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## Avian biodiversity of the Indian River Lagoon System, Florida

Richard L. Turner

Department of Ocean Engineering and Marine Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901-6975

**Abstract** Despite claims about high avian biodiversity in the Indian River Lagoon system, previous efforts to inventory the birds have been limited in geographic extent or in habitat. Compilation of a list of birds could rely on many resources, but ones of widespread availability, greatest historical record, and highest density of sites are two citizen-science projects: the Christmas Bird Count (CBC) and eBird. Lists of species were harvested from 17 CBC sites (“circles”) back to 1910 and from 432 eBird sites (“hotspots”) since 2002 within the boundaries of the Indian River Lagoon National Estuary Program (IRLNEP). In addition to lagoon waters, the boundaries include barrier islands, wetlands, and uplands of the historical drainage. A total of 437 species of bird in 71 families were recorded at the CBC and eBird sites, but 6 species were eliminated because of low counts, lack of independent listing for the region or state in reliable sources, or likelihood of misidentifications. Addition of 12 species from Alan G. Cruickshank’s records for Brevard County brought the total avifauna of the IRLNEP territory to 443 species, with retention of all 71 families. The inventory includes accidental and two extinct species and both established and unestablished exotic species.

**Keywords** Aves, avifauna, Christmas Bird Count, eBird

### Introduction

The Indian River Lagoon (IRL), a barrier-built estuary system on the east coast of Florida (Figure 1), was claimed for decades to be the most biodiverse estuary in the United States, North America, and, by some sources, the world (Turner 2021). This claim was based only on an inventory of fishes and on two statements about IRL birds. The statements about birds were refuted with data by Turner (2021), who additionally argued that the overall claim was invalid for failure to provide data for other biota and comparative data on other regions. Before such geographical comparisons can be made, well-grounded inventories are needed for the IRL and comparable regions. Inventories of biota would be impossible without attention by specialists to individual groups of plants, animals, and microbes. Inventories exist for marine algae (Littler et al. 2008), planktonic diatoms (Hargraves 2002), fish (Gilmore 1977, Gilmore et al. 1981), bryozoans (Winston 1995), and mollusks (Mikkelsen et al. 1995) in the IRL. Inventories for other taxa are more limited in geographic scope within the IRL system (e.g., bryophytes of Merritt Island by Whittier and Miller 1976). But no reasonably complete inventory exists for IRL avifauna; birds were not included in the IRL biodiversity symposium of 1995 (Swain et al. 1995).

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Corresponding author: Richard L. Turner, rturner@fit.edu

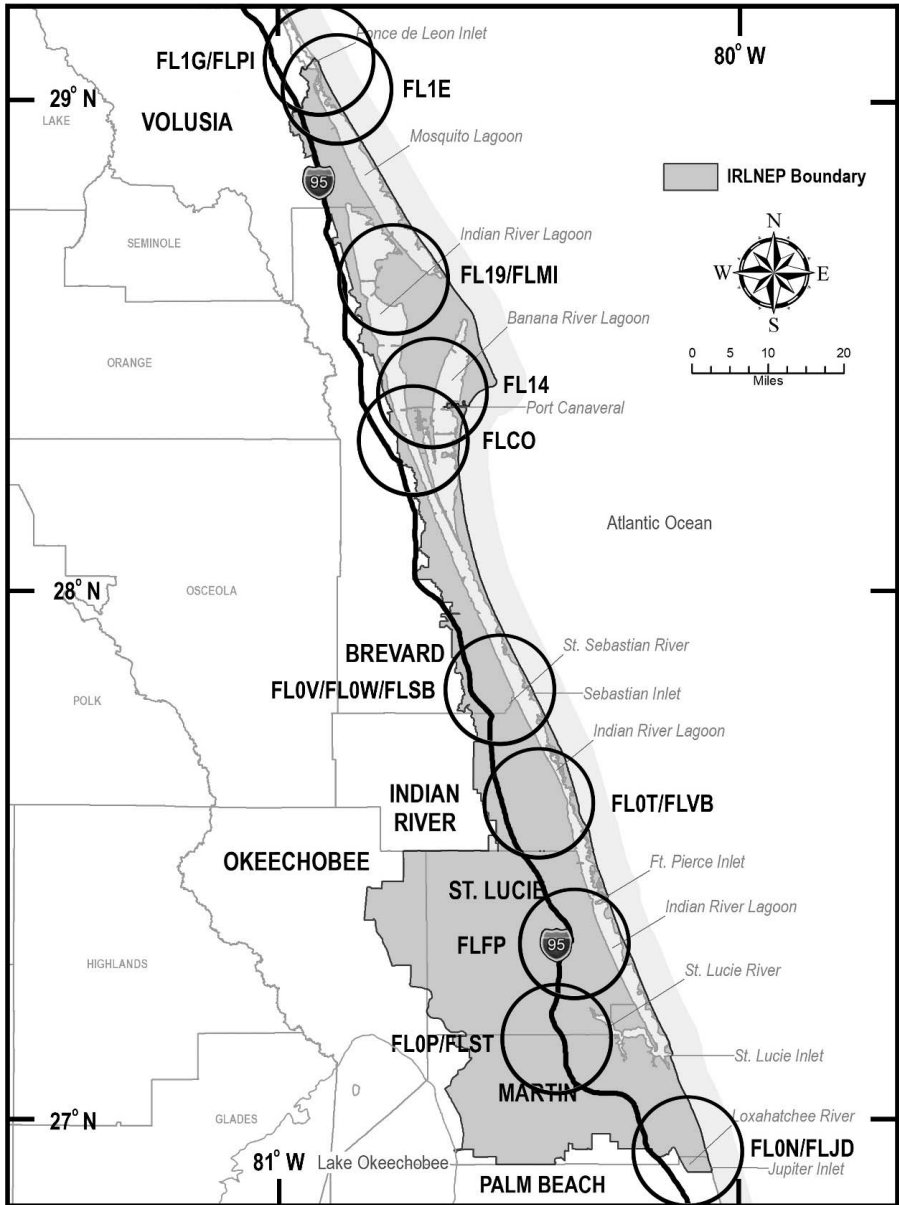


Figure 1. Map of east central Florida with boundaries of the Indian River Lagoon National Estuary Program (IRLNEP) delineated. The region spans seven counties. “Circles” (15-mi diameter) of the 17 Christmas Bird Count sites are plotted. Sites with strong overlap are represented by one circle and indicated by multiple site abbreviations given in Table 1. (Used as modified with permission from IRLNEP.)

Although they are no substitute for total biota, Neornithes is an excellent taxon for geographic comparisons. Birds are well known taxonomically. The visibility and accessibility of birds to people, the availability of inexpensive field guides, the minimal requirements for observation, the proliferation of local birding organizations, and regional birding and wildlife festivals make their informal study a popular hobby worldwide. Birds, therefore, lend themselves well for citizen-science projects (Austin 2014) if experienced birders and professional ornithologists oversee the collection, editing, and final release of data (North American Bird Conservation Initiative U.S. Committee 2009, Sullivan et al. 2009).

The purpose of this paper is to compile a list of bird species and families in the Indian River Lagoon system and its upland drainage areas within the boundaries (Figure 1) of the Indian River Lagoon National Estuary Program (IRLNEP). Many estuaries around the United States have similar programs for which inventories of avifauna could be made for comparisons in the future. A focus on regional avifauna is especially important given the recognition of the impact that climate change and other factors have had on bird populations in North America (Rosenberg et al. 2019).

### Material and Methods

The Christmas Bird Count (CBC) and eBird are citizen-science projects with different characteristics (Sullivan et al. 2009, National Audubon Society 2020b). The CBC started in 1900 by the predecessor societies of the current National Audubon Society, and eBird began in 2002 as a joint effort of the Cornell Lab of Ornithology and the National Audubon Society. Whereas CBC relies on observations made during a 2-wk period in late December to early January, eBird is non-seasonal. CBC occurs in North America after fall migrants have settled into winter locations and before they leave late winter or spring; eBird records the presence of birds in all stages of nesting, migration, and occupation of winter feeding grounds. CBC establishes fixed sites called “circles”, consisting of an area 15 mi in diameter centered on a specific set of geographic coordinates; locations of eBird sites called “hotspots” are determined by individual observers, although many sites are used in common. (The term “hotspot” is used in eBird regardless of the number of species recorded at the site.) A CBC site is under intensive and extensive observation once annually by a team of volunteer birders supervised by a leader or leaders on 1 d during the weeks of the counts; an eBird hotspot has no schedule of observation or set of observers, who report their checklists independently. Species data reported from a CBC site usually include counts or estimates of numbers of birds observed; data for eBird sites often are only presence of the species, although some observers report numbers of birds seen. These two projects complement each other. On the other hand, both databases are monitored by experts in ornithology, and they use a common resource for standardizing names of birds.

Checklists of bird species were harvested on 11–18 July 2020 for eBird sites within the IRLNEP boundaries (Figure 1) (eBird 2020), which include parts of seven counties. Five additional sites were checked from the north side of Ponce de Leon Inlet, three more south of Spruce Creek, and two on the south side of Jupiter Inlet, all of which were just outside the boundaries. These 10 sites added only two additional species and one family, and they were not included in this study. The western boundary was generally considered to be the roadbed of Interstate 95 except in Martin, Saint Lucie, Indian River, and southernmost Brevard counties, where the IRLNEP boundary extends farther west, even into adjoining Okeechobee County. Two sites were excluded within the boundary because no birds were yet reported. In all, data were harvested from 432 sites, providing a wide geographical spread through the IRLNEP boundaries. About half the sites were north of latitude 28° 03' N, near the town line between Melbourne and Palm Bay and south of Melbourne Beach; 144 were on the outer barrier-island system, at inlets, and

Table 1. Distribution of eBird sites in the Indian River Lagoon system by latitude. The number of sites is given for every 10' of latitude. (See map, Figure 1.)

Northern Latitude	Southern Latitude	Number of eBird Sites
29° 10' N	29° 00' N	16
29° 00' N	28° 50' N	20
28° 50' N	28° 40' N	30
28° 40' N	28° 30' N	53
28° 30' N	28° 20' N	42
28° 20' N	28° 10' N	20
28° 10' N	28° 00' N	44
28° 00' N	27° 50' N	19
27° 50' N	27° 40' N	33
27° 40' N	27° 30' N	32
27° 30' N	27° 20' N	33
27° 20' N	27° 10' N	46
27° 10' N	27° 00' N	32
27° 00' N	26° 50' N	12
Total		432

Port Canaveral, 56 on Merritt Island, 20 from the lagoon in general and causeways; 182 were mainland east of Interstate 95; and 30 were west of Interstate 95 from just north of the border between Brevard and Indian River counties southward to the southern boundary of IRLNEP. The 432 sites were reasonably distributed by latitude between the northern and southern boundaries (Table 1).

Only those species entries on checklists that were considered by eBird.org as countable were used. For example, such entries as “woodpecker sp.,” “mallard x mottled duck (hybrid),” and “Indian peafowl (domestic type)” were not countable. Species were assigned to families according to the taxonomic scheme of eBird.org, which is based on Clements (2007), updated annually to 2019 by the Cornell Lab of Ornithology. Scientific names of families and scientific and common names of species were taken from eBird. Common names and numbers for families were taken from Bird Families of the World (<https://www.birdfamiliesoftheworld.com/>), which is also based on Clements (2007).

Species lists for CBCs were harvested from [www.christmasbirdcount.org](http://www.christmasbirdcount.org) (National Audubon Society 2020a) both for those sites that were active for the 120<sup>th</sup> CBC (December 2018–January 2019) and for inactive sites in the IRLNEP area. Sites and years (December start year only) of CBCs are given in Table 2. The 17 sites were mostly near the lagoon shores but were spread over the full north-south extent of the IRLNEP region (Figure 1). The earliest count occurred in 1910, and counts occurred at seven sites in 2018. There was great overlap in the years surveyed, giving a total of 390 site-years. As for eBird species, only those observations for fully identified species were used except for cases in which species have subsequently been split into one within-range species and one or more out-of-range species (Wilson’s/common snipe = Wilson’s snipe, eastern/western-screech owl and screech-owl sp. = eastern screech owl, boat-tailed/great-tailed grackle = boat-tailed grackle, eastern/spotted towhee = eastern towhee, winter/Pacific wren = winter wren, blue-headed/Cassin’s/plumbeous vireo = blue-headed vireo). Species formerly split were recorded under the current name (e.g., Thayer’s gull = Iceland gull, solitary vireo = blue-headed vireo, Caribbean coot = American coot). For each species, the number of years in which the species was reported at each location was recorded regardless of the number of individuals counted. Counts included observations made during the week in which the count-day occurred; such observations are recorded in the CBC database as “cw” for “count week”. In addition to enumerating species at the 17 CBC sites to evaluate geographic distribution along the IRL, presence of species in years during which counts were made at each site were recorded to give an idea of the temporal spread of the species over the 390 site-years.

Table 2. Sites for IRL Christmas Bird Counts. Site codes and names are those used in the CBC database. Latitude and longitude define the center of the 15-mi-diameter “circle”. (See map, Figure 1.) Decimal degrees from the CBC database were converted here to degrees and decimal minutes. “Years surveyed” gives the total number of years in which the site was used for CBCs and the range of calendar years in December for the start of the CBC even if the site was surveyed in January of the following calendar year.

Site Code	Site Name	Latitude (N)	Longitude (W)	Years Surveyed
FLPI	Ponce Inlet	29° 03.7'	81° 00.4'	32: 1987–2018
FL1G	New Smyrna	29° 03.0'	80° 56.0'	1: 1921
FL1E	Coronado Beach	29° 00.0'	80° 53.0'	4: 1910–1913
FLMI	Merritt Island N.W.R.	28° 37.0'	80° 40.9'	53: 1937–1941, 1970–1994, 1996–2018
FL19	Titusville-Merritt Island	28° 37.0'	80° 44.0'	15: 1935–1936, 1951, 1953–1964
FL14	Audubon	28° 26.0'	80° 40.0'	1: 1951
FLCO	Cocoa	28° 21.7'	80° 42.2'	69: 1930, 1933, 1952–2018
FL0W	South Brevard County	27° 53.0'	80° 31.0'	11: 1966–1976
FL0V	South Brevard County	27° 52.0'	80° 34.0'	20: 1977–1996
FLSB	South Brevard County	27° 50.9'	80° 33.0'	22: 1997–2018
FL0T	Vero Beach	27° 41.0'	80° 27.0'	12: 1962–1973
FLVB	Vero Beach	27° 40.0'	80° 25.0'	4: 1996–1999
FLFP	Fort Pierce	27° 25.1'	80° 23.0'	60: 1918, 1948, 1957–1971, 1973–1991, 1995–2018
FL0P	Jensen Beach	27° 15.0'	80° 14.0'	2: 1957–1958
FLST	Stuart	27° 12.7'	80° 15.7'	60: 1959–2018
FL0N	Jonathan Dickinson S.P.	27° 01.0'	80° 07.0'	2: 1995–1996
FLJD	Jonathan Dickinson S.P.	26° 59.5'	80° 08.8'	22: 1997–2018

## Results

The 17 CBC sites and 432 eBird sites shared 324 species in 63 families (Table 3; Appendix). At the CBC sites, 37 species and 1 family were added to the shared list for totals of 361 species in 64 families for the CBCs. The eBird sites, with totals of 400 species and 70 families, added 76 species and 7 families to the shared list. Total count for the IRL system was 437 species in 71 families (Appendix). (Records for six species are excluded from these counts; these records are addressed in the discussion.) Families recorded in eBird and most notably absent from CBC records were pelagic birds (Table 2): Phaethontidae (tropicbirds), Oceanitidae (southern storm-petrels), Hydrobatidae (northern storm-petrels). Because the Apodidae (swifts) were represented in the CBC by only one specimen of chimney swift in 1981 at site FLMI, this migratory family also was effectively absent from CBC records. One unusual record on eBird was inclusion of the extinct Carolina parakeet at St. Sebastian Preserve State Park from archives at the Ontario Royal Museum dated 1 February 1885, long before eBird was established.

The 71 families recorded for the IRL avifauna represent almost 29% of the 248 avian families in the world (Bird Families of the World 2020). The most species-rich families in the IRL were the Anatidae (47 species), Parulidae (39), Scolopacidae (35), Laridae (29), Passerellidae (23), Tyrannidae (19), Icteridae (16), and Accipitridae (15) (Table 3). These are families that have more than 90

species worldwide. Twenty-six of the 71 families in the IRL included at least 15% of world species diversity in each of those families. Of the 26 families, 18 have low (1–19 species) worldwide diversity, and 3 of the 18 families are monospecific. Of the three monospecific families, two have wide geographic ranges either worldwide (Pandionidae) or in the Neotropics (Aramidae); and the third monospecific family (Icteriidae) occurs throughout much of North America. The other eight families having a large proportion (15–39%) of species representation in the IRL have much higher diversity (49–164 species) worldwide. IRL families with very high worldwide diversity (>200 species) were poorly represented in the lagoon region (0.3–6.0% of species). In addition to the three monospecific families, the IRL avifauna had 20 families with only one representative species (Table 3). In all, these 23 families of extremely low IRL species diversity comprised almost one-third of IRL avian diversity at the family level (23 of 71 families).

The 17 CBC sites shared 19 species (Appendix), and 27 other species were recorded at 16 CBC sites. These 46 species demonstrated a wide geographic distribution in the IRL system. At eBird sites, 23 of these 46 species ranked among the 30 species recorded at more than 300 sites. Overall, however, there was little similarity in the rank frequencies of species in two measures of geographic (eBird sites, CBC sites) and one measure of temporal spread (CBC site-years) (Table 4). For example, white ibis ranked first in number of eBird sites, where it was recorded at 393 of the 432 sites. On the other hand, it tied with 26 other species for 47<sup>th</sup> at CBC sites (15 out of 17 sites) and tied with two other species for 50<sup>th</sup> in CBC site-years (371 out of 390 site-years). When these ranks were summed, white ibis ranked 37<sup>th</sup> of all species. On the other hand, little blue heron ranked 19<sup>th</sup> in eBird sites (344 out of 432 sites), tied with 18 other species for 1<sup>st</sup> in CBC sites, and ranked 1<sup>st</sup> in CBC site-years (present in all 390 site-year counts). The top 38 species in summed ranks are listed in Table 4, but there seems to be little in common in the three rankings. This lack of agreement might be due in part to the restricted time-frame of the CBC, when certain species are more prevalent (e.g., painted bunting) and others are absent (e.g., swallow-tailed kite).

## Discussion

Avifauna of Florida is a combination of species from Nearctic and Neotropical regions with accidental occurrences and intentional introductions from other faunas. A high percentage of the state avifauna occurs within the IRLNEP boundaries. Ornithological studies of extant and extinct birds have a long history in the IRL system (Kale 1988).

The first major annotated compilation of avian species in the lagoon region was by Cruickshank (1980) based on a variety of sources. Although his focus was restricted to Brevard County, this county covers a large proportion of IRLNEP by latitude and area (Figure 1). His records included 393 species, of which 373 are shared with those listed here from eBird and CBCs (Appendix). Of the remaining 20 species, 12 with records within IRLNEP boundaries are added to the Appendix, raising the total to 449 species; the other 8 species are rejected as records of pelagic

Table 3. Avian families recorded from the Indian River Lagoon system on eBird and during CBCs, with counts of IRL species and comparison with world diversity (Bird Families of the World 2020). Family numbers in parentheses are those used by Bird Families of the World (2020).

Family	No. of eBird Species	No. of CBC Species	No. of IRL Species	No. of Extant World Species	Percent of World Species Diversity (%)
Anatidae: ducks, geese & waterfowl (8) <sup>1</sup>	42	42	46	164	28.0
Numididae: guineafowl (11)	1	0	1	6	16.7
Odontophoridae: New World quail (12)	1	1	1	33	3.0
Phasianidae: pheasants, grouse & allies (13)	3	3	3	178	1.7
Phoenicopteridae: flamingos (14)	1	0	1	6	16.7
Podicipedidae: grebes (15)	3	5	5	19	26.3
Columbidae: pigeons & doves (16)	7	7	8	331	2.4
Cuculidae: cuckoos (21)	4	2	4	145	2.8
Caprimulgidae: nightjars & allies (23)	4	3	4	97	4.1
Apodidae: swifts (27)	1	1	1	112	0.9
Trochilidae: hummingbirds (29)	3	3	4	348	1.1
Rallidae: rails, gallinules & coots (32)	9	10	10	134	7.5
Aramidae: limpkin (34)	1	1	1	1	100.0
Gruidae: cranes (36)	1	1	1	15	6.7
Recurvirostridae: stilts & avocets (41)	2	2	2	9	22.2
Haematopodidae: oystercatchers (43)	1	1	1	11	9.1
Charadriidae: plovers & lapwings (44)	7	7	7	67	10.4
Scolopacidae: sandpipers & allies (49)	35	26	35	91	38.5
Stercorariidae: skuas & jaegers (53)	4	2	4	7	57.1
Alcidae: auks, murrets & puffins (54)	1	2	2	24	8.3
Laridae: gulls, terns & skimmers (55)	29	23	29	97	29.9
Phaethontidae: tropicbirds (58)	1	0	1	3	33.3
Gaviidae: loons (59)	3	3	3	5	60.0
Oceanitidae: southern storm-petrels (62)	1	0	1	9	11.1
Hydrobatidae: northern storm-petrels (63)	2	0	2	17	11.8
Procellariidae: shearwaters & petrels (64)	7	4	7	94	7.4
Ciconiidae: storks (65)	1	1	1	19	5.3
Fregatidae: frigatebirds <sup>2</sup> (66)	1	1	1	5	20.0
Sulidae: boobies & gannets (67)	3	2	3	10	30.0
Anhingidae: anhingas (68)	1	1	1	4	25.0
Phalacrocoracidae: cormorants & shags (69)	3	2	3	39	7.7
Pelecanidae: pelicans <sup>3</sup> (70)	2	2	2	8	25.0
Ardeidae: herons, egrets & bitterns (73)	12	12	12	63	19.0
Threskiornithidae: ibises & spoonbills (74)	5	3	5	35	14.3
Cathartidae: New World vultures (75)	2	2	2	7	28.6
Pandionidae: osprey (77)	1	1	1	1	100
Accipitridae: hawks, eagles & kites (78)	15	12	15	249	6.0
Tytonidae: barn-owls (79)	1	1	1	18	5.6
Strigidae: owls (80)	5	6	6	211	2.8
Alcedinidae: kingfishers (90)	1	1	1	117	0.9
Picidae: woodpeckers (102)	8	8	8	233	3.4
Falconidae: falcons & caracaras <sup>4</sup> (104)	4	5	5	64	7.8
Psittaculidae: Old World parrots (107)	1	2	2	178	1.1



Table 3. Continued.

Family	No. of eBird Species	No. of CBC Species	No. of IRL Species	No. of Extant World Species	Percent of World Species Diversity (%)
Psittacidae: New World & African parrots (108)	5	5	6	167	3.6
Tyrannidae: tyrant flycatchers <sup>5</sup> (126)	16	10	18	422	4.3
Vireonidae: vireos, shrike-babblers & erpornis (147)	9	4	9	63	14.3
Laniidae: shrikes <sup>6</sup> (166)	1	1	1	33	3.0
Corvidae: crows, jays & magpies (167)	4	4	4	129	3.1
Paridae: tits, chickadees & titmice (178)	2	2	2	63	3.2
Alaudidae: larks (180)	1	1	1	97	1.0
Hirundinidae: swallows (190)	7	5	7	86	8.1
Regulidae: kinglets (200)	2	2	2	6	33.3
Sittidae: nuthatches (202)	2	3	3	27	11.1
Certhiidae: treecreepers (203)	0	1	1	11	9.1
Poliptilidae: gnatcatchers (204)	1	1	1	20	5.0
Troglodytidae: wrens (205)	4	6	6	85	7.1
Sturnidae: starlings (209)	1	4	4	117	3.4
Mimidae: mockingbirds & thrashers (210)	4	3	4	34	11.8
Turdidae: thrushes & allies (211)	9	6	9	170	5.3
Bombycillidae: waxwings (213)	1	1	1	3	33.3
Estrildidae: waxbills & allies (227)	1	0	1	139	0.7
Passeridae: Old World sparrows (230)	1	1	1	43	2.3
Motacillidae: wagtails & pipits (231)	1	1	1	66	1.5
Fringillidae: finches, euphonias & allies (232)	4	4	4	210	1.9
Calcariidae: longspurs & snow buntings (233)	2	2	2	6	33.3
Passerellidae: New World sparrows (236)	20	22	23	130	17.7
Icteridae: yellow-breasted chat (243)	1	1	1	1	100.0
Icteridae: troupials & allies (244)	11	14	16	104	15.4
Parulidae: New World warblers (245)	38	31	39	110	35.5
Cardinalidae: cardinals & allies (247)	10	10	10	49	20.4
Thraupidae: tanagers & allies (248)	1	0	1	377	0.3
Total no. of species recorded	400	361	437	10,721	4.1
Total no. of species adjusted for exclusions	399	356	431	10,721	4.0
No. of unique species <sup>7, 8</sup>	75	32			
Total no. of families recorded	70	64	71	248	28.6
Total no. of families adjusted for exclusions	70	64	71	248	28.6
No. of unique families <sup>9</sup>	7	1			

<sup>1</sup> Red-crested pochard excluded

<sup>2</sup> Great frigatebird excluded

<sup>3</sup> Great white pelican excluded

<sup>4</sup> Gyrfalcon excluded

<sup>5</sup> Gray flycatcher excluded

<sup>6</sup> Northern shrike excluded

<sup>7</sup> Adjusted for excluded species

<sup>8</sup> 324 species in common

<sup>9</sup> 63 families in common

Table 4. Ranks of the top 38 avian species in the Indian River Lagoon system by frequency at eBird and CBC sites and in CBC site-years.

Species	eBird Sites	CBC Sites	CBC Site-years	Rank Sum
<i>Ardea herodias</i> : great blue heron	5	1	2	8
<i>Cardinalis cardinalis</i> : northern cardinal	8	1	2	11
<i>Mimus polyglottos</i> : northern mockingbird	10	1	5	16
<i>Melanerpes carolinus</i> : red-bellied woodpecker	9	1	10	20
<i>Egretta caerulea</i> : little blue heron	19	1	1	21
<i>Cyanocitta cristata</i> : blue jay	15	1	7	23
<i>Egretta tricolor</i> : tricolored heron	23	1	5	29
<i>Cathartes aura</i> : turkey vulture	3	20	14	37
<i>Ardea alba</i> : great egret	12	20	10	42
<i>Pelecanus occidentalis</i> : brown pelican	21	20	2	43
<i>Zenaidura macroura</i> : mourning dove	4	20	19	43
<i>Charadrius vociferus</i> : killdeer	37	1	7	45
<i>Setophaga palmarum</i> : palm warbler	16	20	10	46
<i>Falco sparverius</i> : American kestrel	39	1	7	47
<i>Buteo lineatus</i> : red-shouldered hawk	28	1	18	47
<i>Coragyps atratus</i> : black vulture	5	20	24	49
<i>Egretta thula</i> : snowy egret	17	20	14	51
<i>Leucophaeus atricilla</i> : laughing gull	26	1	24	51
<i>Mycteria americana</i> : wood stork	27	1	24	52
<i>Pandion haliaetus</i> : osprey	2	20	37	59
<i>Dumetella carolinensis</i> : gray catbird	30	20	10	60
<i>Phalacrocorax auritus</i> : double-crested cormorant	13	20	29	62
<i>Setophaga coronata</i> : yellow-rumped warbler	24	20	19	63
<i>Quiscalus major</i> : boat-tailed grackle	10	20	37	67
<i>Calidris alba</i> : sanderling	54	1	14	69
<i>Larus argentatus</i> : herring gull	58	1	14	73
<i>Corvus ossifragus</i> : fish crow	7	47	19	73
<i>Megaceryle alcyon</i> : belted kingfisher	25	20	32	77
<i>Columbina passerina</i> : common ground dove	42	20	19	81
<i>Butorides virescens</i> : green heron	35	1	45	81
<i>Poliophtila caerulea</i> : blue-gray gnatcatcher	31	20	32	83
<i>Turdus migratorius</i> : American robin	47	1	37	85
<i>Larus delawarensis</i> : ring-billed gull	20	47	19	86
<i>Thalasseus maximus</i> : royal tern	36	20	32	88
<i>Quiscalus quiscula</i> : common grackle	14	47	32	93
<i>Thryothorus ludovicianus</i> : Carolina wren	45	20	29	94
<i>Eudocimus albus</i> : white ibis	1	47	50	98
<i>Lanius ludovicianus</i> : loggerhead shrike	44	20	37	101

birds far offshore and, therefore, are not associated with the lagoon system or its drainage.

Kale (1988) summarized paleontological finds of fossil avian species that no longer occur in the region and for which there are no historical records of their presence. He also included several reports of the Carolina parakeet (as did Cruickshank 1980) from locations in the region by naturalists of the late 1800s and early 1900s. Kale (1988) claimed that 367 species of bird occur in the Indian River Lagoon system. He listed 121 species that breed there and an additional 7 species

among the 35 endangered, threatened, and special-concern species. The other 239 species were neither listed nor mentioned. Kale included ivory-billed woodpecker (Picidae: *Campephilus principalis*) among the locally breeding species (as “probably extinct”) and Bachman’s warbler (Parulidae: *Vermivora bachmanii*) among the endangered species. Both species were recorded by Cruickshank (1980), but neither was recorded in CBCs or at eBird sites in the IRL region. Records of the ivory-billed woodpecker were outside the IRLNEP boundaries. Because Kale (1988) described freshwater marsh and upland habitats, it is likely that he otherwise broadly covered avifauna within the current IRLNEP boundaries.

Swain et al. (1994), in an initial attempt to list all biota of the IRL system, tabulated 202 species of bird in 44 families. Aside from their use of a few older names, all 202 species were recorded at IRL CBC and eBird sites. Their list could have been longer, but they included only “bird species which fly over the lagoon”. The effort by Swain et al. (1994) was continued as the Indian River Lagoon Inventory (Smithsonian Institution 2020), but the inventory has since only added Muscovy duck.

Florida’s 525 bird species include more than 25% of those listed for North America (Chesser et al. 2011, Florida Ornithological Society 2018). Of the 437 IRL species recorded on eBird and in CBCs, 413 are listed on the FOS official list (Appendix). This count includes the assumption that the gray-headed swamphen (*Porphyrio poliocephalus*) is probably entered as “purple swamphen” (*Porphyrio porphyrio*, western swamphen) on the FOS list. Of the 24 unlisted species, however, 17 species were listed by Robertson and Woolfenden (1992), on which the FOS list was originally based. Which of the 437 IRL species should be retained?

Most of the 437 species have been recorded at multiple eBird sites, multiple CBC sites, and/or in multiple CBC site-years. They also are listed by FOS. Those species of rare occurrence at eBird sites or by CBCs but included by FOS should be retained, for there is little evidence to question their occasional presence in the IRL region. Of the 24 species not listed by FOS, many of them were listed by Robertson and Woolfenden (1992) as unestablished exotics; but the authors included recorded sightings in Florida. Of these species, mute swan, black swan, Indian peafowl, rose-ringed parakeet, blue-crowned parakeet, red-masked parakeet, common hill myna, and scaly-breasted munia (as “nutmeg mannikin”) were listed by Robertson and Woolfenden (1992), Maehr and Kale (2005), or both; and at least some of these 8 species had multiple eBird/CBC IRL records. Ring-necked pheasant was listed by Cruickshank (1980) and Robertson and Woolfenden (1992). In addition, African collared dove (at least as its domesticated version, *Streptopelia* “risoria”) was listed by all three sources.

Of the remaining 14 species not listed by FOS, graylag goose, swan goose, Mandarin duck, helmeted guineafowl, prairie falcon, gray parrot, and crested myna have been sighted in the state (Robertson and Woolfenden 1992). But seven other species recorded from eBird/CBC sites have no independent corroboration. Three species probably are misidentifications. Great frigatebirds were recorded from five CBC sites in 1940 and 1952–1957, whereas magnificent frigatebirds were recorded

from the same sites for many years since 1957. The shift in identification indicates a change in decisions by the CBC participants and list editors. Great white pelicans were reported from two eBird sites, one record of which posted three photographs of American white pelicans, which had yellow (Sibley 2000, Sterry and Small 2009)—not pink (Peterson et al. 1993, Cillié and Oberprieler 2012)—bare skin around the eyes. Both records have since been removed or corrected (visited 26 October 2020). The third likely misidentification was a count of 68 northern shrikes from the CBC site at Fort Pierce in 1983, when 5–164 loggerhead shrikes were counted in all 59 other years at that site (FLFP, Table 2). Although African sacred ibis is not on the FOS list, the eBird site that recorded the species is accompanied by two photographs, which are archived at the Cornell Lab of Ornithology (<https://macaulaylibrary.org/asset/22486651>, <https://macaulaylibrary.org/asset/22486621>; accessed 26 October 2020). Three species (red-crested pochard, gyrfalcon, gray flycatcher) not on the FOS list have only single records of 1–5 birds in CBCs; none is recorded from Florida on eBird. Robertson and Woolfenden (1992) listed rosy-billed pochard (*Netta peposaca*) as an unestablished exotic, but it would be difficult to misidentify red-crested pochard with this species.

Elimination of 6 species from the 437 species recorded on eBird and in CBCs and the addition of 12 species from Cruickshank (1980) bring the avian diversity of the IRL to 443 species in 71 families (Appendix). Such inventories of biota in a region are only a “snapshot” in time. But, as Helen G. Cruickshank wrote (in Cruickshank 1980), “bird lists lay the foundation for continued study of local species and their status in an area over a long period of time.” It is hoped that the current work will lay the foundation for avian diversity in the waters, wetlands, and uplands of the Indian River Lagoon system as have earlier works on other biota (Whittier and Miller 1976, Gilmore et al. 1981, Mikkelsen et al. 1995, Winston 1995, Hargraves 2002, Littler et al. 2008).

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Appendix. Families and species recorded on eBird and in Christmas Bird Counts (CBC) from the Indian River Lagoon within the National Estuary Program boundaries, with additions from Cruickshank (1980). Family numbers in parentheses are those used by Bird Families of the World (2020). Species names in brackets are rejected for insufficient documentation in Florida or as misidentifications.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<b>Anatidae: ducks, geese, and waterfowl (8)</b>			
<i>Dendrocygna autumnalis</i> : black-bellied whistling duck <sup>2V, 3N, 4N</sup>	133	6	65
<i>Dendrocygna bicolor</i> : fulvous whistling duck <sup>1, 2V, 3N, 4N</sup>	9	9	38
<i>Anser caerulescens</i> : snow goose <sup>1, 2V, 3N, 4N</sup>	17	7	52
<i>Anser rossii</i> : Ross's goose <sup>2V, 4N</sup>	5	2	2
<i>Anser anser</i> : graylag goose <sup>2E</sup>	0	2	14
<i>Anser cygnoides</i> : swan goose <sup>2E</sup>	0	2	6
<i>Anser albifrons</i> : greater white-fronted goose <sup>2V, 4N</sup>	4	1	2
<i>Branta bernicla</i> : brant <sup>1, 2V, 3N, 4N</sup>	14	5	18
<i>Branta hutchinsii</i> : cackling goose <sup>4N</sup>	0	1	1
<i>Branta canadensis</i> : Canada goose <sup>1, 2V, 3N, 4N</sup>	43	6	48
<i>Cygnus olor</i> : mute swan <sup>2E, 3E</sup>	22	1	8
<i>Cygnus atratus</i> : black swan <sup>2E, 3E</sup>	1	0	0
<i>Alapochen aegyptiaca</i> : Egyptian goose <sup>2E, 4E</sup>	48	4	32
<i>Cairina moschata</i> : Muscovy duck <sup>2V, 3E, 4E</sup>	73	7	102
<i>Aix sponsa</i> : wood duck <sup>1, 2V, 3N, 4N</sup>	110	13	279
<i>Aix galericulata</i> : Mandarin duck <sup>2E</sup>	0	1	1
<i>Spatula discors</i> : blue-winged teal <sup>1, 2V, 3N, 4N</sup>	174	14	335
<i>Spatula cyanoptera</i> : cinnamon teal <sup>1, 2V, 3O, 4N</sup>	9	4	7
<i>Spatula clypeata</i> : northern shoveler <sup>1, 2V, 3N, 4N</sup>	99	13	185
<i>Mareca strepera</i> : gadwall <sup>1, 2V, 3N, 4N</sup>	45	11	125
<i>Mareca penelope</i> : Eurasian wigeon <sup>1, 2V, 3O, 4N</sup>	14	4	21
<i>Mareca americana</i> : American wigeon <sup>1, 2V, 3N, 4N</sup>	77	13	226
<i>Anas platyrhynchos</i> : mallard <sup>1, 2V, 3N, 4N</sup>	110	15	285
<i>Anas rubripes</i> : American black duck <sup>1, 2V, 3N, 4N</sup>	2	11	98
<i>Anas fulvigula</i> : mottled duck <sup>1, 2V, 3N, 4N</sup>	295	14	348
<i>Anas bahamensis</i> : white-cheeked pintail <sup>1, 2V, 4N</sup>	10	0	0
<i>Anas acuta</i> : northern pintail <sup>1, 2V, 3N, 4N</sup>	67	14	180
<i>Anas crecca</i> : green-winged teal <sup>1, 2V, 3N, 4N</sup>	79	14	238
[ <i>Netta rufina</i> : red-crested pochard]	0	1	1
<i>Aythya valisineria</i> : canvasback <sup>1, 2V, 3N, 4N</sup>	34	11	105
<i>Aythya americana</i> : redhead <sup>1, 2V, 3N, 4N</sup>	51	11	150
<i>Aythya collaris</i> : ring-necked duck <sup>1, 2V, 3N, 4N</sup>	92	13	270
<i>Aythya marila</i> : greater scaup <sup>1, 2V, 3O, 4N</sup>	76	11	132
<i>Aythya affinis</i> : lesser scaup <sup>1, 2V, 3N, 4N</sup>	173	16	320
<i>Somateria mollissima</i> : common eider <sup>1, 2V, 4N</sup>	28	1	8
<i>Histrionicus histrionicus</i> : harlequin duck <sup>1, 2V, 4N</sup>	2	0	0
<i>Melanitta perspicillata</i> : surf scoter <sup>1, 2V, 3N, 4N</sup>	43	6	36
<i>Melanitta deglandi</i> : white-winged scoter <sup>1, 2V, 3N, 4N</sup>	25	6	30
<i>Melanitta americana</i> : black scoter <sup>1, 2V, 3N, 4N</sup>	112	9	80
<i>Clangula hyemalis</i> : long-tailed duck <sup>1, 2V, 3N, 4N</sup>	25	6	45
<i>Bucephala albeola</i> : bufflehead <sup>1, 2V, 3N, 4N</sup>	61	10	131
<i>Bucephala clangula</i> : common goldeneye <sup>1, 2V, 3N, 4N</sup>	12	7	33
<i>Lophodytes cucullatus</i> : hooded merganser <sup>1, 2V, 3N, 4N</sup>	115	14	325
<i>Mergus merganser</i> : common merganser <sup>1, 2V, 3O, 4N</sup>	1	5	12
<i>Mergus serrator</i> : red-breasted merganser <sup>1, 2V, 3N, 4N</sup>	175	16	361

## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Nonyx dominicus</i> : masked duck <sup>2V, 3O, 4N</sup>	1	0	0
<i>Oxyura jamaicensis</i> : ruddy duck <sup>1, 2V, 3N, 4N</sup>	68	12	148
<b>Numididae: guineafowl (11)</b>			
<i>Numida meleagris</i> : helmeted guineafowl <sup>2E</sup>	1	0	0
<b>Odontophoridae: New World quail (12)</b>			
<i>Colinus virginianus</i> : northern bobwhite <sup>1, 2V, 3N, 4N</sup>	90	14	269
<b>Phasianidae: pheasants, grouse, and allies (13)</b>			
<i>Pavo cristatus</i> : Indian peafowl <sup>2E, 3E</sup>	33	3	7
<i>Phasianus colchicus</i> : ring-necked pheasant <sup>1, 2E</sup>	1	1	1
<i>Meleagris gallopavo</i> : wild turkey <sup>1, 2V, 3N, 4N</sup>	92	10	125
<b>Phoenicopteridae: flamingos (14)</b>			
<i>Phoenicopterus ruber</i> : American flamingo <sup>1, 2V, 3N, 4N</sup>	13	0	0
<b>Podicipedidae: grebes (15)</b>			
<i>Podilymbus podiceps</i> : pied-billed grebe <sup>1, 2V, 3N, 4N</sup>	216	15	380
<i>Podiceps auritus</i> : horned grebe <sup>1, 2V, 3N, 4N</sup>	101	11	209
<i>Podiceps grisegena</i> : red-necked grebe <sup>1, 2S, 4N</sup>	0	2	3
<i>Podiceps nigricollis</i> : eared grebe <sup>1, 2V, 4N</sup>	11	3	25
<i>Aechmophorus occidentalis</i> : western grebe <sup>1, 2V, 4N</sup>	0	2	2
<b>Columbidae: pigeons and doves (16)</b>			
<i>Columba livia</i> : rock pigeon <sup>1, 2V, 3E, 4E</sup>	269	12	277
<i>Patagioenas leucocephala</i> : white-crowned pigeon <sup>2V, 3N, 4N</sup>	4	0	0
<i>Streptopelia decaocto</i> : Eurasian collared-dove <sup>2V, 3E, 4E</sup>	254	10	189
<i>Streptopelia roseogrisea</i> : African collared-dove <sup>1, 2E, 3E</sup>	2	4	7
<i>Columbina inca</i> : Inca dove <sup>2S, 4N</sup>	0	1	1
<i>Columbina passerina</i> : common ground dove <sup>1, 2V, 3N, 4N</sup>	255	16	383
<i>Zenaida asiatica</i> : white-winged dove <sup>1, 2V, 3N, 4N</sup>	119	9	108
<i>Zenaida macroura</i> : mourning dove <sup>1, 2V, 3N, 4N</sup>	388	16	383
<b>Cuculidae: cuckoos (21)</b>			
<i>Crotophaga ani</i> : smooth-billed ani <sup>1, 2V, 3N, 4N</sup>	9	7	95
<i>Crotophaga sulcirostris</i> : groove-billed ani <sup>2V, 3O, 4N</sup>	1	0	0
<i>Coccyzus americanus</i> : yellow-billed cuckoo <sup>1, 2V, 3N, 4N</sup>	95	4	6
<i>Coccyzus erythrophthalmus</i> : black-billed cuckoo <sup>1, 2V, 3N, 4N</sup>	4	0	0
<b>Caprimulgidae: nightjars and allies (23)</b>			
<i>Chordeiles minor</i> : common nighthawk <sup>1, 2V, 3N, 4N</sup>	107	5	8
<i>Chordeiles gundlachi</i> : Antillean nighthawk <sup>2V, 3N, 4N</sup>	1	0	0
<i>Antrastomus carolinensis</i> : Chuck-will's-widow <sup>1, 2V, 3N, 4N</sup>	55	10	58
<i>Antrastomus vociferus</i> : eastern whip-poor-will <sup>1, 2V, 3N, 4N</sup>	25	11	121
<b>Apodidae: swifts (27)</b>			
<i>Chaetura pelagica</i> : chimney swift <sup>1, 2V, 3N, 4N</sup>	204	1	1
<b>Trochilidae: hummingbirds (29)</b>			
<i>Archilochus colubris</i> : ruby-throated hummingbird <sup>1, 2V, 3N, 4N</sup>	98	13	227
<i>Archilochus alexandri</i> : black-chinned hummingbird <sup>2V, 3O, 4N</sup>	1	2	2
<i>Nesophlox evelynae</i> : Bahama woodstar <sup>2V, 3O, 4N</sup>	3	0	0
<i>Selasphorus rufus</i> : rufous hummingbird <sup>1, 2V, 3N, 4N</sup>	0	1	1
<i>Chlorostilbon ricordii</i> : Cuban emerald <sup>1, 2S</sup>	—	—	—
<b>Rallidae: rails, gallinules, and coots (32)</b>			
<i>Rallus elegans</i> : king rail <sup>1, 2V, 3N, 4N</sup>	34	12	171
<i>Rallus crepitans</i> : clapper rail <sup>1, 2V, 3N, 4N</sup>	61	11	216
<i>Rallus limicola</i> : Virginia rail <sup>1, 2V, 3N, 4N</sup>	32	10	134



## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Porzana carolina</i> : sora <sup>1, 2V, 3N, 4N</sup>	66	13	219
<i>Gallinula galeata</i> : common gallinule <sup>1, 2V, 3N, 4N</sup>	214	15	376
<i>Fulica americana</i> : American coot <sup>1, 2V, 3N, 4N</sup>	191	15	372
<i>Porphyrio martinica</i> : purple gallinule <sup>1, 2V, 3N, 4N</sup>	55	9	72
<i>Porphyrio poliocephalus</i> : gray-headed swamphen <sup>3E, 4E, 6</sup>	9	1	1
<i>Coturnicops noveboracensis</i> : yellow rail <sup>1, 2V, 3N, 4N</sup>	1	2	3
<i>Laterallus jamaicensis</i> : black rail <sup>1, 2V, 3N, 4N</sup>	0	5	48
<b>Aramididae: limpkin (34)</b>			
<i>Aramus guarana</i> : limpkin <sup>1, 2V, 3N, 4N</sup>	129	10	159
<b>Gruidae: cranes (36)</b>			
<i>Antigone canadensis</i> : sandhill crane <sup>1, 2V, 3N, 4N</sup>	224	14	323
<b>Recurvirostridae: stilts and avocets (41)</b>			
<i>Himantopus mexicanus</i> : black-necked stilt <sup>1, 2V, 3N, 4N</sup>	108	4	21
<i>Recurvirostra americana</i> : American avocet <sup>1, 2V, 3N, 4N</sup>	68	5	96
<b>Haematopodidae: oystercatchers (43)</b>			
<i>Haematopus palliatus</i> : American oystercatcher <sup>1, 2V, 3N, 4N</sup>	79	10	182
<b>Charadriidae: plovers and lapwings (44)</b>			
<i>Pluvialis squatarola</i> : black-bellied plover <sup>1, 2V, 3N, 4N</sup>	178	16	382
<i>Pluvialis dominica</i> : American golden-plover <sup>1, 2V, 3N, 4N</sup>	11	1	1
<i>Charadrius nivosus</i> : snowy plover <sup>1, 2V, 3N, 4N</sup>	1	2	4
<i>Charadrius wilsonia</i> : Wilson's plover <sup>1, 2V, 3N, 4N</sup>	74	12	79
<i>Charadrius semipalmatus</i> : semipalmated plover <sup>1, 2V, 3N, 4N</sup>	148	15	292
<i>Charadrius melodus</i> : piping plover <sup>1, 2V, 3N, 4N</sup>	58	12	124
<i>Charadrius vociferus</i> : killdeer <sup>1, 2V, 3N, 4N</sup>	272	17	387
<b>Scolopaciidae: sandpipers and allies (49)</b>			
<i>Bartramia longicauda</i> : upland sandpiper <sup>1, 2V, 3N, 4N</sup>	2	0	0
<i>Numenius phaeopus</i> : whimbrel <sup>1, 2V, 3N, 4N</sup>	63	6	47
<i>Numenius borealis</i> : Eskimo curlew <sup>1, 2S</sup>	—	—	—
<i>Numenius americanus</i> : long-billed curlew <sup>1, 2V, 3N, 4N</sup>	3	2	21
<i>Limosa lapponica</i> : bar-tailed godwit <sup>1, 2V, 3O, 4N</sup>	1	1	1
<i>Limosa limosa</i> : black-tailed godwit <sup>2V, 3O, 4N</sup>	3	0	0
<i>Limosa haemastica</i> : Hudsonian godwit <sup>1, 2V, 3O, 4N</sup>	4	0	0
<i>Limosa fedoa</i> : marbled godwit <sup>1, 2V, 3N, 4N</sup>	56	8	106
<i>Arenaria interpres</i> : ruddy turnstone <sup>1, 2V, 3N, 4N</sup>	222	16	376
<i>Calidris canutus</i> : red knot <sup>1, 2V, 3N, 4N</sup>	80	11	144
<i>Calidris virgata</i> : surfbird <sup>2V, 4N</sup>	1	0	0
<i>Calidris pugnax</i> : ruff <sup>1, 2V, 4N</sup>	7	0	0
<i>Calidris himantopus</i> : stilt sandpiper <sup>1, 2V, 3N, 4N</sup>	50	6	45
<i>Calidris ferruginea</i> : curlew sandpiper <sup>1, 2V, 4N</sup>	3	0	0
<i>Calidris alba</i> : sanderling <sup>1, 2V, 3N, 4N</sup>	225	17	385
<i>Calidris alpina</i> : dunlin <sup>1, 2V, 3N, 4N</sup>	116	13	293
<i>Calidris maritima</i> : purple sandpiper <sup>1, 2V, 3N, 4N</sup>	14	7	30
<i>Calidris bairdii</i> : Baird's sandpiper <sup>1, 2V, 4N</sup>	2	0	0
<i>Calidris minutilla</i> : least sandpiper <sup>1, 2V, 3N, 4N</sup>	148	13	271
<i>Calidris fuscicollis</i> : white-rumped sandpiper <sup>1, 2V, 3N, 4N</sup>	30	1	3
<i>Calidris subruficollis</i> : buff-breasted sandpiper <sup>1, 2V, 4N</sup>	6	0	0
<i>Calidris melanotos</i> : pectoral sandpiper <sup>1, 2V, 3N, 4N</sup>	45	2	5
<i>Calidris pusilla</i> : semipalmated sandpiper <sup>1, 2V, 3N, 4N</sup>	89	10	84
<i>Calidris mauri</i> : western sandpiper <sup>1, 2V, 3N, 4N</sup>	109	13	238



## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Limnodromus griseus</i> : short-billed dowitcher <sup>1, 2V, 3N, 4N</sup>	93	12	202
<i>Limnodromus scolopaceus</i> : long-billed dowitcher <sup>1, 2V, 3O, 4N</sup>	52	8	41
<i>Scolopax minor</i> : American woodcock <sup>1, 2V, 3N, 4N</sup>	19	8	86
<i>Gallinago delicata</i> : Wilson's snipe <sup>1, 2V, 3N, 4N</sup>	114	14	359
<i>Phalaropus tricolor</i> : Wilson's phalarope <sup>1, 2V, 3N, 4N</sup>	18	0	0
<i>Phalaropus lobatus</i> : red-necked phalarope <sup>1, 2V, 3O, 4N</sup>	11	5	5
<i>Phalaropus fulicarius</i> : red phalarope <sup>1, 2V, 3O, 4N</sup>	5	1	1
<i>Actitis macularius</i> : spotted sandpiper <sup>1, 2V, 3N, 4N</sup>	193	15	368
<i>Tringa solitaria</i> : solitary sandpiper <sup>1, 2V, 3N, 4N</sup>	72	10	54
<i>Tringa melanoleuca</i> : greater yellowlegs <sup>1, 2V, 3N, 4N</sup>	158	14	328
<i>Tringa semipalmata</i> : willet <sup>1, 2V, 3N, 4N</sup>	216	13	363
<i>Tringa flavipes</i> : lesser yellowlegs <sup>1, 2V, 3N, 4N</sup>	125	12	297
<b>Stercorariidae: skuas and jaegers (53)</b>			
<i>Stercorarius maccornicki</i> : South Polar skua <sup>2S, 3N, 4N</sup>	2	0	0
<i>Stercorarius pomarinus</i> : pomarine jaeger <sup>1, 2V, 3N, 4N</sup>	49	6	43
<i>Stercorarius parasiticus</i> : parasitic jaeger <sup>1, 2V, 3N, 4N</sup>	47	6	29
<i>Stercorarius longicaudus</i> : long-tailed jaeger <sup>1, 2V, 3N, 4N</sup>	5	0	0
<b>Alcidae: auks, murrees, and puffins (54)</b>			
<i>Alle alle</i> : dovekie <sup>1, 2V, 4N</sup>	0	2	2
<i>Alca torda</i> : razorbill <sup>1, 2V, 4N</sup>	8	3	3
<b>Laridae: gulls, terns, and skimmers (55)</b>			
<i>Rissa tridactyla</i> : black-legged kittiwake <sup>1, 2V, 4N</sup>	10	7	28
<i>Xema sabini</i> : Sabine's gull <sup>1, 2V, 4N</sup>	7	1	1
<i>Chroicocephalus philadelphia</i> : Bonaparte's gull <sup>1, 2V, 3N, 4N</sup>	172	16	348
<i>Chroicocephalus ridibundus</i> : black-headed gull <sup>1, 2V, 4N</sup>	3	1	3
<i>Hydrocoloeus minutus</i> : little gull <sup>1, 2V, 4N</sup>	1	0	0
<i>Leucophaeus atricilla</i> : laughing gull <sup>1, 2V, 3N, 4N</sup>	315	17	382
<i>Leucophaeus pipixcan</i> : Franklin's gull <sup>1, 2V, 4N</sup>	10	3	4
<i>Larus heermanni</i> : Heermann's gull <sup>4N</sup>	7	0	0
<i>Larus delawarensis</i> : ring-billed gull <sup>1, 2V, 3N, 4N</sup>	334	15	383
<i>Larus californicus</i> : California gull <sup>2S, 4N</sup>	1	0	0
<i>Larus argentatus</i> : herring gull <sup>1, 2V, 3N, 4N</sup>	222	17	385
<i>Larus glaucooides</i> : Iceland gull <sup>1, 2V, 4N</sup>	8	1	7
<i>Larus fuscus</i> : lesser black-backed gull <sup>1, 2V, 3N, 4N</sup>	160	9	104
<i>Larus hyperboreus</i> : glaucous gull <sup>1, 2V, 4N</sup>	14	4	18
<i>Larus marinus</i> : great black-backed gull <sup>1, 2V, 3N, 4N</sup>	196	12	312
<i>Anous stolidus</i> : brown noddy <sup>1, 2V, 3N, 4N</sup>	10	0	0
<i>Onychoprion fuscatus</i> : sooty tern <sup>1, 2V, 3N, 4N</sup>	13	2	2
<i>Onychoprion anaethetus</i> : bridled tern <sup>1, 2V, 3N, 4N</sup>	13	0	0
<i>Sternula antillarum</i> : least tern <sup>1, 2V, 3N, 4N</sup>	209	4	8
<i>Gelochelidon nilotica</i> : gull-billed tern <sup>1, 2V, 3N, 4N</sup>	54	6	37
<i>Hydroprogne caspia</i> : Caspian tern <sup>1, 2V, 3N, 4N</sup>	213	16	353
<i>Chlidonias niger</i> : black tern <sup>1, 2V, 3N, 4N</sup>	74	1	1
<i>Sterna dougallii</i> : roseate tern <sup>1, 2V, 3N, 4N</sup>	9	3	3
<i>Sterna hirundo</i> : common tern <sup>1, 2V, 3N, 4N</sup>	95	12	151
<i>Sterna paradisaea</i> : Arctic tern <sup>2V, 3O, 4N</sup>	12	0	0
<i>Sterna forsteri</i> : Forster's tern <sup>1, 2V, 3N, 4N</sup>	230	16	375
<i>Thalasseus maximus</i> : royal tern <sup>1, 2V, 3N, 4N</sup>	273	16	379
<i>Thalasseus sandvicensis</i> : Sandwich tern <sup>1, 2V, 3N, 4N</sup>	178	15	313

## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Rynchops niger</i> : black skimmer <sup>1, 2V, 3N, 4N</sup>	167	15	358
<b>Phaethontidae: tropicbirds (58)</b>			
<i>Phaethon lepturus</i> : white-tailed tropicbird <sup>1, 2V, 3N, 4N</sup>	1	0	0
<b>Gaviidae: loons (59)</b>			
<i>Gavia stellata</i> : red-throated loon <sup>1, 2V, 3N, 4N</sup>	11	8	38
<i>Gavia pacifica</i> : Pacific loon <sup>2V, 4N</sup>	1	2	2
<i>Gavia immer</i> : common loon <sup>1, 2V, 3N, 4N</sup>	164	15	339
<b>Oceanitidae: southern storm-petrels (62)</b>			
<i>Oceanites oceanicus</i> : Wilson's storm-petrel <sup>1, 2V, 3N, 4N</sup>	15	0	0
<b>Hydrobatidae: northern storm-petrels (63)</b>			
<i>Oceanodroma leucorhoa</i> : Leach's storm-petrel <sup>1, 2V, 3O, 4N</sup>	8	0	0
<i>Oceanodroma castro</i> : band-rumped storm-petrel <sup>2V, 3O, 4N</sup>	6	0	0
<b>Procellariidae: shearwaters and petrels (64)</b>			
<i>Fulmarus glacialis</i> : northern fulmar <sup>4N</sup>	1	0	0
<i>Pterodroma hasitata</i> : black-capped petrel <sup>1, 2V, 3N, 4N</sup>	4	0	0
<i>Calonectris diomedea</i> : Cory's shearwater <sup>1, 2V, 3N, 4N</sup>	29	1	1
<i>Ardenna gravis</i> : great shearwater <sup>1, 2V, 3N, 4N</sup>	24	1	1
<i>Ardenna grisea</i> : sooty shearwater <sup>1, 2V, 3O, 4N</sup>	10	1	1
<i>Puffinus puffinus</i> : Manx shearwater <sup>1, 2V, 3O, 4N</sup>	2	1	1
<i>Puffinus lherminieri</i> : Audubon's shearwater <sup>1, 2V, 3N, 4N</sup>	10	0	0
<b>Ciconiidae: storks (65)</b>			
<i>Mycteria americana</i> : wood stork <sup>1, 2V, 3N, 4N</sup>	311	17	382
<b>Fregatidae: frigatebirds (66)</b>			
<i>Fregata magnificens</i> : magnificent frigatebird <sup>1, 2V, 3N, 4N</sup>	195	13	211
[ <i>Fregata minor</i> : great frigatebird <sup>7</sup> ]	0	5	11
<b>Sulidae: boobies and gannets (67)</b>			
<i>Sula dactylatra</i> : masked booby <sup>1, 2V, 3N, 4N</sup>	6	0	0
<i>Sula leucogaster</i> : brown booby <sup>1, 2V, 3N, 4N</sup>	22	4	10
<i>Morus bassanus</i> : northern gannet <sup>1, 2V, 3N, 4N</sup>	151	15	305
<b>Anhingidae: anhingas (68)</b>			
<i>Anhinga anhinga</i> : anhinga <sup>1, 2V, 3N, 4N</sup>	348	15	369
<b>Phalacrocoracidae: cormorants and shags (69)</b>			
<i>Phalacrocorax carbo</i> : great cormorant <sup>1, 2V, 3O, 4N</sup>	6	5	19
<i>Phalacrocorax brasilianus</i> : neotropic cormorant <sup>4N</sup>	2	0	0
<i>Phalacrocorax auritus</i> : double-crested cormorant <sup>1, 2V, 3N, 4N</sup>	361	16	381
<b>Pelecanidae: pelicans (70)</b>			
<i>Pelecanus erythrorhynchos</i> : American white pelican <sup>1, 2V, 3N, 4N</sup>	229	12	237
<i>Pelecanus occidentalis</i> : brown pelican <sup>1, 2V, 3N, 4N</sup>	324	16	389
[ <i>Pelecanus onocrotalus</i> : great white pelican <sup>8</sup> ]	2	0	0
<b>Ardeidae: herons, egrets, and bitterns (73)</b>			
<i>Botaurus lentiginosus</i> : American bittern <sup>1, 2V, 3N, 4N</sup>	60	13	152
<i>Ixobrychus exilis</i> : least bittern <sup>1, 2V, 3N, 4N</sup>	50	10	134
<i>Ardea herodias</i> : great blue heron <sup>1, 2V, 3N, 4N</sup>	383	17	389
<i>Ardea alba</i> : great egret <sup>1, 2V, 3N, 4N</sup>	372	16	386
<i>Egretta thula</i> : snowy egret <sup>1, 2V, 3N, 4N</sup>	349	16	385
<i>Egretta caerulea</i> : little blue heron <sup>1, 2V, 3N, 4N</sup>	344	17	390
<i>Egretta tricolor</i> : tricolored heron <sup>1, 2V, 3N, 4N</sup>	321	17	388
<i>Egretta rufescens</i> : reddish egret <sup>1, 2V, 3N, 4N</sup>	157	11	194
<i>Bubulcus ibis</i> : cattle egret <sup>1, 2V, 3N, 4N</sup>	323	13	360

Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Butorides virescens</i> : green heron <sup>1, 2V, 3N, 4N</sup>	274	17	373
<i>Nycticorax nycticorax</i> : black-crowned night heron <sup>1, 2V, 3N, 4N</sup>	166	14	338
<i>Nyctanassa violacea</i> : yellow-crowned night heron <sup>1, 2V, 3N, 4N</sup>	147	15	346
<b>Threskiornithidae: ibises and spoonbills (74)</b>			
<i>Eudocimus albus</i> : white ibis <sup>1, 2V, 3N, 4N</sup>	393	15	371
<i>Eudocimus ruber</i> : scarlet ibis <sup>1, 2V, 4N</sup>	—	—	—
<i>Plegadis falcinellus</i> : glossy ibis <sup>1, 2V, 3N, 4N</sup>	223	14	287
<i>Plegadis chihi</i> : white-faced ibis <sup>1, 2V, 4N</sup>	4	0	0
<i>Threskiornis aethiopicus</i> : African sacred ibis <sup>5</sup>	1	0	0
<i>Platalea ajaja</i> : roseate spoonbill <sup>1, 2V, 3N, 4N</sup>	241	11	158
<b>Cathartidae: New World vultures (75)</b>			
<i>Coragyps atratus</i> : black vulture <sup>1, 2V, 3N, 4N</sup>	383	16	382
<i>Cathartes aura</i> : turkey vulture <sup>1, 2V, 3N, 4N</sup>	389	16	385
<b>Pandionidae: osprey (77)</b>			
<i>Pandion haliaetus</i> : osprey <sup>1, 2V, 3N, 4N</sup>	392	16	378
<b>Accipitridae: hawks, eagles, and kites (78)</b>			
<i>Elanus leucurus</i> : white-tailed kite <sup>1, 3N, 4N</sup>	4	5	9
<i>Elanoides forficatus</i> : swallow-tailed kite <sup>1, 2V, 3N, 4N</sup>	187	0	0
<i>Aquila chrysaetos</i> : golden eagle <sup>1, 2V, 3N, 4N</sup>	1	0	0
<i>Rostrhamus sociabilis</i> : snail kite <sup>1, 2V, 3N, 4N</sup>	49	8	54
<i>Ictinia mississippiensis</i> : Mississippi kite <sup>1, 2V, 3N, 4N</sup>	4	0	0
<i>Circus hudsonius</i> : northern harrier <sup>1, 2V, 3N, 4N</sup>	145	16	372
<i>Accipiter striatus</i> : sharp-shinned hawk <sup>1, 2V, 3N, 4N</sup>	114	14	312
<i>Accipiter cooperii</i> : Cooper's hawk <sup>1, 2V, 3N, 4N</sup>	216	14	321
<i>Haliaeetus leucocephalus</i> : bald eagle <sup>1, 2V, 3N, 4N</sup>	282	15	365
<i>Parabuteo unicinctus</i> : Harris's hawk <sup>1, 2S</sup>	—	—	—
<i>Buteo lineatus</i> : red-shouldered hawk <sup>1, 2V, 3N, 4N</sup>	302	17	384
<i>Buteo platypterus</i> : broad-winged hawk <sup>1, 2V, 3N, 4N</sup>	35	11	94
<i>Buteo brachyurus</i> : short-tailed hawk <sup>1, 2V, 3N, 4N</sup>	47	5	19
<i>Buteo swainsoni</i> : Swainson's hawk <sup>1, 2V, 3O, 4N</sup>	3	5	10
<i>Buteo jamaicensis</i> : red-tailed hawk <sup>1, 2V, 3N, 4N</sup>	191	14	374
<i>Buteo lagopus</i> : rough-legged hawk <sup>1, 2S, 4N</sup>	1	4	10
<b>Tytonidae: barn-owls (79)</b>			
<i>Tyto alba</i> : barn owl <sup>1, 2V, 3N, 4N</sup>	14	14	164
<b>Strigidae: owls (80)</b>			
<i>Megascops asio</i> : eastern screech-owl <sup>1, 2V, 3N, 4N</sup>	81	13	322
<i>Bubo virginianus</i> : great horned owl <sup>1, 2V, 3N, 4N</sup>	123	14	328
<i>Athene cucularia</i> : burrowing owl <sup>1, 2V, 3N, 4N</sup>	8	4	28
<i>Strix varia</i> : barred owl <sup>1, 2V, 3N, 4N</sup>	72	12	251
<i>Asio otus</i> : long-eared owl <sup>1, 2V, 4N</sup>	0	1	1
<i>Asio flammeus</i> : short-eared owl <sup>1, 2V, 4N</sup>	4	5	57
<b>Alcedinidae: kingfishers (90)</b>			
<i>Megaceryle alcyon</i> : belted kingfisher <sup>1, 2V, 3N, 4N</sup>	316	16	379
<b>Picidae: woodpeckers (102)</b>			
<i>Sphyrapicus varius</i> : yellow-bellied sapsucker <sup>1, 2V, 3N, 4N</sup>	173	15	363
<i>Melanerpes erythrocephalus</i> : red-headed woodpecker <sup>1, 2V, 3N, 4N</sup>	72	14	132
<i>Melanerpes carolinus</i> : red-bellied woodpecker <sup>1, 2V, 3N, 4N</sup>	375	17	386
<i>Dryobates pubescens</i> : downy woodpecker <sup>1, 2V, 3N, 4N</sup>	244	15	365
<i>Dryobates borealis</i> : red-cockaded woodpecker <sup>1, 2V, 3N, 4N</sup>	9	8	60

## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Dryobates villosus</i> : hairy woodpecker <sup>1, 2V, 3N, 4N</sup>	17	14	188
<i>Dryocopus pileatus</i> : pileated woodpecker <sup>1, 2V, 3N, 4N</sup>	234	14	372
<i>Colaptes auratus</i> : northern flicker <sup>1, 2V, 3N, 4N</sup>	145	17	371
<b>Falconidae: falcons and caracaras (104)</b>			
<i>Caracara cheriway</i> : crested caracara <sup>1, 2V, 3N, 4N</sup>	73	8	106
<i>Falco sparverius</i> : American kestrel <sup>1, 2V, 3N, 4N</sup>	269	17	387
<i>Falco columbarius</i> : merlin <sup>1, 2V, 3N, 4N</sup>	159	14	282
[ <i>Falco rusticolus</i> : gyrfalcon]	0	1	1
<i>Falco peregrinus</i> : peregrine falcon <sup>1, 2V, 3N, 4N</sup>	144	10	160
<i>Falco mexicanus</i> : prairie falcon <sup>2S</sup>	0	2	2
<b>Psittaculidae: Old World parrots (107)</b>			
<i>Psittacula krameri</i> : rose-ringed parakeet <sup>2E, 3E</sup>	0	2	4
<i>Melopsittacus undulatus</i> : budgerigar <sup>1, 2V, 3E, 4D</sup>	1	2	5
<b>Psittacidae: New World and African parrots (108)</b>			
<i>Psittacus erithacus</i> : gray parrot <sup>2E</sup>	0	1	1
<i>Myiopsitta monachus</i> : monk parakeet <sup>1, 2V, 3E, 4E</sup>	33	6	51
<i>Conuropsis carolinensis</i> : Carolina parakeet (extinct) <sup>1, 2V, 3N, 4N</sup>	1	0	0
<i>Aratinga nenday</i> : nanday parakeet <sup>1, 2E, 3E, 4E</sup>	2	1	1
<i>Thectocercus acuticaudatus</i> : blue-crowned parakeet <sup>2E, 3E</sup>	20	1	6
<i>Psittacara erythrogenys</i> : red-masked parakeet <sup>2E, 3E</sup>	2	1	2
<b>Tyrannidae: tyrant flycatchers (126)</b>			
<i>Contopus cooperi</i> : olive-sided flycatcher <sup>1, 2V, 4N</sup>	—	—	—
<i>Contopus virens</i> : eastern wood-pewee <sup>1, 2V, 3N, 4N</sup>	73	5	7
<i>Empidonax flaviventris</i> : yellow-bellied flycatcher <sup>1, 2V, 3N, 4N</sup>	3	0	0
<i>Empidonax virens</i> : Acadian flycatcher <sup>1, 2V, 3N, 4N</sup>	18	0	0
<i>Empidonax alnorum</i> : alder flycatcher <sup>1, 2V, 3N, 4N</sup>	2	0	0
<i>Empidonax traillii</i> : willow flycatcher <sup>2V, 3N, 4N</sup>	1	0	0
<i>Empidonax minimus</i> : least flycatcher <sup>1, 2V, 3N, 4N</sup>	12	2	3
[ <i>Empidonax wrightii</i> : gray flycatcher]	0	1	1
<i>Sayornis nigricans</i> : black phoebe <sup>1, 2V, 4N</sup>	—	—	—
<i>Sayornis phoebe</i> : eastern phoebe <sup>1, 2V, 3N, 4N</sup>	272	15	372
<i>Sayornis saya</i> : Say's phoebe <sup>2V, 4N</sup>	0	1	1
<i>Pyrocephalus rubinus</i> : vermilion flycatcher <sup>1, 2V, 3N, 4N</sup>	0	1	1
<i>Myiarchus cinerascens</i> : ash-throated flycatcher <sup>2V, 3O, 4N</sup>	11	3	5
<i>Myiarchus crinitus</i> : great crested flycatcher <sup>1, 2V, 3N, 4N</sup>	211	12	147
<i>Myiarchus tyrannulus</i> : brown-crested flycatcher <sup>1, 2V, 3O, 4N</sup>	2	0	0
<i>Myiodynastes luteiventris</i> : sulphur-bellied flycatcher <sup>2S, 4N</sup>	1	0	0
<i>Tyrannus verticalis</i> : western kingbird <sup>1, 2V, 3N, 4N</sup>	18	12	64
<i>Tyrannus tyrannus</i> : eastern kingbird <sup>1, 2V, 3N, 4N</sup>	115	8	31
<i>Tyrannus dominicensis</i> : gray kingbird <sup>1, 2V, 3N, 4N</sup>	98	0	0
<i>Tyrannus caudifasciatus</i> : loggerhead kingbird <sup>1, 2V, 4N</sup>	—	—	—
<i>Tyrannus forficatus</i> : scissor-tailed flycatcher <sup>1, 2V, 3N, 4N</sup>	10	5	13
<i>Tyrannus savana</i> : fork-tailed flycatcher <sup>1, 2V, 4N</sup>	4	0	0
<b>Vireonidae: vireos, shrike-babblers, and erpornis (147)</b>			
<i>Vireo griseus</i> : white-eyed vireo <sup>1, 2V, 3N, 4N</sup>	201	13	356
<i>Vireo bellii</i> : Bell's vireo <sup>1, 2V, 4N</sup>	1	0	0
<i>Vireo flavifrons</i> : yellow-throated vireo <sup>1, 2V, 3N, 4N</sup>	48	9	33
<i>Vireo solitarius</i> : blue-headed vireo <sup>1, 2V, 3N, 4N</sup>	151	14	332
<i>Vireo philadelphicus</i> : Philadelphia vireo <sup>1, 2V, 4N</sup>	11	0	0

Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Vireo gilvus</i> : warbling vireo <sup>1, 2V, 4N</sup>	2	0	0
<i>Vireo olivaceus</i> : red-eyed vireo <sup>1, 2V, 3N, 4N</sup>	92	2	4
<i>Vireo flavoviridis</i> : yellow-green vireo <sup>2V, 4N</sup>	1	0	0
<i>Vireo altiloquus</i> : black-whiskered vireo <sup>1, 2V, 3N, 4N</sup>	24	0	0
<b>Laniidae: shrikes (166)</b>			
<i>Lanius ludovicianus</i> : loggerhead shrike <sup>1, 2V, 3N, 4N</sup>	248	16	378
[ <i>Lanius borealis</i> : northern shrike <sup>9</sup> ]	0	1	1
<b>Corvidae: crows, jays, and magpies (167)</b>			
<i>Cyanocitta cristata</i> : blue jay <sup>1, 2V, 3N, 4N</sup>	355	17	387
<i>Apelocoma coerulescens</i> : Florida scrub-jay <sup>1, 2V, 3N, 4N</sup>	136	12	152
<i>Corvus brachyrhynchos</i> : American crow <sup>1, 2V, 3N, 4N</sup>	110	15	292
<i>Corvus ossifragus</i> : fish crow <sup>1, 2V, 3N, 4N</sup>	382	15	383
<b>Paridae: tits, chickadees, and titmice (178)</b>			
<i>Poecile carolinensis</i> : Carolina chickadee <sup>1, 2V, 3N, 4N</sup>	6	5	30
<i>Baeolophus bicolor</i> : tufted titmouse <sup>1, 2V, 3N, 4N</sup>	95	12	155
<b>Alaudidae: larks (180)</b>			
<i>Eremophila alpestris</i> : horned lark <sup>1, 2V, 4N</sup>	1	3	3
<b>Hirundinidae: swallows (190)</b>			
<i>Stelgidopteryx serripennis</i> : northern rough-winged swallow <sup>1, 2V, 3N, 4N</sup>	107	7	38
<i>Progne subis</i> : purple martin <sup>1, 2V, 3N, 4N</sup>	153	5	11
<i>Tachycineta bicolor</i> : tree swallow <sup>1, 2V, 3N, 4N</sup>	285	15	379
<i>Riparia riparia</i> : bank swallow <sup>1, 2V, 3N, 4N</sup>	38	0	0
<i>Hirundo rustica</i> : barn swallow <sup>1, 2V, 3N, 4N</sup>	237	7	30
<i>Petrochelidon pyrrhonota</i> : cliff swallow <sup>1, 2V, 3N, 4N</sup>	29	0	0
<i>Petrochelidon fulva</i> : cave swallow <sup>2V, 3N, 4N</sup>	9	1	1
<b>Regulidae: kinglets (200)</b>			
<i>Regulus satrapa</i> : golden-crowned kinglet <sup>1, 2V, 3N, 4N</sup>	1	6	11
<i>Regulus calendula</i> : ruby-crowned kinglet <sup>1, 2V, 3N, 4N</sup>	138	14	357
<b>Sittidae: nuthatches (202)</b>			
<i>Sitta canadensis</i> : red-breasted nuthatch <sup>2V, 3N, 4N</sup>	6	2	2
<i>Sitta carolinensis</i> : white-breasted nuthatch <sup>1, 2V, 3N, 4N</sup>	0	5	6
<i>Sitta pusilla</i> : brown-headed nuthatch <sup>1, 2V, 3N, 4N</sup>	33	10	111
<b>Certhiidae: treecreepers (203)</b>			
<i>Certhia americana</i> : brown creeper <sup>1, 2V, 3N, 4N</sup>	0	3	8
<b>Poliotilidae: gnatcatchers (204)</b>			
<i>Poliotilta caerulea</i> : blue-gray gnatcatcher <sup>1, 2V, 3N, 4N</sup>	300	16	379
<b>Troglodytidae: wrens (205)</b>			
<i>Troglodytes aedon</i> : house wren <sup>1, 2V, 3N, 4N</sup>	193	17	364
<i>Troglodytes hiemalis</i> : winter wren <sup>1, 2V, 3N, 4N</sup>	0	6	22
<i>Cistothorus platensis</i> : sedge wren <sup>1, 2V, 3N, 4N</sup>	60	11	187
<i>Cistothorus palustris</i> : marsh wren <sup>1, 2V, 3N, 4N</sup>	67	14	210
<i>Thryothorus ludovicianus</i> : Carolina wren <sup>1, 2V, 3N, 4N</sup>	244	16	381
<i>Thryomanes bewickii</i> : Bewick's wren <sup>1, 2V, 3O, 4N</sup>	0	1	1
<b>Sturnidae: starlings (209)</b>			
<i>Gracula religiosa</i> : common hill myna <sup>2E, 3E</sup>	0	3	3
<i>Sturnus vulgaris</i> : European starling <sup>1, 2V, 3E, 4E</sup>	302	13	352
<i>Acridotheres tristis</i> : common myna <sup>2E, 3E, 4E</sup>	0	5	9
<i>Acridotheres cristatellus</i> : crested myna <sup>2E</sup>	0	1	1

## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<b>Mimidae: mockingbirds and thrashers (210)</b>			
<i>Dumetella carolinensis</i> : gray catbird <sup>1, 2V, 3N, 4N</sup>	301	16	386
<i>Toxostoma rufum</i> : brown thrasher <sup>1, 2V, 3N, 4N</sup>	156	13	307
<i>Mimus gundlachii</i> : Bahama mockingbird <sup>2V, 3O, 4N</sup>	5	0	0
<i>Mimus polyglottos</i> : northern mockingbird <sup>1, 2V, 3N, 4N</sup>	374	17	388
<b>Turdidae: thrushes and allies (211)</b>			
<i>Sialia sialis</i> : eastern bluebird <sup>1, 2V, 3N, 4N</sup>	58	12	164
<i>Catharus fuscescens</i> : veery <sup>1, 2V, 3N, 4N</sup>	22	1	1
<i>Catharus minimus</i> : gray-cheeked thrush <sup>1, 2V, 3N, 4N</sup>	20	0	0
<i>Catharus bicknelli</i> : Bicknell's thrush <sup>3N, 4N</sup>	2	0	0
<i>Catharus ustulatus</i> : Swainson's thrush <sup>1, 2V, 3N, 4N</sup>	41	1	5
<i>Catharus guttatus</i> : hermit thrush <sup>1, 2V, 3N, 4N</sup>	42	11	199
<i>Hylocichla mustelina</i> : wood thrush <sup>1, 2V, 3N, 4N</sup>	19	1	1
<i>Turdus migratorius</i> : American robin <sup>1, 2V, 3N, 4N</sup>	241	17	378
<i>Turdus plumbeus</i> : red-legged thrush <sup>2S, 4N</sup>	1	0	0
<b>Bombycillidae: waxwings (213)</b>			
<i>Bombycilla cedrorum</i> : cedar waxwing <sup>1, 2V, 3N, 4N</sup>	166	14	242
<b>Estrildidae: waxbills and allies (227)</b>			
<i>Lonchura punctulata</i> : scaly-breasted munia <sup>2E</sup>	1	0	0
<b>Passeridae: Old World sparrows (230)</b>			
<i>Passer domesticus</i> : house sparrow <sup>1, 2V, 3E, 4E</sup>	165	14	370
<b>Motacillidae: wagtails and pipits (231)</b>			
<i>Anthus rubescens</i> : American pipit <sup>1, 2V, 3N, 4N</sup>	27	8	87
<b>Fringillidae: finches, euphonias, and allies (232)</b>			
<i>Haemorhous mexicanus</i> : house finch <sup>2V, 3E, 4E</sup>	86	7	48
<i>Haemorhous purpureus</i> : purple finch <sup>1, 2V, 3N, 4N</sup>	1	1	13
<i>Loxia curvirostra</i> : red crossbill <sup>1, 2V, 4N</sup>	—	—	—
<i>Spinus pinus</i> : pine siskin <sup>1, 2V, 3N, 4N</sup>	4	6	29
<i>Spinus tristis</i> : American goldfinch <sup>1, 2V, 3N, 4N</sup>	137	15	342
<b>Calcariidae: longspurs and snow buntings (233)</b>			
<i>Calcarius lapponicus</i> : Lapland longspur <sup>1, 2V, 3O, 4N</sup>	2	2	2
<i>Plectrophenax nivalis</i> : snow bunting <sup>1, 2V, 3O, 4N</sup>	10	1	1
<b>Passerellidae: New World sparrows (236)</b>			
<i>Peucaea aestivalis</i> : Bachman's sparrow <sup>1, 2V, 3N, 4N</sup>	31	10	93
<i>Ammodramus savannarum</i> : grasshopper sparrow <sup>1, 2V, 3N, 4N</sup>	37	12	133
<i>Spizella passerina</i> : chipping sparrow <sup>1, 2V, 3N, 4N</sup>	71	15	318
<i>Spizella pallida</i> : clay-colored sparrow <sup>1, 2V, 3O, 4N</sup>	27	4	17
<i>Spizella pusilla</i> : field sparrow <sup>1, 2V, 3N, 4N</sup>	17	11	126
<i>Chondestes grammacus</i> : lark sparrow <sup>1, 2V, 3N, 4N</sup>	10	6	20
<i>Calamospiza melanocorys</i> : lark bunting <sup>1, 2V, 4N</sup>	—	—	—
<i>Spizelloides arborea</i> : American tree sparrow <sup>2S, 4N</sup>	0	1	1
<i>Passerella iliaca</i> : fox sparrow <sup>1, 2V, 3O, 4N</sup>	0	2	14
<i>Junco hyemalis</i> : dark-eyed junco <sup>1, 2V, 3N, 4N</sup>	4	2	3
<i>Zonotrichia leucophrys</i> : white-crowned sparrow <sup>1, 2V, 3N, 4N</sup>	22	4	25
<i>Zonotrichia querula</i> : Harris's sparrow <sup>1, 2V, 4N</sup>	2	0	0
<i>Zonotrichia albicollis</i> : white-throated sparrow <sup>1, 2V, 3N, 4N</sup>	18	10	85
<i>Poocetes gramineus</i> : vesper sparrow <sup>1, 2V, 3N, 4N</sup>	13	10	134
<i>Ammodramus lecontei</i> : LeConte's sparrow <sup>1, 2V, 3N, 4N</sup>	1	4	7
<i>Ammodramus maritima</i> : seaside sparrow <sup>1, 2V, 3N, 4N</sup>	9	8	89

Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Ammospiza nelsoni</i> : Nelson's sparrow <sup>3N, 4N</sup>	11	2	5
<i>Ammospiza caudacuta</i> : saltmarsh sparrow <sup>1, 2V, 3N, 4N</sup>	11	2	10
<i>Passerculus sandwichensis</i> : savannah sparrow <sup>1, 2V, 3N, 4N</sup>	137	13	353
<i>Centronyx henslowii</i> : Henslow's sparrow <sup>1, 2V, 3N, 4N</sup>	0	7	23
<i>Melospiza melodia</i> : song sparrow <sup>1, 2V, 3N, 4N</sup>	28	14	189
<i>Melospiza lincolni</i> : Lincoln's sparrow <sup>1, 2V, 3O, 4N</sup>	11	4	21
<i>Melospiza georgiana</i> : swamp sparrow <sup>1, 2V, 3N, 4N</sup>	90	13	293
<i>Pipilo erythrophthalmus</i> : eastern towhee <sup>1, 2V, 3N, 4N</sup>	141	17	361
<b>Icteriidae: yellow-breasted chat (243)</b>			
<i>Icteria virens</i> : yellow-breasted chat <sup>1, 2V, 3N, 4N</sup>	9	6	40
<b>Icteridae: troupials and allies (244)</b>			
<i>Xanthocephalus xanthocephalus</i> : yellow-headed blackbird <sup>1, 2V, 3N, 4N</sup>	0	5	14
<i>Dolichonyx oryzivorus</i> : bobolink <sup>1, 2V, 3N, 4N</sup>	75	1	1
<i>Sturnella neglecta</i> : western meadowlark <sup>1, 2V, 4N</sup>	0	3	7
<i>Sturnella magna</i> : eastern meadowlark <sup>1, 2V, 3N, 4N</sup>	80	16	348
<i>Icterus spurius</i> : orchard oriole <sup>1, 2V, 3N, 4N</sup>	15	1	1
<i>Icterus bullockii</i> : Bullock's oriole <sup>1, 3O, 4N</sup>	2	1	3
<i>Icterus pectoralis</i> : spot-breasted oriole <sup>1, 2V, 3E, 4E</sup>	0	1	9
<i>Icterus galbula</i> : Baltimore oriole <sup>1, 2V, 3N, 4N</sup>	44	9	105
<i>Agelaius phoeniceus</i> : red-winged blackbird <sup>1, 2V, 3N, 4N</sup>	239	15	382
<i>Molothrus bonariensis</i> : shiny cowbird <sup>2V, 3N, 4N</sup>	4	0	0
<i>Molothrus aeneus</i> : bronzed cowbird <sup>1, 2V, 3N, 4N</sup>	3	0	0
<i>Molothrus ater</i> : brown-headed cowbird <sup>1, 2V, 3N, 4N</sup>	126	14	286
<i>Euphagus carolinus</i> : rusty blackbird <sup>1, 2V, 3O, 4N</sup>	0	11	107
<i>Euphagus cyanocephalus</i> : Brewer's blackbird <sup>1, 2V, 3O, 4N</sup>	0	5	24
<i>Quiscalus quiscula</i> : common grackle <sup>1, 2V, 3N, 4N</sup>	357	15	379
<i>Quiscalus major</i> : boat-tailed grackle <sup>1, 2V, 3N, 4N</sup>	374	16	378
<b>Parulidae: New World warblers (245)</b>			
<i>Seiurus aurocapilla</i> : ovenbird <sup>1, 2V, 3N, 4N</sup>	140	13	229
<i>Helmitheros vermivorum</i> : worm-eating warbler <sup>1, 2V, 3N, 4N</sup>	64	5	11
<i>Parkesia motacilla</i> : Louisiana waterthrush <sup>1, 2V, 3N, 4N</sup>	31	4	8
<i>Parkesia noveboracensis</i> : northern waterthrush <sup>1, 2V, 3N, 4N</sup>	115	12	145
<i>Vermivora bachmanii</i> : Bachman's warbler (extinct) <sup>1, 2V, 4N</sup>	—	—	—
<i>Vermivora chrysoptera</i> : golden-winged warbler <sup>1, 2V, 3N, 4N</sup>	10	0	0
<i>Vermivora cyanoptera</i> : blue-winged warbler <sup>1, 2V, 3N, 4N</sup>	22	1	1
<i>Mniotilta varia</i> : black-and-white warbler <sup>1, 2V, 3N, 4N</sup>	183	15	320
<i>Protonotaria citrea</i> : prothonotary warbler <sup>1, 2V, 3N, 4N</sup>	26	4	7
<i>Limothlypis swainsonii</i> : Swainson's warbler <sup>1, 2V, 3N, 4N</sup>	12	0	0
<i>Leiothlypis peregrina</i> : Tennessee warbler <sup>1, 2V, 3N, 4N</sup>	37	4	10
<i>Leiothlypis celata</i> : orange-crowned warbler <sup>1, 2V, 3N, 4N</sup>	133	12	293
<i>Leiothlypis ruficapilla</i> : Nashville warbler <sup>1, 2V, 3N, 4N</sup>	24	4	5
<i>Oporornis agilis</i> : Connecticut warbler <sup>1, 2V, 3N, 4N</sup>	17	1	2
<i>Geothlypis philadelphia</i> : mourning warbler <sup>1, 2V, 3O, 4N</sup>	1	0	0
<i>Geothlypis formosa</i> : Kentucky warbler <sup>1, 2V, 3N, 4N</sup>	10	0	0
<i>Geothlypis trichas</i> : common yellowthroat <sup>1, 2V, 3N, 4N</sup>	260	15	371
<i>Setophaga citrina</i> : hooded warbler <sup>1, 2V, 3N, 4N</sup>	34	3	3
<i>Setophaga ruticilla</i> : American redstart <sup>1, 2V, 3N, 4N</sup>	193	13	110
<i>Setophaga kirtlandii</i> : Kirtland's warbler <sup>2V, 4N</sup>	5	0	0
<i>Setophaga tigrina</i> : Cape May warbler <sup>1, 2V, 3N, 4N</sup>	125	8	21



## Appendix. Continued.

Families and Species	No. of eBird Sites	No. of CBC	
		Sites	Years
<i>Setophaga cerulea</i> : cerulean warbler <sup>1, 2V, 3N, 4N</sup>	6	0	0
<i>Setophaga americana</i> : northern parula <sup>1, 2V, 3N, 4N</sup>	210	13	160
<i>Setophaga magnolia</i> : magnolia warbler <sup>1, 2V, 3N, 4N</sup>	67	10	26
<i>Setophaga castanea</i> : bay-breasted warbler <sup>1, 2V, 3N, 4N</sup>	30	4	16
<i>Setophaga fusca</i> : Blackburnian warbler <sup>1, 2V, 3N, 4N</sup>	37	3	7
<i>Setophaga petechia</i> : yellow warbler <sup>1, 2V, 3N, 4N</sup>	70	11	69
<i>Setophaga pensylvanica</i> : chestnut-sided warbler <sup>1, 2V, 3N, 4N</sup>	35	1	1
<i>Setophaga striata</i> : blackpoll warbler <sup>1, 2V, 3N, 4N</sup>	120	0	0
<i>Setophaga caerulescens</i> : black-throated blue warbler <sup>1, 2V, 3N, 4N</sup>	129	9	63
<i>Setophaga palmarum</i> : palm warbler <sup>1, 2V, 3N, 4N</sup>	350	16	386
<i>Setophaga pinus</i> : pine warbler <sup>1, 2V, 3N, 4N</sup>	184	14	366
<i>Setophaga coronata</i> : yellow-rumped warbler <sup>1, 2V, 3N, 4N</sup>	318	16	383
<i>Setophaga dominica</i> : yellow-throated warbler <sup>1, 2V, 3N, 4N</sup>	194	14	341
<i>Setophaga discolor</i> : prairie warbler <sup>1, 2V, 3N, 4N</sup>	225	14	344
<i>Setophaga nigrescens</i> : black-throated gray warbler <sup>1, 2V, 4N</sup>	0	1	1
<i>Setophaga townsendi</i> : Townsend's warbler <sup>2V, 4N</sup>	2	0	0
<i>Setophaga virens</i> : black-throated green warbler <sup>1, 2V, 3N, 4N</sup>	62	9	51
<i>Cardellina canadensis</i> : Canada warbler <sup>1, 2V, 3O, 4N</sup>	3	1	1
<i>Cardellina pusilla</i> : Wilson's warbler <sup>1, 2V, 3N, 4N</sup>	9	5	12
<b>Cardinalidae: cardinals and allies (247)</b>			
<i>Piranga rubra</i> : summer tanager <sup>1, 2V, 3N, 4N</sup>	66	7	24
<i>Piranga olivacea</i> : scarlet tanager <sup>1, 2V, 3N, 4N</sup>	38	1	2
<i>Piranga ludoviciana</i> : western tanager <sup>1, 2V, 3O, 4N</sup>	1	3	4
<i>Cardinalis cardinalis</i> : northern cardinal <sup>1, 2V, 3N, 4N</sup>	380	17	389
<i>Pheucticus ludovicianus</i> : rose-breasted grosbeak <sup>1, 2V, 3N, 4N</sup>	45	3	3
<i>Pheucticus melanocephalus</i> : black-headed grosbeak <sup>1, 2V, 4N</sup>	1	1	3
<i>Passerina caerulea</i> : blue grosbeak <sup>1, 2V, 3N, 4N</sup>	49	5	7
<i>Passerina amoena</i> : lazuli bunting <sup>1, 2V, 4N</sup>	—	—	—
<i>Passerina cyanea</i> : indigo bunting <sup>1, 2V, 3N, 4N</sup>	106	11	162
<i>Passerina ciris</i> : painted bunting <sup>1, 2V, 3N, 4N</sup>	62	13	316
<i>Spiza americana</i> : dickcissel <sup>1, 2V, 3N, 4N</sup>	10	5	33
<b>Thraupidae: tanagers and allies (248)</b>			
<i>Thraupis episcopus</i> : blue-gray tanager <sup>1, 2E</sup>	—	—	—
<i>Coereba flaveola</i> : bananaquit <sup>2V, 3O, 4N</sup>	1	0	0

<sup>1</sup> Species co-listed in Brevard County by Cruickshank (1980)<sup>2</sup> Species co-listed in Florida by Robertson and Woolfenden (1992) as verified natives and exotics (V), unverified stragglers (S), and unestablished exotics (E)<sup>3</sup> Species co-listed in Florida by Maehr and Kale (2005) as natives (N), occasionals (O), and breeding exotics (E)<sup>4</sup> Species co-listed in Florida by the Florida Ornithological Society (FOS) as "natural appearances" (N), established exotics (E), or disestablished exotic (D)<sup>5</sup> Photographic record on eBird<sup>6</sup> Probably listed as *Porphyrio porphyrio* (purple swamphen) by Maehr and Kale (2005) and on FOS list<sup>7</sup> Probably misidentified magnificent frigatebird<sup>8</sup> Probably misidentified American white pelican<sup>9</sup> Probably misidentified loggerhead shrike