GERMINATION OF CASSOWARY EGESTED AND MANUALLY DEFLESHED FRUIT

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ABSTRACT

The germination of seed of seven tree species collected from the droppings of the dwarf cassowary, Casuarius bennetti picticollis, *was compared with the germination of fresh fruit and manually defleshed seed of the same species. For four species,* Flacourtia zippelii, Garcinia latissima, Cryptocarya *sp. and* Prunus *sp., removal of the flesh, either manually or by passage through the gut of the cassowary, significantly enhanced germination of the seed compared with intact fruit. No germination was recorded for any of the seed or fruit of the three* Elaeocarpus *spp. tested. The implications of these results are discussed in terms of rainforest regeneration following logging.*

INTRODUCTION

For plants dependant upon seed dispersal by animals, satisfactory dispersal is achieved through dependable animal visitation and removal of fruit, non-injurious treatment of the seed by the animal vector, and evacuation or regurgitation of the seed at some distance from the parent plant (McKey 1975). Seeds adapted for animal dispersal should germinate poorly unless passed through a vertebrate digestive tract (McKey 1975). Very few studies have compared germination of fresh seeds with those evacuated by a dispersal agent (Krefting and Roe 1949; Rick and Bowman 1961; Noble 1975; Stocker and Irvine 1983). One difficulty is the collection of faecal material from a known source.

Cassowaries, which are large flightless frugivorous birds found in the rainforest of New Guinea and northern Australia, produce sizeable, readily identifiable droppings. The dwarf cassowary, *Casuarius bennetti picticollis*, which inhabits mainly montane rainforest in New Guinea, eats fleshy fruits, the seeds of which are evacuated intact soon after they are consumed (Pratt 1983). Working on Mt. Missim, in the Bulolo-Wau area, Pratt identified 36 species of fruit from seeds in cassowary droppings. Certain species appeared to depend on the cassowary for dispersal away from the parent tree (Pratt 1983).

Very little is known about the germination of seeds after passage through the cassowary gut, although Stocker and Irvine (1983) have shown that seed viability is retained after passage through the cassowary digestive tract. In this study, the germination of seeds from dwarf cassowary droppings collected in April 1984 is compared with that of fresh fruit of the same species. A further collection of fruit of several of these species was made to test germination of fruit from which the flesh had been removed manually.

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METHODS

Twenty-one droppings were collected from a number of sites between 1600 m and 2600 m above sea level (a.s.l) on the western slopes of Mt. Missim, to the east of Bulolo and Wau, during the week of 7th to 13th April 1984. Seeds in the droppings were identified at the time of collection, and fresh fruit of these species were collected from the ground below fruiting trees at the same site. An additional collection of fresh fruit for some of the species was made in May 1984 between 1600 m and 2300 m a.s.l. Each species was collected from the same altitude as that of the first collection. This second collection of fresh fruit had the flesh removed manually using only the thumb and fingers, in order to minimise the chance of damaging the seed coat. In the case of two species, recorded as *Elaeocarpus* sp. A and *E.* sp. B, this involved soaking the fruit in water for 18 hours before the flesh could be removed.

For each species, the size of fruit and seeds was measured. Fresh fruit, seeds from droppings, and seeds from which the flesh had been removed manually were sown in batches of one to ten (depending on size) on one percent water agar, in plastic petrie dishes (Table 1). In this way, seed development could be observed with minimum disturbance. The covered dishes were placed in plastic bags, which were then sealed to prevent the agar from drying out, and placed on a laboratory bench at 25°C. Germination was checked at approximately weekly intervals at which time petrie dishes were taken from the plastic bags for aeration.

RESULTS

Seven plant species were identified from seeds in the twenty-one droppings. These are listed in Table 2 which also shows the sizes of fruit and seed. Six droppings contained a single fruit

Table 1.–**Sample size for faecal, fresh and defleshed seeds.**

Species	Faeces a[1] × b[2]	Fresh a[1] × b[2]	Defleshed a[1] × b[2]
Elaeocarpaceae			
Elaeocarpus sp. A	4 × 2 5 × 2	4 × 2 3 × 2	5 × 2
Elaeocarpus sp. B	4 × 3	4 × 3	5 × 4
Elaeocarpus sp. C	20 × 2	20 × 4	20 × 2
Flacourtiaceae			
Flacourtia zippelii	10 × 4	10 × 2 9 × 2	10 × 9
Guttiferae			
Garcinia latissima	2 × 1 1 × 1	1 × 5	4 × 1 3 × 2 2 × 2
Lauraceae			
Cryptocarya sp.	10 × 4	11 × 2 10 × 2	—*
Rosaceae			
Prunus sp.	6 × 2	7 × 2	—*

a[1] = Number of seeds per petrie dish
b[2] = Number of replicates
* = Fresh fruit not available at second collection.

species, five of these contained only *Flacourtia zippelii* seed and one contained only *Elaeocarpus* sp. C seed. These species were not found in conjunction with others in the remaining droppings which contained two or more species.

After 28 weeks, no germination was recorded for the three *Elaeocarpus* spp. For the four other species, percentage germination of seed taken from the faeces was greater than percentage germination of fresh fruit (Figure 1). For the two species tested (*F. zippelii* and *G. latissima*), the percentage germination of seed from faeces was similar to that for defleshed seed (Figure 1).

Seeds which had passed through the cassowary digestive tract, and manually defleshed seeds germinated more quickly and had a higher germination than those of fresh fruit. For *F. zippelii*, the first germination of egested and manually defleshed seeds was recorded within 12 days of sowing. Although germination of fresh fruit for this species was also good (42 percent by the twelfth week after sowing), it was relatively slow, with the first germination being recorded at day 32 (Figure 1a). For *G. latissima*, both egested and manually defleshed seeds commenced germination by day 26, but there was no corresponding germination of fresh fruit (Figure 1b). For *Cryptocarya* sp. and *Prunus* sp. only egested seeds and fresh fruit were available (Table 1). Very rapid germination took place for egested *Cryptocarya* sp. seed, and 72.5 percent of seed germinated in the first 12 days after sowing. Fresh fruit of *Cryptocarya* sp. showed poor germination (eight percent at 28 weeks after sowing), and two of the three fruit which germinated had had the flesh partly removed prior to collection (Figure 1c). All the egested *Prunus* sp. seeds germinated by day 32, whereas no fresh fruit germinated during the 28 weeks following sowing (Figure 1d). The flesh of all fresh fruit was in poor condition by week 28 since it had been broken down by insects which were present in the fruit at the time of collection, and by saprophytic microorganisms.

DISCUSSION

The results indicate that for those species which germinated in the trial, viability was not lost by the passage of seeds through the cassowary digestive tract. On the contrary, germination was enhanced when compared with fresh fruit. The effects of passage through the cassowary gut could be reproduced *in vitro* by the manual removal of flesh from fresh fruit. The dwarf cassowary as a dispersal agent thus fulfilled at least one of McKey's

Table 2.–**Fruit species in dwarf cassowary droppings from Mt. Missim, and the dimensions of fruit and seed collected from the droppings.**

	Fruit (mm)	Seed (mm)
Elaeocarpus sp. A	40–45 × 30–33	35 × 22
Elaeocarpus sp. B	45–50 × 30	33 × 22
Elaeocarpus sp. C	12–15 × 9–12	9–12 × 7–9
Flacourtia zippelii	25–30	15–25
Garcinia latissima	55–70 × 50–60	45–50 × 35
Cryptocarya sp.	23 × 15	15 × 12
Prunus sp.	35	25

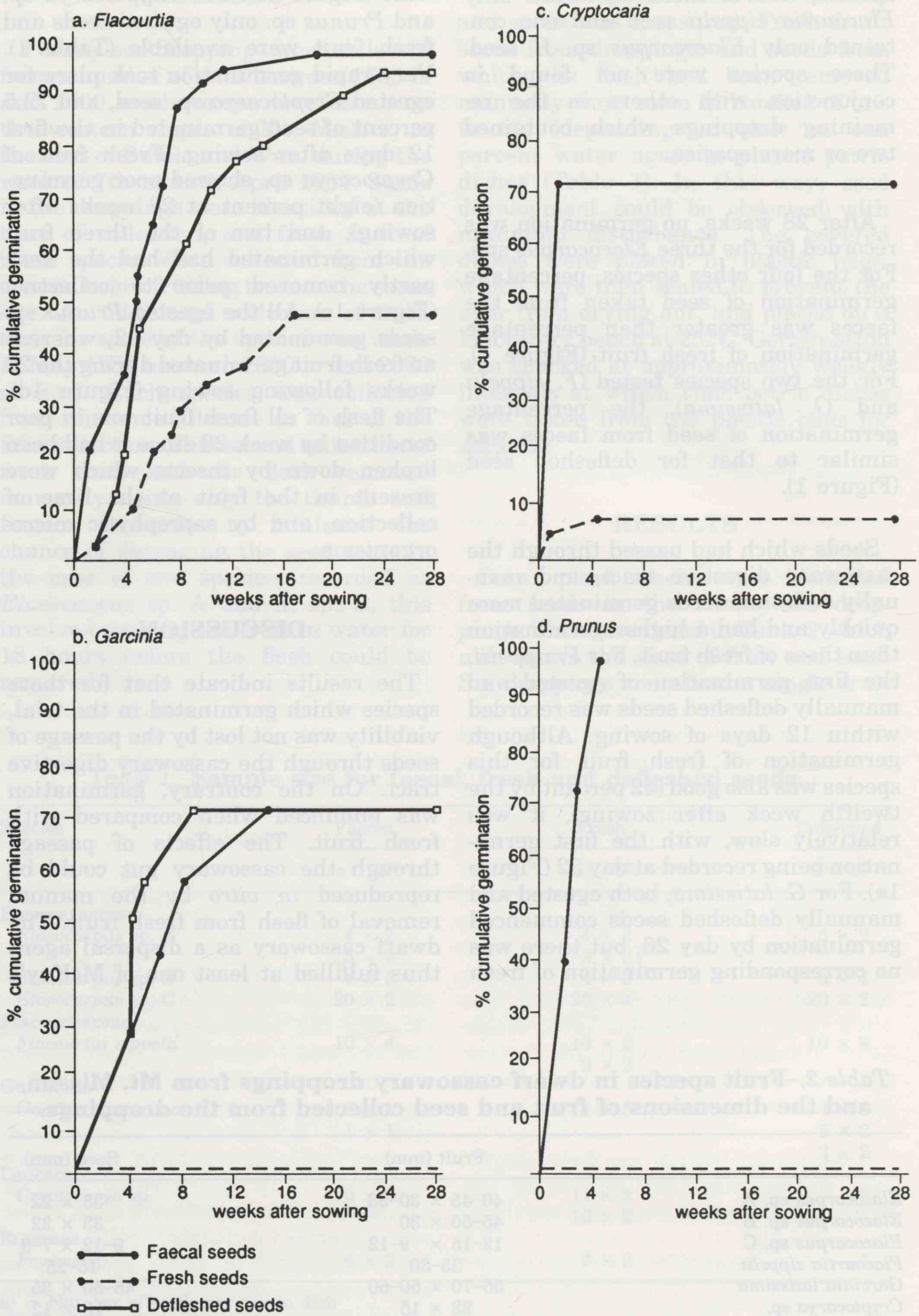

Figure 1.-**Germination of fresh, faecal and defleshed seeds of 4 species.**

(1975) postulates, namely the non-injurious treatment of the seed by the animal vector. Because enhanced germination appeared to depend simply on the physical removal of the flesh from the fresh fruit, agents other than the cassowary, such as insects, other small invertebrates, and microorganisms, may produce the same effect, although this has not been tested. As well as enhancing germination, the cassowary also disseminates seeds away from the parent tree (Pratt 1983). As tropical seeds of mature stage forests may quickly lose their viability (Hopkins *et al.* 1976), timing may also be a critical factor with regard to the removal of the flesh.

Two species which were identified in this study, *Prunus* sp. and *Flacourtia zippelii*, are new food records for the dwarf cassowary. They were not recorded by Pratt (1983) although Stocker (1983) identified *Prunus tunerana* as a species in the diet of the double-wattled cassowary (*C. casuarius*) in North Queensland. The size of Pratt's (1983) study site (6 ha) may have precluded him finding some species which were present on the transect from 1600 m to 2600 m a.s.l in this study.

Stocker (1983) stated that the germination of manually defleshed seeds appeared to be similar to the germination of cassowary egested seeds, as was the case in the present study. However, he did not state whether the germination of fresh fruit was tested. The poor germination which Stocker (1983) recorded for two *Elaeocarpus* species and the good germination for *Prunus tunerana* accords well with the results obtained in this study. De Vogel (1980) has similarly reported poor to fair germination for several *Elaeocarpus* species, and the absence of any germination of the *Elaeocarpus* seed in this study may reflect a long dormancy period.

Current forestry research in Papua New Guinea includes the study of regeneration after logging. The implications of this and other studies (see McKey 1975 for review) are clear. For certain secondary regrowth and many mature phase rainforest plant species, dispersal and germination depend on vertebrate agents such as birds. Hopkins *et al.* (1976) imply that 50 or more years after logging are necessary before mature phase species regeneration becomes effective. The adjacent rainforest or seed source must, therefore, be sufficiently large to maintain a viable breeding population of known dispersal agents over such a period of time. In Papua New Guinea, very little work has been undertaken to identify either the tree species dependent on animal vectors, or the animals which disperse their seeds, although some work has been done by Diamond *et al.* (1977). Accordingly investigations into these aspects of dispersal should be a part of current research on natural regeneration after logging, so that logging techniques can be modified if animal vectors are found to play a significant role in the regeneration of the New Guinea rainforest.

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