Section VI -- Cowbird management, host population regulation and efforts to save endangered species

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Introduction

Concern over continental declines in the distribution and abundance of passerine birds, many of which are Neotropical migrants, has gained increased coverage in the scientific, as well as popular, literature (Hagan and Johnston 1992, Terborgh 1989, 1992, Martin and Finch 1995). These declines have been largely attributed by some workers (Robinson et al. 1995a) to increasingly fragmented and degraded breeding habitats in North America making populations more vulnerable to predation and parasitism. Alternatively, other researchers (Morton 1992, Rappole and McDonald 1992) have argued that habitat destruction

and degradation in the Neotropics is the primary cause of the declines.

However, recent studies have been generally inconclusive as to whether there are overall declines among passerines (Peterjohn et al. 1995, James et al. 1996). These studies show that while many species are decreasing, some at an alarming rate, many others are currently increasing. Furthermore, although some species or groups of species are decreasing in some regions, they are increasing elsewhere. For example, trends derived from the Breeding Bird Survey (Peterjohn et al. 1995) show that while most

Neotropical migrants are decreasing in the central part of North America, most are increasing in the West. Ornithologists may be coming to the realization that, even under normal conditions, passerine abundances and distributions may be much more dynamic than was thought to be the case (Johnson 1994) and that it may be normal for many species to be increasing while others are decreasing at any point in time. Nevertheless, there are some groups of birds, albeit with lower profiles than Neotropical migrants, that are showing widespread declines. For example, significantly more than half of all shrubland and grassland birds in eastern North America, most of which are short distance migrants, are decreasing (Askins 1993).

Peterjohn et al.(this volume) and Wiedenfeld's (this volume)

analyses of Breeding Bird Survey data failed to demonstrate a link between cowbird population trends and trends in common hosts. Although, local scales of observation show that brood parasitism can have significant impacts on the production of young in local populations of widespread host species, these local populations may not decline because numbers are maintained by emigrants from more productive populations (Brawn and Robinson 1996). However, it is likely that parasitism can endanger an entire taxon if habitat destruction and/or highly specific habitat requirements have limited the taxon to one to several small populations, all of which are heavily parasitized. In this overview, we discuss active cowbird management programs initiated to minimize the detrimental impacts of cowbird parasitism on four endangered species whose numbers have been reduced by extensive

degradation and loss of habitat. These four taxa differ in major ways as regards the reasons for their endangered status, their responses to cowbird management and the amount of reproductive loss they experience when parasitized. As regards the latter, only Kirtland's Warbler often fledges at least some of its own young if a cowbird egg hatches (Mayfield 1960). The other three species are smaller and nearly always lose all of their young if even a single cowbird egg hatches. We first briefly discuss each of these four endangered species and then highlight similarities

and differences among them and among the cowbird control programs designed to help their recoveries. We close with a brief discussion of the benefits and costs of cowbird control programs.

Kirtland's Warbler

The first and perhaps the best known of all cowbird management stories is the focus of DeCapita's (this volume) paper on the cowbird control program initiated to protect the Kirtland's Warbler (Dendroica kirtlandii). Unlike the other endangered species treated in this book, this one has had a limited range and population size throughout recorded history. It nests in several counties of northern lower Michigan and only in jack pine (Pinus banksiana) forests 6-24 years after fires. In the last 150 years, it is likely that its numbers peaked at around a few thousand individuals in the late 1800s, which is also the time that it probably became exposed to cowbirds (Mayfield 1960). Warbler numbers were much lower by the 1940s, due probably to fire suppression and cowbird parasitism and

interested parties resolved to conduct a complete census of the species every 10 years. Counts in 1951 and 1961 revealed 432 and 502 singing males. But the 1971 count showed a population crash to 201 singing males. This crash, along with evidence of increased rates of parasitism in the late 1960s and demographic

projections indicating that the species' recruitment rate with cowbird parasitism was not sufficient to avoid extinction led to a cowbird control program initiated in 1972.

DeCapita reports that over 92,000 cowbirds had been removed from the warbler's nesting area as of 1994, with about another 10,000 removed in 1995-96 (DeCapita pers. comm.). Cowbird trapping resulted in nest parasitism dropping from a 1966-1971 mean of 70% to a 1972-1977 mean of 5.6%. During this same period, host fledgling production increased from a 1966-1971 average of 0.8 young per pair per year to 3.08 during 1972-1977 and parasitism has remained low in recent years (Bocetti 1994). Despite these impressive reproductive gains, the numbers of Kirtland's Warblers remained fairly constant until they began to increase rapidly in 1990 10 years after a 10,500 ha wildfire, the Mack Lake Burn, created a massive amount of new habitat. Populations have continued to increase through the 1990s and there were 766 singing males recorded in 1995. As DeCapita shows, much of this dramatic increase is due to birds breeding on the Mack Lake Burn, which indicates that Kirtland's Warbler was limited by the availability of breeding habitat at least in recent decades (Kepler et al. 1996) after nearly all cowbird parasitism was eliminated. It appears that there has always been

plenty of wintering habitat for this species (Kepler et al. 1996,

DeCapita this volume).

Although a shortage of breeding habitat was mentioned as a possible cause for the failure of the numbers of breeding Kirtland's Warbler to increase soon after cowbird control began, it was not identified as the chief limiting factor (Mayfield 1978, 1983, Probst 1986). However, nearly all of the seemingly suitable habitat that was unoccupied was created by planting not by fires and planted habitat is less preferred (DeCapita pers. comm.). It is now recognized (Weise 1987, Kepler et al. 1996) that there was a shortage of good habitat. It is possible that breeding habitat has long had a greater role in limiting the warbler than some researchers assumed in the 1960s and 1970s.

If cowbird parasitism had been the chief or only proximate limiting factor, the population would have increased within a few years after cowbird control nearly eliminated parasitism on the species, as has happened with most managed populations of the Least Bell's Vireo (below, Griffith and Griffith this volume). Given the importance of habitat limitation, was cowbird control worthwhile? Cowbird control was clearly the prudent thing to do in 1971 when it became known that the Kirtland's Warbler population had declined by 60 % and it was also prudent to continue this control while the population hovered around 200 singing males for the next 19 years. Nevertheless, we would argue that there is no clear evidence that cowbird control was beneficial during that period, although it has often been

suggested that cowbird control kept the Kirtland's Warbler from

going extinct (Terborgh 1989, Trail 1992, Kepler et al. 1996). While demographic projections indicated that the 1971 population was not self sustaining, such projections are heavily dependent on estimates of mortality for young and old birds. If the true mortality rates were lower than the estimates, then those 200 pairs of Kirtland's Warbler could have been self sustaining even with cowbird parasitism. In addition, the parasitism rates used in the demographic projections were based mostly on a relatively small sample of 52 nests, found between 1966-71 (DeCapita pers. comm.). Those nests may not have been representative of the entire warbler population, especially if they were limited to one or two study sites.

should cite Walkinshaw 1983 directly. Every nest was from ARS !!

Concluding that Kirtland's Warbler was headed to extinction before cowbird control began, makes it necessary to assume that control just happened to start at the time the warbler's decline was at the carrying capacity that it stayed at for almost the next 20 years, about 200 pairs. Such a coincidence is possible but assuming that the Kirtland's Warbler was already stabilized at about 200 breeding pairs in the early 1970s does not necessitate such an unlikely happenstance of events. Importantly, available data do not show that the Kirtland's Warbler was decreasing at the time of the 1971 census. They show

only that a decrease occurred between 1961 and 1971. That decrease in population to 200 or so pairs could have occurred any time in the 1960s and might not have been due to cowbirds. Indeed, Probst (1986) noted that the amount of breeding habitat decreased between 1961 and 1971 and Kepler et al. (1996)

suggested that this may have contributed to the warbler decline during this period. The reduced population size could have been maintained at about 200 pairs because this corresponded to the amount of habitat present at any one time as produced by management efforts such as pine plantings and small controlled burns. Population stability even in the face of cowbird parasitism is also indicated by the fact that the warbler population was steady between 1971 and 1972 (201 versus 200 singing males, Mayfield 1978) even though there was no cowbird control until 1972. If the population was already declining due to an excess of mortality over recruitment, as is widely assumed, then there should have been fewer birds in 1972.

Although cowbird control may not have been necessary to save Kirtland's Warbler from extinction in the early 1970s, it is obvious that one can not do well controlled experiments to test population level hypotheses on endangered species. So we again stress that cowbird control was an appropriate management tool for Kirtland's Warbler because it is also reasonable to suggest

that the species would have gone extinct without this intervention. But we see no way to distinguish between the latter hypothesis and the alternative one that the size of the breeding population was already stabilized before cowbird control began.

The irony in the story of Kirtland's Warbler is that the Mack Lake Burn was started as a controlled burn to benefit the species. But it went out of control so what is probably the single most beneficial event in this species' recent history was

an accident. Even more ironic is the fact that due to the destruction of 44 buildings and one human fatality, use of controlled burns for warbler management is now rare (Kepler et al. 1996). Agencies attempt to create warbler habitat by planting jack pine at suitable densities but warblers prefer habitat that regenerates naturally after a fire. Mayfield (1993) suggested that Kirtland's Warbler may be much more successful on large habitat patches than on small ones so repetitions of events such as the Mack Lake Burn may be needed for this species' survival. The outlook for Kirtland's Warbler is unclear as the number of singing males on the Mack Lake Burn has declined from 300 in 1994, to 276 and 200 in 1995 and 1996, respectively and the numbers on the burn may approach zero in about 5 years (DeCapita pers. comm.). In addition the total population for the

species fell between 1995 and 1996, from 766 to 692 males, for the first time since the warblers began to use the Mack Lake Burn.

However, events since 1994 provide some cause for optimism. For the first time ever, breeding was documented outside of Lower Michigan. Although small numbers of singing males have been documented over the years in areas near Lower Michigan (such as Michigan's Upper Peninsula, Ontario and Wisconsin), there was never any evidence of breeding. But at least two of eight singing males in the Upper Peninsula of Michigan were paired in 1995 and there were 14 males there in 1996. Furthermore, for the first time ever, more than half (57 %) of all Kirtland's Warblers bred on planted (artificial) habitat in 1995 and 63 % did so in

1996 (DeCapita pers. comm.). This encouraging development may mean that either the Mack Lake Burn has generated so many excess birds that more and more have been induced to accept planted habitat as suitable or agencies have become better at simulating the conditions that prevail after burns. Unfortunately, severe budget cutbacks have reduced funds for research so the current breeding success of birds in planted habitat is not known, although past work has shown that males in planted habitat are less likely to attract mates (Bocetti 1994, Probst and Hayes 1987, Kepler et al. 1996).

Least Bell's Vireo

Unlike Kirtland's Warbler, Griffith and Griffith (this volume) show that the Least Bell's Vireo (Vireo bellii pusillus) experienced a rapid and dramatic increase in its breeding population after cowbird control was begun in 1983. This taxon was originally common over most of California with 60-80 % of its population in the Central Valley (Franzreb 1989). But by 1978 only about 140 singing males could be located and these occurred only from Santa Barbara County southwards (Goldwasser et al. 1980 and addendum on p.745), or in less than 20 % of the original range in California. The vireo's past and present ranges in Baja California are known with less certainty. This taxon, like Kirtland's Warbler, was originally allopatric with respect to cowbirds. But cowbirds colonized its entire range between about 1900 and the late 1930s (Rothstein 1994) and many early records of cowbird parasitism were from vireo nests (Franzreb 1989). A

decline in vireo numbers was first noted in the 1930s (Grinnell and Miller 1944). The decline has been attributed to cowbird parasitism and to the destruction or loss of most this vireo's obligate riparian habitat. For example, the Central Valley lost 95 % of its riparian habitat in this century (Smith 1977).

Some of the most extensive riparian habitat left in southern

California occurs on the Marine Corps Base at Camp Pendleton in San Diego County where about 62 singing males were located in 1983. These vireos experienced a parasitism rate of about 50 % before the cowbird control program described by Griffith and Griffith. After cowbird control, the parasitism rate was about 4-20 % from 1983-87 and 1 % or less since 1988, when the number of traps and their efficiency was increased. As of 1995, 5,349 cowbirds had been removed from Camp Pendleton. The vireo population has increased more than ten fold to 696 between 1983 and 1996. Furthermore, the number of drainages occupied by vireos on Camp Pendleton has increased from three to 14 and banded vireos fledged there have been found breeding at numerous other localities in California, including 275 km away in Ventura County at one of the northernmost breeding sites for the taxon. Griffith and Griffith also briefly report on other more recently instituted cowbird control programs in San Diego, and the adjacent counties of Orange and Riverside, which have also been followed by large increases in breeding vireos. The U. S. Fish and Wildlife Service estimates that there are currently over 1000 pairs of vireos in southern California (L. Hays pers. comm.),

making the increase from about 140 in 1978 one of the most dramatic success stories in bird conservation.

However, the success is far from complete as the numbers of

cowbirds trapped in one year appear to have no effect on the number trapped in the future, as with the Kirtland's Warbler management effort. Furthermore, vireos are not doing as well in their northernmost populations in Ventura and Santa Barbara counties. These populations are especially significant because they are the closest ones to the Central Valley and could serve as stepping stones to recolonization of the taxon's original center of abundance (Franzreb 1989). When cowbird control began in Ventura County along the Santa Clara River in 1991 field workers documented about 11 pairs of vireos (M. Holmgren and J. Greaves pers. comm.). By 1996, about 40 pairs could be found but a larger area was surveyed in that year and it is difficult to determine how much of the increase in vireos was due to increased sampling effort versus actual population growth. Unlike Camp Pendleton, the Santa Clara River is a management nightmare as there is no single concerned entity that controls the habitat where vireos are found. The same is true of the nearby Ventura River, which also has a small number of vireos. Vireos along the Santa Clara are scattered along a span of almost 50 km over which riparian habitat varies from being essentially absent to being present in large patches. Much of the river and the access to it is in the hands of numerous private owners and much of the riparian habitat is under attack from development and human activities such as gravel mining and agriculture. There is no

central authority managing the river and consistent funding is available only to trap cowbirds. The scarcity of funding for censusing vireos and monitoring their nests means that it is difficult to judge whether cowbird trapping has resulted in an increase in breeding vireos. Even the efficacy of cowbird trapping is somewhat compromised because the location of prime riparian habitat and therefore of vireos and of the optimal sites to place cowbird traps is dynamic due to human activity and natural events such as floods.

The northernmost breeding population in Santa Barbara County (Greaves 1987) presents yet other problems. Unlike nearly all other populations, it is in a fairly remote area that has a relatively low cowbird abundance and it experienced a parasitism rate of only 15-25 % (J. Greaves pers. comm.). It was by far the largest known population in the late 1970s when its approximately 50 singing males made up over a third of the taxon's total known population in California (Goldwasser et al. 1980). With 57 singing males, it was still the third largest population in 1986. It declined by 1987 to 25 males (Franzreb 1989) and had only about 20-25 in 1992 and 1994 (J. Greaves pers. comm.) despite the fact that cowbirds were shot starting in 1988 and were trapped from the early 1990s to 1994. Reasons for the decline are unclear beyond the likelihood that cowbirds had little or no effect. Unlike the Santa Clara River population, this one could

be easily managed. It occupies a small stretch of lush riparian habitat, most of which is within a national forest and is unthreatened by development. Study of this important vireo

population might provide considerable insight into this taxon's biology. However, although there were limited funds for cowbird control and for monitoring vireos in the past, none have been available since 1994 despite the vireo's endangered status.

We have discussed these two northern populations not only because of their key geographical importance but because they demonstrate that vireo recovery is likely to require more than indefinite cowbird trapping. The Santa Clara population shows that complex property rights issues may be involved and the Santa Barbara one shows that unknown biological factors can have over-riding importance. These are not problems that occurred on Camp Pendleton.

Griffith and Griffith are perhaps more confident than we are in the efficacy of cowbird control, in part because they and others (Gaines 1974, Laymon 1987) argue that there are large tracts of habitat in the Central Valley and elsewhere that are unoccupied by vireos and other California birds that have declined but that seem suitable except for the presence of cowbirds. But the Kirtland's Warbler story shows that habitat that seems suitable to humans may not be so for the birds even

though that species' biology is known far better than that of the Least Bell's Vireo. In addition, the insight gained from metapopulations and source-sink dynamics (Pulliam 1988) shows that small patches of suitable habitat may not be sufficient to forestall extinction. One or more very large and critically located patches may be necessary. Of course, Griffith and Griffith also stress the importance of habitat and advocate a

vigorous program of habitat protection and augmentation in addition to cowbird control.

The importance of habitat availability is shown by the Arizona Bell's vireo (V. b. arizonae) which breeds from the Colorado River east to central Arizona. It too has declined greatly in this century but unlike the Least Bell's Vireo, it has a long history of sympatry with cowbirds. Brown (1903) noted that nearly every nest he found along the Colorado River in 1900 was parasitized. Had such parasitism been typical along the entire Colorado River, the vireo would have been extirpated in a few years, yet it did not decline until the 1950s (Rosenberg et al. 1991) after dam construction reduced the frequency of floods and made it economical to convert extensive tracts of riparian habitat to agricultural uses. Clearly, the nests Brown found were not typical of the entire population suggesting that both people and cowbirds are especially likely to find certain nests,

perhaps those on the edges of dense riparian zones. Thus arizonae may have been able to survive in the presence of cowbirds because primeval riparian habitat was wide enough to keep parasitism levels in its interior low. Perhaps, the Least Bell's Vireo could also survive in the absence of cowbird control if it had extensive and wide tracts of suitable habitat. Although the nominate race of Bell's Vireo is found in the cowbird's past and current center of abundance (Peterjohn et al. and Wiedenfeld this volume) and is declining (Peterjohn et al. 1995) it is not endangered, presumably because of extensive habitat.

Southwestern Willow Flycatcher

Like the Least Bell's Vireo, the endangered southwestern willow flycatcher discussed by Whitfield (this volume) is also an obligate riparian species of the arid Southwest and has also lost most (about 95 %) of its habitat. In addition, it also has conspecific populations that have experienced long sympatry with cowbirds but that are not endangered, again probably because their habitat is plentiful. Unlike Least Bell's Vireo, this flycatcher still occupies the extent of its original range from western Texas to southern California but many previously occupied sites are now vacant. Unitt (1987) estimated the taxon's entire

population at 230 to 500 pairs but more recent estimates (M. Sogge pers. comm.) are 700-800 pairs, of which about 70 are in California.

Whitfield (this volume) reports on a cowbird control program designed to aid the largest population in California, which occurs along the South Fork of the Kern River. It decreased from 44 to 27 pairs and experienced a 63.5 % parasitism rate from 1989-1992 before large numbers of female cowbirds were trapped. Unlike the other control programs reported in this volume, Whitfield's was designed as a controlled experiment with both a cowbird removal area and a nearby nonremoval area. Cowbird abundance and host breeding success were monitored in both areas. Data from 1993 and 1994 showed declines in both cowbird abundance and parasitism rates on flycatcher nests (to 17.4 %) in the removal area. But the proportion of nests producing at least one

flycatcher was about the same on the removal and nonremoval areas, in part because the former had a much higher rate of nest predation. However, the number of fledglings per pair of flycatchers was higher in 1993 and 1994 on the removal than on the nonremoval area (1.87 versus 1.55) and both areas had higher productivity than in years before cowbirds were trapped (0.93 to 1.00). The flycatcher population stopped declining after small numbers of female cowbirds were removed in 1992 and increased to

34 pairs by 1994 (Whitfield this volume). However, the population remained at 34 pairs in 1995 and declined to 29 pairs in 1996 (Whitfield pers, comm.).

As Griffith and Griffith (this volume) describe, the cowbird removal program at Camp Pendleton to aid the Least Bell's Vireo, may have also benefited the southwestern willow flycatcher whose numbers increased from five pairs in 1981 to 21-25 in 1989-1991. However, numbers there have not increased further between 1991-95 and there was a consensus amongst researchers and managers at the 1996 preseason recovery meeting for the flycatcher and Least Bell's Vireo sponsored by the USFWS that cowbird control is not having the same dramatic effect on breeding population sizes of the flycatcher as it has had on most populations of the vireo. Nevertheless, cowbird trapping may have stemmed the decline of flycatcher populations in California and at least one cowbird removal program was undertaken in 1996 in Arizona.

Reasons for the failure of flycatcher populations to rapidly increase in response to cowbird trapping are unclear. One possibility in some areas is poor reproductive success even in

nests that escape predation and parasitism. Rob Marshall (pers comm.) has found that although such nests in Arizona average 2.4 eggs, they average only 1.3 fledglings. This is an extremely low rate of success for a passerine as usually about 90 % of eggs in

successful unparasitized nests result in fledglings (Rothstein 1975). Flycatchers in Arizona commonly nest in riparian vegetation that is nearly a complete monoculture of the exotic tamarisk (Tamarix spp.). While this altered riparian habitat attracts flycatchers, it could constitute low quality breeding habitat and may keep populations from increasing. However, flycatchers in Whitfield's California study area nest in natural willow-cottonwood woodlands and most eggs that escape predation and parasitism produce fledglings. So the failure of this population to increase rapidly in response to cowbird removal must be due to some other factor. Perhaps this population is experiencing problems on its wintering grounds.

Black-capped Vireo

The Black-capped Vireo (Vireo atricapillus) is unique among the endangered species discussed here in that all of its range is within the cowbird's original center of abundance in the Great Plains. Hayden et al. (this volume) report that it may now be susceptible to extirpation by cowbird parasitism because it has lost extensive amounts of habitat due to agriculture, urbanization and fire suppression as it prefers shrub habitats that exist for 3-25 years after disturbances. Once found as far north as Kansas, this species is now limited to two remnant

populations in Oklahoma and larger numbers in Texas (Robinson et al. 1995b). The emphasis of Hayden et al.'s paper is an overview of a cowbird control program initiated on the Fort Hood Army Installation, in central Texas, in 1988 after surveys indicated over 90% of all nests were parasitized. Other cowbird control programs for this vireo have been conducted elsewhere in Texas and in Oklahoma. As with the previous three endangered species, nest parasitism significantly decreased and nest success significantly increased after cowbird control. Research at Fort Hood is complicated by active military operations that limit efforts to monitor the entire vireo population with equivalent survey efforts. But Hayden et al. report that part of the base monitored with constant effort showed an increase of vireo territories from 66 in 1991 to 156 in 1994. It is worth noting that while the active military operations may interfere with research they often benefit the vireo because they sometimes destroy habitat that has become too old thereby leading to the regeneration of younger, more preferred habitat.

Similarities and Dissimilarities Amongst Cowbird Control Programs

Each of the four cowbird control programs presents remarkably similar conservation needs and produced similar management strategies. Managers at each location were faced with a declining host population. Losses were largely attributable to fragmentation, degradation, or loss of habitat. The land-use

changes that contributed to the decline of these populations have also been cited as contributing factors associated with the range

expansion of the Brown-headed Cowbird (Mayfield 1978), although the ranges of two of the four endangered species were mostly (Southwestern Willow Flycatcher) or totally (Black-capped Vireo) within the original range of cowbirds. Within the context of factors limiting host populations, control of brood parasitism became the most immediate remedy for the drastic declines experienced by these host species.

All four programs show that it is possible to remove most to nearly all cowbirds over fairly large areas with the use of large decoy traps and that removal results in dramatic decreases in parasitism rates and increases in host productivity. But the control programs have mixed results as regards the ultimate measure of success, namely an increase in the numbers of breeding adults. Only the Least Bell's Vireo program described by Griffith and Griffith can be called a clear success here as only it has resulted in huge increases in breeding adults over a decade or more. The Black-capped Vireo program seems to be headed in the same direction but the degree of success is much harder to judge given the shorter time span of intensive control efforts. Control of cowbirds has not increased the numbers of breeding southwestern willow flycatchers. The effects of control

on flycatchers are difficult to assess given the short four year duration of the program but the number of breeding Bell's Vireos increased by about 67 % after four years of controls. Lastly, it is clear that cowbird control alone did not increase the numbers of breeding Kirtland's Warblers. However it is reasonable to conclude that control was necessary to save this species from

extinction, although the opposite conclusion is also reasonable as we have discussed above. Despite uncertainty concerning the effects of some of these control programs, it is clear that cowbird control was an appropriate management tool in each case.

A theme common to all four management programs is the need for increased habitat. All workers agree that cowbirds are not the only major problem threatening the survival of these four endangered taxa. Habitat availability is also critical. Because some of these taxa have conspecific populations that have survived long periods of sympatry with cowbirds, it has been suggested that they could have survived in the presence of cowbirds with no cowbird management if large amounts of their original habitat remained (Rothstein 1994).

All of these programs, except possibly the flycatcher one, show that cowbird control is open ended in that the numbers removed one year seem to have no effect on the numbers removed in subsequent years. The rapid range expansions of the cowbird

(Mayfield 1965, Rothstein 1994) and studies of morphological variation over time and space (Fleischer and Rothstein 1988) indicate that cowbirds have unusually high dispersal rates and this is undoubtedly responsible for the annual flow of cowbirds into control areas. Management efforts to date have not aged cowbirds as yearlings versus older birds, which is easily done for males (Selander and Giller 1965, Ortega et al. 1996), but it would be interesting to do so to determine whether age ratios are skewed towards yearlings after the first year or two of trapping. The only trap-out study that aged males showed that yearlings and

adults had different seasonal capture patterns even in the first year of trapping (Rothstein et al. 1987).

As Whitfield reports, the control program for the southwestern willow flycatcher in the South Fork Kern River Valley may be having long lasting effects on local cowbird numbers. The 329 female cowbirds removed in 1993, was much higher than the numbers removed in 1994 and 1995, 152 and 171, respectively (Whitfield pers. comm.). Removal areas in the three other studies adjoin extensive regions with significant amounts of human habitat disturbance and higher densities of cowbirds. By contrast, while the South Fork Kern River Valley has many people, it is a well defined area surrounded by arid and forested habitats with few people and few cowbirds. So dispersing

cowbirds have to come from relatively far away to replace those removed from this valley and this could mean that an intensive control effort that was expanded to the entire valley might not need to be done on an annual basis. However, it is still too early to confirm that control is indeed having year to year effects since the declines from 1993 to 1995 could reflect region wide trends.

One procedural difference among the four control programs is that the Kirtland's Warbler and Least Bell's Vireo efforts have removed all cowbirds while the other two have removed primarily females. In arguing for the value of the latter methodology, Hayden et al. suggest that the resulting extremely skewed sex ratios may disrupt the mating activity of any remaining females. This is a reasonable supposition as male cowbirds are attracted

to females (Dufty 1982a, Rothstein et al. 1988) and harass them with their incessant courtship behavior to the point that females try to drive off courting males (Yokel and Rothstein 1991) even when sex ratios are normal. Even if it has no value in disrupting female breeding activity, removal of only females might be preferable on the ethical grounds that it is desirable to minimize the killing of any native species.

oh spare me!

All three studies that report data on cowbird capture rates as a function of time, found that the majority of individuals

were caught in the first several weeks of the 2.5 - 4 month trapping periods (DeCapita, Hayden et al. , Griffith and Griffith). DeCapita suggests that some of this trend is due to large numbers of migrants being caught early in the season and it likely also reflects the fact that cowbirds are extremely social and therefore easily captured in decoy traps. The two studies that report detailed data on numbers of both male and female cowbirds captured (DeCapita, Griffith and Griffith) showed the sex ratio to be skewed in favor of males, as in numerous other studies (Rothstein et al. 1986, Weatherhead 1989). Both also show that sex ratio of newly captured birds became even more male biased during the last third to half of the trap-out periods as also reported by Beezely and Reiger (1987). This strong increase in the male:female sex ratio may have occurred because males were more likely than females to respond to the local cowbird "vacuum" due to the trapping by dispersing into the trap-out area. If birds disperse during the breeding season because they are having low reproductive success, then higher male dispersal would be

expected because the male biased sex ratio and the predominance of monogamy in cowbirds means that many males do not breed (Dufty 1982b, Yokel 1986). A trap-out study in the Sierra Nevada reported the opposite pattern in that the sex ratio shifted towards females near the end of the season (Rothstein et al.

1987). This may have occurred because that trap-out study was limited to two heavily used communal feeding sites that some females visited less regularly than most males.

Different areas visited by cowbirds on a daily basis can often be separated into sites used primarily for feeding versus breeding (Rothstein et al. 1984, Thompson 1995, Thompson and Dijak this volume). All of these management studies placed traps in breeding habitat and all except DeCapita's also placed them at feeding sites. More birds can be caught per trap at communal feeding sites such as horse corrals. However, cowbirds at feeding sites may come from large distances and many may not be affecting sensitive hosts. Furthermore, some of the cowbirds that are affecting hosts may not visit communal feeding sites on a regular basis (Rothstein et al. 1987). So it is clear that trapping should not be limited to feeding sites and whether traps at such sites offer any benefits to targeted hosts over an equivalent effort in breeding habitat remains an open question and may vary according to local landscapes.

Limitations and Possible Negative Aspects of Cowbird Control

The open ended nature of most or all cowbird control programs is clearly undesirable from a management viewpoint.

Funding for control efforts must be continuous for the programs

to be successful. Yet funding is far from secure and sometimes it comes from unlikely sources such as the Department of Defense for the programs reported by Griffith and Griffith and by Hayden et al. As described above, one control effort for the Least Bell's Vireo has already lost its funding and has ceased and even the Kirtland's Warbler effort recently suffered a significant decrease in funding (M. DeCapita pers comm). We wonder whether the Endangered Species Act even has the potential to deal effectively with species that need yearly management through and after the recovery period. As the act is now written, endangered hosts that recover to the point of being delisted could lose funding for cowbird control because of their nonendangered status which could eventually return them to the list of endangered species. Clearly, we need to do more than just control cowbirds in areas where endangered passerines occur.

The need for sustained and often costly efforts to control local cowbird populations has motivated many to speculate on the efficiency of winter control programs that could kill millions of cowbirds at large roosts (Ortego and Griffith and Griffith this volume). The ability to potentially eliminate millions of cowbirds on winter roosts could reduce the need for local control programs dealing with endangered species and might even reduce the negative impacts of brood parasitism on numerous host species. Although such actions have some basic appeal, a need for them has not been effectively demonstrated and their

potential conservation benefits also are questionable. As

discussed by Peterjohn et al., Wiedenfeld and Rothstein and Robinson (this volume), there is no clear evidence that cowbirds are limiting the numbers of any species other than a few endangered taxa. Because cowbirds that breed in one area winter over a large region (Dolbeer et al. 1982), it is even possible that large scale control at winter roosts would miss some or all of the cowbirds threatening endangered species and would therefore have no effect on the need for local control efforts. Rothstein and Robinson (1994) pointed out that it would be extremely difficult to determine whether large scale winter control had effects on host breeding success or numbers because these parameters vary naturally. They also pointed out that the killing of millions of individuals of a native species could attract the attention of animal rights groups, especially if the need for such action is not clear, and that this could endanger the continuation of the local cowbird control programs for endangered species. Lastly, we note that a worldwide review of efforts to eradicate large numbers of birds shows that these have limited and at best transitory success (Dolbeer 1986).

Despite the controversy surrounding large scale cowbird control, we suspect that all parties would agree that control can be very effective on a local landscape level even with the

limitations imposed by its open ended nature. But are there any potential negative aspects to local cowbird control? Is it possible to over-do cowbird control? We believe that the answer is clearly yes. Any time some sort of active intervention, such as cowbird control, occurs it can draw attention and resources

from other possible management efforts and some of those might even prove to be more beneficial. Certainly, control uses funds that might go into the development of other management approaches and funds are scarce in all cases of endangered hosts. For example, there are almost no funds in California for monitoring Least Bell's Vireo breeding biology and in some places there are no funds to even monitor the numbers of breeding vireos. If vireos begin to decline, it may be difficult to determine whether the problem lies with breeding success in California or with the availability of wintering habitat in the Neotropics.

One other potential downside of cowbird control is that it can be used as mitigation for habitat destruction of an endangered species. But it is difficult to guarantee the long term continuance of a control program whereas habitat loss can be permanent. We suspect that some land developers consider cowbird control an ally in their attempts to develop habitat of endangered birds and might even push for cowbird control in the absence of clear evidence that it is needed in the particular

area they are affecting.

The need for local data on cowbird parasitism raises one last point about cowbird control. As we have stressed, there was good reason to believe that cowbird control was needed in all four of the management programs discussed in this section. High rates of parasitism were documented and hosts had declined. However, there are currently control programs being initiated with little or no prior quantitative information on local parasitism rates. These programs are being initiated simply

because of high local cowbird abundance, available manpower (sometimes in the form of volunteers) to service traps and the presence of species that might decline locally if they are parasitized heavily. One clear message of papers in this book (see Section IV) and elsewhere (Friedmann 1963, Robinson et al. 1995a,b) is that parasitism rates vary geographically, even over short distances. Parasitism rates in some control areas may be low and in such cases, control programs may be attempting to correct nonexistent problems. Even if local parasitism rates are high, managers should consider whether cowbirds are the only problem or whether local habitats are so poor that host populations might not be self sustaining even in the absence of parasitism as may be the case for birds nesting in some midwestern woodlots (Robinson et al. 1995a). Furthermore, some

of these new control efforts lack monitoring programs to determine whether cowbird control is having an effect on local species. It would be tragic if the bandwagon status that cowbird control is assuming in some places diverts the actions of genuinely concerned people from activities that could be more productive and from problems that may be more profound.

We close this overview be pointing out that a species cannot be considered recovered as long as permanent and direct human intervention is primarily responsible its continued existence. The long-term sustainable recovery of a species will be dependent on understanding the temporal and spatial factors that are most limiting. Birds such as the Least Bell's Vireo, southwestern willow flycatcher, Kirtland's Warbler, and Black-capped Vireo may

in the short-term be limited by brood parasitism. However, the long-term solutions to maintaining viable populations of these and other species will be found in the restoration of breeding habitat and the development of compatible and sustainable land management practices. Additional understanding concerning the winter dynamics of these host species and a reduction in factors that threaten wintering grounds will be critical in maintaining long-term population viability.

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