, substrate, water depth., turbidity more than chemical factor such as DO, BOD and nutrients**.**

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