Feeding Associations Between Howling Monkeys and Basilisk Lizards

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Biotropica, Vol. 11, No. 3 (Sep., 1979), 235-236.

Stable URL:
http://links.jstor.org/sici?sici=0006-3606%28197909%2911%3A3%3C235%3AFABHMA%3E2.0.CO%3B2-F

Biotropica is currently published by The Association for Tropical Biology and Conservation.

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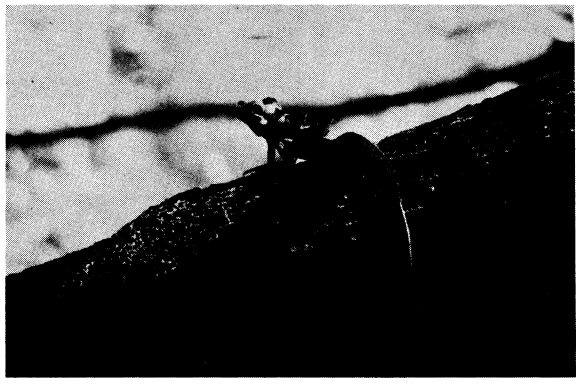
Reports of feeding associations between various Old World monkeys (Cercopithecidae) and their commensals generally emphasized the primate's "wasteful" feeding behavior and hypothesized benefits obtained by the commensals (*Papio ursinus* and *Aepyceros melampus,* Poles 1955, Morgan-Davies 1960; *Cercopithecus aethiops* and *Tragelaphus scriptus,* Patterson 1969, Elder and Elder 1970; *C. aeithops* and *Guttera edouardi,* Hill 1974). Occurrences of feeding associations for New World monkeys (Cebidae) have not been reported.

Evidence is presented here of a feeding association between basilisk lizards *(Basiliscus basiliscus)* and mantled howling monkeys (*Alouatta palliata* Gray). These observations were made during a 14-month study (June 1972-August 1973) of howler behavior and ecology carried out in Costa Rica (Glander 1975).

Basilisks (fig. 1) were common in all parts of the 9.9 ha study area and were frequently seen under *Anacardium excelsum,* particularly when the howlers were feeding in this species. Adult basilisks are opportunistic feeders, ingesting lizards, snakes, frogs, birds, fish, crustaceans, fruit, flowers, and insects (Van Devender 1975). During the howler study I observed an adult male basilisk swallow a hummingbird nest complete with young hummingbirds.

As opportunists, the lizards were seen to exploit a food source not normally available to them. For example, when feeding on fruit pedicels of *Anacardium excelsum* (fig. 2), howlers removed the fruit and pedicel from the tree but ingested only the pedicel and dropped the fruit. Occasionally the howlers dropped a fruit with pedicel still attached or accidentally dislodged one or more fruit with pedicel (fig. 2). On two occasions (3 March and 6 April 1973) a basilisk was observed to be foraging on these dropped fruits. Each time it was a different male (individuals were marked, Van Devender 1975), and only one lizard was present. The foraging lizards ran over to each *Anacardium* fruit after it had been dropped and, if it had the pedicel still attached, broke off the pedicel and ate it. Several times the lizards picked up fruit without the pedicel but immediately dropped them. Neither howlers nor basilisks ever ate the fruit.

During the *Anacardium* fruiting season (February-May 1973) the howlers harvested pedicels from 32 of the 68 *Anacardium excelsum* located in their home range. They averaged 29 min/day and 4.8 fruit/min/monkey or about 139/fruit/day/monkey for each of the eight adults in the group. If each of the eight adults picked approximately the same number of fruit (all group members including the five juveniles fed on pedicels), a minimum of 1112 fruits were dropped each day during the 31 days that the howlers



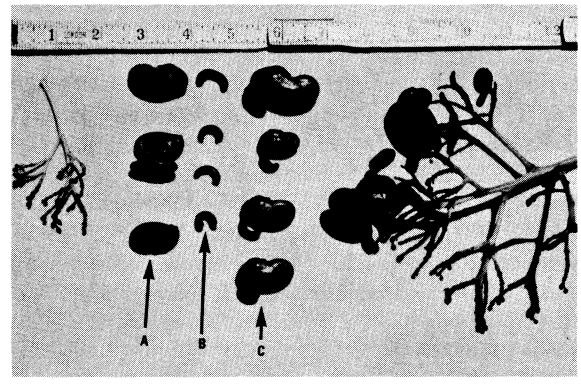


FIGURE 1 (left). Adult male *Basiliscus basiliscus.* Only the males develop crests on the head, body, and tail. The two light-colored objects attached to the first body crest are blood-engorged ticks which the male ate immediately after this picture was taken.

FIGURE 2 (right). Fruits of *Anacardium excelsum.* A. Fruits without pedicels. B. Pedicels. C. Fruits with pedicels attached. Note the position of the fruits at the ends of small terminal twigs on a fruit cluster to the right of C.

fed on the pedicels. This could represent an important food source for one basilisk even if only 1 percent (11) of the dropped fruits contained pedicels.

The lizards profit from this association because even though they are arboreal (Van Devender 1975), they can not reach the fruit since it grows at the very ends of small terminal branches (fig. 2). Basilisks need branches large enough to support their weight and provide purchase for their claws. Howlers are much larger, but their prehensile tails permitted them to support their weight on larger branches while reaching for the fruit. The basilisk's foraging did not affect the howlers. The lizards were not seen foraging under other tree species in which howlers were feeding.

Ingestion of *Anacardium* pedicels may be of small significance to opportunistic feeders such as basilisks but the fact that both howlers and the lizards ate only the pedicels and actively ignored the fruits suggests a dynamic relationship between the tree and its fruit predators. The fruit rind of the closely related *Anacardium occidentale* contains toxic cardol oil (Little and Wadsworth 1964), while pedicels from both *A. excelsum* and *A. occidentale* are eaten by many animals, including humans (pers. obs.). It seems reasonable to assume then that the fruits of *A. excelsum* contain secondary compounds which inhibit ingestion and that the howlers and basilisks were selecting only that part (the pedicels) containing little or no chemicals. Without doubt, nutrients also play a role in food selection for both animals, but the same argument can be made for nutrients, i.e., animals receive greater benefit by selecting those tree parts with less secondary compounds, if nutrient content is equal.

Toxic fruit and edible pedicels may be an evolutionary response of *Anacardium* to insure the dispersal of fruit without injury to the fruit. For this system to work, the dispersal agent should remove both pedicel and fruit and carry them away from the parent tree before ingesting the pedicel and dropping the undamaged fruit. Neither howlers nor basilisks carried the fruit away, and both were probably exploiting the situation. Fruit-eating birds and bats are the more likely dispersal agents.

The fact that both the howlers and lizards demonstrated identical highly selective feeding patterns when feeding on the fruits of *Anacardium* suggests that both are responding to cues not apparent to the observer. What appears to be wasteful or nonbeneficial behavior may in reality be choices for diet optimization, i.e., ingesting only the tree part with favorable chemical properties and avoiding the part with objectionable chemicals. Evolutionarily, wasteful feeding in primates should be selected against just as low cost opportunistic foraging should be selected for in basilisks.

R. W. Van Devender and L. L. Rockwood made helpful comments on an earlier draft. S. Terrell typed the manuscript. My thanks go to each of these individuals.

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