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DISTRIBUTION, ABUNDANCE, AND BREEDING BIOLOGY OF POTENTIAL COWBIRD HOSTS ON SANIBEL ISLAND, FLORIDA

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Abstract.—We present baseline data on the distribution, abundance, and breeding biology of potential cowbird hosts on Sanibel Island, Florida, so that future changes in these bird populations due to habitat alteration and Brown-headed (*Molothrus ater*) and Shiny cowbird (*Molothrus bonariensis*) parasitism may be assessed. The number of species ranged from 5 in the red mangrove swamp to 10 in the interior scrub. The Northern Cardinal (*Cardinalis cardinalis*) was found in all habitats, while the Black-whiskered Vireo (*Vireo altiloquus*), Common Yellowthroat (*Geothlypis trichas*), and Eastern Towhee (*Pipilo erythrophthalmus*) were largely restricted to a single habitat. Highest densities recorded were for the Northern Cardinal and the Black-whiskered Vireo in mangrove habitat and the Common Yellowthroat in *Spartina* marsh. A total of 126 active nests of the ten targeted species were located, with most nests belonging to Red-winged Blackbirds (*Agelaius phoeniceus*), Northern Cardinals, and Gray Kingbirds (*Tyrannus dominicensis*). Predation was the primary cause of nest failure, accounting for 84 of 91 (92.3%) of the failures. Both cowbird species were found primarily in developed areas on the island, although they were also seen in “natural” habitats. As only two parasitized Red-winged Blackbird nests were found, cowbird parasitism does not appear to be a significant threat at this time. We note that this host species is the only one for which we obtained a very large sample size of nests, and that other species are probably also parasitized. However, we feel that it is only a matter of time before higher levels of parasitism are observed.

Recent changes in the range of the brood parasitic Shiny Cowbird (*Molothrus bonariensis*) and Brown-headed Cowbird (*M. ater*) have brought them into contact with avian communities that have never experienced brood parasitism. Historically, the Shiny Cowbird was confined to South America, and the Brown-headed Cowbird was confined to central and western North America. With the reduction of forest and large-scale alterations associated with agriculture and animal husbandry, cowbirds have expanded their geographical ranges, bringing

them into contact with hosts that lack defenses against brood parasitism (Mayfield 1977; Cruz et al. 1985; Cruz et al. 1989, 2000; Pranty 2000). The Shiny Cowbird was first recorded in Florida in 1985 (Smith and Sprunt 1987). From the opposite direction, the North American Brown-headed Cowbird has expanded rapidly through peninsular Florida since 1985 (Cruz et al. 2000).

Because of the small population size and high degree of isolation of the south Florida avifauna (Robertson and Kushlan 1984), contact with cowbirds is potentially more detrimental than in other North American areas where new contact between species occurs more gradually and over a wider area. Not only are many Florida species (e.g., vireos and warblers) restricted in range, but they may also be confined to specific habitats, factors that make them particularly susceptible to detrimental effects of parasitism.

Between July and August 1994, and between April and July 1995, and July 1997, we studied the breeding songbird community on the J. N. "Ding" Darling National Wildlife Refuge (henceforth Refuge) and adjacent properties owned by the Sanibel-Captiva Conservation Foundation (SCCF) on Sanibel Island, southwestern Florida (Fig. 1). Our study was designed to obtain baseline data on (1) the distribution and abundance of Brown-headed and Shiny cowbirds; (2) the abundance, breeding biology, and habitat use of potential cowbird host species; and (3) the potential impact of cowbirds on host populations.

STUDY SITES

We collected data in six different habitat types found on the Refuge and on SCCF: *Spartina* marsh, interior scrub, palm forest, transitional woodland, mixed mangrove woodland, and red mangrove swamp. Descriptions provided are based on personal familiarity with the habitats and Cooley (1955).

1. *Spartina marsh*. Previously far more widespread (Cooley 1955), extensive tracts of *Spartina* remain on the SCCF property and on the Refuge. The dominant vegetation in the marsh habitat is the grass *Spartina latifolia*, which occurs in almost pure stands in some areas. Herbaceous vegetation found in association with *Spartina* included leather fern (*Acrostichum daniaefolium*) and sea oxeye daisy (*Borrchia frutescens*). In drier areas extensive clumps of woody vegetation including sabal palms (*Sabal palmetto*), saltbush (*Baccharis halimifolia*) and wax myrtle (*Myrica cerifera*) occur, while very wet areas often have patches of cattails (*Typha* spp.).

2. *Interior scrub*. The scrub habitat is a mixture of short trees and shrubs (generally < 3 m tall) that form dense thickets in the upland areas. Common woody species include saltbush, wax myrtle, Florida privet (*Forestiera segregata*), wild lime (*Zanthoxylum fagara*), and white indigo berry (*Randia aculeata*). Thickets often contain many thorny lianas, as well as the vines Virginia creeper (*Parthenocissus quinquefolia*) and poison ivy (*Rhus toxicodendron*).

3. *Palm forest*. This upland habitat is dominated by sabal palm, which occurs both in monotypic stands and mixed with various hardwoods. Other trees commonly associated with the palm forest habitat include gumbo limbo (*Bursera simaruba*), strangler fig (*Ficus aurea*), and sea grape (*Coccoloba uvifera*). This forest is much taller than the scrub

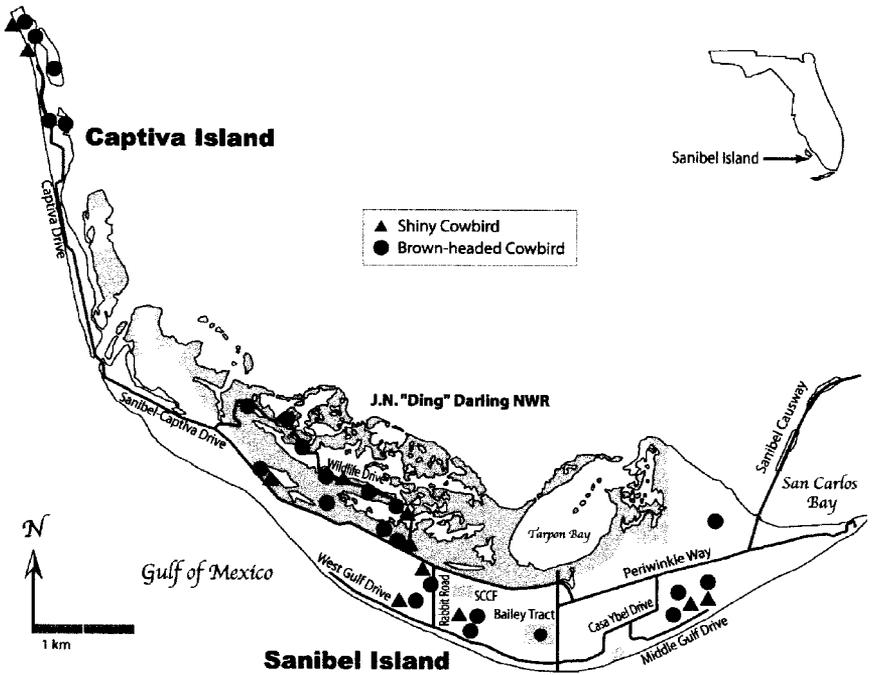


Figure 1. Distribution of Brown-headed and Shiny cowbirds on Sanibel and Captiva Islands. Data based on field observations.

habitat, with trees often reaching heights of 10 m or more, and generally has a relatively open understory with only scattered clumps of shrubby vegetation.

4. *Transitional woodland.* Transitional woodland occurs in a narrow belt between the palm forest and the mangrove woodlands. These areas are periodically flooded by high tides and several more salt-tolerant tree species occur in the zone. Dominant woody plants include white mangrove (*Laguncularia racemosa*), buttonwood (*Conocarpus erectus*), and sea grape. In many areas a thick mat of the succulent *Batis maritima* covers the ground. Trees in this habitat rarely exceed 12 m in height.

5. *Mixed mangrove woodland.* This woodland is primarily a mixture of black mangrove (*Avicennia germinans*) and red mangrove (*Rhizophora mangle*) trees between 6 and 10 m high, with occasional patches of buttonwood and white mangrove. It occurs as a broad belt between the transitional woodland and the red mangrove swamps.

6. *Red mangrove swamp.* This habitat occurs in a belt along the leeward side of the island, and is dominated by red mangrove trees 6 to 12 m tall. In most areas, red mangroves occur in either monotypic stands or in association with black mangrove.

METHODS

Point counts. For seven weeks during June and July 1995, we surveyed the avian community using fixed-radius point counts as described in Hutto et al. (1986). Counts took place once per week at 48 points, eight in each of the six habitats. Ten minutes were spent recording all species seen and heard within 70 m of each point. All counts took place between 07:00 and 09:30 when birds were most actively singing. Densities of potential host species were determined by averaging the number of birds detected at

each point over the seven-week period, adding the averages for all points within a given habitat, and dividing by the amount of habitat surveyed.

Breeding Biology. During July and August 1994 and from April through August 1995, we searched for nests on the Bailey Tract of the Refuge and on the property of the SCCF. Nests were located by actively searching likely nest sites, following birds that appeared to be nesting, or by carefully observing birds that were seen carrying nesting material. Once a nest was located, its contents were noted every 2 to 3 days thereafter until either the nest failed or the young were fledged. If the nest failed, the area was searched for evidence of the cause of failure (animal tracks, punctured eggs, damage to the nest). Nest appearance and mode of disturbance were used to determine the fate of unsuccessful nests. We used the Mayfield method (Mayfield 1975) to determine rate of nesting success for those species for which we located at least 10 nests.

Cowbird censuses. Once per week, we counted cowbird numbers on various areas of Sanibel Island frequented by cowbirds, both on (Wildlife Drive, Shell Mound Trail) and off the Refuge (Lake Murex Estates, East Rocks Subdivision, Rabbit Road, Recreational Center/Elementary School Complex, Beachview Golf Course; Fig. 1). Time spent in each area varied from 30 to 90 minutes, depending upon size of the area. In addition, cowbird observations during the course of other work, including point counts, were noted. These data were used to describe cowbird movements, areas frequented, and an estimate of cowbird numbers on the Refuge and the island.

RESULTS

Point Counts. No cowbirds were recorded during point counts. However, cowbirds were recorded outside the point counts. Data are presented on ten potential host species that were detected during point counts over the course of this study (Table 1). Of these species, only the Northern Cardinal (*Cardinalis cardinalis*) was found in all habitats on the Refuge, while, three species, the Black-whiskered Vireo (*Vireo altiloquus*), Common Yellowthroat (*Geothlypis trichas*), and Eastern Towhee (*Pipilo erythrophthalmus*), were largely or entirely restricted to a single habitat. The remaining six species occurred in a number of habitats, although three of the six occurred in high densities (≥ 10 pair/40 ha) in only one habitat type. The number of species found in a given habitat ranged from 5 in the red mangrove swamp to 10 in the interior scrub.

Breeding biology. We found 108 active nests of potential host species, but significant sample sizes are available only for the Red-winged Blackbird (*Agelaius phoeniceus*—73 nests), Northern Cardinal (10 nests), and Gray Kingbird (*Tyrannus dominicensis*—12 nests). Only 35 of the 126 nests (27.8%) were successful, and Mayfield nest success estimates were low (Table 2). Predation was the primary cause of nest failure, accounting for 84 of 91 nest failures (92.3%). Seven of 73 (9.6%) Red-winged Blackbird nests failed due to abandonment. We found only 2 parasitized nests, both of Red-winged Blackbirds, suggesting a low impact of cowbird parasitism on the breeding avifauna.

Brown-headed and Shiny cowbirds. Both cowbird species were found primarily in developed areas on the island, although they were also seen in "natural" habitats (Fig. 1). This low observation rate in less

Table 1. Densities (pairs/40 ha) of selected bird species in various habitats on Sanibel Island.

Species	<i>Spartina</i> marsh	Interior scrub	Palm forest	Transitional woodland	Mangrove woodland	Mangrove swamp
Gray Kingbird	04.64	*		04.64	05.10	
Great-crested Flycatcher		04.64	04.64	*		05.10
Carolina Wren		10.20	05.10			
White-eyed Vireo	06.50	18.10		04.64	04.64	
Black-whiskered Vireo					*	21.81
Prairie Warbler	*	09.74		04.64	11.60	12.06
Common Yellowthroat	25.06	*				
Red-winged Blackbird	09.28	*			04.64	
Northern Cardinal	*	24.12	22.02	22.38	25.98	22.74
Eastern Towhee		26.45				

*Indicates a species was present at a density of < 4 pairs/40 ha.

Table 2. Breeding biology data for selected bird species on Sanibel Island.

Species	# Nests located	Clutch size	Percent successful	Percent failed	Percent parasitized	Mayfield nest success
Gray Kingbird	12	3.3 (n = 10)	25.0	75.0	0	18.9%
Great Crested Flycatcher	1	4.0 (n = 1)	0	100	0	—
Carolina Wren	1	—	0	100	0	—
White-eyed Vireo	3	3.0 (n = 3)	66.7	33.3	0	—
Black-whiskered Vireo	1	—	0	100	0	—
Prairie Warbler	1	3.0 (n = 1)	100	0	0	—
Common Yellowthroat	1	4.0 (n = 1)	0	100	0	—
Red-winged Blackbird	73	2.7 (n = 56)	36.4	73.6	2.7	30.1%
Northern Cardinal	10	3.0 (n = 8)	70.0	30.0	0	60.9%
Eastern Towhee	5	3.0 (n = 4)	20.0	80.0	0	—

disturbed areas is probably due more to the low numbers of cowbirds on Sanibel, which made detection unlikely away from normal feeding areas. Limited data suggest that a small population is also resident on Captiva Island, and that there may be many cowbirds in agricultural areas on the nearby mainland. During July 1994, we located 6 to 8 pairs of Brown-headed Cowbirds and a pair of Shiny Cowbirds on Sanibel. We regularly saw cowbirds in the Lake Murex estates and the East Rocks subdivision, both less than 1.6 km from the study areas, and on the Beachview Golf Course, 3 km east of the study areas. Individual birds and pairs were often seen on the Rabbit Road bicycle path and along Wildlife Drive on the Refuge (Fig. 1). The largest single group of cowbirds observed included 5 male and 3 female Brown-headed Cowbirds and one male Shiny Cowbird. Brown-headed Cowbirds were heard calling and singing, and were observed courting and mating, indicative of breeding activity. From mid-April through early July 1995 relatively fewer cowbirds were seen on Sanibel Island. At least 2-3 pairs of Brown-headed Cowbirds were seen regularly around East Rocks subdivision and on the softball field (recreation area and elementary school complex) adjacent to the Refuge. Occasionally we saw individuals and pairs along the Wildlife Drive and noted singing, chatter calls, and displays on several occasions, suggesting these birds were breeding.

In July 1997, we again saw Brown-headed Cowbirds along Wildlife Drive (2 males and 2 females), the recreational center/elementary school complex near Refuge headquarters (1 male and 3 females), and the Beachview Golf Course (2 males and 4 females). In all three locations, we observed male cowbirds displaying to females and pairs copulating. We saw a pair of Brown-headed Cowbirds and a pair of Shiny Cowbirds near the Shell Mound Trail on the Refuge.

We were only able to confirm two instances of cowbird parasitism on Sanibel Island. Both involved nests of Red-winged Blackbirds. We note that this host species is the only one for which we obtained a very large sample size of nests, and that other species are probably parasitized. On nearby Captiva Island, a female Prairie Warbler (*Dendroica discolor*) was observed feeding a cowbird young (species unidentified) in June 1997 (Vince McGrath, pers. comm.).

SPECIES ACCOUNTS AND HOST SUITABILITY

Information on cowbird-host interactions in the West Indies and North America (including Florida) allows us to predict the suitability of passerines on Sanibel as cowbird hosts (Cruz et al. 1985; Cruz et al. 1989, 2000; Pranty 2000).

Great Crested Flycatcher (*Myiarchus crinitus*). Great Crested Flycatchers are relatively uncommon on the Refuge, occurring in low densities (4 pairs/40 ha.) in the interior scrub, sabal palm forest, and

red mangrove swamp habitats (Table 1). One active Great Crested Flycatcher nest was located in an old woodpecker hole in a dead sabal palm trunk. The nest contained four eggs when first located on 13 June, but was later predated, possibly by a snake.

Outside of Florida, this flycatcher is infrequently parasitized by Brown-headed Cowbirds; only 12 incidences of parasitism have been reported. Because Brown-headed Cowbirds infrequently parasitize cavity-nesting species, Great Crested Flycatchers are low-suitability hosts for them (Friedmann et al. 1977; Cruz et al. 2000). Shiny Cowbirds, on the other hand, frequently parasitize cavity-nesting species (Friedmann et al. 1977; Cruz et al. 1985; Wiley 1985; Post et al. 1990), including the congeneric Puerto Rican Flycatcher (*M. antillarum*), which has a parasitism rate of 34% (16/47) in Puerto Rico (Cruz et al. 1989; Cruz et al. 2000). We feel that the Great Crested Flycatcher is a potential host on Sanibel Island and other areas of south Florida for the Shiny Cowbird, but possibly of low or marginal suitability for Brown-headed Cowbirds (Table 3).

Gray Kingbird (*Tyrannus dominicensis*). We found Gray Kingbirds in low densities (around 4-5 pairs/40 ha.) in the more open habitats (Table 1). Twelve nests were located in the upper and outer branches of taller trees, and nests were often over water. In ten nests with known clutch size, the mean clutch size was 3.3 eggs (range 3-4). Predation was a major cause of nest failure for Gray Kingbirds, and 9 of 12 (75%) were depredated. The earliest laying date was 3 May and the latest was 27 June. Gray Kingbirds are unlikely to be major hosts for brood parasitism as they are very aggressive and also reject foreign eggs from their nests (Cruz et al. 1985).

Carolina Wren (*Thryothorus ludovicianus*). Carolina Wrens were most abundant in the scrub habitat (10.2 pairs/40 ha.) where heavy understory provided foraging sites. They were also found locally in residential areas and were detected on an irregular basis on the Bailey Tract. A depredated nest was found in a trunk cavity of a sabal palm. The nest was likely depredated by a yellow rat snake (*Elaphe obsoleta*) seen in the area several times. Nowhere is the Carolina Wren a frequent host choice of the Brown-headed Cowbird (Friedmann and Kiff 1985), possibly because of its cavity-nesting habits, although in Illinois, S. Robinson (pers. comm.) found a 15% rate of parasitism. The Shiny Cowbird parasitizes cavity-nesting species in Trinidad, Tobago, and South America, where the House Wren (*Troglodytes aedon*) is a frequent host (Friedmann et al. 1977; Manolis 1982). We feel that Shiny Cowbirds, once established, will have a greater impact on this species than does the Brown-headed Cowbird (Cruz et al. 1999).

White-eyed Vireo (*Vireo griseus*). White-eyed Vireos were most common in the interior scrub, where densities reached 18.1 pairs/40 ha (Table 1). Three White-eyed Vireo nests were located in interior scrub

Table 3. Rankings of 10 potential host species for cowbird brood parasitism and the reasons for those rankings.

Species	Rank	Reasons for ranking	Reported parasitized by ¹	
			Shiny Cowbird	B. H. Cowbird
Northern Cardinal	1	Abundant	No	Yes, high
Red-winged Blackbird	2	Locally common in open habitats	Similar species, High	Yes, low-high
White-eyed Vireo	3	Locally common in many habitats	Similar species, high	Yes, moderate
Prairie Warbler	4	Locally common in many habitats	Similar species, low-high	Yes, moderate
Black-whiskered Vireo	5	Locally abundant in closed habitat	Yes, high	Similar species, moderate
Common Yellowthroat	6	Locally abundant	No	Yes, low-high
Eastern Towhee	7	Locally abundant	No	Yes, low-high
Great Crested Flycatcher	8	Uncommon in closed habitats	Similar species, moderate	Yes, low
Carolina Wren	9	Locally common	No	Yes, low
Gray Kingbird	10	Uncommon, very aggressive	Yes, low	Similar species, low

¹Data from Friedmann et al. (1977), Friedmann and Kiff (1985), and Cruz et al. (1989). Similar species = species of the same genus as the potential host. Parasitism rates (Low = <10%, Moderate = 10-25%, High = >25%).

habitat on the Bailey Tract and the SCCF property. Each nest contained three eggs, as did several nests found on Sanibel by Harrison (1981). All nests were placed within 1.5 m off of the ground. White-eyed Vireos rank high on our scale of susceptibility to brood parasitism (Table 3) as they are important hosts for the Brown-headed Cowbird (Friedmann and Kiff 1985) and related species have proven vulnerable to Shiny Cowbird parasitism in the West Indies (Cruz et al. 1989). Two instances of parasitism have been reported in north Florida (Stevenson 1963; Stevenson and Anderson 1994). In Pasco County, central Florida, a fledgling cowbird was fed by a White-eyed Vireo (Cruz et al. 1998). In Illinois, White-eyed Vireos continue nesting after cowbirds leave in late July and August, but in Florida they breed from April through July, overlapping the breeding season of both Brown-headed and Shiny cowbirds (Cruz et al. 1989). In Puerto Rico, the closely related Puerto Rican Vireo (*V. latimeri*) is heavily parasitized by the Shiny Cowbird, and we found an 87.2% (34/39) rate of parasitism (Cruz et al. 1998).

Black-whiskered Vireo (*Vireo altiloquus*). We found Black-whiskered Vireos almost exclusively in the red mangrove swamp habitat of the Refuge, where densities were high (Table 1). On the Florida Keys this species also occurs commonly in hardwood hammocks (pers. obs.; Chace et al. 2001), but it is not found in the similar palm forest on Sanibel. We located one vireo nest in the upper branches of a white mangrove on the Bailey Tract. It contained an egg on 2 July but was predated or abandoned soon thereafter. Typical clutches in Florida contain 2 or 3 eggs (Stevenson and Anderson 1994).

In the West Indies, Black-whiskered Vireos are common hosts for Shiny Cowbirds, with rates of parasitism of 88%, 73%, and 35% for St. Lucia, Puerto Rico, and Hispaniola, respectively (Wiley 1985, Cruz et al. 1989, Post et al. 1990, Chace et al. 2001). Vireo clutch sizes were significantly smaller in parasitized than in non-parasitized nests, as was host fledgling success (Cruz et al. 1985, 1998).

In 1989, the first reported incidence of parasitism in Black-whiskered Vireos for North America was recorded (Kale 1989). A vireo was feeding a cowbird fledgling, identified as a Brown-headed Cowbird in Everglades National Park. We predict that in the future cowbird parasitism will become an important threat to the survival of Black-whiskered Vireos in south Florida.

Florida Prairie Warbler (*Dendroica discolor paludicola*). The Florida Prairie Warbler is found in a variety of habitats on the Refuge, but is most abundant in mangroves where densities exceed 10 pairs/40 ha (Table 1). Densities are much lower than those recorded on small keys in Florida Bay, where they may exceed 1 pair/ha (Prather and Cruz 1995, 1996). They are, however, similar to densities in other coastal areas of Florida (Robertson 1955). In contrast to the Florida

Keys, the Prairie Warbler occurs in upland habitats (interior scrub) on Sanibel. At least one pair was breeding on the Bailey Tract.

One Prairie Warbler nest was located during this study. An initial egg was laid on 6 May, the eggs hatched on 18 May, and 3 young fledged on 29 May. In the Florida Keys, nests of this species typically contain 2-4 eggs (avg. 2.86, Prather and Cruz 1995). Incubation lasts 10-15 days, with brooding taking place for an additional 10-15 days (Prather and Cruz 1995).

In a study of the nominate race of the Prairie Warbler in Indiana, Nolan (1978) estimated that parasitism caused about 18% of nest failures of this species. Nolan's study was conducted in what has been generally considered the "original" habitat of the cowbird, where cowbirds and Prairie Warblers have coexisted for many years. Prairie Warblers have been observed feeding fledgling cowbirds in Pinellas and Sarasota counties in southwest Florida (Atherton and Atherton 1988), in Everglades National Park (Kale 1989), and on Captiva Island (in 1990 and 1997, McGrath, pers. comm.). As a common cowbird host, the Prairie Warbler should be carefully monitored (Table 3).

Common Yellowthroat (*Geothlypis trichas*). Common Yellowthroats are abundant in the *Spartina* marsh habitat (25 pairs/40 ha.) and also occur rarely in the interior scrub habitat (Table 1). We located one Common Yellowthroat nest on the Bailey Tract. It contained four eggs when found on 25 June 25, but was predated soon after the young hatched on 3 July. This nest, as is typical for the species, was built just above ground level. In Illinois, frequency of nest parasitism on this species ranged from 16.7% to 75%, in Ohio 46.3%, and in Michigan 38.8% (Friedmann 1963, Graber et al. 1983, Cruz et al. 1998). In 1987, a fledgling Brown-headed Cowbird being fed by a Common Yellowthroat was observed in Pasco County, central Florida (Cruz et al. 1998). We feel that this species will be a common cowbird host (Table 3).

Florida Red-winged Blackbird (*Agelaius phoeniceus mearnsi*). Red-winged blackbirds, found in several habitats on Sanibel Island (Table 1), are most abundant around ponds and canals, such as on the Bailey Tract where 15-20 pairs breed. When the *Spartina* marsh habitat was flooded after heavy rains, the density of blackbirds in that habitat approached 13 pairs/ha; the density was about 6 pairs/ha when the marshes were dry.

Redwings build open nests in cattails and outer branches of shrubs, particularly wax myrtle and saltbush, near water. We located 73 Red-winged Blackbird nests. Clutch size ranged from 2-4 eggs (mean = 2.7 eggs; n = 56 nests; Prather and Cruz, in review). A parasitized Red-winged Blackbird nest on the Bailey Tract in 1993 contained one cowbird egg and two blackbird eggs; one on Sanibel in 1994 contained one cowbird and two host nestlings (Cruz et al. 1998, 2000).

Predation is a major cause of nest failure for Red-winged Blackbirds on Sanibel, with 43 of the 73 nests (58.9%) being predated. Experiments showed that redwings on Sanibel were very aggressive toward cowbird and host models placed near the nest, which may help reduce the overall rate of predation and brood parasitism (Prather et al. 1999).

Outside of Florida, the incidence of Brown-headed Cowbird parasitism on redwings has been reported to be as low as 1.6% (Brown and Goetz 1978) and as high as 54% (Hergenrader 1962; Cruz et al. 1998, 2000). In Seminole County, central Florida, a Red-winged Blackbird fed an immature cowbird in 1989; near Florida City, south Florida, a Red-winged Blackbird was observed feeding a fledgling Shiny Cowbird (identified by vocalization) in 1991 (Cruz et al. 1998, 2000). Despite their abundance, Red-winged Blackbirds should be monitored. We rank this species as a very likely cowbird host (Table 3).

Northern Cardinal (*Cardinalis cardinalis*). The Northern Cardinal is the most abundant bird on Sanibel (Table 1) with densities greater than 1 pair per 2 ha in all habitats except *Spartina*. They are common in residential areas. At least 6 pairs nest on the Bailey Tract. Cardinals were observed feeding cowbirds near Pensacola (Escambia Co.) in 1959, and in Washington County in 1987 (Stevenson 1959; Cruz et al. 1998), and on Pine Island (Lee Co.) and Corkscrew (Collier Co.) in south Florida (Cruz et al. 1998). The Northern Cardinal should be monitored as a likely common cowbird host (Table 3).

Eastern (White-eyed) Towhee (*Pipilo erythrophthalmus leucophrys*). The Eastern Towhee is restricted primarily to scrub habitat on Sanibel, where it occurs in high densities (26.5 pairs/40 ha) (Table 1). Towhees seem to require areas with extensive leaf litter and shrubs, and were rarely observed away from areas of low, thick vegetation. Six to eight pairs nest on the Bailey Tract. Eastern Towhees nest in low thick shrubs, where the nest is well concealed. All nests found were within 2 m of the ground. Five nests found each contained 3 eggs.

Friedmann (1971) reported 327 cases of parasitism of towhees and categorized them as frequently rearing cowbirds. Of the 29 host species recorded in the Carolinas, the one most frequently reported is the Eastern Towhee (Cruz et al. 1998). In Gainesville, north-central Florida, an immature Brown-headed Cowbird was fed by a female towhee in July 1980, and in Hernando County, central Florida, a towhee nest with a cowbird eggs was found in 1990 (Cruz et al. 1998). We feel that towhees will be an important cowbird host in Florida (Table 3).

DISCUSSION

While our study provides baseline data on the biology of cowbird host species on the Refuge and Sanibel Island, much needs to be learned. Additional data on breeding biology, particularly of the less

common species, will help detect future changes in breeding success caused by brood parasitism. Continued studies of breeding biology may help to determine why nest predation rates are high for some species, and whether it represents a threat to some of breeding bird populations. Potential nest predators such as raccoon (*Procyon lotor*), Fish Crow (*Corvus ossifragus*), grackles (*Quiscalus* spp.), yellow rat snake, and black racer (*Coluber constrictor*) are common on Sanibel.

Due to the current small numbers of cowbirds on Sanibel, we believe that the incidence of parasitism is low and cowbirds do not appear to pose a threat to the breeding bird community. We found only two parasitized nests, although small numbers of cowbirds were observed on a regular basis. Reports of cowbirds breeding in south Florida are increasing (Hoffman and Woolfenden 1986; Cruz et al. 1998, 2000; Pranty 2000), and some species on Sanibel (e.g., White-eyed Vireo, Black-whiskered Vireo, Prairie Warbler, Northern Cardinal, Rufous-sided Towhee) are parasitized in other parts of their range. We feel that cowbird parasitism poses a potential threat and that these species ought to be monitored.

The Brown-headed Cowbird is an uncommon breeding resident on Sanibel, but has been reported from both coastal and inland areas in south Florida (Cruz et al. 1998). Although they have been recorded year-round, numbers are augmented from mid-summer with the arrival of post-breeding flocks from areas north of Florida (Cruz et al. 1998).

At present, Shiny Cowbirds are uncommon on Sanibel. As most records of Shiny Cowbirds for North America have been recorded from coastal areas (Cruz et al. 1998), we believe that this species will continue to expand its range on Sanibel and other coastal regions of Florida.

We recommend continued studies on the distribution and status of cowbird populations on Sanibel and in south Florida. Data on the presence of defense strategies such as egg rejection, nest attentiveness, and aggressiveness of host species may help determine how vulnerable they are to brood parasitism.

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