

SHORT COMMUNICATION

Harvestmen as predators of bird nestlings

Thomas J. Benson¹: Department of Biological Sciences and Environmental Sciences Program, Arkansas State University, P.O. Box 599, Jonesboro, Arkansas 72467 USA. E-mail: tjbenenson@gmail.com

Neil A. Chartier: Fisheries and Wildlife Sciences Program, North Carolina State University, P.O. Box 7646, Raleigh, North Carolina 27695 USA

Abstract. We report the first confirmed cases of harvestmen (Opiliones) feeding upon live vertebrates. In June and July of 2007, in two independent studies of the ecology of Swainson's warblers (*Limnothlypis swainsonii* Audubon) in Arkansas and North Carolina, we recorded predation of nestlings at two separate nests by harvestmen. Both events were nocturnal, involved relatively young and dependent nestlings, and contributed to or resulted in the death of one or more nestlings. One event involved a group of at least four harvestmen with one to four individuals feeding upon a brown-headed cowbird (*Molothrus ater*) nestling at one time, and the other involved up to two harvestmen present at the nest, but only one individual fed upon the two Swainson's warbler nestlings.

Keywords: Diet, Opiliones, opportunism, predation, vertebrate prey

Harvestmen (Opiliones) are noted opportunists, with individuals documented feeding upon live and dead invertebrates, fungi, fruit, and other plant matter (Halaj and Cady 2000; Machado and Pizo 2000; Acosta and Machado 2007). Additionally, harvestmen have been observed to feed upon dead vertebrates, including birds, mammals, and frogs (Sankey 1949; Castanho and Pinto da Rocha 2005; Acosta and Machado 2007). Although some harvestmen are ambush predators that feed on relatively small food items, other species hunt actively in groups and consume relatively large prey (Acosta and Machado 2007). Harvestmen may subdue large prey over a relatively long period of time while feeding, often while the prey item is still alive, and feeding consists of consuming small pieces of the food item (Acosta and Machado 2007). Here, we report two independent cases of harvestmen attacking and feeding upon live vertebrates (bird nestlings). We observed these events as part of two independent studies on the breeding biology and nest predators of Swainson's warblers (*Limnothlypis swainsonii* Audubon) in Arkansas and North Carolina in June and July 2007, respectively.

The first event occurred on 3 and 4 June 2007 at White River National Wildlife Refuge (WRNWR) in eastern Arkansas. Located in Arkansas, Desha, Phillips, and Monroe counties, WRNWR, at >62,000 ha, is among the largest continuous tracts of bottomland hardwood forest remaining in the Mississippi Alluvial Valley (see Benson et al. 2009). On 15 May 2007, we found a Swainson's warbler nest 1.6 m above the ground in a cane (*Arundinaria gigantea*) plant with four warbler eggs. Later the same day, we installed a time-lapse video system at the nest that included a weatherproof camera with infrared diodes to allow recording at night (Benson et al. 2010). Over the next 7 days, three of the Swainson's warbler eggs were removed by brown-headed cowbirds (*Molothrus ater*), an obligate brood parasite that lays its eggs in the nests of other species, and one cowbird egg was laid. On 2 June at 11:24 h, the cowbird egg hatched. For the next 1.5 days, the female Swainson's warbler continued to incubate the remaining Swainson's warbler egg and brood the newly hatched brown-headed cowbird nestling and began to make periodic trips from the nest to gather food for the nestling. The male Swainson's warbler also periodically delivered food for the nestling. The female

was last on the nest from 18:57 to 20:20 h on 3 June after which she left and did not return until the next morning at 05:44 h.

At 23:56 h on 3 June, a harvestman arrived at the nest and began biting the cowbird nestling on the back of the neck at 23:59 h and stopped after about 2 min. The harvestman appeared to bite the nestling several more times before moving to the nest rim 3 min later where it appeared to move one of its forelegs over the nestling for about 6 min. The harvestman continued to alternate between biting the nestling and moving around on the nest cup for several minutes at a time before leaving the nest for 23 min; at this time the nestling was still able to rotate its body within the nest cup. A harvestman returned to the nest and resumed biting the nestling from 00:56 to 02:25 h; it appeared to bite the head or neck of the nestling as the bird began to move less vigorously but continued to make small movements. At 02:25 h, two additional harvestmen appeared at the nest and immediately climbed onto the nestling while the original harvestman continued to take bites. One of the new harvestmen continued to move around, while the other appeared to participate in the biting and presumably feeding upon the nestling; the nestling continued to make occasional slight twitching movements. This feeding continued with one to four harvestmen until 05:11 h. The nestling stopped twitching around 0400 h and appeared to be dead. During the 5.2 h-long event, at least one harvestman was present at the nest $\geq 94\%$ of the time. At 05:44 h, the female Swainson's warbler returned to the nest and began incubating/brooding. At 06:08 h, the male Swainson's warbler arrived at the nest with food and the female began to poke the dead nestling; at 06:10 h one of the Swainson's warblers removed the dead nestling from the nest, a typical behavior when nestlings die.

The second event occurred on 12 and 13 July 2007 at the Roanoke River National Wildlife Refuge (RRNWR), a temporarily to semi-permanently flooded forested wetland in eastern North Carolina. RRNWR is located on the lower Roanoke River in Bertie County, NC, covers 8,490 ha, and is among the largest intact and relatively undisturbed bottomland forests remaining in the South Atlantic Coastal Plain (Lynch 1981). The primary natural communities at RRNWR are Coastal Plain levee forest and cypress (*Taxodium distichum*) - tupelo (*Nyssa aquatica*) swamp forest (Schafale and Weakley 1990).

On 27 June 2007, we found a Swainson's warbler nest with three warbler eggs. The nest was 1.7 m above the ground in a giant cane plant. Later that day, we installed a time-lapse, infrared video system

¹ Current address: Illinois Natural History Survey, 1816 South Oak Street, Champaign, Illinois 61820 USA

at the nest similar to that described for the Arkansas study site above. This was the fourth nest attempt by this female that was monitored with time-lapse video. The first nest was abandoned on 24 May after the death of a brown-headed cowbird nestling, the second, also parasitized by a cowbird, was abandoned on 3 June after a rain storm, and the third was depredated by a rat snake (*Elaphe obsoleta*) on 20 June. Her fourth nest contained three Swainson's warbler eggs; the first hatched on 10 July at 16:19 h, the second egg hatched on 11 July between 09:30 and 10:32 h, and the last egg did not hatch. For the next 1.5 days, the female continued to brood the two nestlings and incubate the unhatched egg, and began to periodically leave the nest to gather food for the nestlings. During this period, the male also periodically delivered food to the nestlings. The female was last on the nest from 19:56 to 23:26 h on 12 July.

At 23:37 h on 12 July, ants (likely *Aphaenogaster* sp.) arrived at the nest and soon began biting the nestlings. At 00:34 h on 13 July, the first harvestman arrived at the nest, touched the nestlings with its forelegs, and moved out of camera view. Seven min later, with four or five ants present and biting the nestlings, a harvestman arrived, bit a nestling on the head causing it to violently squirm, and moved out of camera view. From 00:50 to 00:58 h, the harvestman alternated between biting the nestling, standing on the nest rim, and standing over the nestling while touching it with its forelegs before leaving the camera view for 10 min. At 01:14 h, as the first harvestman continued to move around the nest touching the nestlings with its forelegs, a second harvestman arrived then moved out of camera view 1 min later without interacting with the nestlings. As four or more ants continued moving over and biting the nestlings, the harvestman continued to move around the nest rim, touching the nestlings with its forelegs, and occasionally biting the nestlings until again leaving at 01:58 h. At this point, the nestlings continued to make small, but less vigorous movements. At 02:24 h, as three or more ants continued to bite the nestlings occasionally, a harvestman moved over a nestling and bit it on the neck, lifting the nestling slightly, and then moved to the nest rim. For the next 30 min, the harvestman alternated between biting the head, neck, and back of the nestlings and standing on the nest rim; ants appeared to briefly drive the harvestman out of camera view twice during this period. The nestlings were now only occasionally making slight twitching movements. While being harassed by ants, the harvestman continued to move across, touch, or bite the nestlings periodically from 03:09 to 04:37 h and appeared to be driven away from the nest three times by ants. By 03:26 h, neither of the nestlings was moving, and both were presumed to have died. During the ~4 h-long event, a harvestman was at or near the nest approximately 70% of the time. The Swainson's warbler female visited the nest at least twice during the night, but did not sit on the nest, touch the egg or nestlings, or attempt to remove ants or harvestmen. She returned to the nest at 05:46 h, sat on the nest for 12 min, and then carried away a dead nestling. She returned at 06:02 h, sat on the nest for 20 min, and then removed the remaining dead nestling. After incubating the remaining egg for a short time, the Swainson's warbler female abandoned the nest later that morning.

Both events were similar in that they largely occurred between midnight and 05:00 h, involved 1- to 2-day-old nestlings, which are featherless and <5 g, in situations where the female was absent but normally would have been brooding, and resulted in or contributed to the death of the nestlings. In both cases, the harvestmen made repeated trips away from the nest and alternated between biting nestlings and standing on the nest rim. Although the events at these two widely separated locations were similar, there were notable differences. The WRNWR event involved multiple harvestmen simultaneously attacking the nestling, which conclusively resulted in the mortality of the cowbird. However, whether mortality resulted directly from harvestman bites or was facilitated by a stress response of the nestling is unknown. The RRNWR event involved only one harvestman attacking the nestlings, although two individuals were

observed at the nest on at least one occasion. Additionally, the RRNWR event involved the nestlings simultaneously being attacked by ants. Because up to 10 ants were present and apparently biting the nestlings during most of the observed 4 h event and biting by the harvestman was more sporadic, the mortality of the nestlings in this case may have been primarily caused by the ants. Nonetheless, despite being driven away by the ants on several occasions, the harvestman spent considerable time biting the nestlings. Unfortunately, the placement and resolution of the cameras did not allow us to determine the extent of injuries to the nestlings.

To our knowledge, this is the first confirmed case of harvestmen feeding on live vertebrates. Harvestmen are known to feed upon dead vertebrates (Sankey 1949). Likewise, Castanho and Pinto da Rocha (2005) found harvestmen feeding on frogs, although it was unknown whether the prey items were captured alive. Our observations are consistent with the known opportunism of harvestmen, and the observation that they forage above the ground (Todd 1949; Adams 1984). Likewise, as we observed, harvestmen primarily forage at night and may devote considerable time to searching for prey during this period (Pereira et al. 2004; Acosta and Machado 2007). Unfortunately, the quality of the video footage did not allow us to identify the harvestmen or ants with greater taxonomic resolution.

When they hatch, songbird nestlings are featherless, have closed eyes, and have limited mobility. For several days, these nestlings are largely helpless and, because of their limited perception and mobility, they might appear functionally similar to carrion for harvestmen. This similarity to carrion likely accounts for the long time period that harvestmen were at or near the nest at both sites. Like other passerines, female Swainson's warblers normally brood nestlings at night until they are fully feathered and are presumably less vulnerable to attack by invertebrate predators. The reason that each warbler female was absent from the nest in these two cases is unknown, but may be related to the presence of biting ants in the second case. Indeed, the nestling period is a vulnerable time for predation by other arthropods, and ants have been observed to cause nest failures for other songbird species (Stake and Cimprich 2003; Reidy et al. 2008) or, as in the RRNWR event, contribute to Swainson's warbler nest failure. Although young songbird nestlings generally are not vulnerable to nocturnal predation by opportunistic groups such as harvestmen because females usually brood during this period, individual harvestmen may exploit these opportunities when present. However, these appear to be rare events. At WRNWR and RRNWR, with >40,000 h of nest monitoring with infrared video cameras, these were the only two recorded events where harvestmen actually fed on nestlings, although they are often present around nests but presumably deterred by the presence of adult birds or older nestlings. Nonetheless, these events indicate that harvestmen display these opportunistic behaviors at widely separated geographic locations, and this may apply beyond bird nestlings to other relatively immobile vertebrates.

ACKNOWLEDGMENTS

In Arkansas, funding for this research was provided by the Arkansas Game and Fish Commission (AGFC) and U.S. Fish and Wildlife Service (USFWS) through a State Wildlife Grant. Additional funds were received from a cost-share program with USFWS and Arkansas State University. We thank C. Rideout and L. Barnhill, formerly of AGFC, for support of this research and help securing initial funding. R. Hines, C. Hunter, and S. Reagan of USFWS provided invaluable assistance. We are grateful to E. Huskinson, N. Anich, C. Roa, J. Sardell, M. Albrechtsen, C. McCarroll, and J. O'Connell for providing valuable field assistance. We thank T. McKay and the Avian Ecology Lab at Arkansas State University for reviewing and providing comments on the video footage.

In North Carolina, funding for this research was provided by North Carolina State University (NCSU), U.S. Geological Survey, USFWS, North Carolina Museum of Natural Sciences (NCMNS), North Carolina Wildlife Resources Commission, The Nature Conservancy, Georgia Ornithological Society, and the Carolina Bird Club. We thank R. Lancia (NCSU), J. Gerwin (NCMNS), and Jean Richter (USFWS) for help in securing initial funding for this research and for their continued support. We are grateful to M. Morales, E. Pannkuk and R. Desjardins for providing valuable field assistance. We thank C. Sorenson (NCSU) for reviewing and providing comments on the video footage. We thank N. Anich, J. Bednarz, J. Gerwin, R. Lancia, and two anonymous reviewers for comments on the manuscript.

LITERATURE CITED

- Acosta, L.E. & G. Machado. 2007. Diet and foraging. Pp. 309–338. *In* Harvestmen: the Biology of Opiliones. (R. Pinto-da-Rocha, G. Machado & G. Giribet, eds.). Harvard University Press, Cambridge, Massachusetts.
- Adams, J. 1984. The habitat and feeding ecology of woodland harvestmen (Opiliones) in England. *Oikos* 42:361–370.
- Benson, T.J., N.M. Anich, J.D. Brown & J.C. Bednarz. 2009. Swainson's warbler nest-site selection in eastern Arkansas. *Condor* 111:694–705.
- Benson, T.J., J.D. Brown & J.C. Bednarz. 2010. Identifying predators clarifies predictors of nest success in a temperate passerine. *Journal of Animal Ecology* 79:225–234.
- Castanho, L.M. & R. Pinto da Rocha. 2005. Harvestmen (Opiliones: Gonyleptidae) predating on treefrogs (Anura: Hylidae). *Revista Iberica de Aracnologia* 11:43–45.
- Halaj, J. & A.B. Cady. 2000. Diet composition and significance of earthworms as food of harvestmen (Arachnida: Opiliones). *American Midland Naturalist* 143:487–491.
- Lynch, J.M. 1981. Roanoke River preserve design project. North Carolina Natural Heritage Program, Raleigh, North Carolina, and The Nature Conservancy, North Carolina Chapter, Durham, North Carolina.
- Machado, G. & M.A. Pizo. 2000. The use of fruits by the Neotropical harvestman *Neosadocus variabilis* (Opiliones, Laniatores, Gonyleptidae). *Journal of Arachnology* 28:357–360.
- Pereira, W., A. Elpino-Campos, K. Del-Claro & G. Machado. 2004. Behavioral repertory of the neotropical harvestman *Ilhaia cuspidata* (Opiliones, Gonyleptidae). *Journal of Arachnology* 32:22–30.
- Reidy, J.L., M.M. Stake & F.R. Thompson, III. 2008. Golden-cheeked warbler nest mortality and predators in urban and rural landscapes. *Condor* 110:458–466.
- Sankey, J.H.P. 1949. Observations on food, enemies and parasites of British harvest-spiders (Arachnida, Opiliones). *Entomologist's Monthly Magazine* 85:246–247.
- Schafale, M.P. & A.S. Weakley. 1990. Classification of the natural communities of North Carolina. Third Approximation. North Carolina Natural Heritage Program, Raleigh, North Carolina.
- Stake, M.M. & D.A. Cimprich. 2003. Using video to monitor predation at black-capped vireo nests. *Condor* 105:348–357.
- Todd, V. 1949. The habits and ecology of the British harvestmen (Arachnida, Opiliones), with special reference to those of the Oxford district. *Journal of Animal Ecology* 18:209–229.

Manuscript received 27 November 2009, revised 3 March 2010.