The Effects of Brood Parasitism on the Reproduction in North American Songbirds

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Introduction

Birds that are considered brood parasites tend to lay eggs in other bird's nests. The new "host" will then continue to incubate and raise their young unknowingly. About 1% of all bird species in the world are considered broad parasites. Families that are brood parasites include the Indicaoridae or honey guilds, about half of the Cuclidae or Cuckoos, two genera in the Ploceidae or Finches, five species of Icteridae or Cowbirds, and a species of duck in the Anatidae family (Payne, 1977). Brood parasites drastically reduce the reproductive success of the host species, and in some scenarios, the host species will finish the breeding season with fewer than normal fledglings or none at all (Brittingham and Temple, 1983). The purpose of this paper will be to discuss how the Brown-headed cowbird has affected the songbirds of North America.

North Americas Brood Parasite

The only brood parasite found in North America is the Brown-headed Cowbird (*Molothrus ater*) and it is in the order Passeriformes and the Icteridae family. Shown in figure 1, the Brown-headed Cowbirds appearance changes depending on sex, known as sexually dimorphic, and easily identifiable by the brown head, black body, and stocky beak. The original range of cowbirds were located west of the Mississippi River prior to the 1800s. These birds preferred large open fields and cultivated areas such as farmlands. Once the settlers in the east started cutting down the eastern forests, it opened up more area for the cowbird to expand their range. In response to brood parasitism, some host species have coevolved to fight back. Some of

the defenses that hosts use are to eject the parasites eggs from the nest, rebuild a new nest floor overtop of the cowbird eggs, or to abandon the nest all together (Brittingham and Temple, 1983).

Host species for the cowbirds tend to be long distance migrants that winter in the Neotropics. Their numbers have slowly declined in smaller forest patches and now mainly reside in untouched tracts (Brittingham and Temple, 1983). The main host species of the cowbird include Warblers (Parulidae), Vireos (Vireonidae), Flycatchers (Tyrannidae), Tanagers (Tanagridae), and Thrushes (Turdidae) (Peer et al. 2013).

Along with the cowbird's negative reputation, many misconceptions about the cowbird has been spread. One misconception is that cowbirds are increasing in abundance, when in actuality, their population is declining. From Breeding Bird Survey data collected between 1966 and 2010, it has been reported that cowbird populations are dropping by 0.6% every year. Michigan, Texas, Arizona, and Oklahoma have the most pronounced decline in cowbirds, according to the survey. Another misconception is that parasitism always limits or reduces the host populations size. Population sizes are limited by many other factors such as resources,

Figure 1. Brown-headed Cowbirds. (A) Male cowbird feeding in open field. (B) Female cowbird perched in edge habitat. Photos taken by William Kish

habitat, and predators. The main hosts that are now imperiled by cowbirds are usually

endangered species that have had other factors affecting their population, such as habitat loss or rare habitat. An example of this would be the Kirtland's Warbler *(Setophaga kirtlandii*) who needs extremely specific habitat to breed, Jack Pine forests 6 to 24 years after a fire. Since many forest management programs stopped controlled burns, that habitat is becoming extremely scarce. One final misconception is that cowbird control programs always increase reproductive output of the host and host population sizes. One example of this is with the Kirtland's Warbler, a rare species because of its extremely specialized nesting need of jack pine forests 6 to 24 years after a fire. In a 1961 census of birds, 502 singing male Kirtland's Warblers were recorded. In 1971, the census was performed again and only 201 singing males were recorded. In 1972, a cowbird control program was implemented where adult cowbirds were killed, and their eggs were removed from warblers' nests. However, the number of singing male Kirtland's warblers was still in the 200s until the 1990s (Peer et al. 2013).

Effects of Brood Parasitism on Passerines

Habitat Type

Originally, the Brown-headed Cowbirds preferred habitat was located in the short-grass prairies and cultivated land in the west. As forests started to clear in the east, they expanded their range and adapted to using broken forests. This caused the cowbird to spatially partition their breeding and feeding activities, breeding in the broken forests and feeding in the grasslands (Coker and Capen, 1995). The spatial partitioning led to many interesting new studies on how the cowbird adapted to these new habitat conditions.

One study performed set out to understand the habitat and microhabitat features on the brood parasitism with two forest hosts. Burhans (1997) studied Indigo Buntings and Field

Sparrows during their breeding season during the years 1992 through 1994. Nests were found in old fields and their adjoining forests with vegetation around the nest being observed. For all years, Field Sparrows were parasitized 14% of the time (n= 228) and Indigo Buntings 59% of the time (n= 188). Indigo Buntings were significantly parasitized more in the forests (73%, n=68) compared to nonforested Indigo Buntings (50.8%, n=188). Significant indicators of parasitism were nest height and side concealment. Field Sparrows' nests tended to be lower to the ground and had more side vegetation concealment than the Indigo Buntings nests (Burhan, 1997). These

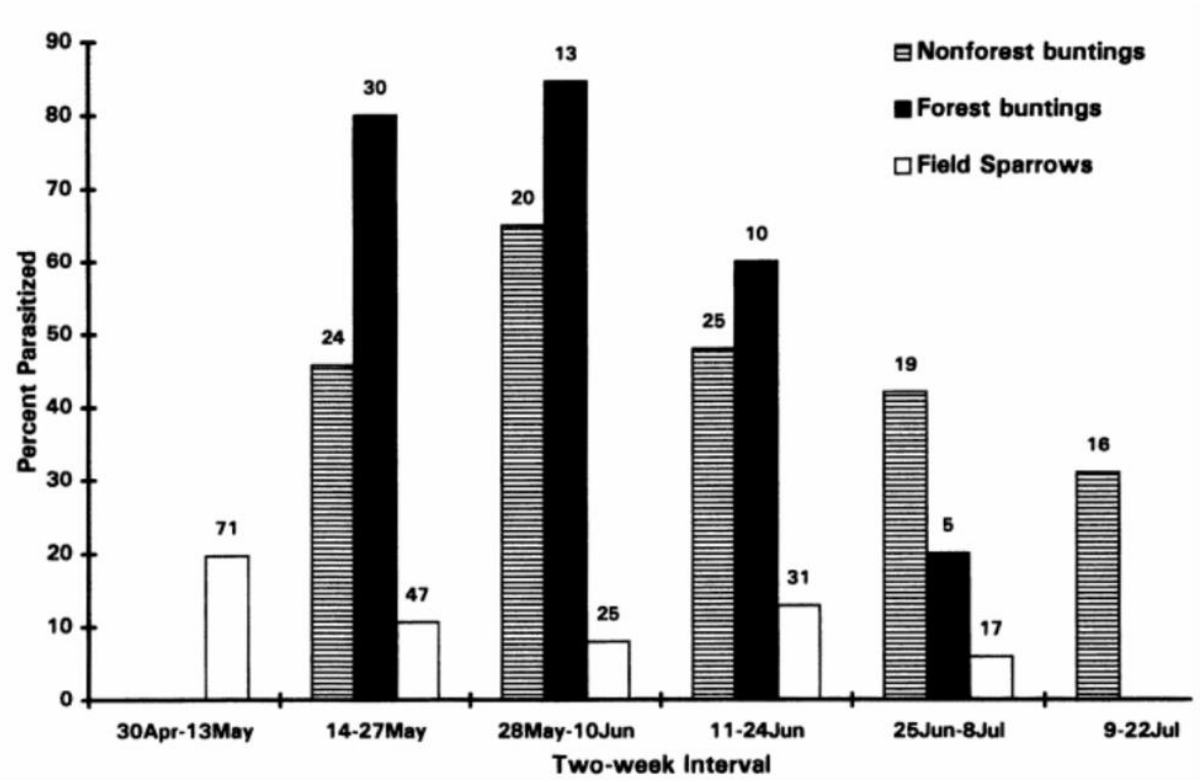

Figure 2. Percent of Indigo Bunting and Field Sparrow nests parasitized over the course of 2 weeks (Burhans, 1997).

results suggest that varying microhabitat features, such as side vegetation concealment, have just as much to do with rates of parasitism as overall habitat and host characteristics. Figure 2 shows the rates of parasitism across the Field Sparrow, grassland dwelling, and the Indigo Bunting, edge and forest dwelling.

The distance from edge forest habitat also has an effect on the rate of parasitism. Johnson and Temple (1990) studied Clay-colored Sparrows, Savannah Sparrows, Grasshopper Sparrows, Bobolinks, Western Meadowlarks in fragmented prairie habitats close to the forest edge. The Savannah Sparrow, Bobolink, and Western Meadowlark all had a higher probability of their nest being parasitized when their nest was near the forest edge (< 45m). Often times, the diversity and density of nesting birds near forest edges are high, cowbirds may be dependent on the density of these nesting birds for selection of hosts (Johnson and Temple, 1990).

Another study set out to study the affects of distance to forest openings, size of forest openings, and forest fragmentation on the rates of brood parasitism. Brittingham and Temple (1983) found that as nests get further and further away from forest openings, the amount of cowbird eggs in a nest decreases and the probability of a nest being parasitized is decreased. When there is more open habitat around a host's nest, the rate of parasitism increases significantly. Lastly, fragmentation increases the rate of parasitism since it increases the amount of forest openings and increases the amount of habitat available for cowbirds to search for available nests (Brittingham and Temple, 1983).

Reproduction

Cowbirds can negatively affect the reproduction of passerines in a variety of ways. Most commonly, they will reduce the reproduction success, the number of host eggs in the nest, and decrease the growth rate of host fledglings.

The Prothonotary Warbler is a migratory passerine that winters in the Neotropics and is the only hole-nesting species in North America that hosts the cowbird. Many different effects of brood parasitism on the Prothonotary Warbler was collected over a four-year study in Illinois.

The field collection was performed by setting up roughly 1200 nest boxes between 25 different sites with natural nests being used as well. The clutch size, hatching success, rate of brood parasitism, nestling survival, and between year returns of adult warblers were all examined. Fifty percent of 1979 nest boxes and 41% of 115 natural cavities were found to be parasitized. The most cowbird eggs in a nest was eight eggs while 46% of the nests received one cowbird egg and 54% received two or more. The average clutch size for the prothonotary warbler with no cowbird eggs was five eggs while nests with four or more cowbird eggs had an average clutch of 3.75 eggs, a 24% decrease in clutch size. Regardless the amount of cowbird eggs, the hatching success of the prothonotary warbler was always lower than the cowbird. With more cowbird nestlings, the amount of warbler nestlings that would survive would decrease, but it had no effect on the cowbird nestling survival. Parasitism had little to no affect on the between year site fidelity of male and female prothonotary warblers. Overall, the greatest effects on the prothonotary warbler was the decreased hatchling success and the increased nestling mortality (Hoover, 2003).

Even a fellow member of the Icteridae family is not safe from brood parasitism. The Red-winged Blackbird is a plains and wetlands dwelling bird that is not safe from the cowbird's parasitic tactics. Clotfelter (1999) studied how the reproduction of the Red-winged Blackbird is affected by brood parasitism. Of the 1320 nests observed, 16.8% of them were parasitized with many of them containing more than one cowbird egg. Once a nest was parasitized, the Red-winged Blackbird would often have fewer eggs in a clutch. Cowbirds often resort to ditching host birds' eggs to make room for when they lay their eggs in the nest. The success of the host birds nest decreased when parasitized as well as the average fledgling production (Clotfelter, 1999).

Another example which shows the impact of brood parasitism on reproduction is the Solitary Vireo (*Vireo solitarius*) or now commonly known as the Blue-headed Vireo. Through field surveys and observations, it was found that unparasitized clutches was significantly larger than those who were not parasitized. This was presumed to be caused by the cowbirds removing host bird eggs. Egg removal by cowbirds was observed in five nests where one or more vireo eggs went missing followed by cowbird eggs appearing. In four of those five nests, bits of broken vireo eggs were found in and or around the nest. The number of fledglings was also higher in unparasitized nests than unparasitized nests. The number of successful fledglings was higher in the cowbirds than the host bird fledglings. Development rates of fledglings was slower in parasitized nests and the cowbirds grew at a faster rate than the vireo chicks. This can be explained by cowbirds typically hatching up to three days before the vireo eggs. Overall, this study found this population of vireos to represent a "sink" (Marvil and Cruz, 1989).

Conservation

Natural Defenses

Many passerine species have coevolved with the cowbird to combat its parasitic life style. Some passerines chase off cowbirds when perched around the vicinity of their nest. For example, Robertson and Norman (1976) told accounts of witnessing a cowbird investigating a Northern Oriole nest. Once the oriole returned, it checked the contents of its nest and then chase off the cowbird, while alarm calling, who was perched in a near by tree. (Robertson and Norman, 1976). Some birds eject cowbird eggs from their nest early after being laid. One study recorded a Warbling Vireo (*Vireo gilvus*) nest which contained three vireo eggs and one cowbird egg at 8:46 am. At 1:30pm on the same day found there to be three vireo eggs and no cowbird eggs, but

pieces of egg shell at the bottom of the nest. Over the course of the study, experimentally parasitized nests were set up and there were 16 cases of ejection and one case of desertion (Sealy, 1996)

Human Intervention

Some ways that humans get involved is through cowbird removals. Many state and federal agencies have set up cowbird removal programs. This involves setting traps for the cowbirds and then killing them. There have been plenty of success stories with this strategy, for example, Kirtland's Warbler, Least Bells Vireo, and the Black-capped Vireo. Data shows that cowbird removals decrease parasitism frequencies from 77% and 85% to 58% and 47% in study plots (Koschiuch and Sandercock, 2008). Another success story comes from a California endangered population of Southwestern Willow Flycatchers (*Empidonux traillii exrimus*). Multiple cowbird traps were set up and any cowbird eggs and fledglings found in hosts nest were removed. Prior to cowbird removals, parasitism rates dropped from 65% to 22% and nest success increased from 23% to 39% (Whitfield et al. 1999).

Conclusion

With an unexpected expansion over to the east coast of the United States, the Brown-headed Cowbird has made some drastic impacts of passerine reproduction. With looking at past studies of cowbird parasitism on North American songbirds, some general trends that can be recognized is interesting. The location of the nest and varying microhabitat features all affect the rate of parasitism. When closer to edge habitat, hosts nests are more likely to be parasitized than those farther away. For nests that are in the forest, the closer to fragmentation and the more amount of open forest close to the nest will increase the probability of parasitism. Although some

species of passerines have adapted defenses to the parasitism, many passerines do not defend against it at all. Some cowbird control programs have started in areas locally and regionally to try and combat these parasites.

Through multiple years of studying the effects of brood parasitism on North American song birds, it can be concluded that the Brown-head Cowbird negatively affects the reproduction of passerines. Hopefully a combination of cowbird control programs and other conservation solutions, passerine species that are at risk or endangered can make a comeback.

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