Efficiency and fitness consequences of two trapping methods for recapturing ground-nesting songbirds

Devin R. de Zwaan,1,3 Sarah A. Trefry,2 and Kathy Martin1,2

1 Department of Forest and Conservation Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada
2 Environment and Climate Change Canada, Pacific Wildlife Research Centre, 5421 Robertson Road, Delta, British Columbia V4K 3N2, Canada

Received 1 August 2018; accepted 29 September 2018

ABSTRACT. Capturing nesting songbirds is a core component of many field studies. However, avoidance of traps and mist-nets by birds can reduce capture efficiency and bias study results, particularly when individuals need to be recaptured multiple times. We describe a novel capture method—the noose-line—for an alpine population of Horned Larks (Eremophila alpestris) studied during three breeding seasons (2015–2017) in northern British Columbia, Canada. Our objective was to develop a safe, efficient method to recapture individuals that exhibited trap avoidance. We compared the capture efficiency (trap success relative to capture effort) and fitness consequences (nest survival and nest attentiveness) of the noose-line (non-selective method) to those of a more traditional bownet trap (selective method) for both naïve (not previously captured) and previously captured Horned Larks. Mean trapping success for the noose-line was high for both naïve (89.7%) and previously captured (62.9%) birds, whereas mean trapping success for the more visible bownet was strongly influenced by bird experience (naïve = 41.4%, previously captured = 12.1%). However, mean capture effort (time required for successful capture) was greater for noose-lines than the bownet (45.3 min vs. 17.5 min) and noose-lines were more likely to capture non-targeted individuals. The trap type used to capture birds did not influence nest survival. Overall, our results suggest that noose-lines can be an effective option for capturing ground-nesting songbirds, particularly for studies where birds must be recaptured, e.g., to retrieve tracking devices or repeatedly measure body condition.

RESUMEN. Eficacia y consecuencias de la aptitud de dos métodos de captura para recapturar pájaros cantores que anidan en el suelo

La captura de pájaros cantores anidando es un componente central de muchos estudios de campo. Sin embargo, la evitación de trampas y de redes de niebla por parte de las aves puede reducir la eficiencia de la captura e introducir un sesgo en los resultados del estudio, particularmente cuando los individuos necesitan ser recapturados varias veces. Describimos un nuevo método de captura, la línea de la soga, para una población alpina de alondras cornudas (Eremophila alpestris) estudiada durante tres temporadas de reproducción (2015–2017) en el norte de Colombia Británica, Canadá. Nuestro objetivo fue desarrollar un método seguro y eficiente para recapturar a las aves que demostraron capacidad a evitar la trampa. Comparamos la eficiencia de captura (éxito de la trampa en relación con el esfuerzo de captura) y las consecuencias de la condición física (supervivencia del nido y atención del nido) de la línea de la soga (método no selectivo) con las de una trampa combinada con red de malla más tradicional (método selectivo) para ambas alondras cornudas ingenuas (no capturado previamente) y capturadas previamente. El éxito medio de captura para la línea de la soga fue alto tanto para las aves ingenuas (89.7%) como para las capturadas previamente (62.9%), mientras que el éxito promedio de captura para la trampa combinada más visible estuvo fuertemente influenciado por la experiencia de las aves (ingenuo = 41.4%, capturado previamente = 12.1%). Sin embargo, el esfuerzo de captura promedio (tiempo requerido para la captura exitosa) fue mayor para las líneas de soga que para la trampa combinada (45.3 min vs. 17.5 min) y las líneas de soga fueron más propensas a capturar individuos no objetivo. El tipo de trampa utilizado para capturar aves no influyó la supervivencia del nido. En general, nuestros resultados sugieren que las líneas de soga pueden ser una opción efectiva para capturar aves cantoras que anidan en el suelo, particularmente para estudios en los que las aves deben ser recapturadas, por ejemplo, para recuperar dispositivos de rastreo o medir repetidamente la condición corporal.

Key words: bownet trap, by-catch, capture effort, Eremophila alpestris, Horned Lark, noose-line, trap avoidance

Capturing birds is a central component of many field studies, allowing measurement of condition and physiological traits, as well as estimates of population trends through uniquely marked individuals (Baillie and Schaub 2009). Many research questions require that targeted individuals be recaptured multiple times (e.g., metabolic, ecotoxicological, and immunocompetence studies) and, increasingly,
to recover tracking devices (Barron et al. 2010). However, because they may detect and avoid traps or mist-nets, capturing and recapturing nesting songbirds can be a significant challenge (Camacho et al. 2017).

Multiple capture techniques have been designed to minimize detection of traps and mist-nets and increase capture efficiency. Complex arrangements of multiple mist-nets (e.g., Martin 1969) or cylindrical traps made from mist-net material and placed over nests (e.g., Sousa and Stewart 2011) can be used to capture songbirds, but reflected sunlight and movement caused by even gentle breezes can increase their visibility. Designs with lower profiles and reduced visibility include bownets and noose-based traps. Bownet traps (hereafter, bownets) have a long history of use for capturing ground-nesting species at nests, including ducks, gulls and terns, shorebirds, and songbirds. The design generally consists of a circular piece of metal with a pivoting, net-covered semicircular bow that lies flat on the ground and closes under spring tension (e.g., Gratto-Trevor 2018, Fig. 1). Bownets can be quickly and easily deployed over ground nests and triggered to close from a distance to capture selected individuals. Noose-based traps, such as bal-chatri traps for raptors (e.g., Berger and Mueller 1959), noose poles for grouse (Zwikel and Bendell 1967), or noose mats for shorebirds (e.g., Gratto-Trevor 2018), are effective at capturing larger species, but few examples of their use to capture songbirds exist (Gartshore 1978), as well as shorebirds and grouse (noose-mat; Mehl et al. 2003, Hoffman and Walker 2016).

We compared trap efficiency (trap success relative to capture effort) and the fitness consequences (nest survival and nest attentiveness) of our modified noose trap (hereafter, noose-line) to the more traditional bownet for naïve (not previously captured) and previously captured birds. Because monofilament line can be difficult to see, we predicted greater capture success with the noose-line, particularly for experienced birds. Given similar trap set-up and handling times, we did not expect the traps to differ in their effects on either nest attentiveness (i.e., nest visitation rates and time to return to nests) or nest survival after capture.

**METHODS**

We studied Horned Larks during three breeding seasons (mid-May to July 2015–2017) near Smithers, British Columbia, Canada (54.8°N, 127.3°W). Horned Larks are small (28–40 g), ground-nesting songbirds inhabiting open-country, sparsely vegetated habitats (Beason 1995). Our study site was
located above treeline (1600–1950 m elevation) in alpine tundra characterized by arctic heathers and grasses. In 2015, naïve adults were captured using a bownet and banded. In 2016 and 2017, both the bownet (Fig. 1) and noose-line (Fig. 2) were used to capture naïve and previously captured (hereafter, experienced) individuals at nests, primarily during the nestling stage.

The bownet was constructed and deployed with modifications from previous designs (see Appendix S1 for detailed instructions). The noose-line was constructed using 2-lb-test (0.91-kg) monofilament fishing line for the nooses and 20-lb-test (9.1-kg) monofilament as an anchoring base-line (Fig. 2). The translucent noose-line was difficult for us (and, we assume, the birds) to detect under most conditions, but were slightly more visible during periods with high winds. Nooses (~6–8 cm in diameter) were tied using a slip-knot and attached to the anchoring base-line at ~5–10-cm intervals (depending on noose size) using overhand knots and epoxy glue for added security. To deploy the noose-lines, we encircled nests and anchored the base-line to the ground using thin metal tent pegs to keep it taut. The flexibility of the base-line allows it to be deployed over uneven ground. One noose-line with larger nooses (~10–12 cm in diameter) was placed close enough to nests to allow the nooses to rest over nest lips, whereas a second noose-line with smaller nooses was typically deployed 10–15 cm from nests. When the two noose-lines were in place, Horned Larks could either be captured on the ground as they approached the nest, or at the edge of the nest cup if they flew directly to it. We observed the trap from behind a nearby rise or hill (~15–30 m away) so that captured birds could be removed from the trap as quickly as possible. See Appendix S2 for more detailed instructions on construction and deployment.

Nests were located during nest building or incubation using systematic territory searches and behavioral observations. Once found, nests were monitored every 2–3 d until

---

**Fig. 1.** Example of a bownet trap set-up around a ground nest, ready to be triggered (top row) and after being sprung (bottom row). The diagram on the left was taken with modification from Gratto-Trevor (2018), whereas the photos on the right are our nets deployed around a Horned Lark nest. See Appendix S1 for detailed instructions on construction and deployment. [Color figure can be viewed at wileyonlinelibrary.com]
approximately the 11th day of incubation when nests began to be visited daily to accurately record hatch date (12-d average incubation; Camfield and Martin 2009). We deployed both trap types 5–8 d post-hatching when parental provisioning rates of nestlings is high and the likelihood of causing premature fledging is low. In 2017, we also deployed both traps on a limited sample of nests during the incubation period (bownet: \(N = 2\), noose-line: \(N = 7\)). To minimize impacts on breeding activity, only one adult was captured per day and capture attempts were limited to 1 h per day for 2 or 3 d. Once captured, birds were measured and banded with one U.S. Geological Survey numbered aluminum band and three plastic color bands. Before release, birds were examined for signs of injury.

For each capture attempt, we recorded trap-efficiency metrics, including trapping success, capture effort, and the number of trap entrances required for capture. Trapping success was a binomial variable, with each capture attempt assigned a 1 (successful) or 0 (unsuccessful). Capture effort was defined as the total duration of time (min) the trap was deployed across all attempts. Therefore, if it took 3 d to capture an adult, trapping success was recorded three times (e.g., 0, 0, 1) and capture effort was recorded as the total time the trap was deployed during the 3 d. Trap entrances were the number of times an individual visited a nest and entered (bownet) or crossed over (noose-line) a trap and could potentially be captured, but was able to exit the trap.

Following release of birds, we conducted two types of behavioral observations to address potential effects of capture type on nest attentiveness: (i) for a randomly assigned subsample of birds (\(N = 11\) bownet and 9 noose-line), nests were observed from a distance of \(~40\) m to record the time until a captured bird returned to provision nestlings, and (ii) for a separate subsample of 10 adults (\(N = 5\) bownet and 5 noose-line), we placed camcorders (Canon VIXIA HF-R500, Canon Inc., Tokyo, Japan) mounted on tripods > 15 m from the nest for 60 min post-capture to record subsequent nest-visitation rates following a 15-min control period. The control period allowed the captured individuals to habituate to the tripod and resume provisioning activity without the confounding influence of our presence. Finally, nests were visited daily following capture to record nest fate (fledged or predated). Exposure days were considered the sum of days from capture to fledging or predation. Nests were considered predated if empty prior to 7 d post-hatch because this is the earliest fledge date recorded for this population (A. F. Camfield, unpubl. data). To determine fate when a nest was found empty after 7 d post-hatching, we located adults and observed whether they were feeding fledglings. For the nine nests where we attempted capture during incubation, we recorded nest fate as abandoned if eggs were cold for several consecutive days and the female was not attending the nest.

All analyses were performed in the R environment (R Core Team 2017). Only nests
where adults were captured during the nestling stage were included in our analyses (N = 9 captures during incubation removed). Patterns of trap-efficiency metrics (trap success and capture effort) were fit using generalized mixed-effects models (GLMMs) in package “lme4” (Bates et al. 2015). We modelled trap success using logistic regression, weighting success by duration (minutes deployed) to control for capture effort, and fit capture effort as a response variable to a Gaussian distribution. In both models, we included trap type and bird experience as explanatory variables, with sex and date as covariates. We also tested support for a trap type by bird experience interaction to address patterns of trap avoidance. This interaction was included if it significantly improved the model as evaluated using Akaike Information Criterion corrected for small sample sizes (AICc) and an AICc difference threshold of 2 (ΔAICc ≥ 2; Anderson et al. 2001). Bird identity was included as a random effect in the trap-efficiency models.

We calculated daily nest survival (DNS) following attempted captures using a discrete proportional hazard model, where nest success was modeled as a binomial variable (successful fledge = 1, predation = 0) offset by exposure days, allowing us to estimate the probability of predation as a function of time (Collett 2003, Murray 2006). Trap success (success/fail) and capture effort were included as fixed effects to account for differences in our presence near nests. Using non-parametric tests, we examined: (i) escapes from traps (i.e., when a bird was captured in the trap, but escaped prior to removal; Fisher’s exact test), (ii) capture of non-targeted birds (bycatch; Fisher’s exact test), and (iii) nest attentiveness behavior (time to return to the nest and nest visitation rate after returning; F-test) between trap types. Values are reported as means ± SE, and the level of significance for all tests was set at α = 0.05.

**RESULTS**

From 2015 to 2017, we captured 86 of 139 Horned Larks we attempted to capture with the bownet (83 of 124 naïve and 3 of 15 experienced), and 33 of 39 individuals we attempted to capture with the noose-line (16 of 19 naïve, 17 of 20 experienced). Of the 33 individuals captured by noose-line, 25 were caught by one or both legs and eight around the neck. We observed no injuries to birds captured using the bownet. One adult captured by noose-line experienced minor bleeding high on one leg (1/33 3.0%), but was observed later in the season with no apparent injuries. During the nestling stage (when most adults were captured), 2.4% of nests (2/84) were abandoned following bownet capture, and none (0/26) were abandoned following capture with the noose-line. During incubation, neither of the two nests was abandoned following use of the bownet trap, whereas two of seven females (28.6%) caught with the noose-line abandoned. These two females were the only individuals fitted with geolocators in our study, a process that required a longer handling time than for banding only.

Overall capture success was greater for noose-lines than the bownet, and for naïve birds than experienced birds once we controlled for capture effort and time of year (Table 1). Additionally, we found a strong interaction between trap type and bird experience (Table 2); we were 5.2 times more likely to capture experienced birds using noose-lines than the bownet, and only 2.2 times more likely to capture naïve birds (Table 1). As expected, capture effort was positively associated with capture success for both trapping methods, independent of bird experience (Table 2). Capturing birds with noose-lines took 3.8 times longer on average (45.3 ± 11.8 min vs. 17.5 ± 1.3 min) and required birds to enter the trap 4.2 times more often before being captured (Table 1). The sex of targeted birds did not influence either capture success or effort. After being captured, eight individuals escaped from the bownet (8/94; 8.5%) and one from the noose-line (1/34, 2.9%; Fisher’s exact test: odds ratio = 0.35, P = 0.45). Non-targeted individuals were captured more often with the noose-line (10/55 individuals; 18.2%) than the bownet (5/160, 3.1%; odds ratio = 0.17, P < 0.01).

Average daily nest survival (DNS) did not differ following capture by the noose-line compared to the bownet (Table 2). After controlling for date and capture effort, DNS was 0.952 ± 0.004 following bownet capture and 0.906 ± 0.027 following noose-line capture,
producing respective average nest survivals of 82.2 ± 9.4% and 67.2 ± 13.5% over an average 3-d post-capture period. DNS was unrelated to either total effort or trap success (Table 2). We found minimal differences between trapping methods in nest attentiveness following capture. On average, individuals captured by noose-line began normal provisioning behavior an average of 12 min later than those captured with the bownet.

Table 1. Mean values (± SE) for trap efficiency and fitness response variables, where trap success and nest survival values are predicted from the models for an average capture effort (min) and date.

<table>
<thead>
<tr>
<th>Response</th>
<th>Bownet</th>
<th>Noose-line</th>
<th>Average</th>
<th>Nb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap efficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trap successa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(T%)</td>
<td>28.6 ± 5.9</td>
<td>76.3 ± 8.3</td>
<td>–</td>
<td>158/48</td>
</tr>
<tr>
<td>(N%)</td>
<td>41.4 ± 5.7</td>
<td>89.7 ± 8.3</td>
<td>65.6 ± 6.0</td>
<td>141/22</td>
</tr>
<tr>
<td>(E%)</td>
<td>12.1 ± 7.7</td>
<td>62.9 ± 8.4</td>
<td>37.5 ± 8.1</td>
<td>17/26</td>
</tr>
<tr>
<td>Capture effort (min)</td>
<td>17.5 ± 1.3</td>
<td>45.3 ± 11.8</td>
<td>31.4 ± 1.8</td>
<td>69/15</td>
</tr>
<tr>
<td>Entrancesc</td>
<td>1.0 ± 0.03</td>
<td>4.3 ± 1.6</td>
<td>2.6 ± 0.6</td>
<td>69/8</td>
</tr>
<tr>
<td>Fitness effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nest survival (%)</td>
<td>82.2 ± 9.4</td>
<td>67.2 ± 13.5</td>
<td>74.7 ± 6.9</td>
<td>158/48</td>
</tr>
<tr>
<td>Delayed nest return (min)</td>
<td>13.8 ± 2.4</td>
<td>25.8 ± 5.6</td>
<td>19.8 ± 3.0</td>
<td>11/9</td>
</tr>
<tr>
<td>Provisioning rate (/10 min)</td>
<td>0.7 ± 0.2</td>
<td>0.6 ± 0.1</td>
<td>0.7 ± 0.2</td>
<td>5/5</td>
</tr>
</tbody>
</table>

Table 2. Parameter estimates for all relevant trap efficiency and fitness response variables (see text for non-parametric tests), with significant variables presented in bold.

<table>
<thead>
<tr>
<th>Response</th>
<th>Model estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap efficiency</td>
<td></td>
</tr>
<tr>
<td>Trap successa</td>
<td></td>
</tr>
<tr>
<td>(T%)</td>
<td>$z = 2.6$</td>
</tr>
<tr>
<td>(N%)</td>
<td>$z = 2.0$</td>
</tr>
<tr>
<td>(E%)</td>
<td>$z = -2.2$</td>
</tr>
<tr>
<td>Capture effort (min)</td>
<td>$z = -5.7$</td>
</tr>
<tr>
<td>Trap * experience</td>
<td>$z = -2.0$</td>
</tr>
<tr>
<td>Sex</td>
<td>$z = -0.1$</td>
</tr>
<tr>
<td>Capture effort (min)</td>
<td>$F_{1, 74} = 29.2$</td>
</tr>
<tr>
<td>Sex</td>
<td>$F_{1, 74} = 1.2$</td>
</tr>
<tr>
<td>Experience (naïve)</td>
<td>$F_{1, 76} = 0.6$</td>
</tr>
<tr>
<td>Date</td>
<td>$F_{1, 78} = 0.5$</td>
</tr>
<tr>
<td>Fitness effects</td>
<td></td>
</tr>
<tr>
<td>Daily nest survival</td>
<td>$z = -1.0$</td>
</tr>
<tr>
<td>Ordinal date</td>
<td>$z = 0.5$</td>
</tr>
<tr>
<td>Capture effort</td>
<td>$z = 0.1$</td>
</tr>
<tr>
<td>Year (2016)</td>
<td>$z = -1.5$</td>
</tr>
<tr>
<td>Year (2017)</td>
<td>$z = 1.2$</td>
</tr>
<tr>
<td>Trap success</td>
<td>$z = 0.7$</td>
</tr>
</tbody>
</table>

aBird identity was a random effect for both trap efficiency models.
bResults for trap type depict noose-line relative to bownet effects, whereas experience depicts naïve relative to experienced.

D. R. de Zwaan et al.  368 J. Field Ornithol.
For capturing Horned Larks, we found the noose-line to be a viable alternative to the bownet. Both traps were equally safe to deploy, with few injuries and abandoned nests. Overall, we had greater capture success with noose-lines, particularly with previously captured birds, suggesting that the noose-line is an effective method for overcoming trap avoidance. As a trade-off, noose-lines required greater capture effort because adults often entered the trap multiple times before being captured, and we were more likely to capture non-target individuals due to the non-selective nature of this trap. As predicted, nest survival did not differ between trapping methods and, although individuals delayed their return to nests after capture by noose-line relative to the bownet, provisioning rates did not differ in the hour following the individual returning to the nest.

One of the primary concerns when testing a new trapping method is the risk of physical injury or stress leading to nest abandonment. Bownets have a long history of effective and safe use if monitored closely, and we also reported no injuries in this study. Our noose-lines were safe, with a negligible rate of minor leg injury (1/35 birds), consistent with shorebirds captured with noose-mats (3/2410; Mehl et al. 2003), and Cinnamon-breasted Rock Buntings (Emberiza tahapisi) captured in a noose ring (0/12; Gartshore 1978). Like bownets, the noose-line requires observers to be vigilant and respond rapidly to remove individuals from the trap to avoid injury or stress from struggling in the trap. Abandonment of nests by captured birds was low for both traps and comparable to rates of reported abandonment (~3%) following capture of songbirds using other trapping methods (e.g., Swanson and Rappole 1994, Sousa and Stewart 2011). Although we observed only two abandonments during incubation, both associated with the extended handling time required to apply light-level geolocators, we recommend waiting until later in the nestling stage and closer to fledging (5–7 d old for Horned Larks) to capture adults to minimize the likelihood of abandonment.

Capture success of both naïve and experienced individuals differed between traps (bownets: 28.6%, noose-line: 76.3% overall), highlighting the effectiveness of the more cryptic noose-lines, particularly at recapturing experienced birds. Although the overall success rate of the noose-line was comparable to that of other trapping methods, our success using the bownet to capture all individuals (naïve and experienced) was lower than reported in studies of other species, including White-winged Doves (Zenaida macroura, 76–82%; Swanson and Rappole 1994), Yellow-
headed Blackbirds (*Xanthocephalus xanthocephalus*, 83%; Newbrey and Reed 2008), and Dickcissels (*Spiza americana*, 85%) and Indigo Buntings (*Passerina cyanea*, 60–73%; Sousa and Stewart 2011). We frequently observed both naïve and experienced birds hesitating near the bownet or leaving without feeding nestlings, likely influenced by the visibility of the trap. We rarely observed this behavior with the noose-line, indicating detectability of noose-lines was low. Additionally, we did not account for the influence that experienced birds may have on naïve mates (i.e., through alarm calls; Griffin 2008) which could reduce nest visits for visible traps like the bownet. Although we did not quantify vocalizations, experienced mates often uttered distress calls near the bownet, a behavior not witnessed with the noose-line. The cryptic nature of the nooses may therefore make the noose-line a more effective trapping method, not only in open habitats where traditional traps may be more detectable, but also among birds where natural variation in “boldness” can influence how they respond to novel objects near their nests (Sih et al. 2004).

Despite the greater capture effort (i.e., time around nests) required for noose-lines in our study, nest survival following a capture attempt did not differ between trapping methods. This is consistent with previous research that indicates researcher presence around nests has minimal effects on predation rates (Mayer-Gross et al. 1997, Border et al. 2018) and, in some cases, may improve nest survival by deterring predators (Weidinger 2008). Still, the explanatory power of our nest-survival model was relatively low ($R^2 = 0.13$), indicating major sources of variance we were unable to address such as the inherent predation risk of nest sites related to nest substrate or cover (de Zwaan and Martin 2018).

In summary, noose-line and bownet traps did not differ in their effects on reproductive success and produced only short-term behavioral effects. Each trap had advantages and disadvantages that make selecting the ideal capture method dependent on the field situation and goals. Whereas the bownet allows targeted capture of a specific individual in a breeding pair and greater control of trapping conditions (i.e., trap release can be timed for when an individual is positioned correctly), the noose-line was more effective at counter-acting trap avoidance, allowing us to recapture individuals multiple times. Using the more visible bownet at particularly exposed nest sites or when attempting to recapture experienced birds may be time-consuming and increase stress experienced by the trap-wary targeted individuals and their young. Similarly, recapturing non-targeted individuals with the noose-line in the process of trying to capture a targeted mate may also lead to unnecessary stress and potentially negative consequences for reproductive success. Therefore, we make the following recommendations: (i) the bownet is a safe and efficient capture method for naïve individuals with no apparent immediate fitness effects, (ii) the noose-line is an effective alternate capture strategy that can be particularly useful in studies that require recapturing birds, e.g., to affix or remove tracking devices such as geolocators and radio-transmitters or to monitor metabolic or physiological parameters, and (iii) trapping during the nestling stage is preferable for both capture methods because of higher nest-visitation rates and low abandonment rates. In addition, we encourage researchers who employ multiple trap designs to explore behavioral and fitness consequences for continual assessment and development of safe, effective capture methods.

ACKNOWLEDGMENTS

We thank A. Sulemanji, D. Maucieri, N. Morrell, N. Froese, and T. Altamirano for their contributions to data collection in the field. We are grateful to M. Mossop for advice and construction of the bownet traps, and A. Trefry for providing original artwork. Funding for the research was provided to DRD and KM by the Natural Sciences and Engineering Research Council of Canada and Environment and Climate Change Canada, and to DRD by the Northern Scientific Training Program and Hesse Research Award (UBC). Data were collected under the UBC Animal Care Committee permit A15-0027 and Canadian Wildlife Service bird banding permit 10761 J.

LITERATURE CITED


**SUPPORTING INFORMATION**

Additional Supporting Information may be found in the online version of this article at the publisher’s web-site.

**Appendix S1.** Instructions for constructing a bownet trap.

**Appendix S2.** Instructions for making a noose-line trap.