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SIT AND WAIT AT THE SOURCE OF DUNG – AN UNUSUAL STRATEGY OF DUNG BEETLES

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Dung beetles make their living by exploiting fecal material dropped by vertebrates. They play an important role in the ecological network of tropical rainforests, e.g., in secondary seed dispersal (Estrada & Coates-Estrada 1991), nutrient recycling (Fincher 1981), pest reduction (Bornemissza 1970), and may form complex communities (Hanski 1991, Vulinec, in press). Within these communities, different species of dung beetles compete intensively for feces (Halffter & Edmonds 1982, Hanski 1991). Unless there is a big difference in the size of beetles, those arriving first at a fecal dropping may be at an advantage in accruing resources compared with those arriving later. Dung beetles that can appropriate feces during defecation and prior to deposition would be at an even greater advantage. In fact, some dung beetle species live in the fur of sloths, tapirs, and howler monkeys where they wait for the "host" to defecate (Halffter & Matthews 1966, Ratcliffe 1980, Howden & Young 1981).

Howden & Young (1981) report collecting *Uroxys gorgon* Arrow and *U. metagorgon* Howden & Young from the fur of live three-toed sloths. As sloth dung hardens rapidly, they suggest that this behavior allows the beetles to utilize sloth dung while it is still soft, less than 5 min old. These sloth specialists apparently use sloth pellets in their unmodified form as brood balls for their offspring (Ratcliffe 1980). Waage & Best (1985) found that *U. besti* Ratcliffe and *Trichillum adisi* Ratcliffe on island sloths near Manaus (Brazil) are abundant on sloths during the dry season, but are absent during the rainy season. Beetles living on sloths in *terra firme* did not show a correlation with season. Australian *Onthophagus parvus* Blanchard and some other related species have modified tarsi adapted to hold on to wallaby and kangaroo hair (Matthews 1972). These species occur in arid ecosystems, where quick exploitation of dung is necessary.

Here we report a further case of such a "sit-and-wait at the source strategy" in dung beetles from the Amazon rainforests of north-eastern Peru, where competition for dung may be intense.

The observations reported here were made during behavioral and ecological field research on a group of red titi monkeys, *Callicebus cupreus* Spix (Pitheciinae, Atelidae, Primates) at the Estación Biológica Quebrada Blanco in north-eastern Peru (4°21'S, 73°09'W; for details of the study site see Heymann 1995). A group of one adult male, one adult female, two infants/juveniles (born November 1997 and November 1998), was observed between May 1997 and December 1998. The group was followed for 1–5 days each month, except for October 1997 and January 1998. Additional information comes from opportunistic sightings of titi monkeys between February 1994 and May 1995.

On at least 10 occasions we saw up to five dung beetles (*Canthidium* sp. near metallicum) sitting in the fur around the anus of the adult male and female titi monkey. When a monkey was defecating, the beetles immediately attached to the feces coming out of the anus, and dropped to the forest floor together with the feces. A few beetles were collected and preserved in alcohol. Our anecdotal observation does not allow substantial conclusions. We can, however, as-

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sume that by arriving on the forest floor with the feces, these dung beetles have an advantage over other dung beetle species. The advantage in early arrival at food sources has generated a number of different strategies in dung beetles. Beetles of several genera (*Canthon, Canthidium,* and *Phanaeus*) have been seen following monkey troops (Vulinec & Quintero, pers. obs.). Other strategies include arboreal foraging, where dung dropped on leaves is rolled off accompanied by the beetle (for example, in *Canthon subhyalinus* Harold, also found at Quebrada Blanco) (Howden & Young 1981). A large number of beetles also perch on leaves for early detection of odors (Gill 1991). Nevertheless, the majority of beetles require a certain period of time to find dung. In a study on secondary seed dispersal by dung beetles in south-eastern Peru, Andresen (1999) found that dung beetles on average arrived within 7 min (± 7 min) at fecal droppings of spider monkeys and howler monkeys. Vulinec (pers. obs.) found differences in arrival time between Amazonian dung beetle species. *Hansreia affinis* (Fabricius) arrived on average after 29.4 min, while *Scybalocanthon* sp. arrived as early as 1 min (mean: 13 min). Other beetles took even longer, for example *Onthophagus bidentatus* Drapiez arrived on average after 40 min, and *Ateuchus setulosus* LeConte arrived on average after 53.5 min. This gap between deposition and beetle arrival allows beetles at the source to have a competitive advantage.

Competition for dung in Neotropical forests may be intense. In one case in the central Amazon, Vulinec (unpublished) found a fresh 1-meter by 1.5-meter pile of dung from a howler monkey troop. All of this dung disappeared within 24 hours of deposition. Arriving with the feces at the forest floor would allow a beetle time for burying or transporting the resource before other dung beetles arrive. In addition to describing an unusual foraging strategy of some dung beetles, our observations also demonstrate that tropical rainforests still contain much surprising natural history.

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