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## **Bronzed Cowbird (*Molothrus aeneus*) Habitat Use and Differential Response to Playback of Host Song**

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BRONZED COWBIRD (*MOLOTHRUS AENEUS*) HABITAT  
USE AND DIFFERENTIAL RESPONSE TO  
PLAYBACK OF HOST SONG

A Thesis

By

MARY JENNIFER GORTON

Submitted to the Graduate School of the  
University of Texas-Pan American  
in partial fulfillment of the requirements of for the degree of

MASTER OF SCIENCE

May 2010

Major Subject: Biology

BRONZED COWBIRD (*MOLOTHRUS AENEUS*) HABITAT  
USE AND DIFFERENTIAL RESPONSE TO  
PLAYBACK OF HOST SONG

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May 2010

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## ABSTRACT

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During the breeding seasons of 2008 - 2009, 180 fixed-radius point-count surveys and broadcasts of host song were conducted in Santa Ana (SANWR) and Laguna Atascosa (LANWR, 2009 only) National Wildlife Refuges to identify Bronzed Cowbird

(*Molothrus aeneus*) habitat use and test the predictions of the host activity hypothesis.

Surveys demonstrated that Bronzed Cowbirds were distributed across all habitat types in both refuges, although there were differences in abundance between the sexes for interior and edge habitats and between habitat types. Bronzed Cowbirds responded differentially to host species playbacks based on suitability and abundance of the host species. The results of this survey are consistent with the predictions of the host activity hypothesis.

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## CHAPTER I

### INTRODUCTION

Brood parasitism is a behavior in which the female of one species deposits her eggs in the nest of another individual (Payne 1977). While perhaps most well known in the Common Cuckoo (*Cuculus canorus*), from which the term cuckold is derived, this social form of parasitism evolved independently in several taxa, including members of the order Hymenoptera and the class Aves (Sorenson and Payne 2002). Brood parasitism allows for the decoupling of the costs associated with the parental care of altricial young and reproductive success by allocating the cost of rearing offspring to another individual (Sealy 1996). This behavior may be either facultative (opportunistic) or obligate. Obligate brood parasites can only reproduce through brood parasitic behavior, and no longer retain behaviors or adaptations associated with parental care, including nest-building and the presence of a brood patch. The hosts of brood parasites often incur a significant reduction in fitness. Cowbirds are known to puncture or eject host eggs and once hatched; cowbirds often out-compete their foster siblings for food, and attract nest predators with their loud and persistent begging calls (Zanette et al. 2007). Cowbird hosts suffer partial to complete brood loss, and in areas with high rates of parasitism, this has a seriously negative impact on host demographics (Zanette et al. 2007).

The high cost of cowbird parasitism for the host and benefit for the parasite suggests that there would be strong selective pressure for parasitized hosts to develop strategies to deter parasites and likewise for parasites to develop mechanisms to maintain the behavior. The co-evolutionary potential within this relationship led Payne (1977) and Rothstein (1990) to declare this a model system for co-evolutionary research. Many species are able to recognize cowbirds or cowbird eggs and have developed mechanisms to reduce or eliminate the threat of parasitism, including agonistic behavior targeting cowbirds, egg ejection, burial, and nest desertion (Sealy 1996, Strausberger and Burhans 2001, Servedio and Hauber 2006). Cowbirds, in turn, lay their eggs before dawn to limit contact with hosts and, as generalists, can also utilize hosts that have not yet developed mechanisms to counter parasitism (Sealy 1996, Peer and Sealy 1997). Rates of cowbird parasitism vary greatly over space and time, which serves to maintain the behavior by periodically reducing the selective pressure on the host.

In the LRGV, the Bronzed Cowbird (*Molothrus aeneus*) is the most common brood parasite, greatly outnumbering the typically more ubiquitous Brown-headed Cowbird (*Molothrus ater*; Carter 1986). Bronzed Cowbirds are small, stout-bodied icterids with thick bills, and like many other members of the family, they exhibit sexual dimorphism. The males are approximately 14% larger than the females, with a distinct neck ruff, black body plumage and an iridescent sheen that ranges from shades of violet on the body to bronze on the rump. Females are comparatively drab, with dull brownish black plumage. Both sexes have red irises, which are brighter red in the male and often appear brown in the female.

In 1915 restricted in the United States to the LRGV, southern Arizona and New Mexico, the Bronzed Cowbird has steadily increased in both abundance and distribution (Friedmann 1929, Kostecke et al. 2004, Ellison et al. 2006). Friedmann (1929) noted an increase between 1914 and 1918 in the LRGV. By the 1960s, the species was reported north of San Antonio and in increasing numbers in Arizona. Bronzed Cowbirds now have been reported as far north as Missouri (Selander and Webster 1963, Johnson and Roer 1968, Lowther 1995). Bronzed Cowbirds now regularly occur within the Edwards Plateau region of Texas during the breeding season (Kostecke et al. 2004) and there is a small breeding population in Louisiana (Lowther 1995).

Knowledge of Bronzed Cowbird home range size and habitat use during the breeding season play an important role in understanding the impacts these birds will have on current and future host populations. In a study in Arizona, Chace (2004) determined that while Brown-headed Cowbird habitat use was significantly skewed in favor of certain habitats, Bronzed Cowbird habitat use showed no significant habitat preference. Ellison et al. (2006) found similar patterns in south-central Texas, where Bronzed Cowbird distribution did not vary significantly from random. As habitat use by cowbirds is known to vary based on geographical area, it is important to examine multiple populations of Bronzed Cowbirds. Quantifying where these birds are found both within the breeding habitat and foraging grounds would allow researchers to develop models of host use and cowbird reproductive output, as has been done extensively for Brown-headed Cowbirds (Gustafson et al. 2002, Jewell et al. 2007). It would also provide valuable information to managers interested in the preservation of declining avian populations by reducing cowbird abundances in areas of concern, as is being done for the

Golden-cheeked (*Dendroica chrysoparia*) and Kirtland's (*D. kirtlandii*) warblers (Mensing 2004).

Bronzed Cowbirds are characterized as generalist brood parasites, with currently 87 different host species known. With additional field work in Mexico and South America, more host species are still being discovered (Friedmann 1929, Thurber 1980, Friedmann and Kiff 1985, Carter 1986, Sealy et al. 1997). Hosts of Bronzed Cowbirds tend toward larger body sizes, typically greater than or equal to that of the cowbird itself, and have a primarily insectivorous diet, at least during the breeding season (Carter 1986). It is unknown how many eggs an individual Bronzed Cowbird is capable of laying during the breeding season and it is likely this number may vary between individuals, although one study recorded four eggs produced by a single female based follicle number, a number much smaller than was previously thought (Niles 1970). For this reason, and the high frequency of loss of cowbird juveniles due to abandonment or predation, it is likely that there is significant pressure on individual females to be able to select more appropriate nests for parasitism (Niles 1970, Hauber et al. 2002).

Host suitability is dependent on several factors. Hosts of cowbirds are those species whose breeding season are synchronous with cowbird reproduction; that fail to successfully defend the nest; build nests that can be accessed by the cowbird; accept the eggs after they have been laid; provide a protein rich diet to juvenile cowbirds, and occur at significant abundances within the cowbirds range (Sealy et al. 2002). Woolfenden et al. (2004) suggested that Brown-headed Cowbirds demonstrate general avoidance of inappropriate hosts, as patterns of host use vary from a random distribution. However,

preferential use of high quality host has yet to be clearly demonstrated with either species.

The high costs associated with raising parasitic offspring and high rates of parasitism can compound the stress already placed on bird populations by habitat loss and fragmentation (Zanette et al 2007). Cowbird parasitism is of particular concern for avian conservationists in the Lower Rio Grande Valley, which retains only 5% of its native vegetation (Lonard and Judd 2002, Hathcock and Brush 2004). Cowbirds have been implicated in the decline of several important LRGV species, including the Summer Tanager (*Piranga rubra*), Hooded Oriole (*Icterus cucullatus*), Audubon's Oriole (*I. graduacauda*) and Orchard Oriole (*I. spurius*; Brush 2005). Early researchers suggested that Bronzed Cowbirds preferentially parasitize certain icterids, particularly Hooded and Audubon's orioles, which were once common in the area (Pleasants 1981, Pleasants and Albano 2001, Flood et al. 2002). Ellison et al. also (2006) reported that Bronzed Cowbirds targeted Orchard and Hooded orioles almost exclusively when these species were common. Carter (1986), however, in the most comprehensive study of Bronzed Cowbirds to date, found no evidence of preferential host use in the LRGV. Whether the cowbirds have changed their host preference as a result of changing host abundance or some other cause is still in question.

While the impacts of cowbirds on host populations are relatively well studied, patterns of habitat use (particularly by Bronzed Cowbirds) and the mechanisms by which cowbirds locate and choose nests for parasitism are not fully understood (Carter 1986). Observations of Bronzed Cowbird laying behavior suggest that cowbird females have previous knowledge of nest sites prior to laying, as nests are approached directly and



laying occurs before dawn (Peer and Sealy 1997). There are two main hypotheses concerning nest location by cowbirds: 1) The active nest-searching hypothesis proposes that cowbirds actively seek and locate nests through systematic searching (Thompson and Gottfried 1981). Female cowbirds have been observed to systematically move through habitats both as individuals and groups, presumably for the purpose of nest location (Clotfelter 1998). Other authors have described what is called flushing behavior among Brown-headed Cowbirds. Female cowbirds make several short flights in dense vegetation, landing abruptly with loud wing flaps and then watching the movements of the birds flushed from the nests (Norman and Robertson 1975). This hypothesis predicts that more conspicuous nests will be parasitized at a higher rate than nests that are well hidden. 2) The host-activity hypothesis suggests that female cowbirds rely on host cues such as vocalization or nest building for laying decisions, either to find the nest initially or to determine appropriate laying time. Thus, they would be attracted to the vocalizations of potential host species (Clotfelter 1998, Robinson and Robinson 2001). The predictions of the host-activity hypothesis include that cowbird females will favor highly vocal species and that the nests of highly vocal individuals, particularly males, will be more likely to be parasitized (Clotfelter 1998, Robinson and Robinson 2001). Additionally, this hypothesis predicts that it would be advantageous for female cowbirds to be able distinguish between heterospecific vocalizations and to preferentially parasitize appropriate hosts and avoid species that are highly aggressive or act as rejecters (Hauber et al. 2002).

Several recent studies focused on Brown-headed Cowbirds have explored these mechanisms for host selection. Robinson and Robinson (2001) tested the predictions of

the nest searching hypothesis and found no evidence of any variation in rates of parasitism for conspicuous versus hidden nests, leading them to conclude that their results were in favor of the host-activity hypothesis. Clotfelter (1998) and Banks and Martin (2001) found evidence that as an individual host's vocalization rates increased on or near the nest, the parasitism rates increased as well. These studies emphasized that the proximity of male vocalization close to the nest made them more susceptible to parasitism (Clotfelter 1998, Banks and Martin 2001). Hauber et al. (2002) demonstrated that Brown-headed Cowbirds had a differential physiological response to playbacks of different host species vocalizations, indicating that this species is able to distinguish between heterospecific songs. There was, however, no behavioral response either in the lab or the field setting to playbacks, as Brown-headed Cowbirds were not attracted to playback of host vocalization in the field unless conspecific chatter was played prior to the host species vocalizations. However, Bronzed Cowbirds did respond to the playback of the Audubon's Oriole song used to aid in oriole surveys in the western LRGV (Monk and Brush 2007). This resulted in an increase in cowbird numbers after the broadcast of the recording, as the cowbirds appeared in the area where oriole song was being played, presumably to investigate a potential host nest (Monk 2003). With the above mixed results these previous investigations, it is clear that further research is required to understand how cowbirds locate potential nest sites.

One purpose of this investigation is to test the predictions of the host activity hypothesis for the Bronzed Cowbirds and their relationship to potential host species. I predicted that Bronzed Cowbirds would 1) be attracted by the recorded playback of host species songs and calls, and 2) that there would be a differential response between

common host species vocalization based on their suitability as hosts. The host species included in this investigation are the Altamira Oriole, Hooded Oriole, Audubon's Oriole, Olive Sparrow (*Arremonops rufivirgatus*), Northern Cardinal (*Cardinalis cardinalis*), Green Jay (*Cyanocorax yncas*), Long-billed Thrasher (*Toxostoma longirostre*), and Couch's Kingbird (*Tyrannus couchii*). In addition, I studied the habitat use and abundance of Bronzed Cowbirds in and around Santa Ana and Laguna Atascosa National Wildlife Refuges.

## CHAPTER II

### MATERIALS AND METHODS

#### **Study Sites**

Surveys were conducted in May and June of 2008 and 2009. This study was conducted at Santa Ana and Laguna Atascosa National Wildlife Refuges (hereafter SANWR and LANWR) and adjacent agricultural areas (Fig. 1). SANWR is an 842-ha tract of sub-tropical habitat located adjacent to Rio Grande in Hidalgo County, TX (Fig. 2). It serves as one of the few remnants of native riparian vegetation and as such is surrounded by cultivated crop land, planted predominantly with sorghum. The area within the refuge is dominated by thorn-scrub, riparian forest and open wetlands (Carter 1986, Lonard and Judd 2002). Laguna Atascosa is an 88,000-ha refuge located in Cameron and Willacy counties adjacent to the Laguna Madre (Fig. 3). The habitats within the refuge range from thorn forest to savannahs and wetlands.

#### **Point Count Surveys**

During the breeding season (May and June) of 2008 and 2009 in SANWR and in 2009 in LANWR, early morning fixed-radius, point-count surveys were conducted twice at each point per breeding season. Based on vegetative and avian community observation at SANWR, four habitat types were included within the study area: riparian forest, thorn scrub, open wetlands, and agricultural fields with two replicates per type (T. Brush, pers. comm.). Five points were located within each habitat replicate using stratified random

sampling methodology to include all habitat types (Fig. 2) (Hutto et al. 1986). Any point located within 200 m of another point was relocated to avoid repeated counts of individuals (Hutto et al. 1986).

At LANWR, thirty points were located along the Paisano, Mesquite, Moranco Blanco, and Lakeside Trails, and Lakeside and Bayside Drives (Fig. 3). Points were grouped into two location types, edge or interior, based on their distance from the edge of the refuge. All points were digitized and mapped as described above. Any point located within 200 m of another point was relocated as described above (Hutto et al. 1986).

Two early morning point count surveys were conducted from dawn to 10:30 am during each breeding season. Surveys were discontinued prior to 10:30 am when weather conditions prevented consistency between days. This included winds exceeding approximately 10 miles per hour, temperatures above 90 degrees F, or precipitation. Points were accessed on foot, with a vehicle or bike used between points. Each point count consisted of an initial ten-minute observation period, during which the number and sex of Bronzed Cowbirds were recorded, as well as their distance from the point. Cowbirds were identified by sight or song and sex was determined through a combination of both, as females have sex-specific calls (Lowther 1995). During the initial observation, all bird species were identified, usually by call, within 0-25, 25-50 and 50-100 m by sight and sound and recorded in the order in which they are observed for analysis (Hutto et al. 1986). Birds that were located outside the point count radius when I arrived at the point but moved into the radius during the ten minute observation period were included in the analysis. Also, individuals that were flushed on approach to the center of the point were included as being within the point-count radius and their distance

from the center was estimated. Birds located at a distance greater than 100 m were documented but not included within the data analysis.

Following the initial counting period at each point, a randomly-selected host song was broadcast at approximately the same volume as a naturally occurring host vocalization (see below), followed by an additional three minutes of observation to allow Bronzed Cowbirds to respond.

### **Host Species**

Host species were selected based on their abundance within the refuges and their ability to fledge parasitic offspring based on literature values published in previous studies. Determination of abundance was based on historical information and literature values from previous studies conducted in the LRGV. Four species were used at both SANWR and LANWR: a rarely utilized host (Altamira Oriole), known and potentially preferred hosts in low abundance (Hooded and Audubon's Oriole), or commonly utilized but poor host (Olive Sparrow), based on Brush (2005). Four additional species were included for the surveys in 2009 at LANWR. Three species were chosen based on their high levels of abundance and frequency of previous parasitism (Carter 1986); Long-billed Thrasher, Green Jay, and Northern Cardinal while the Couch's Kingbird is known to be highly aggressive and actively rejects cowbird eggs.

#### **Hooded Oriole**

Hooded Orioles are icterids with a mass of approximately 24.3 g and are mainly summer residents in the LRGV (Brush 2005). They construct cup nests primarily in palms (*Washingtonia* and *Sabal* spp.). Hooded Orioles produce two broods per season and feed the juveniles insects and arthropods. Hooded Orioles breed from mid to late

April to late July, during which time they vocalize infrequently (Pleasants and Albano 2001). The earliest records of parasitism for the Hooded Oriole were recorded by Gilman in 1914, who documented two nest parasitized by both Brown-headed and Bronzed Cowbirds in Arizona. Friedmann (1929) reported parasitism by both species in the LRGV. Since then authors have suggested that Bronzed Cowbirds preferentially parasitize Hooded Orioles, with 75 of 152 parasitized nests in one study belonging to Hooded Orioles (Ellison et al. 2006).

Their population numbers have declined significantly in the last 80 years, a trend that several authors have attributed mainly to high rates of cowbird parasitism (Oberholser 1974, Brush 2005). Hooded Orioles continue to nest in urban or suburban areas where palms have been utilized in landscaping and where they are parasitized by Bronzed Cowbirds (Brush 2000). During this study, one active nest was located in the northern area of SANWR near the refuge office in a palm. Both male and female orioles were seen in attendance during the breeding season of 2008 but the nest was inactive during the 2009 surveys and no Hooded Orioles were detected. Hooded Oriole is an acceptor species capable of raising one or more cowbirds per brood, but has not been documented with mixed broods containing both cowbirds and orioles (Brush 2000).

### **Audubon's Oriole**

The Audubon's Oriole is a permanent year-round Texas resident with a body mass ranging from 41.4 to 42.5 grams. They build cup nests in relatively open, edge habitats, during which time both males and female sing in proximity to the nest. Two broods are reared during the breeding season in early May through early July. Juveniles are fed insects and spiders. Audubon's Orioles have been recorded defending against

cowbirds in the nest area but they accept cowbird eggs after they have been laid.

Cowbird parasitism has also been considered a contributing factor in the recent declines of Audubon's Orioles in conjunction with riparian habitat loss (Flood et al. 2002, Monk and Brush 2007). The current distribution of Audubon's Oriole in the United States is limited to areas west of SANWR in riparian and thorn-forest tracts. The last documented Audubon's Oriole in SANWR occurred in the 1980s and in LANWR in the 1960s.

### **Altamira Oriole**

Altamira Orioles are currently the most common oriole species in highly-fragmented sections of the LRGV. Annual breeding bird surveys indicate that populations of Altamira Orioles rose significantly during the 1960s, and then declined in the 1970s and 1980s only to increase again through the 1990s (Brush 2005). During the last survey of Altamira Oriole populations at SANWR, active nests ranged from 6 to 10 within a three year period. I located two nesting pairs during my surveys in 2008 and 2009, but as more than 48% of Altamira nests are located along the Rio Grande and I did not census the refuge specifically for orioles (Hathcock and Brush 2004); it is likely that several nests went undetected. Altamira Orioles were historically unrecorded at LAWNR, but a single pair was reported there in 2008-2009 (LANWR staff, pers. comm.). Altamira Orioles construct conspicuous hanging basket nests in nearly inaccessible locations and suffer very low rates of predation related nest failure (Hathcock and Brush 2004). Both males and females vocalize during the brooding and nest building process. During observations of Altamira nest building behavior, several authors have observed cowbirds entering the nest repeatedly in the presence of both adult orioles, Altamira Orioles have rarely been observed rearing cowbird offspring (Werner et



al. 2007). A collection of 150 nests yielded only 2 parasitized nests and Pleasants (1981) found no indication of parasitism. Hathcock and Brush (2004) documented that Altamira Orioles do raise Bronzed Cowbird young to fledging, but Altamira Oriole is generally considered as a rejecter species, based on observations of Bronzed Cowbird egg removal. Some authors have proposed that Altamira Orioles nest near more aggressive host species such as the Great Kiskadee or Couch's Kingbird in order to discourage cowbird parasitism (Hathcock and Brush 2004).

### **Olive Sparrow**

The Olive Sparrow is the smallest and least successful host of the Bronzed Cowbird as it suffers high rates of predation and has never been documented with more than a single parasitic offspring (Carter 1986). Olive Sparrow mass ranges from 21.68 g in females to 23.2 g in males. They build domed or cup nests averaging from 0- 1.5 m from the ground in thorn scrub and riparian habitat. They have a prolonged breeding season from March through September (Brush 1998). Juveniles feed on spiders, insects and seeds. The historic abundances of Olive Sparrows received little attention; however, recent studies have estimated their abundance to be around 99 pairs per 100 ha at SANWR and thus they are the most abundant cowbird host there. During Carter's 1980-1981 study, 11 of 12 Olive Sparrow nests located were parasitized (Carter 1986).

### **Long-billed Thrasher**

Long-billed Thrashers are commonly found in dense thorn forest and riparian habitats with an average abundance of 4.5 birds per/ ha (Tweit 1997). Males and females are relatively large, with a mass of  $67.65 \pm 5.46$  SD grams. They produce two broods between April and July (Brush 2005). Males have been documented in territorial

interactions during the breeding season with both con- and interspecifics. Males vocalize frequently but are usually less conspicuously perched than many of the other species breeding in the LRGV. Both males and females give loud alarm calls in the presence of predators and have been observed chasing off cowbirds that enter territories (Tweit 1997, pers. observ.). Records of parasitism rates vary from no record (Oberholser 1974), to uncommon and were proposed to be an ejector species. Carter however documented Long-billed Thrashers as one of the most commonly utilized host species within the SANWR area and a very successful host, able to fledge both cowbirds and thrashers from a single clutch (Carter 1986).

### **Green Jay**

Green Jays ( $79.0 \pm 1.4$  SD g) nest in open riparian and thorn forest habitats between April and July. Juveniles are fed arthropods, vertebrates, seeds and fruits (Gayou 1995). Carter (1986) estimated that Green Jays occur at high abundances within the refuge, estimating 29 breeding pairs/100 ha. There are few records of cowbird parasitism of this species within the southern portion of its range. Gayou did not report occurrence of parasitism in his study of the social structure, however, Carter (1986) found Green Jays to be parasitized at rates of 100% of the nests observed. Parasitized nests produced only parasitic offspring.

### **Northern Cardinal**

The Northern Cardinal breeds in the LRGV from April to July at an estimated abundance of 10 breeding pairs per ha at SANWR (Carter 1986, Halkin and Linville 1999). Males are highly territorial and sing frequently from conspicuous perches. Females also vocalize while on the nest. Males exhibit defense behaviors against

cowbirds, although this appears to be unsuccessful as they are still frequently parasitized (Halkin and Linville 1999). Scott and Lemon (1996) reported that Northern Cardinals were actually less successful hosts of Brown-headed cowbirds than other smaller host species in the same habitat, but Carter (1986) found no evidence of this for Bronzed Cowbirds. Nests parasitized by Bronzed Cowbirds may result in the complete loss of the cardinal clutch (Carter 1986), although Brush (2005) reported mixed broods of cowbirds and cardinals being fed by the same pair of cardinals.

### **Couch's Kingbird**

Couch's Kingbirds are considered an unsuitable host for both Brown-headed and Bronzed Cowbirds. They inhabit dense thorn forest and riparian forest, breeding from April through mid-August. They feed their offspring primarily insects and both sexes vocalize around the nest. Like many other tyrannids, Couch's Kingbirds vigorously chase both inter- and conspecifics in the nest area to the extent that it has been proposed that other species will preferentially nest close to these kingbirds to benefit from their nest defense behavior. In addition, Couch's Kingbirds ejected 100% of experimental Bronzed Cowbird eggs. Despite this, there are two records of Couch's Kingbirds feeding Bronzed Cowbird fledglings (Carter 1986, Clotfelter and Brush 1995).

### **Broadcast of Host Vocalizations**

The recording of one host species' song and call was played three times per site (approximately 2 min. in length) using recorded songs from Birds Songs of the Lower Rio Grande Valley and Southwestern Texas and a Sony tape recorder (Keller 2000). The volume of the recording was constant at each site and set to simulate the volume of an actual song. A response by Bronzed Cowbirds to the playback, such as vocalizations or

by flying close to the speakers, was recorded during the three-minute period subsequent to the playback. A cowbird was considered to respond if they flew to within 10 m of the tape recorder. Individuals already located within 10 m of the tape recorder were not included in the analysis unless they alighted within 2 m of the tape recorder. Cowbird response was categorized based on the number of birds responding and the sex of the individuals involved. Responses by other species, including Brown-headed Cowbirds or host species within the area were also documented. Additional data was collected with regard to perch use and the activities of cowbirds observed during the initial point count.

### **Vegetation Analysis**

Due to the strong association demonstrated in previous research between vegetation structure and volume on breeding bird populations, a vegetation analysis was also included in this investigation (Mills et al. 1991). Following the surveys, additional habitat composition and structure data was recorded using a variation of the vertical-line intercept technique, also called the pole method, which measures vegetation volume (Mills et al 1991). An extendable, 7.5 m painter's pole was marked in quarter meter increments. This pole was raised at three locations within each point count location, one at the central point and the other two 5 m from the point in a randomly selected cardinal direction. The species and height of all vegetation in contact with the pole was then recorded within each quarter meter segment and the height of trees extending above the pole will estimated to nearest quarter meter. This data was used to calculate an estimate of the volume and structure of vegetation. Each point was classified as edge or interior based the cutoff of 200m from the distance of the boundaries of the wildlife refuge rather

than by habitat type (Chase and Cruz 1998). All vegetation data was collected subsequent to the breeding season point count surveys.

### **Statistical Analysis**

The results of this survey were analyzed using SPSS Statistical Software 17.0 with  $\alpha < 0.05$ . Due to the small sample sizes, nonparametric tests were used to detect differences among and between groups. For vegetation and habitat use, the Kruskal-Wallis test was used for SANWR data to detect differences in 1) mean cowbird abundance among habitat types, 2) mean total vegetation volume among habitat types. The Mann-Whitney U test was used to detect differences in mean cowbird abundance between interior and edge point count locations. At LANWR, Mann-Whitney U was also used to test for significant differences in 1) mean bronzed Cowbird abundance between habitat types and interior and edge point count locations, 2) mean total vegetation volume between habitats. A regression analysis was used to determine if there was any association between Bronzed Cowbird abundance and TVV. A chi-square analysis was used to detect differences in frequency of observed Bronzed Cowbird behaviors during the initial ten-minute point count survey.

For response to the playbacks of host vocalizations, Friedman's test was used to detect significant differences in abundance before and after the broadcasts. A Wilcoxon test was used to detect differences in response between host species. A chi-square analysis was used to detect difference in the frequency of Bronzed Cowbird response types.

## CHAPTER III

### RESULTS

#### **Bronzed Cowbird Distribution and Habitat Use**

##### **SANWR**

Bronzed Cowbirds were present in 66 of the point count surveys and absent from 54. A mean of  $0.88 \pm 1.35$  SD Bronzed Cowbirds per count was detected. Mean Bronzed Cowbird abundance per habitat type is shown in Table 2. A vegetation profile for each habitat is shown in Figures 4-7. Significant differences were detected in total vegetation volume between habitat types (Kruskal-Wallis Test,  $X^2 = 70.28$ ,  $df = 3$ ,  $p < 0.001$ ) however there was no significant difference in Bronzed Cowbird abundance between habitat types (Kruskal-Wallis Test,  $X^2 = 5.846$ ,  $df = 3$ ,  $p = 0.119$ ) (Fig. 3, Table 2). There was no association between total vegetation volume and Bronzed Cowbird abundance (Regression,  $F = 3.809$ ,  $df = 1$ ,  $p = 0.053$ ) (Table 3). Male abundance did not vary significantly across habitat types (Kruskal-Wallis Test,  $X^2 = 10.545$ ,  $df = 3$ ,  $p = 0.517$ ). Female abundance was significantly different between habitat types, with a greater abundance of females present in agricultural habitats than in other habitats (Kruskal-Wallis test,  $X^2 = 10.545$ ,  $df = 3$ ,  $p = 0.014$ ). Mean Bronzed Cowbird abundance also varied significantly between interior and edge point count locations (Mann-Whitney U,  $Z = -2.591$ ,  $p = 0.010$ ). When sex was accounted for, mean female abundance did not vary significantly (Mann-Whitney U,  $Z = -0.089$ ,  $p = 0.929$ ) while male mean abundance

was significantly different (Mann-Whitney U,  $Z = -3.974$ ,  $p < 0.001$ ), with a greater number of males present in edge point count locations.

Bronzed Cowbirds present at the point count locations prior to the broadcast of host song were observed engaged in four main behaviors, silently perched 20%, perched and territorial vocalization, 22%, foraging behavior 38%, and courtship behaviors 16%. There were significant differences between frequency of occurrence of the observed behaviors ( $X^2 = 9.077$ ,  $df = 3$ ,  $p = 0.023$ ).

### **LANWR**

Bronzed Cowbirds were detected at 39 of the point count locations and absent from 21. Mean Bronzed Cowbird abundance across points was  $1.97 \pm 2.29$  SD. Mean Bronzed Cowbird abundance per habitat type was  $1.65 \pm 2.33$  SD per count for savannah/wetland habitats and  $2.20 \pm 2.26$  SD per count for thorn forest habitats. No significant differences were detected between total vegetation volumes for each habitat type (Mann-Whitney U,  $Z = -1.701$ ,  $p = 0.09$ ). Total Bronzed Cowbird abundance was not significantly different between habitat types (Mann-Whitney U,  $Z = -1.451$ ,  $p = 0.147$ ) nor was there any relationship between total vegetation volume and overall Bronzed Cowbird abundance (Regression  $F = 2.72$ ,  $df = 1$ ,  $p = 0.104$ ). Female abundance was not significantly different between habitat types (Mann-Whitney U,  $Z = .134$ ,  $p = 0.893$ ), while males occurred at significantly greater abundances in thorn scrub habitats (Mann-Whitney U,  $Z = -2.00$ ,  $p = 0.04$ ). There was no significant difference between cowbird mean abundance for interior and edge point count locations (Mann-Whitney U,  $Z = -1.019$ ,  $p = 0.308$ ). No significant differences were detected in mean female abundance between edge and interior points (Mann-Whitney U,  $Z = 0.380$ ,  $p =$

0.704), while male mean abundance was significantly different, with a greater abundance of males in edge point count locations (Mann-Whitney U,  $Z = -2.347$ ,  $p = 0.01$ ).

Bronzed Cowbird behavior at LANWR included silently perched, 35%, perched and territorial vocalization, 24%, foraging 35%, and courtship displays 6%, although there was no significant difference in the frequency of the various observed behaviors ( $X^2 = 4.83$ ,  $df = 3$ ,  $p = 0.184$ ). There was no significant difference detected in the frequency of the occurrence of these behaviors between SANWR and LANWR ( $X^2 = 1.50$ ,  $df = 8$ ,  $p = 0.93$ ).

### **Response to Broadcast of Host Vocalizations**

#### **SANWR**

Of the 120 broadcasts of host vocalizations, Bronzed Cowbirds responded 41 times, for an overall response of 34.2%; at least once to each of the species selected for broadcast at this refuge. There was an average response of  $1.39 \pm 1.57$  SD cowbirds per count. Of the 41 responses, the Altamira Oriole song was responsible for 36%, Hooded Oriole 39%, Audubon's Oriole 19% and Olive Sparrow 4% (fig. 14). There were significant differences in the number of cowbirds before and after the playback of the host vocalizations, indicating that Bronzed Cowbirds do respond to host vocalizations (Wilcoxon  $Z = 5.01$ ,  $p < 0.01$ ). There was also a significant difference in the number of responses between the host species vocalizations (Friedman  $X^2 = 92.66$ ,  $df = 2$ ,  $p < 0.001$ ), indicating that there was a differential response between species. The frequency of response between habitat types was significantly different ( $X^2 = 24.200$ ,  $df = 3$ ,  $p < 0.001$ ), with the majority of the responses occurring in the thorn forest and riparian forest habitats. Responses occurred during the actual broadcast of the host vocalization or



within 10 seconds of the end of the recording. No response was recorded after the ten second period immediately following the response, although the three minute observation period was maintained for all point count surveys.

Response behaviors of Bronzed Cowbirds varied. The most common response type, occurring in 46.1% of the observations, involved a single female flying silently into the vicinity (<10 m) of the tree in which the tape recorder was located. The female would approach the area either by flying in over the canopy and alighting on a perch in the upper portion of a tree near where the tape recorder was located or by hopping through the mid-story vegetation and maintaining a mid-story location in the vicinity of the tape player. Once there, she would observe the surrounding area, often with head cocked to the side. After a period of 5 to 26 seconds, the female would leave the area by flying over the canopy of the habitat.

The second most common response, occurring in 20.9% of the observations involved groups of two to five females. These females approached the area similarly to the individual females, although they tended to remain in the area longer, ranging from 7 to 36 seconds, during which time they would alight on several different branches. Neither individuals nor groups of females were heard vocalizing during these responses.

On a few occasions, (7.6% of the observations) responses consisted of a single male. These responses occurred primarily in the wetland and agricultural habitats. Males would approach the area flying well over the habitat, alight on a snag, tree or power line near the tape recorder, and proceed to sing. Two of the three males remained to vocalize in the area for the full three minute observation period, while one left the area and flew

out of sight after a single vocalization because he was chased out of the area by two male Red-Winged Blackbirds.

The last type of response recorded involved a single female or group of females accompanied by a male or males and this occurred 24.4% of the time. The females would arrive in the area first, followed almost immediately by the male. The male would alight in the same tree as the females and then perform the bow and hover displays characteristic of the Bronzed cowbird courtship display. Both the bow and hover displays were performed perched in a tree and were directed at the nearest female. Females terminated the courtship bout by flying out of the area between 5 and 14 seconds after it was initiated. Both the females and the male would follow the first female cowbird to leave the area. There was a significant difference in the frequency at which these responses occurred, with a single male responding less frequently than single females, groups of females or females accompanied by a male ( $X^2 = 17.07$ ,  $df = 3$ ,  $p = 0.01$ ). On three occasions, Bronzed Cowbirds responding to the playbacks were chased from the vicinity almost immediately upon arrival by pairs of Couch's Kingbirds nesting in the vicinity of the point.

Other species also responded to the playback of the host vocalizations. Olive Sparrows on three occasions responded to playbacks of Olive Sparrows song when Bronzed Cowbirds did not; all of these in thorn forest habitat. A single male Altamira Oriole also flew into the vicinity of the tape player in riparian habitat, alighted for less than two seconds and flew out of sight. Also, a single Brown-headed Cowbird female responded to the recording of an Olive Sparrow in thorn forest habitat by approaching the

tape player directly, touching down on it with wings still outstretched and then flying out of sight.

## **LANWR**

Bronzed Cowbirds responded to 11 of the 60 broadcasts of host species vocalizations (18.3%) with an average response of  $2.27 \pm 1.96$  SD cowbirds per response. Bronzed Cowbirds did not respond to all species. There was no response to broadcasts of the Olive Sparrow, Couch's Kingbird, or Hooded Oriole recordings. The majority of responses, 41.6 %, were elicited by the Altamira Oriole, followed by Long-billed Thrasher, 24%, Green Jay at 16.6%, and Audubon's Oriole and Northern Cardinal with 8.3% each. There was a significant difference in Bronzed Cowbird abundance after the playback of the host recording (Wilcoxon  $Z = -2.54$ ,  $p = 0.011$ ), again indicating a response. There was also a significant difference in response among species ( $X^2 = 42.00$ ,  $df = 2$ ,  $p < 0.001$ ). The frequency of response was not significantly different between habitat types ( $X^2 = 0.091$ ,  $df = 1$ ,  $p = 0.763$ ).

All response types observed at SANWR were also recorded at LANWR. The most common response type, 36%, was a single female, followed by multiple females and females accompanied by a male at 27%, and a single male at 9%. There were no significant differences in the frequency of response type for LANWR ( $X^2 = 1.727$ ,  $df = 3$ ,  $p = 0.631$ ). Response behavior was similar in the two refuges.

Additional responses to the recordings included a single Altamira Oriole male flying low over the tape player in the thorn forest habitat near the refuge headquarters. Long-billed Thrashers also responded to the broadcast of the Long-billed Thrasher song by flying into the area of the tape player while the broadcast was still in process and

calling, singing and scolding loudly. Bronzed Cowbirds arrived in the area after this behavioral response by the thrashers for each of the cowbird responses observed. On two occasions, Green Jays responded to the broadcast of Green Jay vocalizations when cowbirds did not.

## CHAPTER IV

### DISCUSSION

#### **Bronzed Cowbird Habitat Use and Distribution**

Bronzed Cowbirds were distributed throughout all habitats studied at both refuges, although male and female patterns of habitat use varied and there was also some variation between the two refuges. Bronzed Cowbirds occurred at higher abundances in LANWR than SANWR during the 2008 and 2009 breeding season. Bronzed Cowbirds were observed in large flocks, sometimes with other species such as the Great-tailed Grackles (*Quiscalus mexicanus*) or Brown-headed Cowbirds, during the breeding season at LANWR, a behavior not observed at SANWR.

Breeding Bird Surveys from LANWR and SANWR indicate that Bronzed Cowbird abundances have also increased slightly along the BBS routes, although not significantly during this time period (USGS BBS 2006). As both refuges are within the historic Bronzed Cowbird distribution (Oberholser 1974) these surveys can provide no answers on the Bronzed Cowbird range expansion.

Total vegetation volume and habitat type appear to have no impact on overall Bronzed Cowbird occurrence as there were no significant differences in total abundance based on these habitat characteristics. Perhaps when abundance is high, birds fill up all suitable habitats. In the southeastern Arizona, results were similar, despite lower abundances (Chace 2004), suggesting that Bronzed Cowbirds are not habitat-specific.

Distinguishing habitat use by males and females appears to be important for examining Bronzed Cowbird distribution during the breeding season (Carter 1986, Lowther 1995, Chace 2004). Female Bronzed Cowbirds at SANWR occurred at the greatest abundances in the agricultural fields adjacent to the wildlife refuge. The sorghum and soy bean fields serve as communal feeding areas for both males and females throughout the morning, as cowbirds were recorded in these locations in both early and late morning surveys. The lack of significant differences detected among habitats in female abundance at LANWR was likely due to the fact that no agricultural areas were included in the surveys.

While Monk (2003) and Rupert (1997) found that Bronzed Cowbird abundances were higher in smaller habitat patches, the distribution of female Bronzed Cowbirds across both interior and edge point count locations indicates that the distance from the edge of the wildlife refuges is likely not a barrier to Bronzed Cowbird parasitism, as it is with Brown-headed Cowbirds (Ries and Sisk 2004, Jewell et al. 2007). The 200-m boundary between edge and interior in this study may mean little to female Bronzed Cowbirds. They could quickly reach even the most interior sections of SANWR, since no point in more than 1 km from the nearest agricultural edge. At LANWR, adequate feeding habitat (grasslands and bare ground) is present as patches within the habitats surveyed and all points surveyed were within 2 km of the nearest agricultural edge.

Thus females' higher abundance in thorn forest and wetland habitats and somewhat lower abundances in riparian forest may be associated with host species abundances, as most of the appropriate hosts are located in these habitats (Jensen and Cully 2004, Brush 2005). Further research in this area comparing urban, agricultural,

and native habitats might yield more insight into the habitat use of female Bronzed Cowbirds.

Overall Bronzed Cowbird numbers in interior and exterior points did not vary significantly for either refuge. However, males at both refuges were more abundant in points near edges than interior points while female distribution did not vary. As males establish and maintain territories in wooded habitats, it is possible that these differences may be attributed to some aspect of territory requirements. First year, or otherwise non-breeding males and other males without territories, may drift in exterior habitats between native and agricultural areas (Carter 1984). It is possible this variation is due to limited territory availability within the refuge, as males establish territories in wooded habitats. These are more limited in LANWR which is primarily coastal prairie and savannah compared to SANWR which has a greater proportion of wooded habitats available.

It is possible this variation is due in part to the relative abundance of wooded habitats in the two refuges. Point count locations were chosen based on including all habitat types rather than their relative abundance at each refuge. It is therefore likely that the point count locations may influence the results of the analysis. Given the current high abundances of Bronzed Cowbirds and cowbird population increases, it is possible that Bronzed Cowbird habitat use may be increasingly influenced by conspecific density and the relative availability of resources in the form of territories and host availability (Jensen and Cully 2004). The high abundance of Bronzed Cowbirds in all habitat types, not just those that contain appropriate hosts suggests that at high abundances Bronzed Cowbirds may utilize suboptimal habitats. Further research to determine patterns of Bronzed Cowbird habitat use that specifically focuses on the impacts of conspecific density may

be important in understanding current and future Bronzed Cowbird distribution as range expansion and abundance continues.

### **Response to Playback of Host Vocalizations**

The results of this analysis are generally consistent with the predictions of the host activity hypothesis. A differential, behavioral response between species indicates that Bronzed Cowbirds can differentiate between heterospecific host vocalizations. Bronzed Cowbirds responded behaviorally to suitable, abundant host species, especially those still present in the immediate region around the study area. Oriole species elicited the majority of responses across both refuges, although they are greatly outnumbered by more abundant host species, such as the Olive Sparrow. The fact that Bronzed Cowbirds responded strongly to Altamira Oriole song playback, despite the poor suitability of Altamiras as host, will be discussed further below.

Olive Sparrows are the most abundant cowbird host present at both refuge locations and consistently elicited low or no response at the two refuges (Carter 1986, Brush 1998). It is likely that this is based on the predation rates on Olive Sparrow nests which make behavioral responses to this species disadvantageous to cowbirds (Carter 1986). Alternatively, Olive Sparrows may be poorer hosts because their small size may reduce feeding rates of cowbird young, but there are no data on this issue.

Based on these results it is likely that Bronzed Cowbirds do preferentially parasitize oriole species when they are readily available, as has been suggested by previous authors (Ellison et al. 2006). The Audubon's Oriole elicited responses at both wildlife refuges, although at lower rates than were recorded during Monk's surveys west of SANWR (2003). It is possible the decrease in interest recorded during my



investigation may be due to the long periods of absence for Audubon's Oriole from LANWR and SANWR, while the species was still present in the southern Starr Co., southwestern Hidalgo Co. and adjacent Tamaulipas area Monk included in his surveys (Monk 2003).

It is interesting that Bronzed Cowbirds would be attracted to Altamira Oriole nests, given the Altamira's ejection behavior. However, since Altamira Orioles build hanging-basket nests and suffers from lower rates of nest predation and nest failure it is likely that it is still advantageous for the cowbirds to parasitize these nests if low rates of acceptance were present in the Altamira populations (Hathcock 2000, Brush 2005). The extent of attempted parasitism by Bronzed Cowbirds on Altamira Orioles deserves further study, since cowbirds are known to puncture host eggs, reducing host reproductive success.

The fact that Hooded Oriole elicited high rates of response at SANWR probably reflects the widespread (albeit at low density) breeding distribution of Hooded Orioles within southern Hidalgo County (T. Brush, unpubl. data). The lack of response to Hooded Orioles song at LANWR, can possibly be attributed to the fact that LANWR lies outside of the historical distribution for Hooded Orioles. Thus this suggests that populations of Bronzed Cowbirds may require at least occasional exposure to host populations for females to gain the experience necessary to recognize appropriate hosts. Response to host activity may be the result of learned experiences at least in regard to which species warrant a response. This would result in differential host use by individual females as they become more specialized in their host use behaviors. If this were indeed the case, one would expect responses to appropriate hosts from older females. This

hypothesis has the drawback of not providing a mechanism to explain how females would gain the knowledge of host success given they have no contact with their offspring after the eggs have been deposited in the host nest.

Alternatively, Bronzed Cowbirds may preferentially parasitize the hosts that they themselves were hosted by (Payne et al. 2000, Ellison et al. 2006). If this were the case, the more cowbird offspring raised successfully by the host, the more potential parasites would be utilizing that particular species. This scenario would provide both a mechanism and an adequate explanation for the behaviors observed among the Bronzed Cowbirds at both refuges. Future research should focus on connecting Bronzed Cowbirds with their foster species and subsequent parasitic behaviors after the juveniles reach sexual maturity. One way in which this could be accomplished would be by utilizing louse population genetics to link cowbirds with their foster species and then utilizing parentage assignment to determine if the females are returning to parasitize their former foster species (Ellison et al. 2006).

Long-billed Thrashers are the most successful and abundant of the non-oriole hosts and also elicited the greatest number of responses compared to other non-oriole species. These results are consistent with the predictions of the host activity hypothesis, although it is likely that host activity cues are not limited to host song (Carter 1986). Interestingly, Long-billed Thrashers also exhibited the strongest intraspecific reaction to the playback of the host vocalizations. It is possible that the vocal and visual disturbance caused by the Long-billed Thrasher was responsible for the strong behavioral response from the Bronzed Cowbirds. If this is the case, the avian disturbances alone may be sufficient to draw cowbirds into an area (Clotfelter 1998).

In the case of Couch's Kingbirds, the cowbirds may have been avoiding that species' aggressive response. Couch's Kingbirds have been observed repeatedly, including during this study, chasing cowbirds near the nest site. Their success at nest defense combined with learned cowbird avoidance may explain their low parasitism rates (Brush 1999).

As it is known that Bronzed Cowbirds continue to parasitize inappropriate or less successful host nests, actual parasitism events are likely based on tradeoffs between host availability, host suitability and the readiness of a female cowbird to lay an egg at a particular time. Given the high abundances recorded for Bronzed Cowbirds in both habitats, it is possible that host use in the Bronzed Cowbirds is heavily influenced by both host and conspecific abundances. Females may not always have access to successful hosts and so utilize less competent hosts, or utilize dump nests in areas of greater conspecific densities. Future research focused on variation in the impacts of conspecific density of Bronzed Cowbirds in different populations may illuminate both Bronzed Cowbird distribution and patterns of host selection.

The variation in response behaviors by Bronzed Cowbirds was an unexpected outcome of this survey. Previous studies have documented no response, responses by individuals or groups, but the sex-specific response of cowbirds was previously undocumented (Hauber et al. 2002, Monk 2003). Additionally, male pursuit of the females responding to the playbacks is of particular note in regard to the male display. On the first occasion noted, a single female approached the tape recorder. She was followed closely by a male. He perched briefly on the lateral branch near the female and then hovered two feet above the branch where she was perched. The duration of the display

was 5 seconds. The male landed and the female terminated the interaction. The other three times followed this basic pattern, with the male arriving after the females, performing a single aerial hover. The interaction was invariably terminated by the females leaving the area.

On one occasion, a male performed for a mixed group of cowbirds, two Bronzed and one Brown-headed (*Molothrus ater*). I was unable to determine if the hover displays were preceded by a terrestrial bow, however, it may be possible that the male's courtship display was interrupted by the recording and that they followed the females to the site for that reason. These observations are similar to those recorded by Gilman (1914), Clotfelter (1995) and Friedmann (1929) and support the promiscuity conclusion drawn by Carter (1986). Male cowbirds displayed multiple times to multiple females, as would be expected in promiscuous mating systems.

Based on my observations, it may be possible that male cowbirds do not necessarily perform the terrestrial bow immediately before performing the aerial hover. However, given the density of vegetation, it may also be possible that the first portion of the display was interrupted by the recorded host song and the male finished the display where the females had relocated to. If this is the case, Clotfelter's assumption that a display is terminated when one individual leaves the feeding ground may be false (Clotfelter 1995). It is possible that the breeding party is simply relocating in response to some stimuli. Of course, given the limited number of observations and density of vegetation, further investigation is necessary. More likely however, male response to the playback of host vocalization may have actually been a response to the movement of the

females within a territory to elicit copulation, especially given the exploded lek nature of the cowbird mating dispersion (Clotfelter 1995).

## CHAPTER V

### CONCLUSIONS

Bronzed Cowbirds utilize all of the habitat types surveyed within the Lower Rio Grande Valley and have apparently increased in abundance within both refuge locations in the past three decades. The number of Bronzed Cowbirds detected at points at both SANWR and LAWNR appears to be somewhat higher than numbers recorded at less fragmented upriver habitats in the western LRGV (Monk 2003). Males appear to float in edge habitats around natural areas, which may account for their greater abundances in edge locations. Female distribution within native habitats was consistent between the two refuges, in that they are both abundant and present in interior and edge habitats, and where most potential hosts are located (Carter 1986). The fact that agricultural areas adjacent to SANWR had the greatest abundance of females probably reflects their need for high food intake during egg production.

Bronzed Cowbirds apparently are able to recognize heterospecific host song to determine nest site location. Recognition may involve early exposure, although this could only be determined conclusively in isolation experiments. Bronzed Cowbirds may learn which hosts are suitable over time and so as their range expansion occurs it is likely that they will be able to successfully parasitize new host species as they are encountered. Refuge managers wishing to control cowbird populations should focus on the habitats

utilized by female cowbirds during the breeding season as male and female habitat use varies during this time of the year. Cowbird removal programs would be most successful in areas of high female abundance, such as the communal feeding grounds in the agricultural areas adjacent to the refuge habitats. Populations in which cowbird removal has been implemented would also serve as ideal locations to study the effects of Bronzed Cowbird density on patterns of distribution and host selection.

Table 1. Mean abundances for Bronzed Cowbirds across all points and for each habitat type in Santa Ana National Wildlife Refuge and adjacent agricultural fields.

	<b>Mean <math>\pm</math> SD Total</b>	<b>Mean <math>\pm</math> SD Males</b>	<b>Mean <math>\pm</math> SD Females</b>
<b>Total</b>	0.88 $\pm$ 1.35	0.48 $\pm$ 0.64	0.61 $\pm$ 1.08
<b>Thorn Forest</b>	0.87 $\pm$ 1.36	0.57 $\pm$ 0.71	0.60 $\pm$ 1.17
<b>Riparian</b>	0.5 $\pm$ 0.82	0.40 $\pm$ 0.49	0.35 $\pm$ 0.62
<b>Wetland</b>	1.30 $\pm$ 1.26	0.65 $\pm$ 0.67	0.90 $\pm$ 1.07
<b>Agricultural</b>	1.20 $\pm$ 2.02	0.30 $\pm$ 0.73	0.90 $\pm$ 1.51



Table 2. Mean abundances for Bronzed Cowbirds across all points and for each habitat type in Laguna Atascosa National Wildlife Refuge.

	<b>Mean <math>\pm</math> SD</b>	<b>Mean <math>\pm</math> SD</b>	<b>Mean <math>\pm</math> SD</b>
	<b>Total</b>	<b>Males</b>	<b>Females</b>
<b>Total</b>	1.97 $\pm$ 2.29	0.76 $\pm$ 0.95	1.29 $\pm$ 1.73
<b>Thorn Scrub</b>	2.20 $\pm$ 2.26	0.765 $\pm$ 0.95	1.29 $\pm$ 1.73
<b>Savannah/Wetland</b>	1.65 $\pm$ 2.33	0.65 $\pm$ 1.06	1.31 $\pm$ 1.95

Table 3. Mean total vegetation volume for each habitat type for Santa Ana National Wildlife Refuge, adjacent agricultural fields and Laguna Atascosa National Wildlife Refuge.

	<b>Mean Total Vegetation Volume <math>\pm</math> SD</b>
<b>Thorn Forest</b>	7.01 $\pm$ 2.92
<b>Riparian Forest</b>	6.28 $\pm$ 1.74
<b>Wetland</b>	3.24 $\pm$ 1.51
<b>Agricultural</b>	1.43 $\pm$ 0.23
<b>Thorn Scrub</b>	4.15 $\pm$ 2.85
<b>Savannah/Wetland</b>	5.31 $\pm$ 2.16

Figure 1. Map of the relative locations of Santa Ana National Wildlife Refuge, on left, and Laguna Atascosa National Wildlife refuge, on right, in the southernmost region of the Lower Rio Grande Valley, Texas.

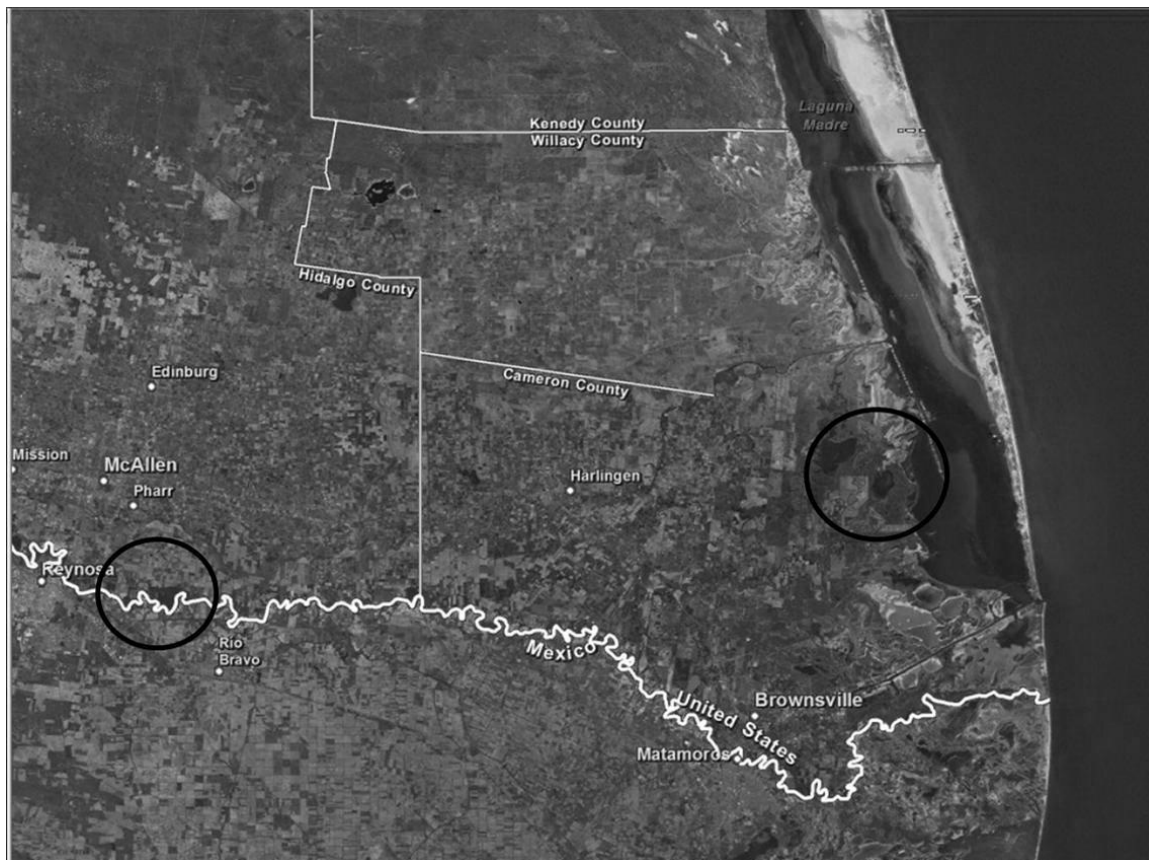


Figure 2. Map of Santa Ana National Wildlife Refuge showing point count locations within the refuge boundaries and the adjacent agricultural areas.



Figure 3. Map point count locations in Laguna Atascosa National Wildlife Refuge. All points are located within the refuge boundaries.



Figure 4. Vegetation profile for riparian forest habitats in Santa Ana National Wildlife Refuge.

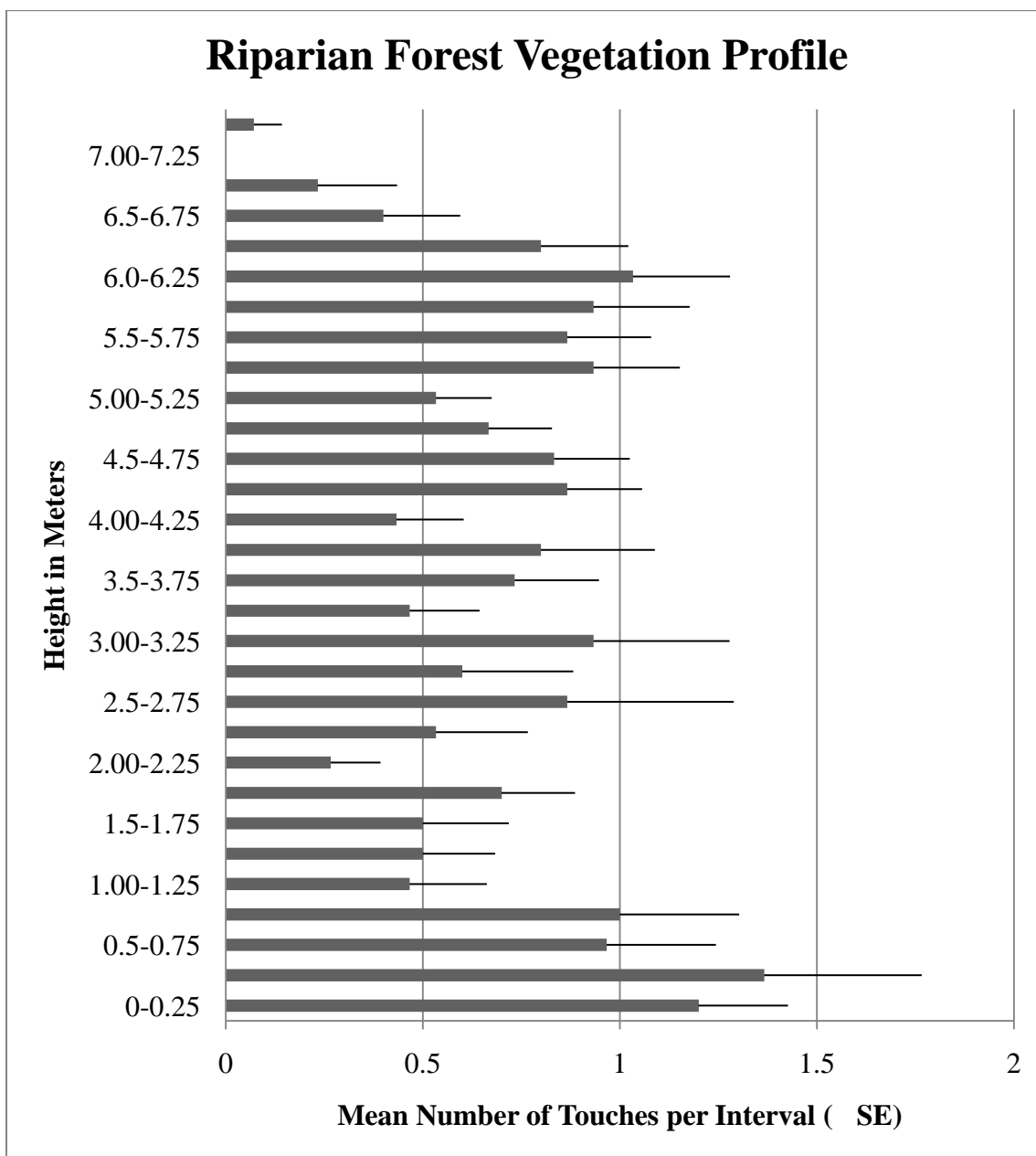


Figure 5. Vegetation profile for thorn forest habitats in Santa Ana National Wildlife Refuge.

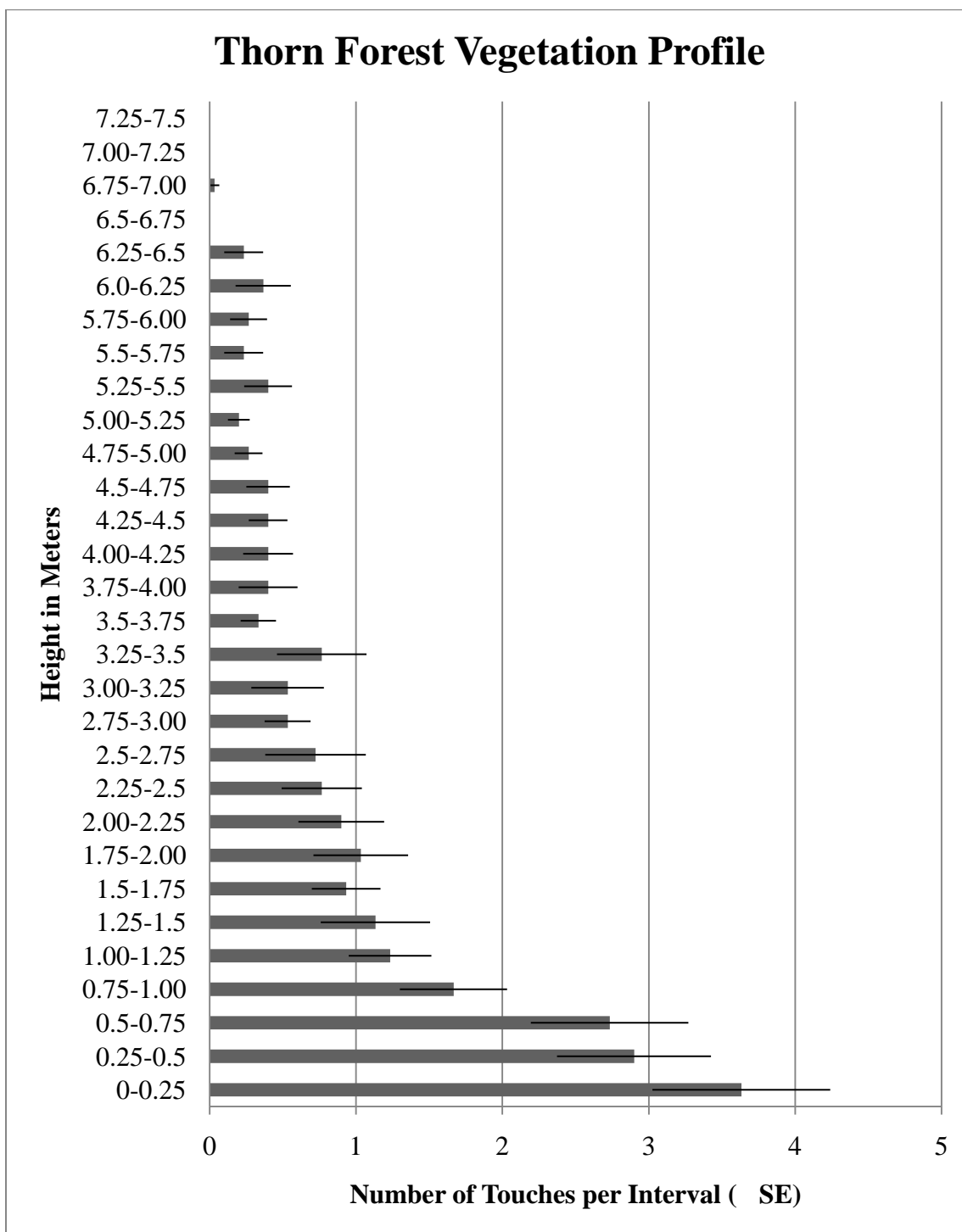


Figure 6. Vegetation profile for wetland habitats in Santa Ana National Wildlife Refuge.

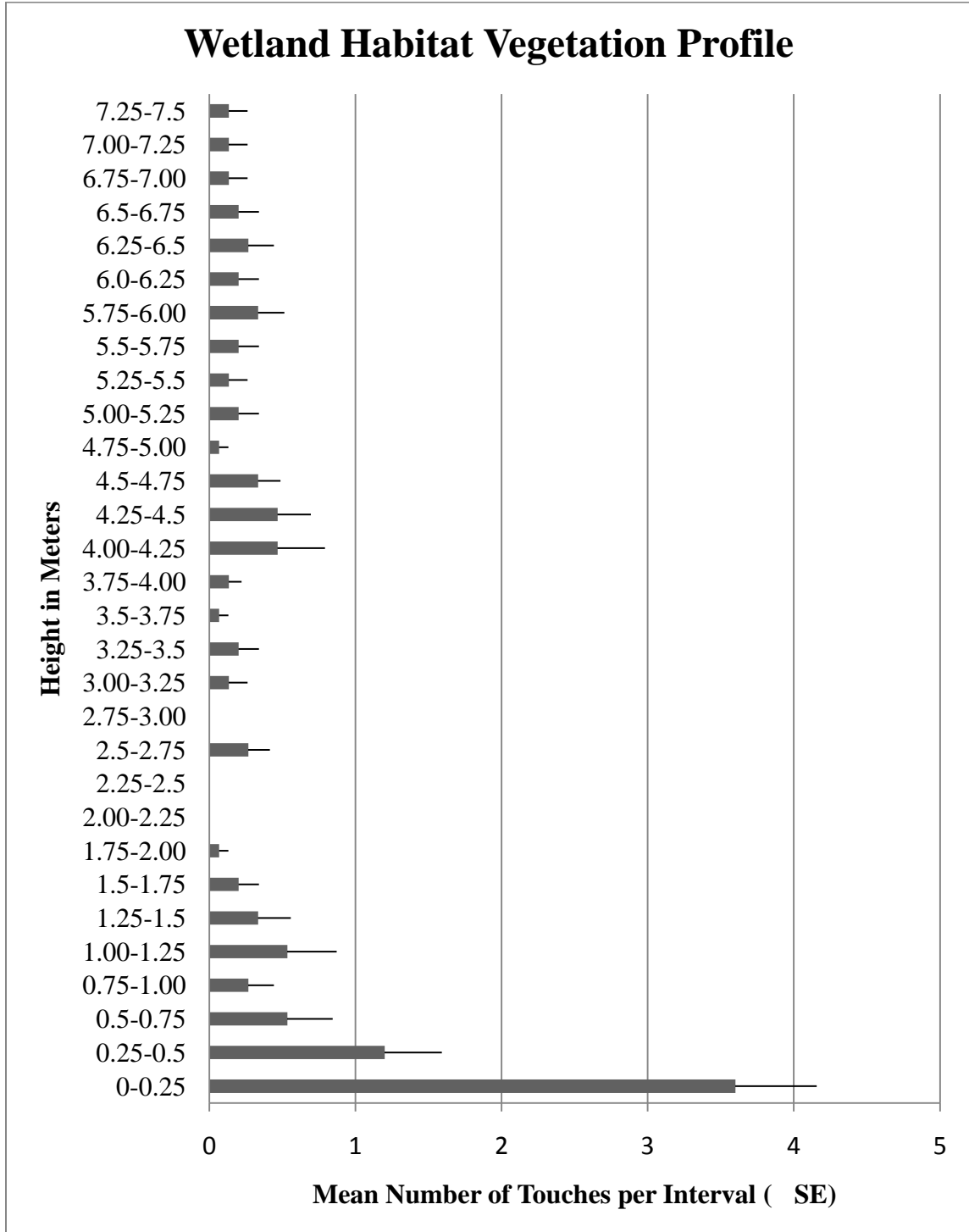




Figure 7. Vegetation profile for agricultural areas near Santa Ana National Wildlife Refuge.

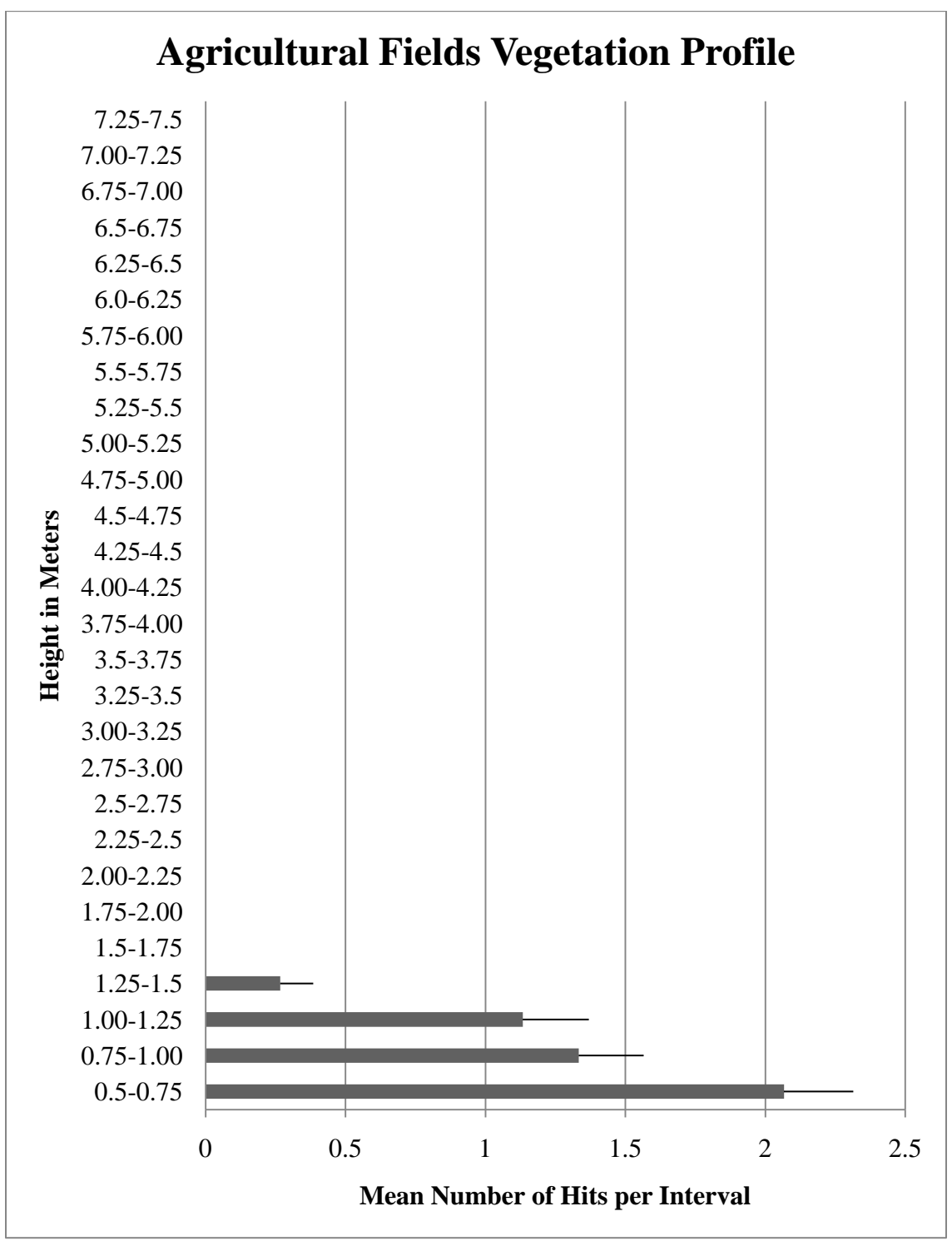


Figure 8. Mean Bronzed Cowbird abundance observed per count within each habitat type in Santa Ana national Wildlife Refuge. Error bars show one SE. No significant differences were detected in mean Bronzed Cowbird abundance between habitat types at Santa Ana National Wildlife Refuge. (Kruskal-Wallis  $X^2 = 5.84$ ,  $df = 3$ ;  $p = 0.119$ ).

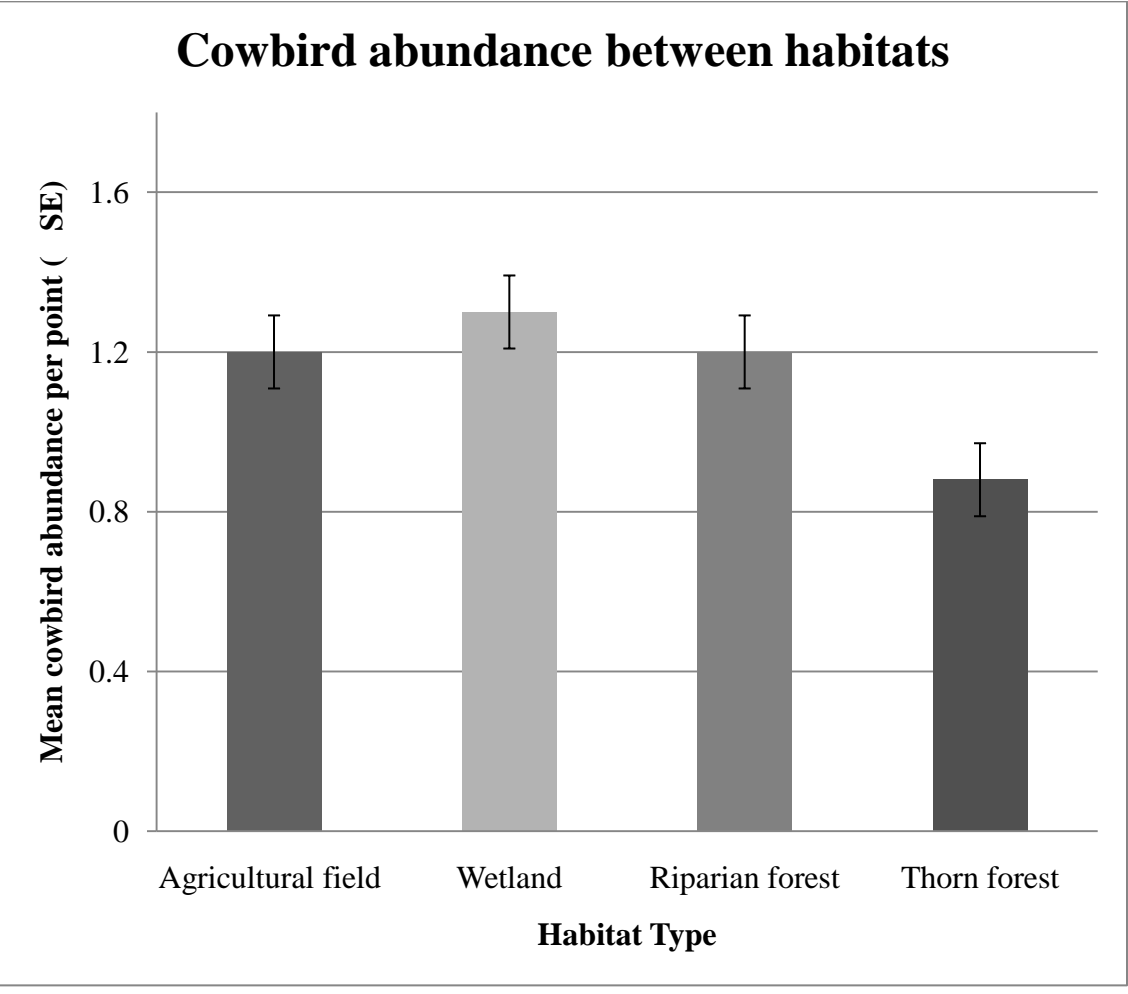


Figure 9. Bronzed Cowbird behavior observed in SANWR.

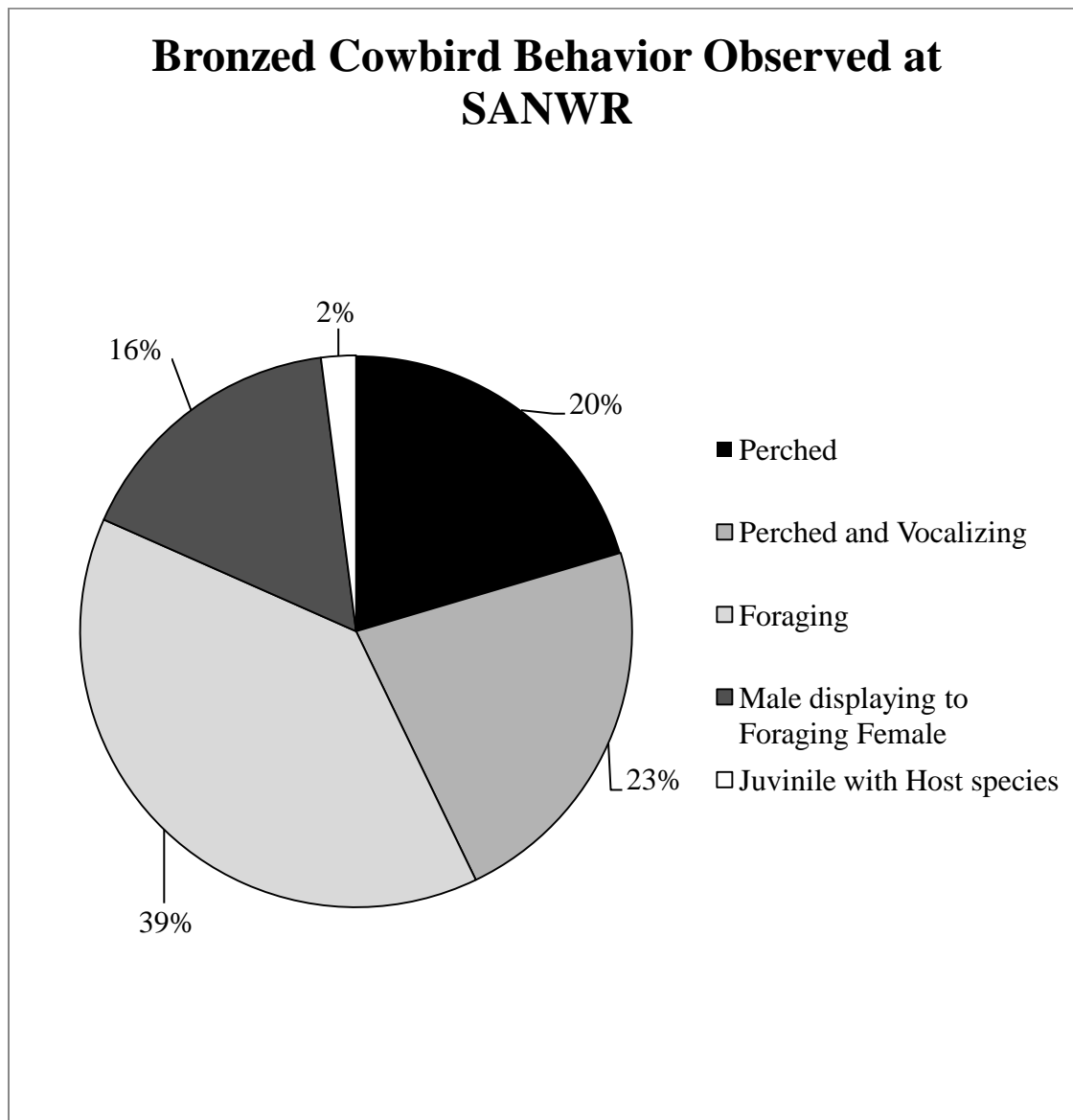


Figure 10. Mean Bronzed Cowbird abundance observed per point per habitat type in Laguna Atascosa National Wildlife Refuge. There was no significant difference detected between habitat types (Mann-Whitney U,  $Z = -1.701$ ,  $p = 0.09$ ).

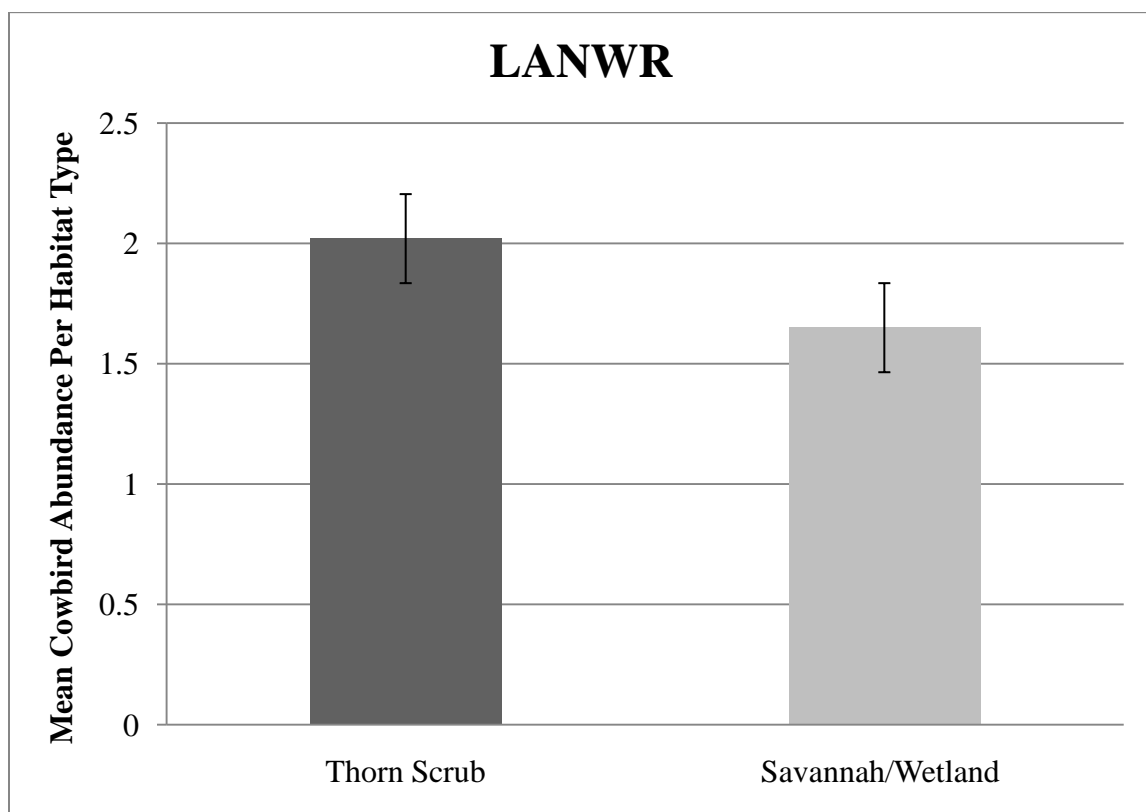


Figure 11. Vegetation profile for thorn scrub habitats in Laguna Atascosa National Wildlife Refuge.

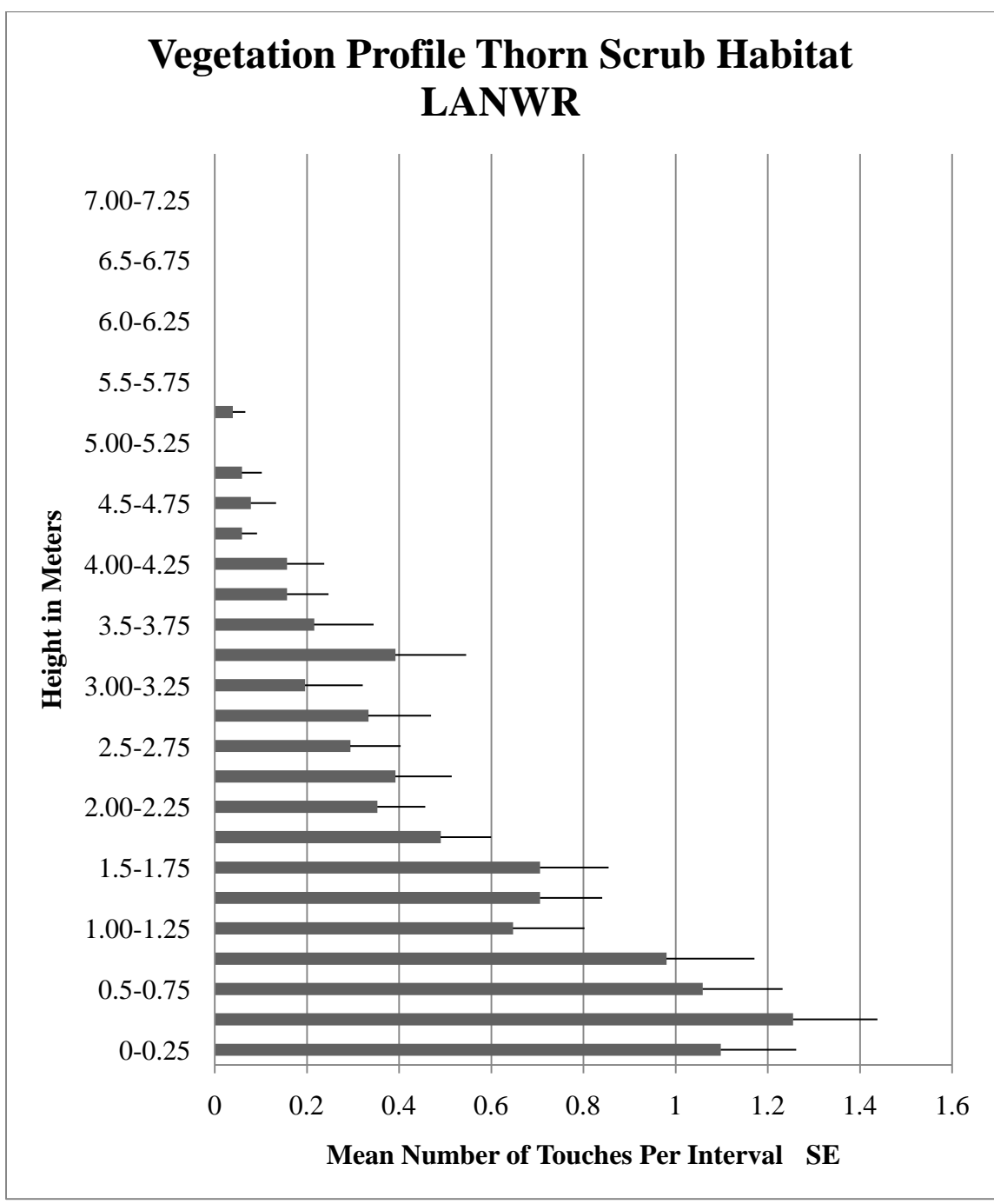


Figure 12. Vegetation profile for open grassland and savannah habitats at Laguna Atascosa National Wildlife Refuge.

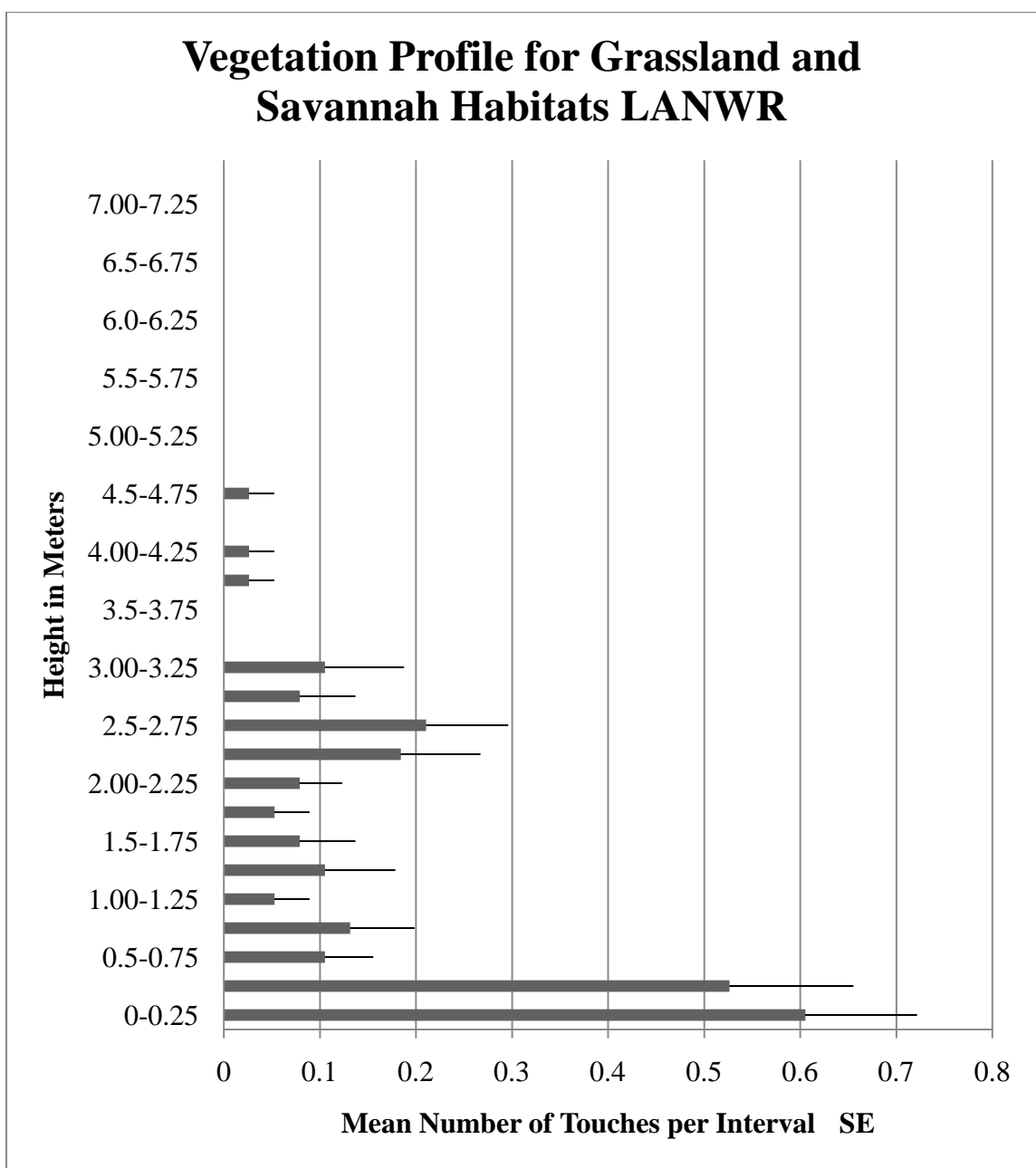


Figure 13. Bronzed Cowbird behavior in LANWR.

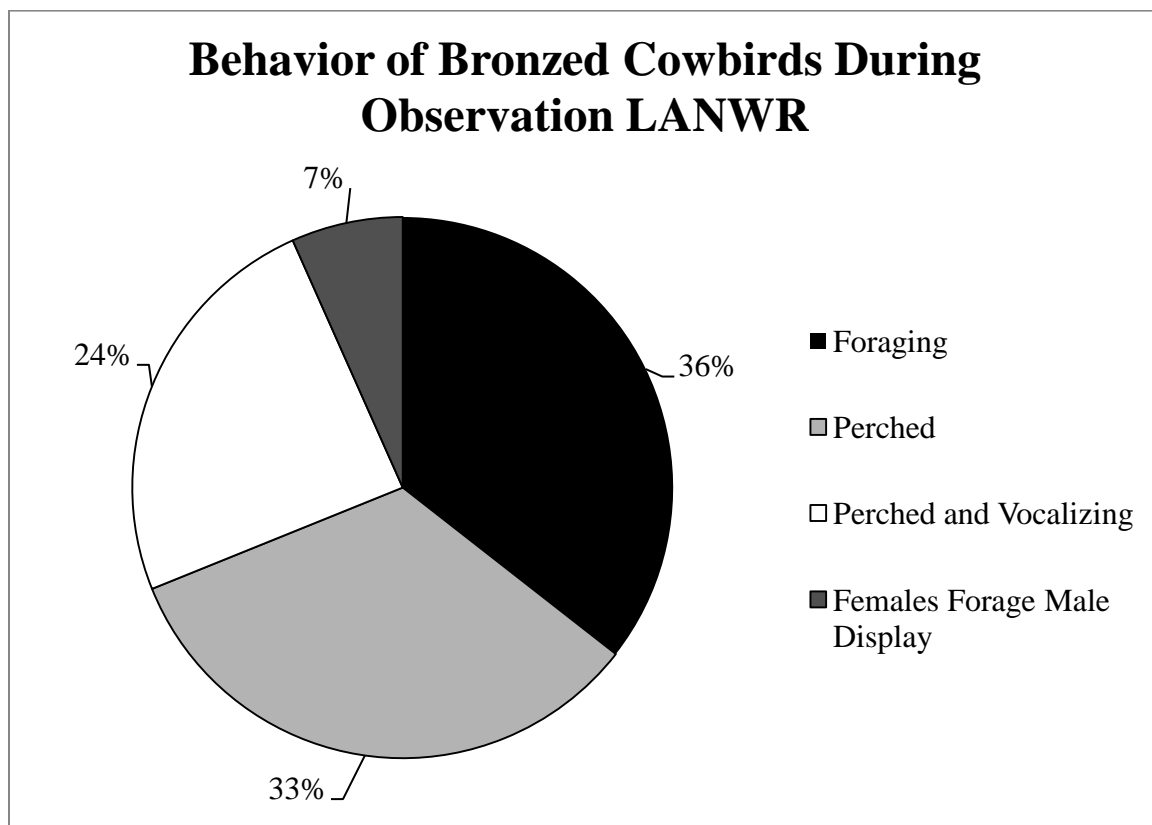


Figure 14. Percent Bronzed Cowbird reponse to playback of host species vocalizations in Santa Ana National Wildlife Refuge. There was an overall response rate of 36% (N=120). There were significant differences were detected in response between the host species (Friedman  $X^2= 92.66$  df= 2;  $p= <0.001$ ).

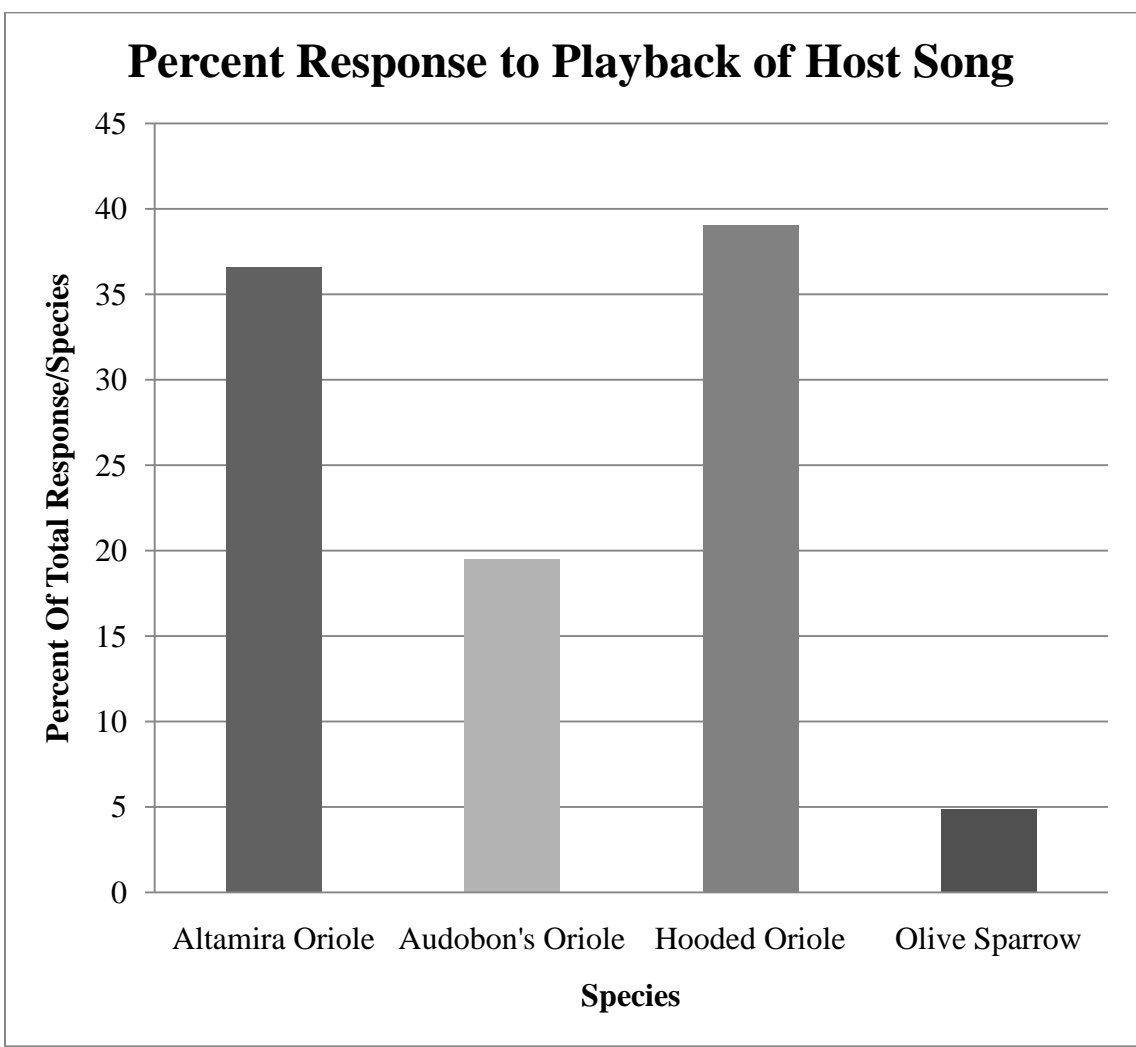




Figure 15. Percent Bronzed Cowbird response type observed in SANWR.

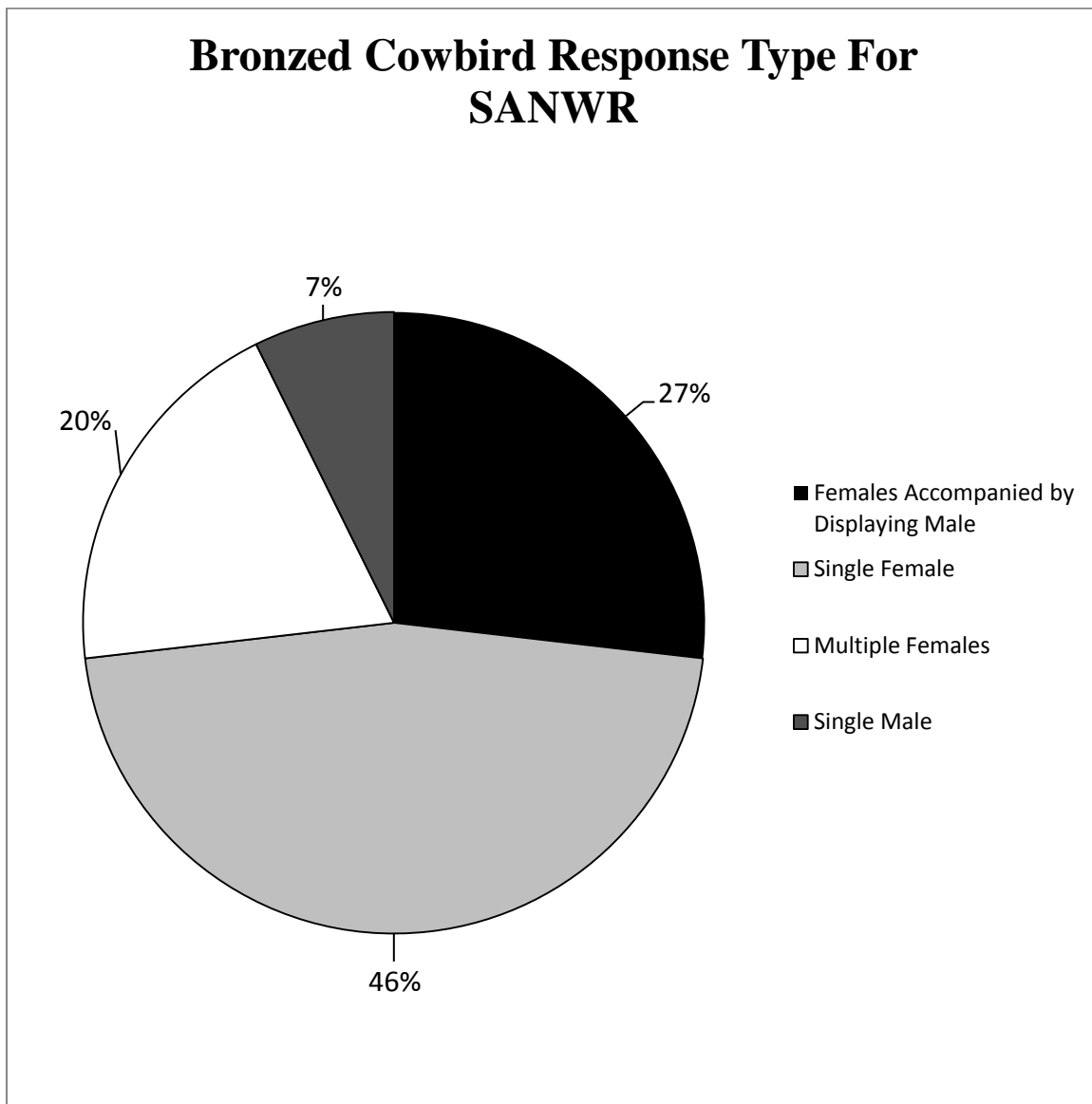


Figure 16. Percent response to playbacks of host vocalizations for Laguna Atascosa National Wildlife Refuge at an overall rate of 20% (N=60). Species that elicited no response were not graphed but included the Olive Sparrow, Hooded Oriole, and Couch's Kingbird. Significant differences were detected in response between species (Friedman  $X^2= 42.00$   $df= 2$ ;  $p= <0.001$ ).

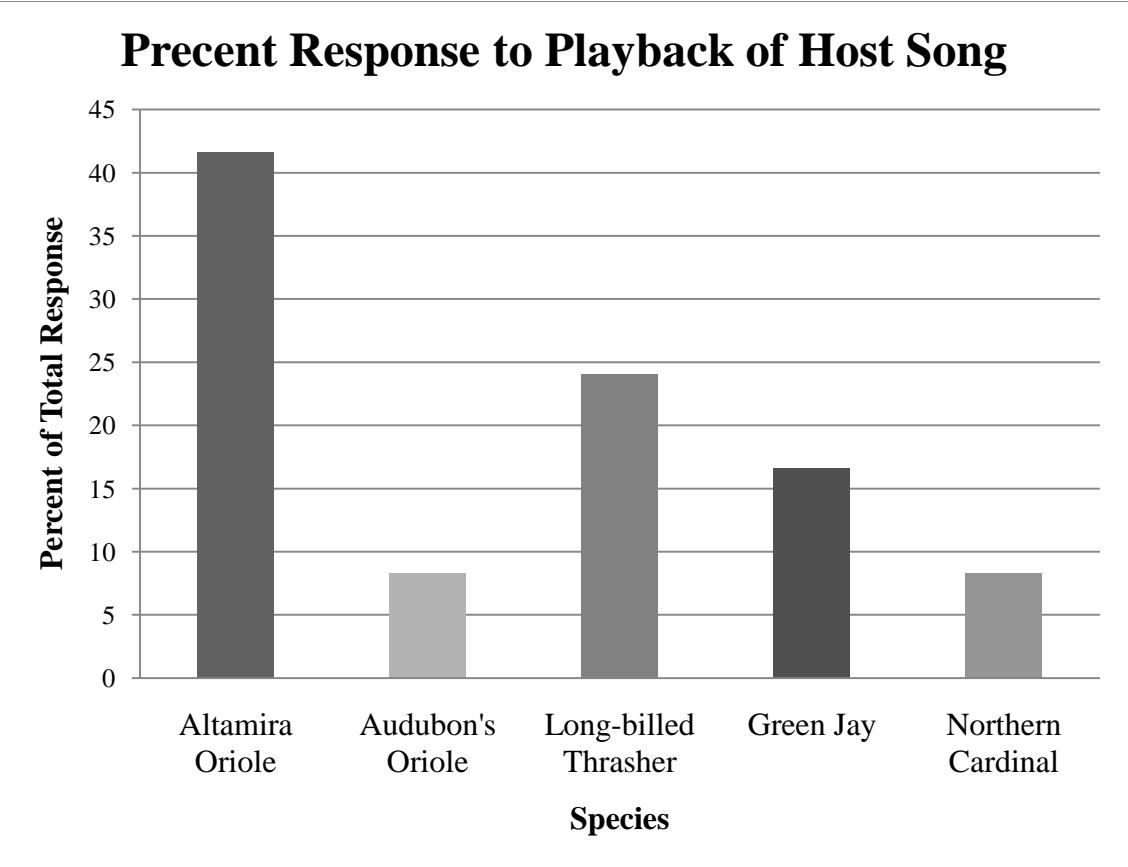
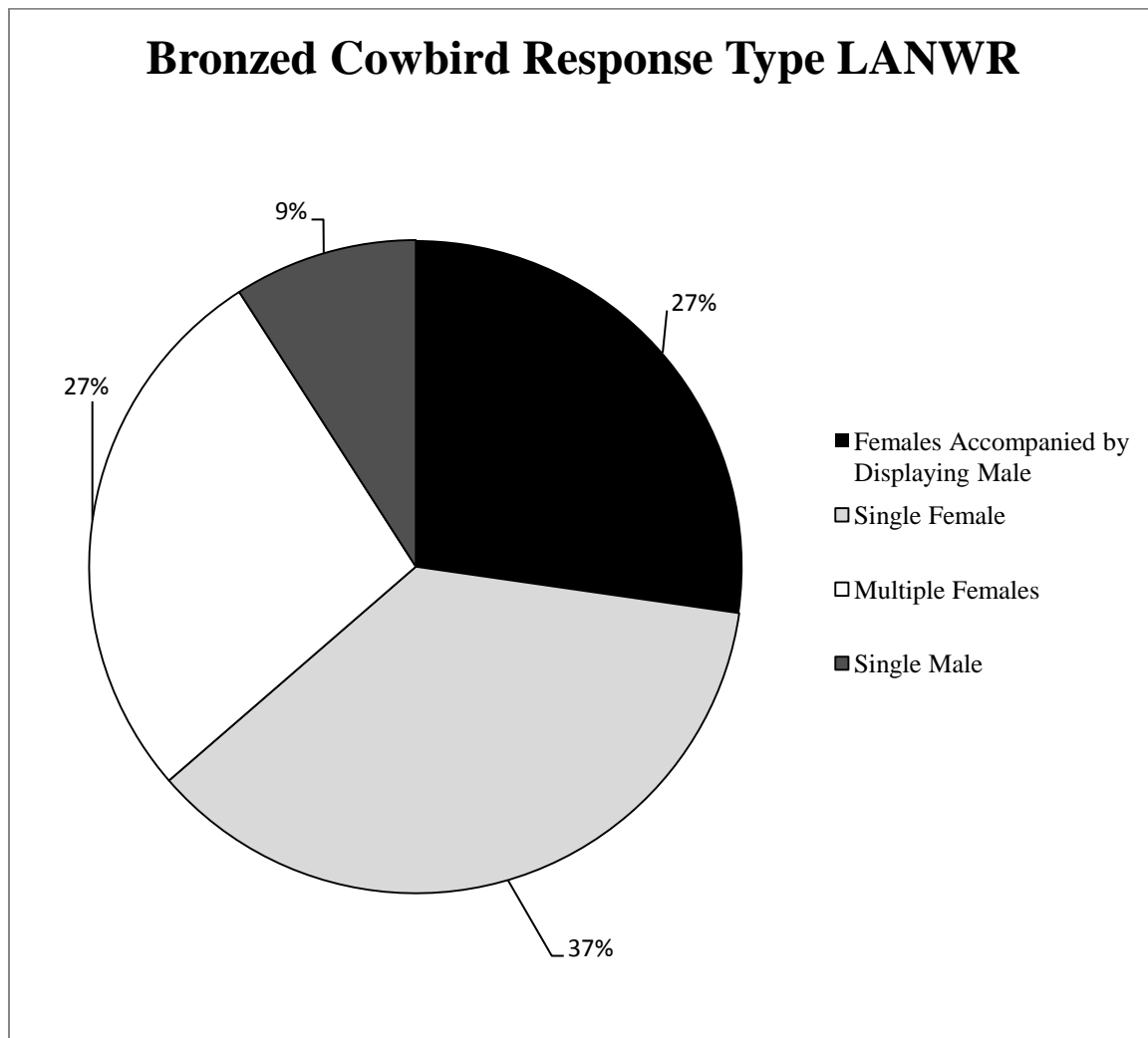


Figure 17. Percent response types observed in LANWR.



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Mary Jennifer Gorton, daughter of Robert E. Gorton Jr. and Danita E. Martin, was born on September 4, 1984 in El Paso, TX. She received a Bachelor of Science with an emphasis in Environmental Biology from Emporia State University in 2006, during which time she worked as a Park Ranger for the U.S. Army Corps of Engineers. After graduation, she conducted research for the Institute for Bird Populations in Texas and Missouri and raised, preconditioned and released endangered black-footed ferrets (*Mustela nigripes*) in Colorado and Utah for the Bureau of Land Management. As a graduate student she also conducted research for Texas A&M University AgriLife Extension Agency. Her thesis research was presented at the Hispanic Engineering Science and Technology Conference, where she and Dr. Timothy Brush won best graduate student poster in Biology and the American Ornithologist Union/ Cooper Ornithological Society Joint Conference in 2010. In May 2010, she received her M.S. in Biology from the University of Texas-Pan American.

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