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Flowering and Fruiting Phenology of Selected Mangrove Species in Tabon, Quezon, Palawan

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ABSTRACT

The flowering and fruiting phenology of *Rhizophora apiculata* Bl., *R. stylosa* Griff., *R. mucronata* Lam., and *Xylocarpus granatum* Konig at Brgy. Tabon, Quezon, Palawan under Philippine climate type I were monitored from November 1997 to October 1998. Ten individuals of these species were selected from three 100-m long and 6-m wide transects and visited every second Saturday of the month to score the flowers and fruits using crown density method.

R. apiculata flowered from November to February (peak in January) at 75% intensity and 100% prevalence and fruited from March to July (peak in May) at 62.5% intensity, 98% prevalence and 98% fruit set. Flowering of *R. stylosa* occurred from January to April (peak in May) at 85% intensity and 95% prevalence while fruiting occurred from May to September (peak in July) at 75% intensity with 92% prevalence and 96.8% fruit set. With 80% intensity and 100% prevalence, *R. mucronata* flowered from July to October (peak in September) and fruited from November to April (peak in January) at 77.5% intensity, 66.7% prevalence and 82% fruit set. *X. granatum* flowered from November to February (peak in January) at 60% intensity and 100% prevalence and fruited from March to June (peak in April) at 32.5% intensity, 92.5% prevalence and 90% fruit set.

Keywords: *flowering, fruiting, phenology, mangrove, Palawan*

INTRODUCTION

Palawan still has an estimated 44,500 ha of mangrove forest or roughly 40% of all that remains in the entire country (PCSD 1998). These mangrove forests are highly threatened by conversion into fish and prawn farms and resorts, and are heavily exploited for charcoal production and tan barking, leaving cleared mangrove areas which need rehabilitation.

Phenology pertains to the study of periodicity of growth or production of plant parts such as leaves, flowers and fruits. Its importance lies in relation to seed propagule production, nutrient enrichment, seed and seedling selection, and nursery operations. The main purpose of phenological studies has been to describe

the seasonal variability of food for mammals and birds and to try to determine which climatic factors might be responsible for triggering flower and fruit set.

The study of phenology could play an important role in developing sound practices to restore degraded ecosystems such as mangrove and conserve biodiversity. This also enables the identification of "keystone" species, those that flower or fruit at times when other food resources are in short supply, thus supporting a wide range of animal pollinators and seed dispersal agents which in turn are potential to the survival of many other plant species. Knowledge on the seasonality of flowering and fruiting has much to contribute towards the development of effective management strategies for the conservation of forest since phenological data could be used to plan seed collection and nursery work programs (Elliott *et al.* 1993).

MATERIALS AND METHODS

The Study Site

Tabon (Figure 1) is one of the 14 barangays in Quezon, Palawan situated at 118°3'51.5" to 118°4'49" East and 90°18' to 90°16' 42" North, under Philippine climate type I (two pronounced seasons: dry from November to April and wet during the rest of the year). Its total land area is 3,132 ha, of which 2,676 ha is alienable and disposable land, 456 ha terrestrial forestland, and 443 ha mangrove area.

Typical flora found in mangrove swamps is observed in this area. Bakauan bato (*Rhizophora stylosa* Griff.), Tawalis (*Osbornia octodonta* F. Muell.), Tabigi (*Xylocarpus granatum* Konig), and Bakauan lalaki (*Rhizophora apiculata* Bl.) dominated the area (Remegio 1999). Fishpondification, which is a common problem in Philippine mangrove areas is occurring in this site. Likewise, logging of mangrove trees for charcoal production, fuel, and house construction is common.

Selection of Sample Trees

Mangrove species with 10 individuals were selected from three 100m long and 6m wide transects, which were established at right angles from the edge of the seaward zone. Only four mangrove tree species, which were *R. apiculata, R. stylosa* and *R. mucronata* of Rhizophoraceae family and *X. granatum* of Meliaceae family were found to have 10 individuals present within the transects. Thus, these were the only species considered for flowering and fruiting phenological studies, and marked as samples.

Observation on the Flowering and Fruiting of Mangrove Species

The sample trees were visited every second Saturday of the month starting from November 1997 until October 1998. They were scanned using binoculars and scored for flowers and fruits using the crown density method (Koelmeyer, 1959; Elliot *et al.* 1993). This method uses a linear scale of 0-4 with 4 representing the maximum intensity of flowers and fruits (usually distributed across the whole crown). Values of 3, 2, and 1 represents three quarters, half and one-quarter of the maximum intensity, respectively. A value of 0.5 was used to indicate the presence of small amounts of flowers and fruits below one quarter of the maximum intensity. All data were recorded for analysis.

Data Analysis

The data were analyzed using the following (Elliot *et al.* 1993):

1. Intensity - means of the maximum monthly flower/fruit scores for all flowering/fruiting individuals and converted to percentage of the maximum value of 4;

2. Prevalence - number of individuals that flowered/fruited in a year expressed as percentage of the total sample size of each species; and

3. Fruit set – number of individuals fruiting expressed as percentage of the number of individuals flowering.

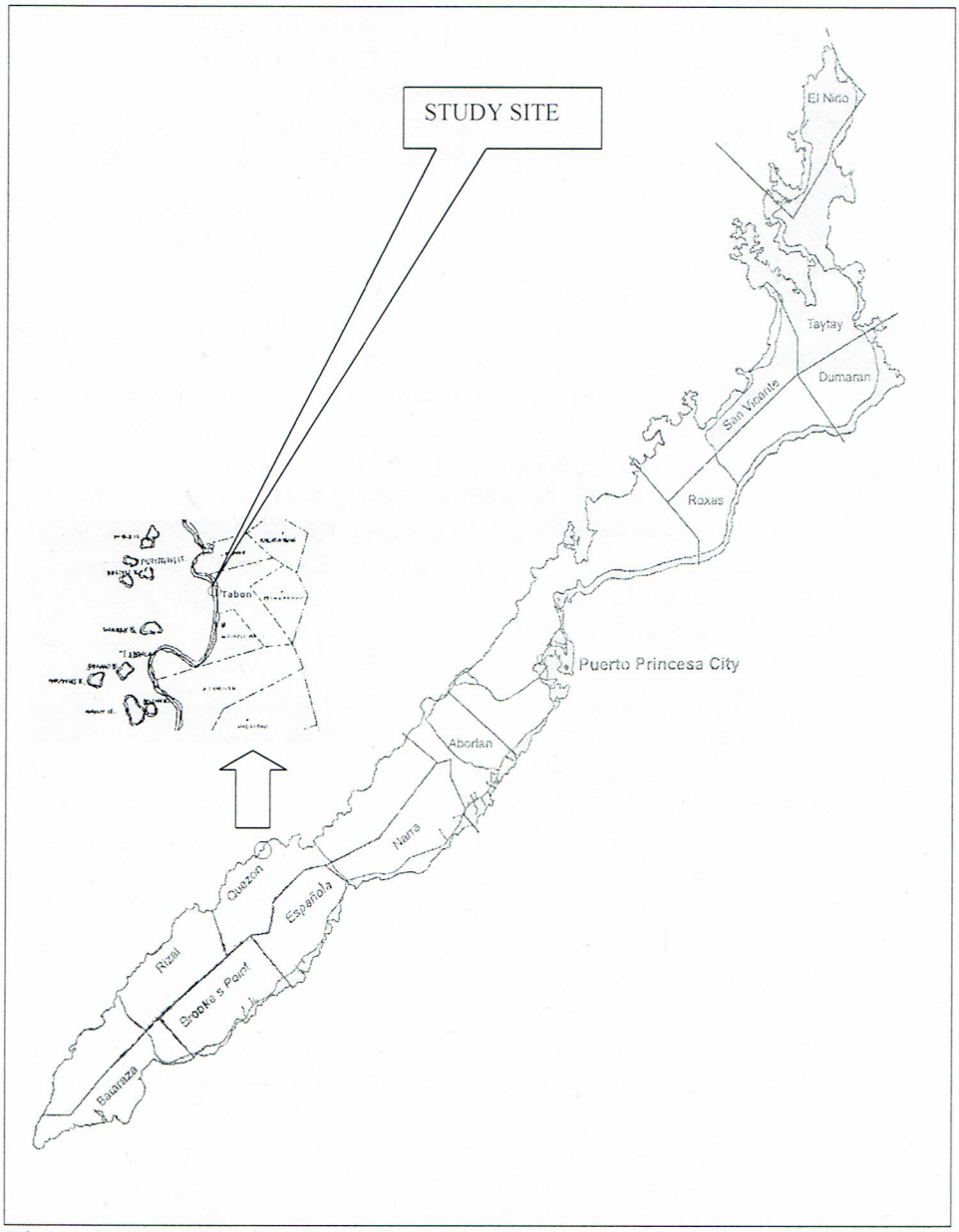

Figure 1. Map showing the study site.

RESULTS AND DISCUSSION

Flowering

The four mangrove species showed a flowering period of 4 months (Figure 2). *R. apiculata* and *X. granatum* synchronously flowered from November to February with flowering peak in January for both species. *R. stylosa* flowered from January to April and attained the peak in March while that of *R. mucronata* occurred from July to October and most flowers were observed in September.

The flowering pattern of *R. apiculata* agrees with that of Bonnittee (1978) who reported that this species starts to flower in November and heavy flowering occurs from December to January while *R mucronata* flowers in October.

However, the flowering pattern observed in the four mangrove species deviates with the report of Palis *et al.* (1997). Under climate type I, they revealed that *R. apiculata* produces only few flowers throughout the year, although more is produced between October to November while *X. granatum* flowers only from September to November. *R. stylosa* flowers between February to March and between April to July. Its peak flowering occurs in May. In addition, *R. mucronata* flowers throughout the year and most flowers are observed in October.

The reason for flowering pattern inconsistency of the four mangrove species in this study with that of Palis *et al.* (1997) for climate type I is uncertain. However, Murphy and Lugo (1986) stated that no single environmental factor is responsible for the type or timing of phenological events in tropical tree species. Different species probably respond to different environmental factors so that flowering coincides with the most favorable season for sexual reproduction (Janzen 1967). Other factors of probable significance on phenology include day length and plant age (Longman 1978), internal growth correlation (Borchet, 1978), and combinations of biotic and abiotic factors (Frankie *et aI.*, 1974).

The flower intensity of the four species was generally lower than 100% (Table 1) because most of the individuals did not consistently attain the maximum intensity when they flowered even in the same length of time (4 months). Among the four species, *R. stylosa* produced flowers as much as 85% of its canopy while *X. granatum* was the least with only 60%. On the other hand, the flowering intensity of *R. mucronata* and *R. apiculata* were 80% and 75%, respectively. According to Gill and Tomlimson (1969), *Rhizophora* flowers fall off the ground 2 days after blooming. Probably, the three species under genus *Rhizophora* had reached their maximum flowering intensity but their flowers had fall on the ground before observation was done. This might also true for *X. granatum.*

There was generally high flower prevalence in the four mangrove species indicating that most individuals produced flowers. In fact, all individuals (100%)

of *R. apiculata*, *R. mucronata* and *X. granatum* and 95% of *R. stylosa*. produced flowers.

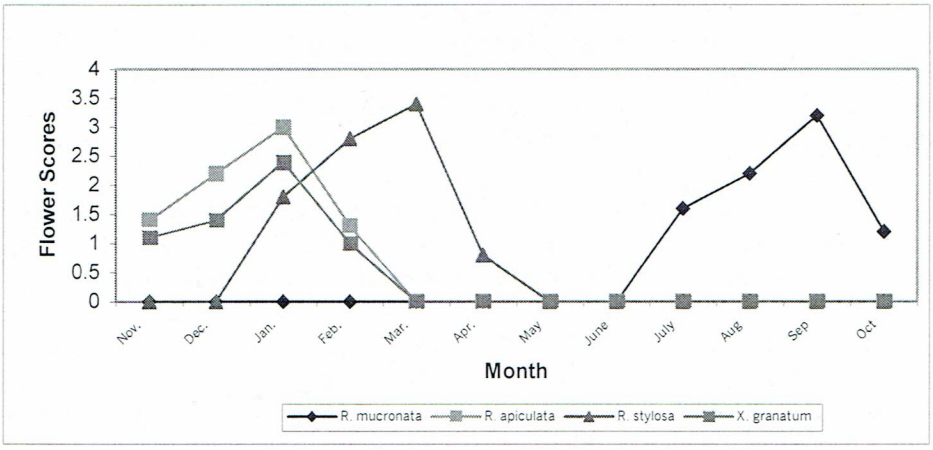

Figure 2. Flowering phenology of the four mangrove species

Table 1. Flowering intensity and prevalence of the four mangrove species.

Species	Intensity (%)	Prevalence (%)
R. apiculata	75	100
R stylosa	85	95
R mucronata	80	100
X. granatum	60	100

Fruiting

The four mangrove species showed discrete fruiting patterns during the study period (Fig. 3). The fruiting of *R. mucronata* occurred for 6 months from November to April and peaked in January. *R. apiculata* had fruits for 5 months from March to July with peak fruiting in May. *R. stylosa* fruited also for 5 months from May to September with fruiting peak in July while *X. granatum* fruited only for 4 months from March to June and in April.

Bonnittee (1978) observed the fruiting of *R. mucronata* in November to December. Encendencia (1978) also observed that *R mucronata* in Pagbilao, Quezon Province had fully developed fruits at 6-8 months but found peak fruiting between May and June. In this study, the peak fruiting of this species was observed in January. This peak fruiting difference is attributed to different climatic pattern of Palawan from that of Quezon Province being different in geographical

location. On the other hand, Encendencia (1978) found that fruits of *R. apiculata* developed fully from 5-7 months with peak between October to November. Difference in peak fruiting of this species is also attributed to difference in geographical location.

It was also noted that the fruiting of the four mangrove species in this study is inconsistent with that of the report of Palis *et al.* (1997) for fruiting phenology under climate type I. In their report, *R. mucronata* bears fruits throughout the year except in July and between August and September with more fruits during October to November. Fruiting of *X. granatum* occurs between August to September and October to December with several fruits between August to October. *R. apiculata* has fruits throughout the year with most fruits between May to June and between December to January. Moreover, fruiting of *R. stylosa* occurs throughout the year except in November with several fruits between August to September.

Again, the reason for inconsistency in fruiting pattern is uncertain. The same possibilities are proposed as in the flowering pattern of these four mangrove species

Fruiting intensity and prevalence values were lower than those of flowering. This is because the former depends to a large extent to the respective flowering values (Elliott *et al.* 1993). The results imply that not all flowers became fruits since as stated, flowers of *Rhizophora* fall off the ground after 2 days of blooming (Gill and Tomlimson 1969). This could be attributed to climatic factors such as wind, which probably disturbed the trees consequently detaching the flowers from the mother trees.

Among the four mangrove tree species, *X. granatum* produced the least fruits, only to a maximum intensity of 32.5% while those of *R. mucronata* produced the most fruits up to a maximum intensity of 77.5%. The maximum fruiting of the *R. stylosa* and *R. apiculata* reached up to 75% and 62.5%, respectively. The result implies that the three species of *Rhizophora* could be the source of propagules being high in fruiting. This could be one of the reasons why Remegio (1999) found *Rhizophora* spp. as the dominant species in this area.

Fruiting prevalence of the four mangrove tree species is generally high. Majority of *R. apiculata* (98%), *R. stylosa* (92%), and *X. granatum* (92.5%) individuals fruited while only 66.7% of *R. mucronata*. Likewise, there was generally high fruit set among the 4 mangrove tree species. This means that most of the trees that bear flowers also bear fruits.

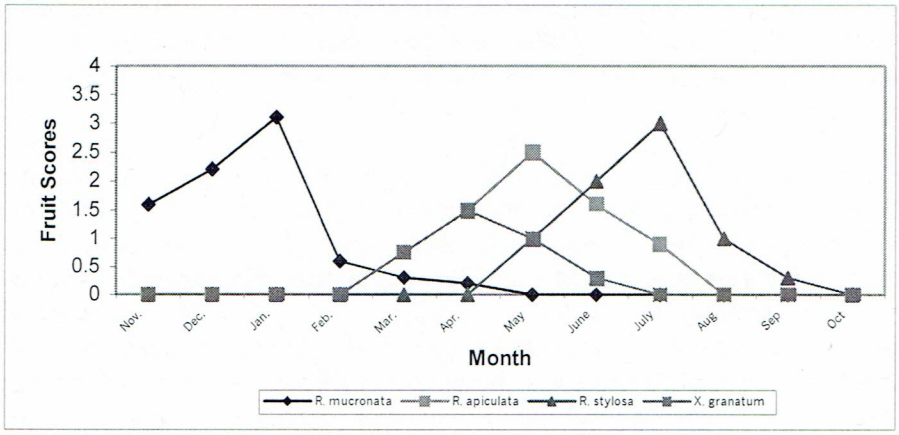

Figure 3. Fruiting phenology of the four mangrove species.

Table 2. Fruiting intensity, prevalence and fruit set of the four mangrove tree species.

Species	Intensity (%)	Prevalence (%)	Fruit Set (%)
R. apiculata	62.5	98.0	98.0
R stylosa	75.0	92.0	96.8
R mucronata	77.5	66.7	82.0
X. granatum	32.5	92.5	90.0

RECOMMENDATION

The results of this study revealed that the *Rhizophora* species have high fruiting intensity, prevalence and fruit set. When these species are to be used for rehabilitation of cleared mangrove areas under Philippine climate type I particularly in Rizal and Quezon municipalities, it is recommended to collect seeds during their peak fruiting month (January for *R. mucronata*, May for *R. apiculata*, and July for *R. stylosa*) to obtain abundant propagules.

It is also recommended to investigate the different environmental factors responsible for the timing of flowering and fruiting of mangrove species to be able to answer questions on inconsistencies of phenological events of the same species at the same climate type but at different locations.

The dynamics between flowering pattern and pollinator abundance as well as fruiting timing and frugivore population are interesting areas for further scientific inquiry.

Furthermore, flowering and fruiting phenology of mangrove species in the East site of Palawan under Philippine climate type III is worth investigating.

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