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MOVEMENTS AND HOME RANGE ESTIMATES OF FEMALE BROWN-HEADED COWBIRDS ALONG THE RIO GRANDE, NEW MEXICO

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Abstract. We studied daily and seasonal movements of female Brown-headed Cowbirds (*Molothrus ater*) at two riparian sites along the Rio Grande in central New Mexico in 1998 and 1999. One site was in close proximity (<2 km) to livestock grazing, while the other site was ungrazed. Forty-eight female cowbirds were captured, fitted with radio transmitters, and tracked over a 2-month period. Maximum daily movements averaged 1.9 km (±0.79 SD) in 1998 and 1.4 km (±0.54 SD) in 1999. Seasonal maximum movements averaged 5.3 km (±3.43 SD) in 1998 and 2.7 km (±0.83 SD) in 1999. Daily and seasonal movements did not differ between sites. Home ranges were also calculated using a fixed kernel home range estimator and the minimum convex polygon estimator. Home range sizes did not differ between sites. Female Brown-headed Cowbirds at our sites along the Rio Grande have smaller daily commuting distances and home ranges than other studies have previously shown. Since daily and seasonal movements did not differ between sites, the exclusion of livestock from Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat may have limited beneficial effects within this system.

Key Words: Brown-headed Cowbird, *Empidonax traillii extimus*, home range, livestock, *Molothrus ater*, movements, New Mexico, radiotelemetry, Southwestern Willow Flycatcher.

The breeding ecology of Brown-headed Cowbirds (*Molothrus ater*) in relation to host species, especially State and Federal threatened and/or endangered species such as the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), is often of special concern to researchers, land managers, and resource agencies in the southwestern United States (Rothstein et al. 1984, Friedman and Kiff 1985, Harris 1991, Sogge et al. 1997a; Ahlers and White 1998, 2000; Ahlers and Tisdale-Hein 2000, Ahlers et al. 2001, Rothstein et al. *this volume*). The cowbird's use of spatially differentiated breeding and feeding areas is well documented, but commuting distances are variable and appear to be site-specific (Raim 1978, Rothstein et al. 1984, Nickel 1992, Thompson 1994, Gates and Evans 1998, Curson et al. 2000, Goguen and Mathews 2001). The presence of livestock in riparian systems complicates the understanding of spatial relations because the abundance and distribution of Brown-headed Cowbirds is often influenced by the presence and distribution of livestock (Goguen and Mathews 1999, 2001).

It is believed that livestock grazing in and around riparian habitat may provide Brown-headed Cowbirds with greater opportunities to parasitize endangered species such as the Southwestern Willow Flycatcher by (1) providing greater access to nests, (2) improving foraging opportunities, and (3) establishing foraging areas closer to flycatcher nesting areas (U.S. Fish and Wildlife Service 2001, Rothstein et al. *this volume*). Brown-headed Cowbirds are highly mobile and can impact flycatcher nesting success even if livestock grazing is remote from flycatcher nesting habitat (Rothstein et al. 1984, U.S. Fish and Wildlife Service 2001). Site-specific movement and home range estimates for cowbirds are of value to resource managers because they provide insight into habitat utilization and livestock associations within the system. These data also provide the opportunity to aid in the recovery of endangered species, such as the Southwestern Willow Flycatcher, without causing unnecessary cultural and economic impacts (U.S. Fish and Wildlife Service 2001). The purposes of this paper are to: (1) quantify Brown-headed Cowbird movement in riparian areas with extensive anthropogenic activity and year-round grazing, and in riparian areas that are comparatively free of anthropogenic influence and grazed seasonally; and (2) provide preliminary home range estimates for cowbirds using both of these habitats. We describe daily and seasonal movement patterns, as well as home range estimates, of female Brown-headed Cowbirds along the Rio Grande, near Socorro, New Mexico.

METHODS

STUDY SITES

The study area includes riparian forest communities and adjacent flood plain along 100 km of the Rio Grande from San Acacia Diversion Dam to the delta of Elephant Butte Reservoir in New Mexico (Fig. 1). The study area was divided into two units based on land use.

The San Acacia Unit (SAU) extends from San Acacia Diversion Dam to the northern boundary of the Bosque del Apache National Wildlife Refuge. Riparian

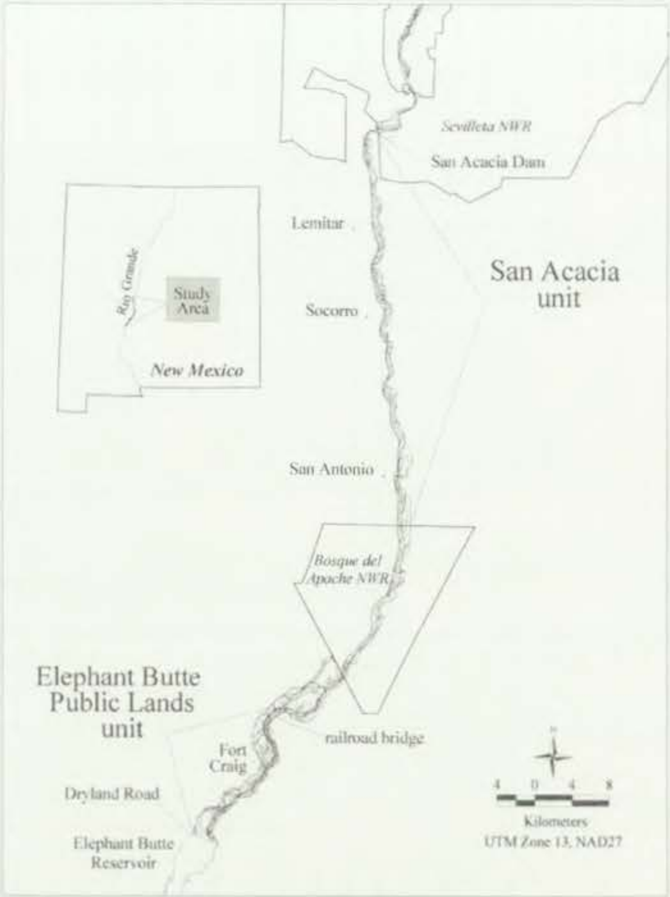

FIGURE 1. Radiotelemetry study unit boundaries along the Rio Grande in central New Mexico, 1998–1999.

communities contain patches of cottonwood (*Populus* spp.), Goodding's willow (*Salix gooddingii*), and coyote willow (*Salix exigua*), but are dominated by non-native saltcedar (*Tamarisk* sp.). Upland areas east of the river support a creosotebush- (*Larrea tridentata*) mesquite (*Prosopis* sp.) complex. The flood plain to the west is predominantly irrigated small-grain agricultural lands and irrigated livestock pasture grazed year-round. Stocking rates for livestock are greater than surrounding upland areas due to the availability of water for irrigation. Brown-headed Cowbird feeding areas were well defined within the irrigated pastures, livestock feed lots, and other open areas.

The Elephant Butte Public Lands Unit (EBPLU) extends from the northern boundary of Elephant Butte Public Lands to the delta of Elephant Butte Reservoir. Southwestern Willow Flycatchers breed within this area, and this unit supports some of the largest patches of native riparian habitat along the Rio Grande; however, the majority of the historic flood plain is decadent saltcedar. Uplands on either side of the riparian corridor support a creosotebush-mesquite complex. This unit contains portions of three grazing allotments, although grazing was not permitted from 15 April to 1 August. Habitat features attractive to feeding Brown-headed Cowbirds were not well defined in or adjacent to this site; however, non-instrumented Brown-headed Cowbirds were often observed feeding along access and maintenance road right-of-ways, borrow sites, and other open areas scattered throughout the site.

TELEMETRY

We captured and outfitted 27 and 21 (in 1998 and 1999, respectively) female Brown-headed Cowbirds with 1.6-g backpack-style radio transmitters (Advanced Telemetry Systems [ATS], Isanti, MN) as described by Thompson (1994). Females fitted with the transmitters were captured within the respective study units between 28 May and 18 June in 1998, and 28 May and 1 July in 1999, and all were assumed to be breeding. Transmitters had a range of 0.8 km and a battery life of at least 60 d. Automatic scanning receivers with computer interfaces (ATS model R2100) were coupled with 3-lead antennas to receive signals from radio-tagged (instrumented) birds. Technicians conducted searches for instrumented females from a levee running parallel to the river and throughout the study area, from 31 May to 10 August in 1998, and 29 May to 2 August in 1999.

Temporally separated locations were initially collected from late-May to early-July in 1998, while later in the season, individuals were tracked continuously throughout the day. In 1999, we focused on tracking individual female cowbirds continuously throughout the daylight hours and breeding season. Detected signals were first located via compass bearing and Universal Transverse Mercator (UTM) coordinate recorded from a Garmin 12 global positioning system unit at the technician's location. Another UTM coordinate and bearing was taken 100–800 m from the first location. In 1998, these data were uploaded into a Geographic Information System (GIS) ArcView 3.2/Spatial Analyst database and intersection points plotted. In 1999, technicians input both bearings and UTM coordinates into a spreadsheet model on-site upon signal acquisition. The model determined if a signal location could be calculated based on the computed intersection of bearings. If a bird's location could not be computed, another position fix was acquired. Coordinate data were downloaded periodically into our GIS database. For each signal location, the time interval between respective bearings and UTM coordinates did not exceed 15 min, and was commonly less than 3 min. Technicians attempted to acquire at least four valid position locations/hr for each bird throughout the 16-hr daily tracking period. These locations were not considered independent of one another.

DATA ANALYSIS

Telemetry data were analyzed to determine daily and seasonal distance traveled, and home range characteristics. These movements were compiled on both an individual and sample population basis for each year. Individual mean maximum daily distances were calculated from the maximum straight line distances recorded for each day of tracking. A day consisted of at least ten coordinate locations with at least one location per hr for more than six hours beginning in the early morning. The sample population mean maximum daily distance was determined using individual mean maximum daily movements.

The individual maximum seasonal distance traveled was calculated as the greatest straight line distance between the two coordinate locations farthest away from one another over the course of the breeding season (≥21 days). The mean maximum seasonal distance of the sample population was calculated from individual maximum seasonal movements. Maximum seasonal distance was calculated for individuals tracked for a minimum of two days producing ten or more UTM-coordinate locations spanning the breeding season. Individuals provided data for one or both movement types based on our analysis criteria.

Home ranges were estimated using a GIS ArcView/Spatial Analyst program extension from the U.S. Geological Survey–Biological Resources Division, Alaska Biological Science Center (Hooge and Eichenlaub 1997). The minimum convex polygon (MCP; Mohr 1947, Stickel 1954, Jennrich and Turner 1969) and the fixed kernel home range (KHR; Worton 1989) estimators were used and compared. The KHR output for each individual provided home range area calculations for a 95-percent shapefile probability, with smoothing determined by ad hoc least-squares cross-validation (Silverman 1986). The MCP home range area estimate for each individual is based on a single shapefile theme selected for the entire data set. We chose to couple the 100-percent MCP to the 95-percent KHR to illustrate the centers of activity within each cowbird's home range and to provide a comparative perspective when analyzing the utilization distribution (Harris et al. 1990, Samuel and Fuller 1994, Seaman and Powell 1996, Hansteen et al. 1997).

Potential concerns associated with autocorrelated movement and home range data were addressed in the study design. Sampling methodology sought collection of location data over a minimum of a 6-hr period on a daily basis, and extended over a minimum of 21 days throughout the breeding season. Data collected over a sufficient time frame, with sufficient relocations, alleviate concerns associated with autocorrelation (Otis and White 1999, Seaman et al. 1999).

RESULTS

TELEMETRY

All 27 instrumented female Brown-headed Cowbirds were detected in 1998; however, seven did not provide usable data. Five individuals provided only seasonal movement data, and the remaining 15 were evaluated for both daily and seasonal movement. All 21 instrumented females were detected in 1999, but four did not provide usable data. Six individuals provided only daily movement data, and one provided only seasonal movement data. The remaining ten individuals provided both daily and seasonal data.

In 1998, individuals were tracked on average 7.6 days (±2.9 SD, range = 3–13) to obtain 26 locations (±13 SD, range = 9–57); in 1999, individuals were tracked on average 5.2 days (±2.3 SD, range = 1–9) to obtain a mean of 106 (±60 SD, range = 28–223) locations.

We conducted field trials to determine the ability of field technicians to locate instrumented birds. Field technicians triangulated the position of a known transmitter, and were determined to be able to consistently estimate actual transmitter locations within 200 m. All measurements calculated within our database were rounded to the nearest 100 m.

DAILY AND SEASONAL MOVEMENTS

Female Brown-headed Cowbirds moved a mean maximum daily distance of 1.9 km (±0.8 SD, range = 1.0–4.2, N = 15) in 1998, and traveled a mean maximum seasonal distance of 5.3 km (±3.4 SD, range = 2.1–13.0, N = 20; Table 1). The mean maximum daily distance traveled on the SAU was 2.0 km (±1.1 SD, N = 7), and 1.8 km (±0.5 SD, N = 8) on the EBPLU. Seasonally, eight individuals traveled a mean maximum distance of 4.7 km (±2.9 SD) on the SAU,

TABLE 1. MEAN MAXIMUM DAILY AND MEAN MAXIMUM SEASONAL MOVEMENTS OF INSTRUMENTED FEMALE COWBIRDS ON TWO STUDY AREAS ALONG THE RIO GRANDE, NM, IN 1998

Bird Number	Study Area[a]	Days Tracked	Number of Locations	Mean Maximum Daily Distance (km)[b]	Maximum Seasonal Distance (km)[b]
2	EBPLU	6	19		8.3
3	EBPLU	10	26	1.5	4.2
5	EBPLU	6	24	2.2	12.9
6	EBPLU	8	12		2.2
7	EBPLU	4	9		5.0
9	EBPLU	11	28	2.0	3.8
10	EBPLU	11	26	1.6	2.1
12	EBPLU	13	36	1.1	13.0
14	EBPLU	11	29		6.1
17	EBPLU	10	25	1.6	3.1
31	EBPLU	3	11	1.8	3.4
32	EBPLU	3	19	2.6	3.5
21	SAU	5	18	1.8	3.1
22	SAU	10	30	4.2	8.1
23	SAU	5	9		6.3
24	SAU	4	14	1.3	2.8
25	SAU	8	44	1.0	2.1
26	SAU	9	46	2.6	9.7
27	SAU	8	35	1.7	2.7
28	SAU	8	57	1.5	2.8
Mean ± SD				1.9 ± 7.9	5.3 ± 3.4

[a] EBPLU = Elephant Butte Public Lands Unit; SAU = San Acacia Unit.

[b] See METHODS for explanation of movement types.

while 12 individuals on the EBPLU exhibited a mean maximum seasonal distance of 5.6 km (±3.9 SD) in 1998.

Cowbirds in 1999 had a mean maximum daily distance of 1.4 km (±0.5 SD, range = 0.5–2.5, N = 16), and a mean maximum seasonal distance of 2.7 km (±0.8 SD, range = 1.6–3.7 km, N = 11; Table 2). Mean maximum daily distance traveled on the SAU was 1.2 km (±0.5 SD, N = 10), and 1.6 km (±0.6 SD, N = 6) on the EBPLU. Seven individuals traveled a mean maximum seasonal distance of 2.5 km (±0.8 SD)

TABLE 2. MEAN MAXIMUM DAILY AND MEAN MAXIMUM SEASONAL MOVEMENTS OF INSTRUMENTED FEMALE COWBIRDS ON TWO STUDY AREAS ALONG THE RIO GRANDE, NM, IN 1999

Bird Number	Study Area[a]	Days Tracked	Number of Locations	Mean Maximum Daily Distance (km)[b]	Maximum Seasonal Distance (km)[b]
2	EBPLU	4	103	0.9	
3	EBPLU	6	111	1.2	2.1
4	EBPLU	2	67	2.1	
6	EBPLU	7	125	2.5	3.7
7	EBPLU	7	164	1.5	3.7
10	EBPLU	6	83	1.3	3.1
1	SAU	5	161	1.6	1.9
12	SAU	2	38	0.8	
13	SAU	8	223	1.1	2.0
14	SAU	9	195	1.0	2.0
15	SAU	4	41		1.6
16	SAU	1	28	1.5	
17	SAU	8	79	0.5	3.7
18	SAU	6	192	1.5	3.4
19	SAU	4	33	0.6	
20	SAU	3	58	1.8	
21	SAU	6	106	1.8	2.7
Mean ± SD				1.4 ± 0.5	2.7 ± 0.8

[a] EBPLU = Elephant Butte Public Lands Unit; SAU = San Acacia Unit.

[b] See METHODS for explanation of movement types.

on the SAU, while four individuals on the EBPLU exhibited a mean maximum seasonal distance of 3.1 km (± 0.8 SD) in 1999.

We used a two-factor ANOVA (Type III sum of squares; Statgraphics Plus Ver 5.0) to detect the influence of study area (SAU and EBPLU) and year (1998 and 1999) on the dependent variables mean daily maximum distance and seasonal maximum distance traveled. Daily and seasonal distances traveled did not differ significantly between the two study areas (P = 0.76, F = 0.09, df = 1, 28 for mean daily maximum distance traveled; P = 0.43, F = 0.63, df = 1, 28 for seasonal maximum distance traveled). Distances traveled in 1998 were significantly greater than distances traveled in 1999 (P = 0.04, F = 4.56, df = 1, 28 for mean maximum daily; P = 0.04, F = 4.63, df = 1, 28 for maximum seasonal distance traveled). The interaction of study area and year did not have a significant effect on movement types.

Because the 1998 data were skewed in comparison to 1999, we compared medians of both movement types in different years using a rank sign test (Wilcoxon W). Median distances traveled in 1998 were also greater than distances traveled in 1999 (P = 0.02, W = 64 for daily movements; P = 0.01, W = 48 for seasonal movements). The distributions of the samples (Kolmogorov-Smirnov test) did not differ statistically between years (P = 0.12, K-S = 1.17, D_N = 0.421 for daily movement; P = 0.06, K-S = 1.33, D_N = 0.5 for seasonal movement).

HOME RANGE

Eleven individuals provided data that spanned the entire 1999 breeding season and provided sufficient locations to permit home range analysis (mean locations per female = 135 ± 54 SD, range = 41–223; Table 3). There was no statistical difference in home range size between units for either estimator (two-sample comparison of means: KHR, t = 1.02, df = 3, 6, P = 0.33; MCP, t = 1.66, df = 3, 6, P = 0.13). Four individuals in the EBPLU exhibited mean KHR areas of 143 ha (±66 SD, range = 77–237). Seven individuals in the SAU exhibited mean KHR areas of 92 ha (±76 SD, range = 19–229). Individuals on the EBPLU exhibited a mean MCP of 249 ha (±40 SD, range = 186–286), while SAU individuals exhibited a mean MCP of 187 ha (±60 SD, range = 117–299). Schoener's ratio (Schoener 1981) was applied to the fixed kernel estimator to quantify the degree of autocorrelation within each female's home range; all 11 home range estimates were positively autocorrelated.

DISCUSSION

LOCAL MOVEMENTS, HOME RANGE, AND LIVESTOCK ASSOCIATIONS

Female cowbirds' use of space reflects their parasitic breeding strategy and preference or requirement for specific foraging habitats (Rothstein et al. 1984), and this use varies with habitat occupied and resource availability (hosts, feeding areas, etc.) throughout the United States (Table 4). Individuals using riparian areas of the Rio Grande find host nests and meet their daily resource requirements in the same localized areas within a mean maximum daily distance of 1.4 to 1.9 km. Observations of movements in this system indicate smaller local travel patterns than those reported from other upland studies in the western United States (Rothstein et al. 1984, Curson et al. 2000, Goguen and Mathews 2001). A comparable study of spacing patterns of Brown-headed Cowbirds in riparian areas on the

TABLE 3. KERNEL (KHR) AND MINIMUM CONVEX POLYGON (MCP) HOME RANGE ESTIMATORS (IN HA) FOR 11 INSTRUMENTED FEMALE COWBIRDS ON TWO STUDY SITES ALONG THE RIO GRANDE, NM, IN 1999

			Home Range Estimator (ha)		
Bird	Site[a]	Locations	KHR—95% Prob	MCP—100%	Schoener's Ratio
3	EBPLU	111	173	186	0.172
6	EBPLU	125	237	280	0.423
7	EBPLU	164	77	286	0.735
10	EBPLU	83	85	244	1.051
1	SAU	161	26	166	1.355
13	SAU	223	19	146	1.110
14	SAU	195	34	138	1.546
15	SAU	41	47	117	1.101
17	SAU	79	163	246	0.313
18	SAU	192	125	299	0.145
21	SAU	106	229	197	0.441
Mean			110 ± 80	210 ± 64	

[a] EBPLU = Elephant Butte Public Lands Unit; SAU = San Acacia Unit.

TABLE 4. COMPARISONS OF BROWN-HEADED COWBIRD MOVEMENTS AND HOME RANGES

Sources	Geographic Area/Habitat Type	Maximum and/or Mean Commuting Distance (km)	Home Range Area (ha)
Curson et al. 2000	Colfax County, NM Short-grass prairie/coniferous forest	Maximum^{a} = 20.6 $\overline{X}^{a,f}$ = 11.8; N = 9 $\overline{X}^{a,h}$ = 19; N = 3	N/A
Dufty 1982	Broome County, NY Deciduous forest/agricultural areas	N/A	$\overline{X}^{c,d}$ = 20.4, N = 12
Gates and Evans 1998	Allegany County, MD Anthropogenic forest landscape	Maximum^{a,f} = 6.14 $\overline{X}$ = 2.27 ± 0.25 SE, N = 35 Maximum^{a,g} = 9.84 $\overline{X}$ = 2.96 ± 0.43 SE, N = 25 Maximum^{a,h} = 4.91 $\overline{X}$ = 1.35 ± 0.32 SE, N = 20	$\overline{X}^{a,e}$ = 1592 ± 287 SE, N = 27 $\overline{X}^{a,j}$ = 31.6 ± 2.2 SE, N = 27
Goguen and Mathews 2001	Colfax County, NM Short-grass prairie/coniferous forest	Maximum^{a} = 8.46 $\overline{X}^{a,k}$ = 1.94 ± 0.22 SE, N = 9; 3.14 ± 0.14 SE, N = 3 $\overline{X}^{a,l}$ = 1.47 ± 0.16 SE, N = 15; 2.51 ± 0.16 SE, N = 9	MCP $\overline{X}^{a,e,k}$ = 1154.9 ± 276.3 SE, N = 4 KHR $\overline{X}^{a,e,k}$ = 1184.8 ± 273.9 SE, N = 4 MCP $\overline{X}^{a,e,l}$ = 586.4 ± 103.8 SE, N = 16 KHR$\overline{X}^{a,e,l}$ = 634.0 ± 91.5 SE, N = 16
Nickel 1992	San Diego County, CA Riparian, native/exotic vegetation	Maximum^{a} = 3.5, $\overline{X}$ = 2.2, N = 13	$\overline{X}^{a,d}$ = 47.5 ± 6.7 SE, N = 10 $\overline{X}^{a,e}$ = 137.3 ± 19.2 SE, N = 10
Raim 1978	N/A	$\overline{X}^{c}$ = 1.5, N = 60	N/A
Rothstein et al. 1984	Mono County, CA Eastern Sierra Nevada	Maximum^{a} = 4.3, $\overline{X}$ = 3.5, N = 5 Maximum^{b} = 6.7, $\overline{X}$ = 3.9, N = 7	$\overline{X}^{c,d}$ = 68, N = 13 $\overline{X}^{c,e}$ = 442, N = 13
Sechrist and Ahlers (this study)	Socorro County, NM Riparian, native/exotic vegetation	1998 Maximum^{a,m} = 4.2 $\overline{X}^{n}$ = 1.9 ± 0.79 SD, N = 15 1999 Maximum^{a,m} = 2.5 $\overline{X}^{n}$ = 1.4 ± 0.54, N = 16	MCP $\overline{X}^{a,e}$ = 210 ± 64 SD, N = 11 KHR $\overline{X}^{a,e}$ = 110 ± 80 SD, N = 11
Thompson 1994, Thompson and Dijak 2000	Union County, IL; Shannon, Reynolds, Boone and Carter Counties, MO Deciduous forest and cool season pasture/cropland	Maximum^{a} = >10 $\overline{X}^{a,f}$ = 1.2 ± 0.08 SE, N = 86 $\overline{X}^{a,g}$ = 2.6 ± 0.28 SE, N = 70 $\overline{X}^{a,h}$ = 3.6 ± 0.39 SE, N = 56	Median^{a,e,i} = 261 – 845, N = 84

[a] Female Brown-headed cowbirds.

[b] Male Brown-headed cowbirds.

[c] Male and female Brown-headed cowbirds.

[d] Area of non-feeding home range.

[e] Total home range area.

[f] Mean distances from breeding to feeding ranges.

[g] Mean distances from feeding ranges to roost.

[h] Mean distances from roost to breeding ranges.

[i] Non-normal distributions favoring median estimates.

[j] Estimate(s) of Core Range.

[k] Commuting distances/home range of cowbirds in ungrazed borders, <2 km from study area. Mean commuting distances given are before and after livestock removal.

[l] Commuting distance/home range of cowbirds on grazed study area. Mean commuting distances given are before and after livestock removal.

[m] Sample population mean for maximum seasonal distance traveled.

[n] Grand mean of sample population for maximum seasonal distance traveled.

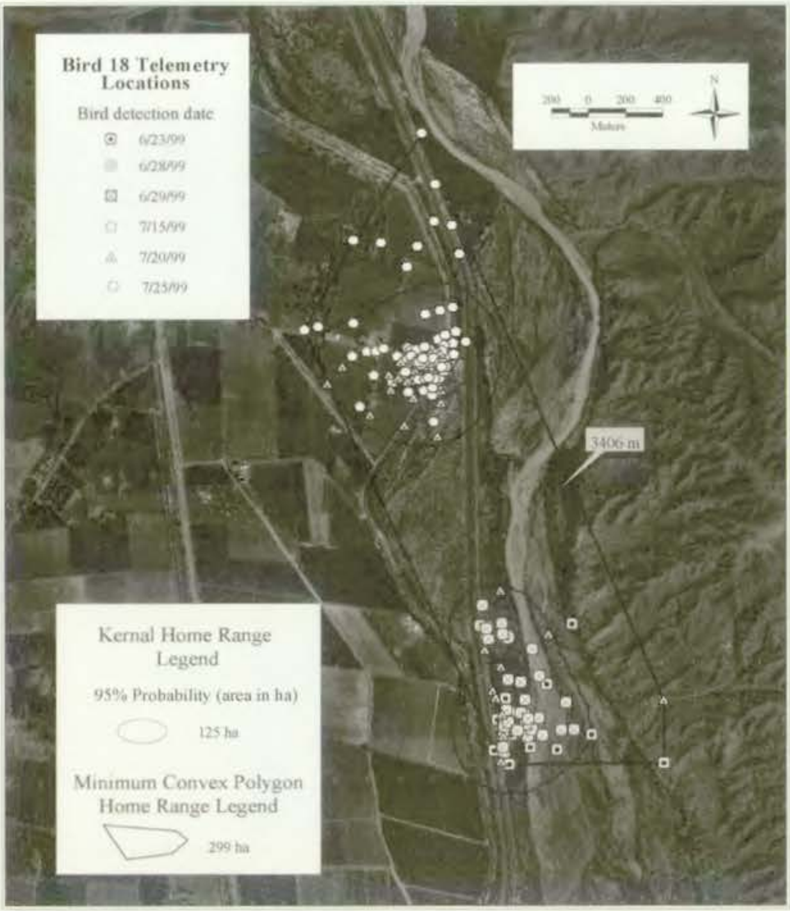

FIGURE 2. One-hundred percent minimum convex polygon and 95 percent kernel home range estimators for bird 18, illustrating centers of activity within the San Acacia Unit.

San Luis Rey River in California (Nickel 1992) reported that female commuting distances between breeding and feeding areas averaged 2.2 km, with a maximum distance traveled of 3.5 km (N = 10).

Our analyses of both daily and seasonal movement patterns revealed statistically significant differences between years, but not between sites. We attribute the variability between years to the increased effort devoted to tracking all instrumented birds as long and as often as possible in 1999. Our sampling methodology sought to incorporate rapid collection of location data on each individual over the course of an entire breeding season, and thus adequately describe daily and seasonal movement, as well as home ranges. We found that attempts to gather independent location data in 1998 often resulted in a loss of signal from instrumented birds (primarily due to signal attenuation in dense vegetation), and thus a loss of information. While home range estimates based on autocorrelated data have received criticism (Hansteen et al. 1997, Otis and White 1999) because they tend to underestimate home range sizes, other studies of highly mobile species (Andersen and Rongstad 1989, Reynolds and Laundre 1990, Ostro et al. 1999) have shown that autocorrelated data produce reliable home range estimates in comparison to statistically independent estimates.

The SAU supports extensive livestock grazing on irrigated pasture adjacent to riparian habitats used by potential host species. Goguen and Mathews (1999, 2001) and others (e.g., U.S. Fish and Wildlife Service 2001) believe the presence of livestock is a primary factor influencing cowbird distribution and abundance in the western United States; however, our movement data do not suggest livestock, anthropogenic food sources, and potential hosts in juxtaposition equate to shortened commuting distances in comparison to

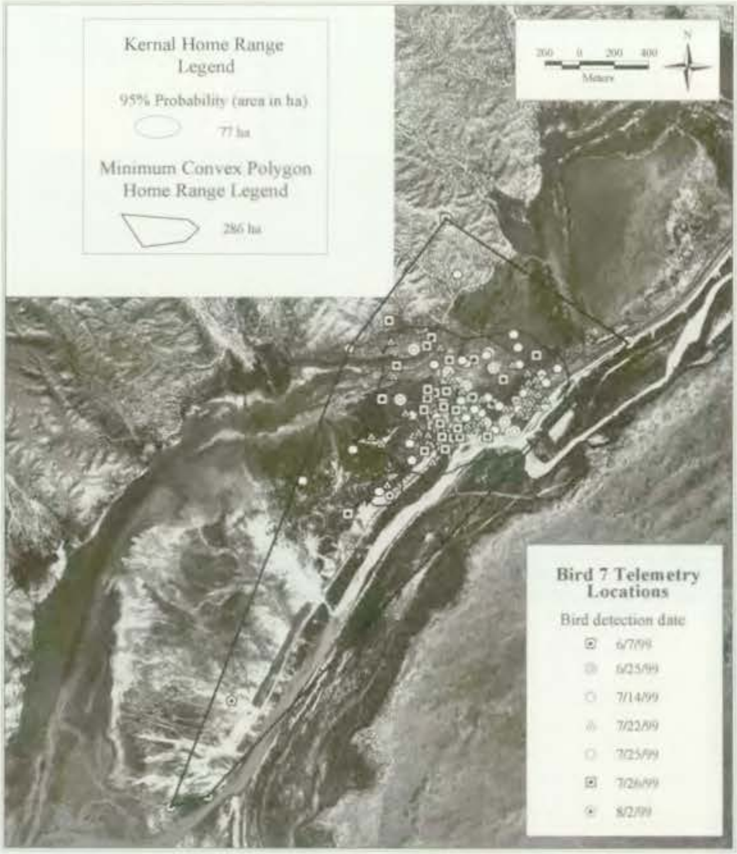

FIGURE 3. One-hundred percent minimum convex polygon and 95 percent kernel home range estimators for bird 7, illustrating a single center of activity within the Elephant Butte Public Lands Unit.

areas such as the EBPLU that are relatively free of anthropogenic influence.

There was no statistical difference between units in home range sizes with either estimator. Preliminary analysis of home range data indicates some females of the SAU such (such as bird 18; Fig. 2) exhibit multiple centers of activity and core ranges over the breeding season, while EBPLU females such as bird 7 (Fig. 3) appear to exhibit a defined center of activity. Further analysis of habitat utilization and core ranges of these birds is clearly warranted because (1) the relationship between livestock and Brown-headed Cowbirds remains unclear in this system, and (2) habitat features attractive to Brown-headed Cowbirds in the livestock-free EBPLU have yet to be identified. Cattle were not permitted on the EBPLU during the breeding season in either year, but cowbird captures remained consistent over a 4-year period (E. Best, unpubl. data). Cowbirds were also abundant on the Bosque del Apache National Wildlife Refuge where no grazing occurs (Tisdale-Hein and Knight *this volume*). Cowbirds are opportunistic, and if food resources are available, readily adapt to livestock-free environments (Rothstein et al. *this volume*). Tisdale-Hein and Knight (*this volume*) speculate that if food resources are adequate within the commuting distance of cowbirds, then the densities of potential hosts likely determine cowbird densities during morning hours regardless of whether sites are actively grazed or ungrazed. Thompson et al. (2000) reported a similar scenario in the midwestern United States; at local or habitat level scales, cowbird numbers were positively correlated with extent of edge and host density. The linear nature of riparian systems, especially in the xeric southwestern United States, suggests home ranges of cowbirds would be geographically constrained. Available data (Table 4) indicate that female Brown-headed Cowbirds in riparian areas of the western United States have smaller overall home ranges than their upland counterparts. For example, home ranges in the eastern Sierra Nevada (mean = 442 ha; Rothstein et al. 1984) and travel distances in the upland front range of New Mexico (mean = 19 km, N = 3; Curson et al. 2000) suggest some of the largest home ranges reported for breeding female cowbirds, compared to smaller values for cowbirds in riparian areas of Southern California (mean = 137 ha, N = 10; Nickel 1992) and New Mexico (range of means = 187–249 ha via MCP estimate; this study).

LIVESTOCK MANAGEMENT AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service (2001: Append. F, p. 15) implies that anthropogenic opportunities for cowbird feeding should be at least 7 km from the habitat of endangered species, (e.g., the Southwestern Willow Flycatcher) to effectively reduce brood parasitism. Livestock removal buffers in certain areas of Arizona already incorporate this distance (Goguen and Mathews 1999). It is further suggested that this distance may need to be increased in some instances to upwards of 14 km (e.g., Curson et al. 2000).

Our findings that cowbirds can occupy and apparently meet their ecological requirements in areas devoid of livestock, such as the EBPLU, indicate that livestock removal buffers may not achieve desired management goals in this system. Thus, some livestock exclusion areas established to reduce local cowbird population levels and, by extension, reduce parasitism of Southwestern Willow Flycatchers, may fail to accomplish either. The U.S. Fish and Wildlife Service (2001: Appendix G, p. 23) states that livestock should be excluded from Southwestern Willow Flycatcher sites "where the exclusion would result in the greatest ecological improvement and least economic loss." We concur with Rothstein et al. (*this volume*) that in order to achieve these goals, the relationship between cowbirds and nesting Southwestern Willow Flycatchers and/or flycatcher habitat should be evaluated on a site-specific basis.

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