An Efficient and Inexpensive Apparatus for Collecting Fecal Samples During Banding Studies: Revisiting an Underutilized Technique

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ABSTRACT

Using fecal samples to analyze trophic levels, glucocorticoids, and diet of birds is common in avian research. However, several methods of fecal sample collection often do not provide a complete sample and can induce unnecessary stress in birds. Parrish et al. (1994) described a new fecal sampling apparatus to opportunistically collect feces of mist-netted birds. However, based on the paucity of citations for this method, it appears that it has not been widely accepted or implemented in field studies. In this paper we describe a modification of the fecal sampling apparatus outlined in Parrish et al. (1994), and suggest that this technique eliminates many of the shortcomings associated with other common methods of fecal sample collection. Our compact fecal sampling apparatus is constructed using inexpensive materials and can be implemented in many banding studies, including remote operations. In the summer of 2015 we tested the efficacy of this fecal sampling apparatus on 99 passerines of three species (44 Worm-eating Warblers (Helminthus vermivorum), 29 Ovenbirds (Seiurus aurocapillus), and 26 Scarlet Tanagers (Piranga olivacea). Eighty birds successfully deposited in the apparatus (31 Worm-eating Warblers, 26 Ovenbirds, and 23 Scarlet Tanagers), resulting in an 81% success rate for fecal collection. We deem this technique highly effective and recommend its implementation in future banding studies that incorporate a fecal sampling research component.

North American Bird Banders

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These instructions apply to major manuscripts only; other sections of the journal follow a less formal style (see recent issues). Manuscript: Submit two copies of your manuscript, double-spaced, on 8 1/2 x 11-inch (21 x 28-cm) paper with 1-in. (2.5-cm) margins, to the Editor for the banding association covering your area. Electronic submission is acceptable with the prior approval of the Editor. All manuscripts should be submitted in the following sections: Abstract (emphasize results; list species studied), Introduction (define problem, methods, results, Discussion, Acknowledgments, and Literature Cited). When submitting a manuscript, the author should advise the Editor of the extent to which the data and/or text have been used, or are expected to be used, in any other publication or posted on the World Wide Web. Significant re-use of any previously published material is acceptable when the individual publisher grants permission. One metric unit for all measurements. Capitalize the English names of all birds (but not other animals or plants) and give scientific name in italics at the first mention of each organism. When two species’ names are used together (in Blue and Evening grosbeaks), do not capitalize the genus name. Give time based on the 24-hour clock, as 0300, and use continental dating, e.g., 25 Nov 1988. Use Arabic numerals for numbers. When using statistics, provide a citation for the method. In describing mist-net capture rates, use “birds per 100 net-hours”, to be spelled out in the first use as an estimate of the container but subsequently abbreviated to “birds/hour.” A net is defined as one 12-meter net up to 0.09 meters wide and made of 0.25 millimeter nylon or monofilament. In footnotes, references should be from the text in: (Jones 1987) for one author, (Jones and Smith 1987) for two authors, and (Jones et al. 1987) for three or more authors. In the Literature Cited section, arrange references in alphabetical order by last name with several papers by the same author(s) arranged chronologically. Give each reference (so diploma or masters) by the following form: Jones, A.B., C.D. Smith, and E.F. Johnson. 1977. Capturing California Condors. North American Bird Banders 1:21-25. Please do not use footnotes or endnotes in this section. For other details of style, format, and abbreviations, see Scientific Style and Format: the CBE manual for authors, editors, and publishers, 6th edition, 1994. When using information on birds banded by others, consult “Policy on Release of Banding and/or Recovery Data” in the North American Bird Banding Manual, Vol.1. For the final submission of the manuscript, provide a printed copy and include a computer-generated copy of the manuscript and any tables. Use Word or WordPerfect to prepare the final manuscript; use tabs and default settings only. Include author’s full name, postal address and e-mail address immediately below the title of the paper. Once the manuscript has been accepted for publication, the author must obtain approval from the NABB Production Manager prior to any subsequent publication (electronic or print) or posting to a World Wide Web site. Any such re-publication must advise readers of the original publication source (NABB) and state that the manuscript is reprinted with permission. Tables, figures, and photographs: Submit tables and figures on separate sheets, one per page. Submit photographs as black and white. The Production Manager can provide an estimate of the cost of the card after the manuscript has been accepted for publication in For further details on preparing manuscripts for publication in NABB, please contact the Production Manager. Acceptable manuscript must be in PDF format; a non-PDF file will not be published. Questions and answers for manuscript preparation should be directed to the Editor of the author’s regional association.

Front Cover: Rough-legged Hawk by George West

North American Bird Banders

In the given information, the focus is on the process of collecting fecal samples from birds for avian research. The text highlights the challenges associated with traditional methods and introduces a revised and more effective apparatus. The study demonstrates the efficacy of this new apparatus in collecting fecal samples from various species of birds, concluding with an 81% success rate in the summer of 2015. The paper encourages the adoption of this technique in future banding studies to improve data collection.

In the conclusion, the text mentions the increasing number of research applications involving avian feces (Fair et al. 2010) and highlights the need for efficient field sampling methods. The document concludes with a strong endorsement of this new apparatus, emphasizing its potential in the field of avian research.
be challenges using this method. Transporting large plastic sheets may be cumbersome in remote banding operations. In addition, depending on the method of fecal analysis there may be potential for sample contamination if feces come in contact with a soiled net. Finally, if many birds are simultaneously caught in the same net, correctly assigning fecal samples to individual birds may become difficult.

Another common method for collecting fecal samples involves placing birds in an enclosed box or paper bag for a pre-determined period of time and collecting any deposited feces after this period (Poulin et al. 2002, Lindström et al. 2009). This “box method” is also employed in diet studies in which birds are given ad-libitum to induce a regurgitation response (Poulin et al. 2002, Carlisle and Holberton 2006). Using this method, a bird may defecate (or regurgitate) shortly after being placed in the container, but must remain inside until the predetermined time has elapsed. Not only can this method cause unnecessary stress for the bird, but it may also compromise the quality of the fecal sample. Similar to cloth handling bags, the bird can rub the fecal sample into its feathers and onto the holding container walls as it flaps and moves around, effectively decreasing the amount of the remaining available fecal sample.

Parrish et al. (1994) described an elegant solution to these problems. By attaching wire mesh and a Ziploc® (SC Johnson, Racine, WI) bag to the bottom of a polypropylene sock, Parrish et al. (1994) collected feces from 347 migratory birds in Rhode Island with a 72% success rate. This method also minimizes stress in birds by opportunistically collecting feces during the holding period prior to banding. Although the Parrish et al. (1994) method yields improved results compared to many other common methods of fecal sample collection, it appears that it has not been widely accepted or implemented in avian field studies. After completing a thorough literature search using several online databases (e.g., Agricola, Web of Science, Wildlife and Ecology Studies Worldwide, etc.) we only identified three references to the Parrish et al. (1994) technique over the past 20 years. Based on the paucity of citations for the Parrish et al. (1994) method, and the continuation of less desirable fecal sampling collection techniques in the literature, we feel the need to reiterate this technique and advocate for its use in future avian research.

In the present manuscript we describe a modification of the Parrish et al. (1994) technique for collecting fecal samples from small passerines. We implemented this modified fecal sampling apparatus in a field study in southern Indiana (Brown and Monroe counties) in the summer of 2016. Here we report the efficiency of this fecal sampling apparatus and provide a detailed description of the pros and cons of our modification with the original Parrish et al. (1994) design.

METHODS

The modified fecal sampling apparatus was constructed using inexpensive materials: a white paper lunch bag, 1.27-cm hexagonal plastic-coated wire mesh (Menard® Eau Claire, WI), and duct tape. To begin assembly, the bottom of the lunch bag was cut or torn away, leaving an opened-out, 27 x 13 x 8 cm chamber. Wire cutters were used to cut an 18 x 13 cm piece of wire mesh that was larger than the base of the paper bag, allowing for approximately 2.5-cm clearance on all sides. The excess 2.5-cm of mesh material was bent upward on all sides to create a rectangular base of equal dimension to the base of the bag. The newly formed wire base was inserted into the paper bag, and duct tape was used to secure the folded ends of the mesh to the inside of the bag, thoroughly covering any exposed wire points (Fig. 1). Replacing the bottom of the paper bag with a wire mesh platform provided a “pseudo- perch” for birds and allowed fecal samples to pass through unimpeded.

To collect feces from birds, we positioned the fecal sampling apparatus approximately 0.25-m off the ground with a small Ziploc® bag placed directly underneath. We closed the top of the paper bag by folding it over, and attached the apparatus to a young sapling or supple woody stem (Smilax spp. worked best in our field sites). Although we attached the apparatus to natural structures in our study, it could also be attached to a low-hanging clothesline in more permanent banding operations. In addition, we used Ziploc® freezer bags placed flat on the ground below the apparatus to catch fecal samples, but any reusable plastic sheet would suffice (Fig. 2).

During the summer of 2016 we tested this fecal sampling apparatus on 99 wild-caught passerines representing three different species in southern Indiana: Worm-eating Warbler (Helmitheros vermivorum), Ovenbird (Seiurus aurocapillus), and Scarlet Tanager (Piranga olivacea). Birds were captured with 12-in long, 30-mm mesh, four-tier, black, tethered, nylon mist nets. After we extracted birds from the nets, we placed them in cotton handling bags and carried them back to a central banding station. We banded each bird and recorded morphometric data (i.e., wing chord length, tail length, culmen length, and mass) before placing it in the fecal sampling apparatus. Once a bird was placed in the apparatus it was checked every minute for a total of 10 min. If a bird provided a fecal sample before the maximum time, it was immediately released.

We used a 27-gauge insulin syringe (BD Micro-Fine IV, Becton, Dickinson and Co., Franklin Lakes, NJ) to effectively collect both the liquid and solid components of feces. We collected the liquid component of feces first, and then used the fine tip of the syringe to scrape the remaining solid component into a 1.5-ml microcentrifuge tube. Complete fecal samples were then frozen for future analysis. The wire mesh and plastic bags were cleaned with alcohol swabs between uses. As a result of constant folding and unfolding, the paper bag component of the fecal-sampling apparatus generally needed to be replaced after approximately 20 uses, but the wire mesh base could be saved and reused.

RESULTS

We tested the efficacy of the fecal sampling apparatus on 99 small passerines in southern Indiana (44 Worm-eating Warblers, 29 Ovenbirds, and 26 Scarlet Tanagers). Eighty birds successfully defecated in the apparatus (31 Worm-eating Warblers, 26 Ovenbirds, and 23 Scarlet Tanagers) resulting in an 81% success rate. Average masses for Worm-eating Warblers, Ovenbirds, and Scarlet Tanagers was 13.2 g ± 1.3 g, 19.0 g ± 1.1 g, and 28.7 g ± 1.8 g, respectively (mean ± SD). Although birds were given 10 min to defecate, most defecated within 2 min of being placed in the apparatus.

DISCUSSION

The fecal sampling apparatus was highly effective, producing complete fecal samples 81% of the time. The scale of this apparatus also proved to be adequate for passerines ranging in size from 11.0–32.0 grams (the size of the smallest Worm-eating Warbler to the largest Scarlet Tanager, respectively). This efficient design produced complete fecal samples with inexpensive materials and eliminated many of the pitfalls associated with pre-existing fecal sampling strategies.

Unlike most pre-existing methodologies (excluding Parrish et al. 1994) in which the moment of defecation may be unclear, this apparatus allows feces to fall through holes in the wire mesh and onto a plastic bag, enabling researchers to easily observe the exact moment of defecation. Birds can then be released immediately after defecating, preventing them from being detained for an unnecessary period of time. In addition, defecation through the wire mesh prevents birds from ruining the fecal sample by flapping or rubbing against it as is commonly the case when birds are enclosed in a box or bag (P. Ruhl, personal observation). This becomes even more crucial as the size of the fecal sample decreases. In our study, fecal samples from Worm-eating and Ovenbirds could be as small as 0.1 mL. Thus, our fecal sampling apparatus allowed us to collect complete samples from birds whose feces may have, otherwise, been difficult to salvage using other methodologies.

Our design differs from the apparatus described in Parrish et al. (1994) in three main aspects, namely composition, sample collection, and timing. Our apparatus is composed of a white paper lunch bag instead of a polypropylene sock. This paper composition is advantageous in two ways: First, it provides a more rigid structure (similar to a cage) providing a larger platform, giving the bird more space to move, and minimizing the chance of defecation (i.e., sample loss) on the apparatus itself. Second, the white material allows for quick inspection...
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Our modification does not involve the attachment of a sampling bag to the bottom of the apparatus (although this could easily be added if desired). By placing Ziploc® bags on the ground below the apparatus and collecting feces directly from these bags we were able to concentrate feces in a small (1.5 ml) tube. This allows for easier processing for certain lab applications (e.g., stable isotope studies) that require freeze-drying and powdering. In addition, by specifically collecting feces with a syringe immediately after defecation, we ensured that the fecal samples were not contaminated with feathers or other foreign objects that might drop into an attached sampling bag.

Unlike Parrish et al. (1994), we did not place birds in the fecal sampling apparatus immediately after removing them from the mist nets. Instead, we placed birds in the apparatus for a maximum of 10 minutes after they had already been banded and processed. Because our modification of the apparatus is composed of a paper lunch bag rather than a polypropylene sock, it is not as durable and cannot be easily tied off. Thus, it cannot serve the same function as a cloth handling bag. Rather, our paper lunch bag iteration of the Parrish et al. (1994) method replaces other “box methodologies” commonly used for fecal sample collection, but with the added benefit of immediate recognition of defecation. Although birds in our study were not placed in the fecal sampling apparatus immediately after they were removed from mist nets, our success rate was higher than that reported in Parrish et al. (1994), suggesting that the timing (i.e., how soon birds are placed in the fecal sampling apparatus) may not be critical. It is possible that the 19 birds that did not provide a fecal sample in our study may have defecated while they were entangled in mist nets or being carried in cloth handling bags. However, we observed several birds (~10) defecate prior to placement in the apparatus, yet still provide an adequate fecal sample after being placed in the apparatus. We posit that the most important factor is the birds’ ability to stand or perch on the wire platform. Because birds often defecate just prior to flight (Van der Veen and Sivars 2000), we suggest that placing them in the container with a wire bottom provides the impetus for defecation. Thus, the timing is less important than the physical placement in the apparatus itself.

Our described modification of the Parrish et al. (1994) fecal sampling apparatus is lightweight and compact (17-g), allowing for easy transport to remote banding stations. In contrast to other methods (e.g., placing plastic sheets under every mist net) our apparatus is much more efficient. This design also allows for a high level of adaptability in set-up, without compromising productivity. Composed of inexpensive materials, this fecal sampling apparatus can be implemented in many field studies, regardless of budget.

ACKNOWLEDGMENTS

This is a contribution of the Hardwood Ecosystem Experiment, a partnership of the Indiana Department of Natural Resources, Purdue University, Ball State University, Indiana State University, Drake University, Indiana University of Pennsylvania, and The Nature Conservancy. All birds were captured and handled in accordance with Federal Banding Permit #21781 and Purdue Animal Care and Use Committee guidelines (protocol # 110000078C002). We thank J. Suich for assistance with fieldwork and J. Tinklenberg for her review of this manuscript. We thank the Amos Butler Audubon Society, Indianapolis, IN, for providing a grant to fund field support. Funding and support of this research project was also provided by the Department of Forestry and Natural Resources, Purdue University.

Fig. 1. Photograph of a fully assembled fecal sampling apparatus.

Fig. 2. Photograph of a typical field set-up; fecal sampling apparatus with Ziploc® bags and fecal sample underneath.
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LITERATURE CITED


Avian Morphometric Data from a Long-term Bird Banding Effort in North Texas

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ABSTRACT

Morphometric data can be useful in determining age and sex of bird species that exhibit regional variation. We analyzed morphometric data from 12,834 individuals of 58 species banded at a long-term bird banding station in North Texas from 1978-2014. Mean wing length, tail length, and body mass are reported for resident and migratory birds banded in this flyway. For 20 species, males had longer mean wing length; in 14 species males had longer mean tail length, and for 3 species males had greater mean body mass than females. For 12 species, adult birds had longer wing length, tail length, or body mass than younger birds.

INTRODUCTION

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Our objective was to report morphometric data including wing length, tail length, and body mass for birds captured at a long-term banding station along the Central Flyway in north Texas. Morphometric data were examined within the context of age and sex for species including residents, short-distance Neartic-Neotropical migrants, and long-distance Neartic-Neotropical migrants. These data will improve our understanding of morphometric variation in this region of the Central Flyway.

METHODS

From 1978 through 2014, passerine and nearpasserine birds were banded in diverse habitats totaling 117 ha at the Heard Natural Science Museum and Wildlife Sanctuary (hereafter, Heard Museum) in McKinney, TX (33°09'33.07"N, 96°36'49.57"W; elevation 192 m). Heard Museum habitats included mid-successional prairie grassland, green ash (Fraxinus pennsylvanica), black willow (Salix nigra) forest, intermittently flooded mid-successional forest with sugarberry (Celtis laevigata), Osage orange (Maclura pomifera), cedar elm (Ulmus crassifolia), and honey locust (Gleditsia triacanthos). Birds were also...