



Ophiophagous Combatants: Predation on a Kingsnake (*Lampropeltis* sp.) by a Coachwhip (*Coluber flagellum*) in the Sonoran Desert

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The Coachwhip (*Coluber* [syn: *Masticophis*] *flagellum*) is a large, broad-ranging snake native to much of the southern half of the United States and northern Mexico (Ernst and Ernst 2003), where it occupies habitats that include deserts, savannahs, dry grasslands, and sparsely vegetated woodlands. Taxonomic confusion between *Coluber* and *Masticophis* is largely the result of discordant evidence to lump (Pyrton et al. 2013; Figueroa et al. 2016) or separate the genera (Myers et al. 2017). At the specific/subspecific levels, several differentiated populations of *C.* (or *M.*) *flagellum* exist, albeit some molecularly unresolved (see Myers et al. 2017), but genomic data are trending toward delimiting and elevating *C.* (or *M.*) *piceus*, among others, to full species (O’Connell and Smith 2018). If adopted, the results *sensu* O’Connell and Smith (2018) would yield two species of coachwhips in Arizona — the highly variable “Red Racer” (*C.* [or *M.*] *piceus*) throughout most of the state south of the Mogollon Rim (e.g., Tucson) and the “Western Coachwhip” (*C.* [or *M.*] *flagellum*) across the Cochise Filter Barrier in southeastern Arizona (Holycross and Mitchell 2020). In any case, snakes in the *C.* (or *M.*) *flagellum* complex exhibit highly variable coloration and patterns, and additional genomic sampling may be necessary to resolve deeper introgression or incomplete lineage sorting to unravel cryptic systematics (O’Connell and Smith 2018). Therefore, until sufficient evidence leads to adoption of nomenclature by the authoritative bodies (see Crother 2017), we hereafter conservatively refer to the Coachwhip as *Coluber flagellum*.

Across its range, *C. flagellum* is a dietary generalist (e.g., insects, birds, herpetofauna, small mammals) that most frequently preys on lizards, but ophiophagy of other snakes (including cannibalism) is not uncommon (see dietary lists in Ernst and Ernst 2003; Holycross and Mitchell 2020). Generally, the Coachwhip is an active diurnal forager and its swiftness allows it to quickly overcome and swallow prey (Ernst and Ernst 2003). However, *C. flagellum* also employs a highly successful ambush strategy from vegetated cover for the capture of swift saurian prey (Ernst and Ernst 2003; Clark

2010). Its size, speed, and generalist nature make *C. flagellum* a formidable predator.

Syntopy among ophiophagous snakes occurs in several areas of Arizona. For example, Regal Ring-necked



Fig. 1. Predation by an adult black-phase Coachwhip (*Coluber flagellum*) on a subadult kingsnake (*Lampropeltis* sp.) (arrow). When first encountered, the Coachwhip had already initiated ingestion of the kingsnake. Photograph from a video by Samantha L. Johnson.

Snakes (*Diadophis punctatus regalis*), Sonoran Coralsnakes (*Micruroides euryxanthus*), and multiple species of North American Racers, Coachwhips, and Whipsnakes (i.e., *Coluber* [*Masticophis*] spp.) and Kingsnakes and Milksnakes (i.e., *Lampropeltis* spp.) occur in the reptile-rich Sabino Canyon Recreation Area (SCRA) in the southern foothills of the Santa Catalina Mountains in Tucson, Arizona (Lazaroff et al. 2006). The snakes in this area represent an interesting ophiophagous intraguild. Although niche separation among ophiophagous snakes apparently occurs in the SCRA (e.g., *C. flagellum* occurring in less densely vegetated areas than Sonoran Whipsnakes, *C. bilineatus*; *Coluber* being primarily diurnal whereas *Lampropeltis* is mostly nocturnal), occasional encounters between these snakes certainly occur. In Arizona, ophiophagous predators are known to become ophiophagous prey (e.g., *Coluber* preying on *Diadophis*; *Lampropeltis* on *Coluber*; Holycross and Mitchell 2020).

At about 1040 h on 13 July 2021, we were alerted by rustling noises coming from a Deergrass (*Muhlenbergia rigens*) tussock in the dry stream bank adjacent to lower Sabino Creek in the SCRA (UTM 517735, 3575255, \pm 10 m, WGS84). A closer observation revealed an adult “black phase” *C. flagellum* feeding on a subadult kingsnake (*Lampropeltis* sp.) (Fig. 1). The Coachwhip was in the process of swallowing the limp and presumably dead kingsnake. Despite the proximity of the observer, the *C. flagellum* swiftly ingested its meal in the shaded cover of the dense Deergrass. However, once finished, the Coachwhip vigorously emerged from the vegetation with its anterior portion elevated while simultaneously striking defensively in the direction of the camera before hastily moving upstream along the bank (Fig. 2). At the time of observation, ambient temperature was 37.9 °C, relative humidity 36.7%, and atmospheric pressure 924.4 mbar; conditions were clear, wind still, and no precipitation. Although the area had received approximately 3.8 cm of precipitation since the beginning of the seasonal summer monsoon (15 June), the streambed was mostly dry, although tinaja pools within less than 50 m contained water. Since 2018, we have occasionally encountered Coachwhips as well as Sonoran Whipsnakes (*C. bilineatus*) in the vicinity, although the latter is usually observed farther upstream in more tightly clumped riparian vegetation (BRB, pers. obs.).

Because we did not wish to interrupt the meal, we did not get a conclusive view of the kingsnake in real time or

via video — largely due to the rapidity of the Coachwhip swallowing its meal — and thus cannot say with certainty if the prey was a California Kingsnake (*L. californiae*) or a Desert Kingsnake (*L. splendida*). Both species are syntopic in the region but pattern intergradation renders identification challenging (Drost 2020), and although only the California Kingsnake is listed in the SCRA’s herpetological field guide (as *L. getula californiae*; Lazaroff et al. 2006), that resource predates more contemporary taxonomic updates (Pyron and Burbrink 2009a, 2009b).

Attempted ophiophagy is not always successful. Successful predation did not occur between two constrictors in Honduras — a Central American Indigo Snake (*Drymarchon melanurus*) and a Central American Boa (*Boa imperator*) — when the *Boa* coiled around the *Drymarchon* in defense (Brown and Murcia 2021). In southern Arizona, both *L. californiae* and *L. splendida* are known to prey on *C. flagellum*, although such encounters are not common (Holycross and Mitchell 2020). Repp (2002) described an in-progress battle between a Coachwhip and a much smaller kingsnake (“*L. getula splendida*”) — also near Tucson — in which the kingsnake appeared to have the upper hand via constriction around the head of the Coachwhip, although the author suspected that the Coachwhip had initiated the encounter; the outcome was inconclusive. Thus, to the best of our knowledge, we present the first confirmed predation of a kingsnake by a Coachwhip in Arizona (and possibly beyond). Although *C. flagellum* successfully employs both active and ambush foraging strategies, ambush from the shaded cover of vegetation occurs more frequently during the hot summer months. Although we could not determine if the kingsnake happened upon the Coachwhip hiding in the Deergrass or vice-versa, that the Coachwhip actively detected its meal via visual or chemosensory cues (Clark 2010) appears more likely, because, in the SCRA, *C. flagellum* is more tolerant of hot diurnal conditions than the more nocturnally active *Lampropeltis*.

Climatic change likely will bring drier and warmer conditions to the southwestern United States (Archer and Predick 2008), and riparian herpetofauna will be subjected to a variety of increasingly potent climate-related stressors that almost certainly will have negative effects on populations and diversity (Lazaroff et al. 2006; Griffis-Kyle et al 2018; Bateman and Riddle 2020). If prey species becomes scarce, some predators might be driven to risk more challenging meals; for example,



Fig. 2. Immediately after consuming a kingsnake (*Lampropeltis* sp.), an adult Coachwhip (*Coluber flagellum*) emerged from a Deergrass (*Muhlenbergia rigens*) tussock in the direction of an observer while striking defensively at the camera before rapidly escaping. Photographs from a video by Samantha L. Johnson.

a Regal Ring-necked Snake (*Diadophis p. regalis*) preying on a neonatal Black-necked Gartersnake (*Thamnophis cyrtopsis*) in the SCRA (Blais and Binford-Walsh 2020). In 2020, Tucson experienced near record drought, and the high-intensity Bighorn Fire affected montane regions in the Santa Catalina Mountains which led to post-fire flooding (McMahan 2020; McMahan et al 2021). Burn scar slurry deposits are evident along lower Sabino Creek in the SCRA and the extent of the effect on certain riparian taxa still requires more data. One outcome might be that predators like *C. flagellum* take what they can get, even if the prey is more challenging.

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