Peer Reviewed

# Efficacy of Trapping and Shooting in Removing Breeding Brown-Headed Cowbirds

**SCOTT G. SUMMERS,** *The Nature Conservancy of Texas, Fort Hood, TX 76544-0190, USA*
**RICHARD M. KOSTECKE,**[1] *The Nature Conservancy of Texas, Fort Hood, TX 76544-0190, USA*
**GARRETT L. NORMAN,** *The Nature Conservancy of Texas, Fort Hood, TX 76544-0190, USA*

## Abstract

*Trapping often is used to mitigate brood parasitism by brown-headed cowbirds (*Molothrus ater*). The efficacy of trapping to remove locally breeding cowbirds has not been compared to shooting, an alternative removal method. We used cluster analysis to group female cowbirds trapped and shot at Fort Hood, Texas, USA, during the 2003 and 2004 breeding seasons as potential local breeders (PLBs) or migrants based on their color, mass, ovarian development, and wing chord. The PLBs were paler and smaller, generally fitting the description of* M. a. obscurus*, the expected race of locally breeding cowbirds. We detected enlarged ovaries in 0% of migrants (*$n = 1{,}634$*) and 18% of PLBs (*$n = 959$*). We compared the efficiency (proportion of PLBs removed) and effectiveness (total no. of PLBs removed) of trapping and shooting. Monthly shooting efficiency was high (>90%) and always greater than that for trapping. Trapping efficiency was temporally variable but greatest in March (50%). Despite its inefficiency, trapping removed at least 8-fold more PLBs during March and April than shooting. Effectiveness of trapping and shooting was similar in May. Shooting removed 3-fold more PLBs in June than trapping. The cost of removing a single PLB by trapping in March and April was <$4 but increased to $153 by June. Cost of removing a single PLB by shooting ranged from $14–19 during all months except March, when few breeding cowbirds were shot. Knowledge of the efficacy of cowbird removal techniques over the breeding season will allow managers to strategically apply control to enhance program benefits.* (WILDLIFE SOCIETY BULLETIN 34(4):1107–1112; 2006)

## Key words

*brood parasitism, brown-headed cowbirds, cost-effectiveness, cowbird control, Fort Hood,* Molothrus ater*, shooting, Texas, trapping.*

Brood parasitism by brown-headed cowbirds (*Molothrus ater*) reduces host species' reproductive output (Pease and Grzybowski 1995, Ortega 1998). Trapping cowbirds can be an effective means of reducing brood parasitism by cowbirds and, subsequently, increasing host species' productivity (e.g., DeCapita 2000, Griffith and Griffith 2000), though effects on host species' population growth are debatable (Hall and Rothstein 1999, Rothstein et al. 2003). Trapping, however, is not effective or practical in all situations (e.g., in remote sites where it may be impossible to set traps; Winter and McKelvey 1999). Shooting is an alternative means of cowbird removal and has been considered a supplement to trapping (Stutchbury 1997, Eckrich et al. 1999). There are no direct comparisons of the effectiveness or of the costs and benefits of trapping versus shooting cowbirds.

Comparisons are difficult due to the varying natures of trapping and shooting. Trapping is a passive technique that collects cowbirds from a large, undefined area and, typically, over a relatively long time frame. Additionally, traps often are set during migratory periods and sometimes on communal feeding grounds (e.g., Eckrich et al. 1999). Thus, traps indiscriminately capture locally breeding and migrant cowbirds. In contrast, shooting is an active and selective technique that removes individual cowbirds exhibiting breeding behavior within host species' habitat (Stutchbury 1997, Eckrich et al. 1999).

Because most cowbird removal programs measure success by the number of female or total cowbirds removed (Rothstein et al. 2003), inevitably, trapping appears to be the more successful technique as it removes a greater number of cowbirds than shooting (e.g., Eckrich et al. 1999). However, use of such a measure of success, particularly in the absence of data on parasitism frequency and host species' nest success and population growth, may misrepresent the actual impact of a trapping program on a local host species' population. Large numbers of cowbirds may be removed, but the number of local breeders removed is unknown.

Cowbird control has benefited endangered black-capped vireos (*Vireo atricapilla*) at Fort Hood, Texas, USA (Eckrich et al. 1999, Kostecke et al. 2005). Fort Hood has reported the total number of female cowbirds removed as one of its measures of trapping success. However, the number of removed females that were local breeders has been unclear. Thus, monthly efficiency (i.e., proportion) and effectiveness (total no.) of trapping versus shooting in removing local breeders has been unknown. To provide a basis for refining cowbird control efforts, we estimated the monthly efficiency and effectiveness of trapping versus shooting.

We used morphometric, phenotypic, and physiological characters to categorize female cowbirds removed at Fort Hood as belonging to a pool of potential local breeders (PLBs) or migrants. After categorization, we compared the monthly efficiency and effectiveness of trapping versus shooting in removing PLBs. We also assessed the costs associated with trapping and shooting relative to the number of PLBs removed.

[1] *E-mail: rkostecke@tnc.org*

***Table 1.*** Number of female brown-headed cowbirds (*Molothrus ater*) trapped and shot at Fort Hood, Texas, USA, during Mar–Jun 2003 and 2004 from which we obtained morphometric, phenotypic, and physiological measurements.

| | | No. measured (total no. of females collected) | | | | |
|---|---|---|---|---|---|---|
| **Year** | **Removal** | **Mar** | **Apr** | **May** | **Jun** | **Total** |
| 2003 | Trapped | 110 (850) | 50 (1,916) | 76 (909) | 4 (12) | 240 (3,687) |
| | Shot | 1 (1) | 28 (55) | 13 (34) | 17 (37) | 59 (127) |
| 2004 | Trapped | 980 (1,199) | 753 (811) | 458 (495) | 11 (12) | 2,202 (2,517) |
| | Shot | 1 (3) | 37 (40) | 32 (46) | 23 (34) | 93 (123) |

## Study Area

Fort Hood occupied 88,500 ha within Bell and Coryell Counties in central Texas. Land area was 65% perennial grassland and 31% woodland (U.S. Army Land Condition Trend Analysis Program, unpublished data). Fort Hood was used primarily for military training and secondarily for other uses (e.g., cattle grazing and outdoor recreation). Installation-wide cowbird removal has been practiced since 1988 (Eckrich et al. 1999). The trapping and shooting protocols we used and the effort we put into each removal method were similar to what Eckrich et al. (1999) reported.

## Methods

We conducted cowbird management activities on Fort Hood under the federal Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43), as well as under the auspices of Federal Fish and Wildlife Scientific Collecting and Depredation Permits MB085693-0 and MB096751-0 and Texas Scientific Permit No. SPR-0204-356. Cowbird management complied with federally mandated standard conditions for migratory bird depredation permits (50 CFR Part 13; 50 CFR 21.41), and we euthanized cowbirds by accepted means (Andrews et al. 1993). Our trapping and shooting protocols have received veterinary review (D. N. Phalen, D.V.M, Texas A&M University, College Station, Tex.). We obtained morphometric, phenotypic, and physiological measurements from cowbird carcasses prior to their disposal pursuant to the standard conditions for migratory bird depredation permits.

We obtained morphometric, phenotypic, and physiological data from 46% of shot and 7% of trapped female cowbirds during March–June 2003 (Table 1). Due to time and storage constraints, the females we measured were a subset of the total shot or trapped during each month. We obtained data from 87% of females collected during March–June 2004 (Table 1). We did not obtain data from all 2004 females because some were too damaged to measure accurately. Morphological measurements included mass and wing chord. We used an interval scale to subjectively categorize the phenotypes of collected females (1 = pale, 2 = intermediate, 3 = dark) because color differences among cowbird races were obvious. During necropsies, we assessed ovarian development and ranked development on an interval scale (0 = reduced ovaries, 1 = enlarged ovaries). We considered ovaries with follicles >2 mm in diameter that had visible yolks to be enlarged (Payne 1965, 1976).

We used cluster analysis (PROC FASTCLUS; SAS Institute 1999) to place female cowbirds into groups based on their color, mass, ovarian development, and wing chord. We standardized the data before analysis so measurements had means of 0 and variances of 1 (McGarigal et al. 2000). Three cowbird sub-species (*M. a. artemisiae*, *M. a. ater*, and *M. a. obscurus*) occur on Fort Hood as breeders or migrants (Lowther 1993, Pyle 1997, Ortega 1998). Therefore, we initially set the maximum number of clusters to 3, though we assessed other clustering solutions (e.g., 2 clusters). We used the cubic clustering criterion (CCC) and pseudo *F*-statistic (PFS) to determine the number of clusters to use (McGarigal et al. 2000).

Fort Hood's locally breeding cowbirds should primarily be *M. a. obscurus*, which are paler and smaller than *M. a. artemisiae* and *M. a. ater* (Lowther 1993, Pyle 1997, Ortega 1998). Therefore, we categorized cowbirds that fell within the cluster characterized by smallest mean values for color index, mass, and wing chord, as PLBs. To compare the efficiency and effectiveness of trapping and shooting, we calculated the monthly proportions of PLBs removed by each technique. We combined 2003 and 2004 data for analysis. We used Tukey's single-degree-of-freedom test for nonadditivity (PROC GLM with SOLUTION option; Milliken and Johnson 1989, SAS Institute 1999) to test for month, removal method, and month × removal method interaction effects ($\alpha = 0.05$). We present 95% confidence intervals for all proportions.

To assess the economic costs (United States dollars [USD], 2004) associated with the removal of a single PLB by trapping and shooting, we calculated the monthly costs associated with each removal method. For shooting, we used the following figures: $15 per hour spent shooting (total hours spent shooting by all personnel during Mar–Jun were 24, 72, 80, and 72, respectively) for personnel, $17.50 per month for ammunition, and $2.74 per hour for travel (i.e., gasoline and vehicle wear and tear). For trapping, we used the following figures: $15 per hour spent trapping (total hours spent attending traps by all personnel during Mar–Jun were 112, 104, 104, and 144, respectively), $175 per month for fire ant (*Solenopsis invicta*) insecticide, $40 per month for bait during March–May and $80 for bait during June, and $5.48 per hour for travel. After we calculated the monthly cost of performing each removal technique, we calculated costs of removing a single PLB during each month by dividing the monthly costs by the number of PLBs removed. Our cost estimates do not include start-up costs (e.g., the costs of guns and traps).

*Table 2.* Mean (95% CI) morphometric, phenotypic, and physiological measurements of potential local breeders (PLBs) and migrant female brown-headed cowbirds (*Molothrus ater*), as determined by cluster analysis, collected at Fort Hood, Texas, USA, during Mar–Jun 2003 and 2004.

| Group | Mean (95% CI) morphometric, phenotypic, and physiological measurements | | | |
|---|---|---|---|---|
| | Color[1] | Wing chord (mm) | Mass (g) | Ovarian development[2] |
| PLBs ($n = 959$) | 1.15 (1.12–1.17) | 94.98 (94.82–95.14) | 34.26 (34.07–34.44) | 0.18 (0.16–0.21) |
| Migrants ($n = 1,634$) | 2.58 (2.55–2.61) | 100.36 (100.24–100.48) | 38.63 (38.47–38.79) | 0.00 (0.00–0.00) |

[1] Color was subjectively ranked on an interval scale of 1–3; 1 indicating a pale female and 3 a dark female.
[2] Ovarian development was categorized as 0 (reduced ovaries) or 1 (developed ovaries).

## Results

We measured 2,594 female cowbirds (Table 1). The use of 2 clusters was appropriate as CCC and PFS values were higher for the 2-cluster (CCC = 77, PFS = 1,675) than for the 3-cluster (CCC = 21, PFS = 874) solution. The 3-cluster solution was essentially a 2-cluster solution because 1 of the 3 clusters only had a single cowbird placed in it. Solutions with >3 clusters made little biological sense and had lower CCC and PFS values than the 2-cluster solution. The large PFS value for the 2-cluster solution indicated high within-cluster homogeneity. The 2 clusters were comprised of 1) dark, large females, and 2) pale, small females (i.e., PLBs; Table 2). We detected enlarged ovaries in 18% of PLBs and 0% of dark, large females.

We detected a month × removal method interaction effect ($F_{1,\ 2} = 90.94$, $P = 0.01$); hence, the proportion of PLBs removed varied over time between removal methods (Table 3). The proportions of PLBs shot were similar among months. In contrast, there was a 7-fold decrease in the proportion of PLBs trapped between March and May and a 12-fold increase between May and June. Shooting removed a higher proportion of PLBs than trapping during all months. Except for March, total numbers of PLBs shot per month were similar (Table 4). Total number of PLBs trapped each month dropped 49-fold between March and June. Trapping removed 8- to 256-fold more PLBs than shooting during March and April. Trapping removed only 1.3-fold more PLBs than shooting in May. Shooting removed 3-fold more PLBs than trapping in June.

The costs of shooting were highest in March but decreased thereafter (Fig. 1). The cost of trapping increased over time, especially in June (Fig. 1). Compared to shooting, trapping costs were lower in March and April, similar in May, and higher in June.

## Discussion

### Identification of PLBs

We designated pale, small females as PLBs, and 18% of these females had enlarged ovaries. These characteristics suggested that PLBs likely were *M. a. obscurus*, Fort Hood's locally breeding cowbird race. Not all PLBs would have parasitized local hosts, though. The breeding range of *M. a. obscurus* extends north of Fort Hood (Ortega 1998), and an unknown number of PLBs probably would have migrated farther north to breed. Indeed, most of these PLBs did not have the enlarged follicles typical of female cowbirds during their breeding season (Payne 1965). Thus, if we used the total number of females identified as PLBs, we would have overestimated the actual number of local breeders removed.

Conversely, if we only used ovarian development to identify local breeders, we might underestimate the actual number of local breeders removed. The 18% of PLBs with developed ovaries probably parasitized local hosts as the presence of yolky follicles >2 mm in diameter suggests that ovulation would have occurred, approximately, within a week (Payne 1965). However, some of the females with recrudescent ovaries may have been in their early stage of reproductive development. Therefore, the true proportion of locally breeding females that we removed lies somewhere between 18–100% of the females we identified as PLBs. Although coarse, the number of PLBs identified by our cluster analysis provided us with a more realistic assessment of the impact we may have had on local cowbirds and, thus, populations of their host species relative to using a tally of all female cowbirds removed.

### Efficiency and Effectiveness of Trapping Versus Shooting

Shooting was more efficient than trapping in removing PLBs because it is a selective removal technique that targets cowbirds exhibiting breeding behavior within host species'

*Table 3.* Proportion (95% CI, sample size) of potential locally breeding relative to migrant female brown-headed cowbirds (*Molothrus ater*) removed by trapping and shooting at Fort Hood, Texas, USA, Mar–Jun 2003 and 2004.

| Removal | Proportion (%) | | | | |
|---|---|---|---|---|---|
| | Mar | Apr | May | Jun | Overall |
| Trapped | 50 (47–53, $n = 1,089$) | 27 (24–30, $n = 803$) | 7 (5–9, $n = 534$) | 87 (60–98, $n = 15$) | 33 (33–33, $n = 2,441$) |
| Shot | 100 (16–100, $n = 2$) | 100 (94–100, $n = 65$) | 93 (81–99, $n = 45$) | 100 (91–100, $n = 40$) | 98 (94–100, $n = 152$) |

***Table 4.*** Estimated no. of potential local breeder (PLB) and migrant female brown-headed cowbirds (*Molothrus ater*) removed by trapping and shooting at Fort Hood, Texas, USA, during Mar–Jun 2003 and 2004, extrapolated from proportions of PLB and migrant females trapped and shot.

| | | No. of females removed | | | |
|---|---|---|---|---|---|
| Removal method | Group | Mar | Apr | May | Jun |
| Trapping | PLB | 1,025 | 736 | 98 | 21 |
| | Migrant | 1,025 | 1,991 | 1,306 | 3 |
| Shooting | PLB | 4 | 95 | 74 | 71 |
| | Migrant | 0 | 0 | 6 | 0 |

habitat. In contrast, trapping is a nonselective technique that removes migrants and local breeders (DeCapita 2000, Rothstein and Cook 2000, Siegle and Ahlers 2004). Thus, the lower efficiency of trapping resulted from the large proportion of migrants captured.

In contrast to shooting, the monthly efficiency of trapping varied. The highest proportion (50%) of PLBs was trapped in March. However, efficiency dropped substantially through May. We speculate that this pattern was related to cowbird migration. Although there has been no investigation of the migration chronologies of the different cowbird races in Texas, our data suggest that the races might exhibit different migratory patterns with PLBs passing through Fort Hood earlier than females breeding farther north.

Removal efforts vary by cowbird control program. Some programs activate traps 2–4 weeks before arrival of endangered host species, to remove large numbers of cowbirds as they migrate into the region (Eckrich et al. 1999, DeCapita 2000). Other programs adopt a more conservative approach, only activating traps after hosts have begun to nest or at the beginning of the cowbird "resident period" (i.e., when cowbirds begin to disperse from migratory or winter flocks into host habitat; Siegle and Ahlers 2004), so most captures are assumed to be local breeders. The justification for the former approach is to remove as many PLBs as possible before they disperse into host habitat, regardless of whether migrants also are removed. In contrast, the conservative approach seeks to reduce the risk of removing migrants.

The assumptions behind these approaches have not been tested. The justification for trapping cowbirds in March at Fort Hood could be valid because the efficiency and effectiveness of traps were greatest in March. However, the probability of removing migrants also was high and removed cowbirds may not have been local breeders. Contrary to the supposition that nontarget cowbird captures should decrease after the onset of the resident period (Siegle and Ahlers 2004), our data indicate that the risk of capturing migrants actually was higher after the onset of the resident period at Fort Hood (beginning of Apr). Migrants dominated trap captures in April and May. Although the generally acknowledged pattern of a decline in captures after the first few weeks of trapping could be attributed, in part, to the passing of migrants through an area (DeCapita 2000, Siegle and Ahlers 2004), the decline

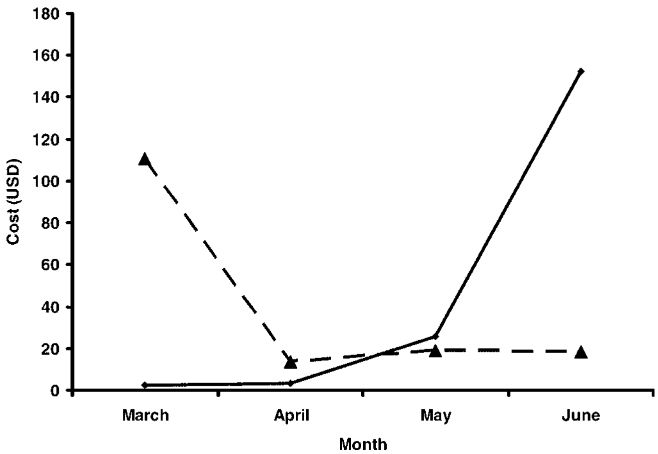


***Figure 1.*** Monthly costs (United States dollars [USD], 2004) associated with removal of a single potential locally breeding female brown-headed cowbird (*Molothrus ater*) by trapping (solid line) or shooting (dashed line) at Fort Hood, Texas, USA, Mar–Jun 2004.

also may have been due to changes in cowbird behavior, as local breeders dispersed for breeding, making them less susceptible to trapping (DeCapita 2000). We observed that migrants dominated trap captures during much of the resident period.

### *Trade-Offs Between Trapping and Shooting*

Trapping activities generally are conducted for several months during host species' breeding seasons (e.g., DeCapita 2000, Griffith and Griffith 2000), if not longer (e.g., Eckrich et al. 1999). However, the potential impact of trapping on populations of host species is not necessarily constant over these time frames. Our data indicated that trapping at Fort Hood was most efficient and effective, as well as less costly, during March and April. Efficiency and effectiveness of trapping declined after April and the cost of removing a single PLB increased dramatically by June. The high cost of trapping PLBs later in the season, particularly in June at Fort Hood, may be acceptable because females removed in June perhaps are even more likely to be local breeders and even a few female cowbirds could substantially depress the reproductive success of a host population (Stutchbury 1997; S. G. Summers, The Nature Conservancy, unpublished data).

In contrast, though always more efficient, shooting only approached or exceeded the effectiveness of trapping during May and June. Except in March, when many hours may be spent in host habitat without seeing cowbirds, the cost of shooting generally was moderate and stable. In May the costs of trapping and shooting were similar, but by June shooting was not only more effective but also less costly. Thus, although trapping is typically considered to be the primary means of cowbird removal (e.g., Eckrich et al. 1999), our data suggested that managers at Fort Hood might consider shifting primarily to shooting later in the breeding season based on its greater efficiency and effectiveness and lower cost compared to trapping.

The use of trapping and shooting also should be evaluated in relation to potential nontarget hazards. The capture of nontarget species in traps is an undesirable but unavoidable consequence of trapping (Rothstein et al. 2003). Risks to common nontarget species may be acceptable if trapping provides substantial benefits to endangered hosts. For example, early in the season, most non-cowbird captures at Fort Hood were migratory blackbirds (*Xanthocephalus xanthocephalus*, *Agelaius phoeniceus*; S. G. Summers, The Nature Conservancy, unpublished data). We suspect these blackbirds receive little negative impact from their short (<1 day) stays in traps. Thus, the benefit of removing substantial numbers of PLBs outweighed the cost of capturing nontarget species early in the season. Later in the season, hatch-year individuals of nontarget species were trapped and were more prone to die in traps (S. G. Summers, The Nature Conservancy, unpublished data). Risks to nontarget species later in the season are less acceptable, particularly because shooting, a selective technique that exclusively targets locally breeding cowbirds, was more efficient and effective, as well as less costly, than trapping. Additionally, removing nontarget cowbirds may be ethically and legally questionable (Hall and Rothstein 1999, Rothstein et al. 2003). This removal may be an unavoidable cost because trapping of PLBs generally was associated with the capture of large numbers of migrants. Although the exclusive use of shooting would eliminate most of the risk of removing migrants, it may not be sufficient to remove enough local breeders at the landscape level, especially early in the season, to make much of an impact on local cowbirds and populations of their hosts.

## Management Implications

Based on the color and size of female cowbirds, we believe it is possible to separate PLBs from migrants at Fort Hood in central Texas. Such separation will lead to more realistic estimates of numbers of PLBs removed and to more accurate assessments of the impacts of a control program on local populations of cowbirds and host species. However, differentiation of PLBs from migrants may not be possible where multiple subspecies do not occur or where gene flow may have obscured morphological and phenotypic differences between subspecies (Fleischer et al. 1991, Ortega and Cruz 1992).

Flexibility in trapping protocols selected should be promoted to determine which removal technique to use and when. Managers have an ethical obligation to continually assess their management plans and to apply management techniques that will best aid populations of host species impacted by cowbirds (Hall and Rothstein 1999, Rothstein et al. 2003). Although trapping is the most widely employed removal technique, it may not always be the most appropriate, effective, or efficient removal technique.

## Acknowledgments

Funding was provided by the United States Army through cooperative agreement DPW-ENV-02-A-0001 with The Nature Conservancy. The content of this manuscript does not necessarily reflect the position or policy of the United States government and no official endorsement should be inferred. J. W. Bailey, D. A. Cimprich, J. D. Cornelius, K. Ellison, T. A. Greene, and 2 anonymous referees reviewed the manuscript.

## Literature Cited

Andrews, E. J., B. T. Bennett, J. D. Clark, K. A. Houpt, P. J. Pasco, G. W. Robinson, and J. R. Boyce. 1993. Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 202:229–249.

DeCapita, M. E. 2000. Brown-headed Cowbird control on Kirtland's Warbler nesting areas in Michigan, 1972–1995. Pages 333–341 *in* J. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, editors. Ecology and management of cowbirds and their hosts: studies in the conservation of North American passerine birds. The University of Texas, Austin, USA.

Eckrich, G. H., T. E. Koloszar, and M. D. Goering. 1999. Effective landscape management of brown-headed cowbirds at Fort Hood, Texas. Studies in Avian Biology 18:267–274.

Fleischer, R. C., S. I. Rothstein, and L. S. Miller. 1991. Mitochondrial DNA variation indicates gene flow across a zone of known secondary contact between two subspecies of the brown-headed cowbird. Condor 93:185–189.

Griffith, J. T., and J. C. Griffith. 2000. Cowbird control and the endangered Least Bell's Vireo: a management success story. Pages 342–356 *in* J. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, editors. Ecology and management of cowbirds and their hosts: studies in the conservation of North American passerine birds. The University of Texas, Austin, USA.

Hall, L. S., and S. I. Rothstein. 1999. Section III: cowbird control: the efficacy of long term control and proposed alternatives to standard control practices. Studies in Avian Biology 18:254–259.

Kostecke, R. M., S. G. Summers, G. H. Eckrich, and D. A. Cimprich. 2005. Effect of cowbird removal on black-capped vireo nest success and population growth at Fort Hood, Texas. Ornithological Monographs 57:28–37.

Lowther, P. E. 1993. Brown-headed cowbird (*Molothrus ater*). Account 47 *in* A. Poole and F. Gill, editors. The birds of North America. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

McGarigal, K., S. Cushman, and S. Stafford. 2000. Multivariate statistics for wildlife and ecology research. Springer-Verlag, New York, New York, USA.

Milliken, G. A., and D. A. Johnson. 1989. Analysis of messy data. Volume 2: nonreplicated experiments. Chapman and Hall/CRC, Boca Raton, Florida, USA.

Ortega, C. 1998. Cowbirds and other brood parasites. University of Arizona, Tucson, USA.

Ortega, C. P., and A. Cruz. 1992. Gene flow of the *obscurus* race into the north-central Colorado population of brown-headed cowbirds. Journal of Field Ornithology 63:311–317.

Payne, R. B. 1965. Clutch size and numbers of eggs laid by brown-headed cowbirds. Condor 67:44–60.

Payne, R. B. 1976. The clutch size and numbers of eggs of brown-headed cowbirds: effects of latitude and breeding season. Condor 78:337–342.

Pease, C. M., and J. A. Grzybowski. 1995. Assessing the consequences of brood parasitism and nest predation on seasonal fecundity in passerine birds. Auk 112:343–363.

Pyle, P. 1997. Identification guide to North American Birds, Part I. Columbidae to Ploceidae. Slate Creek, Bolinas, California, USA.

Rothstein, S. I., and T. L. Cook. 2000. Introduction: cowbird management, host population limitation, and efforts to save endangered species. Pages 323–332 *in* J. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, editors. Ecology and management of

cowbirds and their hosts: studies in the conservation of North American passerine birds. The University of Texas, Austin, USA.
Rothstein, S. I., B. E. Kus, M. J. Whitfield, and S. J. Sferra. 2003. Recommendations for cowbird management in recovery efforts for the southwestern willow flycatcher. Studies in Avian Biology 26:157–167.
SAS Institute. 1999. SAS/STAT® user's guide, version 8. SAS Institute, Cary, North Carolina, USA.
Siegle, R., and D. Ahlers. 2004. Brown-headed cowbird management techniques manual. United States Department of the Interior, Bureau of Reclamation, Ecological Planning and Assessment Group, Denver, Colorado, USA.
Stutchbury, B. J. M. 1997. Effects of female cowbird removal on reproductive success of hooded warblers. Wilson Bulletin 109:74–81.
Winter, K. J., and S. D. McKelvey. 1999. Cowbird trapping in remote areas: alternative control measures may be more effective. Studies in Avian Biology 18:282–289.

***Scott G. Summers*** (left) received his B.S. in wildlife biology from Texas State University (1994). He has worked for The Nature Conservancy at Fort Hood since 1997. In addition to controlling cowbirds, he works with the Fort Hood prescribed fire program. He is a staunch proponent of using sound science when applying cowbird control. ***Richard M. Kostecke*** (center) received a B.S. in biology from the University of Kansas (1995), an M.S. in zoology from North Dakota State University (1998), and a Ph.D. in wildlife science from Texas Tech University (2002). His M.S. research focused on the assessment of hazards to avian and mammalian predators and scavengers associated with the use of an avicide to reduce populations of crop-depredating blackbirds in the northern Great Plains. Field work for his Ph.D. was conducted at Cheyenne Bottoms, Kansas, where he investigated the effects of cattail control on aquatic invertebrates and migratory wetland birds. Currently, he works as a Project Scientist for The Nature Conservancy at Fort Hood, Texas, where his research efforts focus on the ecology and management of black-capped vireos, golden-cheeked warblers, and cowbirds. He is an Associate Wildlife Biologist and has served as a peer-reviewer for The Journal of Wildlife Management and The Wildlife Society Bulletin. ***Garrett L. Norman*** (right) received his B.S. in wildlife and fisheries science from Texas A&M University (2000). He has been with The Nature Conservancy at Fort Hood, Texas, since 2001 as a Field Biologist and Fire Technician. His duties are split between controlling cowbird parasitism in the spring and summer and conducting prescribed fires in autumn and winter.

*Associate Editor: Schweitzer.*