

**AVIFAUNA IN MARITIME FOREST AND SHRUB
HABITATS ON NAVY SUBMARINE BASE KINGS BAY IN
SOUTHEASTERN GEORGIA**

Larry Bryan

*Savannah River Ecology Laboratory
Aiken, SC 29802
lbryan@srel.uga.edu*

Chris Depkin

*Savannah River Ecology Laboratory
Aiken, SC 29802*

Paul Schoenfeld

*NAVFAC Southeast
Navy Submarine Base
Kings Bay, GA 31547*

Susan Wilde

*D. B. Warnell School of Forestry and Natural Resources
University of Georgia, Athens, GA 30602*

Introduction

The diverse habitats of the South Atlantic and Gulf coastal regions, including various forest and shrub types and fresh- and saltwater marshes, provide valuable resources for many avian species (Johnson et al. 1974, Bellis and Keough 1995). Maritime forests, shrublands and marsh hammocks (i.e., raised topographic features in salt marshes) along these coasts are particularly important habitats for songbirds, especially Neotropical migrants moving to and from their breeding and wintering sites (Cohrs and Cohrs 1994, Moore et al. 1995, Hunter et al. 2001, Brittain et al. 2010). Migratory species tend to utilize a series of “islands” of stopover habitats, including forests and shrublands, for shelter and “refueling” during their travels (Able 1999, Moore and Aborn 2000). In fact, marsh hammocks may be critical stopover habitat for migrants (Cox 1988, Cohrs and Cohrs 1994, Somershoe and Chandler 2004). Studies of Georgia and South Carolina marsh hammocks in winter and spring documented >110 avian species and suggested that species richness was associated with hammock size (Fabrizio and Calvi 2003, Whitaker et al. 2004).

Broad-leaf maritime forests are typically dominated by Live Oaks (*Quercus virginiana*), whereas maritime shrublands are dominated by thickets of Saw Palmetto (*Serenoa repens*), Yaupon Holly (*Ilex vomitoria*), and/or Wax Myrtle (*Morella cerifera*). These habitats range in size from contiguous stands on the mainland and barrier/sea islands covering dozens or hundreds of hectares to smaller patches on marsh islands and hammocks covering just a few hectares. Permanent and summer resident bird species of regional concern occurring in these forest and shrub habitats include the Common Ground-Dove (*Columbina passerina*) and Painted Bunting (*Passerina ciris*), respectively (Hunter et al. 2001, Atlantic Coast Joint Venture and U.S. Fish and Wildlife Service 2008).

Relatively few recent avian studies have been conducted in maritime habitats in the South Atlantic region. Brittain et al. (2010) documented 55 species during 2 breeding season surveys on Sapelo Island, Georgia, and found several species/habitat relationships for species of concern. These relationships, which suggest the importance of maritime forest and shrub habitats in combination with adjacent habitats (e.g., salt marsh) to specific avifauna (e.g., Painted Bunting), were later confirmed by stable isotope analyses of feathers of Georgia coastal birds (Brittain et al. 2012). Additionally, Springborn and Meyers (2005) documented the importance of a diversity of coastal habitats, including maritime forest, shrub and saltmarsh, to the conservation of the declining Painted Bunting (Springborn and Meyers 2005). These important avian habitats are at risk, primarily due to both development and sea level rise (SLR) (Brittain and Craft 2012). Development is the principal factor in the acreage decline of coastal hardwood/maritime forest habitats, whereas SLR poses the greatest risk to the loss of maritime shrub habitats.

The avifauna of the mainland component of Kings Bay Navy Submarine Base (NSB), within the South Atlantic coastal region, has been previously documented during multiple surveying efforts. Kepler and Sykes (1996) employed point counts in spring to document the occurrence of 38 and 47 species on NSB in maritime forest and shrub habitats, respectively. Using the same methodology in spring, Burst and Fleming (2005) documented 29 and 45 species in the same habitat types, respectively, in 2004-2005. Also, Forsythe (2005) censused winter birds along established routes on the facility in 2004 and 2005, recording 31 and 27 species in maritime forest and maritime shrub habitats, respectively.

In 2010, we initiated a 2-year project to document winter and spring avifauna utilizing the maritime forest and shrub habitats of NSB, with emphasis on recording occurrences and observation rates of species of concern and/or

listed species. Additionally, we examined species occurrence relative to the “form” (i.e., mainland versus island) of these 2 habitat types.

Methods

Study Area

The NSB is located in Camden County, Georgia, within the South Atlantic Coastal Plain. The installation comprises approximately 6475 ha, including a variety of habitats ranging from urban/developed areas to pine plantation to maritime forest (Live Oak)/shrublands to salt marsh/open water. Thus, the base provides habitat for a variety of avifauna, including resident and migrant species of concern. Approximately 768 ha of maritime forest habitat exist on the NSB, with 737 ha on the mainland component of the base, and 31 ha associated with marsh hammocks and Drum Point Island. Approximately 465 ha of maritime shrub habitat also exist on the NSB, with 252 ha on the mainland component of the base, and 213 ha associated with the Crab Island dredge containment site. Drum Point Island (22.6 ha), Crab Island, and the 4 surveyed marsh hammocks (5.1, 2.4, 0.7, and 0.3 ha) are surrounded by salt marsh and some open water habitats.

Surveys

Maritime forest and shrub habitats were surveyed generally utilizing the methods, mainland survey routes, and point locations employed in the Forsyth (2005) and Burst and Fleming (2005) studies. Winter surveys consisted of multiple timed, meandering surveys during November-February. The mainland components of both maritime habitat types were surveyed 4 times (2010/2011). There were 2 winter surveys of Crab Island (2010/2011; maritime shrub) and 3 winter surveys of Drum Point Island and the 2 largest marsh hammocks (2011/2012; maritime forests). The 2 smallest hammocks were only surveyed twice. One individual (CD) made all observations. These surveys documented species occurrence and species/birds observed per hour for each habitat type.

Spring surveys consisted of point counts generally following the methods of Hamel et al. (1996), tallying all birds observed or heard for a 10-minute period regardless of distance, including flyovers, in May-June. All point locations were spaced >250 m apart and a single count at each point occurred between 30 minutes prior to sunrise to 3 hrs post-sunrise. There were 28 total established

points within maritime forest habitat, including 10 total points on the island component (i.e., 4 points on Drum Point Island and 6 total points on the 4 marsh hammocks, including 2 each on the 2 larger hammocks). There were 26 total count points in maritime shrub habitat, including 6 on Crab Island. One individual (CD) made all observations, documenting species occurrence and average species/birds observed per point.

Avian species abundance data for both (winter and spring) seasonal surveys were examined relative to the 2 principal habitat types: maritime forest and maritime shrub. In addition, given the contrast in surveyed habitat types relative to adjoining habitat types (i.e., upland versus salt marsh/open water), we further examined avifauna in island/hammock habitat types (maritime oak and shrubland) relative to similar mainland habitat types. We arbitrarily defined “common” or more abundant species as those averaging >5 individuals per hour (ind/hr) for winter surveys and >1 individual per point (ind/point) for spring point counts. Scientific names of all observed avifauna are listed in Tables 2 and 3.

Species of Concern

Although all species detected per the methodology above were recorded, special consideration was given to those species listed as “Highest” and “High” priority in the South Atlantic Migratory Bird Initiative Conservation Plan (SAMBI) (Atlantic Coast Joint Venture and U.S. Fish and Wildlife Service 2008) and/or listed as “Extremely High” and “High” priority species for the South Atlantic Region by Partners in Flight (PIF) (Hunter et al. 2001).

Results

Overall, 117 avian species were observed in the 2 maritime habitats during the study, including 31 species of concern (Tables 1-3). Surveys in maritime forest habitats documented 69 avian species during winter and 47 species during spring, including 12 and 10 species of concern, respectively. Surveys in maritime shrub habitats documented 60 avian species during winter and 61 species during spring, including 11 and 17 species of concern, respectively. For maritime forest habitats, our surveys suggested that overall species abundance was greater during the winter than spring for both habitat forms (i.e., mainland and island), with an especially pronounced difference in abundance of bird species suggested between seasons in island forests (Table 1). For maritime

shrub habitats, overall seasonal bird species abundance was relatively equal, although spring abundance was greater for the mainland shrublands and winter abundance was greater for the island shrublands (Table 1). The most common winter species recorded included Yellow-rumped Warbler, American Robin, Northern Cardinal, and Savannah Sparrow, whereas Northern Cardinal, Carolina Wren, and White Ibis were most common in spring surveys.

The most common winter species recorded in both habitat types and forms were Yellow-rumped Warblers, whose observations ranged from 10-30 ind/hr, and American Robins, whose observations ranged from 4-45 ind/hr among all habitat types and forms except island maritime shrub, where they were not seen. Other common (>5 ind/hr) species in winter mainland maritime forest habitats were Turkey Vulture, Ruby-crowned Kinglet, Tufted Titmouse, and Red-bellied Woodpecker. Species common to both mainland and island maritime shrublands in winter were Savannah Sparrow and Mourning Dove.

The most common species recorded in spring among all habitat types and forms were Northern Cardinal, averaging >1 ind/point, and Carolina Wren, averaging 1.28 ind/point in forests and 0.6 ind/point in shrub habitat. Common, habitat-specific spring species included Bobolink (2.8 ind/point) and Northern Parula (1.28 ind/point), which were found in mainland maritime forests, and White Ibis (>2 ind/point), which was found in maritime shrub habitats.

The 31 species of concern observed included resident, spring resident (breeding season), and migrants; several exhibited habitat-related and/or seasonal trends in occurrence (Table 2). Wood Stork and Eastern Towhee were observed during both seasonal (winter and spring) surveys in all maritime habitats and forms. Northern Parula was also observed during both seasonal surveys, but primarily in mainland and island maritime forest habitats during the spring. Common Ground-Dove and Loggerhead Shrike were observed during winter and spring in maritime shrub habitats, although the ground-doves were more prevalent on the islands and shrikes were more prevalent on the mainland. Painted Bunting was observed in maritime shrub habitats during spring, as was Willet and several wading bird species of concern (e.g., Snowy Egret, Tricolored Heron). Species of concern observed only during winter surveys included American Kestrel in shrub habitat and several non-resident sparrows, such as Vesper Sparrow, in or adjacent to maritime forest or shrub habitats (Table 2).

Observation rates for the more common species of concern were highly variable among habitats and seasons, although none averaged >5 ind/hr during winter surveys, and only 6 species exceeded 1 ind/hr in winter (Table 2). For the

spring surveys, White Ibis was common (>1 ind/point) in mainland maritime forest and both maritime shrub forms. Common Ground-Dove, Eastern Towhee, and Painted Bunting were also common in island maritime shrub habitats, and Northern Parula was common within mainland maritime forest habitat.

Discussion

The NSB offers multiple diverse and apparently resource-abundant habitats for winter resident, spring resident (breeding season), and migratory avifauna. Overall species abundance observed here was somewhat similar to that reported from other South Atlantic coastal habitats (Fabrizio and Calvi 2003, Whitaker et al. 2004, Brittain et al. 2010), as well as to earlier surveys of NSB (Kepler and Sykes 1996, Burst and Fleming 2005, Forsythe 2005). As in previous studies, occurrence of all avian species, including species of concern, varied both by habitat type (maritime forest vs. shrub), habitat form (mainland vs. island), and season (winter vs. spring). For example, the increased species abundance observed in the spring maritime shrub surveys was largely due to sightings of wading bird and other waterbird species of concern that breed locally on NSB. However, detailed comparisons to other studies are problematic due to differences in methodology and effort.

There are important considerations regarding species abundance recorded at NSB in this study relative to habitats, habitat forms, and seasonality. Concerning habitat form (mainland vs. island), the mainland survey areas were generally embedded in relatively large areas of maritime forest or shrub habitat, and thus the bird species encountered were likely to be traditionally associated with one of these specific habitat types. In contrast, the survey areas on the islands were various-sized (often small) patches of habitat types generally surrounded by salt marsh habitat and/or open water (e.g., Crab and Drum Point Islands); thus, several of the observed species may have been more typically associated with edge or salt marsh/open water habitats than with maritime forest/shrub habitats found on islands. For example, several marsh-associated species such as Marsh Wren, Seaside Sparrow, Nelson's Sparrow, and Saltmarsh Sparrow were documented in maritime forests and shrublands on islands. Similarly, White Ibis, which utilizes salt marshes as foraging habitat, was documented as a prevalent species in both maritime habitats simply because it was observed in large flocks flying to marshes during the surveys.

We also note that the mainland habitat surveys in this study were more rigorous than island habitat surveys relative to the total number of winter

surveys (4 for the mainland vs. 2-3 per island, respectively) and total number of survey points (38 points for the mainland vs. 16 for islands). Additionally, survey methodology varied seasonally (spring point counts vs. winter meandering walks). These differences in survey effort may have resulted in more and/or different species recorded. Concerning seasonal trends, the timing of the surveys was such that the varied arrival/departure times of certain migrants (e.g., Bobolink) resulted in high counts for these species during the spring surveys -- a period typically associated with summer resident/breeding birds. Similarly, Northern Parula was occasionally observed in late winter surveys, suggesting a year-round residence, when it likely was just returning to the region.

Conclusion

Bird species found on the NSB benefit from both diverse and rare habitats, as well as from the juxtaposition of these habitats within the regional landscape. Among the 31 documented species of concern were 5 of the region's most at-risk species of concern: Wood Stork (federally endangered species), Painted Bunting, Loggerhead Shrike, Common Ground-Dove and Saltmarsh Sparrow. Whereas Wood Stork (and other wading bird species of concern) breeds locally and utilizes local fresh- and saltwater marshes, Painted Bunting and Common Ground-Dove, as well as Northern Parula and Eastern Towhee, are habitat-specialists that typify the avifauna that utilize maritime forest and shrub habitats within this region and benefit from conservation of these habitats.

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Table 1. Avian species abundance observed in maritime forest and maritime shrub habitats on Kings Bay Navy Submarine Base during winter and spring surveys, 2010-2012.

Habitat type	Habitat location	Season	Species	SOC ¹
Maritime forest	Combined ²	Winter	69	12
		Spring	47	10
	Mainland	Winter	49	6
		Spring	37	8
	Island/hammock	Winter	57	8
		Spring	33	6
Maritime shrub	Combined ²	Winter	61	11
		Spring	60	17
	Mainland	Winter	50	6
		Spring	57	16
	Crab Island	Winter	34	8
		Spring	21	9
	Combined habitats³	Winter	88	19
		Spring	70	19

¹Species of Concern based on the South Atlantic Migratory Bird Initiative Conservation Plan and the Partners in Flight protocol.

²Includes data for both mainland and island habitats.

³Data for maritime forest and maritime scrub habitats combined.

Table 2. Observation rates¹ of avian species of concern in maritime forest and maritime shrub habitats on Kings Bay Navy Submarine Base, by season and location, 2010–2012.

Species of concern	Maritime forest						Maritime shrub					
	Winter		Spring		Winter		Spring		Winter		Spring	
	Mainland	Island ²	Mainland	Island ²	Mainland	Island ³	Mainland	Island ³	Mainland	Island ³	Mainland	Island ³
Effort¹:	3.35 hrs	10.40 hrs	18 points	8 points	5.10 hrs	6.00 hrs	20 points	6 points	6 points	20 points	6 points	6 points
Brown Pelican (<i>Pelecanus occidentalis</i>)	-	0.1	-	-	-	-	-	-	-	-	-	-
Snowy Egret (<i>Egretta thula</i>)	-	-	-	-	-	-	0.25	0.33	-	0.25	0.33	-
Tricolored Heron (<i>Egretta tricolor</i>)	-	-	-	-	-	-	0.60	0.67	-	0.60	0.67	-
Little Blue Heron (<i>Egretta caerulea</i>)	-	-	-	-	0.20	-	0.25	0.50	-	0.25	0.50	-
Black-crowned Night-Heron (<i>Nycticorax nycticorax</i>)	0.30	-	-	-	-	-	-	-	-	-	-	-
Yellow-crowned Night-Heron (<i>Nyctanassa violacea</i>)	-	-	-	-	-	-	0.10	-	-	0.10	-	-
White ibis (<i>Eudocimus albus</i>)	0.30	-	0.06	1.30	-	-	12.95	2.67	-	12.95	2.67	-
Wood Stork (<i>Mycteria americana</i>)	-	0.19	0.28	0.10	0.20	-	0.15	-	-	0.15	-	-
Northern Harrier (<i>Circus cyaneus</i>)	-	-	-	-	-	0.33	-	-	-	-	-	-
American Kestrel (<i>Falco sparverius</i>)	-	-	-	-	1.37	0.50	-	-	-	-	-	-
Northern Bobwhite (<i>Colinus virginianus</i>)	-	-	0.11	-	-	-	-	-	-	-	-	-
Common Moorhen (<i>Gallinula chloropus</i>)	0.30	-	0.06	-	-	-	-	-	-	-	-	-
American Oystercatcher (<i>Haematopus palliatus</i>)	-	-	-	-	-	-	-	0.17	-	-	0.17	-
Willet (<i>Tringa semipalmata</i>)	-	-	-	-	-	-	0.15	0.67	-	0.15	0.67	-
Common Ground-dove (<i>Columbina passerina</i>)	-	0.10	-	-	-	1.00	0.05	1.33	-	0.05	1.33	-

Table 2 continued.

Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	-	-	-	-	-	-	-	-	-	0.10	-
Chimney Swift (<i>Chaetura pelagica</i>)	-	-	-	-	0.17	-	-	-	-	0.30	-
Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)	-	-	-	-	-	-	-	-	-	0.05	-
Northern Flicker (<i>Colaptes auratus</i>)	0.10	-	-	-	-	-	-	-	-	-	-
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	-	-	-	-	-	0.98	-	0.17	0.25	-	-
Brown Thrasher (<i>Toxostoma rufum</i>)	-	-	-	0.10	-	-	-	-	-	0.20	-
Painted Bunting (<i>Passerina ciris</i>)	-	-	-	-	0.11	0.60	-	-	-	0.25	1.00
Eastern Towhee (<i>Pipilo erythrophthalmus</i>)	0.90	0.29	-	0.40	-	0.59	0.33	0.80	1.17	-	-
Northern Parula (<i>Setophaga americana</i>)	0.60	0.1	1.28	0.60	0.60	-	0.10	0.10	-	-	-
Le Conte's Sparrow (<i>Ammodramus leconteii</i>)	-	-	-	-	-	-	-	0.17	-	-	-
Grasshopper Sparrow (<i>Ammodramus savannarum</i>)	-	-	-	-	-	-	-	0.17	-	-	-
Nelson's Sparrow (<i>Ammodramus nelsoni</i>)	-	0.19	-	-	-	-	-	-	-	-	-
Saltmarsh Sparrow (<i>Ammodramus caudacutus</i>)	-	1.15	-	-	-	-	-	-	-	-	-
Seaside Sparrow (<i>Ammodramus maritimus</i>)	-	1.06	-	-	-	-	-	-	-	-	-
Vesper Sparrow (<i>Poocetes gramineus</i>)	-	-	-	-	-	-	-	1.00	-	-	-
White-throated Sparrow (<i>Zonotrichia atricapilla</i>)	-	-	-	-	-	1.18	-	-	-	-	-

¹Winter observation rates = average number of individuals observed per hour; spring observation rates = average number of individuals observed per count point.

²Island maritime forest habitat was located on marsh hammocks and Drum Point Island.

³Island maritime shrub habitat was located on Crab Island dredge spoil containment area.

Table 3. List of non-species of concern birds observed during winter and spring surveys of maritime forest and maritime shrub habitats on Kings Bay Navy Submarine Base, 2010-2012.

Species	
Anhinga (<i>Anhinga anhinga</i>)	Carolina Chickadee (<i>Poecile carolinensis</i>)
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	Carolina Wren (<i>Thyrothorus ludovicianus</i>)
Great Blue Heron (<i>Ardea herodias</i>)	House Wren (<i>Troglodytes aedon</i>)
Great Egret (<i>Ardea alba</i>)	Sedge Wren (<i>Cistothorus platensis</i>)
Green Heron (<i>Butorides virescens</i>)	Marsh Wren (<i>Cistothorus palustris</i>)
Bufflehead (<i>Bucephala albeola</i>)	Golden-crowned Kinglet (<i>Regulus satrapa</i>)
Turkey Vulture (<i>Cathartes aura</i>)	Ruby-crowned Kinglet (<i>Regulus calendula</i>)
Black Vulture (<i>Coragyps atratus</i>)	Blue-gray Gnatcatcher (<i>Poliophtila caerulea</i>)
Red-shouldered Hawk (<i>Buteo lineatus</i>)	Eastern Bluebird (<i>Sialia sialis</i>)
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	American Robin (<i>Turdus migratorius</i>)
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Hermit Thrush (<i>Catharus guttatus</i>)
Cooper's Hawk (<i>Accipiter cooperii</i>)	Gray Catbird (<i>Dumetella carolinensis</i>)
Peregrine Falcon (<i>Falco peregrinus</i>)	Northern Mockingbird (<i>Mimus polyglottos</i>)
Osprey (<i>Pandion haliaetus</i>)	Cedar Waxwing (<i>Bombycilla cedrorum</i>)
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	European Starling (<i>Sturnus vulgaris</i>)
Wild Turkey (<i>Meleagris gallopavo</i>)	Orange-crowned Warbler (<i>Oreothlypis celata</i>)
American Coot (<i>Fulica americana</i>)	Yellow-rumped Warbler (<i>Setophaga coronata</i>)
Clapper Rail (<i>Rallus longirostris</i>)	Black-throated Blue Warbler (<i>Setophaga caerulescens</i>)
Killdeer (<i>Charadrius vociferus</i>)	Palm Warbler (<i>Setophaga palmarum</i>)
Common Snipe (<i>Gallinago gallinago</i>)	Pine Warbler (<i>Setophaga pinus</i>)
Black-bellied Plover (<i>Pluvialis squatarola</i>)	Blackpoll Warbler (<i>Dendroica striata</i>)
Ring-billed Gull (<i>Larus delawarensis</i>)	Yellow-throated Warbler (<i>Dendroica dominica</i>)
Laughing Gull (<i>Larus atricilla</i>)	Black-and-white Warbler (<i>Mniotilta varia</i>)
Mourning Dove (<i>Zenaida macroura</i>)	American Redstart (<i>Setophaga ruticilla</i>)

Table 3 continued.

Rock Pigeon (<i>Columba livia</i>)	Ovenbird (<i>Seiurus aurocapilla</i>)
Great Horned Owl (<i>Bubo virginianus</i>)	Common Yellowthroat (<i>Geothlypis trichas</i>)
Belted Kingfisher (<i>Megaceryle alcyon</i>)	Yellow-breasted Chat (<i>Icteria virens</i>)
Red-bellied Woodpecker (<i>Melanerpes carolinus</i>)	Summer Tanager (<i>Piranga rubra</i>)
Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>)	Northern Cardinal (<i>Cardinalis cardinalis</i>)
Downy Woodpecker (<i>Picoides pubescens</i>)	Blue Grosbeak (<i>Passerina caerulea</i>)
Pileated Woodpecker (<i>Dryocopus pileatus</i>)	Chipping Sparrow (<i>Spizella passerina</i>)
Great Crested Flycatcher (<i>Myiarchus crinitus</i>)	Savannah Sparrow (<i>Passerculus sandwichensis</i>)
Eastern Phoebe (<i>Sayornis phoebe</i>)	White-crowned Sparrow (<i>Zonotrichia leucophrys</i>)
Red-eyed Vireo (<i>Vireo olivaceus</i>)	Song Sparrow (<i>Melospiza melodia</i>)
White-eyed Vireo (<i>Vireo griseus</i>)	Swamp Sparrow (<i>Melospiza georgiana</i>)
Blue-headed Vireo (<i>Vireo solitarius</i>)	Bobolink (<i>Dolichonyx oryzivorus</i>)
Yellow-throated Vireo (<i>Vireo flavifrons</i>)	Brown-headed Cowbird (<i>Molothrus ater</i>)
Blue Jay (<i>Cyanocitta cristata</i>)	Red-winged Blackbird (<i>Agelaius phoeniceus</i>)
American Crow (<i>Corvus brachyrhynchos</i>)	Common Grackle (<i>Quiscalus quiscula</i>)
Fish Crow (<i>Corvus ossifragus</i>)	Boat-tailed Grackle (<i>Quiscalus major</i>)
Tree Swallow (<i>Tachycineta bicolor</i>)	Orchard Oriole (<i>Icterus spurius</i>)
Barn Swallow (<i>Hirundo rustica</i>)	House Finch (<i>Haemorphous mexicanus</i>)
Tufted Titmouse (<i>Baeolophus bicolor</i>)	American Goldfinch (<i>Spinus tristis</i>)
