Studies in Avian Biology No. 18:254–259, 1999.

SECTION III: COWBIRD CONTROL: THE EFFICACY OF LONG-TERM CONTROL AND PROPOSED ALTERNATIVES TO STANDARD CONTROL PRACTICES

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THE PROBLEM

Relatively little research has been conducted on the types of measures that can be employed to control Brown-headed Cowbird (*Molothrus ater*) numbers or to reduce levels of parasitism of sensitive host species without limiting cowbird numbers. The predominant control technique has consisted of intensive trapping and removal (Rothstein and Cook in press), and few other options have been discussed. This session of the 1997 conference was initially designed to provide a forum for evaluating other measures for controlling the impacts of cowbirds on hosts; however, the forum resulted primarily in papers that evaluated the long-term impacts of traditional controls (i.e., trapping and shooting) on cowbirds. Thus, the majority of the papers in this section provide illustrations of the outcomes of intensive control programs; only one paper speaks to the possible effects of an alternative control measure on cowbirds and hosts. We hope that the dearth of papers on this topic will stimulate researchers and managers to explore it more in the future.

EVALUATING THE EFFECTS OF LONG-TERM COWBIRD CONTROL

Whitfield et al. describe a control program implemented from 1993 through 1997, during which the authors trapped cowbirds, addled their eggs, and removed their chicks from nests of endangered Southwestern Willow Flycatchers (*Empidonax traillii extimus*) on the Kern River, Kern County, California. They found that parasitism rates decreased substantially over the time period, from an average of 65% in four years preceding trapping to 22% since cowbird control began. Concordant with the change in parasitism rates, the number of flycatcher fledglings per female per season increased from 1.4 to 1.72.

However, there was no marked increase in the number of breeding pairs occupying the study site, which apparently had room for population expansion. There were 34 pairs at the start of trapping in 1993, and 38 in 1997. Trapping may have stopped a decline in the size of the breeding population, which numbered 44 pairs in 1989 and declined to 24 in 1992 before cowbird control began. But the most recent data show yet another decline, even with cowbird trapping, to 26 pairs in 1998 (M. Whitfield, pers. comm.). Assessing effects of cowbird control on the size of the breeding population is complicated further by an apparent increase in the Kern River flycatcher population from 26 pairs in 1982 to 44 in 1989, even though no cowbird trapping was done in those years (Harris and Sanders 1987; Whitfield et al.). Whitfield et al. point out that surveys done in the 1980s may not have been comparable because they used varying methodologies and covered different-sized areas; however, they suggest that flycatcher numbers were probably at least stable then despite the lack of cowbird control. They further suggest that this stability may have occurred because of lower rates of parasitism in the 1980s, but we note that Harris (1991) reported a parasitism rate of approximately 68% (of 19 nests) in 1987, comparable to the mean pre-control rate of 65% for 1989–91 reported by Whitfield et al.

It seems clear that the Kern River flycatcher population has low productivity, because Whitfield et al.'s demographic analysis indicates that the number of fledglings produced annually seems too small to result in population growth in most years. Increasing the effectiveness of cowbird control so that parasitism rates fall below 22% could help, but Whitfield et al.'s data further suggest to us that high rates of nest predation and possibly other factors may indicate that the Kern River population would not be self-sustaining even with a parasitism rate of zero. Assuming all cases of parasitism result in an irreversible and complete loss of annual reproductive output for flycatchers (which actually exaggerates the effect of parasitism because flycatchers at the Kern River desert 54% of parasitized nests and subsequently renest [Harris 1991]), the average parasitism rate of 22% since 1993 means that the population has realized only 78% of the potential output it would realize with no parasitism. If this population were to realize all of its potential without parasitism, it would produce 1.28 times as many young per female (or 2.23 young per female; 1.28 x the mean of 1.74 young since 1993 reported by Whitfield et al.). An annual output of 2.23 young per female is just barely within the range that is needed to keep most populations of passerines stable, using available estimates for annual survival rates

of juveniles and adults (Robinson et al. 1993, 1995). Thus, it is difficult to determine if continued cowbird removal will result in increased population sizes of Willow Flycatchers at the site. Nevertheless, we agree with Whitfield et al. that continued cowbird control, as conducted via trapping and/or addling eggs and removing cowbird chicks, is prudent, but we also think that some effort should be directed towards decreasing nest predation. One unique aspect of Whitfield et al.'s study is that it indicates that cowbird trapping suppresses cowbird numbers from one year to the next in the Kern River area. This year-to-year effect has not been found in other trapping programs (Rothstein and Cook in press), probably because cowbirds have very high dispersal rates (Fleischer and Rothstein 1988, Fleischer et al. 1991).

Winter and McKelvey discuss another long-term cowbird trapping program (1992–1997) that was designed to aid in the conservation of Least Bell's Vireos (*Vireo bellii pusillus*) and Willow Flycatchers on the Cleveland National Forest, San Diego County, California. The authors report that numbers of pairs and fledging success were high for flycatchers during the study, whereas numbers of pairs and fledging success were low for two of three vireo populations. In fact, two of the vireo populations were either extirpated or reduced to a single male by 1997. They conclude that their cowbird trapping efforts, for the most part, were ineffective in lowering parasitism rates on Least Bell's Vireos because of a limited number of traps that could be placed in the remote and rugged breeding locations on the National Forest. For remote sites, the authors suggest that nest monitoring and cowbird egg removal may be more effective, and less costly, than cowbird trapping. In addition to the flexible cowbird management approach advocated by Winter and McKelvey, it is worthwhile considering whether any cowbird management at all should be pursued with such small vireo populations, which ranged in size from only 4 to 6 pairs. There are now over 1000 pairs of vireos elsewhere in San Diego County (U.S. Fish and Wildlife Service 1998), and so it is questionable if these small populations will ever make a major contribution to the vireo's recovery if the local riparian habitat they use is limited. Unless small populations have the potential to become very large or occur in regions where an endangered species is still rare, the scarce resources available for conservation might be put to better use than that of aiding small populations that may be marginal under any circumstances.

Unlike the vireos, the Willow Flycatcher population studied by Winter and McKelvey was near an existing road, which allowed for effective cowbird trapping, and only 2 of 82 nests were parasitized over four years. This flycatcher population was stable over the course of the study and ranged from 18–24 pairs. However, as the authors point out, it is unclear whether this stability could be attributed to cowbird control or whether control was even needed because no data were collected on pre-trapping rates of parasitism. This lack of pre-trapping data is unfortunate and conflicts with suggested cowbird control program guidelines that urge the collection of such data due to the considerable spatial variation in cowbird parasitism rates that can occur even within a single host species (Robinson et al. 1993). Without pre-trapping baseline data on rates of parasitism, managers run the risk of initiating control activities that will continue for many years without evidence that cowbird control is needed or is more cost-effective than other management approaches.

Eckrich et al. discuss a program that used trapping and shooting of Brown-headed Cowbirds on Ft. Hood, in Bell and Coryell counties, Texas, to aid the recovery of Black-capped Vireos (*Vireo atricapillus*). Cowbird control from 1987 to 1997 emphasized four measures: trapping in pastures with high concentrations of cattle, rather than in host breeding habitat; manipulating trap numbers; using several different trap designs to increase capture efficiency; and conducting both systematic and opportunistic shooting of cowbirds. Control was relatively ineffective until 1991 when trapping efforts were concentrated in cowbird feeding areas. The authors suggest that host breeding habitat is so extensive on Fort Hood that trapping in breeding habitat is not cost-effective, but they do show that a regular shooting program in which female cowbirds are attracted by playbacks in breeding habitat is an effective supplement to trapping at feeding sites.

Before any cowbird control began, vireos at Fort Hood experienced a parasitism rate of 90.9%. When trapping was not focused on cowbird feeding sites from 1988–1990, parasitism rates were still above 50%. But the rate has generally been below 20% since then, and was only 8.6% in 1997. The cowbird control program at Fort Hood is the second control program, after the program for the Least Bell's Vireo in southern California (Griffith and Griffith in press), for which there is good evidence that control has led to an increase in an endangered host species. Territorial male Black-capped Vireos at Fort Hood have increased from 85 in 1987 to 357 in 1997. However, this is a much slower rise than for the Least Bell's Vireo at Camp Pendleton in southern California (Griffith and Griffith in

press), and may be due to relatively ineffective control efforts prior to 1991. Thus, in the future there should be an accelerated rate of vireo increase at Fort Hood if cowbird parasitism has been limiting vireo population growth. As with most cowbird control programs, the numbers of cowbirds killed at Fort Hood has not decreased since the program began.

EFFECTS OF COWBIRD TRAPS ON HOSTS

Terpening, in the fourth paper, reports on an incident in Travis County, Texas, in which an endangered host, a Golden-cheeked Warbler (*Dendroica chrysoparia*), was seen feeding, from outside a trap, a juvenile Brown-headed Cowbird caught in the trap. After several days, an adult warbler was found dead inside the same trap. To minimize chances of host mortality from cowbird trapping, the author recommends that traps be checked every day and that attempts be made to place traps in cowbird foraging areas rather than in host breeding areas. The former suggestion is well taken and should be followed even when there is little or no chance of capturing host species. The federal guidelines for animal welfare that apply to universities and other entities that receive federal funding cover all vertebrates (cowbirds too!) and require daily checks for captive animals.

Although placing cowbird traps at feeding sites may be the best strategy in some landscapes, as Eckrich et al. argue, we are not sure that risks to endangered host species should be a major factor in trap placement. Terpening's review of other trapping programs indicates that captures of endangered species are extremely rare. Because they are insectivores, none of the endangered North American species for which cowbird trapping might be beneficial are likely to be attracted to cowbird traps for food, although many non-endangered non-target species are attracted. However, if host birds are attracted into traps to feed their "offspring" more often than is currently reported in the literature, then this could be a more serious problem. Of more importance perhaps is that placement of traps at feeding sites could compromise the efficacy of cowbird trapping in landscapes where trapping is more effective in breeding habitat (see Griffith and Griffith in press). And, trapping at feeding sites can result in the capture of numerous cowbirds that are not threatening endangered species, so the killing of such birds conflicts with animal welfare guidelines, and is ethically suspect.

THE EFFECT OF FIRE ON PARASITISM RATES

In the final paper in this section, Clotfelter et al. report the effects of prescribed burning on cowbird parasitism of Red-winged Blackbirds (*Agelaius phoeniceus*) at a prairie reserve in Wisconsin. The likelihood of a nest being parasitized decreased with increasing distance from the nearest habitat edge or road, but increased with increasing distance from the perimeter of a burn. Parasitism was not related, however, to the quality or timing (spring versus fall) of a burn, nor to the time elapsed since a burn. There was a trend for blackbird nests in burned areas to have fewer cowbird eggs, and the success of nests increased with increasing distance from the perimeter of the burn. The authors suggest that if future research demonstrates results similar to theirs, wildlife managers might consider using burns to lessen rates of parasitism on particular host species.

SYNTHESIS

The first three contributions in this section on cowbird control provide two important lessons. First, even extreme reductions in the level of parasitism and increases in host productivity do not guarantee population increases in endangered species impacted by cowbirds. Only trapping programs to aid the Least Bell's and Black-capped vireos have resulted in large increases in endangered hosts (Eckrich et al. *this volume,* Griffith and Griffith in press, Rothstein and Cook in press). By contrast, the Kirtland's Warbler (*Dendroica kirtlandii*) did not increase for over 15 years after trapping reduced parasitism to negligible levels (DeCapita in press). The Southwestern Willow Flycatcher story may prove to be similar to that of the Kirtland's Warbler, as Whitfield et al. show for the Kern River population. Fifteen years of cowbird trapping for Least Bell's Vireos at Camp Pendleton also has not resulted in any major changes in Southwestern Willow Flycatcher numbers occurring on the base. Thus, the effects of cowbird control for this species are questionable, and although there appears to be much unoccupied breeding habitat in many parts of the flycatcher's range, it is also questionable whether we are able to accurately assess habitat suitability or not. This difficulty in assessing habitat suitability is shown by the recent history of Kirtland's Warbler. Rothstein and Cook (in press) summarized literature that suggested that neither breeding nor wintering habitat were limiting for this species in the 1970s and early 1980s, yet the warbler began to increase only after the creation of new breeding areas (Kepler et al. 1996, DeCapita in press) and wintering areas (Haney et al. 1998; see also Sykes and Clench 1998). Thus, although cowbird control has brought-about decreases in parasitism rates and increases in host reproductive output in many cases, it has

a mixed track record as regards the ultimate measure of "success" for rare hosts, namely increases in host population size. However, even though cowbird control has not resulted in increases in two of the four endangered species that have prompted its use, it may have kept these species, Kirtland's Warbler and Southwestern Willow Flycatcher, from declining. Nevertheless, the evidence that trapping forestalled declines is somewhat equivocal (Rothstein and Cook in press) and the 50% success rate of cowbird control programs should motivate managers to seek additional solutions to the problems of endangered hosts.

The second lesson demonstrated by the papers on cowbird control is that there is no single formula for maximizing the efficacy of control programs. As we have discussed, different strategies, such as trapping in breeding versus feeding habitat, and using trapping versus shooting or nest monitoring, seem to work well in different situations. The message here is that managers need to be flexible and innovative in designing control programs for their own local areas.

Another important point to keep in mind is that even when control programs seem to have resulted in rapid and large increases in endangered hosts, they typically have little effect on year-to-year numbers of cowbirds and so must be carried out each year (Eckrich et al. *this volume*; Griffith and Griffith in press). Thus, even when cowbird control measures are appropriate and effective management tools, they are short-term fixes such that control must be repeated year after year or until some other management option is adopted. More appropriate tools for long-term management might be measures such as the restoration of breeding habitat, and the development of land use practices that minimize cowbird numbers. These types of long-term measures will be key in recovering the population viability of declining hosts. As with other aspects of cowbird parasitism, effective long-term measures are likely to be landscape-specific. An example of such a measure is T. L. Cook et al.'s (unpubl. data) demonstration of the effects of removing cattle from a portion of Fort Hood. In this situation, Cook et al. found that removal of cattle, and, hence, removal of cowbird feeding sites, led to a steep decline in parasitism rates of Black-capped Vireos (from 34.8% in 1996 to 0% in 1997) on their study site. Their results therefore suggest that in some instances, moving the primary foraging areas of cowbirds may affect parasitism as strongly as cowbird trapping can.

Another point to consider about cowbird impacts on endangered hosts is the possibility that no management is needed once local populations of such species become large. Based on evidence collected from several studies of cowbird and host laying strategies, S. I. Rothstein (unpubl. data) proposed that the impact of parasitism will be reduced naturally as host population sizes increase, due to differences between cowbird and host egg-laying rates. Thus, in effect, large host populations may "swamp" the impact of cowbirds so that a population that experienced a high rate of parasitism when it was small may experience a much lower rate, from a similar number of cowbirds, when it is large. This extrapolation assumes that cowbirds do not increase in direct proportion to the endangered host, which is likely if the host is just one of a number of local species that are parasitized. Because the rates of parasitism on enlarged populations of an endangered host may be low enough to allow the population to continue to grow, it is possible that cowbird removal could be discontinued in areas where host populations have shown significant increases in size. An important consequence of discontinuing trapping in these situations would be that the money could be directed to other projects that are essential for recovering host species. In addition, other downsides of cowbird control, such as impacts on non-target species (Rothstein and Cook in press), could be avoided. But most importantly, if cowbird control does not have to be continued once local populations become large, then it is a much better management tool than we have realized up to now, because it may only need to be carried out until local populations have increased.

Despite considerable evidence showing the need for a flexible approach to cowbird management, the government agencies that fund and mandate management actions are likely to suffer from considerable inertia, as do most bureaucracies. If this inertia results in inflexibility once cowbird control programs are initiated, then recovery efforts may be retarded in regards to the long-term goal of the Endangered Species Act, namely, to restore endangered species to the point where they no longer need management intervention. It is unclear to us if a species can be removed from the Endangered Species List if it is the subject of perpetual management efforts. Another aspect of this situation is that of funding for cowbird control: cowbird trapping has become a large business in some regions. For example, in tabulating data on trapping programs, D. C. Hahn (unpubl. data) estimated that at least $1,000,000 is spent annually for cowbird trapping in California alone, and the work is completed primarily by consulting firms. Thus, there is a potential profit incentive for individuals and firms to lobby for cowbird control and this in-

centive may add further inflexibility to cowbird control programs.

From a completely different angle, Griffith and Griffith (in press, and unpubl. data) have argued for regional trapping, rather than just localized trapping where impacted hosts occur, to reduce cowbird numbers over large areas. They suggest that regional control could be more cost-effective than local control, could increase the productivity of a number of host species in addition to a few endangered ones, and would be longer lasting than local control, which usually has no effect from one year to the next. It is not clear how regional control would be achieved, but one cost-effective approach they suggest could be to kill cowbirds by the millions in large winter roosts. Rothstein and Robinson (1994) have pointed out several significant drawbacks to such suggested approaches, including that local trapping may still be required because cowbirds breeding in the southwestern U.S. may not join large wintering flocks. As for benefiting hosts in addition to endangered ones, recent analyses have found little or no evidence that cowbirds limit the populations of any passerines other than the several species formally recognized as endangered (Peterjohn et al. in press, Wiedenfeld in press). Even if cowbirds do affect the distribution and abundance of other species, it is worth keeping in mind that ecologists have found that numerous species affect other species in nature, and that some, such as "keystone species", may even shape entire communities or faunas. Thus, because the Brown-headed Cowbird is an ancient inhabitant of North America (e.g., DNA evidence indicates that it split from its sister species, the Shiny Cowbird [*Molothrus bonariensis*] about a million years ago [S. I. Rothstein, unpubl. data], and fossils dating to a 0.5 million years ago have been found at sites across North America from California to Florida [Lowther 1993]), some of the effects of cowbirds on other species are natural.

MANAGEMENT QUESTIONS

The studies presented in this section seem to indicate that localized cowbird removal programs are only one way among several for combating brood parasitism. Before any method of controlling brood parasitism is chosen, however, there are at least four items to consider:

1. The nature of the problem. Is cowbird control, of any kind, clearly warranted? For instance, have host populations been shown to be declining, and is parasitism a major reason for the decline? Or, is habitat loss the primary reason, which would warrant habitat restoration rather than, or in combination with, cowbird control? Would a cowbird control program only be addressing the proximate, rather than the ultimate, reasons for declines (Rothstein and Cook in press)? It is clear that some cowbird control programs are dealing only with proximate issues because they involve hosts that have long been sympatric with cowbirds and presumably have become endangered because of anthropogenic effects. For example, the ranges of the Black-capped Vireo and Golden-cheeked Warbler are completely within the cowbird's ancestral center of abundance in the center of North America (Mayfield 1965), and most of the extant population of a third endangered species, the Southwestern Willow Flycatcher, is within a region where cowbirds have long occurred (Rothstein 1994).

2. Long term monitoring. Unfortunately there are instances in California in which there have been funds available for trapping cowbirds, but none available for assessing the numbers of the host species the trapping is targeted to aid. Thus, we suggest that managers need to consider if monitoring, both of the cowbird and its host, will be carried out during the management program. If it will, how frequently will it occur? How will "success" be measured in the program? Will there be any experimental evaluations of the program, for example, as in an adaptive management framework (e.g., Morrison and Marcot 1995)?

3. The nature of the funding. Cowbird trapping programs for declining host species usually need to be long-lived, and so funding must similarly be long-term. If a cowbird control program is to be started, will the money be there to see it through? Or, could the money perhaps be put to a better use, for example, for studying reproductive success and population sizes, or for conducting focused trapping at wintertime roost locations used by local cowbird populations that impact endangered hosts? The former use of funds may be especially appropriate for the Southwestern Willow Flycatcher, some of whose populations appear to have limited reproductive output even in the absence of cowbird parasitism.

4. The ethics of cowbird control. If the situation indicates that removal of cowbirds from a locale or a region is a necessity, then we need to ask if we have the right to kill large numbers of cowbirds, which are a native species, and which are successful primarily because we paved the way for them to become so. The ethical questions surrounding cowbird control are difficult to answer, but must be addressed because the public will want to see that we have considered these issues. Indeed, the use of vertebrate species in research at universities and other entities that receive federal funds must be

fully justified according to federal animal welfare guidelines. These guidelines dictate that researchers use no more than the minimum number of subjects needed to meet objectives, and that all subjects be treated humanely. Thus, it would be ironic, at best, to fail to set high scientific standards for justifying cowbird control actions taken in response to another federal mandate, the Endangered Species Act.

Future research on cowbird control, and management of cowbird and host populations will need to consider the above issues so that sound programs can be designed for recovering host species. We hope that the papers in this section provide managers and researchers with food-for-thought in regards to how such programs can be developed.

ACKNOWLEDGMENTS

We thank J. Rotenberry, M. L. Morrison, and the other co-editors of this proceedings for their diligence in bringing this publication to fruition in such a timely manner, and for their comments and insights both at the 1997 Conference and on earlier drafts of this paper.