

Long-term monitoring of Brown-Headed
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Study



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**LONG-TERM MONITORING OF BROWN-HEADED COWBIRD
PARASITISM IN CITY OF BOULDER MOUNTAIN PARKS
AND OPEN SPACE**

report on 1997 research results

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LONG-TERM MONITORING OF BROWN-HEADED COWBIRD PARASITISM IN CITY OF BOULDER MOUNTAIN PARKS AND OPEN SPACE.

Abstract

The impact of Brown-headed Cowbird (*Molothrus ater*) parasitism on breeding songbirds in Boulder County, Colorado was monitored for the 7th intermittent year since 1984. In 1998, 114 nests of 16 species were found and monitored, and Western Wood-pewees (*Contopus sordidulus*) were tested for their response to cowbird eggs and models of female cowbirds at the nest. Cowbirds continue to have a consistent and heavy impact on the reproductive success of a number of ponderosa pine forest breeding birds. Cowbirds parasitized 50% of Plumbeous Vireo (*Vireo plumbeus*) nests ($n = 14$), 60% of Warbling Vireo (*V. gilvus*) nests ($n = 10$), and 100% of Virginia's Warbler (*Vermivora virginiae*) nests ($n = 2$). We have never found a Western Wood-pewee nest parasitized despite the relatively high parasitism on Plumbeous Vireos in the same habitat. We tested several hypotheses to explain this pattern, and determined that pewees accept cowbird eggs, but yet are not aggressive towards model cowbirds. It is possible that pewees use cryptic behavior around cowbirds and avoid detection, one such strategy may be that females sit tightly on the nest which does not allow female cowbirds to deposit an egg. Future work will continue to elucidate this apparent discrepancy between pewees and vireos. Impacts of landscape effects on patterns of cowbird parasitism and nest predation, and thus on the success of ponderosa pine breeding songbirds are discussed.

Introduction

The monitoring of avian reproductive success is crucial in determining the population status of breeding songbirds (Ralph *et al.* 1993). Avian populations can maintain a stable number of breeding pairs and yet experience nearly zero reproductive success through the immigration of young adults into habitats with high rates of nest predation and parasitism (Van Horne 1983, Chace 1995). High frequency of nest predation and cowbird parasitism are commonly associated with edge habitats, and are maintained through high densities of nest

predators and parasites within landscapes that have high human populations (Gates and Gysel 1978, Brittingham and Tempie 1983, Wilcove 1985, Wilcove *et al.* 1986, Temple and Cary 1988, Gates and Giffen 1991, Robinson 1992, *et al.* 1995, Chace 1995, D. Craig pers. comm). Boulder County has a growing human population that supports a large Open Space program. These habitats set aside in the Open Space program benefit wildlife; however, some breeding migratory songbirds may have negative population growth curves (Chace 1995). Our monitoring of nesting activity can directly identify the factors limiting avian reproduction within specific habitats.

Some of the factors affecting the avian community in City of Boulder Open Space and Mountain Parks have already been identified (Marvil and Cruz 1989, Chace 1995, D. Craig pers. comm.). Plumbeous Vireos (*Vireo plumbeus*) have experienced an annual rate of 50% nest parasitism and nest predation from 1984-1986 and 1993-1994 (Marvil and Cruz 1989, Marvil unpubl. data 1984-1986, Chace 1995, Chace *et al. in press*). Warbling Vireos (*Vireo gilvus*) have also experienced a high frequency of parasitism (48.3%) but lower predation (34.5%, n = 29, unpubl. data). Recent work on the Warbling Vireo in Manitoba, Canada has revealed the evolution of cowbird egg rejection behavior (Sealy 1996). Whether this behavior has evolved in the Boulder County population is unknown, and only through nest monitoring and experimental egg placement could this be determined. The Manitoba population does provide knowledge that such behaviors can evolve quickly and once a rejection behavior is established in a population that species would be a much lower conservation management priority.

Compared to other species in the ponderosa pine forest, Western Wood-pewees (*Contopus sordidulus*) are rarely known to be parasitized (Friedmann 1963, Chace and Cruz 1997). Investigations to determine why this dichotomy in reproductive success exists within the avian community is important to better understand the evolution of anti-parasite adaptations. Several hypotheses can be tested to explain this pattern. First, Western Wood-pewees may successfully defend their nests from cowbirds through aggressive attacks. Host

aggression may have evolved as a behavior adapted for specifically reducing cowbird parasitism. Hosts have been observed driving cowbirds away from the nest (Neudorf and Sealy 1992, 1994), and cowbirds have been reported to be injured from aggressive host interactions (Leathers 1956). Second, Western Wood-pewees may build cryptic nests and use secretive behavior to avoid being parasitized. An increase in nest camouflage has been suggested as an adaptation against brood parasitism (Rothstein 1976a, 1976b, Gochfeld 1979). Third, Western Wood-pewees may use nest capping behavior to avoid being parasitized. Hobson and Sealy (1989) described nest attentiveness as a defensive mechanism evolved by hosts to be most vigilant around the nest during the time when they are the most vulnerable to being parasitized. One manifestation of this behavior is nest capping, where in the presence of a cowbird a potential host quietly stays on the nest, preventing the deposition of an egg (Nakumara 1995). Finally, Western Wood-pewees may eject cowbird eggs placed in their nest. The best studied anti-parasite adaptation is cowbird egg rejection, in which the host either grasp-ejects or puncture-ejects the cowbird egg (Rothstein 1975a, 1975b, Davies and Brooke 1988, Rohwer and Spaw 1988, Ortega and Cruz 1988, Rohwer *et al.* 1989).

The focus of our 1997 study was to compile recent knowledge of reproductive success of songbirds breeding in the ponderosa pine forests of Boulder County, identify species particularly sensitive to cowbird parasitism, and finally test several hypotheses to explain why some abundant bird species, such as the Western Wood-pewee, are rarely parasitized.

Methods

Study sites were located in Boulder County, Colorado, on either City of Boulder Open Space or City of Boulder Mountain Parks. Nests were found in the ponderosa pine and montane riparian communities along the foothills between Eldorado Springs on the south, Flagstaff Mountain on the North.

Nests were located through observations of nesting and territorial behavior (Ralph *et al.* 1993). Once found, nests were monitored at least once every three days from day one until the

nests were inactive. Nest contents were observed directly, or with a 6.5 m mirror pole. All efforts were made to not attract nest predators to the nest site (Picozzi 1975, Westmoreland and Best 1985, Major 1990). The Mayfield method (1965, 1971) was used to calculate the probability of a nest surviving to fledge at least one young.

Birds were censused among eighteen 50 m radius point counts along two transects in the Shanahan Ridge area. Both transects were in the ponderosa pine forest and were censused three times during the course of the breeding season. The relative abundance of each bird species was determined by the equation:

$$\frac{\# \text{ detections}}{\# \text{ counts}} \times 100$$

To test the response of Western Wood-pewees to cowbirds, we placed cowbird and control models (female House Sparrow *Passer domesticus*) 5 m from ten Western Wood Pewee nests for 5 minutes. Control and cowbird models were presented on different days, and the order was randomized among the ten pewee nests. Level of aggression was recorded following Smith *et al.* (1984). We also examined Western Wood-pewees response to cowbird eggs placed in six pewee nests. After placing the egg, nests were observed for 1 hour immediately following placement, and then later that same day, and once every 24 hours for each consecutive day that the cowbird egg remained in the nest.

Results

114 nests of 16 species were found, with nests of Western Wood-pewees, American Robins, Plumbeous Vireos, Warbling Vireos, Chipping Sparrows, and Broad-tailed Humingbirds comprising the majority (Table 1). Many of these same species were also found to be very common from our point count censuses (Figure 1). Cowbird parasitism and nest predation ranged from 0% to 100% among nests monitored. Cowbirds parasitized more than 50% of Plumbeous Vireo, Warbling Vireo, and Virginia's Warbler nests (Table 1). Nest predators destroyed greater than 50% of nests of all species monitored, except Western Wood-pewees, Plumbeous Vireos, Warbling Vireos, Western Tanagers, Black-headed Grosbeak, Spotted Towhee, and Chipping Sparrows. Although, the low predation and parasitism on some species

may be due to small sample sizes. The combined effects of parasitism and predation on species is reflected in the Mayfield Method estimations of nest success (Table 1). Mayfield calculations were conducted only on those species of which we had an adequate sample size. The estimated probability of success ranged from 23% in American Robins and Plumbeous Vireos to 53% in Chipping Sparrows.

Point count censusing detected 29 species, and revealed that Western-wood pewees, American Robins, and Chipping Sparrows are among the most abundant species (Figure 1). Moderately abundant species include the Plumbeous Vireo, Western Tanager, Spotted Towhee, Brown-headed Cowbird, Mountain Chickadee, White-breasted Nuthatch, and House Finch.

Western Wood-pewees showed little aggression towards either the cowbird or control model. Typically, when either model was placed within 5 m of pewee nests, the males were out of sight while females incubated (Figures 2 and 3). Only at one nest, of ten, did a pewee strike the cowbird model (Figure 2). No cowbird eggs placed into six Western Wood-pewee nests were removed, thus indicating that pewees are cowbird egg acceptors.

Discussion

Brown-headed Cowbirds continue to have negative impacts on the reproductive success of Plumbeous Vireos and other Neotropical migrant songbirds breeding in the ponderosa pine forests of Boulder County. Plumbeous Vireos have experienced 50% cowbird parasitism since 1984 (Marvil and Cruz 1989, Chace 1995, Chace *et al. in press*). Warbling Vireos also appear to be a favorite host of the Brown-headed Cowbird, a 60% parasitism frequency is similar to that found in the same locations by Chace (unpubl.) in 1993 and 1994. Virginia's Warbler nests are difficult to find, but when they are found they are usually parasitized (Chace and Cruz 1996). Additionally, we found a parasitized Chipping Sparrow nest. Two of the three (Western Wood-pewee and Chipping Sparrow) most abundant breeding songbirds are known cowbird egg acceptors, and yet only one of these nests was parasitized (Figure 1 and Table 1). The most heavily parasitized species were less common (Warbling Vireos not showing

up because they most often occur in montane riparian forests and not ponderosa pine where the censusing took place).

Why Western Wood-pewees are rarely parasitized is a perplexing question given that they are occasionally parasitized in other regions (Friedmann 1963, Curson 1996) and that cowbirds frequently parasitize Plumbeous Vireos in the same habitat, often within the same overlapping home ranges. We rejected the hypothesis that pewees are cowbird egg rejectors when all six cowbird eggs placed in pewee nests were not removed, including one that hatched. However, we hope to test more nests in 1998 to increase the sample size to a total of twenty nests. We also rejected the hypothesis that pewees defend their nest sites against cowbirds, when the cowbird model was only attacked once, and there was no difference in pewee response to the cowbird model or control model (Figures 2 and 3). However, pewees may be responding to the model differently than to a live cowbird. Therefore in 1998 we will use remote camera equipment to examine pewee response to actual cowbirds. Third, we have tentatively accepted the hypothesis that pewees use cryptic behavior, including possible nest capping, to defend against cowbird parasitism. The most common response of female pewees to the cowbird model was to continue incubating, while males were often out of sight (Figures 2 and 3). Again, pewees may respond differently to actual cowbirds and therefore we will reevaluate this hypothesis in 1998 with remote camera equipment.

Nest predators, most likely corvids, impacted nearly all species monitored. When species with low sample sizes are removed from analysis, it can be seen quite clearly that 20% to 60% of open-cup passerine nesting attempts fail in Boulder County due to predation (Table 1). The combined effects of cowbird parasitism and nest predation lower the probability of nesting success for those species, especially among the vireos (Table 1). Other species that were not parasitized by cowbirds typically had equal or higher nesting success, except for the American Robin (Table 1).

The impact of cowbirds and nest predation on the ponderosa pine songbird community is strongly negative. Breeding Bird Survey show that throughout most of their ranges corvids,

particularly Steller's Jays and Common Ravens, are increasing significantly (Table 1). Likewise, Brown-headed Cowbirds are showing increasing trends across the West (Table 1). This data does not bode well for the future of sensitive songbird populations in the West. Most species monitored in this study are showing stable population trends in the West, with the exception of the Western Wood-pewee, Common Nighthawk, and Mourning Dove (Table 1). However, Breeding Bird Survey routes do not always census each habitat type well enough. Labor intensive population studies, such as this, in conjunction with other studies across a large geographic region may provide a better assessment.

Many of the bird species that breed in the ponderosa pine forests of the Colorado Front Range are sensitive across their southwestern range. In Arizona and New Mexico, the Plumbeous Vireo and Virginia's Warbler are designated as high priority species in southwestern ponderosa pine forests, and are of special concern in Arizona (Hall *et al.* 1997). In addition, New Mexico also lists the Hammond's Flycatcher, Dusky Flycatcher, Cordilleran Flycatcher, Broad-tailed hummingbird, Townsend's Solitaire, and Warbling Vireo as species of special concern (Hall *et al.* 1997). Likewise, in Colorado the Plumbeous Vireo and Virginia's Warbler are of concern, as well as the MacGillivray's Warbler (Winternitz and Crumpacker 1985). Most recently, the Western Working Group of the Partners-in-Flight program listed the MacGillivray's Warbler, Virginia's Warbler, and Green-tailed Towhee as Priority Species in Colorado (Rich and Breadmore 1997).

Some of the factors affecting the avian community in City of Boulder Open Space and Mountain Parks have already been identified (Marvil and Cruz 1989, Chace 1995a, D. Craig pers. comm.). Plumbeous Vireo nests located near openings in the forest canopy are more likely to be parasitized, while those nests near roads and residential areas are more likely to be preyed upon (Chace 1995). However, the few successful nests do not produce enough offspring to offset the combined impacts of predation and parasitism, even with conservative offspring and adult survivorship frequencies (Chace 1995). These patterns may be important for other open-cup nesting songbirds as well. David Craig (pers. comm.) has found that nest predators,

such as corvids, are in high abundances near residential areas and roads, which correlates strongly with the rates of predation that he found on both actual and artificial nests. This also correlates well with our earlier studies on landscape effects on Plumbeous Vireos (Chace 1995).

Similar to David Craig's work on corvids, our future work in Boulder County will be to determine the distribution and abundance of cowbirds across the Boulder County landscape, and to identify landscape features that may influence parasitism on Neotropical migrant songbirds. Additionally, we will continue our work examining examining songbird reproductive success, particularly of those species considered sensitive in southwestern ponderosa pine forests.

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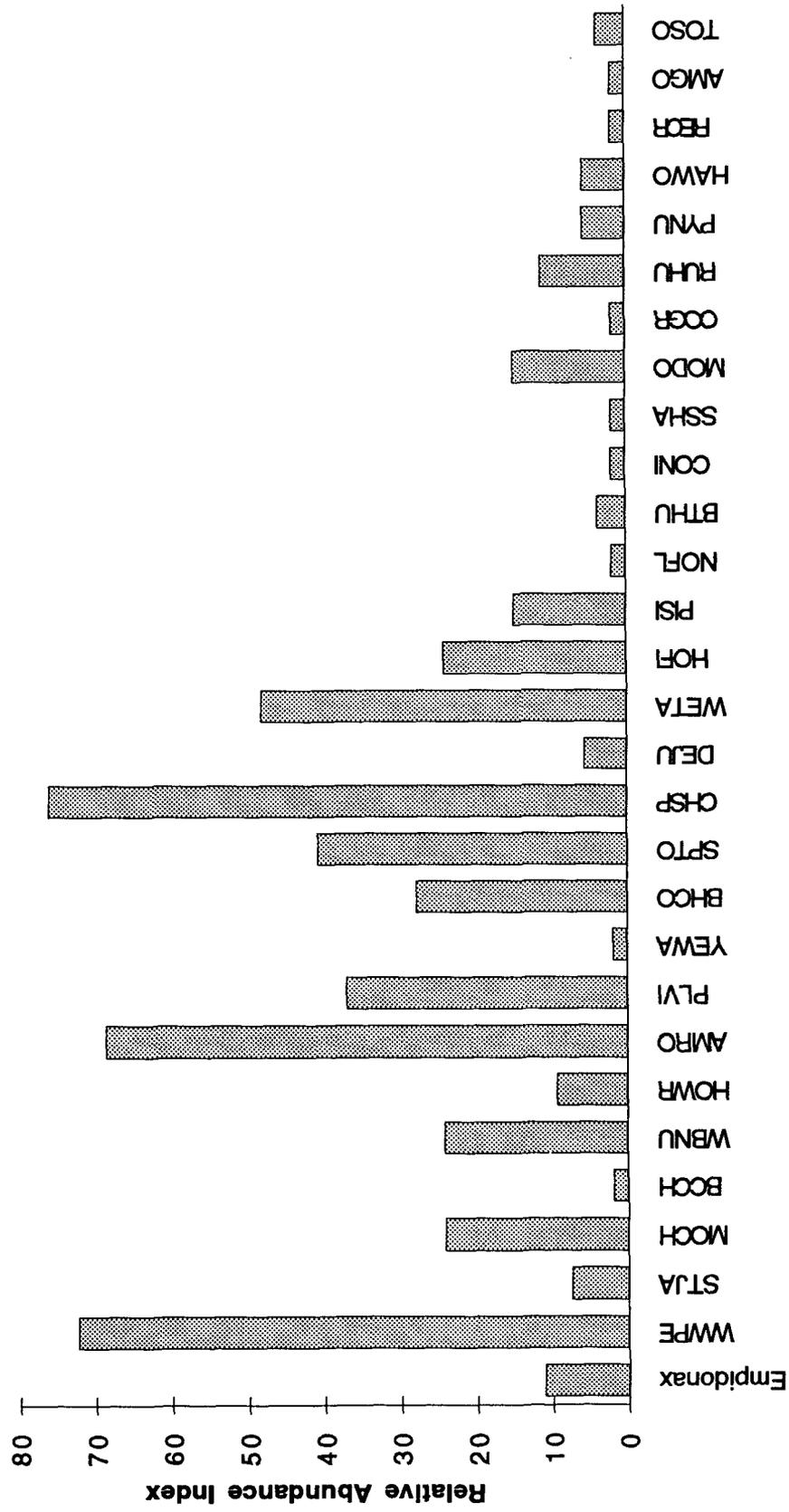
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Table 1. Breeding success and Breeding Bird Survey Trends (1966-1996) of birds monitored on City of Boulder Open Space and Mountain Parks, 1997. Trends reported as increasing or decreasing are significant, $P < 0.20$. Mayfield's Method (1965, 1971) was used to calculate the probability of a nest surviving to fledge at least one young.

Species	1997					Breeding Bird Survey				
	N	% Para	%Pred	%Success	Prob. Success	Colorado	Southern Rockies	Central Rockies	West	Survey-Wide
Western Wood-pewee	35	0%	31.4%	57.1%	0.46	stable	decline	stable	decline	decline
Hammond's Flycatcher	1	0%	100.0%	0%	---	stable	stable	stable	increase	stable
Dusky Flycatcher	1	0%	100.0%	0%	---	stable	stable	stable	stable	stable
American Robin	15	0%	60.0%	33.3%	0.23	stable	stable	stable	increase	increase
Plumbeous Vireo	14	50%	21.4%	42.8%	0.47	stable	stable	increase	ND	ND
Warbling Vireo	10	60%	40.0%	20.0%	0.23	stable	stable	increase	increase	increase
Virginia's Warbler	2	100%	100.0%	0%	---	stable	stable	ND	increase	increase
Audubon's Warbler	1	0%	100.0%	0%	---	stable	stable	stable	stable	stable
Western Tanager	2	0%	0%	100.0%	---	stable	stable	stable	stable	stable
Black-headed Grosbeak	4	0%	25.0%	75.0%	0.49	increase	stable	increase	stable	stable
Spotted Towhee	3	0%	0%	100.0%	---	stable	stable	increase	increase	increase
Gray-headed Junco	2	0%	50.0%	50.0%	---	stable	stable	ND	increase	stable
Chipping Sparrow	12	8.3%	41.7%	58.3%	0.53	stable	stable	stable	stable	stable
Mourning Dove	2	0%	50.0%	50.0%	---	stable	stable	decline	decline	decline
Common Nighthawk	1	0%	100.0%	0%	---	stable	stable	stable	decline	decline
Broad-tail Hummingbird	9	0%	55.6%	44.4%	0.33	stable	stable	ND	stable	stable
Impacting Species										
Brown-headed Cowbird						increase	increase	decline	stable	decline
Stellar's Jay						stable	stable	increase	increase	increase
Blue Jay						ND	ND	ND	stable	decline
American Crow						stable	stable	stable	decline	increase
Common Raven						increase	increase	increase	increase	increase

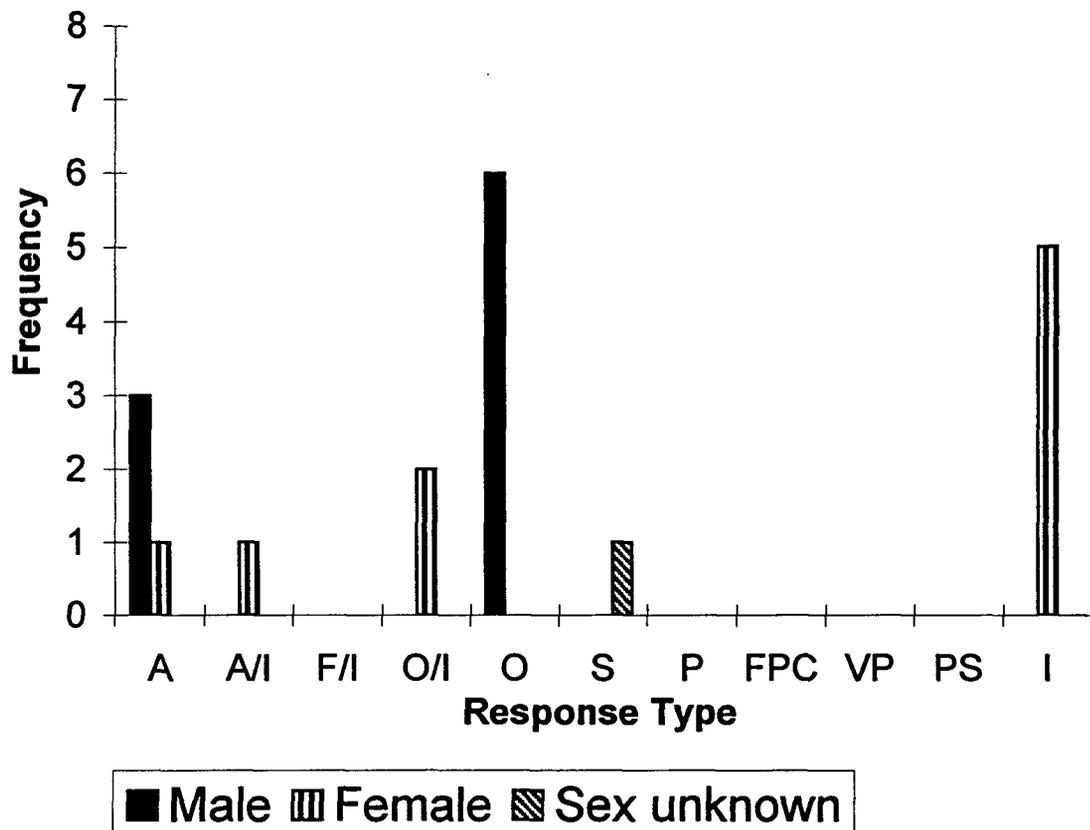
ND = no data available

Figure 1. Relative abundance of breeding songbirds in the ponderosa pine forests of Shanahan Ridge



Species - see Appendix 1. for abbreviatio

Response of Male and Female Western Wood-pewee to a Cowbird Model



A - Alarm calling >5m from model

A/I - Alarm calling followed by incubation

F/I - Feeding followed by incubation

O/I - Bird out of sight followed by incubation

O - Bird out of sight

S - Swoops at model

P - Perched within 5 m of model

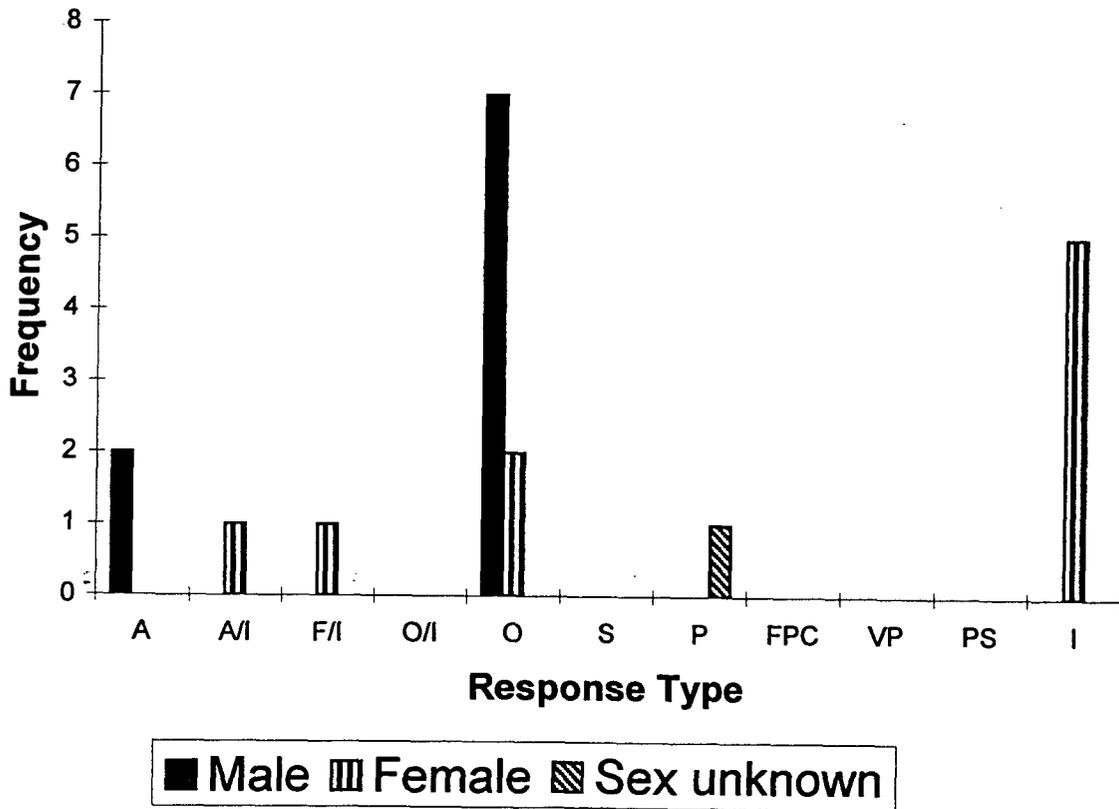
FPC - Flight and perch changes over model

VP - In view, perched >5m from model

PS - Perched and singing

I - Incubating

Response of Male and Female Western Wood-pewee to a Control Model



Note: Alarm calling initiated when observer approached vicinity of nest to set up the model.

Appendix 1. Species codes, names, and relative abundance scores used in figure 1.

Species		Relative Abundance*
Empidonax	Empidonax Flycatchers <i>Empidonax</i> sp.	11.11111
WWPE	Western Wood-pewee <i>Conotopus sordidulus</i>	72.22222
STJA	Stellar's Jay <i>Cyanocitta stelleri</i>	7.40740
MOCH	Mountain Chickadee <i>Poecilegambeli</i>	24.07407
BOCH	Black-capped Chickadee <i>Poecile atricapillus</i>	1.85185
WBNU	White-breasted Nuthatch <i>Sitta carolinensis</i>	24.07407
HOWR	House Wren <i>Troglodytes aedon</i>	9.25925
AMRO	American Robin <i>Turdus migratorius</i>	68.51851
PLVI	Plumbeous Vireo <i>Vireo plumbeus</i>	37.03703
YEWA	Yellow Warbler <i>Dendroica petechia</i>	1.85185
BHOO	Brown-headed Cowbird <i>Molothrus ater</i>	27.77777
SPTO	Spotted Towhee <i>Pipilo maculatus</i>	40.74074
CHSP	Chipping Sparrow <i>Spizella passerina</i>	75.92592
DEJU	Dark-eyed Junco <i>Junco hyemalis</i>	5.55555
WETA	Western Tanager <i>Piranga ludoviciana</i>	48.14814
HOFI	House Finch <i>Carpodacus mexicanus</i>	24.07407
PISI	Pine Siskin <i>Carduelis pinus</i>	14.81481
COFL	Common Flicker <i>Colaptes auratus</i>	1.85185
BTHU	Broad-tailed Hummingbird <i>Selasphorus platycercus</i>	3.70370
CONI	Common Nighthawk <i>Chordeiles minor</i>	1.85185
SSHA	Sharp-shinned Hawk <i>Accipiter striatus</i>	1.85185
MODO	Mourning Dove <i>Zenaida macroura</i>	14.81481
COGR	Common Grackle <i>Quiscalus quiscula</i>	1.85185
RUHU	Rufous Hummingbird <i>Selasphorus rufus</i>	11.11111
PYNU	Pygmy Nuthatch <i>Sitta pygmaea</i>	5.55555
HAWO	Hairy Woodpecker <i>Picoides villosus</i>	5.55555
RECR	Red Crossbill <i>Loxia curvirostra</i>	1.85185
AMGO	American Goldfinch <i>Carduelis tristis</i>	1.85185
TOSO	Townsend's Solitaire <i>Myadestes townsendi</i>	3.70370

*Relative Abundance Index = #detections/(#counts) x 100