

Notes on the Treatment of Palm Fruits by Long-tailed Macaques (*Macaca fascicularis*)

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The dispersal agents for many Sundaland palms are unknown (Uhl and Dransfield 1987, Kiew and Davison 1989) though a large number of vertebrate frugivores seem to be attracted to the fruit. Anthropoid primates, including members of the genus *Macaca*, eat the fruits of rattan palms (Dransfield 1979, Whitten and Whitten 1982, Caldecott 1986) and the Mentawai gibbon (*Hyllobates klossii*) eats ripe *Arenga obtusifolia* fruit (Whitten 1980). In the course of a study on the diet of the long-tailed macaque (*Macaca fascicularis*) in Bukit Timah Nature Reserve in Singapore between July 1986 and November 1987, it became clear that the fruits of some palms were important in its diet. The ability of *Macaca fascicularis* to disperse palm seeds could be critical to the survival of these plants in Bukit Timah since most of the larger birds reported in the literature as possible dispersers (e.g., hornbills and pheasants, Kiew and Davison 1989) are absent or extinct. The musang (*Paradoxurus hermaphroditus*), which is a possible disperser of rattans (Uhl and Dransfield 1987), is now very rare there and seldom seen.

Approximately sixty percent of the 71 ha of Bukit Timah is primary forest (Corlett 1988). The reserve has a more or less intact flora with over 800 species of seed plants having been collected there this century (Corlett 1989). Twenty-eight species of palms have been recorded including 19

rattan spp. (Corlett, pers. comm.), some of which, such as *Calamus oxleyanus*, are plentiful. In addition, *Oncosperma horridum* is common in some valleys. On the fringes of the primary forest, *Caryota mitis* is the only native palm though there are several planted *Elaeis guineensis* on one of the summits. Curiosity as to the factors influencing the maintenance of what appears to be a typical coastal hill forest flora, given that much of the large fauna has disappeared (Corlett 1988), alerted our attention to the possibility that the 80 individuals of *Macaca fascicularis*, the largest common frugivore left, could be important in dispersing large seeds.

One group of more than 30 animals was studied for 510 hr by a standardized scan-sampling method (Corlett and Lucas 1990). Group members were observed eating ripe fruit on 1,964 occasions and unripe fruit, 205 times. 223 records of feeding on ripe palm fruits were obtained and 33 on unripe fruit. Rattan palm species were identified after the study utilizing Dransfield (1979, 1984).

Rattans

143 records involved the consumption of apparently ripe rattan fruit. At least 65 of these were of *Calamus oxleyanus* which appeared to fruit over much of the observation period. Other *Calamus* spp. could not be determined with any certainty but

probably included *C. luridus* and a member of the *C. insignis* group. Three records were of *Daemonorops* spp. and included *D. didymophylla*. One record was of an undetermined *Korthalsia* sp. However feeding on *K. echinometra* and *K. rosstrata* was also seen in ad-lib observations.

Feeding while perched on a rattan plant was extremely rare, quite obviously due to the spiny nature of the leaf sheath. Monkeys most often took a sprig of fruit and removed the scaly epicarp by bringing the fruit to the incisor teeth and making a single bite. This was then dropped. They then placed the seed (i.e., stone plus sarcotesta in *Calamus* and *Daemonorops* or seed plus mesocarp in *Korthalsia*) in one of their two cheek pouches positioned behind the molar teeth. It was difficult to count the number of seeds that could be placed in one cheek pouch but calculation from the slightly smaller fruits of *Eugenia longifolia* suggests that up to 10 seeds could easily be accommodated. Seeds were then brought back to the mouth, apparently one-by-one, and the flesh removed with the cheek teeth. On many occasions, this involved a loud noise resembling fracture. However, we could not confirm that any stones were destroyed by the teeth in this way and, following the noise, seeds that were still in one piece were often removed by the monkey from its mouth so that it could inspect the remaining flesh visually. We assumed that the noise involved the scraping off of flesh using the cheek teeth. As far as could be ascertained, all rattan stones were eventually dropped from the mouth. No stones were found in 76 fecal samples that were examined by sieving.

The macaques often moved away from the plant while processing the flesh. In 32 recorded instances, adult males, females and juveniles, took rattan stones between 10–100 m away from the plant. On only two occasions, however, was an entire sequence seen of plucking the fruit, moving 20 m and then dropping the stone.

However, this indicates a clear potential for dispersal.

Oil Palms

Elaeis guineensis palms have been planted around the lower of two summits. Entrance to the telecommunications area there is restricted but there are less than ten of these trees. 65 observations of feeding on the fruit flesh were made. Monkeys also cheek-pouched the "seed" (seed plus endocarp with some flesh attached to it) and were seen removing them from the mouth with hands at a distance of up to 100 m from the nearest oil-palm tree. One instance of an *Elaeis* stone being dropped 20 m from the nearest tree was recorded. No *Elaeis* stones were found in the feces.

The monkeys tried on several occasions to break open the endocarp with the molar teeth in order to eat the kernel, but without success. They have been introduced to the taste of the kernel by personnel stationed in the reserve who break open the endocarp and hand the pieces to the monkeys.

Oncosperma horridum

Sixteen observations of feeding on *Oncosperma horridum* fruits, which were available in March–August 1987, were made. Few of the stones had the dark purplish flesh completely cleaned off. However, monkeys were observed with fruit in the cheek pouches nearly 100 m from the nearest tree. No stones appeared in the feces and therefore they must have been dropped at some point. Potential for dispersal would depend on whether removal of the flesh is important for viability of the seed—which it appears to be for some *Calamus* spp. (Ng 1983).

Caryota mitis

Green unripe fruits (33 records) of the common fish-tailed palm were eaten in all but two months of the period of observation. Though many observations of cheek-

pouching following by dropping (or spitting) of the stones were made (maximum distance from a plant for an entire plucking-to-dropping sequence was 10 m), these were the only palm stones found in the feces. However, they were rare being only 8 "seeds" out of more than 5,000. Since over 98% of individual seeds in the feces were <4 mm in maximum width and *C. mitis* seeds are 8–10 mm irregular spheres, this is somewhat perplexing. *Caryota* stones were the largest "seeds" found in the feces. It is unclear why the macaques were not apparently deterred by calcium oxalate crystals in the fruit (Dransfield 1974), particularly since a *berok* monkey (*Macaca nemestrina*), famous for having been used for making botanical collections, appears to have died after eating *Caryota* (Kiew and Davison 1989).

Discussion

We have no information on the viability of palm "seeds" that were dropped or spat out. However, a cleaned "seed" dropped singly 20 m or more from a parent plant is probably more successfully dispersed than if deposited in a fecal clump with many other seeds (Corlett and Lucas 1990). What we cannot judge is if this dispersal happened frequently enough for long-tailed macaques to be considered good dispersal agents. *Macaca fascicularis* is typically an animal of riverine, mangrove and secondary forest. However, no rattans other than *Plectocomia elongata* are found in secondary forest at Bukit Timah. We did observe long-tailed macaques consuming *P. elongata* fruits in the central Catchment area of Singapore in mid-1985. Most fruits were processed very rapidly in a "suck and spit" manner (Dransfield 1979). We presented some *P. elongata* fruits to captive *Macaca fascicularis*. Over a lengthy period, two animals succeeded in breaking the stone but with so much effort that we doubt whether the stones are destroyed commonly in the wild.

We tentatively conclude that macaques may influence the dispersal and, therefore, the distribution of rattans. *Calamus* is listed by Caldecott (1986) as one of the key genera for macaques in the Sundaland region because it is commonly mentioned in dietary lists. Nevertheless, there has probably been little if any coevolution between macaque and rattan. Macaques have only been in South east Asia for the last one million years (Delson 1980) whereas the different genera of palms must surely have been established before then. Though the importance of macaques as dispersers in a forest with an intact fauna should be studied, they should be considered as potential dispersal agents of forest palms.

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Principes, 36(1), 1992, p. 48

South Florida Chapter, International Palm Society Fall 1991 Show and Sale at Fairchild Tropical Garden

The thirteenth "modern" Fall Show and Sale of the South Florida Chapter was anything but unlucky. Plants in a record number—over 3,900—were grabbed up by palm enthusiasts on the weekend of November 2 and 3. Over 400 species of palms were offered by 56 growers. All of the available space was occupied by plants ranging from seed pots to field-grown specimens. Long-time observers of the Chapter's Fall event agreed that more well-grown species of palms were available than ever before. And for at least the third consecutive year, the average price per plant, \$15.84, was actually lower than that of the year before.

The theme for this year's Show and Sale was Palms of Australia and Lord Howe Island. Numerous exceptional palms were entered into the education/show display in the Montgomery Auditorium. Containerized specimens of *Wodyetia bifurcata* scraped the high ceiling of the expansive room to create a palmetum atmosphere. Awards were given for first, second, third and honorable mention in the categories of: Australian/Lord Howe Island Palm, Rare and Difficult-to-Grow Palm, Indoor/Patio Palm, Field-Grown Palm, Open Category and *Chamaedorea*. The ribbon for Best of Show was awarded this year to Bill Shannon for his hybrid *Chamaedorea stolonifera* × *ernesti-augusti*. The same specimen won a first-place ribbon in its class in 1990.

In the sale area there was the traditional repotting demonstration by Louise Futch. For the fourth consecutive year, an information table staffed by Chapter volunteers provided buyers with guidance in the grower area and advice on cultivation techniques, as well as the chance to obtain the Biennial T-shirts and color palm posters offered by the Chapter. Special thanks are due De Hull, Sale Chairman, Bill Theobald, Education Chairman, and those nongrower Chapter members who have repeatedly volunteered their time and resources to help make this event a success year after year. We are particularly grateful to those growers who devoted the extra effort to bring in palms. Not only were these plants desirable, but also they went out into the community at a reasonable cost. At the same time, these growers provided income to Fairchild Tropical Garden and the Chapter. As before, we feel that we have succeeded in reaching our goal of acquainting the public with the palm family and making a wide variety of plants available to them.

The theme for 1992 is Palms of Mexico and Central America. The Spring Sale in Broward County will be held May 2 and 3 at Flamingo Gardens. The Fall Show and Sale will be held November 7 and 8, the weekend before the 1992 International Palm Society Biennial Meeting. The Chapter invites IPS members to offer their services for any of the numerous volunteer assignments needed to ensure smooth functioning of these two significant events which promise to be both hectic and exciting. Please call LEONARD GOLDSTEIN at 539-7142 (W) or 667-4609 (H) and/or BILL THEOBALD at 252-4416 (W) or 251-0246 (H), in Area Code 305.