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**ALCALUS BALUENSIS (Dwarf Mountain Frog). PREDATION.** *Alcalus baluensis* is a small, stream-associated frog endemic to the island of Borneo. This species is found along rocky, fast-flowing streams, but little else is known of its natural history (Inger et al. 2017. A Field Guide to the Frogs of Borneo. Natural History Publications. Kota Kinabalu. Malaysia. 228 pp.). The arachnid family Sparassidae (huntsman spiders) are globally distributed throughout warm tropical regions. This family predates a wide range of small vertebrates, with two Bornean *Heteropoda* sp. known to prey upon large anuran tadpoles (Airamé and Sierwald 2000. J. Arachnol. 28:251–253). Here, we document the predation of an *A. baluensis* froglet by a spider (*Heteropoda* sp.). At 2048 h on 6 March 2018 we found a froglet that had been recently caught by a large, female *Heteropoda* sp. (Fig. 1) within the Deramakot Forest Reserve, Borneo, Malaysia (5.33859°N, 117.48147°E, WGS 84; 159 m elev.). The spider and prey were found adjacent to a 3.4-m wide, fast-flowing stream within a previously logged forest. The spider appeared to have spread several web strands over the deceased *A. baluensis*, and stood motionless over the froglet. After several minutes of observations, the observers left the area but the spider had yet to begin feeding.

We thank the Sabah Forestry Department for allowing us to conduct research within the Deramakot Forest Reserve. Additionally, we thank Siti Salihahfarhain Saidin for identification of the arachnid.



FIG. 1. Recent metamorph *Alcalus baluensis* froglet preyed by a large *Heteropoda* sp. within the Deramakot Forest Reserve, Borneo, Malaysia.

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**ANAXYRUS CANORUS (Yosemite Toad). BREEDING BEHAVIOR.** *Anaxyrus canorus* is a bufonid endemic to California that

breeds in ephemeral snowmelt-fed meadow ponds at high elevation in the Sierra Nevada. Sex ratios during breeding are typically male-dominated, with operational sex ratios between 9.9–37.9:1 (Sherman 1980. A Comparison of the Natural History and Mating System of Two Anurans: Yosemite toads (*Bufo canorus*) and black toads (*Bufo exsul*). Ph.D. Dissertation, University of Michigan, Ann Arbor, Michigan. 394 pp.). Females must accrue sufficient gonadal and liver fat stores for hibernation and reproduction, and hence skip one or more consecutive breeding years (Morton 1981. Copeia 1981:234–238). Therefore, breeding females almost always have unpaired males to choose from, which they select directly (by approaching trilling males) or indirectly (by allowing faster males to approach and clasp them), which they do in roughly equal proportions (Sherman 1980, *op. cit.*). Male attacks on amplexant pairs are common (Sherman 1980, *op. cit.*), but to my knowledge, no record exists of females attacking amplexant pairs, and records of female-dominated breeding aggregations are rare.

These observations occurred between 1715 h and 1805 h on 18 May 2016 within a small montane meadow (0.98 ha) in Yosemite National Park, Tuolumne County, California (37.84619°N, 119.68439°W, WGS 84; 2445 m elev.). The focal meadow and five other meadows within 1.6 km comprise a cluster of meadows that toads occupy. The dominant vegetation surrounding meadows is Red Fir (*Abies magnifica*) mixed with Lodgepole Pine (*Pinus contorta* ssp. *murrayana*). The temperature at a nearby weather station (3.1 km E, 37 m lower in elev.) ranged from 0.67–17.78°C that day, and -1.67–17.78°C the previous five days. A late spring storm 11 days earlier had deposited 22 mm of snow, during which time the average temperature was 10°C colder. The focal meadow was ca. 50% covered in snow during the observation.

No male breeding chorus was heard upon approaching the meadow or during the observation. While surveying the meadow, 16 toads were found: five amplexant pairs, one unpaired male, and five unpaired females. One of the unpaired females was found entrenched inside a snowdrift crevasse, caused by the fracturing of one edge into the breeding pond, and she was apparently too cold to continue movement during the observation. Two of the other unpaired females (hereafter denoted “UPF1” and “UPF2”) actively hopped throughout the pond, and the remaining two females sat buried in vegetation around the pond edge. At 1724 h, UPF1 approached UPF2, and UPF2 aggressively attacked UPF1, by tongue-flicking and bumping into her. Between 1740 and 1744 h, three amplexant pairs were approached and harassed by UPF1 (once) and UPF2 (five times). UPF1 ceased these behaviors at 1741 h when the unpaired male approached and amplexed her, thus forming a 6<sup>th</sup> amplexant pair. However, UPF2 never obtained a mate, and continued to harass amplexant pairs. The unpaired females exhibited a variety of behaviors: (1) approaching the pair, (2) bumping into the pair, (3) pushing against the amplexant male with her head, (4) pressing down on the amplexant female with her forelimbs, and (5) hopping on top of the amplexant pair. In response, the amplexant males usually emitted a release call. Footage of this observation is available at <https://youtu.be/EspmwdPasBE>.

To my knowledge, such competition among females has never been observed in pond-breeding anurans, with the exception of midwife toads (*Alytes*), which display male parental care (Verrell and Brown 1993. Ethology 93:247–257). At least two hypotheses can account for these observations. One possible explanation is that intrasexual competition is natural for highly gravid females,

but breeding aggregations are almost never male-limited, and hence this behavior is almost never displayed. Female-biased sex ratios have only been recorded in the declining Tioga Pass population during the 1980s, due to a faster extirpation rate of males than females (Sherman and Morton 1993. *J. Herpetol.* 27:186–198). Another possibility is that some “female” individuals are sex-reversed or intersex males exhibiting both male and female secondary sexual characteristics. Extreme temperatures and exposure to steroid hormones are known to override genetic sex determination in amphibians (Norris and Lopez 2011. *Hormones and Reproduction of Vertebrates, Volume 2: Amphibians*. Elsevier Academic Press, San Diego, California. 219 pp.). Bufonids are particularly susceptible, because males retain müllerian ducts (oviducts) and a Bidder’s organ (rudimentary ovaries) during development that can become functional if the testes are damaged (Witschi 1933. *Am. J. Anat.* 52:461–515). *Anaxyrus canorus* has the most well developed Bidder’s organ of any bufonid examined (Witschi 1933, *op. cit.*). Feminized males with hermaphroditic characters have been found in natural populations of other toads, including *Bufo viridis*, *Rhinella marina*, and *Anaxyrus microscaphus* × *woodhousii* (Witschi 1933, *op. cit.*; Sullivan et al. 1996. *Copeia* 1996:470–472; McCoy et al. 2008. *Environ. Health Persp.* 116:1526–1532). More work should be done to further explore these hypotheses.

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**ANAXYRUS PUNCTATUS (Red-spotted Toad). CANNIBALISM.**

Among amphibians, cannibalism takes one of several forms: adults or larvae feeding on eggs (oophagy), adults or larvae feeding on larvae, and adults or larvae feeding on adults (Kuzmin 1991. *J. Bengal Nat. Hist. Soc.* 10:11–27). Although cannibalism is known from a variety of amphibian taxa, it seems to be more commonly exhibited by some groups than others. Additionally, some types of cannibalism appear to be more common than others, with larva on adult cannibalism exhibited least often (Kuzmin 1991, *op. cit.*). Hence the value of our report. We are documenting, for what we believe to be the first time, the cannibalism of adults by larvae within the family Bufonidae.



FIG. 1. Adult *Anaxyrus punctatus* being consumed by conspecific larvae, 21 June 2017.

At 2030 h on 20 June 2017, along the Burr Trail in the Grand Staircase Escalante National Monument, Garfield County, Utah, USA (37.84845°N, 111.37381°W, WGS 84; 2083 m elev.) we found two ephemeral pools containing larval *Anaxyrus punctatus*. As the sun set for the day we left the site. Later we returned to the site on 21 June 2017 at 0050 h hoping to document adult amphibians. Upon reexamining one of the pools we discovered three dead adult *A. punctatus* being rapidly consumed by larvae of the same species (Fig. 1). Due to the unusual observation, we returned the following night, 22 June 2017 at 0030 h, where a fourth toad was found dead and being devoured. The remains of the three previous adult toads were still present. At this time multiple aquatic macroinvertebrates, including dragonfly nymphs and fly larvae, were also found to be feeding on the carcasses. In these small, closed aquatic systems, even a single toad carcass represents a tremendous input of nutrients, let alone four simultaneously.

It was unclear whether this was an instance of active or passive cannibalism (i.e., scavenging) as the toads were already dead when we encountered them. However, as was noted above, the adults were clearly not present during the first encounter, but were present approximately 4.5 h later. It seems there are three likely explanations for the observed phenomenon. First, the adult toads entered the water, were overtaken by the larvae, killed and then consumed. Second, some other type of animal killed the toads and left them in the water. Third, the toads were injured, entered the water after passage of the observers, and were then overtaken by the larvae and consumed.

Regardless of the means by which the adults were killed, this still constitutes a unique observation. Secondly, a review of the literature has shown adult cannibalism by larvae to be exceedingly rare among the Amphibia, with the possible exception of the Gymnophiona (Kuzmin 1991, *op. cit.*).

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**AROMOBATES CANNATELLAI (Cannatella frog). PREDATION.**

*Aromobates cannatellai* is a recently described small frog in the family Aromobatidae, with an Andean distribution from Estado Táchira, Venezuela, to Norte de Santander department, Colombia, with an altitudinal distribution from 750 to 1140 m (Barrio-Amorós and Santos 2012. *Zootaxa* 3422:1–31). It is diurnal and terrestrial



FIG. 1. *Ancylometes bogotensis* preying *Aromobates cannatellai* in the tropical dry forest of northeastern Colombia.