

Observations on the foliage production in some mangrove species of Goa

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ABSTRACT

Growth with respect to the shoot height, production of leaves, buds, flowers and fruits in RHIZOPHORA MUCRONATA and KANDELIA RHEEDII of mangroves were studied for a period of thirteen months by tagging method. Growth in both plants was continuous with bimodal leaf growth, with the primary and secondary peaks respectively in December and April in R. MUCRONATA and in October and March in K. RHEEDII. The average period of life for R. MUCRONATA leaves was 6-7 months and for K. RHEEDII leaves, it was 5-6 months. Maximum leaf-fall was found in January and February respectively in R. MUCRONATA and K. RHEEDII. Development from floral bud to mature propagule took about five months in R. MUCRONATA and about six months in K. RHEEDII.

INTRODUCTION

Mangroves are one among the specialized tropical marine ecosystems and have long been recognized as suitable environment for growth and survival of the young of several commercially important fishes and prawns. As in several other marine ecosystems, the food chain in the mangrove is detritus based and many of its inhabitants, both young and adult, are detritivores and suspension feeders. However, unlike in other environments, a large part of the detritus here does not originate from phytoplankton or zooplankton-the primary and secondary production levels are comparable to those in the adjoining coastal waters-but from mangrove vegetation. Thus, the terrestrial production forms an important contribution to the aquatic food chain by way of the falling foliage and its subsequent decomposition to detritus (Untawale *et al.*, 1977).

It then becomes obvious that an understanding of the source of this detritus i.e., mangrove foliage and its dynamics-growth of mangrove trees, leaf growth and leaf fall rate, and phenology, is of extreme importance in assessing and quantifying the contribution of the terrestrial component to the aquatic component of the mangroves. From this point of view, the studies of Aksornkoae (1975), Gill and Tomlinson (1971), Christensen and Andersen (1977), Wium Andersen and Christensen (1978), Christensen (1978) and Wium-Andersen (1981), are of importance. However in India, though the mangroves cover an estimated area of 0.35 million hectares and support good capture and culture fisheries, the latter increasing steadily, there is a virtual paucity of data regarding growth and phenology of mangrove trees. This work is an attempt in this direction and presents data on the general growth and phenology of *Rhizo-*

phora mucronata and *Kandelia rheedii* of the family Rhizophoraceae.

MATERIALS AND METHODS

The mangrove area selected for the phenology studies is located at Chodan Island, about 8 km upstream from the mouth region of the Mandovi estuary of Goa. Mangroves in this area cover about 300 ha and the dominant species are *Avicennia officinalis*, *Rhizophora mucronata*, *Sonneratia acida* and *Kandelia rheedii*.

For the present investigation, twenty twigs each of *R. mucronata* and *K. rheedii* were tied with a numbered metallic tag with the help of a thin nylon thread, on the growing shoot just above the two uppermost leaves. Monthly observations of the length of the shoot, number of leaves, floral buds, flowers and fruits formed, and number of leaves, and fruits fallen, were made for one year and their average was taken in presenting the results.

RESULTS

Growth of *R. mucronata* and *K. rheedii* (Figs. 1 and 2) showed that while both species have a continuous growth, *K. rheedii* grows (average growth 1.28-0.21 cms/month) several times faster than *R. mucronata* (average growth cms/month).

LEAF FORMATION AND LEAF-FALL :

In *R. mucronata*, maximum number of leaves per shoot (7.9) was observed in December which decreased subsequently to 6.35 leaves per shoot in April. In *K. rheedii*, the maximum number of average leaves was 11.4 in October and it decreased

to 7.0 in April (Figs 1 and 2). Leaf-fall was found to be maximum in January in *R. mucronata* (1.78 leaves/shoot) and in February in *K. rheedii* (2.0 leaves shoot) (Figs. 1 and 2).

FLORAL PHENOLOGY :

Both *R. mucronata* and *K. rheedii* developed small shoots with 3-4 primordia in the axils of leaves which branched and rebranched into 4-6 small pedicels which gave rise to floral buds and then to flowers. This, after fertilization gave rise to fruits with a growing hypocotyl on the plant itself. After completion of the growth, fully matured seedlings dropped down in the marshy area

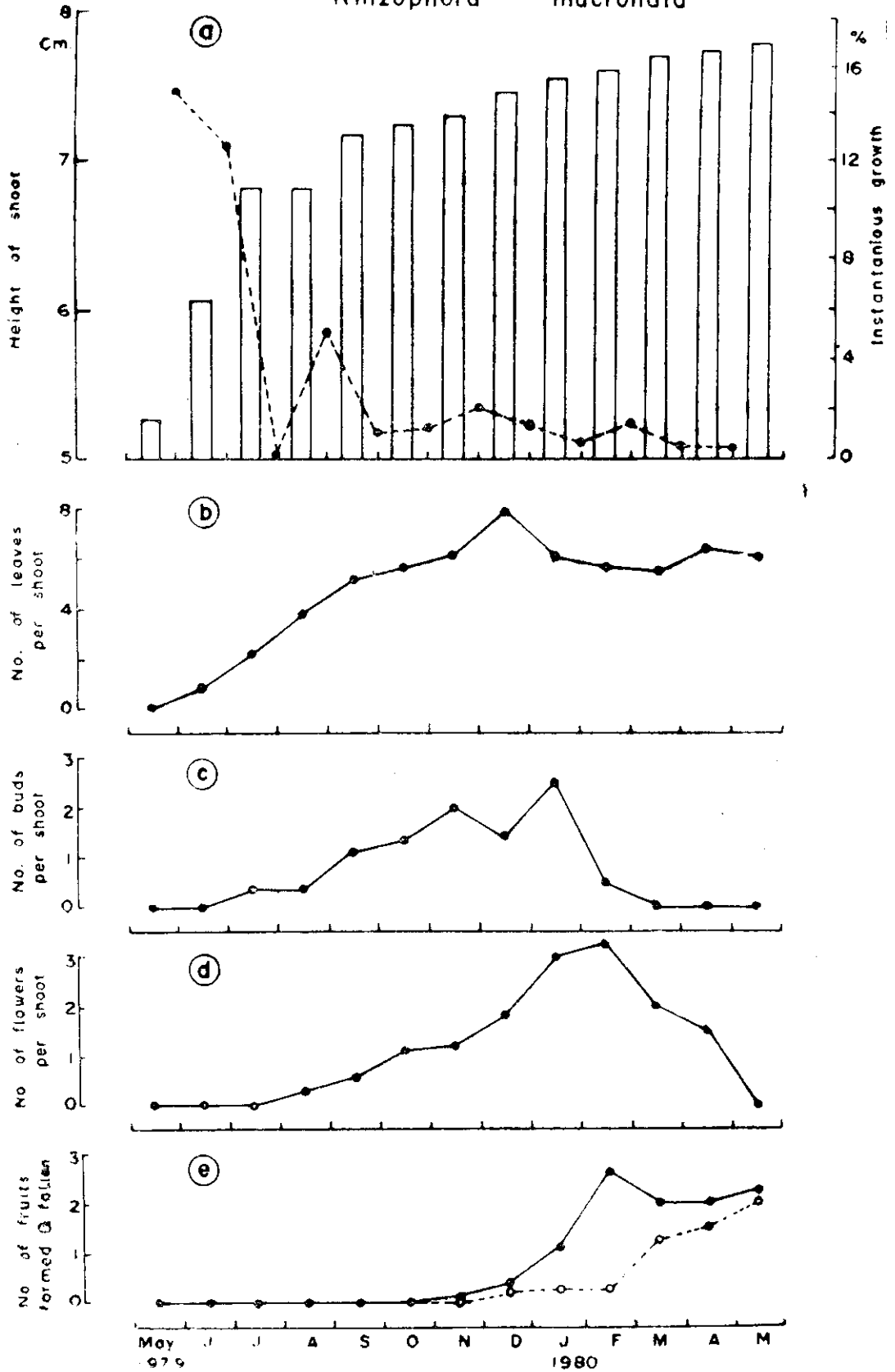
Floral bud primordia started appearing in July in *R. mucronata* and in August in *K. rheedii* (Figs. 1 and 2) and both species showed floral formation by the end of August.

Maximum number of flowers, 3.3 per shoot, were found in February in the case of *R. mucronata* while *K. rheedii* showed a maximum of 7 flowers in November (Figs. 1 and 2). All flowers did not develop into fruits but a majority of them dropped off in between the observation dates.

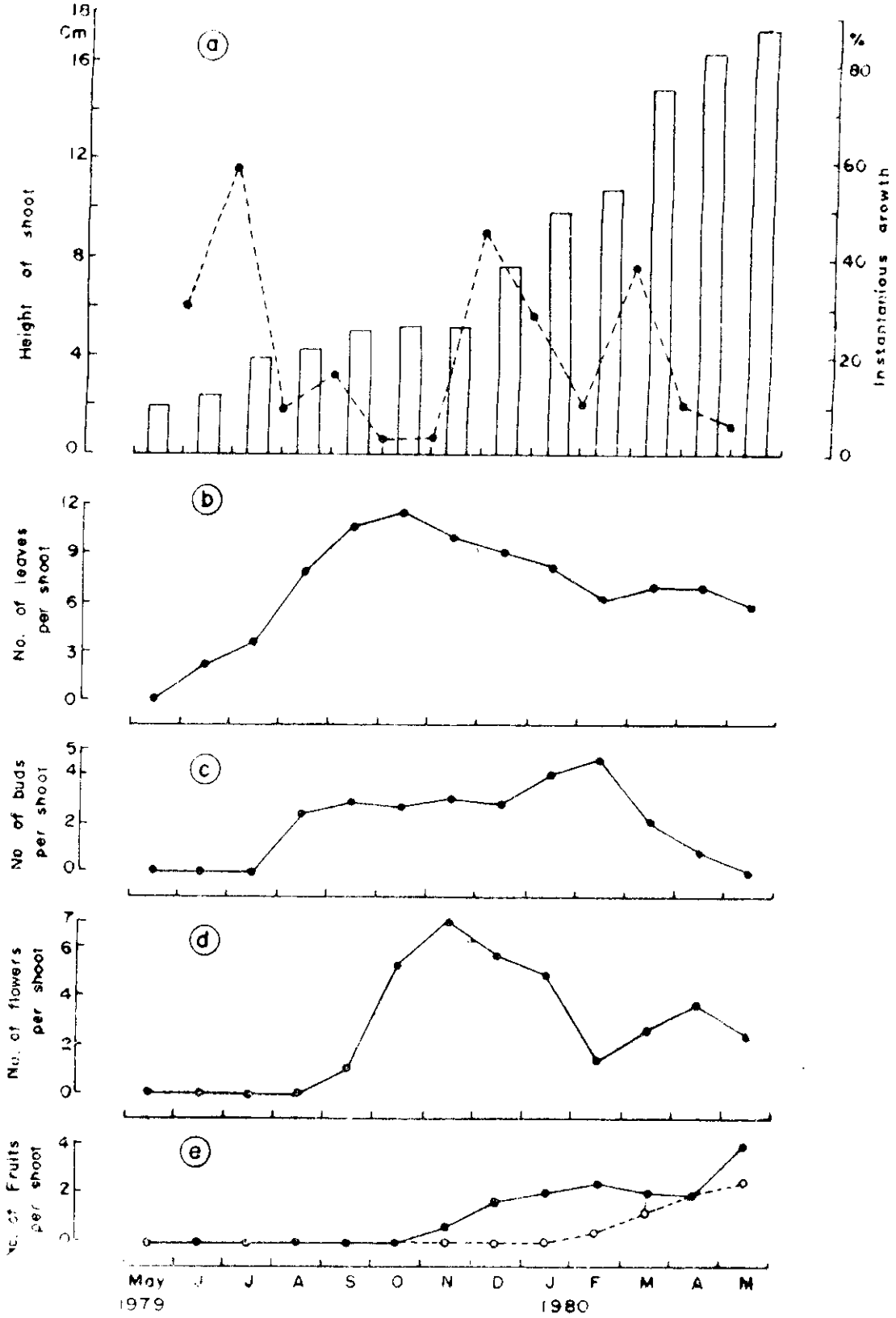
FRUITS :

Seedlings of *R. mucronata* appeared in November and reached a maximum in February (2.6/shoot). In *K. rheedii*, seedlings appeared in October and reached the maximum (4/shoot) in May (Figs. 1 and 2). Number of fruits increased from December onwards in *R. mucronata* and from (Figs. 1 and 2). February onwards in *K. rheedii*

Rhizophora mucronata



Kandelia rheedii



DISCUSSION

In both species, growth was continuous throughout the year, except in October–November when the growth was nil in the case of *K. rheedii* and July–August in the case of *R. mucronata*. However, instantaneous growth rates which measure the monthly rate of growth showed that both species do not grow uniformly in all months (Figs 1 and 2). Growth varied from nil to 58% in *K. rheedii* while in *R. mucronata*, it varied from nil to 14%. Maximum growth in *K. rheedii* was in monsoon months and in *R. mucronata*, in pre-monsoon months, indicating the most favourable periods for growth.

Both *R. mucronata* and *K. rheedii* showed bimodal growth of leaves, with the primary peak in December and the secondary peak in April in *R. mucronata*; in *K. rheedii* the primary and secondary peaks were respectively in October and March (Figs. 1 and 2). This is similar to the observations of Christensen and Wium-Andersen (1977) that *R. apiculata* shows bimodal growth of leaves, with the first peak at the beginning of heavy rains, and the second at the end of the monsoon. However, Gill and Tomlinson (1971) observed only an unimodal leaf growth in *R. mangle*.

In the present investigation, total life period of a leaf of *R. mucronata* was found to be about 6–7 months and 5–6 months in *K. rheedii*. The maximum leaf fall was found in January and February in *R. mucronata* and *K. rheedii* respectively. Gill and Tomlinson (1971) showed that leaf fall in *R. mangle* was greater in summer.

On the other hand, Christensen and Wium-Andersen (1977) found that leaf fall in *R. apiculata* was more or less uniform throughout the year. Pool *et al.* (1975) correlated high leaf fall of *R. mangle* with prolonged draught or heavy rainstorm. It has been suggested (Pant *et al.* 1980) that there might be a peak of leaf-fall in the mangroves of Goa, associated with the monsoon, but the present work could not be continued during the subsequent monsoon (June–September) to verify this.

The fallen leaves drift away with the estuarine circulation, and the drifting depends on the tidal amplitude, water current and wind speed. The leaf-fall is ecologically important as it forms the major source for protein-rich food, detritus, for the detritivorous organisms (Christensen and Wium-Andersen, 1977; Untawale *et al.*, 1975; Heald, 1971; Sumitra-Vijayaraghavan and Wafar, 1981).

In both species, the floral buds, after their appearance, open into flowers within one or two months. This is similar to what Gill and Tomlinson (1977) observed in *R. mangle*. However, according to Christensen and Andersen (1977), *R. apiculata* has a primordia and floral buds with resting period for each about one year, and thus a period of about two and a half years is required for the development of the flower. In *Cariops tagel* the development from floral bud to mature fruit takes about 12–18 months (Wium-Andersen and Christensen, 1978). In the present investigation, propagules of *K. rheedii* became visible two months after the bud formation and after that about three months were required for the propa-

gules to mature. Thus the total development time in *K. rheedii* from bud to seedling was about six months. In *R. mucronata* first propagule appeared after the fourth month of the bud formation and within a month it became mature (Table 1).

It was observed that out of all flowers formed on the plant, only a few developed into fruits and the rest withered out. In *K. rheedii* and *R. mucronata*, maximum number of flowers were found in November and February respectively which may be correlated to low temperature. Bonnitee Wipa (1978) observed flowering in *R. mucronata* in October and found a maximum number of flowers in November and December. In Florida, according to Gill and Tomlinson (1971), maximum number of flowers were found during the humid period.

Guppy (1906) opined that the mangrove flowers are self fertilized in the present study, petals and stamens were

found withered off after four to five days of the opening of the flowers. According to Wium-Andersen (1981) the flowering period for the flowers of *R. mucronata* is one to two days. It is evident from these observations that fertilization takes place within this short period. Similar observations were made by Gill and Tomlinson (1971) also. Seedlings of both these mangrove species require four to five months for their complete development to the maximum length. This is similar to the time required in *R. mucronata* (Christensen and Wium-Andersen, 1976), whereas, according to Guppy (1906) seedlings of *R. mucronata* take seven to eight months and those of *R. mangle* eight to twelve months (Gill and Tomlinson, 1971) for complete development.

So far, there is practically no work done on the rate of establishment of seedlings in Indian mangroves. Such a study will be of extreme importance from the mangrove management point of view.

TABLE - 1

Stage	<i>Rhizophora mucronata</i>		<i>Kandelia rheedii</i>	
	Month	Duration	Month	Duration
1. Floral bud primordia	July	—	August	120 days
2. Flower	August	30 days	September	30 days
3. Seedling	November	90 days	November	60 days
4. Dropping	December	30 days	February	90 days
5. Total period	July - December	150 days	August - February	180 days

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