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The diet of *Bothrops asper* (GARMAN, 1884) in the Pacific lowlands of Ecuador

The Terciopelo, *Bothrops asper* (GARMAN, 1884), is a large pitviper species ranging from Mexico to northwestern South America (CAMPBELL & LAMAR 2004). It is an important causer of snakebite casualties wherever it occurs (WARRELL 2004). In Ecuador, where *B. asper* is usually referred to as "equis", this species is distributed throughout the Pacific lowlands and adjacent western versant of the Cordillera Occidental of the Andes up to at least 1,700 m a.s.l. (FREIRE & KUCH 1994; CISNEROS-HEREDIA & TOUZET 2004). It has also been collected in two dry inter-Andean valleys in southern Ecuador which are connected by rivers to the Pacific lowlands (CISNEROS-HEREDIA & TOUZET 2004; U. KUCH & F. P. AYALA-V., unpublished). *Bothrops asper* is by far the most commonly encountered and medically most important venomous snake

in western Ecuador. It is found in a variety of natural habitats, from dry coastal scrub to cloud forests (CISNEROS-HEREDIA & TOUZET 2004), as well as in agricultural lands and around human habitations. While aspects of the natural history of certain populations of *B. asper* were comprehensively studied (SOLÓRZANO & CERDAS 1989), little has been published about Ecuadorian populations (CAMPBELL & LAMAR 2004; KUCH et al. 2004).

Here we report the results of an analysis of stomach and intestine contents of preserved specimens of *B. asper* in the collection of the Museo de Zoología de la Pontificia Universidad Católica del Ecuador, Quito, Ecuador (QCAZ).

We dissected 21 specimens of *B. asper*, and found evidence of prey in 14. Of these, only one contained undigested or only partly digested prey. Thirteen specimens were found to contain remains of digested prey (see Appendix for locality information and catalogue numbers). The specimens containing prey (seven males, seven females) were assigned to three classes based on the study by SOLÓRZANO & CERDAS (1989) and personal observations on sexual size dimorphism and size at maturity of Ecuadorian *B. asper*: juveniles (29-38 cm snout-vent-length [SVL], four males; 40-49 cm SVL, four females); subadults (58 cm SVL, one male; 85 and 90 cm SVL, two females); and adults (115 and 95.2 cm SVL, two males; > 83 cm SVL, one female [head missing]). Among the 13 snakes containing only remains of digested prey, evidence that rodents had been eaten (hair of members of the family Muridae, also rodent bones and incisors) was found in six, insect remains in nine (from the orders Coleoptera [1], Diptera [2], Hemiptera [3], Hymenoptera [2], Orthoptera [1], unidentified [3]) and anuran remains arms, legs and/or skull of *Eleutherodactylus achatinus* [BOULENGER, 1898], Leptodactylidae) in three. One of these snakes contained lizard bones, and another plant matter (leaves), apparently ingested along with insect prey.

Eight of the 14 snakes with prey contained at least two different prey species (bird and centipede [1], insect and rodent [3], insect and lizard [1], insect and frog [2], and coleopterans and hemipterans [1]).

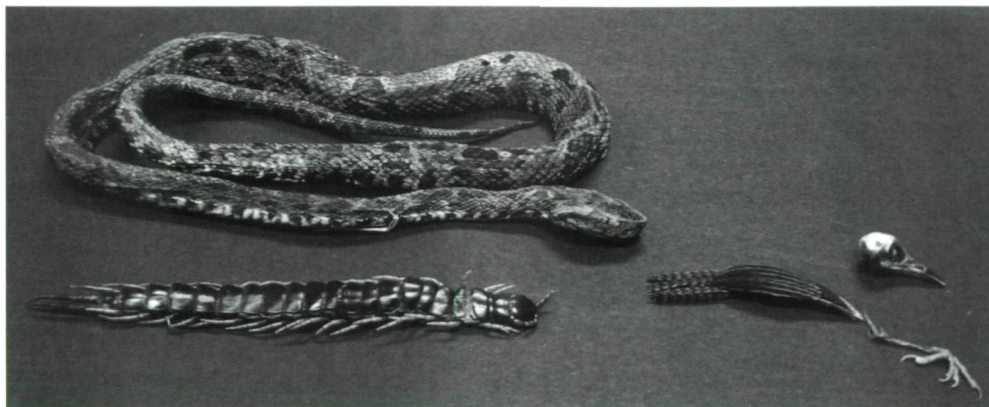


Fig. 1: Adult male *Bothrops asper* (GARMAN, 1884) (QCAZ 6732) from near Muisne, Provincia de Esmeraldas, Ecuador (TL = 109.8 cm), containing a bird and a large centipede. Photograph by David SALAZAR-V.

The single *B. asper* in our series that contained undigested or only partially digested prey (fig. 1) was an adult male (QCAZ 6732) of 95.2 cm SVL (109.8 cm total length [TL]) and a body mass (after removal of prey) of 201 g, which contained a juvenile individual (cranial ossification of 70%) of *Thryothorus nigricapillus* (Aves, Passeriformes, Troglodytidae), and an unidentified centipede (19.6 cm TL, 14.9 g). The maximal diameter of the centipede was 4.1 cm and the minimal diameter of the snake between its head and the level of its stomach 3.3 cm. Prey/predator mass ratio (0.07) and length ratio (0.18) for the centipede lie within the range of previously reported values for *Bothrops* species (CAMPBELL & LAMAR 2004).

CAMPBELL & LAMAR (2004) reviewed the diet of *Bothrops* spp. and found that most species feed largely on ectothermic prey as juveniles but shift to endothermic prey when they reach a size sufficient to swallow such prey items. Among the limited sample studied by us, there was no clear distinction between juvenile and adult snakes regarding the extent to which ectothermic and endothermic prey had been ingested. Of eight juveniles, three contained only insects, one contained a frog, two insects and rodents, and two both insects and frogs. Of three subadult snakes, two contained only rodents, and a female of 90 cm SVL contained lizard and orthopteran remains. One of the three adult snakes contained only rodent remains, the second

rodent remains with parts of insects, and the third a bird with a centipede. However, the insect remains encountered along with frog, lizard, and rodent bones in all the age classes of this species may well be secondary stomach contents, reflecting insectivorous habits of the snake's prey rather than of the snake itself.

Among the invertebrate prey found in members of *Bothrops* (and other terrestrial pitvipers), centipedes have been by far the most common, other records included orthopterans, crayfish, and even slugs (CAMPBELL & LAMAR 2004). In the case of *B. asper*, a large centipede was previously found in a juvenile snake from Gorgona Island, Colombia (PARKER 1926), and centipedes, orthopterans and various unidentified invertebrates were recorded as part of the prey of juveniles of that species in Guatemala (CAMPBELL 1998). Our data show that adult *B. asper* will eat centipedes too, as has been reported for other *Bothrops* species (CAMPBELL & LAMAR 2004), and predation of coleopterans and hemipterans by juvenile *B. asper* as documented here adds two more orders of ubiquitous insects to the dietary spectrum of these pitvipers.

The ectothermic vertebrate prey of *B. asper* has been reported to include anoles, geckos, skinks, frogs (*Eleutherodactylus* sp., *Rana forreri* BOULENGER, 1883), and snakes including conspecifics (CAMPBELL & LAMAR 2004). Four additional frog species have been recorded as prey of *B. asper* in Costa Rica (M. SASA, pers. comm.). In addition to

the frog and lizard remains recovered from three juveniles and one subadult female above, one of the authors (A.F.L.) found a subadult *B. asper* dead on the road near Quevedo, Provincia de Cotopaxi, Ecuador; it contained in its stomach a cane toad, *Bufo marinus* (LINNAEUS, 1758). These specimens were not preserved, and it is unclear whether the ingestion of this unusual and highly toxic prey item might have played a role in the snake's death, e.g., by affecting its ability to move (PHILLIPS et al. 2003). However, juveniles of the closely related species *Bothrops atrox* (LINNAEUS, 1758) and *Bothrops leucurus* WAGLER, 1824 have previously been reported to eat toads (*Bufo typhonius* LINNAEUS, 1758, and *Bufo* sp., respectively; DIXON & SOINI 1986; RIPA 1997).

The endothermic vertebrate prey of *B. asper* is diverse and known to include mostly rodents, but also opossums, birds, and rabbits (CAMPBELL & LAMAR 2004). The juveniles in the present series confirm that these snakes may successfully prey on small mammals very soon in their lives, as previously reported (KUCH et al. 2004) for a specimen measuring only 35 cm in total length, about the size of a large neonate (CAMPBELL & LAMAR 2004). Although based on a small sample, our data are supported by observations on captive-born litters of *B. asper* in the Instituto Nacional de Higiene y Medicina Tropical "Leopoldo Izquieta Pérez" (Guayaquil, Ecuador), in suggesting that these opportunistic feeders will thrive on a life-long diet of agricultural pests: rodents and insects. This may be one of the factors rendering *B. asper* so successful in man-made habitats in Ecuador. There, this very dangerous species has been noted to replace other, less versatile pitvipers (A. FREIRE LASCANO, unpublished data) some of which, besides having narrower habitat requirements, may depend more on declining amphibian and reptile populations as prey.

APPENDIX: Examined specimens containing prey remains: ECUADOR: Cañar: Manta Real (QCAZ 4112); EL ORO: El Guayabo (QCAZ 4055); Esmeraldas: 5 km W of Durango (QCAZ 4215), Muisne (QCAZ 6732); Guayas: Naranjal (QCAZ 685, QCAZ 688); Manabí: Guala (QCAZ 1656-1657); Pichincha: 5 km W of La Florida (QCAZ 1163), Santo Domingo de los Colorados (QCAZ 498-499, QCAZ 1250), Puerto Quito (QCAZ 1252-1253).

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