High potential of a disturbance-tolerant frugivore, the common palm civet *Paradoxurus hermaphroditus* (Viverridae), as a seed disperser for large-seeded plants

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The common palm civet *Paradoxurus hermaphroditus* is a small mammal belonging to the order Carnivora (2–5 kg) that is widely distributed in Southeast Asia. They live in a broad array of natural habitats and survive well in human-modified areas (Corlett 1998). They are reported to be highly frugivorous animals (Davis 1962; Bartels 1964; Alcala and Brown 1969; Joshi et al. 1995; Grassman 1998; Yoneda et al. 1998; Krishnakumar and Balakrishnan 2003; Su and Sale 2007) and thus have been regarded as important seed dispersal agents (Gruezo and Soligam 1990; Rabinowitz 1991). In human-modified areas, this species is one of the few frugivorous mammalian species reported to exist (Corlett 1998).

Despite their potential importance, little reliable information exists on their food habits and role as seed dispersers, especially in areas where several carnivores occur in sympatry. In all previous studies, the diet of civets was estimated by fecal analysis, and the civet species was identified on the basis of the size, shape, color, smell of the feces as well as the hairs found in it. However, this method may lead to false identification of the civets (Viverridae) because the body size and hair color of different civet species are similar. In this study, we used molecular techniques to overcome the difficulty in differentiating between species with their feces samples, and we evaluated the importance of civets as seed dispersers (especially in the case of large-seeded plants) in the Tabin Wildlife Reserve in Sabah, Malaysia. Large seed size is known to be the major factor that limits the number of potential dispersers available for a plant (Corlett 1998). Generally, large-seeded plants depend only on large frugivores, which are highly vulnerable to human disturbances, for seed dispersal. Because small carnivores generally have relatively wide gapes and swallow their prey whole (Nowak 2005), we predicted that civets possess a high potential for swallowing large seeds. To evaluate this relative potential, we compared the size of the seed swallowed by civets with that of the seeds swallowed by other sympatric frugivorous mammals.

**Materials and methods**

This study was conducted in the Tabin Wildlife Reserve (Tabin) in the Malaysian state of Sabah. Tabin (5°05′–5°22′N, 118°30′–118°55′E) covers an area of 122,539 ha and is almost exclusively surrounded by large agricultural areas with oil palm (*Elaeis guineensis*) plantations. Most areas in Tabin have been heavily logged and are dominated by pioneer species such as *Duabanga moluccana* or *Neolamarckia (=Anthocephalus) cadamba* (Mitchell 1994). Most terrestrial megafauna remain in Tabin, such as the Asian elephant (*Elephas maximus*) or the Asian two-horned rhinoceros (*Dicerorhinus sumatrensis*), but large arboreal frugivores such as the Borneo orangutan (*Pongo pygmaeus*) or the Mueller’s gibbon (*Hylobates muelleri*) are rare around the base camp. All seven species of Viverridae inhabiting the lowlands of Borneo have been confirmed to be present (Yasuma and Andau 2000). In Tabin, the common palm civet is the most common frugivorous mammals along with the pig-tailed macaque.

We collected civet-like feces along the 6-km gravel road going to the central part of Tabin. We routinely searched for feces by riding on a motorcycle early in the morning (0630 hours) for 19–24 days each month from May to November in 2008. The collected feces samples...