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Shit Happens (to be Useful)! Use of Elephant Dung as Habitat by Amphibians

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ABSTRACT

Although elephants are commonly cited as an example of ecosystem engineering, cases involving Asian elephants are missing in the literature. In a dry environment of southeastern Sri Lanka, I examined 290 elephant dung piles and found a total of six frogs from three different species in 1.7 percent ($N = 5$) of the dung piles. This suggests a facilitative role of elephants by providing habitat for amphibians.

Abstract in Spanish is available at http://www.blackwell-synergy.com/loi/btp.

Key words: Asian elephant; Bundala National Park; ecosystem engineering; *Elephas maximus*; facilitation; *Microhyla*; Sri Lanka.

AN ECOSYSTEM ENGINEER IS AN ORGANISM capable of controlling the availability of resources for other organisms by modifying the physical environment (Jones *et al*. 1994). Elephants are frequently cited as a paradigmatic example of ecosystem engineers (*e.g*., Wright & Jones 2006) and many studies exist, indeed, focusing on the impact of African savanna elephants *Loxodonta africana* on the ecosystem (*e.g*., Laws 1970, Caughley 1976, Dublin *et al*. 1990, Skarpe *et al*. 2004). At a smaller scale (patch level), feeding by savanna elephants has a facilitative effect on arboreal lizards by creating refuges in the crevices of broken vegetation (Pringle 2008). Much less is known about Asian elephants *Elephas maximus* as ecosystem engineers and the ways in which they might impact on other organisms.

In the dry season of 2008 (August 2–September 8), I inspected Asian elephant dung piles in a dry environment of southeastern Sri Lanka, looking for seeds. I was surprised when, in a waterhole close to Bundala National Park (NP), I found a little *Microhyla ornata* frog inside elephant dung (Fig. S1). Altogether, I inspected 290 dung piles and found a total of six frogs in a total of five piles, making an average of one of 58 (or 1.7%) elephant dung piles occupied by frogs. These frogs belonged to three different species: four *Microhyla ornata* (two in a single dung pile), one *M. rubra*, and one *Sphaerotheca* sp. *Microhyla ornata* frogs were in all cases within the dung, in dung piles deformed by some degree of diarrhea and still humid inside. *Microhyla rubra* and *Spaerotheca* sp. frogs were, in contrast, under the dung, in the interface with the ground. Four of the dung piles with frogs were found in the surroundings of Bundala NP (three at 6.207° N, 81.236° E and one at 6.199° N, 81.203° E) while the fifth was found in a waterhole close to Gonnaruwa (6.226° N, 81.117° E), 10–13 km away from the other samples.

Frogs like *M. ornata* live among leaves in the litter. In the waterholes and scrublands where these particular frogs were found, litter is scarce. Elephants, however, can be locally abundant during the dry season and their dung may hence provide additional habitat resources in the form of daytime refuge, much in the same way as leaf litter. It is noteworthy that I also inspected 180 dung piles of free-ranging domestic bovids (cow *Bos taurus* and buffalo *Bubalus bubalis*) in the same locations as elephant dung and found no frogs in them. This difference in use by frogs is likely to stem from differences in the physical structure of these types of dung. Elephant dung contains large amounts of undigested vegetal matter that give it a complex physical structure compared with the relatively homogenous, fine-grained dung of bovids. Indeed, aside from these frogs, I also found a broad array of invertebrates including beetles, termites, ants, spiders, scorpions, centipedes, and crickets in many of the elephant dung piles, suggesting that a dung pile can become a small ecosystem on its own.

This is, to my knowledge, the first description of elephant dung as microhabitat for a vertebrate and one of the clearest examples of ecosystem engineering by Asian elephants. This finding opens the door to a whole new suit of studies concerning the use of elephant dung by amphibians—*e.g*., what are the thermal and hydric profiles within the dung? Is this phenomenon exclusive to the dry season? Is it geographically widespread? Is there an actual positive selection of dung as habitat? Do frogs prey on the invertebrate fauna of the dung?—as well as by invertebrates. This illustrates just one of the many ways in which Asian elephants could act as ecosystem engineers. More studies on the role of Asian elephants as ecological drivers are necessary if we wish to understand the wider consequences of the rapid decline of the largest animals roaming Asian forests and woodlands.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

FIGURE S1. *Microhyla ornata* frog inside dung of Asian elephant in the surroundings of Bundala National Park, southeastern Sri Lanka.

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