

Observations of Small-toothed Palm Civets *Arctogalidia trivirgata* in Khao Yai National Park, Thailand, with Notes on Feeding Techniques

*J. W. Duckworth*¹ and *A. R. Nettelbeck*²

Small-toothed Palm Civet (=Three-striped Palm Civet) *Arctogalidia trivirgata* occurs widely across Southeast Asia. Historically it has sometimes been considered as a scarce or declining species, or one confined to remote areas. This note documents observations from Khao Yai National Park, which is among the sites in Southeast Asia best surveyed for mammals. In the context of other recent records, there is no compelling reason to consider the species as rare, localised or declining, but instead simply one that, through its behaviour, is easily overlooked by standard mammal collecting and survey techniques.

Field observations

During 5–9 May 1995, Small-toothed Palm Civets were found three times (two singles, one duo) along the main road north of the park headquarters and visitor centre, in 7¹/₄ hours spot-lighting by foot (following methodology of DUCKWORTH *ET AL.*, 1994). All were in the canopy of roadside broad-leaved evergreen forest (see SMITINAND, 1968) at c. 760–800 m altitude. Animals were active, crashing noisily as they ran (as typical of the species: DUCKWORTH, 1997) and, twice, making a spectacular canopy-to-canopy leap across the main road north of the headquarters. Such leaps were preceded by vigorous to-and-fro shaking of the jump-off perch, thereby decreasing substantially the distance to be covered. All were calling, with two call-types just as given in Laos (see DUCKWORTH, 1997): loud disyllabic snorts, and soft, rather hollow-sounding, *tchuck* calls, given about once per second. On 12 October 1995, a silent male Small-toothed Palm Civet was found eating figs in a small *Ficus hispida* (Moraceae) tree, only 8 feet above ground, near the headquarters at 2225 h, and later watched for 90 minutes (see below); the animal left the bush by walking along the roadside wires (recalling the agility on ropes of a shipboard captive noted by STERNDAL [1884], and BANKS'S [1931] general admiration for its climbing abilities). On 21 January 1996 two were observed at about 2100 h in a large flowering tree by the park headquarters, foraging singly, calling (with 'high-pressure' *snish* notes) and moving actively; at one stage, one animal jumped onto the roof of a building, making a loud bang.

The animals were identified by their diagnostic calls and the clear views through 10 x 40 binoculars under illumination by a hand-held Nitech Xcell halogen spot-light (100,000 cp). Standard pelage features and the diagnostic ear pattern (naked pink inner surface with thick dark intrusions from the rim, with duller pink, lightly-haired, outer surface) of the northern races of the species (see VAN BEMMEL, 1952) were readily visible, because no animal fled

¹Wildlife Conservation Society; current address, East Redham Farm, Pilning, Bristol, BS35 4JG, U.K.

²Holsteinischestrasse 54, D-10717 Berlin, Germany.

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from illumination. The species typically permits a close approach and prolonged viewing (e.g. WALSTON & DUCKWORTH, 2003; BORISSENKO *ET AL.*, 2004). During the visit of May 1995, two Common Palm Civets *Paradoxurus hermaphroditus* were also observed; although no other species can realistically be misidentified as Small-toothed Palm Civet, this latter, along with Masked Palm Civet *Paguma larvata*, is probably the most likely source of confusion for inexperienced observers. Giant flying squirrels *Petaurista* may conceivably also be misidentified as arboreal civets. JWD was already familiar with all these species from extensive nocturnal mammal surveys in Laos (DUCKWORTH *ET AL.*, 1994; DUCKWORTH, 1997; EVANS *ET AL.*, 2000). The Small-toothed Palm Civet observations in Khao Yai were spread across many months and several miles of road, precluding any possibility that they might refer to released pets. The latter is a possible source of any novel record around the park's headquarters (LYNAM *ET AL.*, 2006: 81, 82, 209), and evidently explains some anomalous records of Small-toothed Palm Civet elsewhere (e.g. SU SU, 2005).

Given recent records from evergreen or semi-evergreen forest from Huay Kha Khaeng Wildlife Sanctuary (RABINOWITZ, 1991; CONFORTI, 1996) to the west of Khao Yai, Phu Khieo Wildlife Sanctuary (GRASSMAN, 2004) to the north, various Lao sites (DUCKWORTH, 1997) to the north-east, and Cambodia (WALSTON & DUCKWORTH, 2003) to the east, the species' occurrence in Khao Yai is not at all unexpected. With no published survey using appropriate methodology across the National Park, it is unclear how widespread or abundant the species is there. The contact frequency of approximately once per 2½ hours in May 1995, although based on too few observations to be definitive, compares well with those of once per 4 hours in Cat Tien National Park, Vietnam (BORISSENKO *ET AL.*, 2004) and once per 7–8 hours for various sites in Laos (DUCKWORTH, 1997). This may reflect the optimal search conditions provided by Khao Yai's road (a long viewing distance with good sighting into the canopy) and, perhaps, the low levels of hunting, at least for species of low commercial value, in the headquarters area of the park for the preceding two decades (NETTELBECK, 1997).

Detection of the species and requirements for survey

The species was missing from lists of Khao Yai mammals by both SRIKOSMATARA & HANSEL (1996) and LYNAM *ET AL.* (2006). This doubtless reflects two reasons advanced long ago by POCOCK (1939) to explain the general paucity of field observations on the species, and by VAN BEMMEL (1952) for the low numbers of museum specimens. Firstly, it is strongly nocturnal (STERNDALÉ, 1884; BANKS, 1931; HARRISON, 1962; BATTEN & BATTEN, 1966; DUCKWORTH, 1997), and extensive observations by day during 1992–1996 into fruit trees in this part of Khao Yai, sufficient to detect many Binturongs (NETTELBECK, 1997), found no Small-toothed Palm Civet (ARN, personal observations). Secondly, it only very rarely comes to the ground. Although the genus seems never to have been subject to a field study, its general anatomy (VAN BEMMEL, 1952) coupled with observations of captive animals (e.g. STERNDALÉ, 1884) and general field sightings (e.g. HOSE, 1893; DAVIS, 1962; PAYNE *ET AL.*, 1985; RABINOWITZ, 1991) indicate strong arboreality. HARRISON (1962) categorised the species as 'undercanopy' rather than 'canopy', but this is evidently not appropriate in at least parts of the range. Of 32 field contacts in Laos during 1992–1996, 23 were in the canopy, 8 in the midstorey, and 1 in the understorey; none descended to the floor (DUCKWORTH, 1997), although GRASSMAN (2004) did catch one in a ground-level box trap baited with a live chicken. These habits mean that two common survey techniques for nocturnal animals, camera-trapping and

examination of hunted animals in markets and villages (many of which are snared), greatly under-record this civet, by comparison with ground-dwelling small carnivores. Furthermore, searches for footprints would be unlikely to detect Small-toothed Palm Civet, and it is anyway unclear whether its prints are distinct from other similarly-sized Southeast Asian carnivores. Finally, village reports about small carnivores demand extreme care if identification to species is attempted, although given this species' distinctive behaviour and calls, habitual night hunters might well know and recognise Small-toothed Palm Civets.

Active spot-lighting is essential in surveying Small-toothed Palm Civets. Recent spot-light searching showed that the species is common in evergreen forest in south and central Laos (DUCKWORTH, 1997; the north remains unsurveyed by this technique), and provided the first record, other than interpolation on generalised range maps, for Cambodia (WALSTON & DUCKWORTH, 2003) and the first recent record in Vietnam (BORISSENKO *ET AL.*, 2004). Both these latter were from sites (Seima Biodiversity Conservation Area and Cat Tien National Park), where, as in Khao Yai, extensive large mammal surveys using a conventional mix of diurnal observation, camera-trapping, sign searches and discussions with local people failed to find the species, despite generating impressive complements of other large mammal species (WALSTON & DUCKWORTH, 2003; POLET & LING, 2004). Small carnivore community assessments relying largely on camera-trapping find the species only incidentally (e.g. HOLDEN, 2006, LONG & MINH HOANG, 2006), or not at all (e.g. AZLAN, 2003, JOHNSON *ET AL.*, 2006). No survey should conclude that Small-toothed Palm Civet is absent or even scarce at a site unless sufficient spot-lighting has been undertaken. For similar reasons, past opinions that the species is rare (e.g. DANG HUY HUYNH & PHAM TRONG ANH, 1974) or in strong decline (e.g. LEKAGUL & MCNEELY, 1977) should be questioned.

Feeding behaviour

Because Small-toothed Palm Civet usually feeds high in the canopy, we had not observed its precise feeding methods previously (and have done so only once since); nor do they seem to have been recorded in the literature, even in descriptions of captive animals such as STERNDALE (1884), BANKS (1931), HEUBEL (1940) and BATTEN & BATTEN (1966). The animal on 12–13 October 1995 afforded an excellent opportunity to observe it feeding during 0000–0130 h at a range of 4–8 m. It fed on very juicy clustered cauliflorous figs *Ficus hispida* of c. 2.5 cm diameter. Most in the small tree were green and unripe. Ripe figs were more yellow in colour, and the civet selected these by sniffing each fruit for a second or so at c. 2.5 cm range, as it moved its head slowly past each clump of figs. The animal plucked the whole fig from the branch with its mouth, and then made 2–5 rapid, inaudible, mandibulations seemingly to get the fruit into position and, perhaps, to split its skin. The civet then squeezed its jaws together deliberately (with clearly audible squelching noises) a number of times 1–2 seconds apart (14, 15, 8, 24, 20, 15, 25, 15, 16, 6 times on 10 respective fruits). Seemingly, the tongue pressed the fruit to the teeth and/or roof of the mouth and squeezed or rubbed out the fig juice between jaw movements. The squashed residue of rind, flesh and the seeds (which latter were very small), was then allowed to drop ('spat out' would be too active a verb). During much of the observed feeding period, the civet wagged its ears slowly but almost ceaselessly.

A frugivore is likely to handle fruits in different ways depending on the plant species. For example, Brown Palm Civet *Paradoxurus jerdoni* usually consumes seeds but with the large, fleshy fruit of *Palaquium ellipticum* (Sapotaceae) it either chews up or drops out

the seeds (D. MUDAPPA *in litt.* 2006). It seems possible that fruit-pressing may be a habitual feeding style of Small-toothed Palm Civet: the species' singular dentition, with small peg-like premolars and molars, non-occluding molar rows even when jaws shut, as well as an undulating palate (GREGORY & HELLMAN, 1939; POCOCK, 1939; LEKAGUL & MCNEELY, 1977) would seem to assist this sort of fruit-processing. According to POCOCK (1939), somewhat similar characters are shown by Binturong *Arctictis binturong*, another civet which eats much fruit (LAMBERT, 1990; NETTELBECK, 1997). Fruit-pressing is evidently but one of several feeding techniques used by Small-toothed Palm Civet, and indeed recorded stomach contents could seem to suggest that the species is quite carnivorous (POCOCK, 1939; DAVIS, 1962; LIM BOO LIAT & BETTERTON, 1977). Notably, HARRISON (1962) was perplexed when he found only animal material in two stomachs examined, despite captives much preferring fruit over flesh. However, fruit-pressing and, with some plant species, any form of fruit consumption would leave very few, potentially no, remains in the stomach (or in faeces) identifiable by conventional methods, and such dietary analyses will not, therefore, reflect the true relative importance of fruit. Moreover, fruit, however consumed, is often well digested and absorbed into the system, making its detection difficult for species with either few large seeds, e.g. mango *Mangifera indica*, or insignificant seeds e.g. cultivated bananas *Musa* spp. (D. MUDAPPA *in litt.* 2006). Civets are said to be significant seed dispersal agents in Asian forests, with Small-toothed Palm Civet sometimes highlighted because of its strong frugivory (e.g. PAYNE 1995, MEIJAARD *ET AL.* 2005). However, fruit-pressing will result in minimal dispersal at best for the fig. Squirrels also shed most or all seeds in the uneaten fig residue, and hence have no value for the fig in dispersal (LAMBERT, 1990); by contrast, the other chiefly frugivorous sympatric civet, Binturong, does ingest and then pass out large quantities of fig seeds (LAMBERT, 1990), as does Brown Palm Civet (MUDAPPA, 2001). Small-toothed Palm Civet's peculiar dentition suggests that fruit-pressing is among its main feeding techniques. However, a single observation can allow only a tentative suggestion, and full studies of the species' feeding behaviour and role in seed dispersal would be most informative.

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