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ASSESSING THE IMPACT OF BROWN-HEADED COWBIRD PARASITISM IN EIGHT NATIONAL PARKS

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Abstract. In 1995 and 1996 we conducted point count surveys and nest searches to examine the need to manage Brown-headed Cowbird (*Molothrus ater*) populations in eight western national parks. Our goal was to examine what impact, if any, Brown-headed Cowbird parasitism was having on passerines in the parks, and how current management practices might be affecting cowbird activity. The parks selected for this study were: Golden Gate National Recreation Area, Great Basin National Park, Lake Mead National Recreation Area, Montezuma Castle National Monument, Organ Pipe Cactus National Monument, Point Reyes National Seashore, Sequoia-Kings Canyon National Parks, and Yosemite National Park. We located and monitored 1295 nests of potential cowbird hosts. Parasitism had a significant impact on host reproduction in four of the eight parks: Golden Gate, Great Basin, Lake Mead, and Montezuma Castle. All of the parks had some form of livestock within or adjacent to their boundaries (cattle or horses), and proximity to grazing was significantly correlated with parasitism rates.

Key Words: brood parasitism, Brown-headed Cowbird, *Molothrus ater,* National Parks.

Birds are recognized as an important component of the biological resources protected and managed by the National Park Service. Park units provide vital breeding areas for a variety of avian species, including many neotropical migrants. Neotropical migrant birds (NTMB) are receiving much attention from international, federal, and state resource agencies and conservation organizations because many species have shown significant declines in all or part of their range (Ehrlich et al. 1992). Declines in the populations of some neotropical migrant bird populations have been documented by Breeding Bird Surveys over the past forty years in eastern North America and the past several decades in western North America (Askins et al. 1990, Sauer and Droege 1992).

The primary factors contributing to the recent declines of NTMBs are loss and fragmentation of habitat on breeding grounds in North America and deforestation and pesticides on Latin American wintering grounds. More recently, declines in the populations of some species have been linked to the range expansion of the parasitic Brown-headed Cowbird (*Molothrus ater*; Gaines 1974, Laymon 1987). Robinson et al. (1993) suggest that brood parasitism by cowbirds has become one of the major threats to neotropical migrants on the breeding grounds. Cowbirds are the only obligate brood parasite in North America, they have a large number of potential hosts, and they often remove or damage the host eggs (Friedmann and Kiff 1985). Populations of cowbirds have increased throughout North America over the last eighty years (Brittingham and Temple 1983, Laymon 1987). A number of NTMBs, including several species of flycatchers, vireos, warblers, tanagers, and grosbeaks are suffering heavy losses in productivity and population decreases at least partially due to cowbird parasitism (Brittingham and Temple 1983, Laymon 1987, Whitfield 1990). Freidmann and Kiff (1985) reported that cowbirds have been recorded parasitizing 220 species of birds, of which 144 species have successfully raised young cowbirds. Studies done by Gaines (1974) on riparian songbirds breeding in the Sacramento Valley of California indicated that virtually all of the species that declined this century are highly parasitized by the Brown-headed Cowbird.

Many of the NTMB species impacted are riparian obligate species. Riparian areas support the highest breeding bird diversity and density of any habitat type, and they often have the highest proportion of species of management concern (Thomas et al. 1979, Laymon 1987). Cowbird parasitism in riparian zones can therefore affect a major part of the bird community in an area. As human populations outside the National Parks have expanded and caused alteration of riparian habitats, the remaining riparian areas within the parks have increased in importance as neotropical migrant habitat.

There are several Park Service-wide issues and park-specific Resource Management Plans that are directly addressed by this study. The most important service-wide resource management issues are: (1) impacts on threatened, endangered and other sensitive species; (2) degradation of park resources due to non-native animals; and (3) disruption of natural ecosystems.

The threats to neotropical migrant birds within the National Park System are broad, immediate, and complex. The magnitude of the resource threat is demonstrated by the number of park units with riparian habitats that have been

damaged by cattle, erosion, and the presence of parasitic cowbirds, and the number of bird species that are involved. Parasitic cowbirds have expanded their range in the West in association with livestock grazing both in and adjacent to park units. Horse stables in the parks and other external developments have also aided the cowbird by providing concentrated sources of food (Rothstein et al. 1980). The threat is immediate because many NTMBs are listed or are proposed for listing as state and federal endangered species (Cunningham 1993). The impacts of cowbird parasitism are complex because cowbirds can affect neotropical migratory birds in several ways: (1) removal of host eggs results in lowered clutch size; (2) competition for food by the aggressive cowbird chicks may result in mortality of host young; and (3) the effort to feed the fledgling cowbird may adversely affect multiple nesting attempts. Neotropical migrants are especially vulnerable to parasitism because: (1) many build open-cup nests, which are the most frequent target of cowbirds (Friedmann 1929); (2) the cowbird egg-laying season generally coincides with the peak egg-laying season of most neotropical migrants; and (3) cowbirds usually parasitize hosts that are smaller (cowbirds weigh 30–60 grams, while most warblers, vireos and flycatchers weigh less than 20 grams) and have a smaller egg size. This interaction results in nest failure or reduced reproductive output for the host species (Best and Stauffer 1980, Robinson et al. 1993).

In addition to a general mandate to protect endangered species and other resources within parks, the Park Service should be concerned with determining how park actions may be contributing to the local and regional cowbird problem. For example, cowbirds are known to concentrate at, and benefit from, pack mule stations and horse corrals at Grand Canyon National Park (Johnson and Sogge 1995). In Yosemite National Park and Sequoia-Kings Canyon National Park, cowbirds concentrate at stock areas, as well as at campgrounds (Beedy and Granholm 1985). Cowbirds are common in riparian zones in these parks, but these numbers may be influenced by the presence of park-provided, concentrated food sources. Thus, the parks need to determine the extent to which they are contributing to the problem and decide on remedies to the situation.

We examined what impact, if any, Brown-headed Cowbirds were having on passerines in eight western National Parks, and how current management practices might be affecting cowbird activity. The objectives of the project were to: (1) survey neotropical migratory bird populations; (2) monitor neotropical migratory bird nesting success and cowbird parasitism; (3) survey cowbird populations; and (4) determine if cowbirds were having enough of an impact on host populations to initiate a removal program. Because many NTMB species are riparian obligates, we focused on riparian habitats for this study. We spent two seasons studying the level of parasitism in these eight parks.

This study was intended to give an overview to determine problem areas within the parks studied. It was intended to develop a methodology to allow managers to determine problems in their area and at what parasitism level they will need to respond to cowbird presence to protect adequately the species in their parks. We wished to develop readily measurable parameters to detect a certain level of cowbird parasitism that may require intervention on the part of managers. It should be considered a preliminary study, intended to gather data necessary for management decisions, and identify those host species which should be the subject for future studies.

METHODS

The parks selected for this study were chosen because they have extensive riparian habitat, the presence of Brown-headed Cowbirds has been documented, and they represent a range of habitats and elevations. The project was conducted for two years (1995 and 1996) and focused on all potential cowbird hosts, with particular focus on neotropical migrant land birds. The following parks were selected for the study: Golden Gate National Recreation Area, Great Basin National Park, Lake Mead National Recreation Area, Montezuma Castle National Monument, Organ Pipe Cactus National Monument, Point Reyes National Seashore, Sequoia-Kings Canyon National Parks, and Yosemite National Park (Table 1).

Point counts were conducted to assess the size of both host and cowbird populations. Point counts were timed to coincide with host breeding season in each park, rather than Brown-headed Cowbird presence. Each point was surveyed 6–8 times each year at 2-week intervals in each park. Each point count lasted 10 min, and detections were categorized as flyovers, <50 m of the point, or >50m from the point. We also noted if species detected were within the riparian habitat. Surveys were conducted between 10 min before sunrise to 5 hr after sunrise. One technician worked in each park, and this person conducted all of the point counts and most or all of the nest searches in a given park. In the low desert and coastal parks we began surveying in early March, and in the mountain parks we began surveys in late April or early May.

TABLE 1. LOCATION AND CHARACTERISTICS OF THE EIGHT NATIONAL PARKS IN WHICH SURVEYS AND NEST-SEARCHING WERE CONDUCTED

Park	Location	Type of Brown-headed Cowbird habitat in each park	Timing of point counts
Golden Gate National Recreation Area	2 km N of San Francisco, CA	Horse stable, riding trails, and picnic grounds	mid-March to mid-June.
Great Basin National Park	On Utah border 130 km E of Ely, NV	Extensive livestock grazing	early May to early August.
Lake Mead National Recreation Area	45 km SE of Las Vegas, NV	Wild burros & cattle within park; bordered by agriculture	mid-March to mid-June.
Montezuma Castle National Monument	100 km N of Phoenix, AZ	Surrounded by livestock grazing and agriculture	late March to early July.
Organ Pipe Cactus National Monument	15 km S of Ajo, AZ	Agriculture and low-intensity livestock grazing adjacent	early March to early June.
Point Reyes National Seashore	30 km N of San Francisco, CA	Cattle pasture and horse stables within and adjacent to park	late March to late June.
Sequioa-Kings Canyon National Parks	In the Sierra Nevada Mountains, CA	Campgrounds, horse stables and trails in the parks	late April to late July.
Yosemite National Park	In the Sierra Nevada Mountains, CA	Campgrounds and horse stables and trails in the park	late April to late July.

A qualitative survey of the vegetation of each site was conducted during 1995. From this information we determined average width and length of the riparian habitat in each survey area.

A total of 584 separate point count sites were surveyed during both 1995 and 1996. Sites were located at 200-m intervals in riparian habitat. Each park had 65–90 points, with the exception of MOCA, which had only 22 sites. In GRBA, for example, we had 90 points in 5 drainages, and we had 16–19 points in each drainage. Each year we surveyed a combined total for all eight parks of 126 km of streams and meadows. All sites were located within 3 km of a road. We used point count data to determine mean detections/point and frequency of detection for each park.

From the point count data we calculated overall Brown-headed Cowbird frequency. This is the percentage of points at which cowbirds are encountered at least once during the point count surveys. Cowbird frequency through time is the percentage of points at which cowbirds are encountered during a given survey period.

Nest searching and monitoring were conducted to determine the level of parasitism and what, if any, impacts cowbirds were having on host species reproductive success. We also assessed the relationship between the number of cowbirds detected and the level of parasitism observed. Nest searches were conducted for potential cowbird host nests (any open-cup nesting passerine) within the riparian corridor at a subset of the point count areas. Because of the distances between survey areas it was not possible to effectively search for and monitor nests in all areas. Due to time and personnel constraints, only approximately 80% of the survey areas within each park were included in this part of the project, rather than all sites. We therefore selected sites with the best habitat and with good access (less than 1 hr driving time). When possible, some sites within a park were near potential cowbird foraging areas while other sites were more isolated from cowbird foraging areas.

Nest searching was conducted during the same time period as the point counts, and continued for 1–2 months after completion of the point counts. We used standard practices to search for and mark the nests (Ralph et al 1993). Between 25 and 40 hr/week were spent conducting nest searches. Emphasis was placed on finding nests of species that are known to be preferred hosts of cowbirds. Nests were checked every 3–7 days.

A nest was considered successful if it fledged at least one host young. Determination of this was based on observation of fledglings in the area of the nest and the condition of the nest.

TABLE 2. RESULTS OF COWBIRD HOST NEST SEARCHING FOR EIGHT NATIONAL PARKS, 1995–1996

Park	Total # of nests	Total # successful (%)	Total # parasitized (%)
Golden Gate	209	118 (56.5%)	9 (4.3%)
Great Basin	180	108 (60.0%)	13 (7.2%)
Lake Mead	113	62 (54.9%)	15 (13.3%)
Montezuma Castle	52	26 (50.0%)	14 (26.9%)
Organ Pipe Cactus	195	115 (59.0%)	1 (0.5%)
Point Reyes	282	129 (45.7%)	26 (9.2%)
Sequioa-Kings Canyon	134	85 (63.4%)	4 (2.9%)
Yosemite	131	96 (73.3%)	3 (2.2%)
Total	1296	739 (57.0%)	85 (6.6%)

This is a simplified method of determining nest success, but the broad scope of the project and limited personnel (one researcher per park) forced us to use this method. We were unable to use the more detailed Mayfield method (Mayfield 1975) due to this lack of personnel, and also due to variation in nest-check interval between the parks. We included only potential host nests for which both nest success and parasitism were known in all analyses.

We used two different methods to determine if Brown-headed Cowbird parasitism was having a significant impact on host populations. First, we evaluated whether the level of parasitism at each park was severe enough to threaten host species. For the first test we set an overall 30% level of parasitism to indicate a significant impact, because Mayfield's (1977) and Laymon's (1987) results indicate that a parasitism rate of 30% may lead to an unstable host population. Secondly, we did a Chi-square analysis to determine if parasitized nests were significantly less successful than unparasitized nests. Success was defined as a nest fledging at least one host young.

We conducted surveys of surrounding areas that had potential cowbird foraging habitat. This information was used to determine the direct-flight distance between the riparian survey areas and known cowbird foraging sites. These sites included cattle feedlots, dairies, active livestock pastures, and horse stables. We determined width and length of the riparian habitat at the survey points from visual examination of the sites and topographic maps.

RESULTS

We combined the data from both years to examine host success and cowbird parasitism level (Table 2). Overall nest success in the parks was 57%. A total of 15 different species were parasitized. Parasitism frequencies ranged from 0.5% to 26.9%, with an overall park average of 6.6%.

The four most commonly parasitized hosts were Song Sparrow, Wilson's Warbler, Bell's Vireo, and Warbling Vireo (Table 3). The parasitization of Bell's Vireos are of particular interest. We found a total of 91 nests, 12 of which were parasitized, although none of the 53 nests found in Organ Pipe were parasitized.

In our first evaluation of the significance of parasitism, no parks met the criterion of an overall 30% parasitism rate to indicate a significant negative impact of cowbird parasitism. In our second evaluation, comparing fledging success of parasitized versus non-parasitized nests, we found that in four of the parks Brown-headed Cowbirds were having a significant impact on overall host reproductive success (Table 4). Additionally, we found that, when compared by individual drainages, a higher average success rate at a park was significantly correlated to a lower parasitism rate (Pearson $r = -0.44$, $N = 79$, $P < 0.05$).

We next combined the data from all the parks to do regression analysis on parasitism rates for each site within the parks for the following variables: overall Brown-headed Cowbird frequency, nest success, distance to cowbird foraging habitat, and width and length of riparian habitat (Table 5). The following variables were identified as significant correlates of parasitism by the regression analysis: (1) frequency of occurrence of Brown-headed Cowbirds within each area (Pearson $r = 0.32$, $N = 79$, $P < 0.05$); (2) nest success (Pearson $r = -0.44$, $N = 79$, $P < 0.05$); (3) distance to cowbird foraging sites (Pearson $r = -0.30$, $N = 76$, $P < 0.05$); (4) length of the habitat (Pearson $r = 0.23$, $N = 76$, $P < 0.05$); and (5) width of the riparian corridor (Pearson $r = 0.42$, $N = 76$, $P < 0.05$). Average host occurrence was not significant (Pearson $r = 0.05$, $N = 79$, $P > 0.05$). This last finding is somewhat surprising, since other studies have found that cowbird frequency does increase in response to host abundance (Barber and Martin 1997).

We next looked at the number of nests found during each survey period as an indication of nesting activity. This was not significant (Pearson $r = 0.13$, $N = 111$, $P > 0.05$), indicating

TABLE 3. COMPARISON OF SPECIES OCCURANCE AND COWBIRD PARASITISM IN EIGHT NATIONAL PARKS, 1995–1996

Host species	Number of parks		Number of nests	
	Occurred	Parasitized	Total	Parasitized
Dusky Flycatcher *Empidonax oberholseri*	3	2	24	3
Blue-gray Gnatcatcher *Polioptila caerulea*	1	1	11	3
Black-tailed Gnatcatcher *Polioptila melanura*	2	1	40	5
Warbling Vireo *Vireo gilvus*	6	1	76	8
Solitary Vireo *Vireo solitarius*	3	1	10	1
Bell's Vireo *Vireo bellii*	3	2	91	14
Lucy's Warbler *Vermivora luciae*	2	1	19	1
Yellow-rumped Warbler *Dendroica coronata*	3	1	11	1
Common Yellowthroat *Geothlypis trichas*	3	1	28	2
Yellow-breasted Chat *Icteria virens*	2	1	13	1
Wilson's Warbler *Wilsonia pusilla*	6	3	76	8
Brewer's Blackbird *Euphagus cyanocephalus*	5	3	85	4
Northern Cardinal *Cardinalis cardinalis*	2	1	12	1
Blue Grosbeak *Guiraca caerulea*	2	1	6	2
American Goldfinch *Spinus tristis*	2	1	22	1
Canyon Towhee *Pipilo fuscus*	2	1	9	1
Chipping Sparrow *Spizella passerina*	3	1	20	1
Song Sparrow *Melospiza melodia*	5	5	182	22

that we were locating nests at a similar rate throughout the time period examined. We also compared the number of nests found vs. host abundance. Not surprisingly, the number of nests detected increased as host abundance increased (Pearson $r = 0.21$, $N = 85$, $P < 0.05$). The percentage parasitism was not significantly correlated with the number of nests found (Pearson $r = 0.03$, $N = 95$, $P > 0.05$). This indicates that an increase in parasitism is not simply a result of finding more nests. In each park a small peak in nest detections occurred before the peak in cowbird frequency.

TABLE 4. RESULTS OF CHI-SQUARE ANALYSIS ON NEST SUCCESS IN PARASITIZED VS. UNPARASITIZED NESTS IN EIGHT NATIONAL PARKS, 1995–1996

Park	Chi-square (df = 1)	P-value	N
Golden Gate	4.09	0.043	209
Great Basin	9.85	0.002	180
Lake Mead	15.96	<0.001	113
Montezuma Castle	8.38	0.004	52
Organ Pipe Cactus	1.43	0.232	195
Point Reyes	1.19	0.275	282
Sequoia-Kings Canyon	0.3	0.583	134
Yosemite	2.34	0.126	131

We compared survey period to percentage parasitism and percent success through time. The percentage did increase through time (Pearson $r = 0.38$, $N = 99$, $P < 0.05$), no doubt a reflection of the increase in cowbird abundance through time. Nest success did not change significantly with the passage of time (Pearson $r = 0.13$, $N = 99$, $P > 0.05$).

We found that the following variables were significantly correlated with cowbird frequency

TABLE 5. COWBIRD PARASITISM RATE, FREQUENCY OF OCCURRENCE, AND LANDSCAPE VARIABLES IN EIGHT NATIONAL PARKS, 1995–1996

Park	Overall parasitism (%)	Cowbird frequency (%)	Distance to foraging sites (m)	Habitat width (m)	Habitat length (km)	Livestock nearby
Golden Gate	4	26	733	39.5	2.6	yes
Great Basin	6	31	1000	60.7	10.9	yes
Lake Mead	12	95	512	240	3.7	yes
Montezuma Castle	22	90	200	300	1.8	yes
Organ Pipe Cactus	1	22	575	137	5.3	no
Point Reyes	9	87	330	81.7	3	yes
Sequoia-Kings Canyon	3	50	500	23.7	2.5	no
Yosemite	2	24	1083	34	1.6	no

through time: survey period (Pearson $r = 0.44$, $N = 99$, $P < 0.05$), percentage parasitism through time (Pearson $r = 0.40$, $N = 99$, $P < 0.05$), and percent nest success through time (Pearson $r = -0.23$, $N = 99$, $P < 0.05$). These indicate that as time progressed, cowbird frequency and parasitism increased while nest success decreased.

DISCUSSION

We scheduled the survey periods to coincide with the host breeding season in each park, ranging from early March to May, and we observed that cowbirds began to arrive in late April in most of the parks. The overall low parasitism rates found on this study may be partially attributable to timing of nesting rather than overall parasitism.

The parasitism rates found during this study were relatively low compared to those in other riparian systems reported by researchers at the Sacramento, California, Partners in Flight symposium (October 1997: G. R. Geupel, unpubl. data; C. P. Ortega, unpubl. data; M. J. Whitfield, unpubl. data; E. Greene *this volume*). In the four parks with a significant impact of parasitism on host nest success (Golden Gate, Great Basin, Lake Mead, and Montezuma Castle) there is either livestock grazing within the park or agriculture contiguous with the park boundary. Thompson (1994) found that cowbirds in the Midwest were foraging primarily in short grass or agricultural areas and breeding in forested areas, which should account for our findings. Three of the other four parks (Organ Pipe, Sequoia-Kings Canyon, and Yosemite) are all somewhat isolated from agricultural impacts.

One anomaly in our findings is that Point Reyes, with grazing both in and adjacent to the park, did not show a significant impact on reproduction from parasitism. It is possible the data may have been heavily affected because two nest search sites at this park were over one km from grazing land, and both of these sites experienced lower parasitism than other sites in the park.

Our survey did not find did that certain management practices, such as horse packing stations, camping, and picnic areas, encourage Brown-headed Cowbirds enough to be a significant factor in the level of cowbird parasitism. We also did not find a widespread impact of parasitism on host populations in the parks studied. We did find, however, that for some species parasitism rates were very high, and could be having a negative impact on those host populations. A more in-depth study focusing on those species used as hosts in this study, and attempting to find nests at earlier stages and following them more closely, may clarify the severity of the threat to these hosts.

There were a number of biases in our data set. For example, most of our nests were found during incubation or nestling stages. We therefore very probably missed parasitism events that occurred before incubation began if the nest was abandoned or depredated. We did not check nests with enough frequency to employ the more complex methods of determining the impact of parasitism on nest success, such as those suggested by Pease and Grybowski (1995). Our estimate of success does not take into account the differences between abandonment, depredation, and loss specifically due to parasitism. Also, it does not account for the fact that an individual female may re-nest several times during the breeding season after loss of a nest. Few nests were found during nest-building. This may well result in an underestimate of the effects of parasitism on nests, since they are usually parasitized during the egg-laying stage. It was unlikely that we would detect those nests which were abandoned early as a direct result of parasitism. Additionally, we had fewer than 10 nests for most species, so sample size was also a factor in our ability to determine the impacts in a given park on a given species.

This study presents an overview of parasitism

in several western National Parks. Cowbirds do appear to be negatively impacting several host species in Golden Gate, Great Basin, Lake Mead, and Montezuma Castle. None of the species with high parasitism rates in this study are either state or federally listed as endangered. The Park Service may decide that they do not need to alter their current management practices. Also, few of the factors affecting cowbird densities are under the control of the National Park Service. They may, however, wish to reconsider the policy of allowing livestock grazing within parks, since this seems to be an important factor contributing to cowbird parasitism which is within the parks control. The factors affecting parasitism in the parks could be clarified with a study which focused on the hosts identified by this project, particularly one which attempted to find nests in very early stages, and monitored cowbird abundance throughout the entire study.

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