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EFFECTIVE LANDSCAPE MANAGEMENT OF BROWN-HEADED COWBIRDS AT FORT HOOD, TEXAS

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Abstract. Fort Hood is an 87,890 ha military installation in central Texas that contains the largest known breeding populations of the endangered Black-capped Vireo (*Vireo atricapillus*) and the Golden-cheeked Warbler (*Dendroica chrysoparia*) under any single management authority. Habitat loss and brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) have been cited as critical factors associated with the decline of both species. In 1987, prior to initiation of cowbird control efforts, 90.9% of vireo nests on Fort Hood were parasitized. Due to the large size of Fort Hood and the wide distribution of endangered bird habitat, it is not feasible to trap and/or shoot cowbirds in every block of habitat. We implemented a cowbird control program that emphasized trapping in pastures with high cattle concentrations, manipulation of trap numbers, and innovations in trap designs. Trapping, in conjunction with a rigorous, methodical shooting program, reduced parasitism to 8.6% by 1997.

Key Words: Black-capped Vireo, brood parasitism, cowbird control, Golden-cheeked Warbler, *Molothrus ater.*

Managers of Brown-headed Cowbird (*Molothrus ater*) populations have to consider landscape-level mosaics of habitat in deciding how to control cowbird abundance and parasitism (Robinson et al. 1993). Robinson et al. (1995a) state that in areas with locally endangered hosts, intensive cowbird trapping and removal may be the best immediate protection strategy. Fort Hood, a large military base in central Texas, has the largest known breeding populations of the endangered Black-capped Vireo (*Vireo atricapillus*) (vireo hereafter) (Grzybowski 1995) and Golden-cheeked Warbler (*Dendroica chrysoparia*) (warbler hereafter) (USFWS 1992) under a single management authority. Here, we update Hayden et al.'s (in press) report on cowbird management and vireos at Fort Hood from 1987 to 1994 with data collected in 1994–1997. These additional data present new insight into methods and recommendations for control of parasitism on a landscape scale. Our paper also addresses a research need identified by Robinson et al. (1995a) to measure the effect of cowbirds on host populations using trapping and shooting to manipulate parasitism rates. Barber and Martin (1997) recently reported on other factors besides cowbird removal, such as abundance of alternate hosts, that appears to influence rates of cowbird parasitism of vireos at Fort Hood.

Before presenting our new data, we first briefly review the status of the warbler and vireo and the cowbird impacts these hosts experience. The Golden-cheeked Warbler was listed as endangered in May 1990 because of habitat loss, degradation, and increasing fragmentation (USFWS 1992). Pulich (1976) estimated the total breeding population of the warbler throughout its range to be approximately 15,000 birds. However, Ehrlich et al. (1992) indicate a breeding population of only 2,200–4,600 warblers in 1990. Although the number of warblers on Fort Hood is unknown, 915 male warblers were reported on the installation in 1996 (Jette et al. 1998). The precise number of warblers is probably higher because of the large size of the installation and restrictions on entering the areas the Army uses for live-fire activities. In 1963, Pulich (1976) found a parasitism rate as high as 84.2% in Kendall County, Texas. Parasitism by cowbirds appears to be an increasing threat in much of the warbler range due to habitat fragmentation (Collar et al. 1992). Parasitization of warbler nests on Fort Hood, 1991–97, was not substantial with 8.7% (4 of 46) nests parasitized (R. Craft pers. comm., Jette et al. 1998). Because the initiation of warbler studies coincided with increased cowbird control effectiveness in 1991, there are no estimates of warbler parasitization prior to effective cowbird management.

The Black-capped Vireo was listed as an endangered species in 1987 (USFWS 1991). Brood parasitism undoubtedly contributed to the decline of the vireo (Robinson et al. 1995a). The estimated global population of the vireo is controversial, ranging from less than 2,000 pairs (Collar et al. 1994) to between 3,139 and 9,463 pairs based on a breeding population in Coahuila (Benson and Benson 1990). The number of territorial male vireos on Fort Hood has risen from 85 in 1987 (Tazik and Cornelius 1993) to 357 in 1997 (Koloszar 1998). Initial data from the 1998 breeding season indicate a continuing increase in the vireo population, in both numbers and newly occupied habitat (J. Koloszar pers. comm.). As in the case of the warbler, the actual number is unknown due to size of the installation and restrictions on entry into live-fire areas.

The primary reasons stated in the U.S. Fish

and Wildlife Service Recovery Plan (USFWS 1991) for listing the vireo are (1) documented population decline, (2) loss of suitable habitat, and (3) brood parasitism by the Brown-headed Cowbird (cowbird hereafter). Of these, parasitism previously had the greatest effect on Fort Hood. In addition to the Brown-headed Cowbird, the Bronzed Cowbird (*M. aeneus*) is found on Fort Hood (approximately 12 are trapped per breeding season). Also, two Shiny Cowbirds (*M. bonariensis*) have been trapped on Fort Hood (Hunt 1991, G. Eckrich pers. obs. 1993). Initial studies on the installation in 1987 and 1988 reported a cowbird parasitism rate of vireo nests at 90.8% and vireo nest success rate at 4.7% (Tazik and Cornelius 1993). Based on 60% adult annual survival and juvenile survival of 30%, Tazik and Cornelius (1993) determined a critical parasitism rate (the highest parasitism rate the population can withstand without decline) of approximately 35%.

The vireo recovery plan (USFWS 1991) states that cowbird removal is needed in vireo breeding sites where parasitism is a threat to reproductive success, and that removal should begin about two weeks prior to arrival of vireos. Fort Hood Natural Resources Branch initiated cowbird control measures in 1988, but with little effect. Subsequent experimentation with trap placement, numbers, and styles, combined with shooting has successfully reduced cowbird parasitism of vireo nests and increased cowbird capture rates. Our research has emphasized studies of vireos because vireo nests are easier to locate than warbler nests, thus providing larger sample sizes. However, warblers should benefit from cowbird reduction and lower parasitism rates since warbler habitat lies within the areas influenced by the cowbird control program.

STUDY AREA

Fort Hood is an active Army installation that occupies 87,890 ha within Bell and Coryell counties, and is adjacent to the city of Killeen. The installation has a mixture of perennial grassland (65%) and woodland (31%). The remainder of the installation is a build-up cantonment area. Ashe juniper (*Juniperus ashei*) and various oak species (*Quercus* spp.) dominate the woodland (Tazik et al. 1993). Most of the installation has free-ranging cattle, with the exception of the cantonment area and one non-live fire training area. Fort Hood has two basic types of training areas (Fig. 1). In maneuver (non-live fire) training areas two armored divisions with other corps support units conduct year round training. There is no direct firing of weapons; however, artillery units fire indirectly at targets in the impact area in the center of the installation. The maneuver training areas constitute 53,300 ha or 61 % of the entire installation and are divided into East Range, West Range, and West Fort Hood (WFH). Researchers and cowbird control personnel usually have access to these areas. The live-fire (LF) training areas and the artillery impact area (classified a permanent "dudded" zone due to presence of duds, unexploded, but still live munitions) cover about 24,000 ha. Researchers and cowbird control personnel have sporadic access to the areas in which units fire, and have no access to the artillery impact area. Housing areas, motor pools, and barracks make up the Fort Hood cantonment area. Although the cantonment area is not grazed, extensive mowed fields, lawns, parade grounds, a horse stable, golf courses, and airfields provide suitable foraging areas for cowbirds. Cowbird control measures at Fort Hood have been applied to the entire installation since endangered birds and cowbird feeding areas are present installation-wide. The wide distribution of the warblers and vireos across the installation (Fig. 1) necessitated a cowbird control strategy combining trapping and shooting since some cowbirds are trap-shy while others ignore traps in favor of feeding areas (cattle concentrations and bird feeders) off post.

Warbler habitat is dominated by Ashe juniper (needed for nesting material) and various oak species, especially Texas oak, along with other hardwood species (Pulich 1976). There are approximately 16,000 ha of warbler habitat on Fort Hood. Vireo habitat is described as low scrubby growth, mostly deciduous and of irregular height and distribution, but with spaces between small thickets and clumps and with hardwood foliage to ground level (Graber 1961). Vireos are often found in areas that have recently been burned, with the highest concentrations in areas subjected to hot fires (Grzybowski 1995). Burned areas on Fort Hood have been occupied by vireos as early as two years after a burn. Fort Hood has approximately 4,300 ha of available vireo habitat in all stages of occupancy and successional growth.

METHODS

TRAPPING

Beginning in 1991, trapping efforts focused on pastures frequently grazed by cattle since cowbirds prefer foraging on ground with short grass and in proximity to grazing mammals (Friedmann 1929, Mayfield 1965). Cowbird trapping had been initiated in 1988 following the standards of the cowbird control program to save the Kirtland's Warbler (*Dendroica kirklandii*) (Shake and Mattson 1975). In 1988 three traps were placed in one vireo breeding colony

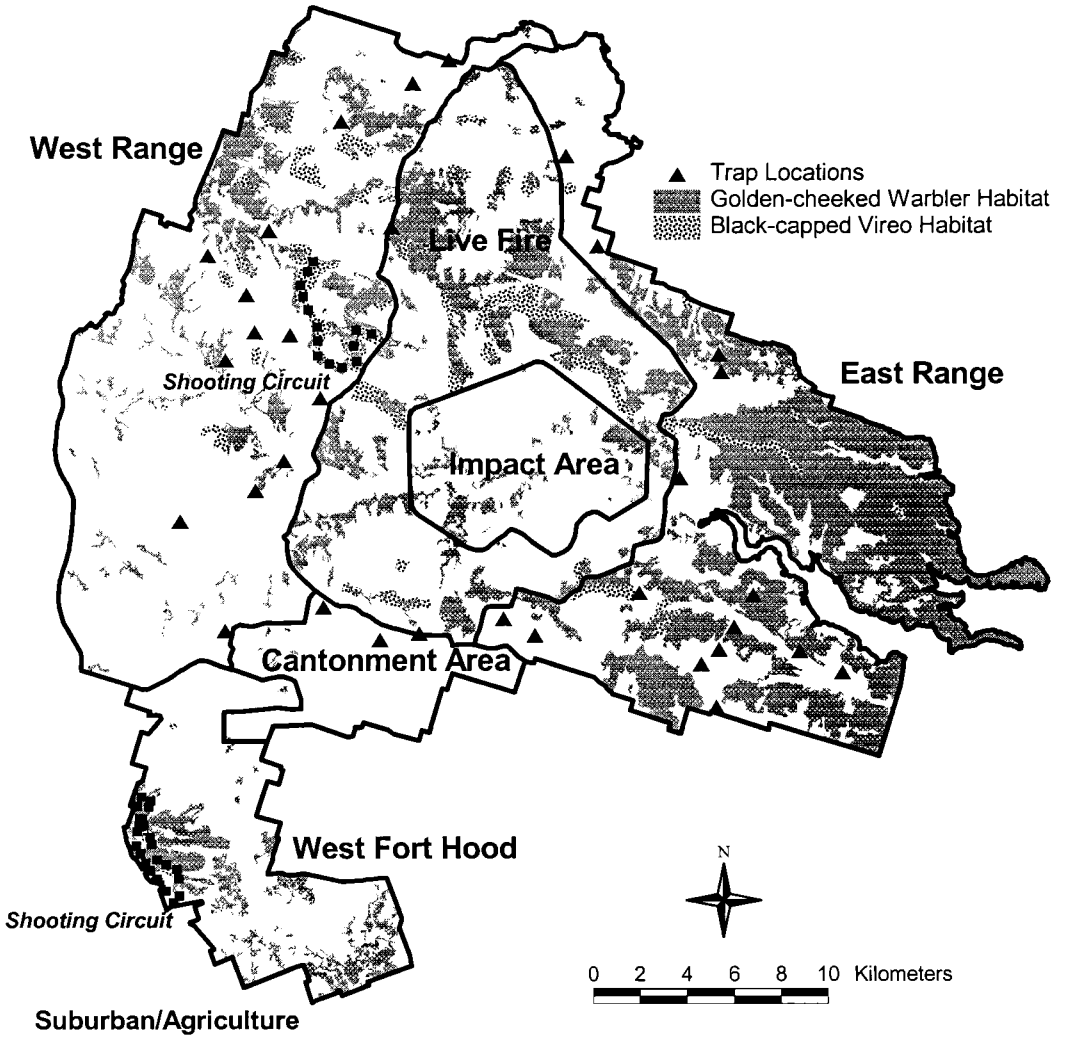

FIGURE 1. Brown-headed Cowbird trap distribution and shooting circuits in relation to designated Black-capped Vireo and Golden-cheeked Warbler habitat across the Fort Hood military installation, 1997, Fort Hood, Texas.

and operated during the breeding season, 1 March–30 June (Tazik and Cornelius 1993). The number of traps was increased to 8 in 1988 and 25 in 1990 (Hayden et al. in press). The trapping strategy was changed in 1991 by placing 40 traps in cattle grazing areas, and leaving 12 in vireo habitat. The number of traps varied in subsequent years due to vandalism, new construction, flooding, or military activity. After reaching a high of 52 in 1991, 30 traps were in operation in 1997 along a 115 km circuit (Fig. 1).

Control efforts varied according to area. The area with the most cowbird control effort was the West Range where both trapping and shooting were used. Very limited trapping and shooting were conducted in the Live-fire Area because of limited access. West Fort Hood (WFH) presented a unique problem in cowbird control because it is a 6,628 ha peninsula-shaped area surrounded by civilian suburban and agricultural lands (Fig. 1). No cattle were grazed on WFH from 1992 until reintroduction in December 1996. Prior to the 1992 breeding season, all cowbird control measures were suspended on WFH to determine the effect of cowbird removal. Trapping was resumed in 1993. When cowbirds were repeatedly observed flying from vireo breeding habitat past traps to civilian homes to feed (G. Eckrich pers. obs.), we changed the cowbird control strategy for West Fort Hood. In

TABLE 1. TRAP CAPTURE RATE (# FEMALES/TRAP DAY) BY TRAP TYPE FOR BROWN-HEADED COWBIRDS TRAPPED DURING 1997 BREEDING SEASON ON FORT HOOD, TEXAS

	Trap capture rate				
Trap type (N)	March	April	May	June	All
Australian (3)	0.142	0.958	1.242	0.051	0.606
Hybrid (5)	2.354	1.900	1.045	0.147	1.294
Mega (10)	2.108	2.471	3.226	0.248	2.024
USFWS (12)	0.519	0.587	0.524	0.087	0.430
Total	1.158	1.296	1.365	0.131	0.990

1994 we removed all traps from WFH due to their low 1993 capture rate of 0.11 females/trap day versus 0.46 installation-wide and instituted a rigid, methodical shooting program.

The other area with variation in cowbird control was the East Range, containing a 10,800 ha cowbird telemetry research area (Fig. 1) for a 5-year (1994–1998) study (Cook et al. 1998) of spatial and temporal movements of female cowbirds. The number of traps in that area was reduced from 14 in 1993 to 5 in 1994–95, and 3 in 1996–97 to prevent interference with radio-tracking operations. Additionally, all shooting in that area was stopped in 1994.

In accordance with the USFWS Biological Opinion (1993a), trapping has occurred year round. Individual traps were closed when the capture of non-target species exceeded cowbirds, military training interfered, or the trap was repeatedly vandalized. Since one person carried out all cowbird control measures (trapping and shooting) in 1996 and 1997, trap placement had to allow for coverage of as much of the installation as possible in a single day. All traps were placed near paved or improved roads and on terrain that was accessible throughout the year. Four cowbird trap designs were used on Fort Hood in 1996–97. There were three Washington starling traps (1.8 m × 2.4 m × 1.8 m) (USFWS 1984), 12 standard USFWS traps (1.8 m × 2.4 m × 1.8 m) (USFWS 1973), five Hybrid traps (1.8 m × 2.4 m × 2.1 m), and ten Mega traps (4.88 m × 4.88 m × 2.44 m). John Cornelius of the Fort Hood Natural Resources Branch designed the Hybrid and Mega traps based on cowbird control personnel observations and lessons learned. The respective trap capture rates are in Table 1. The apparent advantage of Mega traps is somewhat misleading. While that style trap can catch and hold more birds, Mega traps are placed only at sites that have had high capture rates in preceding seasons. We left 10–15 cowbirds in the Washington starling, USFWS, and Hybrid traps to act as decoys. Approximately 50 decoys were left in the Mega traps, the premise being that more decoys attract more birds since breeding season social aggregations occur during the afternoon at feeding sites (Robinson et al. 1995a, Rothstein et al. 1987). We have found the sex ratio of decoy birds to be irrelevant to capture rates, in contrast to the 2 males to 3 female ratio of Griffith and Griffith (in press). Traps with few or no females were as effective in catching females as those with a more even sex ratio. The number of females in each trap was intentionally kept low to minimize the number of potentially escaping birds if a trap was vandalized or damaged by storms, cattle, predators, or armored vehicles.

Vegetation in and within 50 cm of the traps was maintained at approximately 5 cm or less so that field personnel could better detect snakes which periodically enter traps to eat cowbirds. Captured female cowbirds were killed by cervical dislocation, while males were banded with USFWS bands and released. Cowbirds were removed as needed to relieve overcrowding or reduce the number of females. The number of birds removed per trap was recorded each visit.

SHOOTING

Shooting female cowbirds in vireo breeding habitat and wherever else found throughout the year augmented the trapping program. A methodical shooting program was conducted along two shooting circuits covering three previously existing vireo study areas on base (Fig. 1). There was no shooting in the telemetry study area, which contains a fourth vireo study area. Additionally, there was no shooting in human occupied areas.

One person, in conjunction with running the trap circuit, patrolled the two circuits on alternating days. Each circuit was covered between 0700–1130 hours from 1 March–30 June. Periodic stops along the circuits were made at sites with dead snags or potential cowbird foraging areas. There was no specific distance between shooting points since suitable shooting sites occurred at irregular intervals along both circuits. Taped playback of the female chatter (rattle) call was played at each stop to attract cowbirds within shooting range (Dufty 1982b). Some females were specifically targeted when field technicians with the Fort Hood endangered species program reported specific time and location of cowbird sightings in vireo habitat. Opportunistic shooting such as in grazing areas (Rothstein et al. 1987) was conducted throughout the year as time and circumstances (safety and presence of personnel) permitted.

RESULTS AND DISCUSSION

TRAPPING

A total of 3,413 female cowbirds were removed by trapping in 3449 trap days (TD) (trap

TABLE 2. BROWN-HEADED COWBIRD PARASITISM RATE (PERCENT PARASITIZED, TOTAL NUMBER OF NESTS) OF BLACK-CAPPED VIREO NESTS BY YEAR AND REGION ON FORT HOOD, TEXAS

	East Range	West Range	West Fort Hood	Live Fire	Total
1987[a]	90.3 (31)	—	100 (1)	100 (1)	90.9 (33)
1988[a]	84.4 (32)	83.3 (12)	100 (19)	95.8 (24)	90.8 (87)
1989[a]	51.8 (56)	70.8 (24)	58.6 (29)	83.7 (43)	65.1 (152)
1990[b]	66.7 (15)	25.0 (4)	100 (5)	53.3 (15)	63.0 (39)
1991[c]	13.6 (22)	50.0 (2)	25.0 (8)	57.1 (35)	38.8 (69)
1992[c]	4.2 (24)	14.3 (7)	42.9 (21)	61.5 (13)	29.2 (68)
1993[c]	14.8 (27)	13.3 (15)	60.0 (15)	22.2 (9)	25.8 (67)
1994[c]	11.1 (45)	3.8 (26)	11.8 (34)	25.0 (28)	12.8 (133)
1995[c]	18.5 (65)	0.0 (22)	6.9 (29)	21.0 (62)	15.2 (178)
1996[c]	34.8 (23)	18.2 (33)	14.8 (27)	29.6 (27)	22.9 (118)
1997[d]	1.6 (62)	9.1 (22)	11.3 (53)	16.2 (37)	8.6 (174)

[a] Taken from Table 6 in Hayden et al. 1998.
[b] Taken from Table 3 in Hunt 1991.
[c] Taken from Table 7 in Weinberg et al. 1998.
[d] Taken from Table 2.7 in Koloszar 1998.

capture rate = 0.989 females/TD) during the period 1 March–30 June 1997. Vireo parasitization was reduced to 8.6% in the 1997 breeding season (Koloszar 1998). The initial vireo studies on Fort Hood in 1987 found a cowbird parasitism rate of 90.9% (Table 2) and only a 4.7% nest success rate (Tazik and Cornelius 1993). Cowbird control efforts were initiated in 1988 by placing traps in vireo breeding habitat, and 10 females were removed from 3 traps in 230 trap days, yielding 0.04 females per trap day (TD). Six traps were operated in vireo habitat during 1989 and 120 females removed (0.05 females/TD), and in 1990, 25 traps in vireo habitat yielded 162 females (0.12 females/TD)(Hayden et al. in press). Trapping in breeding habitat has been successful in protecting birds such as Least Bell's Vireo (*Vireo bellii pusillus*) in southern California (Griffith and Griffith in press). However, this strategy, combined with random shooting of females, proved ineffective on Fort Hood (Table 2) in reducing parasitism to the 35% level, below which estimates indicate the vireo population can sustain itself (Tazik and Cornelius 1993).

Changing the trapping focus from vireo habitat to cattle grazing concentrations caused a dramatic increase in the number of female cowbirds captured, from 162 in 1990 to 1284 in 1991 (0.24 females/TD)(Hayden et al. 1998). A concurrent decrease in parasitism rates was detected, from 63% (N = 39) (Hunt 1991) in 1990 to 38.8% (N = 67) in 1991 (Hayden and Tazik 1991). As of 1993, all traps were placed in open cattle grazing areas.

The Spearman correlation between the number of female cowbirds removed per year and the parasitism rate of vireo nests from 1987–1997 was highly significant ($r_s = -0.952$, $P < 0.01$; Fig. 2). Barber and Martin (1997) also reported a relation between the level of cowbird parasitism of vireos at Fort Hood and the number of female cowbirds removed; however, their analysis involved comparison among different sites, not among different years. It is important to note that these statistical relationships indicate that if trapping were suspended or reduced, the frequency of parasitism would probably increase. When trapping effort within the aforementioned East Range cowbird telemetry study area was reduced, and all shooting stopped, parasitism rose to 34.8% in 1996 (Table 2). The 1997 drop to 1.6% parasitism in the East Range was potentially due to two factors: the reduction of cattle from 752 animal units (animal unit = 1 bull or 1 cow plus calf) to 103 and higher capture rates of four specific Mega traps (Table 3). These four traps had been placed into operation for the 1996 breeding season with 2.9 cm (1⅛ inches) entry slots to exclude non-target species. After cowbird control personnel observed female cowbirds being reluctant to enter through such a narrow slot, we concluded that cowbirds, not just non-target species, were also being excluded. Widening the slots to 3.2 cm (1¼ inches) did increase non-target captures while greatly increasing the number of cowbirds caught (Table 3). The effect of cattle removal/reduction may also explain that while three of the four Mega traps with widened slots saw significant increases in their capture rates, one trap (3OAK) declined (Table 3). This trap was the only one of the four with no cattle present in 1997. Since the increasing parasitism rates on the east range from 1994 to 1996 were based on reduced trapping effort and cessation of shooting, the results may not meet the criteria of a scientific experimental removal program in which all cowbird control measures are stopped

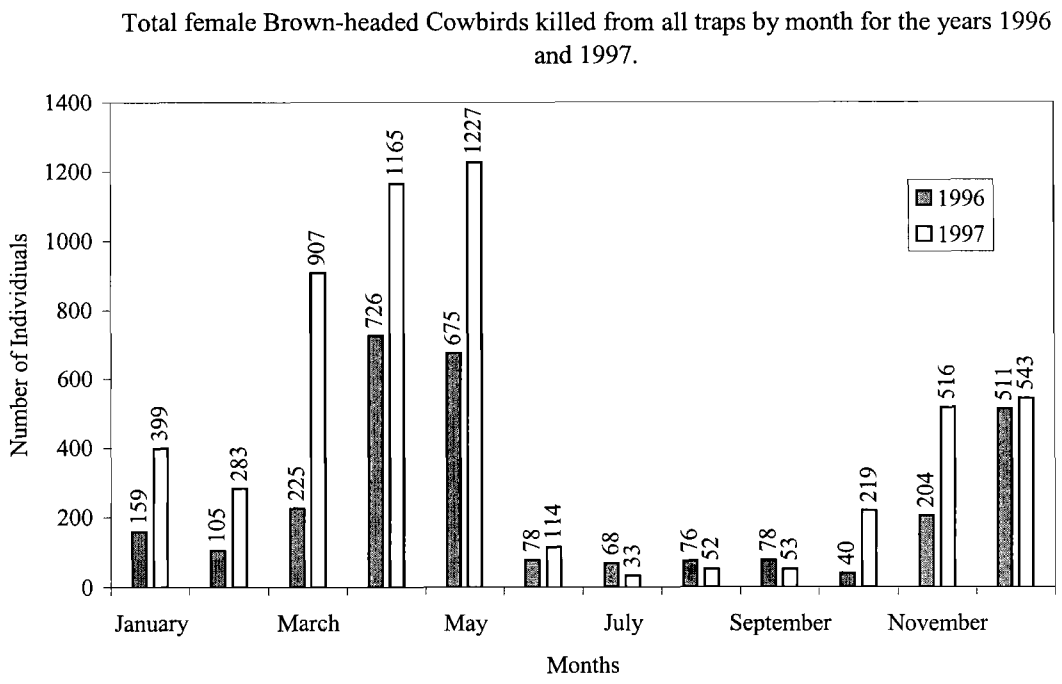

FIGURE 2. Relationship between Black-capped Vireo brood parasitism rate and number of female Brown-headed Cowbirds removed from the landscape study area population during the 1 Mar–30 June breeding season from 1987 to 1997, Fort Hood, Texas. ($r_s = -.952$, $P < 0.01$)

to access parasitism rates in the absence of cowbird control (Robinson et al. 1995a).

The number of cowbirds removed from Fort Hood over the past 10 years has not decreased (Fig. 2). In a calendar year most cowbirds are caught in spring and fall migration (Fig. 3). The percentage of captured birds that are year round Fort Hood residents, migrants coming to Fort Hood to breed, migrants passing through Fort Hood, or birds wintering at Fort Hood from elsewhere is unknown. In an effort to learn more about the cowbird populations found at Fort Hood throughout the year, more than 2,000 males have been banded each year since 1991. Few band recoveries have been reported to date. In addition to recaptures on Fort Hood and birds recovered in central Texas, three birds banded during spring migration have been recovered in Canada (Alberta and British Columbia). Two birds banded in January were recovered the following spring in Paris, Tennessee, and Wilmington, North Carolina.

The sharp increase in females trapped in 1997 (3413) versus 1996 (1704) was probably a result of the accumulation of several factors. Trap capture rates throughout the installation rose; however, two factors may be significant—vandalism and slot width. In April 1996, vandals destroyed or severely damaged four traps, including two Mega traps, in the telemetry study area on the

TABLE 3. COMPARISON OF THE NUMBER OF FEMALE BROWN-HEADED COWBIRDS AND NON-TARGET INDIVIDUALS (IN PARENTHESES) CAPTURED IN MEGA STYLE TRAPS ON FORT HOOD, TEXAS, USING A SLOT WIDTH OF 2.9 CM IN 1996 VERSUS 3.2 CM IN 1997

	3OAK		OCMV		RORI		HENC	
	1996	1997	1996	1997	1996	1997	1996	1997
March	12 (0)	11 (36)	1 (0)	3 (0)	1 (0)	29 (1)	0 (0)	134 (0)
April	45 (1)	18 (0)	11 (0)	62 (0)	1 (0)	105 (2)	0 (0)	136 (16)
May	1 (1)	38 (1)	13 (0)	133 (13)	4 (0)	43 (0)	4 (0)	55 (22)
June	0 (0)	6 (0)	2 (0)	1 (0)	0 (0)	9 (0)	3 (0)	10 (0)

Note: Non-target species captured were House Finches (*Carpodacus mexicanus*), Red-winged Blackbirds (*Agelaius phoeniceus*), and Common Grackles (*Quiscalus quiscala*).

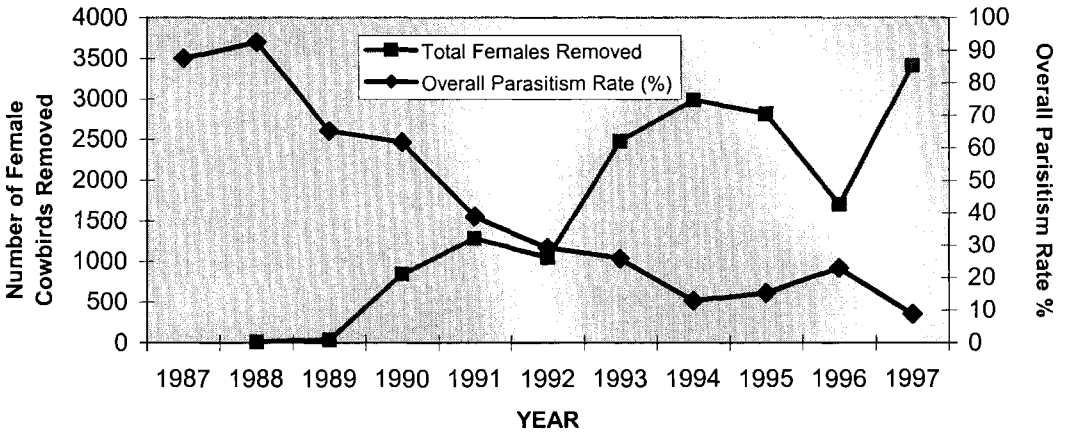

FIGURE 3. Total numbers of female cowbirds killed from all traps by month for the years 1996 and 1997 at Fort Hood, Texas

east side of the installation. The vandalism released at least 200 female cowbirds, although many of these were likely migrants. Only one trap (a Mega) was repairable; thus, the potential captures of the other 3 traps were lost. There was no vandalism in that area in 1997. The increased capture rates of the four Mega traps with widened slots in 1997 probably lowered parasitism rates in nearby vireo breeding areas. However, other factors such as global population dynamics, drought, cattle movement, and military presence, may also be important.

SHOOTING

Sixty-seven female cowbirds were shot in 1997, representing 1.9% of all females removed during the breeding season. We believe selective shooting is an effective and efficient way to target females in breeding habitat as a complement to our trapping program since it has been conducted in conjunction with trap operation without requiring additional personnel. Having reviewed Fort Hood data from 1987–94, Hayden et al. (in press) state that more data are needed to assess if shooting in occupied habitat on a methodical basis is effective in reducing site-specific parasitism rates. In 1989 Fort Hood implemented routine shooting of female cowbirds in occupied vireo habitat in the expectation that parasitism would drop. Although 119 females were shot, parasitism rates were not appreciably affected (Tazik and Cornelius 1993). Tazik and Cornelius (1993) hypothesized that the overall cowbird population density on Fort Hood might have been too high to make shooting effective at that time. Shooting has been the only control measure used on WFH since 1994. Although traps were used on WFH in 1990, nest parasitism was 100% (N = 5). After improved trapping and random shooting the rate dropped to 25% (N = 8) in 1991. After all cowbird control was stopped in 1992, even in conjunction with cattle removal, parasitism rose to 42.9% (N = 21). Resumption of trapping in 1993 did not reduce parasitism. The parasitism rate reached 60% (N = 34) while the installation-wide rate dropped to the lowest recorded level (25.8%, N = 67) to that date (Table 2). After removing all traps and instituting a rigid, methodical shooting program, parasitism changed to 11.8% (15 females shot) in 1994, 6.9% (22 females shot) in 1995, 15.4% (21 females shot) in 1996, and 11.3% (15 females shot) in 1997. We do not know the threshold at which the landscape-scale cowbird population density drops low enough to make shooting females in breeding habitat an effective management tool.

CONCLUSIONS

Brood parasitism in situations similar to ours (a large area with widely dispersed endangered bird habitat) can be limited by a landscape approach to cowbird control that combines effective cowbird trapping with a methodical shooting program. We recommend the use of predation-resistant, easy-to-fabricate traps such as the Fort Hood Hybrid and Mega trap designs. Information on these traps may be obtained from John Cornelius, Fort Hood Natural Resources Branch (254) 287-2885, e-mail: corneliusj@hood-emh3.army.mil. These traps should be placed in primary cowbird feeding areas, usually near cattle concentrations, to reduce the overall cowbird population. To complement the trapping program, we suggest a shooting program in breeding habitat to eliminate specific territorial

females. Although trapping at cowbird feeding sites and a shooting program in breeding habitat have proved to be highly effective at Fort Hood, other strategies for removing cowbirds may be equally or more effective in other landscapes. For example, Griffith and Griffith (in press) report that cowbird numbers in a large southern California landscape were reduced effectively with extensive trapping in breeding habitats and with no shooting program.

While the Fort Hood cowbird control effort and other successful programs have demonstrated that an endangered avian species can be protected from brood parasitism, trapping and shooting do not correct land management practices that ultimately cause the problem. Cowbird control is a never-ending management option requiring scarce money and time. Further studies are necessary to address the questions of species recovery in terms of cowbird control, habitat loss and fragmentation, cattle grazing, urbanization, and cost effectiveness of various land management alternatives.

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