

SHORT COMMUNICATION

A vertebrate-eating jumping spider (Araneae: Salticidae) from Florida, USA

Martin Nyffeler¹, G. B. Edwards² and Kenneth L. Krysko³: ¹Section of Conservation Biology, Department of Environmental Sciences, University of Basel, CH-4056, Basel, Switzerland; E-mail: martin.nyffeler@unibas.ch; ²Curator Emeritus: Arachnida & Myriapoda, Florida State Collection of Arthropods, Gainesville, FL 32608, USA; ³Division of Herpetology, Florida Museum of Natural History, University of Florida, Gainesville, FL 32611, USA

Abstract. The salticid spider *Phidippus regius* C.L. Koch, 1846 is documented preying on small frogs (*Hyla* spp., *Osteopilus septentrionalis*) and lizards (*Anolis carolinensis* and *Anolis sagrei*) in Florida, USA. Female as well as male *P. regius* were engaged in feeding on this type of vertebrate prey. A total of eight incidents of *P. regius* devouring vertebrates have been witnessed in seven Florida counties. Furthermore, we report an incident of a large unidentified *Phidippus* sp. (possibly *P. bidentatus* F. O. Pickard-Cambridge, 1901) preying on an immature anole lizard in Costa Rica. *P. regius*, otherwise known to feed almost exclusively on insects and spiders, is one of the world's largest salticid spiders reaching a maximum recorded body length of 2.2 cm. Most other salticid spiders appear to be too small in body size to overcome vertebrate prey. Vertebrate predation by salticid spiders has not been previously documented in the scientific literature. Together with Salticidae, spiders from 27 of 114 families (24%) are currently known to occasionally consume vertebrate prey.

Keywords: Generalist predators, predation, prey, Dactyloidea, Hylidae, Southeastern USA

With >5,900 described species, the jumping spider family (Salticidae, a member of the clade Dionycha) is the largest spider family, composing ≈13% of the total spider species (World Spider Catalog 2017). Accordingly, the spider species in this family exhibit an enormous diversity of life styles and foraging strategies (Edwards et al. 1974; Ross 2008; Meehan et al. 2009; Pekár & Toft 2015; Nyffeler et al. 2016). More than a decade ago, Jackson et al. (2005) discovered an East African salticid (*Evarcha culicivora* Wesolowska & Jackson, 2003) which was imbibing vertebrate blood after piercing the bodies of female mosquitoes which recently had a blood meal. The report of this first jumping spider feeding on vertebrate blood was considered a major discovery by the arachnological scientific community. But not only are there salticids that indirectly feed on vertebrate blood after piercing the bodies of blood-fed mosquitoes, there are also spiders from this family that directly feed on vertebrate prey. An incident of this type was witnessed in the early 1990s in the Gainesville area in northern peninsular Florida, USA. There, two former wildlife graduate students witnessed a large salticid spider (*Phidippus regius* C.L. Koch, 1846) in the process of devouring a small tree frog. These students mentioned their observation of a frog-eating jumping spider as a side note during the '1995 North American Amphibian Monitoring Program Conference' in Toronto, Canada (O'Neill & Boughton 1996), but they did not regard this as something spectacular since they were not aware of the fact that vertebrate-eating was a behavioral trait at that time unknown for jumping spiders. Actually, feeding on small frogs and lizards by spiders in Florida is not uncommon, but this refers to non-salticid spiders (e.g., Goin 1943; Owen & Johnson 1997; Jeffery et al. 2004).

We decided to conduct an internet survey to find out how widespread vertebrate predation by salticids might be. This was achieved by searching for reports using Google Search, Google Scholar, Google Books, and Google Pictures as well as the Thomson-Reuters and Scopus databases. During our search we found six additional reports of predation on small vertebrates by salticids, all of which had been posted more recently on social media sites along with photographic evidence. Some of the bloggers who had posted reports were contacted by us to obtain additional information on their

observations. In addition, there was another incident that was reported directly to one of the authors (GBE) but not posted. Photographs were deposited in the digital archives of the Division of Herpetology (UF-Herpetology), Florida Museum of Natural History, University of Florida. In the following we give an account of the eight predation events (Table 1 and Fig. 1), followed by a discussion of the phenomenon of vertebrate predation by salticids.

Phidippus regius is one of the world's largest salticids reaching a maximum recorded body length of 2.2 cm in adult females and 1.8 cm in adult males. Large females have a leg span approaching 3.5 cm, and the largest males may have a leg span exceeding 4 cm, although they have less body mass than females. The front legs have enlarged setae (macrosetae, often erroneously referred to as 'spines') on the ventral surface that assist with prey capture, and of course, like most spiders, they have a venomous bite. These spiders reach an adult female body mass of ≈0.5–1 g (Anderson et al. 1979; Anderson 1990). They are stout, heavy-bodied, powerful spiders that are capable of jumping more than their body length straight up a vertical surface to catch prey (Edwards 1980). They have been previously observed to catch invertebrate prey (predominantly insects and spiders) much larger than themselves, including such relatively dangerous prey as adult shieldback katydids twice the length of the spider (GBE, pers. obs.). They live in old field habitats and often frequent small palms and palmettoes (≈1.0–3.0 m height) as adults, where females nest inside the newest fully developed but unopened leaf (Edwards 1990). From these protected nests, the females can forage on the trunk and other leaves, and onto adjacent shrubs or small trees if available.

Phidippus regius captured frogs with a body length of ≈1–1.5 times the spider's length and lizards with a snout-vent length of ≈1.5–2.5 times the spider's length (Table 1). Some salticids are known to capture prey organisms up to three times their own length and twice their own mass (Robinson & Valerio 1977). No mass measurements of vertebrate prey of *P. regius* are available. But based on the predator/prey size ratios (Table 1) we can deduce from literature data that the frogs (≈1.5–3 cm body length) devoured by *P. regius* had an estimated mass of ≈0.375–2 g (comp. frog body mass data by Stuckert et al. 2009; Costa-Pereira et al. 2010), whereas the captured

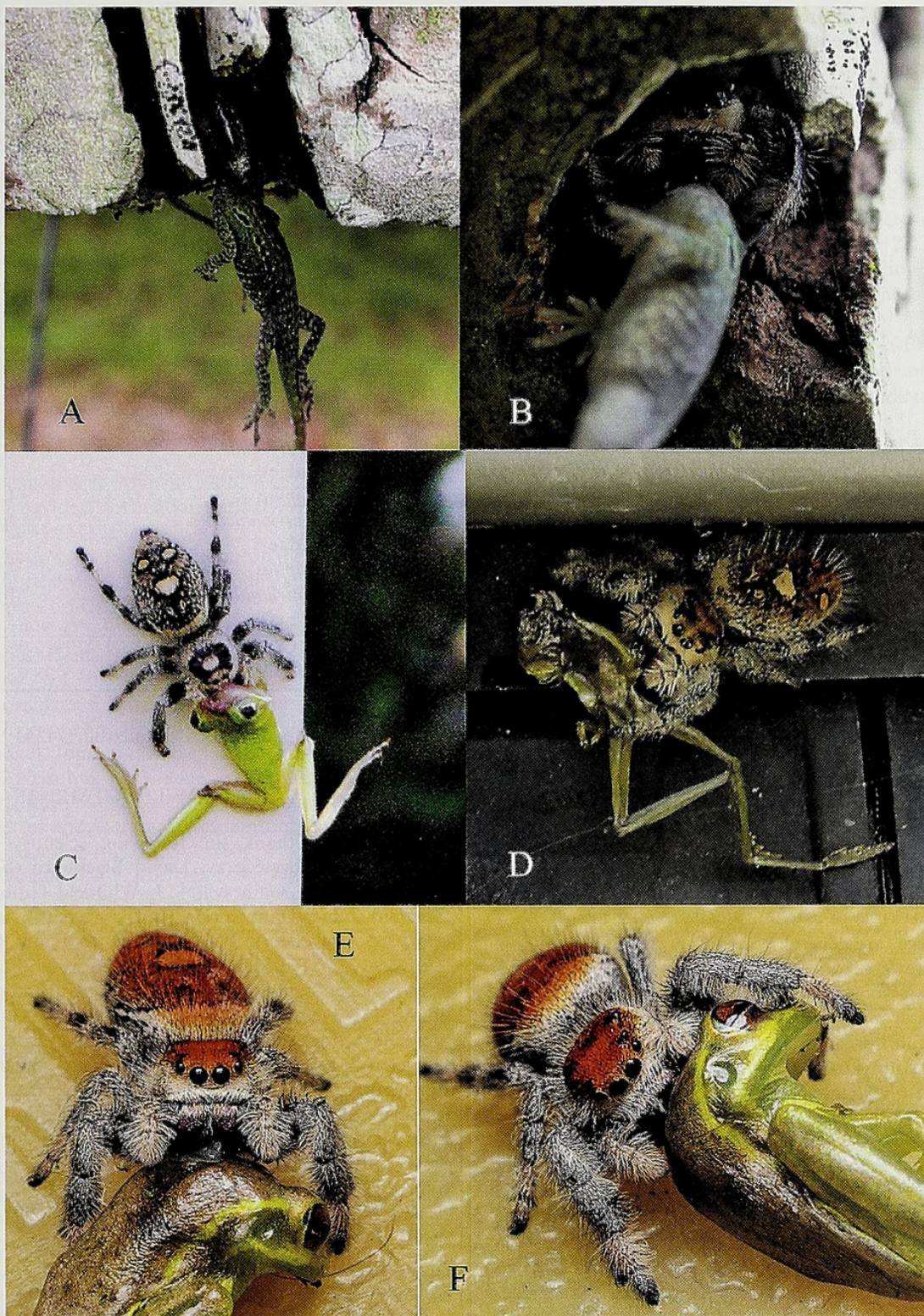


Figure 1.—A. & B. Female *Phidippus regius* consuming a Caroline anole (*Anolis carolinensis*) in the Sunnyhill Restoration Area, Florida (photographs by Jeff Hollenbeck; UF-Herpetology 179622); C. Female *Phidippus regius* feeding on a Cuban tree frog (*Osteopilus septentrionalis*) in a residential area in Land O'Lakes, Florida (photograph by Jeanine DeNisco; UF-Herpetology 179483); D. Female *Phidippus regius* eating a juvenile Cuban tree frog (*Osteopilus septentrionalis*) in a rural area in Holopaw, Florida. The spider was found sitting in the water filtration system attached to a well (photograph by Loret Setters; UF-Herpetology 179623). E. & F. Female *Phidippus regius* eating a Cuban tree frog (*Osteopilus septentrionalis*) in Lake Placid, Florida (photograph by Martin Fisher; UF-Herpetology 179625).

lizards ($\approx 2.3\text{--}5$ cm snout-vent length) had an estimated mass of $\approx 0.5\text{--}3$ g (comp. lizard body mass data by Meiri 2010; Senczuk et al. 2014). Most species of salticid spiders are probably too small—with a body mass of only 0.006–0.2 g (Greenstone & Bennett 1980; Anderson 1990)—to be able to overpower such large vertebrate prey.

However, it is highly likely that apart from *P. regius*, other large salticid species occasionally prey on small vertebrates. An incident of this type was witnessed in 1993 on the peninsular region of Puntarenas, Costa Rica, referring to a large unidentified *Phidippus* sp. devouring an immature anole lizard (Stanislav Macik, pers.

Table 1.—Eight incidents of predation on small vertebrates by the jumping spider *Phidippus regius* in Florida, USA. Length estimates (cm) used to calculate predator/prey ratios are based on photographs. Predator length = total body length, excluding legs. Prey length = snout-vent length.

Location	Habitat type	Spider predator	Prey species	Predator/prey length ratio	Source
Alachua County: Gainesville area	Pine flatwoods site	<i>P. regius</i> Large individual	<i>Hyla femoralis</i> (Hylidae)	N/A	O'Neill & Boughton (1996)
Escambia County:	Spider resting on concrete block wall	<i>P. regius</i> Male	Unident. (Hylidae)	N/A	*
Hillsborough County: Tampa	Planted plot of saw palmetto (<i>Serenoa repens</i>)	<i>P. regius</i> Male	<i>Hyla squirella</i> (Hylidae)	1 : 1	Scott Pittenger (pers. comm.)
Marion County: Umatilla Sunnyhill Restoration Area	Restoration area; spider sitting in a crack in a fence.	<i>P. regius</i> Female	<i>Anolis carolinensis</i> (Dactyloidae)	1 : 2.5	Jeff Hollenbeck (pers. comm.)
Pasco County: Land O'Lakes	Backyard adjacent to a conservation area; spider resting on a fence	<i>P. regius</i> Female	<i>Osteopilus septentrionalis</i> (Hylidae)	1 : 1	Jeanine DeNisco (pers. comm.)
Osceola County: Holopaw	Garden; spider found sitting on water filtration system attached to a well	<i>P. regius</i> Female	<i>Osteopilus septentrionalis</i> (Hylidae)	1 : 1	Loret Setters (pers. comm.)
Highlands County: Lake Placid	Ranch; spider was dragging a frog across an old plastic container	<i>P. regius</i> Female	<i>Osteopilus septentrionalis</i> (Hylidae)	1 : 1.5	Martin Fisher (pers. comm.)
N/A, Florida	N/A	<i>P. regius</i> Male	<i>Anolis sagrei</i> (Dactyloidae)	1 : 1.5	**

* A photo sent to one of the authors (GBE) by email has been inadvertently erased

** Photo posted on the 'etsi' website is no longer available at http://img2.etsystatic.com/006/0/6684602/il_fullxfull.374244

comm.). This was likely *P. bidentatus* F. O. Pickard-Cambridge, 1901, the largest known species in Central America with a maximum recorded female body length of about 1.7 cm (Eric Olson, pers. comm.; Edwards 2004). Moreover it is conceivable that large salticids such as *Hyllus* spp. in Africa and Asia, approximately the same size as *Phidippus regius*, are capable of catching small frogs or lizards.

Spiders, by and large, are generalist predators that utilize a large number of different prey categories (Riechert & Harp 1987). "Being a generalist predator has some advantages in that there are always different prey choices around" (Moore 2015). If one of their staple prey gets scarce, generalist predators can switch to alternative prey. A generalist feeding behavior is particularly advantageous in the case of cursorial spiders (e.g., *Phidippus* spp.) known to feed infrequently in the field (see Jackson 1977; Dean et al. 1987; Young 1989; Nyffeler 1999). *Phidippus regius* with its ability to occasionally capture small vertebrate prey in addition to its usual invertebrate prey, is a typical example of a predator with a generalist feeding behavior and the exceedingly broad feeding niche of this spider is presumed to improve its survival.

A literature survey conducted by us revealed that spiders from 26 families (i.e., Actinopodidae, Agelenidae, Anyphaenidae, Araneidae, Barychelidae, Clubionidae, Corinnidae, Ctenidae, Ctenizidae, Cybaeidae, Cyrtaucheniidae, Desidae, Dipluridae, Gnaphosidae, Hexathelidae, Idiopidae, Liocranidae, Lycosidae, Nephilidae, Pholcidae, Pisauridae, Sparassidae, Tetragnathidae, Theraphosidae, Theridiidae, and Trechaleidae) have been reported so far to include vertebrates in their diets (compare Butler & Main 1959; Vollrath 1978; McCormick & Polis 1982; Brunet 1998; Gopi Sundar 1998; Menin et al. 2005; Toledo 2005; Wehtje 2007; Pertel et al. 2010; Almeida-Reinoso & Coloma 2012; Brooks 2012; Ficetola et al. 2012; Nyffeler & Knörnschild 2013; Rojas-Morales & Escobar-Lasso 2013; Nyffeler & Pusey 2014; Australian Museum 2016; Kerr-Dineen 2016). Together with the Salticidae reported in this paper, spiders from 27 out of 114 families (= 24% of all families) are currently known to occasionally consume vertebrate prey.

ACKNOWLEDGEMENTS

We wish to thank the following scientists for assistance in identifying vertebrate prey: David Blackburn (Florida Museum of Natural History, Gainesville), J. Whitfield Gibbons (University of Georgia), James Hanken (Harvard University), and Jonathan Losos (Harvard University). We also wish to thank C. Kenneth Dodd (University of Florida) for habitat information. We also wish to acknowledge Stanislav Macik (Czech Arachnological Society) for granting us permission to use unpublished information on the incident witnessed in Costa Rica and Eric Olson (Brandeis University) for information on jumping spiders in Costa Rica. Furthermore, we thank those Floridians (see Table and figure legends) who provided unpublished information and photographs. Last but not least, we wish to thank Thomas Jones (East Tennessee State University) and two anonymous reviewers for their valuable comments on an earlier draft.

LITERATURE CITED

- Almeida-Reinoso, D. & L.A. Coloma. 2012. *Rulyrana orejuela* (Orejuela Glass Frog). Predation. *Herpetological Review* 43:126.
- Anderson, J.F. 1990. The size of spider eggs and estimates of their energy content. *Journal of Arachnology* 18:73–78.
- Anderson, J.F., H. Rahn & H.D. Prange. 1979. Scaling of supportive tissue mass. *Quarterly Review of Biology* 54:139–148.
- Australian Museum 2016. Red-headed mouse spider, *Missulena occatoria*. Online at <http://australianmuseum.net.au/red-headed-mouse-spider-missulena-occatoria> Accessed 5 January 2016.
- Brooks, D.M. 2012. Birds caught in spider webs. A synthesis of patterns. *Wilson Journal of Ornithology* 124:345–353.
- Brunet, B. 1998. *Spiderwatch: A Guide to Australian Spiders*. New Holland Publishers, Sydney.
- Butler, W.H. & B.Y. Main. 1959. Predation on vertebrates by mygalomorph spiders. *Western Australian Naturalist* 7:52.

- Costa-Pereira, R., F.I. Martins, E.A. Sczesny-Moraes & A. Brescovit. 2010. Predation on young treefrog (*Osteocephalus taurinus*) by arthropods (Insecta, Mantodea and Arachnida, Araneae) in Central Brazil. *Biota Neotropica* 10:469–472.
- Dean, D.A., W.L. Sterling, M. Nyffeler & R.G. Breene. 1987. Foraging by selected spider predators on the cotton fleahopper and other prey. *Southwestern Entomologist* 12:263–270.
- Edwards, G.B. 1980. Taxonomy, ethology, and ecology of *Phidippus* (Araneae: Salticidae) in eastern North America. PhD Dissertation, University of Florida, Gainesville.
- Edwards, G. B. 1990. Anecdotal field notes on Florida *Phidippus* (Araneae: Salticidae), with notes on territoriality in *P. regius*. *Peckhamia* 2(6):96–100.
- Edwards, G.B. 2004. Revision of the jumping spiders of the genus *Phidippus* (Araneae: Salticidae). *Occasional Papers of the Florida State Collection of Arthropods* 11:1–156.
- Edwards, G.B., J.F. Carroll & W.H. Whitcomb. 1974. *Stoidis aurata* (Araneae: Salticidae), a spider predator of ants. *Florida Entomologist* 57:337–346.
- Ficetola, G.F., R. Pennati & R. Manenti. 2012. Do cave salamanders occur randomly in cavities? An analysis with *Hydromantes strinatii*. *Amphibia-Reptilia* 33:251–259.
- Goin, C.J. 1943. The lower vertebrate fauna of the water hyacinth community in northern Florida. *Proceedings of the Florida Academy of Sciences* 6:143–154.
- Gopi Sundar, K.S. 1998. Observations on gnaphosid spider preying on *Philautus* species. *Hamadryad* 23:76.
- Greenstone, M.H. & A.F. Bennett. 1980. Foraging strategy and metabolic rate in spiders. *Ecology* 61:1255–1259.
- Jackson, R.R. 1977. Prey of the jumping spider *Phidippus johnsoni* (Araneae: Salticidae). *Journal of Arachnology* 5:145–149.
- Jackson, R.R., X.J. Nelson & G.O. Sune. 2005. A spider that feeds indirectly on vertebrate blood by choosing female mosquitoes as prey. *Proceedings of the National Academy of Sciences of the United States of America* 102:15155–15160.
- Jeffery, B.M., J.H. Waddle & A.J. Maskell. 2004. *Hyla cinerea* (Green Treefrog). Predation. *Herpetological Review* 35:158.
- Kerr-Dineen, L. 2016. Tiny spider catches a giant snake in its web for an inspiring victory. *USA Today* February 12, 2016. Online at <http://ftw.usatoday.com/2016/02/tiny-spider-catches-a-giant-snake-in-its-web-for-an-inspiring-victory> Accessed 1 November 2016.
- McCormick, S. & G.A. Polis. 1982. Arthropods that prey on vertebrates. *Biological Reviews* 57:29–58.
- Meehan, C.J., E.J. Olson, M.W. Reudink, T.K. Kyser & R.L. Curry. 2009. Herbivory in a spider through exploitation of an ant–plant mutualism. *Current Biology* 19:R892–R893.
- Meiri, S. 2010. Length–weight allometries in lizards. *Journal of Zoology* 281:218–226.
- Menin, M., D. de Jesus Rodrigues & C.S. de Azevedo. 2005. Predation on amphibians by spiders (Arachnida, Araneae) in the Neotropical region. *Phyllomedusa: Journal of Herpetology* 4:39–47.
- Moore, P.A. 2015. *The Hidden Power of Smell: How Chemicals Influence Our Lives and Behavior*. Springer International Publishing, Cham, Heidelberg, New York, Dordrecht, London.
- Nyffeler, M. 1999. Prey selection of spiders in the field. *Journal of Arachnology* 27:317–324.
- Nyffeler, M. & M. Knörnschild. 2013. Bat predation by spiders. *PLoS One* 8:e58120.
- Nyffeler, M. & B.J. Pusey. 2014. Fish predation by semi-aquatic spiders: a global pattern. *PLoS One* 9:e99459.
- Nyffeler, M., E.J. Olson & W.O.C. Symondson. 2016. Plant-eating by spiders. *Journal of Arachnology* 44:15–27.
- O'Neill, E.D. & R. Boughton. 1996. PVC pipe refugia: A sampling method for studying treefrogs. *Proceedings of the 1995 North American Amphibian Monitoring Program Conference*, 27 September–1 October 1995, Toronto, Ontario, Canada.
- Owen, R.D. & S.A. Johnson. 1997. *Pseudacris ocularis* (Little Grass Frog). Predation. *Herpetological Review* 28:200.
- Pekár, S. & S. Toft. 2015. Trophic specialisation in a predatory group: the case of prey-specialised spiders (Araneae). *Biological Reviews* 90:744–761.
- Pertel, W., R.L. Teixeira & R.B. Ferreira. 2010. Comparison of diet and use of bromeliads between a bromelicolous and a bromeligenous anuran at an inselberg in the southeastern of Brazil. *Caldasia* 32:149–159.
- Riechert, S.E. & J.M. Harp. 1987. Nutritional ecology of spiders. Pp. 645–672. *In* *Nutritional Ecology of Insects, Mites, Spiders and Related Invertebrates*. (F. Slansky & J.G. Rodriguez, eds.). John Wiley & Sons, New York.
- Robinson, M.H. & C.E. Valerio. 1977. Attacks on large or heavily defended prey by tropical salticid spiders. *Psyche* 4:1–10.
- Rojas-Morales, J.A. & S. Escobar-Lasso. 2013. Notes on the natural history of three glass frogs species (Anura: Centrolenidae) from the Andean Central Cordillera of Colombia. *Boletín Científico del Museo de Historia Natural de la Universidad de Caidas* 17:127–140.
- Ross, L.K. 2008. A jumping spider feeding on an earthworm. *Peckhamia* 71(1):1–2.
- Senczuk, G., A. García, P. Colangelo, F. Annesi & R. Castiglia. 2014. Morphometric and genetic divergence in island and mainland populations of *Anolis nebulosus* (Squamata: Polychrotidae) from Jalisco (Mexico): an instance of insular gigantism. *Italian Journal of Zoology* 81:204–214.
- Stuckert, A.M., J.P. Stone, J.R. Asper, M.G. Rinker, C.L. Rutt, N.C. Trimmer et al. 2009. Microhabitat use and spatial distribution in Picado's Bromeliad Treefrog, *Isthmohyla picadoi* (Anura, Hylidae). *Phyllomedusa: Journal of Herpetology* 8:125–134.
- Toledo, L.F. 2005. Predation of juvenile and adult anurans by invertebrates: current knowledge and perspectives. *Herpetological Review* 36:395–399.
- Vollrath, F. 1978. A close relationship between two spiders (Arachnida, Araneidae): *Curimagua bayano* synecious on a *Diplura* species. *Psyche* 85:347–353.
- Wehtje, W. 2007. Trapdoor spider (Cyrtacheniidae; *Aptostichus*) depredates western snowy plover chick (*Charadrius alexandrinus*). *Southwestern Naturalist* 52:435–436.
- World Spider Catalog. 2017. World Spider Catalog. Natural History Museum Bern, online at <http://wsc.nmbe.ch>, version 17.5, last accessed 16 January 2017.
- Young, O.P. 1989. Field observations of predation by *Phidippus audax* (Araneae: Salticidae) on arthropods associated with cotton. *Journal of Entomological Science* 24:266–273.

Manuscript received 2 February 2017, revised 8 March 2017.



Nyffeler, Martin, Edwards, G. B., and Krysko, Kenneth L. 2017. "A vertebrate-eating jumping spider (Araneae: Salticidae) from Florida, USA." *The Journal of arachnology* 45(2), 238–241. <https://doi.org/10.1636/joa-17-011.1>.

View This Item Online: <https://www.biodiversitylibrary.org/item/274742>

DOI: <https://doi.org/10.1636/joa-17-011.1>

Permalink: <https://www.biodiversitylibrary.org/partpdf/289907>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In Copyright. Digitized with the permission of the rights holder

Rights Holder: American Arachnological Society

License: <https://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <http://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.