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Growth Period of Aquatic Plants for Birds Nesting at Bung Borapet, Nakhon Sawan

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ABSTRACT

Studies on the growth period of aquatic plants that were to be nested by birds was undertaken at Bung Borapet, Changwat Nakorn Sawan. It was found that the minimum densities of various plants for bird nesting were different and depended on nesting conditions. *Salvinia cucullata* Roxb., *Potamogeton malaianus* Miq. and *Pheudoraphis spinescens* Vickery with density of 267, 203 and 229 g m^{-2}were used for nesting by *Hydrophasianus chirurgus*, respectively. While *Porphyrio porphyrio*, *Porzana cinerea* and *Ixobrychus cinnamoneus* preferred to nest over the water level, therefore, *Eichhornia crassipes* (Mart.) Solms, *Pheudoraphis spinescens* Vickery, *Typha angustifolia* L. and *Nelumbo nucifera* Gaerth with the densities of 1,050, 464, 4,133 an 886 g m^{-2} were utilized, respectively. Growth period requirements of aquatic plants also differed accordingly to plant species and environmental factors. *Pseudoraphis spinescens* required the longest period of 11-15 months, whilst *Potamogeton malaianus* required the shortest period of 5 months. Whereas, *Eichhornia crassipes*, *Nelumbo nucifera* and *Typha angustifolia* required the period of 6 months, *Salvinia cucullata* required 7 months. The physical and chemical quality of the water obtained from Bung Borapet were found suitably for all common aquatic plants in the following ranges : depth of 135-345 cm, water transparency of 57-182 cm., temperature of 27.5-29.2 °C, DO of 2.9-5.2 mg/l, B.O.D. of 2.1-3.1 mg/l, alkalinity of 95.2-108.9 mg/l, pH of 7.2-7.8. The average amounts of base nutrient, nitrate, phosphate and potassium were 0.16, 0.01 and 3.9 mg/l, respectively. The ground-table soil was characterized as clay with the pH of 5.1 and 1% organic matter.

Key words : growth period, aquatic plant, bird nesting, Bung Borapet

INTRODUCTION

Bung Borapet is a big source of fresh water of Nakhon Sawan province and also of the central region of Thailand. This fruitful swamp is served for the fresh fishery development center and for the source of fishery cultures. With the great density of various aquatic plants, the swamp is characterized to be the suitable habitat and nesting of several birds, and has been notified as the animal forbidden area since 1975. Results from the great density of various aquatic plants has led to the sedimentation and more shallowness. To solve this problem, the Department of Fishery launched the project for water drainage and area renovation during February to October, 1992. This caused an ecology change in

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the lost of a number of aquatic plants along with the more impact of severely weeds such as *Pseudoraphis spinescens*. This ecological change also had impact to several aquatic plants required for bird nesting.

Recently, a number of aquatic plants in Bung Borapet has declined progressively according to the report of 73 species identified (Sripen, 1979) to 46 species (Plordprasop, 1982). After the swamp drainage in 1992 and re-reservoir, the Division of Fresh Fishery reported for the only remaining 32 species. Suchada (1987) pointed out that factors influencing the growth of aquatic plants including, the water depth level, light, water transparency, temperature, gases content, and the chemical component of minerals and compounds. Other factors affecting the distribution of aquatic plants were wind, water level, rainfall, and the competition among the plants (Amornrat, 1984). Study on nesting and laying behavior of birds in Bung Borapet (Siriporn, 1983) revealed more than 10 species : 1 species in the area of water-level aquatic plants, *i.e. Hydrophasianus chirurgus* ; 5 species in the area of emerged aquatic plants, *i.e. Hydrophasianus chirurgus*, *Dendrocygna javanica*, *Metopidius indicus*, *Ixobrychus cinnamoneus*, and *Ixobrychus sinensis* ; 6 species in the area of sedges, *i.e. Ixobrychus cinnamoneus*, *Ixobrychus sinensis*, *Dupetor flavicollis*, *Dendrocygna javanica*, and *Gallicrex cineru* ; 3 species in the area of aquatic forest, *i.e. Ixobrychus cinnamoneus*, *Dendrocygna javanica*, and *Porzana cinerea*. Wildlife Conservation Division (1983) reported 11 species of birds that required nesting materials from the aquatic plants, *i.e. Salvinia cucullata*, *Nelumbo nucifera*, *Scirgus grossus* , *Eichhornia crassipes*, *Typha angustifolia* and *Pheudoraphis spinescens*. Obhas (1991) found more than 107 species of birds in the Bung Borapet, those that nested only around the edge of the swamp were about 14 species. Most of the birds mest in rainy season during July. This indicated the significance of aquatic plants on nesting behaviors, particularly the water birds. The objectives of this study were, therefore, to determine the effects of growth period and density of particular aquatic plants on bird nesting behaviors in the Bung Borapet, and to evaluate the factors influencing the growth of water birds, *i.e.* physical and chemical properties of water and ground-table soil of the swamp. The information obtained, particularly on the elementary biology, will be very useful and can be exploited for area management to facilitate further development correspondingly with the maximized preservation of resources and environment with less disadvantage.

MATERIALS AND METHODS

The aquatic plants nested by the birds at Bung Borapet were utilized in the study were :

1. Cuculate salvini, *Salvinia cucullata Roxb.*
2. Deepreenam, *Patamogeton malaianus Miq.*
3. Narrow leaved cattail, *Typha angustifolia* L.
4. Water hyacinth, *Eichhornia crassipes (Mart) Solms*
5. Sacred lotus, *Nelumbo nucifera Gaerth.*
6. Yak preak nam, *Pseudoraphis spinescens Vickery.*

The birds studied at Bung Boraphet were :-

1. Nok E Jaew *Hydrophasianus chirurgus*
2. Nok E Koang *Porphyrio porphyrio*
3. Nok Unchun Kue Khao *Porzana cinerea*
4. Nok Yang Fai Thummada *Ixobrychus cinnamoneus*
5. Nok Yang Fai Hua Dum *Ixobrychus sinensis*
6. Nik Yang Dum *Dupetor flavicollis*
7. Nok Ped Dang *Dendrocygna javanica*
8. Nok Prik *Metopidius indicus*

Density of bird nesting aquatic plants

On the area of the swamp where bird nesting could be observed, the 1 × 1 quadrat was used for the collecting of sampling aquatic plants, *i.e. S. cucullata*, *E. crassipes*, *P. malaianus*, *N. nucifera*, *T. angustifolia*, and *P. spinescens*. Sampling plants were then determined for fresh and dry weight, and density (biomass) per m^2. In all cases, maximum number of practical samplings were suggested.

Growth period of bird nesting aquatic plants

Three plots of the size 2 × 2 m were assigned for each of the investigated floating aquatic plants, *i.e. S. cucullata* and *E. crassipes*. For the submerged and emergent aquatic plants such as *P. malaianus*, *N. nucifera*, and *T. angustifolia*, a plot size of 5 × 3 m was assigned for each plants. All aquatic plants were allowed for their natural growth and then samplings were executed by using a 1 × 1 m quadrat. Sampling plants were analyzed for fresh and dry weight as well as the density at monthly interval. For the *P. spinescens*, only the naturally well growth plot of the size 5 × 3 m was selected to determine for growth change at monthly interval using the same sampling method.

The data observed for plant density (per m^2) of each plant were compared for the growth period that in turn was suitable for bird nesting according to the method indicated.

Water quality of the swamp

The Van-dron water sampling tube was used for the collecting of sampling water from 4 sites of the Bung Borapet. These sites were assigned for the evaluation of the amount of water soluble oxygen, B.O.D. value, pH, nitrate (NO_3-N), phosphate (PO_4-P) and potassium (K) using the Standard Method (Swingle, 1969). The pH value was measured wiith pH-meter. The values of water transparency and depth were obtained through the Secchi dich. Temperature was measured with thermometer. Data were collected at monthly interval for the period of 12 months from May 1993 to April 1994.

The study was conducted on the area of internal edge of the Bung Borapet, Nakhon Sawan Province. Four sites were selected for sampling of the water swamp. The first site was the outlet of waterway close to the Fresh Water Fisheries Development Center, Amphur Muang, Changwat Nakhon Sawan. The second site was at the center of the Bung Borapet, Ban Kloe Ta Seng. The third site was at the first inlet of waterway, Klong Bon, Ban Panomset while the fourth site was the second inlet of waterway, Klong Huayhin, Amphur Tha Ta Ko.

In addition, plot layout for the growth study of the aquatic plants was assigned at the center of the Bung closely to the Bung Borapet Conservation Section, Ban Kloe Ta Seng.

RESULTS AND DISCUSSION

Density of bind nesting aquatic plants

The results from the study on density of the plants that birds can nest was calculated as the relative density to the dry weight m^{-2} basis (Table 1 and Table 2). It was found that density of each plant differed greatly depending upon the condition of nesting behavior of different birds. Those nesting at the water level, *e.g. H. chirurgus*, preferred not much dense materials such as *S. cucullata* at the lowest density of 267 g m^{-2}, *P. malaianus* of 203 g m^{-2} and *P. spinescens* of 229 g m^{-2}. For birds nesting over the water level, *i.e. P. porphyrio*, *P. cinerea*, *I. cinnamoneus*, *I. sinensis*, and *M. indicus*, required the more dense materials such as *E. crassipes*, *P. spinescens*, and *T. angustifolia*, at the densities of 1,050, 454 and 4,133 g m^{-2}, respectively. In case of *N. nucifera*, most of the birds did not require to nest directly but preferred the leaves that floated at the water level and over the water level for hiding or supplementing nesting materials. The

clump of this plant that birds preferred would normally have the emergent leaves at the density at least 886 g m^{-2}.

Moreover, the requirement of more suitable nesting materials was considered, *e.g.* for the ability of supporting the weight of bird' s egg and body. For example, *H. chirurgus*, *G. cinerea*, and *D.flavicollis* preferred to nest a rough one on the cluster of *S. cucullata*, *P. malaianus*, or the decayed plants and laid their eggs over the water level. By contrast, *P. porphyrio* preferred to nest over the water level in the area of dense aquatic plants and

Table 1 Species of aquatic plants and species of birds living on the plants at Bung Borapet.

Aquatic plants	Bird species							
	1	2	3	4	5	6	7	8
S. cucullata	+						+	+
E. crassipes		+	+	+	+	+		
P. malaianus	+						+	+
T. angustifolia		+	+	+	+	+		
N. nucifera	+							
P. spinescens	+	+	+	+	+	+		

1. *H. chirirgus*
2. *D. flavicollis*
3. *P. porphyrio*
4. *P. cinerea*
5. *I. sinensis*
6. *I. cinnamoneus*
7. *D. javanica*
8. *M. indicus*

Table 2 The biomass (gm/m^2) of some aquatic plants that birds can nest at Bung Borapet, Nakhon Sawan.

Aquatic plant	Sample 1*	Sample 2	Sample 3	Average
Salvinia cucullata Roxb.	267*	320	389	325.3
Eichhornia crassipes (Mart.) Solms	1,050*	1,225	1,365	1,213.3
Potamogeton malaianus Miq.	203*	240	285	242.7
Nelumbo nucifera Gaertn	886*	1,064	1,132	1,027.3
Typha angustifolia L.	4,133*	5,227	5,887	5,075.6
Pheudoraphis spinescens Vickery[1]	229*	264	321	271.3
Pheudoraphis spinescens Vickery[2]	454*	543	678	561.7

1 = nesting at the water level
2 = nesting over the water level
* = lowest density of aquatic plants that birds can nesting

hided their nests in the clump of *E. crassipes* or beneath the leaves of *N. nucifera*. This place of nesting would be very secure in preventing of not to be dispersed easily by wind and swamp water. It was also noticed that birds might use different nesting materials, *e.g.* in the past, *H. chirurgus* use *S. cucullata* to build up 2-3 layers of the nest (Division of Wildlife Conservation, 1983). But today, the birds preferred more to nest on the dead clump of *P. malaianus* and *P. spinescens* at the water level.

Growth period of bind nesting aquatic plants

The growth period of *S. cucullata*, *E. crassipes*, *P. malaianus*, *N. nucifera*, and *T. angustifolia* in Bung Borapet through the observation of dry weight ($g\ m^{-2}$) and the ecological change of aquatic plants after the re-reservoir of the swamp water since January 1993 to April 1994, indicated that growth period of each plant required for bird nesting differed significantly depending on plant species and environmental conditions. *P. malaianus* required the shortest period of 5 months, whilst, *E. crassipes*, *N. nucifera* and *T. angustifolia* required 6 months. The other, *S. cucullata* required 7 mouths and *P. spinescen* required 11-15 mouths. It was then considered that at the time of study, the swamp condition was probably most suitable for the growth of *P. malaianus*.

The average of water level of 229 cm over the year would be best suitable for the growth of *P. malaianus* (Chanpen, 1983). The average of water transparency was relatively high of 113 cm due to rainfall and less removal of the alluvium causing full light of this plant. On the contrary other aquatic plants *e.g. S. cucullata* and *E. crassipes* that were mixed with *N. nucifera* or algae had faster early growth stage than those of the loose clumps. Yet lower growth rate was noticed at the later stage of growth due to shading of the above water level leaves of *N. nucifera*. Besides the annually growth habit, growth period of the aquatic plants in Bung Borapet was influenced by the infestation of the insect larvae in the family *Noctuidae*. The larvae preferred to maintain feeding on the emergent leaves and the reproductive parts of the plants causing death of the aquatic plants. This type of ecosytem change occurs at leat once a year during August to September.

In case of *P. spinescens*, the study was emphazied on growth change of the plants predominating over the swamp at the time of water drainage and commencing of re-reservoir of the water. Well growth of the plants at the early stage was noticed correspondingly with plant elongation. Thereafter, the growth declined due to no longer adaptation to the very long period of submergence. At the time of this study, it was noticed that the birds began to use *P. spinescens* for nesting in 2 types, the one at the water level and that over the water level. And the birds, especially *H. chirurgus*, preferred to use more *P. spinescens* than in the past.

Water quality of the swamp

Detailed study in both physical and chemical water qualities through the analyses of sampling water from the 4 designated sites revealed that the Bung Borapet water was characterized to be suitable for normal growth and the living of most animals and plants (table 3). The average of water level over the year was 135-345 cm and none of any adverse effects on the classified layers of water temperature was detected. The average of 113 cm of water transparency was considered as relatively clear water. The 28.5^{o}C mean temperature was claimed to be optimal range for the growth of living organisms in the swamp. Water soluble oxygen (D.O.) content at the average of 4.4 mg/l was also denoted in the optimal range (Swigle, 1969). Except that of the second inlet of the waterway where a relatively lower value of 2.9 mg/l was observed due to severe waste water release from houses located

Table 3 Chemical and physical properties of water at Bung Borapet.

Depth	135 – 345 cm	240 cm
Water Transparency	57 – 182 cm	113 cm
Temperature	27.5 – 29.5 °C	28.5 °C
pH	7.2 – 7.8	7.5
D.O.	2.9 – 5.2	4.4
B.O.D.	2.1 – 3.1	2.6
Base nutrient		
- nitrate	0.16 mg/l	
- phosphate	0.01 mg/l	
- potassium	3.9 mg/l	

around the edge of the swamp correspondingly with the high density of aquatic plants. B.O.D value of the swamp averaged 2.6 mg/l eventhough a high value of 3.1 mg/l from the second inlet of the waterway was detected. Hence, the swamp water was considered acceptably and was not claimed to be waste water according to the standard B.O.D. value in the range of 1.5-4.0 mg/l given for the ground–surface soil water quality (Division of Environmental Quality Standard, 1991). The average of pH was 7.5. The average of base nutrients was 102.5 mg/l. The average amount of nitrate, phosphate and potassium were 0.16, 0.01 and 3.9 mg/l, respectively. The amount of swamp nutrients was acceptably in the case of being natural water resource, but was considered relatively low in the sense of plant water quality causing poor growth of the plants. The porn bottom soil of the swamp was classified as clay with relatively low organic matter of 1%. In addition, poor growth of the submerged plants was also denoted.

According to the Bung Borapet Development Project, the processes of water drainage, the clean out of the pond bottom soil, and the drying out of the ground-surface wamp would result in the marked change of the ecosystem towards the drought prone area. These would reflect directly to the growth of a number of aquatic plants in quantity and species. In addition, indirect influence was noticed for animals that required those plants. The authors would suggest the modified methods of water drainage that might have less adverse effects on the ecosystem of the swamp, at the same time would serve the maximum objectives of the project as follows :

1. No fully water drainage at once is strongly recommended to avoid the severe effects on aquatic plants. At the same time, sequential zones for step further development should be designed. For instance, the water drainage at certain zone planned for the development will be use for aquatic animal preserve or serve as the preservation area of the living and nesting birds. This can be done through the preserve of the area in the way which causes less ecosystem change along with other developmental processes.
2. Long period of drying out of the ground-surface should be avoided to prevent the lost of tuberous aquatic plants. At the same time some inland weeds such as *P. spinescens* would disperse over the swamp. This weed was considered to be one of the noxious weeds due to the tolerance to

either drought and submerge area in the swamp. Moreover, the weed grows and disperses quickly, therefore is difficult to control. After the re-reservoir of the swamp water, some of this weed would die causing bad smell and the shallowness of the swamp. It is suggested that water drainage should commence in dry season from December when the water level is certainly low. The clean up of the pond bottom soil must complete prior to the coming rainy season. Supply of water in the early stage of re-reservoir is essentially to allow the period that all aquatic plants can grow well since June which is the time that bird nesting could commence at least 3-4 months earlier than usual.

CONCLUSION

The conclusion of the studies could be drawn as follows :

1. A study on density of the aquatic plants that birds can nest revealed the lowest density of each plant to be differed according to the requirement of different birds. All birds apparently preferred *N. nucifera* as hiding place or for a supplemented nesting materials at the lowest density of 886 g m^{-2}.

2. The growth periods of the aquatic plants that birds can nest differed greatly depending on plant species and environmental conditions. Birds could nest in 2 types : the one over the water level at the period of 11 months and, that of the water level at 15 months. For aquatic plants mixed with *N. nucifera* or algae would grow well in the early stage due to the better and firmly clumps of the plants. But later, poor growth was denoted due to the shading effects of the leaves of *N. nucifera*.

3. Results from the analyses of physical and chemical qualities revealed the swamp water to be acceptable for normal standard of the living organisms.

4. The competition of soil at the ground-surface level of the swamp was characterized as clay with pH 5.1 and 1% of organic matter.

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