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A review of the prey of *Chlorosoma viridissimum* (Serpentes: Dipsadidae) reveals an ontogenetic shift in diet

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Abstract. Ontogenetic dietary shifts are well documented in snakes in general, but remain poorly explored in many neotropical taxa. We review 12 dietary records of *Chlorosoma viridissimum* and find that adults prey on mammals, while juveniles feed on ectothermic vertebrates such as frogs and lizards. We also report a novel observation of a juvenile preying on Boesman's Snouted Treefrog *Scinax boesemani* (Goin, 1966) high in a tree in central Amazonia. Our findings reveal distinct ontogenetic dietary patterns in this species: juveniles consume ectothermic prey such as anurans and lizards, while adults shift to endothermic prey (e.g., mammals). This trend mirrors those observed in other snakes and reflects ecological adaptations to body size, metabolic demands, and the availability of suitable prey. Despite its broad distribution across South America, ten of the documented predation events involving *Chlorosoma viridissimum* are restricted to the state of Amazonas, Brazil, highlighting the lack of ecological data from other parts of its range. These results underscore the importance of age-related dietary studies for understanding snake trophic ecology and call for further research across the species' range to uncover potential geographic and ecological variations.

Keywords: Amazon, common green racer, feeding behavior, neotropical snakes, predation.

Many snake species undergo significant ontogenetic shifts in their diets, adapting their feeding strategies as they grow (Shine & Wall 2007, Cipriani et al. 2017, Chuliver & Scanferla 2024). For example, viperid snakes, elapids, and pythons exhibit ontogenetic dietary shifts, transitioning from feeding on frogs and lizards to increasingly larger mammals as they mature (e.g., from ectothermic to endothermic prey) (Shine 1989, 1991, Andrade & Abe 1999, Martins et al. 2002, Valdujo et al. 2002, Nogueira et al. 2003, Natusch & Lyons 2012, Patterson et al. 2022). Ontogenetic dietary shifts may also serve as a strategy to minimize intraspecific competition, particularly when juveniles and adults co-occur (Meik et al. 2010). This dietary shift not only reflects the growing snake's increased size but also its changing ecological role within the ecosystem (Schalk & Cove 2018, Grundler 2020, Chuliver & Scanferla 2024). Despite these insights, detailed knowledge of feeding ecology, particularly for Neotropical snake species, remains limited. (Guedes et al. 2018, Silva et al. 2018, Van den Burg 2020).

The genus *Chlorosoma* Wagler, 1830 (resurrected by Arredondo et al. 2020),

comprises three species: *C. dunupyana* Melo-Sampaio, Passos, Martins, Jennings, Moura-Leite, Morato, Venegas, Chávez, Venâncio & Souza 2020, *C. laticeps* (Werner, 1900), and *C. viridissimum* (Linnaeus, 1758) (Uetz et al. 2024). Among these, the Common Green Racer (*Chlorosoma viridissimum*) is a large, conspicuous dipsadid snake that reaches up to 1.1 m in length. It displays a vibrant leaf-green coloration on the dorsal region of the body and head, while the underside transitions to a lighter shade, with the ventral surface of the head being distinctly white (Martins & Oliveira 1998, Fraga et al. 2013). It exhibits diurnal and predominantly arboreal habits, occurring in the eastern lowlands of northern and central South America, including a broad geographical range that encompasses southern Venezuela, Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, and Suriname (Nogueira et al. 2019, Arredondo et al. 2020). In Brazil, it is prevalent in the Amazon region, occurring in the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, Mato Grosso, and Maranhão. Additionally, it has been recorded in marginal habitats such as the Cerrado, Caatinga, and Chiquitano Dry Forests, and a single population is present in the lowland forest of the Atlantic coast of the Bahia state (Marques 1999, Entiauspe-Neto et al. 2018, Nogueira et al. 2019).

Data on predatory events are essential for understanding ecological and geographic variations in widely distributed species such as *Chlorosoma viridissimum* (Nogueira et al. 2019, Van den Burg 2020). Based on two records from Amazonas state—an adult and a juvenile—Jorge & Simões (2018) suggested that *C. viridissimum* could exhibit ontogenetic variation in prey consumption. Building on this, we compiled and reviewed published records on the diet of *C. viridissimum*. We supplemented this with new data documenting a juvenile preying on *Scinax boesemani* (Goin 1966) at a high elevation in central Amazonia. Furthermore, we examined whether *C. viridissimum* undergoes ontogenetic dietary shifts. Specifically, we investigated whether juveniles consume predominantly ectothermic prey, with adults shifting to include endothermic prey.

To conduct a comprehensive review of prey records of *C. viridissimum*, we performed extensive searches across multiple online databases, including Google Scholar, JSTOR, Science Direct, Scielo, Scopus, and Web of Knowledge. A broad range of search terms was employed to capture literature published in English, Portuguese, and Spanish: "*Chlorosoma viridissimum*" OR "*Philodryas viridissima*" OR "*Philodryas viridissimus*" AND (diet OR prey OR presa OR predation OR predação OR depredación OR feeding). We also examined all available issues of Herpetological Review (1967–2024) and Herpetology Notes (2002–2024), journals that traditionally publish natural history notes and may not be indexed on widely used platforms like Google Scholar, particularly for content available exclusively online. Data collection was concluded in late December 2024. Additionally, we employed the "snowball method," reviewing the reference lists of identified articles to uncover further records. To complement our findings, we utilized the SquamataBase package in R (version 4.3.3), an open-source tool and database containing predator-prey records for snakes worldwide (Grundler 2020). Dietary descriptions lacking specific prey identification (e.g., general statements indicating that *C. viridissimum* consumed bats, anurans, and/or rodents) were excluded from our analysis, and prey taxa were identified to the most specific taxonomic level possible based on the available data.

Although *C. viridissimum* is widely distributed across South America, published information on its natural history, particularly regarding diet and foraging behavior, remains scarce. We found evidence of an ontogenetic shift because only adults included endothermic prey (n = 6), while juveniles (n = 6) consumed anurans or lizards. In addition to dietary records from the literature, we also included a directed observation. On 7 October 2022, at 16:02 h, at the Reserva Florestal Adolpho Ducke/INPA (RFAD) base camp in Manaus, Amazonas, northern

Brazil (2°55'49.2"S, 59°58'31.8"W, datum WGS84; elevation 78 m a.s.l.), we observed and photographed a juvenile *Chlorosoma viridissimum* in the process of swallowing an adult *Scinax bosemani* (Goin 1966) approximately 4 meters high in a mango tree (*Mangifera* sp). The guards alerted the first author, who observed and photographed the predator-prey interaction (Fig. 1). The observation lasted approximately 10 minutes. The snake began consuming the anuran from the posterior end, likely because of the position of capture and the prey's stillness, before swiftly ascending higher into the tree and becoming inaccessible for further observation. Neither individual was collected.

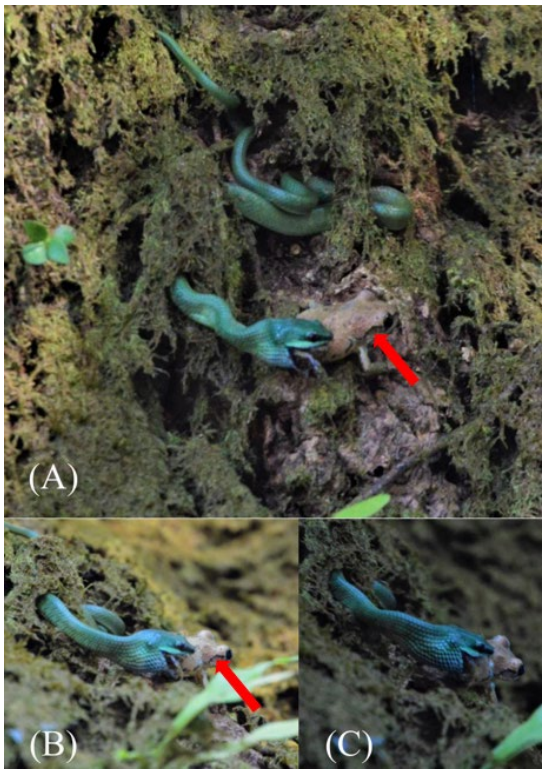

Figure 1. Juvenile Common Green Racer (*Chlorosoma viridissimum*) preying on *Scinax boesemani* approximately 4 meters above the ground in a Mango tree at the Reserva Florestal Adolpho Ducke (RFAD), Manaus, Brazil. The red arrows indicate the dark line running from the nostrils to the posterior region of the tympanum, a distinguishing feature that helps differentiate this anuran species from its congeners. (A) The snake began feeding from the posterior end of the anuran; (B–C) After approximately 2 minutes, the snake had consumed two-thirds of the anuran. Photos by the first author.

The snake was identified as a juvenile *C. viridissimum* due to its distinctive coloration: the dorsum is green to deep green, becoming paler ventrolaterally. At the same time, the head is also green but darker than the dorsum. Unlike other similar species, the lips are bluish-white (Martins & Oliveira 1998, Fraga et al. 2013). The anuran was later identified through careful photo analysis as *Scinax boesemani*, a species commonly found in open areas and forest edges of the RFAD (Lima et al. 2012). This identification was made by Albertina Lima, a biologist-researcher with 40 years of experience focused on Amazonian anurans, based on specific characteristics observed in the photograph. Other congeners found in the RFAD, including *S. ruber* (Laurenti, 1768) and *S. garbei* (Miranda-Ribeiro, 1926), can be distinguished from *S. boesemani* by the absence of a dark line running from the nostril to the posterior region of the tympanum, as indicated by red arrows in Fig. 1.

Although the size at sexual maturity remains undefined for *C. viridissimum*, available data suggest that individuals with a snout–vent length (SVL) below approximately 500 mm can be considered juveniles (Martins & Oliveira 1998, Rivera et al. 2009, Jorge & Simões 2018). Based on this criterion, the three individuals reported by Martins & Oliveira (1998), with SVLs ranging from 256 to 489 mm, were classified as juveniles. An additional record of an individual with a snout–vent length (SVL) of 540 mm was found in the SquamataBase database (Grundler 2020), based on a specimen housed in the University of Michigan Museum of Zoology's Reptile and Amphibian Collection, collected in the Departamento de Pando, northwestern Bolivia. Although the specimen includes a precise SVL measurement, the source did not provide information on age class or reproductive status. Due to its intermediate body size—near the presumed threshold between juvenile and adult stages—we excluded this record from our analyses of ontogenetic dietary patterns to avoid potential misclassification.

Of the thirteen records compiled in our

review, all six adult records document exclusive predation on mammals, while juvenile records indicate consumption of ectothermic prey such as anurans and lizards (Fig. 2, Table 1). These observations support the hypothesis that *C. viridissimum* exhibits ontogenetic dietary shifts, with juveniles primarily feeding on ectotherms (Martins & Oliveira 1998, Jorge & Simões 2018, this study) and adults targeting endothermic mammals, including bats, rodents, and squirrels (Otto & Miller 2004, Chávez-Arribasplata et al. 2016, Jorge & Simões 2018). Ontogenetic dietary shifts in snakes are relatively well documented. They are typically linked to changes in body size, gape width, locomotor performance, and metabolic demands, which together enhance foraging efficiency and energy intake (Andrade & Abe 1999, Durso & Mullin 2017, Patterson et al. 2022). In *C. viridissimum*, the observed pattern likely reflects such morphological and energetic constraints, as well as prey availability in different microhabitats or times of day. These ontogenetic changes can also reduce intraspecific competition by segregating resource use across life stages (Cundall & Greene 2000, Shine & Wall 2007).

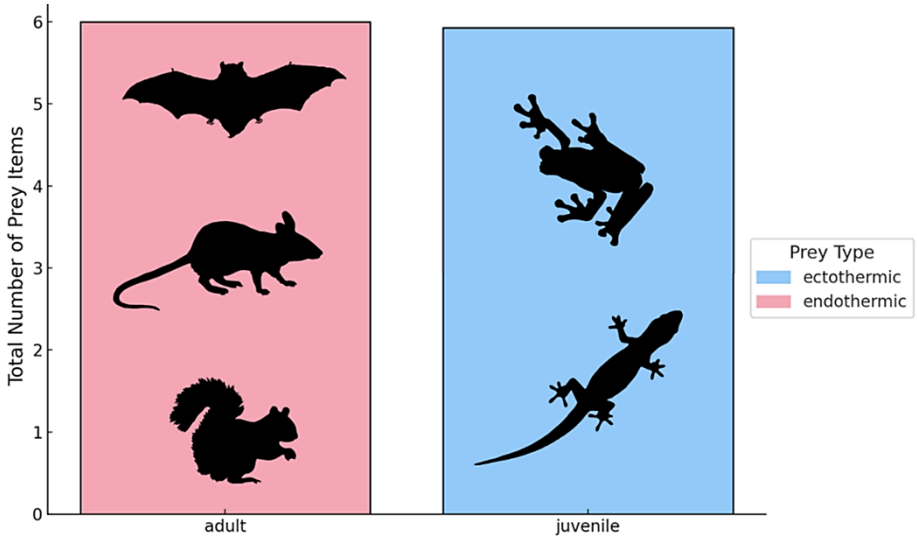

Figure 2. Stacked bar chart illustrating the dietary prey type (ectothermic or endothermic) of *Chlorosoma viridissimum* by individual age (adult or juvenile). Silhouette images from PhyloPic (https://www.phylopic.org/). The silhouette images are not in scale.

Despite its wide geographic distribution across the Brazilian Amazon (Nogueira et al. 2019), most documented prey items for *C. viridissimum* originate from a limited number of localities: southeastern Peru (2), northwestern Bolivia (1), and predominantly the state of Amazonas, Brazil (10) (Fig. 3). The concentration of predation records in Amazonas can be primarily attributed to the high number of scientific expeditions conducted in this region, while other parts of the species' range remain under-sampled due to fewer research efforts (Fraga et al. 2013, Jorge & Simões 2018, Guimarães et al. 2024).

These findings emphasize the need for expanded studies across the species' distribution to better understand its dietary habits and ecological role, especially in less-studied areas (Entiauspe-Neto et al. 2018, Nogueira et al. 2019). The data summarized here align with previous studies (Martins & Oliveira 1998, Jorge & Simões 2018) indicating that *C. viridissimum* exhibits a notable dietary shift as it matures, primarily targeting small ectothermic vertebrates such as frogs and lizards during its juvenile stage. As individuals grow, their diet shifts toward larger endothermic prey, including mammals such as bats and rodents.

Table 1. Reports of the predatory events involving prey items reported for *Chlorossoma viridissimum*. Prey taxa were classified to the highest possible taxonomic resolution based on the available data. An asterisk (*) indicates a case where the predator abandoned the attempt to capture the prey. DO = direct observation; DGT: dissected gut contents.

Snake age	Prey items	Locality	Event basis	Reference
Adult	Mammalia: Chiroptera: Molossidae: *Molossus molossus* (Pallas, 1766)	Peru, Madre de Dios	DO	Chávez-Arribasplata et al. (2016)
Adult	Mammalia: Chiroptera: Phyllostomidae	Peru, Madre de Dios	DO*	Otto & Miller (2004)
Adult	Mammalia	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Adult	Mammalia	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Adult	Mammalia: Rodentia	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Adult	Mammalia: Rodentia: Sciuridae: *Sciurus* (*Guerlinguetus*) *aestuans* (Linnaeus, 1766)	Brazil, Amazonas	DO	Jorge & Simões (2018)
Juvenile	Amphibia: Anura: Hylidae	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Juvenile	Amphibia: Anura	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Juvenile	Amphibia: Anura	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Juvenile	Reptilia: Squamata	Brazil, Amazonas	DGT	Martins & Oliveira (1998)
Juvenile	Reptilia: Squamata: Gekkonidae: *Hemidactylus mabouia* (Moreau de Jonnês 1818)	Brazil, Amazonas	DGT	Jorge & Simões (2018)
NA	Amphibia: Anura: Hylidae	Bolivia, Pando	DGT	Grundler (2020)
Juvenile	Amphibia: Anura: Hylidae: *Scinax boesemani* (Goin, 1966)	Brazil, Amazonas	DO	This work (2025)

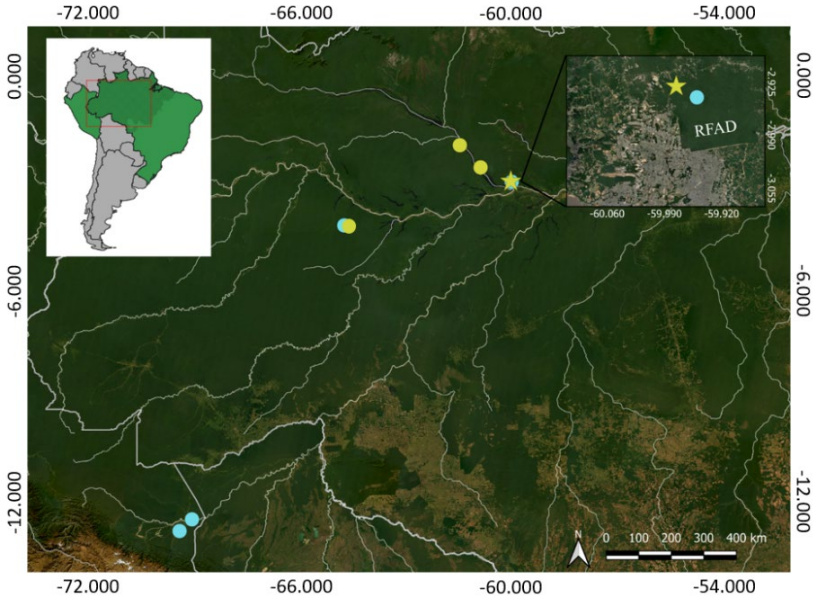

Figure 3. Map showing predation events involving *Chlorosoma viridissimum*, categorized by predator age, including only cases with categorized prey and predator. Blue circles = adult individuals (endothermic prey); yellow circles = juveniles (ectothermic prey); and the star highlights our observed event. A detailed inset in the top-right corner focuses on the Reserva Florestal Adolpho Ducke (RFAD) in Manaus, Amazonas, Brazil.

Although existing records provide initial clues, the diet and foraging behavior of *C. viridissimum* remain poorly understood. Potential geographic variation in dietary composition also warrants investigation, as prey availability likely differs across habitats. Records such as the one presented here are essential for understanding the natural history and trophic ecology of *C. viridissimum*, particularly regarding the prey availability within their natural habitats. Therefore, the observed trends in the predation behavior of *C. viridissimum* underscore the importance of considering age-related dietary shifts when studying snake ecology. We also recommend future studies to gain a deeper understanding of the diet of *C. viridissimum* by analyzing gut or stomach contents from specimens held in zoological collections to refine its ontogenetic dietary patterns further.

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