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Floral Biology and Insect Visitation of the Monoecious Palm Prestoea decurrens on the Pacific Coast of Colombia

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ABSTRACT

We studied the floral biology and insect visitation of the monoecious, protandrous palm *Prestoea decurrens* H. Wendl. in Chocó, Colombia. The palm has staminate and pistillate phases of 18 and 7 d duration, respectively. Flowers open in the late morning and staminate flowers abscise in the afternoon the same day. Pistillate flowers apparently are at anthesis for 2 d, and if not pollinated, abscise on the 3rd d. Both staminate and pistillate flowers are whitish-yellow, with no perceptible scent. Staminate flowers offer pollen and both flowers produce nectar. Flies, bees, wasps, beetles, and one species of crab visit the inflorescences regularly during staminate anthesis. Only a few insects visit the inflorescences during pistillate anthesis. Due to their foraging at both morphs and high pollen loads we conclude that halictid bees play the principal role in pollination followed by trigonid bees and small flies.

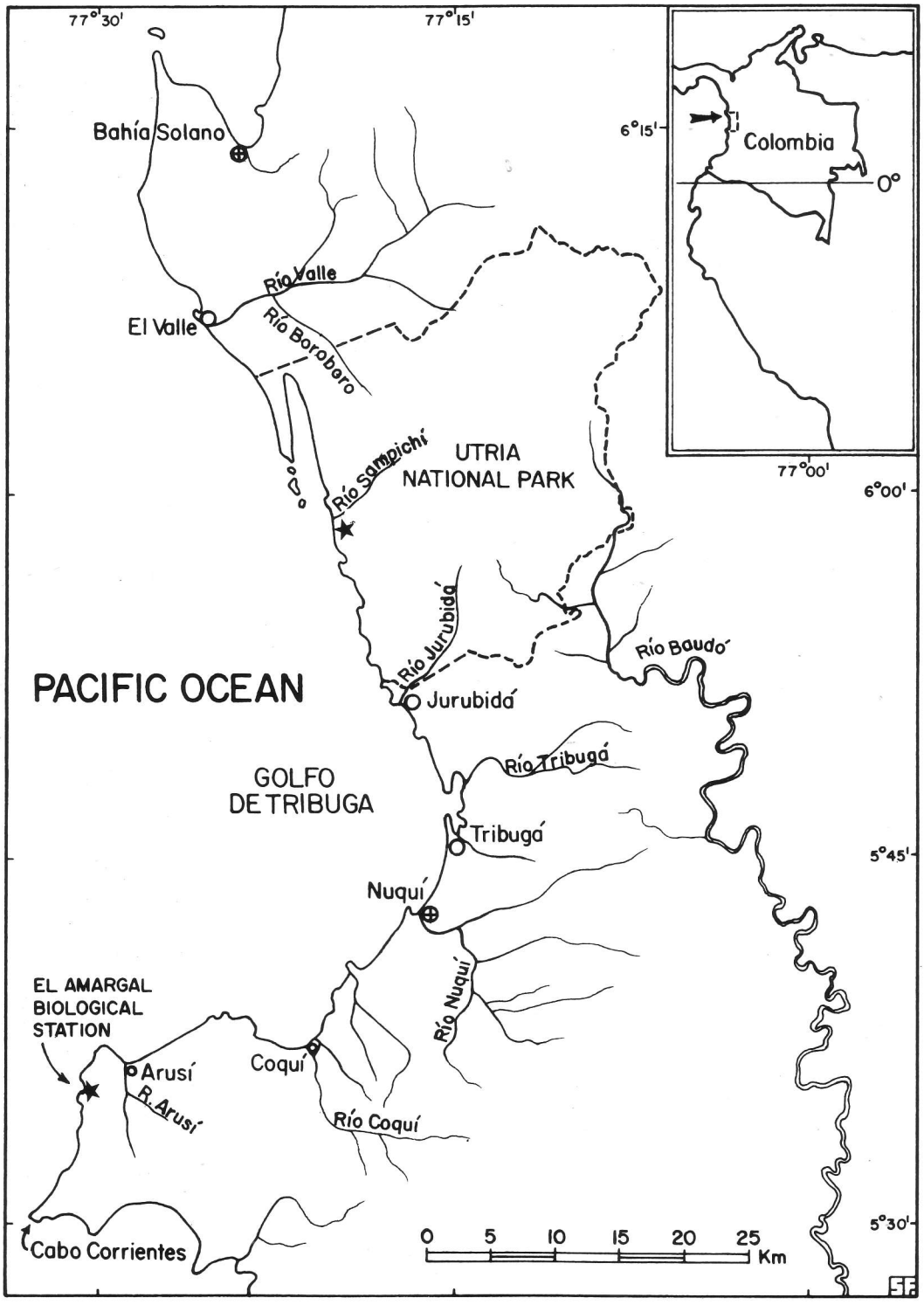
Prestoea is a genus of small to medium-sized, monoecious palms. The genus belongs to the subtribe Euterpeinae of tribe Areceae in subfamily Arecoideae, and consists of 10 species of neotropical distribution (Henderson and Galeano, in press). One species, *P. acuminata* (Willd.) H. E. Moore has economic importance for Ecuador because its palm hearts are canned for export (Balslev and Henderson 1987, Borgtoft Pedersen and Balslev 1992 as *P. trichoclada* (Burret) Balslev and Henderson). Most of the other species have narrow ranges and none of them is much used or cultivated. Few notes exist on the pollination of *Prestoea* despite of the accessibility of the inflorescences in this genus (Bannister 1970, Bullock 1981). This paper seeks to fill this gap by providing data on the floral biology and insect visitors of *P. decurrens* H. Wendl. in Colombia.

Study Sites and Observation Periods

The present study was conducted at two localities of slightly disturbed primary wet forest (*bosque muy húmedo tropical*, according to IGAC 1977). Both were located at 0–20 m elevation in the Department of Chocó, on the Pacific coast of Colombia (Fig. 1). Rainfall in the area ranges between 5 023 mm at Bahía Solano in the north (HIMAT 1993) and 8 080 mm per year at El Amargal in the south (Fundación Inguedé 1994). Investigations were carried out on scattered individuals in a 1.5-ha "tagual" (periodically inundated vegetation dominated by the palm *Phytelephas seemannii* O. F. Cook.) and nearby hills near the mouth of Río Sampichí in the Parque Nacional Utría through March and April 1994. Additional insect collections and observations were made at El Amargal Biological Station in May 1994.

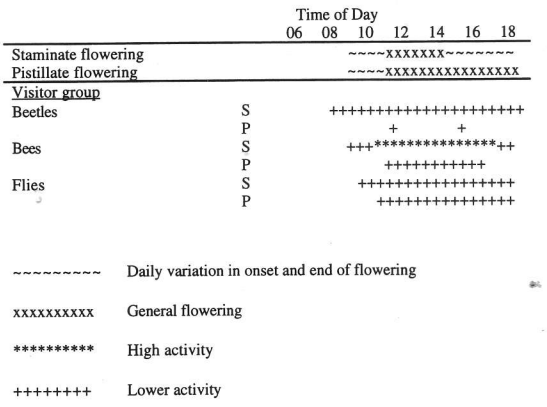
Methods

Seven palms bearing 10 inflorescence buds and exposed inflorescences were tagged for observations. Individual pistillate flowers were marked with a water-based marker pen in order to study their development. The flowering sequence and insect activity were recorded on daily visits. Insect visitors to the staminate flowers were observed for 6 h and to the pistillate flowers for 5 h. The presence and position of nectaries were tested using glucose testing paper (Clinistix℠). A solution of neutral red that stains fatty substances (includ-



1. Location of the Gulf of Tribugá. Study sites are marked with stars.

2. Inflorescence of *Prestoea decurrens*.



3. The diurnal pattern of visitation of the different insect groups to inflorescences of *Prestoea decurrens* in relation to flowering. S: visitation to staminate phase inflorescences. P: visitation to pistillate phase inflorescences.

ing oil-containing cells) was used to test for the presence of pollen kitt and scent-producing floral parts (Vogel 1990). The temperature of a selected inflorescence was measured before and after splitting of the peduncular bract. A digital thermometer with a 2 mm diameter probe was inserted in the center of the bud or flower-bearing parts. In order to reveal the specificity of the visitors to *Prestoea decurrens*, insects were also collected on several co-existing palm or palm-like species, including *Cocos nucifera* L., *Phytelephas seemannii* O. F. Cook, *Welfia regia* H. Wendl. ex André (Palmae), *Asplundia* sp., and *Carludovica palmata* Ruiz and Pav. (Cyclanthaceae). Vouchers of the palm have been deposited at AAU, COL, and FMB. Insect vouchers have been deposited in the entomological collections at Instituto de Ciencias Naturales, Universidad Nacional de Colombia, at INDERENA, Bogotá, at the Zoological Museum, University of Aarhus, and at the respective institutions of the specialists that helped with identifications. Numbers are given to some of the species and one genus in order to make possible comparisons with other publications of the specialists (see Acknowledgments) or the authors.

Results

Prestoea decurrens is a medium-sized cespitose palm with 2–7 stems up to 7 m tall and 12 cm in diameter. It is common along rivers and streams in lowland wet forests from Nicaragua to western Ecuador. Inflorescences of *P. decurrens* are branched to one order with 36–68 rachillae ($\bar{X}$ = 50.3, N = 7) (Fig. 2) that are enclosed in bud by a single, slender peduncular bract. Flowers are unisexual and generally grouped in triads of two lateral staminate and one central pistillate flower. The development of the pistillate flowers is often suppressed at the distal end of each rachillae, resulting in staminate dyads. Each rachilla bears from 206 to 320 triads ($\bar{X}$ = 268.3, N = 4) and from two to 18 dyads ($\bar{X}$ = 6.5, N = 4). Flowers of both morphs are whitish-yellow with no perceptible odor. The filaments and the connectives stained weakly red with neutral red. This may indicate that these tissues produce a very weak scent. No other tissues in the inflorescence changed color. Staminate flowers offer pollen and both staminate and pistillate flowers produce nectar. Pollen of *P. decurrens* is sticky. It stained when treated with neutral red, which indicates presence of pollen kitt.

The individuals studied flowered throughout the period of observation; and the presence of buds

Table 1. Visitors to the inflorescences of Prestoea decurrens. *Relative abundances are indicated as follows: very common (***), common (**), uncommon (*), and not observed ( ). Localities at which the insects were observed: A = El Amalgal, S = Sampichí. Insects observed on other hosts were marked with a number and letter (s = staminate, p = pistillate) referring to host plant species and its phase.* Cocos nucifera *(1)*, Phytelephas seemannii *(2)*, Welfia regia *(3)*, Asplundia *sp. (4), and* Carludovica palmata *(5)*.

Order/Family Subfamily or tribe	Visitor	Staminate Phase	Pistillate Phase	Locality	Other Hosts
Coleoptera					
Chrysomelidae					
Alticinae	*Brasilaphthona* sp. 2	**		A	
	Near *Centralaphthona* sp. 1	**		S	
	Near *C.* sp. 3	**		S	
	Hypolampsis sp. 3	**		A	
Galerucinae	*Monolepta* sp.	**		A	
Curculionidae					
Baridinae, Centrinini	*Bondariella* sp. 3	**		S	
Cholinae	*Cholus cananchensis* Heller	**		A, S	
Erirhininae, Derelomini	*Phyllotrox* sp. 27	**		S	4s, 5s
	P. sp. 28	**	*	S	5s
	Genus 2, sp. 1	**		S	5s
Staphylinidae					
Aleocharinae	*Amazoncharis?*	*		S	
Diptera					
Cecidomyidae	Cecidomyidae sp. 1		**	S	
	C. sp. 2		**	S	
	C. sp. 3		**	S	
Chloropidae	Chloropidae sp. 1	*		A	
Drosophilidae	*Drosophila* sp.	**	**	S	
Milichiidae	Milichiidae sp. 1	*		A	
Mycetophilidae	Mycetophilidae sp. 1		**	S	
Hymenoptera					
Apidae					
Meliponinae	*Plebeia* aff. *minima* (Gribodo)	**		A, S	
	Trigona spinipes	**	*	S	
	T. williana Friese	**		S	2s/p
Halictidae	*Dialictus* sp.	***		A, S	
	Neocorynura sp.	***	**	A, S	
	Undet. sp. 1	***		A, S	
	Undet. sp. 2	***		S	
	Undet. sp. 3	***		S	
Decapoda					
Grapsidae	*Sesarma* cf. *miersii* Rathbun	**		S	

of different degrees of development suggests that this species flowers throughout the year, a fact confirmed by G. Galeano (personal communication). *Prestoea decurrens* is protandrous with no overlap between staminate and pistillate phases. All flowers are closed at the splitting of the bract and no insects are present. This situation may last for up to 1 d until 9:00 to 11:30 a.m. when the first staminate flowers open and anthers dehisce (Fig. 3). Individual staminate flowers are only at anthesis for a few hours and abscise in the afternoon the same day. The staminate phase of the inflorescence lasts 18 d, with daily pulses of up to 1 000 flowers per inflorescence. Then there is a pause lasting two days which is followed by a pistillate phase seven days long. Pistillate flowers also open between 9:00 and 11:30 a.m. The stigmas remain humid and whitish-yellow for 2 d and are probably receptive this long. On the 3rd d they turn brownish, and the flowers either drop

off or start to develop into fruits. No rise in temperature was recorded before or during anthesis.

At least 26 species of insects and one species of crab regularly visited the inflorescences of *P. decurrens* during the staminate phase (Fig. 3, Table 1). Halictid bees came in tens and were the most conspicuous and numerous insects. They moved along the rachillae and busily collected pollen. We observed that at least one species stored pollen grains on the ventral side of its body. Each insect usually foraged for several minutes before leaving. Also meliponid bees collected pollen, but they were usually fewer than the halictids. Small flies (*Drosophila*, Chloropidae, Milichiidae, Otitidae) often visited the staminate flowers by the tens. They were all observed to forage on nectar. Whether they also eat pollen is unclear. Less than 30 individuals of small chrysomelids and curculionids visited the inflorescences particularly during daytime. They fed on pollen grains and nectar and used the inflorescence as a site for copulation. Usually a few individuals (<5) deviated by staying over night on the inflorescences, mostly resting inactive along the rachillae. The most conspicuous of the beetles was *Cholus cananchensis*, a 10 mm long, yellow and black curculionid. A few of them (<10) stayed on the rachillae for hours, often with the purpose of copulating. All beetles were passive and rarely arrived and left the inflorescences compared with the bees and most of the flies. A nectar-eating crab (*Sesarma* cf. *miersii*) visited the staminate flowers during daytime. Typically two or three individuals at a time clung to the rachillae while feeding on nectar using their claws. These crabs mostly ascended in the morning and descended in the afternoon the same day.

There were fewer visitors to the inflorescences in the pistillate phase in terms of both individuals and species (Fig. 3). During a 5-h period of observations at a particular inflorescence during pistillate anthesis, the following insects were recorded as visitors: ≈50 Cecidomyidae and Mycetophilidae, 15 Drosophilidae, five Halictidae, three small unidentified Diptera, two Meliponidae, one Otitidae (?), one *Phyllotrox*, and one small unidentified beetle (Table 1). They all foraged on nectar. The bees moved from flower to flower and often touched these with their mouthparts, their legs, and their abdomen. They typically visited two or three rachillae before leaving.

We have no data on fruit set, but we observed that a Madarini weevil (Baridinae, Curculionidae) frequently bored holes in unripe fruits, which subsequently dried out. This fruit predator was common at both localities.

Discussion

Inflorescence phenology of *P. decurrens* in Colombia follows the pattern described by Bullock (1981) for the same species in Costa Rica, where however, the staminate phase lasted only 10–14 d, and the pistillate phase only 3 d. The pause between the two phases was similar at both localities. Fertilization of a flower by another from the same plant (geitonogamy) in this species is probably a rare phenomenon. First, there is no overlap of staminate and pistillate phases of one inflorescence. Second, consecutive inflorescences on the same stem usually have a great difference in developmental stage; thus when an inflorescence enters the staminate phase, the pistillate phase of the previous inflorescence has passed several weeks ago. Third, the probability of simultaneous staminate and pistillate phases on different stems of the same cluster is low because there are few stems in each cluster (mostly 1–4), and flowering appears to occur throughout the year.

Wind pollination of *P. decurrens* is probably insignificant because pollen apparently has pollen kitt and therefore is sticky, and because winds in the habitat of this palm are rarely of any strength. We also rule out the importance of beetles in pollination, although a few of them were present both at staminate and pistillate anthesis. First, they were typically staying passive for hours and rarely visited the flowers to feed on nectar and pollen. Second, they rarely moved between inflorescences. Also the crab was sedentary and therefore probably did not contribute to pollination.

Diptera were the most common visitors to female inflorescences in terms of number of individuals. However, none of them belonged to the groups known as efficient pollinators, as, e.g., Syrphidae. For various reasons we consider the role of flies visiting *P. decurrens* less important than the bees. To begin with, the flies were more passive than the bees when visiting an inflorescence. Next, compared with the bees, flies rarely traveled between inflorescences. Also, all the flies visiting *P. decurrens* were very small and usually sparsely haired, and therefore incapable of transporting large loads of pollen grains. Additionally, the flies were rarer than the bees on staminate inflorescences. Schmid (1970) cited the same reasons to rule out small flies as pollinators of *Asterogyne martiana* (Mart.)

H. Wendl., and different studies have actually demonstrated that drosophilids did not carry any or only little pollen when visiting pistillate flowers of the palms *Aiphanes erinacea* (Karst.) H. Wendl. (Borchsenius 1993), *Aphandra natalia* (Henderson & Balslev) Barfod (Ervik 1993), and *Phytelephas seemannii* (Bernal and Ervik, in press).

The meliponids usually collect pollen on many different taxa of plants (Heithaus 1979) (i.e., they are polytropic, see Grant 1949, Faegri and van der Pijl 1980) and *Trigona williana* was much more abundant at the inflorescences of the nearby and abundantly flowering *Phytelephas seemannii* (Bernal and Ervik, in press). The probability was therefore high that the meliponids brought more foreign than co-specific pollen when visiting pistillate flowers of *P. decurrens*. The halictids, in contrast, were oligotropic (visiting some related taxa of plants only) or apparently even monotropic (visiting one single or some closely related plant species only). We never observed them on any other plant species. There is therefore a high chance that they bring exclusively co-specific pollen. Both the behavior and abundance of the halictids (Table 1) and their potentially large pollen loads suggest that they were the most important pollinators of *P. decurrens*. Populations of bees are, however, often varying in both composition and size during the year. This phenomenon is correlated with the degree of sociality: eusocial bees are less seasonal than solitary bees (Heithaus 1979). The family Halictidae exhibits a wide range of social systems. We do not know the degree of sociality or seasonality of the Halictidae visiting *P. decurrens* and therefore cannot rule out the possibility that the fauna of bees pollinating *Prestoea decurrens* changes during the year. Bullock (1981) observed a whole set of different species of bees visiting *P. decurrens* flowers in Costa Rica from December to September. These included two species of *Trigona*, one *Neocorynura*, one *Lasioglossum*, and one unidentified Halictidae. Bullock suggested that bees were the pollinators, but did not point to any species as being particularly important.

The general morphology and phenology in *Prestoea* agree well with the syndrome of bee pollination (melittophily) in palms suggested by Henderson (1986). Melittophily is likely to be a widespread pollination syndrome in *Prestoea*. A study by Bannister (1970) supports this assumption. She reported that *Prestoea acuminata* (Willd.) H. E. Moore (as *Euterpe globosa* Gaertn.) was protandrous with a very short overlap between staminate and pistillate phases in Puerto Rico. She considered "honeybees and small flies" to be pollinators.

In the palm family melittophily along with cantharophily and myiophily are considered the major pollination syndromes (Henderson 1986). Later studies have added new documentation to this statement (Zona 1987, Bøgh 1996). Halictid bees, however, have not been addressed any special attention, although they often visit palms (Olesen and Balslev 1990) and also participate in the pollination of at least some palms including *Sabal* (Zona 1987 and references therein).

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CHAPTER NEWS AND EVENTS

(By Jim Cain unless otherwise noted)

News from North Queensland

The North Queensland Palm Society (NQPS) met on February 5 at Tumbetin Lodge, The Palmetum, Townsville. Bob Smyth, from the Chemical Department, James Cook University, spoke to the group on chemicals in the garden.

The group met again on March 4 and scheduled further 1996 general meetings for April 1, May 6, June 3, July 1, August 5, September 2, October 7, and November 4, all at Tumbetin Lodge starting at 7:30 p.m. In addition there will be a Palm Lovers' Weekend held during the Queen's Birthday weekend celebration on June 8–9, since last year's celebration was such an overwhelming success.

There will also be a PACSOA weekend on October 11–13, in conjunction with the Townsville Branch and Friends of the Palmetum. This will feature Don Hodel from California, author of "*Chamaedorea Palms,*" Ray Osborne from Africa, John Dowe, and two others yet to be confirmed.

Year 1996 will culminate on December 2 with the Society Christmas Party. NQPS Officers for 1996 are: Lorraine Tooth, President and Treasurer; Jill Whatley, Vice President; Kerry Robertson, Secretary.

News from Mackay and Rockhampton (Queensland, Australia)

Six members of The Palm and Cycad Society of Mackay (branch of PACSOA) traveled to Rockhampton on December 2-3, 1995, as guests of the Rockhampton Palm and Cycad Society. Visits were made to the garden of Allan and Jenny Moorhead, followed by the Rockhampton Botanic Gardens. In addition to viewing the many plants, members were given a taste of a rare fruit, Grumichamas. Palms featured in the Rockhampton Botanic Gardens included lovely specimens of

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