LRH: Zenzal et al.

RRH: Short Communications

A Tennessee Warbler (*Oreothlypis peregrina*) captured in the web of a golden silk orb-weaver (*Nephila clavipes*)

Theodore J. Zenzal Jr.[1,2,3]*, Liliana Calderon[4‡], Joshua Lefever[2‡], and Vincent Weber[2‡]

[1]Wetland and Aquatic Research Center, U.S. Geological Survey, Lafayette, LA

[2]School of Biological, Environmental, and Earth Sciences, University of Southern Mississippi, Hattiesburg, MS

[3]Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL

[4]Deparment of Entomology and Wildlife Ecology, University of Delaware, Newark, DE

[‡] These authors contributed equally

*Corresponding author: tzenzal@usgs.gov

Abstract.—During migration, transient birds usually find themselves stopping in unfamiliar habitats in order to rest and refuel before resuming migratory flight. Here we document, to our knowledge, the first case of a Tennessee Warbler (*Oreothlypis peregrina*) entrapped in a spider web. The warbler's tarsus became caught in the mooring thread of a golden silk orb-weaver (*Nephila clavipes*) web and the bird was unable to free itself, resulting in death. While the role of spider web-related mortalities are likely minimal, they may represent a type of additive mortality that has been largely unconsidered during migration. Given the spatiotemporal overlap in the prevalence of spider webs and movement of migratory birds, researchers should document and report such anecdotal observations to determine the role spiders may play in mortality events during migration.

Keywords: Alabama, autumn, migration, mortality, spider web, stopover, unfamiliar habitat

Migratory birds take advantage of temperate breeding grounds and tropical wintering areas to increase their overall fitness. This strategy is used by approximately two billion birds (Horton et al. 2019), which makes up two-thirds of all birds breeding in eastern North America (Rappole 1995). These migratory individuals undertake movements spanning thousands of kilometers, which requires obtaining adequate food resources to build fuel reserves. The majority of individuals rarely make non-stop flights between breeding and wintering areas, rather they must stop *en route* to refuel in typically unfamiliar habitats (Moore et al. 2005). It is during stopovers in unfamiliar habitats that individuals may suffer mortality.

Mortality is thought to be substantial during migration (e.g., Sillett and Holmes 2002, Paxton et al. 2017, Rockwell et al. 2017, Ward et al. 2018), including predation, building strikes, starvation, and miscellaneous natural sources of mortality (e.g., Lindström 1990, Graham 1997, Brooks 2012, Zenzal et al. 2013 and references therein). While predation, building strikes, and starvation/exhaustion have been monitored or tested (e.g., Lindström 1990, Klaassen and Biebach 1994, Machtans et al. 2013, Loss et al. 2014), other natural sources of mortality are typically discreet, anecdotal events. For example, small landbirds have experienced mortality from accidental sources, such as vegetation or spider webs (e.g., Nealen and Nealen 2000, Hinam et al. 2004, Brooks 2012, Walther 2016). Spider web induced mortalities, in particular, have been fairly well documented, but the cause of mortality can differ on a case-by-case basis. In some instances, spiders (e.g., *Nephila* sp.) may consume birds that become ensnared in a web, while in other cases a bird may perish from simply being trapped in a web and unable free itself (Brooks 2012, Walther 2016). When Brooks (2012) reviewed cases of birds entrapped in spider webs, he found that all birds wrapped in silk were unable to free themselves and invariably perished. When not wrapped in silk, the majority of birds were able to free themselves without

48 human intervention. Here, we describe the first known occurrence of a Tennessee Warbler
49 (*Oreothlypis peregrina*) mortality due to a spider web.

50 We made our observation during daily landbird migration banding operations at a station
51 within the Bon Secour National Wildlife Refuge on the Fort Morgan Peninsula of Alabama,
52 USA. The station is located on the north side of the peninsula within the Refuge's Sand Bayou
53 Unit between Bon Secour Bay and Oyster Bay (30.27°N, 87.75°W). The habitat is dominated by
54 pines (*Pinus elliotti, P. taeda*) and oaks (*Quercus virginiana, Q. myrtifolia, Q. marilandica, Q.*
55 *hemisphaerica*) in the canopy and oaks (*Quercus* sp.), huckleberry (*Gaylussacia* sp.), holly (*Ilex*
56 sp.), jasmine (*Gelsemium* sp.), and blueberry (*Vaccinium* sp.) in the understory. The Alabama
57 coast attracts large numbers of migrants during autumn (e.g., Woodrey and Moore 1997, Kelly et
58 al. 1999, Deppe et al. 2015, Zenzal and Moore 2016), and represents the last potential stopover
59 habitat before an individual must negotiate crossing the Gulf of Mexico. The banding station
60 operated daily, weather permitting, from 31 August through 3 November 2018. Nylon mist nets
61 were open from approximately 30 minutes prior to sunrise, closed by 13:00 (central daylight
62 time), and checked every 30 minutes.

63 At 650 (CDT) on 13 October 2018 a hatch-year Tennessee Warbler was found ensnared in the
64 mooring thread of an abandoned golden silk orb-weaver web. The web was located ~10 m high
65 in an oak tree over a mist net at the banding site. The warbler's tarsus was wrapped in the
66 mooring thread only and the bird did not make contact with other parts of the web. We observed
67 the warbler struggle for ~3–4 h before expiring, likely due to exhaustion, dehydration, or heat
68 stroke. The warbler remained in the mooring thread for some days, desiccating over time rather
69 than being consumed by a spider.

It is apparent that spider webs, especially those of orb-weavers, can be hazardous for small landbirds as they move throughout the habitat (e.g., Graham 1997, Brooks 2012, Walther 2016, Queller and Murphy 2019). The hazards of spider webs may increase for landbird migrants that find themselves in unfamiliar stopover habitat encountered *en route*. In most documented scenarios, birds that are not wrapped in silk are generally able to free themselves, whereas those that become engulfed in silk usually do not survive (Brooks 2012). However, the Tennessee Warbler in our observation was unable to free itself when its tarsus became ensnared by just the mooring thread of an abandoned golden silk orb-weaver web.

While only a small minority of birds not wrapped in silk were unable to free themselves (Brooks 2012), the Tennessee Warbler's inability to free itself may be attributed to its unique scenario. This individual presumably flew a long distance the night before alighting on the northern coast of the Gulf of Mexico near our study site. While we were not able to examine it due to the height at which it was suspended, it is possible the individual was already exhausted from its migratory flight and was unable to generate enough power to free itself. Most Tennessee Warblers captured on the Fort Morgan peninsula during autumn migration tend to have moderate fat scores (score = 3; Helms and Drury 1960) and a mean mass of 10.6 g (standard deviation = 1.7 g, range = 6.3-15.6 g; n = 819; FR Moore, University of Southern Mississippi, 2019, pers. comm.), this average mass is just below the average mass (11 g) of birds reported being entrapped by spider webs (Brooks 2012). The relatively small size of the bird was likely no match for the strength of the mooring thread of a golden silk orb-weaver, whose web can span 1–2 m in diameter (Weems and Edwards 2011) and has been identified as the most common genus of spider to entrap birds (Brooks 2012, Walther 2016) as well as bats (Nyffeler and Knörnschild 2013).

93 The ability for migrants to negotiate challenges during migration is directly related to
94 their survival and subsequent fitness (Moore 2018). Migration is a time of high mortality during
95 the annual cycle (e.g., Sillett and Holmes 2002, Paxton et al. 2017, Rockwell et al. 2017, Ward et
96 al. 2018), when individuals must balance resource acquisition, competition, and predation in
97 unfamiliar habitats (Moore 2018). It is in these unfamiliar areas that spiders, such as orb-weavers
98 (e.g., *Nephila* sp.), may present a hazard to unsuspecting migrants. While spider webs likely
99 account for a small number of mortalities during migration, the impact of spider web-related
100 mortality is likely biased low as most of these incidences are probably unobserved or unreported
101 (see Brooks 2012, Walther 2016). As Queller and Murphy (2019) point out, it is indeed curious
102 that there are few reports in the United States and Canada given the range of orb-weavers
103 throughout the temperate zone. Yet spider web-related mortalities represent a type of additive
104 mortality on migratory populations that contributes to the already high frequency of mortality
105 that occurs during migration.

106 Here we document the first record of a Tennessee Warbler captured in a spider web as
107 well as the first known mortality of an avian species to occur due to a spider web in Alabama.
108 The novelty of both aspects is surprising given that Tennessee Warblers are commonly observed
109 during the breeding season and autumn migration (Sullivan et al. 2009, eBird 2017) across the
110 United States and Canada when orb-weavers tend to be present (e.g., Weems and Edwards
111 2011). Further, in Baldwin County, Alabama alone over 1,100 Tennessee Warblers have been
112 banded during autumn migration since 1990 (FR Moore, University of Southern Mississippi,
113 2019, pers. comm.) at a time when orb-weaver webs tend to be quite common in the region (TJZ,
114 2019, pers. observ.). Field biologists should heed the advice of Brooks (2012) to keep good field

115 notes and report interesting natural history notes, which can provide valuable information to
116 increase our understanding of a species' ecology and natural history.

117

Acknowledgements

We thank the Bon Secour National Wildlife Refuge for allowing us to work on their property. We are grateful for constructive comments from EJ Lain, FR Moore, MP Ward, WG Vermillion, and two anonymous reviewers that improved this manuscript. The University of Southern Mississippi, University of Illinois at Urbana-Champaign, and University of Delaware provided support, computer time, and/or copy services. This work as well as all authors were funded through the NOAA RESTORE Act Science Program (NA17NOS4510092) awarded to TJZ. Additional research funding was provided by the Alabama Ornithological Society awarded to LC. Any use of trade, firm, or product names is for descriptive purposes and does not imply endorsement by the U.S. Government.

Literature Cited

Brooks DM. 2012. Birds caught in spider webs: A synthesis of patterns. The Wilson Journal of Ornithology 124: 345–353.

Deppe JL, Ward MP, Bolus RT, Diehl RH, Celis-Murillo A, Zenzal TJ, Moore FR, Benson TJ, Smolinsky JA, Schofield LN, Enstrom DA, Paxton EH, Bohrer G, Beveroth TA, Raim A, Obringer RL, Delaney D, Cochran WW. 2015. Fat, weather, and date affect migratory songbirds' departure decisions, routes, and time it takes to cross the Gulf of Mexico. Proceedings of the National Academy of Sciences 112: E6331–E6338.

eBird. 2017. eBird: An online database of bird distribution and abundance [web application]. Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org

Graham DL. 1997. Spider webs and windows as potentially important sources of hummingbird mortality. Journal of Field Ornithology 68: 98–101.

Helms CW, Drury WH. 1960. Winter and migratory weight and fat field studies on some North American buntings. Bird-Banding 31: 1–40.

Hinam HL, Sealy SG, Underwood TJ. 2004. Ruby-throated Hummingbird, Archilochus colubris , entanglements in burdock, Arctium spp., at Delta Marsh, Manitoba. The Canadian Field-Naturalist 118: 85–89.

Horton KG, Doren BMV, Sorte FAL, Cohen EB, Clipp HL, Buler JJ, Fink D, Kelly JF, Farnsworth A. 2019. Holding steady: Little change in intensity or timing of bird migration over the Gulf of Mexico. Global Change Biology 25: 1106–1118.

149 Kelly JF, Smith R, Finch DM, Moore FR, Yong W. 1999. Influence of Summer Biogeography
150 on Wood Warbler Stopover Abundance. The Condor 101: 76–85.

151 Klaassen M, Biebach H. 1994. Energetics of fattening and starvation in the long-distance
152 migratory garden warbler, *Sylvia borin*, during the migratory phase. Journal of
153 Comparative Physiology B 164: 362–371.

154 Lindström Å. 1990. The role of predation risk in stopover habitat selection in migrating
155 bramblings, Fringilla montifringilla. Behavioral Ecology 1: 102–106.

156 Loss SR, Will T, Loss SS, Marra PP. 2014. Bird–building collisions in the United States:
157 Estimates of annual mortality and species vulnerability. The Condor 116: 8–23.

158 Machtans C, Wedeles C, Bayne E. 2013. A First Estimate for Canada of the Number of Birds
159 Killed by Colliding with Building Windows. Avian Conservation and Ecology 8: 6.

160 Moore FR. 2018. Biology of landbird migrants: a stopover perspective. The Wilson Journal of
161 Ornithology 130: 1–12.

162 Moore FR, Woodrey MS, Buler JJ, Woltmann S, Simons TR. 2005. Understanding the stopover
163 of migratory birds: a scale dependent approach. In: CJ Ralph and TD Rich, editor. Bird
164 Conservation Implementation and Interegration in the Americas Albany, CA: Pacific
165 Southwest Research Station, Forest Service, U.S.D.A. p. 684–689.

166 Nealen HJ, Nealen PM. 2000. Ruby-throated Hummingbird Death by Common Burdock
167 (*Arctium minus*). Wilson Bulletin 112: 421–423.

168 Nyffeler M, Knörnschild M. 2013. Bat predation by spiders. PLOS ONE 8: e58120.

169 Paxton EH, Durst SL, Sogge MK, Koronkiewicz TJ, Paxton KL. 2017. Survivorship across the
170 annual cycle of a migratory passerine, the willow flycatcher. Journal of Avian Biology
171 48: 1126–1131.

172 Queller PS, Murphy TG. 2019. Painted Bunting (*Passerina ciris*) caught in the web of a giant
173 lichen orb-weaver spider. Wilson Journal of Ornithology 131: 191–194.

174 Rappole JH. 1995. The Ecology of Migrant Birds: A Neotropical Perspective. Washington, D.C.,
175 USA: Smithsonian Institution Press.

176 Rockwell SM, Wunderle JM, Sillett TS, Bocetti CI, Ewert DN, Currie D, White JD, Marra PP.
177 2017. Seasonal survival estimation for a long-distance migratory bird and the influence of
178 winter precipitation. Oecologia 183: 715–726.

179 Sillett TS, Holmes RT. 2002. Variation in survivorship of a migratory songbird throughout its
180 annual cycle. Journal of Animal Ecology 71: 296–308.

181 Sullivan BL, Wood CL, Iliff MJ, Bonney RE, Fink D, Kelling S. 2009. eBird: A citizen-based
182 bird observation network in the biological sciences. Biological Conservation 142: 2282–
183 2292.

184 Walther BA. 2016. Birds caught in spider webs in Asia. Avian Research 7: 16.

185 Ward MP, Benson TJ, Deppe J, Zenzal TJ, Diehl RH, Celis-Murillo A, Bolus R, Moore FR.
186 2018. Estimating apparent survival of songbirds crossing the Gulf of Mexico during
187 autumn migration. Proc. R. Soc. B 285: 20181747.

188 Weems HV, Edwards GB. 2011. Golden Silk Spider, *Nephila clavipes* (Linnaeus) (Arachnida:
189 Araneae: Tetragnathidae). 5.

190 Woodrey MS, Moore FR. 1997. Age-Related Differences in the Stopover of Fall Landbird
191 Migrants on the Coast of Alabama. The Auk 114: 695–707.

192 Zenzal TJ, Fish AC, Jones TM, Ospina EA, Moore FR. 2013. Observations of predation and
193 anti-predator behavior of Ruby-throated Hummingbirds during migratory stopover.
194 Southeastern Naturalist 12: N21–N25.

195 Zenzal TJ, Moore FR. 2016. Stopover biology of Ruby-throated Hummingbirds (*Archilochus*
196 *colubris*) during autumn migration. The Auk 133: 237–250.

197