J Ornithol (2010) 151:749–753
DOI 10.1007/s10336-010-0503-2

SHORT NOTE

Removal of nestling radio-transmitters by adult Sprague's Pipit (*Anthus spragueii*)

Ryan J. Fisher · Kimberly M. Dohms · Stephen K. Davis

Received: 26 October 2009 / Revised: 8 January 2010 / Accepted: 2 February 2010 / Published online: 24 February 2010

Abstract Fledgling birds are notoriously difficult to find and capture because of their cryptic behavior. As a result, researchers usually affix transmitters to nestlings to study aspects of post-fledging ecology. However, parents may attempt to remove nestling transmitters, which could negatively impact nestlings. We attached radio-transmitters to 95 Sprague's Pipit (*Anthus spragueii*) nestlings using a modified Rappole and Tipton leg harness. Within 1–2 days after transmitter attachment, we recorded six cases of parents removing transmitters from nestlings and depositing the transmitters outside the nest. At one of these nests, we videotaped parents pecking and pulling at nestlings that had transmitters and also dragging a nestling out of the nest by the transmitter. Of 12 video-monitored nests where we attached transmitters to nestlings, 33% had cases of parents attempting to remove transmitters by pecking and pulling at nestlings. Our observations highlight the need to closely monitor nestlings with transmitters so that researchers have the opportunity to reattach transmitters should parents remove them and to monitor the health of nestlings. Video-monitoring nests could also help to identify any unseen, negative impacts on nestlings due to transmitter attachment.

Communicated by F. Bairlein.

R. J. Fisher (✉) · K. M. Dohms
Department of Biology, University of Regina,
3737 Wascana Parkway, Regina, SK S4S 0A2, Canada
e-mail: fisherry@uregina.ca

S. K. Davis
Canadian Wildlife Service, 300-2365 Albert St., Regina,
SK S4P 2K1, Canada

Keywords *Anthus spragueii* · Nestling · Rappole and Tipton harness · Transmitter · Video

Introduction

Although many avian conservation strategies have focused on the nesting period, the post-fledging period (time between leaving the nest and migration) has been largely ignored due to difficulties following young birds (Naef-Daenzer et al. 2001). The cryptic nature of many fledglings precludes the use of banding and re-sighting techniques to study movement and survival, and, until recently, transmitters have been too large to affix to small passerines (Naef-Daenzer et al. 2001). Although transmitters weighing <1 g are now readily available, there are a variety of transmitter attachment techniques that can impact fledgling survival and behavior, and transmitter retention (i.e., the length of time a transmitter remains attached to the bird; Sykes et al. 1990). Leg harnesses (e.g., Rappole and Tipton 1991) have been successfully used to affix transmitters to nestlings with no reported negative effects on survival or behavior (Naef-Daenzer et al. 2001; Suedkamp Wells et al. 2003; Yackel Adams et al. 2006; Berkeley et al. 2007; White and Faaborg 2008). Using the Rappole and Tipton (1991) attachment technique, transmitter battery life is the primary factor determining how long researchers are able to follow fledglings, rather than transmitters falling off or being removed by birds themselves (Naef-Daenzer et al. 2001; Suedkamp Wells et al. 2003; Yackel Adams et al. 2006). While Kershner et al. (2004) suggested that fledglings may remove their own transmitters, others have documented parents pecking at or removing nestling markers, transmitters, and neck ligatures (Hamel 1974; Oniki 1981; Mattsson et al. 2006; Little et al. 2009). Most studies of fledgling ecology are limited by low sample sizes due to transmitter cost, and low nest and fledgling survival. Hence, identifying factors influencing transmitter retention are crucial for obtaining a reasonable sample of fledglings and thus making robust inferences about their ecology.

We initiated a radio-telemetry study in 2004 of Sprague's Pipit (*Anthus spragueii*; hereafter, pipit) fledglings. The inconspicuous nature and cryptic plumage of pipits necessitate the use of radio-transmitters to study fledgling ecology (Davis and Fisher 2009). Pipits have low nest (Davis 2003) and fledging survival (R.J.F., unpublished data), making each radio-tagged bird important for making rigorous inferences regarding the post-fledging period of this threatened species (COSEWIC 2000). Here, we report on six cases of parents removing transmitters from nestlings and four cases of parents attempting to remove transmitters from nestlings.

Methods

We conducted a 4-year study (2004–2008) examining the fledgling ecology of Sprague's Pipit in the Last Mountain Lake National Wildlife Area, Saskatchewan, Canada (51°2′N, 105°15′W) and the Nokomis Prairie Farm Rehabilitation Administration pasture (51°3′N, 105°13′W). We flushed adults from their nests by dragging a 25-m nylon rope, weighted with aluminum tin cans attached every 0.5 m, across the vegetation (Davis 2003). We monitored nests every 2–4 days until fledging or the nest failed. We attached transmitters to nestlings 2 or 3 days prior to the expected fledging date (Davis and Fisher 2009). At this age, pipits could only make short (10–15 cm) crawling movements while out of the nest (R. Fisher, personal observations). Primary feathers were just beginning to emerge from pins (approximately 1–2 mm) and individuals weighed between 15–20 g (K.M.D., unpublished data). We affixed 0.65- or 0.90-g radio-transmitters (model BD-2; Holohil Systems, Carp, ON, Canada) to nestlings with a modified Rappole and Tipton (1991) leg harness (Suedkamp Wells et al. 2003; Naef-Daenzer 2007). The leg harness was constructed with elastic cotton beading cord (0.5 mm diameter) and, as a modification to the Rappole and Tipton (1991) technique, we used a small drop of epoxy glue on the underside of the transmitter to fasten it to the nestling's lower back feathers. Furthermore, we also used epoxy glue to secure the leg harness knots to the transmitter. Transmitters were attached to 1–4 individuals from each brood (brood size range = 1–6 nestlings), provided that nestlings were at least 16 g. We used 16 g as a lower threshold so that transmitter mass was always near 5% of the bird's mass (Aldridge and Brigham 1988). All nestlings were banded with a federal aluminium leg band and then returned to the nest. Fledglings were radio-tracked once per day thereafter.

In 2006 and 2007, we also monitored a subset of pipit nests using video recorders as part of a separate study. We installed small (37 × 86 mm^2), color, infrared video cameras (National Electronics Bullet C/IR) at randomly selected nests. Cameras were mounted on small metal stands approximately 30 cm from the nest opening. Cameras were connected to a time-lapse 24-h videocassette recorder (VCR; Sanyo SRT 2400DC or 4040DC) and a 12-V battery located at least 50 m from the nest. We recorded video footage continuously beginning late in incubation or on hatch day until nestlings fledged or the nest failed. To identify sexes of parents on the video, we also trapped and color-banded both parents (Dohms and Davis 2009). All protocols were approved by the Canadian Wildlife Service and University of Regina President's Committee on Animal Care.

Results

We attached transmitters to 95 nestlings from 47 nests and recorded six instances where transmitters were found outside the nest, while the nestling was alive in the nest (Table 1). In each case, the harness loops were intact, the knots still glued together, and several contour feathers were attached to the bottom of the transmitter. Nestlings did not sustain any visible wounds or any significant feather loss.

Video-monitoring of 12 nests revealed four unsuccessful attempts by adults to remove transmitters from nestlings and one successful attempt. At the video-monitored nest where parents successfully removed the transmitter (nest 4; Table 1), we observed the following events. At 1137 hours on 21 July, we attached transmitters to two nestlings. We observed both parents pecking at or pulling on something in the nest nine times over a 7-h period afterwards. At 1253 hours, an unidentified parent pulled a nestling by the transmitter out of the nest. At 1435 hours, we observed the adult male pull a nestling from the nest by the transmitter. In both cases after parents pulled a nestling from the nest, the nestling quickly returned to the nest while the parent was present. Video equipment failure prevented us from observing the parents removing the transmitter that was found the following day.

At the four video-monitored nests where attempts by adults were unsuccessful in removing the transmitters, we observed the female adult attempting to remove transmitters. In three of the cases, the female returned within 2 h of the transmitter being attached (1 h 15 min, 1 h 26 min, and 1 h 49 min) and pecked and pulled at the transmitter of one nestling. At the other nest, the female returned approximately 4 h 43 min after transmitter attachment and dragged the nestling with the transmitter out of the nest.

Table 1 Details of six cases where Sprague's Pipit (*Anthus spragueii*) nestling transmitters were found outside the nest

Year	Nest number	Brood size (no. of nestlings with transmitters)	Date transmitters attached	Date transmitter(s) found outside of nest	Number of transmitters found outside of nest	Approximate distance away from nest transmitter(s) was/were found (m)	Nestling(s) successfully fledged	Nest video-monitored
2004	1	4 (2)	24 June	25 June	1[a]	5	Unknown[b]	No
2007	2	4 (2)	6 June	8 June[c]	2	40, 1	Yes	No
2007	3	4 (2)	7 June[d]	8 June	1	10	Yes	No
2007	4	4 (2)	21 July[d]	22 July	1	50	Yes	Yes
2008	5	5 (2)	11 June	12 June	1	70	Unknown[e]	No

[a] We removed this harness, due to a poor fit, from the nestling at the time of attachment, but left the transmitter glued to the back of the nestling

[b] The nestling remained in the nest for 3 days after reattaching the transmitter and on the 4th day we found the transmitter approximately 10 m from the nest. The transmitter was either removed and the fledgling had left the nest or the fledgling had been depredated

[c] We had returned to the nest on 7 June to check the nestlings and their transmitters were still properly attached

[d] Transmitters were attached to two nestlings in each of these nests; however, in each case, only one transmitter was removed

[e] Transmitter was not reattached due to inclement weather

Approximately 1 min later, the nestling returned to the nest. After the single occasions of females attempting to remove transmitters, none of them exhibited any unusual behavior toward the nestlings. At three of these nests, one nestling of the brood had a transmitter, while at the other nest, two nestlings had transmitters. At the other eight video-monitored nests, we observed no unusual behavior by adults toward nestlings with transmitters (average number of nestlings per brood with transmitters = 2, range 1–3).

Adults abandoned one nest after we attached transmitters to nestlings; however, we observed parents returning to the nest after transmitters had been attached and then abandoning the nest during inclement weather several hours later. With the exception of nestlings that were predated, all nestlings that either had their transmitters removed and re-attached or had parent's attempting to remove transmitters, fledged. Nestlings whose parents did not attempt to remove transmitters fledged approximately 1 day sooner after transmitter attachment than nestlings who had parents successfully remove or attempt to remove their transmitters (1 day vs. 2 days). Of the nestlings whose transmitters were removed or had parents attempt to remove the transmitters, 40% survived until the transmitter failed after 21 days, 30% died, and 30% could not be located due to lost transmitter signals.

Discussion

We observed adults attempting to remove nestling transmitters but did not directly observe them removing the transmitters. However, the most parsimonious explanation is that adults removed the transmitters. This is based on the fact that nestlings would have to stretch one loop of the harness (perhaps with their beaks) while "stepping" out of the stretched loop (Mattsson et al. 2006) and then remove the glued transmitter from their backs. From our experience handling nestling pipits, they are not capable of such fine motor coordination at such an early age (9–12 days old). Furthermore, nestlings have limited space to move inside the nest making this task even more difficult.

We are aware of one documented case of parents removing transmitters from nestlings (Mattsson et al. 2006) and one case in which researchers speculated that adults removed transmitters (Whittier and Leslie 2005). Mattsson et al. (2006) observed high fledgling mortality due to parents picking up nestlings by the transmitter and depositing them outside the nest. Our video observations suggest that parents tried to remove the transmitters by pecking and pulling on the transmitter and in some cases dragging the nestling from the nest. There was no effect of attempted or successful transmitter removal on fledging success. However, at two other nests without video-monitoring, we observed mortalities of two radio-marked young while the rest of the unmarked brood survived. We did not observe any wounds that could have resulted from parents pecking at the nestlings, and we suspect that these individuals were simply smothered by other members of the brood. Furthermore, having parents attempt to remove transmitters did not cause premature fledging. The effect on post-fledging survival due to parents attempting to remove transmitters was negligible; the 40% apparent survival of these individuals is higher than the 22% apparent survival of the entire population of radio-marked fledglings (R.J.F., unpublished data).

It is unclear whether previous studies (Naef-Daenzer et al. 2001; Suedkamp Wells et al. 2003; Yackel Adams et al. 2006; Berkeley et al. 2007; White and Faaborg 2008) observed negative effects of transmitter attachment, were not able to observe nestlings or fledglings after transmitter attachment, or simply did not report any observed negative effects such as those documented in our study. Researchers using radio-transmitters should report all instances of transmitter or harness malfunction, reasons why transmitters may fall off or were removed, and any negative effects on individuals that may be attributed to the transmitters. Identifying potential problems with current transmitter attachment techniques would help improve or develop new protocols in the future.

The modified Rappole and Tipton (1991) leg harness is an effective attachment technique that appears to have little impact on movement or behavior of most avian species (Naef-Daenzer et al. 2001; Suedkamp Wells et al. 2003; Yackel Adams et al. 2006; Naef-Daenzer 2007). For small, cryptic species, radio-transmitters are the only reliable way to follow fledglings. Young pipits typically remain motionless, make few vocalizations, and hide in relatively tall grass within 5 days of leaving the nest, making it difficult and time-consuming to catch or re-sight them once they have fledged (Davis and Fisher 2009). Furthermore, without transmitters, researchers might step on fledglings while trying to capture them or while walking in the nesting area.

The low percentage of transmitters (approximately 6%) that were removed from nestlings indicates that this is not a significant problem in this species. However, if the other attempts at removing transmitter had been successful, it could have reduced our sample size by another 6%. Sample sizes for studies on the post-fledging ecology of endangered or threatened species are often limited by low nest success and low post-fledging survival. Thus, identifying the causes of transmitter loss and how to mitigate those losses is extremely important for making robust inferences during this time period. Despite the acute stress on individuals that were removed from the nest and jostled by parents, there did not seem to be any chronic negative effects on nestlings. We recommend that radio-tagged nestlings be monitored daily to provide researchers with opportunities to monitor nestling health and to reattach transmitters. We encourage the use of video-monitoring of nests to help identify any unseen negative impacts on nestlings as a result of transmitter attachment and to mitigate any nestling transmitter removal issues.

Zusammenfassung

Die Entfernung von an Nestlingen befestigten Radiosendern durch adulte Präriepieper (*Anthus spragueii*)

Flügge Vögel sind aufgrund ihres heimlichen Verhaltens notorisch schwer zu finden und zu fangen. Daher befestigen Forscher üblicherweise Sender an Nestlingen, um Aspekte ihrer Ökologie nach dem Ausfliegen zu untersuchen. Allerdings könnten die Altvögel versuchen, die Sender von den Nestlingen zu entfernen, was die Nestlinge beeinträchtigen könnte. Wir haben an 95 Nestlingen des Präriepiepers (*Anthus spragueii*) Radiosender mit Hilfe eines abgewandelten Rappole und Tipton Bein-Harness befestigt. Innerhalb von 1–2 Tagen nach dem Befestigen der Sender haben wir sechs Fälle registriert, in denen die Eltern die Sender von den Nestlingen entfernten und außerhalb des Nests ablegten. An einem dieser Nester haben wir auf Video aufgezeichnet, wie die Eltern an Nestlingen mit Sendern herumpickten und -zogen, und einen Nestling zerrten sie an seinem Sender aus dem Nest. In 33% von 12 videoüberwachten Nestern, in denen wir Sender an den Nestlingen befestigt hatten, versuchten die Eltern, die Sender durch Picken und Ziehen zu entfernen. Unsere Beobachtungen zeigen die Notwendigkeit auf, besenderte Nestlinge eingehend zu überwachen, so dass Forscher die Gelegenheit haben, die Sender erneut zu befestigen, falls die Altvögel sie entfernen, sowie die Gesundheit der Nestlinge zu beobachten. Videoaufzeichnungen von Nestern könnten außerdem dabei helfen, unbemerkte negative Folgen der Besenderung für Nestlinge zu erkennen.

Acknowledgments We thank the numerous field assistants that participated in our study. We also thank G. McMaster, R. Poulin, and T. Wellicome for loaning camera systems and R.M. Brigham for comments on an earlier draft of this manuscript. Financial support was received from the Saskatchewan Fish and Wildlife Development Fund, Canadian Wildlife Service, Government of Canada Inter-departmental Recovery Fund, World Wildlife Fund Endangered Species Recovery Fund, and Natural Sciences and Engineering Research Council of Canada scholarships to R.J.F. and K.M.D.

References

Aldridge HDJN, Brigham RM (1988) Load carrying and maneuverability in an insectivorous bat: a test of the 5% "rule" of radiotelemetry. J Mammal 69:379–382

Berkeley LI, McCarty JP, Wolfenbarger LL (2007) Postfledging survival and movement in dickcissels (*Spiza americana*): implications for habitat management and conservation. Auk 124:396–409

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2000) COSEWIC assessment and status report on the Sprague's pipit (*Anthus spragueii*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario

Davis SK (2003) Nesting ecology of mixed-grass prairie songbirds in southern Saskatchewan. Wilson Bull 115:119–130

Davis SK, Fisher RJ (2009) Post-fledging movements of Sprague's pipit. Wilson J Ornithol 121:198–202

Dohms KM, Davis SK (2009) Polygyny and male parental care by Sprague's pipit. Wilson J Ornithol 121:826–830

Hamel PB (1974) Age and sex determination of nestling common grackles. Bird Band 45:16–23

Kershner EL, Walk JW, Warner RE (2004) Postfledging movements and survival of juvenile eastern meadowlarks (*Sturnella magna*) in Illinois. Auk 121:1146–1154

Little LP, Strong AM, Perlut NG (2009) Aggressive response of adult bobolinks to neck ligatures on nestlings. Wilson J Ornithol 121:441–444

Mattsson BJ, Meyers JM, Cooper RJ (2006) Detrimental impacts of radio-transmitters on juvenile Louisiana waterthrushes. J Field Ornithol 77:173–177

Naef-Daenzer B (2007) An allometric function to fit leg-loop harnesses to terrestrial birds. J Avian Biol 38:404–407

Naef-Daenzer B, Widmer F, Nuber M (2001) Differential post-fledging survival of great and coal tits in relation to their condition and fledging date. J Anim Ecol 70:730–738

Oniki Y (1981) Individual recognition of nestlings. J Field Ornithol 52:147–148

Rappole JH, Tipton AR (1991) New harness design for attachment of radio transmitters to small passerines. J Field Ornithol 62:335–337

Suedkamp Wells KM, Washburn BE, Millspaugh JJ, Ryan MR, Hubbard MW (2003) Effects of radio-transmitters on fecal glucocorticoid levels in captive Dickcissels. Condor 105:805–810

Sykes PW, Carpenter W, Holzman S, Geissler H (1990) Evaluation of 3 miniature radio transmitter attachment methods for small passerines. Wildl Soc Bull 18:41–48

White JD, Faaborg J (2008) Post-fledging movement and spatial habitat-use patterns of juvenile Swainson's thrushes. Wilson J Ornithol 120:62–73

Whittier JB, Leslie DM (2005) Efficacy of using radio-transmitters to monitor least tern chicks. Wilson Bull 117:85–91

Yackel Adams AA, Skagen SK, Savidge JA (2006) Modeling post-fledging survival of lark buntings in response to ecological and biological factors. Ecology 87:178–188