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On the Cover: Great Kiskadee (*Pitangus sulphuratus*) nestling near fledging age in Sulphur, Calcasieu Parish, at the first successful nest documented for Louisiana (see Rutt et al. pp. 74–79). Photo credit: Thomas J. Finnie

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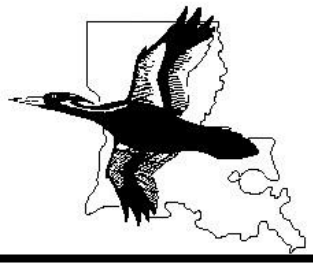

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RESEARCH ARTICLE

Birds in the diet of American alligators

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ABSTRACT

American alligators (*Alligator mississippiensis*) are opportunistic predators that prey upon or scavenge a wide variety of vertebrates and invertebrates. Fish and crustaceans are typically the most frequently encountered items in most diet analyses whereas birds are relatively uncommon in comparison. However, most alligator food habits analyses rely on stomachs collected from alligators legally harvested during short (one month in the fall) hunting seasons. Thus, these analyses may underrepresent the importance of birds because they provide data from a short period during which birds may not be readily available. In this paper we report on the frequency of birds found in a sample of over 500 stomachs collected by Louisiana alligator hunters and review published and unpublished accounts of alligator consumption of birds. In most cases, we could not tell whether the bird was caught and consumed alive or scavenged; however, several reports of direct observation of alligator depredation illustrate that alligators will prey on live birds when available. Considering all sources, we found evidence of alligators consuming at least 40 bird species, including two waterfowl species (Black-bellied Whistling-Duck [*Dendrocygna autumnalis*] and Blue-winged Teal [*Anas discors*]) not previously reported as alligator food. Among the most frequently recorded species were waterfowl and wading birds, two groups of birds that may be particularly susceptible to alligator depredation as flightless or naïve juveniles or as flightless adults during summer molt. Because alligator food habit studies typically do not occur during the summer when these groups of birds are breeding and population densities relatively high, their importance in alligator diets may be underestimated.

Keywords: American alligator, birds, food habits, predation, scavenging, stomach content analysis

INTRODUCTION

American alligators (*Alligator mississippiensis*) are opportunistic predators that prey upon or scavenge a wide variety of vertebrates and invertebrates (Wolfe et al. 1987, Gabrey et al. 2009, Gabrey 2010). In diet studies based on stomach-content analysis, fish and crustaceans are typically the most frequently recorded food items. The frequency of other vertebrates usually is less than that of fish and often varies geographically – mammals are more frequently encountered in stomachs from alligators taken in Louisiana, whereas reptiles, particularly turtles, are more frequently encountered in stomachs from Florida (McNease and Joanen 1977, Delany and Abercrombie 1986, Gabrey 2010). Regardless of location, birds appear to be an uncommon component of the alligator diet (Delany and Abercrombie 1986, Wolfe et al. 1987).

While alligators have been observed depredating live birds and eggs (McIlhenny 1935, Folk et al. 2014), most food habits studies rely on analysis of stomach contents of alligators that have been harvested during legal seasons, culled as nuisance animals, or collected specifically for food habits or other scientific purposes. In such cases, whether the prey was captured alive or was scavenged is unknown. In this paper, we report on the incidence of bird remains found in 551 alligator stomachs collected in conjunction with Louisiana Department of Wildlife and Fisheries' (LDWF) nutria management activities (http://nutria.com/site9.php) in south Louisiana. We also review the literature regarding birds as stomach contents, summarize published accounts of alligator depredation on birds, and document two new species of duck not previously reported as alligator prey.

METHODS

Alligator stomachs were collected from cooperating trappers in Lafourche and Terrebonne parishes during the September 2002, 2003, and 2004 trapping seasons, and in Cameron, Vermilion, and St. Charles parishes during the 2003 and 2004 seasons. The most common method used by alligator hunters in Louisiana takes advantage of the alligators' scavenging behavior by suspending a secured hook baited with chicken or other meat 1-2 feet above the water surface (http://www.wlf.louisiana.gov/alligator-hunting-regulations-overview); the captured alligator is then dispatched with a firearm. Occasionally "blackbirds" (grackles or Red-winged Blackbirds) are used as bait.

Upon collection, stomachs were immediately frozen and stored until analysis. Stomachs were later thawed and the contents emptied into a 1 mm mesh sieve and rinsed. We then identified the contents to the lowest taxonomic level possible, counted the number of individuals (if possible) of each prey category, and recorded the wet weight of each prey category. Identification of prey items was facilitated through the use of relevant keys, field guides, experience or consultation with other biologists. In this paper, we report only the presence of bird species and the percentage of stomachs from which each species was recorded. For additional details regarding stomach collection, data collection and analysis methods, and demographics of harvested alligators, see Gabrey et al. (2009) and Gabrey (2010).

We also searched published and unpublished accounts of alligator stomach contents analyses, published accounts of bird band recoveries from alligator stomachs, and observations of alligators consuming birds. We used EBSCOhost and Google Scholar to search for relevant studies. Key words included "alligator, "diet," "food habits," "depredation," "bird," and "scavenging." Our purpose was to identify those bird species that are susceptible to alligator depredation and summarize the frequency of occurrence of birds in alligator diets and not to provide a complete review of alligator diets. Therefore, we excluded from our literature summary those stomach-content studies in which no bird remains were present. However, we did include those studies in which bird remains were present but not identified to species as these

studies provide information regarding the frequency of occurrence of birds.

RESULTS

We examined the contents of 551 alligator stomachs collected over the three years, with 71% from males (mean total length = 237.2 cm ± 37.7 S.D.) and 29% from females (mean total length = 208.9 cm ± 17.1 S.D.). Fifty-three stomachs (10%) contained some type of bird remains. Remains from 49 stomachs consisted of Boat-tailed or Great-tailed grackles (*Quiscalus* spp., Tables 1 and 3) with shotgun pellet holes, or a number of black feathers and/or claws (podotheca) from grackles. We assumed that these grackles were the bait used to capture the alligators.

The remaining four stomachs contained remains of birds that were presumably caught or scavenged by alligators, and not used as bait. The stomach from a 2.16 m male taken at Lacassine National Wildlife Refuge in Cameron Parish during the 2003 season contained the foot of a Snowy Egret and no other animal remains. A stomach from a 2.24 m male harvested in 2004 in Terrebonne Parish contained feathers, talons, and rhamphotheca of a Barred Owl along with crayfish shell fragments, insect body parts, and fish remains. Two other stomachs collected in 2004, one from a 2.13 m female from Terrebonne Parish and one from a 2.39 m male from St. Charles Parish, contained the remains of Common Gallinules.

In addition to the remains described above, we found a USGS band from a Black-bellied Whistling-Duck in the stomach of a 2.36-m female alligator that had been harvested on Lacassine National Wildlife Refuge in Cameron Parish in southwest Louisiana in late August 2003. The duck was banded at the same refuge on 13 June 1999 as an after-hatch-year, sex-unknown bird. The stomach also contained 20 g of vegetation but no other animal remains. This is the first published evidence of alligators consuming this species of duck (Table 1).

In our review of the literature, we found eight investigations that recovered bands or radio transmitters from 11 species in alligator stomachs (Table 1). Most bands were from aquatic species such as waterfowl, herons, or cranes; however bands from a Northern Bobwhite and an Osprey were also recovered.

In our review, 21 investigations of alligator stomach contents found birds or bird remains in at least one stomach (Table 2). These studies reported on the stomach contents from alligators that were harvested during legal seasons, dispatched as nuisance animals, or collected specifically for food habits or other scientific purposes. At least 34 bird species were reported (Table 3). In four of these studies, birds were present in at least 20% of stomachs (Kellogg 1929, McIlhenny 1935, McNease and Joanen 1977, Elsey et al. 2004).

The seasonal timing of collection and the sizes of alligators collected varied somewhat for diet studies reporting bird consumption. Eight of the 21 studies listed in Table 2 (excluding the present one) relied exclusively on stomachs collected during fall (August through October); only three studies (McIlhenny 1934, O'Neil 1949, Elsey et al. 2004) did not collect stomachs during fall (Table 1). The remainder collected stomachs from alligators during fall hunting seasons and at least one other season.

Three of the 21 studies listed in Table 2 (excluding the present one) provided data on the length of alligators containing bird remains. Nine of 27 stomachs from alligators between 1.51–2.08 m in length contained Mottled Duck remains compared to none of 16 stomachs from alligators between 2.11–3.28 m in length (Elsey et al. 2004). McIlhenny (1934) reported the presence of "herons" in stomachs of all 25 animals (14 males, 11 females) he collected. These alligators ranged in length from 5 ft 3 in to 10 ft 1 in (1.60 to 3.07 m). Kellogg (1929) reported bird remains in the stomachs of alligators ranging from 5 to 10 ft (1.5 to 3.0 m).

TABLE 1. Bird species for which bands and/or radio transmitters have been recovered from alligator stomachs.

Species	State(s)	Reference(s)
Black-bellied Whistling-Duck *(Dendrocygna autumnalis)*	LA	This study
Whooping Crane[1] (*Grus americana*)	FL	Folk et al. 2014
Northern Bobwhite[2] (*Colinus virginianus*)	FL	Martin et al. 2008
Mottled Duck (*Anas fulvigula*)	LA	Elsey et al. 2004
American Coot (*Fulica americana*)	FL	Delany 1986
Northern Pintail (*Anas acuta*)	FL	Delany 1986
Ring-billed Gull (*Larus delawarensis*)	FL	Delany 1986
Osprey (*Pandion haliaetus*)	FL, NC	Delany 1986, Fuller 1981
Great Egret (*Ardea alba*)	LA	Valentine et al. 1972
Little Blue Heron (*Egretta caerulea*)	SC	Chamberlain 1930
Tri-colored Heron (*Egretta tricolor*)	SC	Chamberlain 1930

[1] A band and radio transmitter.

[2] A radio transmitter, but no other evidence of the bird.

FIGURE 1. Photograph taken by RME on Rockefeller State Wildlife Refuge, Grand Chenier, Louisiana in the spring of 1994 of an American alligator swimming while carrying a dead Canada Goose in its mouth.

FIGURE 2. Photograph taken by Phillip L. Trosclair, III, biologist, on Rockefeller State Wildlife Refuge, Grand Chenier, Louisiana of an American alligator near a Blue-winged Teal carcass; whether the alligator killed the bird or not is unknown.

Table 2. Studies documenting stomach contents or observations of depredation of birds by American alligators, the percent of stomachs examined that contained bird remains (no bands), and the number of bird species identified in each study.

Author (State)	No. of stomachs examined (% with birds)	Season[1]	Number of species
This study (LA)	551 (10[2])	3	≥ 3
Saalfeld et al. 2011 (TX)	62 (18)	2, 3	3
Elsey et al. 2004 (LA)	43 (21)	2	1
Delany et al. 1999 (FL)	219 (6)	3	2
Barr 1997 (FL)	635 (4)	1, 3	≥ 3
Barr 1994 (FL)	80 (6)	1, 2, 3	Not reported
Rice 1994 (FL)	175 (12)	1, 2, 3	≥ 4
Elsey et al. 1992 (LA)	123 (7)	3	Not reported
Hayes 1992 (TX)	187 (3)	2, 3	Not reported
Delany 1990 (FL)	80 (1)	3	Not reported
Delany et al. 1988 (FL)	111 (17)	2, 3	≥3
Sloan 1987 (LA)	321 (4)	1, 2, 3	≥ 4
Wolfe et al. 1987 (LA)	100 (10)	3	≥ 3
Delany and Abercrombie 1986 (FL)	350 (9)	3	
Taylor 1986 (LA)	111 (11)	3	≥ 6
McNease and Joanen 1977 (LA)	314 (47[3])	3	≥ 9
Valentine et al. 1972 (LA)	413 (1)	1, 2, 3	13
Chabreck 1971 (LA)	20 (15)	3	≥ 1
Giles and Childs 1949 (LA)	318 (11)	2, 3	≥ 4
O'Neil 1949 (LA)	375 (6)	1, 2	Not reported
McIlhenny 1934 (LA)	25 (100)	1, 2	≥1
Kellogg 1929 (LA/TX)	12 (100)	1	3
Kellogg 1929 (LA, TX)	24 (Not reported)	1	3
Kellogg 1929 (LA,TX, GA, FL)	157 (7)	1, 2, 3	6

[1] Seasons: 1 = spring (February to April); 2 = summer (May to July); 3 = fall (August to September).

[2] Of 551 stomachs examined, 53 contained bird remains or a bird band. Remains in 49 of the 53 stomachs were confirmed or presumed to be from grackles used as bait.

[3] Of 314 stomachs examined, 148 contained bird remains. Remains in 96 of the 148 stomachs were identified as grackles or blackbirds and were likely used as bait.

Table 3. Bird remains found in American alligator stomachs. Species are listed based on the number of references in which they were reported.

Species	Source
Common Gallinule *(Gallinula galeata)*	This study, Valentine et al. 1972, McNease and Joanen 1977, Delany 1986, Sloan 1987, Delany et al. 1988, Rice 1994[1], Barr 1997, Delany et al. 1999, Saalfeld et al. 2011
American Coot *(Fulica americana)*	Kellogg 1929, Valentine et al. 1972, Delany and Abercrombie 1986, Taylor 1986, Wolfe et al. 1987, Delany et al. 1988, Barr 1997
Great-tailed Grackle[2] (*Quiscalus mexicanus*)	Giles and Childs 1949, Chabreck 1971, Valentine et al. 1972, McNease and Joanen 1977, Sloan 1987
Mottled Duck *(Anas fulvigula)*	Kellogg 1929, Valentine et al. 1972, McNease and Joanen 1977, Sloan 1987, Elsey et al. 2004
Anhinga *(Anhinga anhinga)*	Delany 1986, Rice 1994, Delany et al. 1999, Saalfeld et al. 2011
Rail (Clapper, King) *(Rallus longirostris, R. elegans)*	Kellogg 1929, Giles and Childs 1949, Valentine et al. 1972, Wolfe et al. 1987
Cattle Egret *(Bubulcus ibis)*	Delany 1986, Delany et al. 1988, Saalfeld et al. 2011
Purple Gallinule *(Porphyrio martinica)*	Giles and Childs 1949, Valentine et al. 1972, McNease and Joanen 1977
Barred Owl *(Strix varia)*	This study, Taylor 1986
Green Heron *(Butorides virescens)*	Valentine et al. 1972, McNease and Joanen 1977
Least Bittern (*Ixobrychus exilis*)	Kellogg 1929, McNease and Joanen 1977
Mallard *(Anas platyrhynchos)*	Kellogg 1929, Taylor 1986
Pied-billed Grebe (*Podilymbus podiceps*)	Kellogg 1929, Delany 1986
Red-winged Blackbird[2] (*Agelaius phoeniceus*)	McNease and Joanen 1977, Wolfe et al. 1987
Snowy Egret *(Egretta thula)*	Giles and Childs 1949, Valentine et al. 1972
Wood Duck (*Aix sponsa*)	Taylor 1986, Delany 1986
American Robin *(Turdus migratorius)*	Barr 1997
Black-crowned Night-heron *(Nycticorax nycticorax)*	Valentine et al. 1972
Black-necked Stilt *(Himantopus mexicanus)*	Valentine et al. 1972
Blue Jay (*Cyanocitta cristata*)	McNease and Joanen 1977
Boat-tailed Grackle[2] (*Quiscalus major*)	This study
Common Grackle[2] (*Quiscalus quiscula*)	Taylor 1986
Double-crested Cormorant *(Phalacrocorax auritus)*	Rice 1994
Great Egret *(Ardea alba)*	Sloan 1987
Horned Grebe *(Podiceps auritus)*	Kellogg 1929
Little Blue Heron *(Egretta caerulea)*	Valentine et al. 1972
Northern Bobwhite (*Colinus virginianus*)	Martin et al. 2008
Purple Martin (*Progne subis*)	McNease and Joanen 1977
Sandhill Crane (*Grus canadensis*)	Folk et al. 2014
Short-eared Owl *(Asio flammeus)*	Kellogg 1929
Sora (*Porzana carolina*)	Valentine et al. 1972

Table 3. Continued.

Species	Source
White-faced Ibis (*Plegadis chihi*)	Valentine et al. 1972
White Ibis (*Eudocimus albus*)	Rice 1994
Whooping Crane *(Grus americana)*	Folk et al. 2014
Unidentified grackle[3] (*Quiscalus* sp.)	Sloan 1987
Unidentified hawk	Taylor 1986
Unidentified waterfowl	Taylor 1986
"Gallinule"	McIlhenny 1935
"Herons"	McIlhenny 1934
"Marsh Owl"	Kellogg 1929

[1] One individual identified as "Common Moorhen/American Coot".

[2] These species are commonly used as bait.

[3] Although alligator hunters use grackles commonly for bait, this study did not collect stomachs from hunters; thus, these grackles were either caught alive or scavenged by the alligators.

In addition to stomach contents studies and band recoveries, alligators have also been observed depredating birds. Folk et al. (2014) observed alligators preying on Whooping and Sandhill cranes and depredating crane nests in Florida. McIlhenny (1935) reported two observations of alligators chasing and consuming Mottled Ducks and King Rails in Louisiana. McIlhenny (1935) also reported depredation on Canada and Snow Geese (*Branta canadensis* and *Chen caerulescens*, respectively), as well as domestic fowl. Also, one of us (RME) photographed (Figure 1) an alligator with a Canada Goose in its mouth at Rockefeller Wildlife Refuge in Grand Chenier, Cameron Parish, Louisiana in spring 1994. Another Rockefeller biologist photographed (Figure 2, date uncertain) another alligator near a heavily damaged Blue-winged Teal (*Anas discors*) carcass on the refuge; to our knowledge, this species has not been reported as alligator food/prey. In both photographs, it is unclear whether the alligator killed or scavenged the bird. Also, on at least two occasions during early September waterfowl seasons, RME has observed alligators consuming hunter-shot teal before the teal could be retrieved. In June 2014, J. O. Coulson, T. D. Coulson and B. Bradshaw (personal communication) observed an alligator (estimated length ca. 1.5 m) stalk a family of Black-bellied Whistling-Ducks (2 adults, 5 flightless juveniles) on Bayou Sauvage National Wildlife Refuge, Orleans Parish, in southeastern Louisiana. The alligator caught and swallowed one of the juveniles, while the remaining four scattered into the surrounding vegetation. The parent ducks pursued the alligator for about 4 meters, driving it away from the remaining ducklings by fluttering over it and striking at its back a few times as it swam away.

Alligators also appear to prey on juveniles or eggs of birds when available. Juveniles or eggs of Sandhill Cranes (Folk et al. 2014), Mottled Ducks (Sloan 1987, Elsey et al. 2004), Clapper Rails (Giles and Childs 1949), Purple Gallinules (Giles and Childs 1949), Great Egrets (Valentine et al. 1972), and Common Gallinules (Sloan 1987) have been found in alligator stomachs.

Overall, several lines of evidence (presence of completely or partly digested remains; presence of bands or radio transmitters; and direct observations of depredation on adults, young, or eggs), show that alligators have consumed at least 41 bird species. As would be expected, most species are those associated with aquatic habitats (wading birds, waterfowl, rails, etc.); however, remains of such terrestrial species as American Robin, Blue Jay, and Northern Bobwhite were also found in alligator stomachs.

DISCUSSION

Based upon the bird remains we found in stomachs, on previous reports, and on observations of alligators hunting live birds, it appears that alligators usually depredate live birds opportunistically, either when the birds are disadvantaged (e.g., flightless), are in or near the water (swimming, wading, walking on top of aquatic vegetation), or are concentrated. Some of the more commonly consumed species are also poor fliers. Alligators also scavenge dead birds as a result of road kill (possibly explaining the presence of terrestrial species), as flightless juvenile wading birds that have fallen out of the nest, or as hunter-shot waterfowl that had yet to be retrieved.

The two most frequently identified bird species reported from alligator stomach analyses were Common Gallinules and American Coots. Gallinules are abundant all year and coots are abundant from early fall to late spring in alligator habitat, especially in Louisiana (Lowery 1972). Both species forage along shorelines, on floating vegetation, and while swimming in large flocks on open water where alligators often congregate. As neither bird is known for agility, it is not surprising that alligators would prey upon these species occasionally.

Several species of black birds found in alligator stomachs may represent their use as bait rather than alligator depredation. Many alligator hunters use "grackles" or "blackbirds" (Common, Great-tailed and Boat-tailed grackles, Red-winged Blackbirds) as bait (McNease and Joanen 1977, S. W. Gabrey personal observation). Collectively, these four species were the second most frequently recorded species, present in eight studies (including the present one). However, only one study (Sloan 1987) collected alligators specifically for the purpose of identifying stomach contents over a one-year period and did not collect from alligators harvested during fall hunting seasons. Thus, the relatively high occurrence in alligator stomachs of these birds compared to that of other bird species in most of these studies is likely due to their use as bait. However, as evidenced by Sloan (1987), alligators apparently will consume them when available.

Several waterfowl species appear vulnerable to alligator depredation mostly during spring or summer as flightless juveniles or as flightless adults during summer molt (Elsey et al. 2004). These include Mottled Ducks (the fourth most frequently recorded species), Blue-winged Teal (this study), Black-bellied Whistling-Ducks (this study), Wood Ducks (Delany 1986, Taylor 1986), Northern Pintails (Delany 1986), Mallards (Kellogg 1929, Taylor 1986), and Canada and Snow Geese (McIlhenny 1935).

Alligators commonly exploit rookeries of wading and diving birds because of the multiple foraging advantages they provide. Birds are extremely concentrated, breeders are pressured to find food for their young, and flightless young may fall from the nest. We found evidence of alligators consuming 11 colonially nesting species including: Black-crowned Night-Heron; Green, Tri-colored, and Little Blue herons; Cattle, Great, and Snowy egrets; White and White-faced ibis; Anhinga; and Double-crested Cormorant (Tables 1 and 3). Nell and Frederick (2015) suggested that alligators associated with wading bird colonies receive "non-trivial" energetic benefits in the form of nestling carcasses that fall from over-water nests. However, it is not known whether any of these birds were scavenged rather than hunted.

Alligator diet analyses that rely heavily on stomachs collected from hunters during the fall trapping season (September in Louisiana) are probably biased. The apparently small contribution of birds (compared to fish or crayfish) reported in published accounts may reflect seasonal differences in prey availability (Elsey et al. 2004) or in alligator habitat selection (McIlhenny 1935). Alligators may take birds more frequently than assumed during summer when flightless waterfowl or naïve juveniles (Elsey et al. 2004) or fledglings (McIlhenny 1934, Valentine et al. 1972), including wading birds at rookeries (discussed above), are more abundant. In addition, harvested alligators are typically taken from deep-water canals and lakes, a habitat in which birds are uncommon during the September alligator trapping season. Most

alligator trapping activity takes place during the first 2 weeks of September, whereas large numbers of potentially vulnerable migratory waterfowl do not arrive in Louisiana until October or November (Lowery 1974). Thus, most alligator stomachs used for food habits studies have been collected at a time of year during which the availability of vulnerable birds is low.

Birds are assumed to be a minor component of the diet of American alligators because they are found in alligator stomachs infrequently or because they contribute little to the overall mass or volume of stomach contents. However, most food habits studies are based on data collected during a short, one month trapping season and, therefore, may not be representative of alligator food habits at other times of the year. Future investigations into the importance of birds and other prey in the alligator's diet should consider sampling during all seasons and incorporating energetic and nutritional composition of the prey items and volume or biomass contribution in addition to the frequency of occurrence.

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RESEARCH ARTICLE

Avian Frugivory in Louisiana

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ABSTRACT

This report expands upon a survey of bird frugivory in Louisiana, published in 1998, in which 26 observers recorded 65 species of birds utilizing the fruits of 49 species of native, naturalized, and exotic plants in Louisiana. In the 18 years subsequent to that publication, 30 additional observers joined the original corps, adding 21 new bird species, eight additional plant species, and dozens of new bird/fruit interaction pairings to the original report. The importance of Louisiana's native fruiting plants to birds was also categorized based on the diversity of bird species (both observed and from the literature) attracted to them. Though anecdotal and strictly qualitative in nature, it is hoped that these records will generate additional bird frugivory studies in Louisiana, as well as assist wildlife managers and habitat restorationists in planning bird conservation projects throughout the U.S. Gulf Coastal region.

Keywords: bird, frugivory, Louisiana, conservation, restoration, native plants

Avian nutritional studies in North America were originally undertaken to assess potential threats and benefits to agricultural crops (Beal and Kalmbach 1927), in life histories (Beal 1896, 1911, 1912, 1915a, 1915b, 1918; Chapin 1925, McAtee 1908), and to address population issues of certain game bird species (Wright 1915a, 1915b). By the mid-20th century, at least some diet studies had become focused on wildlife conservation (Martin et al. 1951). Then, by the end of the 20th century, in response to population declines of many more bird species (Askins et al. 1990, Martin and Finch 1995), federal and state agencies developed and published various conservation plans for native birds or flora, fauna and habitats that took on a more holistic approach (e.g., Lower Mississippi Valley Joint Venture Board 1990; Rich et al. 2004, Lester et al. 2005, Rosenberg et al. 2016). Each of these plans cited habitat loss as the primary cause, and habitat conservation and restoration as the primary solution to address these bird population declines.

Frugivory is especially important to bird conservation in the Americas because many primarily insectivorous songbirds routinely alter

their diets to include fleshy fruits during migratory and winter periods when fewer insects and invertebrates are available (Parrish 1997). The extent to which many temperate-breeders such as warblers, flycatchers and vireos depend on fruit during the non-breeding season is still largely unknown (Faaborg 2002). However, it is clearly significant because fruiting plants have evolved phenological fruiting strategies to capitalize on birds as seed dispersers (Thompson and Willson 1979).

Most investigations into bird frugivory issues in the Americas have been conducted at latitudes well north of the U.S. Gulf Coast (e.g., Stiles and White 1982, Willson 1986, Wheelwright 1988, White 1989, Sallabanks 1993, Witmer 1998, Levey and Martinez del Rio 2001, McWilliams et al. 2004, Smith et al. 2007). Yet the Gulf Coast region deserves further attention because it supports seasonally high densities of neotropical and nearctic migratory songbird populations from throughout eastern North America (Barrow 2000a, 2000b, Moore 2000, Gauthreaux et al. 2006), and, relatively few avian frugivory studies have been conducted here (e.g., Skeate 1987, Strong 1999, Brown et al. 2002, Strong et al. 2005).

Compilation of bird frugivory observations along the Gulf Coast in Louisiana began in 1994 (Fontenot 1998). The initial, 5-year avian frugivory survey involved 26 observers recording 1041 bird/fruit interactions, with 65 species of birds consuming the fleshy fruits of 51 species of plants (Fontenot 1998). The 1998 publication stimulated additional reports of bird frugivory observations from Louisiana. This report updates the ongoing survey effort in Louisiana, incorporating new bird-fruit associations. I also use these qualitative observations to identify some of the more important fleshy-fruited plants of the region in hopes that this information will be of use for bird conservation and habitat restoration efforts along the Gulf Coast.

METHODS

Botanists use the term "fruit" in a general sense to denote sexually generated propagules of many types. However, in this study, as with all of the avian frugivory studies cited herein, the term "fruit" is used in an ecological sense: "a fleshy, nutritious, edible pulp surrounding or attached to seed(s) or in which seeds are embedded" (Willson 1986; see also Snow 1971, Thompson and Willson 1979).

Regarding this report, additional observers were recruited via LABIRD-L, a list-serve operated discussion group devoted to Louisiana birds and bird issues. Observers were instructed to record the date, location, bird species and plant species involved in each bird-fruit interaction which resulted in the bird(s) actually consuming the fruit(s). Observers disregarded any bird-fruit interaction that did not result in actual fruit consumption (i.e., simply "mouthing" or quickly regurgitating). Observers were encouraged to seek out bird-fruit interactions on a year round basis, though summer observations were low as fewer plant species are fruiting at that time and fewer observers are out in the field during that season. Due to the qualitative and anecdotal nature of this survey, no effort was made to quantify specific bird-fruit relationships. Likewise, no effort was made to segregate bird species according to their potential value as seed dispersers vs. seed predators as is often done in evolutionary studies.

We also surveyed the literature for bird-plant frugivorous interactions that were not observed in Louisiana but that should be expected based on individual bird and plant ranges of published reports from outside of the state. To further assist land managers and habitat restorationists, these findings are included in the results, but are noted as being from the literature, with citations provided.

Common and scientific names of birds follow the fifty-seventh supplement of the American Ornithologist's Union's Checklist of North American Birds (Chesser et al. 2016).
Common and scientific names of plants follow the USDA Plants Database (USDA, NRCS 2017). Scientific names of birds and plants are

provided in their respective species lists in the results section.

RESULTS

The results presented here include and expand upon the avian frugivory interactions reported in 1998 (Fontenot 1998), which listed 65 species of birds using 49 species/cultivars of plants in Louisiana. In the ensuing 18 years of compilation subsequent to the 1998 survey report, 29 additional observers have expanded the total statewide observer network to 56 professional and experienced amateur ornithologists and naturalists who have logged several hundred additional bird/fruit interactions. These efforts have increased the combined Louisiana roster of known avian frugivores to 86 species from 20 families, observed using at least 57 different plant species, hybrids, and horticultural cultivars representing 28 plant families (Table 1).

The bird and plant species lists below provide details about the frugivory reports compiled in Table 1. They are presented first by bird families and respective species and the plant species from which each was observed eating fruits. The bird list is followed by a list of the plant families and species involved, along with the bird species which were observed to consume each. Generalized notes regarding the Louisiana status of each bird species (Lowery 1974) and plant species (Brown 1965, Thomas and Allen 1993, 1996, 1998) have been included as well. Generalized Louisiana fruit availability dates (in parentheses) follow the Louisiana status information for each plant species.

Birds

We recorded avian frugivory in Louisiana in a wide variety of birds, most of which are primarily insect or seed eaters, including woodpeckers, flycatchers, vireos, thrushes, mimic thrushes, sparrows and finches, grosbeaks, warblers, and blackbirds.

It is noteworthy that a number of frugivorous bird species reported in the literature have yet to be observed in frugivorous interactions in Louisiana. Notables of conservation and management concern include: Wild Turkey observed feeding on the fruits of Poison Ivy, Holly spp., Dogwood spp., Catbrier spp., Red Bay, Black Gum, Wild Grape spp. (Martin et al. 1951), Strawberry Bush, Huckleberry spp., American Persimmon, Supplejack, and Serviceberry (Seidenberg 1995); Northern Bobwhite observed feeding on the fruits of Japanese Honeysuckle, Flowering Dogwood, Black Gum, Blackberry spp. (Martin et al. 1951), Huckleberry spp., Supplejack, Serviceberry, Hawthorn spp., and Black Cherry (Seidenberg 1995); Warbling Vireo feeding on the fruits of Sumac spp., Poison Oak, Elderberry, Dogwood spp., Pokeberry, Cherry spp., and Wild Grape spp. (Martin et al. 1951); Fox Sparrow feeding on the fruits of Poison Ivy, Hawthorn spp., Catbrier spp., Virginia Creeper, and Wild Grape spp. (Martin et al. 1951); and Eastern Meadowlark feeding on fruits of Chokeberry (Martin et al. 1951).

Observed birds are listed in phylogenetic order by family.

COLUMBIDAE

Eurasian Collared-Dove *(Streptopelia decaocto)* – Locally common year round resident. **Observed:** Mulberry spp.

Inca Dove *(Columbina inca)* – Locally common year round resident, especially within southern half of the state. **Observed:** Mulberry spp.

White-winged Dove *(Zenaida asiatica)* – Locally common year round resident in southwestern Louisiana; rare elsewhere. **Observed:** Southern Magnolia, Mulberry spp. **Literature:** Prickly Ash (Martin et al. 1951), Pigeonberry (Schwertner et al. 2002).

Mourning Dove *(Zenaida macroura)* – Common year round resident statewide. **Observed:** Southern Magnolia, Mulberry spp. **Literature:** Pokeberry (Martin, etal. 1951), Serviceberry, Huckleberry spp. (Seidenberg 1995).

TROCHILIDAE

Ruby-throated Hummingbird *(Archilochus colubris)* – Common spring migrant and

breeding statewide; often abundant in fall migration. **Observed:** American Persimmon, Common Pear (technically not "frugivory" but birds were observed gleaning fruit juices from holes pecked in fruit by other/passerine birds).

PICIDAE

Red-headed Woodpecker *(Melanerpes erythrocephalus)* – Uncommon year round resident statewide. **Observed:** Southern Magnolia, Mulberry spp., Black Cherry. **Literature:** Sumac spp., Poison Ivy, Elderberry, Rough-leaf Dogwood, Flowering Dogwood, Black Gum, Catbrier spp., Virginia Creeper, Wild Grape spp. (Beal 1911, Martin et al. 1951).

Red-bellied Woodpecker *(Melanerpes carolinus)* – Common year round resident statewide. **Observed:** Poison Ivy, Elderberry, Rough-leaf Dogwood, Sassafras, Southern Magnolia, Mulberry spp., Black Gum, Common Pear, Black Cherry, Hackberry, Pepper Vine, Virginia Creeper. **Literature:** Palmetto spp., Sumac spp., American Holly, Deciduous Holly, Flowering Dogwood, Huckleberry spp., Catbrier spp., Pokeberry, Wild Grape spp. (Beal 1911), Hawthorn spp. (Williams and Batzli 1979).

Yellow-bellied Sapsucker *(Sphyrapicus varius)* – Common winter resident statewide. **Observed:** Poison Ivy, Southern Magnolia, Black Gum, Devilwood, Supplejack, Hackberry, Virginia Creeper. **Literature:** Poison Sumac, American Holly, Inkberry Holly, Deciduous Holly, Elderberry, Strawberry Bush, Flowering Dogwood, Eastern Red Cedar, Sassafras, Catbrier spp., Pokeberry (Beal 1911).

Downy Woodpecker *(Picoides pubescens)* – Common year round resident statewide. **Observed:** Poison Ivy, Rough-leaf Dogwood, Black Gum, Common Pear, Virginia Creeper. **Literature:** Mulberry spp. (Merriam 1890), Elderberry, Flowering Dogwood, Blueberry spp., Pokeberry, Serviceberry, Blackberry spp. (Beal 1911).

Hairy Woodpecker *(Picoides villosus)* – Common year round resident statewide. **Observed:** Southern Magnolia, Black Gum. **Literature:** Virginia Creeper (Martin et al. 1951).

Northern (Yellow-shafted) Flicker *(Colaptes auratus)* – Common year round resident statewide. **Observed:** Poison Ivy, Common Pear, Virginia Creeper. **Literature:** Sumac spp., Holly spp., Elderberry, Rough-leaf Dogwood, Flowering Dogwood, Eastern Red Cedar, Huckleberry spp., Blueberry spp., Spicebush, Red Mulberry, Southern Magnolia, Tupelo Gum, Black Gum, Pokeberry, Black Cherry, Blackberry spp., Catbrier spp., Hackberry (Beal 1911), Arrowwood Viburnum (Rybczynski and Riker 1981), Chokeberry, Devil's Walkingstick (Miller and Miller 1999), Wild Grape spp. (Martin et al. 1951).

Pileated Woodpecker *(Dryocopus pileatus)* – Common year round resident statewide. **Observed:** Poison Ivy, Southern Magnolia, Black Gum, Common Pear, Black Cherry. **Literature:** Dwarf Sumac, Poison Sumac, American Holly, Dahoon Holly, Elderberry, Viburnum spp., Rough-leaf Dogwood, Flowering Dogwood, American Persimmon, Sassafras, Tupelo Gum, American Fringetree, Blackberry spp., Catbrier spp., Hackberry, Virginia Creeper, Wild Grape spp. (Beal 1911), Palmetto spp. (Martin et al. 1951).

TYRANNIDAE

Eastern Wood-Pewee *(Contopus virens)* – Common breeder in northern half of state; common migrant statewide. **Observed:** Prickly Ash. **Literature:** Mulberry spp. (Merriam 1890), Poison Ivy, Elderberry, Rough-leaf Dogwood, Blueberry spp., Pokeberry, Blackberry spp. (Beal 1912).

Acadian Flycatcher *(Empidonax virescens)* – Common breeder and migrant in mature forests statewide. **Observed:** Elderberry, Rough-leaf Dogwood, Hackberry. **Literature:** Blackberry spp. (Beal 1912).

Alder Flycatcher *(Empidonax alnorum)* – Uncommon spring migrant; fairly common fall migrant statewide. **Observed:** Poison Ivy, Rough-leaf Dogwood.

Willow Flycatcher *(Empidonax traillii)* – Uncommon to rare spring and fall migrant statewide. Breeds locally in very small numbers near the Shreveport/Bossier City area. **Observed:** Rough-leaf Dogwood, Prickly Ash.

Literature: Elderberry, Eastern Red Cedar, Blackberry spp. (Beal 1912).

Least Flycatcher *(Empidonax minimus)* – Uncommon spring and fairly common fall migrant statewide. Occasionally overwinters within coastal zone forests. **Observed:** Rough-leaf Dogwood, Hawthorn spp., Hackberry. **Literature:** Mulberry spp. (Merriam 1890), Elderberry, Pokeberry, Blackberry spp. (Beal 1912).

Eastern Phoebe *(Sayornis phoebe)* – Rare breeder in northern half of state; common winter resident statewide. **Observed:** Poison Ivy, Carolina Moonseed, Rough-leaf Dogwood, Virginia Creeper. **Literature:** Mulberry spp. (Merriam 1890), Dwarf Sumac, Poison Sumac, Dahoon Holly, Elderberry, Arrowwood Viburnum, Eastern Red Cedar, American Persimmon, Sassafras, Pokeberry, Catbrier spp., Black Cherry, Blackberry spp., Sweetleaf, Hackberry, Blueberry spp. (Beal 1912).

Ash-throated Flycatcher *(Myiarchus cinerascens)* – Rare winter resident, mostly in southern half of state. **Observed:** Wax-leaf Ligustrum, Chinese Privet, Catbrier spp., Bird Pepper, Hackberry. **Literature:** Elderberry (Beal 1912).

Great Crested Flycatcher *(Myiarchus crinitus)* – Common breeder statewide. **Observed:** Elderberry, Rough-leaf Dogwood, Mulberry spp., Prickly Ash, Salt-matrimony Vine, Hackberry. **Literature:** Huckleberry spp., Blueberry spp., Sassafras, Spicebush, Pokeberry, Black Cherry, Blackberry spp., Virginia Creeper, Wild Grape spp. (Beal 1912).

Tropical/Couch's Kingbird *(Tyrannus melancholicus/couchii)* – Occasional vagrant fall, winter, spring mostly within coastal parishes. **Observed:** Chinaberry, Hackberry.

Eastern Kingbird *(Tyrannus tyrannus)* – Common breeder and migrant statewide. **Observed:** Elderberry, Rough-leaf Dogwood, Red Bay, Southern Magnolia, Mulberry spp., Black Gum, Pokeberry, Japanese Yew, Black Cherry, Prickly Ash, Salt-matrimony Vine, Hackberry, American Beautyberry, Virginia Creeper. **Literature:** Sumac spp., Fig spp., Eastern Red Cedar, Huckleberry spp., Blueberry spp., Spicebush, Sassafras, Serviceberry, Chokeberry, Blackberry spp., Wild Grape spp. (Beal 1912).

Scissor-tailed Flycatcher *(Tyrannus forficatus)* – Uncommon breeder throughout western half of the state; rare in eastern half during fall migration; occasionally overwinters in Plaquemines parish. **Observed:** Southern Magnolia. **Literature:** Mulberry spp., Pigeonberry, Dewberry, Hackberry (Foreman 1978).

LANIIDAE

Loggerhead Shrike (*Lanius ludovicianus*) – Common year round resident statewide. **Observed:** Hackberry.

VIREONIDAE

White-eyed Vireo *(Vireo griseus)* – Common breeder and migrant statewide; uncommon winter resident (mainly south Louisiana). **Observed:** Poison Ivy, Japanese Honeysuckle, Rough-leaf Dogwood, Spicebush, Sweetbay Magnolia, Chinese Privet, Supplejack, Prickly Ash, Virginia Creeper. **Literature:** Sumac spp., Wild Grape spp. (Chapin 1925), Holly spp., Elderberry, Sassafras, Blackberry spp. (Martin et al. 1951).

Blue-headed Vireo *(Vireo solitarius)* – Common winter resident statewide. **Observed:** Poison Ivy, Big-leaf Magnolia, Catbrier spp., Wild Grape spp. **Literature:** Viburnum spp., Dogwood spp. (Chapin 1925), Sumac spp., Elderberry spp. (Morton et al. 2014).

Philadelphia Vireo *(Vireo philadelphicus)* – Uncommon spring and fall migrant statewide. **Observed:** Spicebush, Prickly Ash, Virginia Creeper. **Literature:** Dogwood spp., Wild Grape spp. (Chapin 1925), Arrowwood Viburnum (Rybczynski and Riker 1981).

Red-eyed Vireo *(Vireo olivaceus)* – Common breeder and migrant statewide. **Observed:** Elderberry, Rough-leaf Dogwood, Southern Magnolia, Mulberry spp., Prickly Ash, Hackberry, American Beautyberry, Virginia Creeper. **Literature:** Blueberry spp., Spicebush, Red Bay, Sassafras, Blackberry spp., Wild Grape spp. (Chapin 1925), Black Gum (Martin et al. 1951), Arrowwood Viburnum (Rybczynski and Riker 1981).

CORVIDAE

Blue Jay *(Cyanocitta cristata)* – Common year round resident statewide. **Observed:** Elderberry, Rough-leaf Dogwood, American Persimmon, Firebush, Southern Magnolia, Wild Grape spp. **Literature:** Huckleberry spp., Blueberry spp., Black Gum, Pokeberry, Chokeberry, Hawthorn spp., Black Cherry, Blackberry spp. (Beal 1896), Devil's Walkingstick (Miller and Miller 1999).

American Crow *(Corvus brachyrhynchos)* – Common year round resident statewide. **Observed:** Southern Magnolia, Mulberry spp., Black Cherry, Virginia Creeper. **Literature:** Sumac spp., Black Gum, Pokeberry, Catbrier spp., Blackberry spp. (Beal and Kalmbach 1927), Wild Grape spp. (Martin et al. 1951).

Fish Crow *(Corvus ossifragus)* – Common year round resident in central and southern Louisiana; less common in north. **Observed:** American Persimmon, Virginia Creeper. **Literature:** Wild Grape spp. (Martin et al. 1951), Flowering Dogwood, Black Gum, Eastern Red Cedar, Mulberry spp., Pokeberry, Catbrier spp., Wild Grape spp. (McGowan 2001).

PARIDAE

Carolina Chickadee *(Poecile carolinensis)* – Common year round resident statewide (less so in coastal parishes). **Observed:** Poison Ivy, Common Pear, Hackberry, Wild Grape spp. **Literature:** Blueberry spp., Blackberry spp. (Beal and Kalmbach 1927), Mulberry spp., Honeysuckle spp., Virginia Creeper (Mostrum et al. 2002).

Tufted Titmouse *(Baeolophus bicolor)* **–** Common year round resident statewide (less so in coastal parishes). **Observed:** Poison Ivy, Common Pear, Hackberry. **Literature:** Sumac spp., Elderberry, Huckleberry spp., Blueberry spp., Mulberry spp., Blackberry spp. (Beal and Kalmbach 1927), Virginia Creeper, Wild Grape spp. (Martin et al. 1951).

POLIOPTILIDAE

Blue-gray Gnatcatcher *(Polioptila caerulea)* – Fairly common breeder (north of the coastal parishes) statewide; common spring and fall migrant statewide; fairly common in winter within the southern half of the state. **Observed:** Hackberry.

REGULIDAE

Ruby-crowned Kinglet *(Regulus calendula)* – Common winter resident statewide. **Observed:** Poison Ivy, American Beautyberry. **Literature:** Winged Sumac, Eastern Red Cedar, Dogwood spp., Elderberry spp. (Swanson et al. 2008).

TURDIDAE

Eastern Bluebird *(Sialia sialis)* – Common year round resident (less so in coastal parishes) statewide. **Observed:** Winged Sumac, Poison Ivy, Elderberry, Rough-leaf Dogwood, Mulberry spp., Pokeberry, Supplejack, Hackberry, Mistletoe, Virginia Creeper. **Literature:** Deciduous Holly, Arrowwood Viburnum, Strawberry Bush, Flowering Dogwood, Eastern Red Cedar, American Persimmon, Blueberry spp., Red Bay, Black Gum, Hawthorn spp., Black Cherry, Blackberry spp., Catbrier spp. (Beal 1915a), Devil's Walkingstick (Miller and Miller 2007), Chokeberry (Seidenberg 1995), Smooth Sumac, Carolina Moonseed, American Holly, Dahoon Holly, Japanese Honeysuckle, Red Bay, Camphor Tree, (Gowaty and Plissner 2015) .

Mountain Bluebird *(Sialia currucoides)* – Occasional winter vagrant. **Observed:** Hackberry.

Townsend's Solitaire *(Myadestes townsendi)* – Accidental (one Louisiana record). **Observed:** Yaupon Holly, Eastern Red Cedar.

Veery *(Catharus fuscescens)* – Fairly common spring and fall migrant. **Observed:** Elderberry, Rough-leaf Dogwood, Spicebush, Peppervine, Virginia Creeper. **Literature:** Winged Sumac, Huckleberry spp., Black Gum, Pokeberry, "Yew sp.," Serviceberry, Crabapple, Black Cherry, Catbrier spp. (Beal 1915b).

Gray-cheeked Thrush *(Catharus minimus)* – Fairly common spring and fall migrant. **Observed:** Elderberry, Spicebush, Mulberry spp. **Literature:** Arrowwood Viburnum, Rough-leaf Dogwood, Flowering Dogwood, Black Gum, Pokeberry, Crabapple, Black Cherry, Catbrier spp., Wild Grape spp. (Beal 1915b).

Swainson's Thrush *(Catharus ustulatus)* – Fairly common spring and fall migrant.

Observed: Poison Ivy, Dwarf Palmetto, Spicebush, Mulberry spp., Black Gum, Black Cherry, Prickly Ash, American Beautyberry, Peppervine, Virginia Creeper. **Literature:** Sumac spp., Elderberry, Arrowwood Viburnum, Flowering Dogwood, Eastern Red Cedar, Pokeberry, Blackberry spp., Catbrier spp., Hackberry, Wild Grape spp. (Beal 1915b).

Hermit Thrush *(Catharus guttatus)* – Common migrant and winter resident statewide. **Observed:** Winged Sumac, Poison Ivy, Yaupon Holly, Dwarf Palmetto, Arrowwood Viburnum, Rough-leaf Dogwood, Black Gum, Chinese Privet, Supplejack, Hawthorn spp., Catbrier spp., Salt-matrimony Vine, Hackberry, Virginia Creeper. **Literature:** American Holly, Inkberry Holly, Strawberry Bush, Flowering Dogwood, Eastern Red Cedar, Spicebush, Sassafras, Mistletoe, Pokeberry, Chokeberry, Wild Grape spp. (Beal 1915b), Deciduous Holly, American Beautyberry, Sweetbay Magnolia, Huckleberry spp. (Strong et al. 2005).

Wood Thrush *(Hylocichla mustelina)* – Common breeder and migrant statewide. **Observed:** Dwarf Palmetto, Spicebush, Southern Magnolia, Black Gum, Virginia Creeper. **Literature:** American Beautyberry, Elderberry, Rough-leaf Dogwood, Flowering Dogwood, Huckleberry spp., Blueberry spp., Mulberry spp., "Yew sp.," Black Cherry, Blackberry spp., (Beal 1915b), Devil's Walkingstick (Miller and Miller 2007), Arrowwood Viburnum (Rybczynski and Riker 1981), Holly spp., Pokeberry, Wild Grape spp. (Evans et al. 2011).

American Robin *(Turdus migratorius)* – Common to abundant winter resident; uncommon breeder statewide. **Observed:** Winged Sumac, Poison Ivy, Chinese Holly, Deciduous Holly, Yaupon Holly, Flowering Dogwood, Camphor Tree, Sassafras, Southern Magnolia, Chinaberry, Chinese Privet, Pokeberry, Supplejack, Carolina Buckthorn, Hawthorn spp., Hackberry, American Beautyberry, Virginia Creeper, Wild Grape spp. **Literature:** American Holly, Elderberry, Arrowwood Viburnum, Strawberry Bush, Rough-leaf Dogwood, Eastern Red Cedar, American Persimmon, Huckleberry spp., Blueberry spp., Spicebush, Red Bay, Mulberry spp., Tupelo Gum, Black Gum, Mistletoe, Serviceberry, Black Cherry, Blackberry spp., Catbrier spp. (Beal 1915b), Devil's Walkingstick (Miller and Miller 2007), Chokeberry (Seidenberg 1995).

MIMIDAE

Gray Catbird *(Dumetella carolinensis)* – Common breeder in northern portion of the state; common migrant statewide, uncommon in winter in southern half. **Observed:** Poison Ivy, Dwarf Palmetto, Elderberry, Blueberry spp., Spicebush, Southern Magnolia, Mulberry spp., Black Gum, Pokeberry, Hawthorn spp., Black Cherry, Hackberry, American Beautyberry, Mexican Beautyberry, West Indian Lantana, Virginia Creeper, Wild Grape spp. **Literature:** Arrowwood Viburnum (Rybczynski and Riker 1981) Yaupon Holly, Catbrier spp., Dewberry spp. (Smith et al. 2011).

Brown Thrasher *(Toxostoma rufum)* – Common year round resident. **Observed:** Poison Ivy, Dwarf Palmetto, Elderberry, Rough-leaf Dogwood, Spicebush, Turk's Cap, Carolina Moonseed, Black Gum, Pokeberry, Hackberry, American Beautyberry, Peppervine, Virginia Creeper. **Literature:** Holly spp., Huckleberry spp., Blueberry spp. (Beal and Kalmbach 1927), Wild Grape spp. (Martin et al. 1951), Chokeberry, Devil's Walkingstick (Miller and Miller 1999), Sumac spp., Cherry spp., Blackberry spp. (Cavitt and Haas 2014).

Sage Thrasher *(Oreoscoptes montanus)* – Occasional fall/winter vagrant; few records, mostly within the coastal zone. **Observed:** Hackberry. **Literature:** Wild Grape spp. (Martin et al. 1951).

Northern Mockingbird *(Mimus polyglottos)* – Common year round resident statewide. **Observed:** Winged Sumac, Poison Ivy, 'Burford' Holly, 'Savannah' Holly, Dwarf Palmetto, Trumpet Honeysuckle, Elderberry, Rough-leaf Dogwood, Flowering Dogwood, American Persimmon, Blueberry spp., Spicebush, Southern Magnolia, Turk's Cap, Chinaberry, Carolina Moonseed, Mulberry spp., Black Gum, Pokeberry, Carolina Buckthorn, Firebush, Bird Pepper, Hackberry, Mistletoe,

Night-blooming Jessamine, American Beautyberry, West Indian Lantana, Sorrelvine, Virginia Creeper, Wild Grape spp. **Literature:** Blackberry spp., Catbrier spp. (Beal and Kalmbach 1927), Hawthorn spp. (Seidenberg 1995).

STURNIDAE

European Starling *(Sturnus vulgaris)* – Common to Abundant year round statewide. **Observed:** Elderberry, Rough-leaf Dogwood, Mulberry spp., Black Cherry, Hackberry, Virginia Creeper. **Literature:** Sumac spp., Holly spp., Blackberry spp. (Cabe 1993).

BOMBYCILLIDAE

Cedar Waxwing *(Bombycilla cedrorum)* – Common winter resident (November-May) statewide. **Observed:** Poison Ivy, 'Burford' Holly, Deciduous Holly, Yaupon Holly, Flowering Dogwood, Camphor Tree, Carolina Moonseed, Mulberry spp., Black Gum, Chinese Privet, Supplejack, Loquat, Red-tipped Photinia, Black Cherry, Catbrier spp., Hackberry, Mistletoe, American Beautyberry, Wild Grape spp., Nandina. **Literature:** Swamp Privet (Adams et al. 2007), Chokeberry (Seidenberg 1995).

PASSERIDAE

House Sparrow *(Passer domesticus)* – Common year round resident statewide. **Observed:** Elderberry, Mulberry spp., Pokeberry.

FRINGILLIDAE

House Finch *(Haemorhous mexicanus)* – Common statewide, especially around residences. **Observed:** Elderberry, Eastern Red Cedar, Mulberry spp., Chinese Privet, Pokeberry, Supplejack, Hackberry.

Purple Finch *(Haemorhous purpureus)* – Fairly common winter resident throughout most of the state; uncommon in coastal zone. **Observed:** Japanese Honeysuckle, Chinese Privet, Supplejack, Carolina Buckthorn, Hackberry. **Literature:** Mulberry spp. (Merriam 1890), Poison Ivy, Dogwood spp., Eastern Red Cedar, Black Gum, Wild Grape spp. (Martin et al. 1951), Sumac spp., Blackberry spp., Coral Honeysuckle (Wootton 1996).

American Goldfinch *(Spinus tristis)* – Common winter resident statewide. **Observed:** Japanese Honeysuckle, Elderberry, Chinese Privet, Hackberry. **Literature:** Mulberry spp. (Merriam 1890).

PARULIDAE

Prothonotary Warbler (*Protonotaria citrea*) – Common migrant and locally common breeder statewide. **Observed:** Elderberry, Mulberry spp.

Tennessee Warbler *(Oreothlypis peregrina)* – Common migrant statewide. **Observed:** Mulberry spp.

Orange-crowned Warbler *(Oreothlypis celata)* – Common winter resident. **Observed:** Camphor Tree, Virginia Creeper.

Nashville Warbler *(Oreothlypis ruficapilla)* – Fairly common migrant statewide; few winter records from coastal parishes. **Observed:** Pokeberry, Hackberry.

Tropical Parula *(Setophaga pitiayumi)* – Occasional winter vagrant mostly within coastal zone. **Observed:** Camphor Tree.

Magnolia Warbler *(Setophaga magnolia)* – Common migrant statewide. **Observed:** Hackberry. **Literature:** Virginia Creeper (Dunn and Hall 2010).

Yellow Warbler *(Setophaga petechial)* – Common migrant statewide. **Observed:** Mulberry spp.

Blackpoll Warbler *(Setophaga striata)* – Fairly common statewide in spring migration; occasional in fall. **Observed:** Mulberry spp. **Literature:** Arrowwood Viburnum, Pokeberry (DeLuca et al. 2013).

Pine Warbler *(Setophaga pinus)* – Common breeder north of Interstate-10 corridor; common statewide in migration and winter. **Observed:** Common Pear. **Literature:** Sumac spp., Flowering Dogwood, Wild Grape spp. (Martin et al. 1951), American Persimmon, Virginia Creeper (Rodewald et al. 2013).

Yellow-rumped Warbler *(Setophaga coronata)* – Common winter resident statewide. **Observed:** Poison Ivy, American Holly, Rough-leaf Dogwood, Camphor Tree, Mulberry spp., Chinese Privet, Wild Grape spp. **Literature:**

Palmetto spp., Eastern Red Cedar, Common Persimmon (Martin, et al. 1951), Catbrier spp., Virginia Creeper (Hunt and Flaspohler 1998).

Yellow-breasted Chat *(Icteria virens)* – Common migrant and breeder statewide; occasionally overwinters within coastal zone. **Observed:** Japanese Honeysuckle, Elderberry, Rough-leaf Dogwood, Mulberry spp., Pokeberry, Black Cherry, Hackberry. **Literature:** Blueberry spp., Blackberry spp. (Martin et al. 1951), Wild Grape spp. (Eckerle and Thompson 2001).

EMBERIZIDAE

Green-tailed Towhee *(Pipilo chlorurus)* – Occasional in winter, mostly within southern half of state. **Observed:** Catbrier spp. **Literature:** Elderberry, Serviceberry (Martin et al. 1951).

Spotted Towhee *(Pipilo maculatus)* – Rare but regular in winter, especially in northern half of state. **Observed:** Hackberry. **Literature:** Poison Oak (Martin et al. 1951).

Eastern Towhee *(Pipilo erythrophthalmus)* – Common year round resident statewide. **Observed:** Winged Sumac. **Literature:** Holly spp., American Beautyberry, Blueberry spp., Magnolia spp., Hackberry, Blackberry spp., Wild Grape spp. (Martin et al. 1951).

Chipping Sparrow *(Spizella passerina)* – Common year round resident statewide. **Observed:** Mulberry spp., Pokeberry, Tree Huckleberry.

White-throated Sparrow *(Zonotrichia albicollis)* – Common migrant and winter resident statewide. **Observed:** Poison Ivy, Yaupon Holly, Japanese Honeysuckle, Flowering Dogwood, Carolina Moonseed, Mulberry spp., Chinese Privet, Hawthorn spp., Catbrier spp., Hackberry, American Beautyberry, Tree Huckleberry. **Literature:** Blueberry spp., Elderberry, Wild Grape spp. (Martin et al. 1951). Arrowwood Viburnum (Rybczynski and Riker 1981).

Harris's Sparrow *(Zonotrichia querula)* – Rare but regular in winter, especially in northern half of the state. **Observed:** Chinese Privet.

White-crowned Sparrow *(Zonotrichia leucophrys)* – Locally common winter resident statewide. **Observed:** Elderberry, Chinese Privet, Salt-matrimony Vine. **Literature:** Arrowwood Viburnum (Rybczynski and Riker 1981).

Dark-eyed Junco *(Junco hyemalis)* – Poison Ivy, American Beautyberry, Hackberry, Tree Huckleberry.

CARDINALIDAE

Summer Tanager *(Piranga rubra)* – Common breeder and migrant statewide; occasional in winter. **Observed:** Poison Ivy, Elderberry, Rough-leaf Dogwood, Carolina Moonseed, Hairy Huckleberry, Mulberry spp., Black Gum, Pokeberry, Japanese Yew, Black Cherry, Hackberry, American Beautyberry, Tree Huckleberry, Peppervine, Virginia Creeper. **Literature:** Blackberry spp. (Martin et al. 1951), Blueberry spp. (Robinson and Douglas 2012).

Scarlet Tanager *(Piranga olivacea)* – Common migrant statewide. **Observed:** Mulberry spp., American Beautyberry, Virginia Creeper. **Literature:** Sumac spp., Elderberry, Dogwood spp., Black Gum, Blackberry spp., Wild Grape spp. (Martin et al. 1951).

Western Tanager *(Piranga ludoviciana)* – Rare but regular spring migrant within coastal parishes; occasional in winter. **Observed:** Chinese Privet. **Literature:** Pacific U.S. – Elderberry, Mulberry spp., Serviceberry (Martin et al. 1951).

Northern Cardinal *(Cardinalis cardinalis)* – Common year round resident statewide. **Observed:** Winged Sumac, Poison Ivy, 'Burford' Holly, Deciduous Holly, Yaupon Holly, Dwarf Palmetto, Trumpet Honeysuckle, Elderberry, Little-leaf Viburnum, Rough-leaf Dogwood, Flowering Dogwood, Blueberry spp., Firebush, Southern Magnolia, Turk's Cap, Chinaberry, Mulberry spp., Chinese Privet, American Fringetree, Pokeberry, Japanese Yew, Carolina Buckthorn, Hawthorn spp., Common Pear, Prickly Ash, Bird Pepper, Hackberry, American Beautyberry, Peppervine, Virginia Creeper, Wild Grape spp. **Literature:** Swamp Privet (Adams et al. 2007), Devil's Walkingstick (Miller and Miller 2007), Serviceberry, Black Cherry (Beal and Kalmbach 1927).

Rose-breasted Grosbeak *(Pheucticus ludovicianus)* – Common migrant statewide. **Observed:** Elderberry, Southern Magnolia,

Mulberry spp., Black Gum, Tupelo Gum, Wax-leaf Ligustrum, Loquat, Black Cherry, American Beautyberry, Wild Grape spp. **Literature:** Rough-leaf Dogwood, Pokeberry, Supplejack, Hawthorn spp., Blackberry spp. (McAtee 1908).

Black-headed Grosbeak *(Pheucticus melanocephalus)* – Occasional in winter, mostly within coastal zone. **Observed:** Salt-matrimony Vine. **Literature:** Elderberry (Martin et al. 1951).

Indigo Bunting *(Passerina cyanea)* – Common breeder and migrant statewide; rare in winter, mostly in southern half of state. **Observed:** Mulberry spp., Pokeberry. **Literature:** Elderberry, Blackberry spp. (Martin et al. 1951)

Painted Bunting *(Passerina ciris)* – Fairly common breeder and migrant statewide; rare in winter, mostly in southern half of state. **Observed:** Trumpet Honeysuckle, Mulberry spp., Pokeberry.

ICTERIDAE

Rusty Blackbird *(Euphagus carolinus)* – Uncommon to locally common winter resident statewide, especially in bottomland hardwood, batture, and other riparian forests. **Observed:** Hackberry. **Literature:** American Holly, Devil's Walkingstick, Flowering Dogwood, Black Gum, Elderberry, Blackberry spp., Wild Grape spp. (Avery 2013).

Brown-headed Cowbird *(Molothrus ater)* – Common year round resident statewide. **Observed:** Mulberry spp.

Common Grackle *(Quiscalus quiscula)* – Common year round resident statewide. **Observed:** Elderberry, American Persimmon, Mulberry spp., Hackberry, Virginia Creeper.

Orchard Oriole *(Icterus spurius)* – Common breeder statewide. **Observed:** Mulberry spp., Wild Grape spp. **Literature:** Huckleberry spp., Blueberry spp., Blackberry spp. (Martin et al. 1951).

Baltimore Oriole *(Icterus galbula)* – Locally common breeder statewide (scarce within coastal zone); rare in winter. **Observed:** Elderberry, American Persimmon, Mulberry spp., Pokeberry, Loquat, Wild Grape spp. **Literature:** Blueberry spp., Serviceberry, Cherry spp., Blackberry spp. (Martin et al. 1951).

Table 1. Bird species observed consuming fruits of plants in Louisiana: total species and species totals by bird family.

	Species Totals	Columbidae	Trochilidae	Picidae	Tyrannidae	Laniidae	Vireonidae	Corvidae	Paridae	Polioptilidae	Regulidae	Turdidae	Mimidae	Sturnidae	Bombycillidae	Fringillidae	Passeridae	Parulidae	Emberizidae	Cardinalidae	Icteridae
ANACARDACEAE																					
Winged Sumac	6											3	1						1	1	
Poison Ivy	25			5	2		2		2		1	4	3		1			1	2	2	
AQUIFOLIACEAE																					
Burford Holly	4											1	1		1					1	
Savannah Holly	1												1								
Deciduous Holly	3											1			1					1	
American Holly	1																	1			
Yaupon Holly	6											3			1				1	1	
ARECACEAE																					
Dwarf Palmetto	7											3	3							1	
BERBERIDACEAE																					
Nandina	1														1						
CAPRIFOLIACEAE																					
Japanese Honeysuckle	5						1									2		1	1		
Trumpet Honeysuckle	3												1							2	
Elderberry	24			1	3		1	1				3	3	1		2	1	2	1	3	2
Little-leaf Viburnum																				1	
Arrowwood Viburnum	1											1									
CORNACEAE																					
Rough-leaf Dogwood	21			2	6		2	1				3	2	1				2		2	

Table 1. Continued.

	Species Totals	Columbidae	Trochilidae	Picidae	Tyrannidae	Laniidae	Vireonidae	Corvidae	Paridae	Polioptilidae	Regulidae	Turdidae	Mimidae	Sturnidae	Bombycillidae	Fringillidae	Passeridae	Parulidae	Emberizidae	Cardinalidae	Icteridae
CORNACEAE																					
Flowering Dogwood	5											1	1		1				1	1	
Tupelo Gum	1																			1	
Black Gum	15			5	1							3	3		1					2	
CUPRESSACEAE																					
Eastern Red Cedar	2											1				1					
EBENACEAE																					
American Persimmon	6		1					2					1								2
ERICACEAE																					
Hairy Huckleberry	1																			1	
Tree/Winter Huckleberry	3																		2	1	
Blueberries	3												2							1	
LAURACEAE																					
Camphor Tree	5											1			1			3			
Spicebush	9						2					4	3								
Red Bay	1				1																
Sassafras	2			1								1									
MAGNOLIACEAE																					
Southern Magnolia	18	2		5	2		1	2				2	2							2	
Big-leaf Magnolia	1						1														
Sweetbay Magnolia	1						1														
MALVACEAE																					
Turk's Cap	3												2							1	
MELIACEAE																					
Chinaberry Tree	4				1							1	1							1	

Table 1. Continued.

	Species Totals	Columbidae	Trochilidae	Picidae	Tyrannidae	Laniidae	Vireonidae	Corvidae	Paridae	Polioptilidae	Regulidae	Turdidae	Mimidae	Sturnidae	Bombycillidae	Fringillidae	Passeridae	Parulidae	Emberizidae	Cardinalidae	Icteridae
MENISPERMACEAE																					
Carolina Moonseed	6				1								2		1				1	1	
MORACEAE																					
Mulberry sp.	37	4		2	2		1	1				3	2	1	1	1	1	6	2	6	4
OLEACEAE																					
American Fringetree	1																			1	
Wax-leaf Ligustrum	2				1															1	
Chinese Privet	15			1	1		1					2			1	3		1	3	2	
Devilwood	1			1																	
PHYTOLACCACEAE																					
Pokeberry	16				1							2	3			1	1	2	1	4	1
PODOCARPACEAE																					
Japanese Yew	3				1															2	
RHAMNACEAE																					
Supplejack Vine	7			1			1					2			1	2					
Carolina Buckthorn	4											1	1			1				1	
ROSACEAE																					
Hawthorn sp.	6				1							2	1						1	1	
Loquat	3														1					1	1
Red-tip Photinia	1														1						
Common Pear	9		1	4					2									1		1	
Black Cherry	12			3	1			1				1	1	1	1			1		2	
RUBIACEAE																					
Firebush	3							1					1							1	
RUTACEAE																					
Prickly Ash	9				4		3					1								1	
SMILACACEAE																					
Catbrier	6				1		1					1			1				2		

Table 1. Continued.

	Species Totals	Columbidae	Trochilidae	Picidae	Tyrannidae	Laniidae	Vireonidae	Corvidae	Paridae	Polioptilidae	Regulidae	Turdidae	Mimidae	Sturnidae	Bombycillidae	Fringillidae	Passeridae	Parulidae	Emberizidae	Cardinalidae	Icteridae
SOLANACEAE																					
Bird Pepper	3				1								1							1	
Night-blooming Jessamine	1												1								
Salt-matrimony Vine	5				2							1							1	1	
ULMACEAE																					
Hackberry	37			2	7	1	1		2	1		4	4	1	1	3		3	3	2	2
VERBENACEAE																					
American Beautyberry	16				1		1		1		1	2	3		1				2	4	
Mexican Beautyberry	1												1								
Lantana	2												2								
VISCACEAE																					
Mistletoe	3											1	1		1						
VITACEAE																					
Ivy Treebine	1												1								
Peppervine	6			1								2	1							2	
Virginia Creeper	26			4	2		3	2				6	3	1				1		3	1
Wild Grape sp.	13						1	1	1			1	2		1			1		3	2

Fruit-bearing Plants

With only a few exceptions, the fleshy-fruited plants native to Louisiana are woodland inhabitants. Most of the plant citations below include habitat notes that are intended to assist conservation and restoration planners and land managers. Most of the plant genera involved contain one or more species native to nearly all woodland habitat types in Louisiana. However, some are limited to more upland and/or better-drained sites; others to sandy/acidic soils only. Also noteworthy is the fact that the majority of Louisiana's native fleshy-fruited species occupy woodland edge, woodland glade, agricultural hedgerow, roadside, streamside, and fallow field positions receiving substantial amounts of direct sunlight.

Plants are listed in alphabetic order by family. Dates when fruit is available to birds are given in parentheses.

ANACARDIACEAE

Winged Sumac *(Rhus copallinum)* – Native and very common statewide along woodland edges of most forested habitats, roadsides, hedgerows, fallow fields. Two additional species, Smooth Sumac *(R. glabra)* and Aromatic Sumac *(R. aromatica)* are mostly restricted to the northern half of the state. (September-December). **Observed:** Eastern Bluebird, Hermit Thrush, American Robin, Northern Mockingbird, Eastern Towhee, Northern Cardinal. **Literature:** Red-headed Woodpecker, Red-bellied Woodpecker, Northern Flicker, Pileated Woodpecker (Beal 1911), Eastern Phoebe, Eastern Kingbird (Beal 1912), White-eyed Vireo (Chapin 1925), American Crow, Tufted Titmouse (Beal and Kalmbach 1927), Veery, Swainson's Thrush (Beal 1915b), Warbling Vireo, Scarlet Tanager (Martin et al. 1951), Wild Turkey (Halls 1977), Northern Bobwhite, Gray Catbird, European Starling (Hunter 1995).

Eastern Poison Ivy *(Toxicodendron radicans)* – Native and very common statewide in nearly all forested habitats. **Atlantic Poison Oak** *(T. pubescens)*, native to the northern half of the state and the easternmost Florida parishes is included as well. It is very similar to poison ivy in foliage appearance and fruiting, though more shrub-like than vine-like in habit. (August-January). **Observed:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Northern Flicker, Pileated Woodpecker, Alder Flycatcher, Eastern Phoebe, White-eyed Vireo, Blue-headed Vireo, Carolina Chickadee, Tufted Titmouse, Ruby-crowned Kinglet, Eastern Bluebird, Swainson's Thrush, Hermit Thrush, American Robin, Gray Catbird, Northern Mockingbird, Brown Thrasher, Cedar Waxwing, Yellow-rumped Warbler, White-throated Sparrow, Dark-eyed Junco, Summer Tanager, Northern Cardinal. **Literature:** Red-headed Woodpecker (Beal 1911), Hairy Woodpecker (Baird 1980), Eastern Wood-Pewee (Beal 1912), Wild Turkey, Carolina Wren, Purple Finch, Fox Sparrow (Martin et al. 1951), Wood Duck, Northern Bobwhite (Halls 1977).

AQUIFOLIACEAE

'Burford' Holly *(Ilex cornuta 'Burfordii')* – A common cultivar of Chinese holly, popularly planted in gardens statewide. (October-March). **Observed:** American Robin, Northern Mockingbird, Cedar Waxwing, Northern Cardinal.

'Savannah' Holly *(Ilex cassine x opaca)* – A common cultivar which is a hybrid of Dahoon Holly and American Holly – both native Louisiana species. Planted in gardens/landscapes statewide. (October-March). **Observed:** Northern Mockingbird.

Deciduous Holly *(Ilex decidua)* – Native statewide mostly in bottomland hardwood forest edge habitat; also hedgerows, roadsides, and fallow fields. Mostly limited to circumneutral (pH 6.7-7.0) silty-clay soils; occasionally planted in garden settings. (October-February). **Observed:** American Robin, Cedar Waxwing, Northern Cardinal. **Literature:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Pileated Woodpecker (Beal 1911), Eastern Bluebird (Beal 1915a), Wild Turkey, Northern Bobwhite (Halls 1977).

American Holly *(Ilex opaca)* – Native statewide in Mixed Pine-Hardwood Forests; widely planted elsewhere. (October-February).

Observed: Yellow-rumped Warbler. **Literature:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Northern Flicker (Beal 1911), Hermit Thrush (Beal 1915b), American Robin (Beal 1915a), Brown Thrasher (Beal and Kalmbach 1927), White-throated Sparrow (Martin et al. 1951), Wild Turkey, Northern Bobwhite, Mourning Dove (Halls 1977).

Yaupon Holly *(Ilex vomitoria)* – Native statewide in most forested habitats including coastal woodlands; most common along woodland edges, roadsides, hedgerows. (October-April). **Observed:** Townsend's Solitaire, Hermit Thrush, American Robin, Cedar Waxwing, White-throated Sparrow, Northern Cardinal. **Literature:** Wild Turkey, Northern Bobwhite (Halls 1977).

ARECACEAE

Dwarf Palmetto *(Sabal minor)* – Native statewide in low forests; most abundant in bottomland hardwood forest habitats. (August-January). **Observed:** Swainson's Thrush, Hermit Thrush, Wood Thrush, Gray Catbird, Northern Mockingbird, Brown Thrasher, Northern Cardinal. **Literature:** Red-bellied Woodpecker (Beal 1911), Pileated Woodpecker, Yellow-rumped Warbler (Martin et al. 1951).

BERBERIDACEAE

Nandina *(Nandina domestica)* – Exotic species (China) commonly planted in gardens statewide. Occasionally escapes into the wild, but not reported to be invasive. (November-February). **Observed:** Cedar Waxwing. **Literature:** American Robin**,** Northern Mockingbird, Northern Cardinal (Langeland and Craddock Burks 1998).

CAPRIFOLIACEAE

Japanese Honeysuckle *(Lonicera japonica)* – Invasive exotic, naturalized in most forested habitats statewide including coastal forests. (August-January). **Observed:** White-eyed Vireo, Yellow-breasted Chat, White-throated Sparrow, Purple Finch, American Goldfinch. **Literature:** Northern Bobwhite (Martin et al. 1951), Wild Turkey (Halls 1977), Eastern Bluebird, Hermit Thrush, American Robin, Northern Mockingbird, White-crowned Sparrow, Song Sparrow, Dark-eyed Junco (Handley 1945), Northern Cardinal (Baird 1980).

Trumpet Honeysuckle *(Lonicera sempervirens)* – Native to Mixed Pine-Hardwood Forests statewide; widely planted in gardens elsewhere. (August-January). **Observed:** Northern Mockingbird, Northern Cardinal, Painted Bunting. **Literature:** Purple Finch (Hunter 1995).

Elderberry *(Sambucus canadensis)* – Native statewide along most woodland edges, roadsides, hedgerows, fallow fields. (July-December). **Observed:** Red-bellied Woodpecker, Acadian Flycatcher, Great-crested Flycatcher, Eastern Kingbird, Red-eyed Vireo, Blue Jay, Eastern Bluebird, Veery, Gray-cheeked Thrush, Gray Catbird, Northern Mockingbird, Brown Thrasher, European Starling, House Sparrow, Prothonotary Warbler, Yellow-breasted Chat, Summer Tanager, White-crowned Sparrow, Northern Cardinal, Rose-breasted Grosbeak, Common Grackle, Baltimore Oriole, House Finch, American Goldfinch. **Literature:** Red-headed Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Northern Flicker, Pileated Woodpecker (Beal 1911), Eastern Wood-Pewee, Willow Flycatcher, Eastern Phoebe, Ash-throated Flycatcher, Couch's/Tropical Kingbird (Beal 1912), White-eyed Vireo, Warbling Vireo, Scarlet Tanager, White-throated Sparrow (Martin et al. 1951), Tufted Titmouse (Beal and Kalmbach 1927), Swainson's Thrush, Wood Thrush (Beal 1915b), American Robin (Beal 1915a), Northern Bobwhite, Wild Turkey, Mourning Dove (Halls 1977).

Little-leaf Viburnum/Small-leaved Arrowwood (*Viburnum obovatum*) – Dense suckering shrub native to wetland habitats in Alabama, Georgia, Florida, and South Carolina. Steadily gaining popularity as a garden plant statewide in Louisiana. (August-February). **Observed:** Northern Cardinal.

Arrowwood Viburnum (*Viburnum dentatum*) – Native statewide throughout most all upland forest habitats, including more elevated portions of coastal spoilbank forests. (September-November). **Observed:** Hermit Thrush. **Literature:** Northern Flicker, Philadelphia Vireo, Red-eyed Vireo, Wood

Thrush, Gray Catbird, White-throated Sparrow, White-crowned Sparrow (Rybczynski and Riker 1981), Eastern Phoebe (Beal 1912), Eastern Bluebird (Beal 1915a), Gray-cheeked Thrush, Swainson's Thrush, American Robin (Beal 1915b).

CORNACEAE

Rough-leaf Dogwood (*Cornus drummondii*) – Native statewide along woodland edges, roadsides, hedgerows, fallow fields. A "pioneer" species, most common during early stages of ecological succession from fallow field to forested habitat. (August-October). **Observed:** Red-bellied Woodpecker, Downy Woodpecker, Acadian Flycatcher, Alder Flycatcher, Willow Flycatcher, Least Flycatcher, Great-crested Flycatcher, Eastern Kingbird, White-eyed Vireo, Red-eyed Vireo, Blue Jay, Eastern Bluebird, Veery, Hermit Thrush, Northern Mockingbird, Brown Thrasher, European Starling, Yellow-rumped Warbler, Yellow-breasted Chat, Summer Tanager, Northern Cardinal. **Literature:** Red-headed Woodpecker, Northern Flicker, Pileated Woodpecker (Beal 1911), Blue-headed Vireo, Philadelphia Vireo (Chapin 1925), Tree Swallow (Beal 1918), Gray-cheeked Thrush, Wood Thrush (Beal 1915b), American Robin (Beal 1915a), Scarlet Tanager, Purple Finch (Martin et al. 1951), Rose-breasted Grosbeak (McAtee 1908), Northern Bobwhite (Hunter 1995).

Flowering Dogwood *(Cornus florida)* – Native statewide in the interior of sandy-loam Mixed Pine-Hardwood Forests and Riparian Forests; frequently planted in garden settings. (August-December). **Observed:** American Robin, Northern Mockingbird, Cedar Waxwing, White-throated Sparrow, Northern Cardinal. **Literature:** Northern Bobwhite (Martin et al. 1951, Halls 1977), Red-headed Woodpecker, Red-bellied Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Northern Flicker, Pileated Woodpecker (Beal 1911), Eastern Bluebird (Beal 1915a), Gray-cheeked Thrush, Swainson's Thrush, Hermit Thrush, Wood Thrush (Beal 1915b), Wild Turkey, Brown Thrasher, Wood Duck (Halls 1977), Tufted Titmouse, Eastern Towhee, Dark-eyed Junco, Purple Finch, Common Grackle (Baird 1980), Summer Tanager, Yellow-rumped Warbler (Hunter 1995).

Tupelo Gum *(Nyssa aquatica)* – Native to Baldcypress-Tupelo Swamps statewide. (September-December). **Observed:** Rose-breasted Grosbeak. **Literature:** Wood Duck (Halls 1977).

Black Gum *(Nyssa sylvatica)* – Native primarily to Mixed Pine-Hardwood Forests statewide. (September-December). **Observed:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Hairy Woodpecker, Pileated Woodpecker, Eastern Kingbird, Swainson's Thrush, Hermit Thrush, Wood Thrush, Gray Catbird, Northern Mockingbird, Brown Thrasher, Cedar Waxwing, Summer Tanager, Rose-breasted Grosbeak. **Literature:** Red-headed Woodpecker, Northern Flicker (Beal 1911), Northern Bobwhite, Wild Turkey, Red-eyed Vireo, Scarlet Tanager, Purple Finch (Martin et al. 1951), Blue Jay, American Crow (Beal and Kalmbach 1927), Eastern Bluebird, American Robin (Beal 1915a), Veery, Gray-cheeked Thrush (Beal 1915b), Wood Duck, European Starling (Halls 1977).

CUPRESSACEAE

Eastern Red Cedar *(Juniperus virginiana)* – Native statewide along woodland edges, roadsides, hedgerows, fallow fields. A "pioneer" species most common in the early stages of ecological succession from fallow field to forested habitat. (September-January). **Observed:** Townsend's Solitaire, House Finch. **Literature:** Yellow-bellied Sapsucker, Northern Flicker (Beal 1911), Willow Flycatcher, Eastern Phoebe (Beal 1912), Tree Swallow (Beal 1918), Eastern Bluebird, American Robin (Beal 1915a), Swainson's Thrush, Hermit Thrush (Beal 1915b), Yellow-rumped Warbler, Purple Finch (Martin et al. 1951), Cedar Waxwing (Mohr 1901), Wild Turkey, Northern Bobwhite (Halls 1977), Blue Jay (Hunter 1995).

EBENACEAE

American Persimmon *(Diospyros virginiana)* – Native statewide within most upland and lowland forest types, including coastal forests. (September-November). **Observed:** Ruby-throated Hummingbird, Blue

Jay, Fish Crow, Northern Mockingbird, Common Grackle, Baltimore Oriole. **Literature:** Wild Turkey (Seidenberg 1995), Pileated Woodpecker (Beal 1911), Eastern Phoebe (Beal 1912), Eastern Bluebird, American Robin (Beal 1915a), Yellow-rumped Warbler (Martin et al. 1951), Northern Bobwhite (Halls 1977), Gray Catbird, Cedar Waxwing (Hunter 1995).

ERICACEAE

Hairy Huckleberry *(Gaylussacia mosieri)* – Native shrub in pine forests restricted to the eastern Florida parishes. Often listed as "Huckleberry spp." as numerous huckleberry species exist throughout the U.S., including at least two additional native species in Louisiana. (June-October). **Observed:** Summer Tanager. **Literature:** Northern Bobwhite, Wild Turkey, Mourning Dove (Seidenberg 1995), Red-bellied Woodpecker, Northern Flicker, Pileated Woodpecker (Beal 1911), Great-crested Flycatcher, Eastern Kingbird (Beal 1912), Blue Jay (Beal 1896), Tufted Titmouse (Beal and Kalmbach 1927), Veery, Wood Thrush (Beal 1915b), American Robin (Beal 1915a), Gray Catbird, Scarlet Tanager, Orchard Oriole (Martin et al. 1951), Eastern Bluebird, Northern Mockingbird, Northern Cardinal, Eastern Towhee (Miller and Miller 1999).

Tree/Winter Huckleberry *(Vaccinium arboreum)* – Small tree native to sandy-loam soils in pine forests statewide. Generically more closely related to the blueberry species than to huckleberry species. (November-January). **Observed:** Summer Tanager, White-throated Sparrow, Dark-eyed Junco.

Blueberries *(Vaccinium spp.)* – Over 10 species native to Louisiana, mostly restricted to acidic sandy-loam soils of the pinelands. Numerous commercial orchards growing horticultural selections are also dotted throughout the state. (June-September). **Observed:** Gray Catbird, Northern Mockingbird, Northern Cardinal. **Literature:** Downy Woodpecker, Northern Flicker (Beal 1911), Great-crested Flycatcher, Eastern Kingbird (Beal 1912), Red-eyed Vireo (Chapin 1925), Blue Jay (Beal 1896), Eastern Bluebird (Beal 1915a), Wood Thrush, American Robin (Beal 1915b), Brown Thrasher, Carolina Chickadee, Tufted Titmouse (Beal and Kalmbach 1927), Yellow-breasted Chat, Eastern Towhee, White-throated Sparrow, Orchard Oriole, Baltimore Oriole (Martin et al. 1951), Wild Turkey, Scarlet Tanager (Halls 1977), Northern Bobwhite, Eastern Phoebe, Summer Tanager (Hunter 1995).

LAURACEAE

Camphor Tree *(Cinnamomum camphora)* – Oriental native evergreen tree; once widely planted in the southern portion of the state; occasionally escapes cultivation, especially within the coastal zone forests. (October-December). **Observed:** American Robin, Cedar Waxwing, Orange-crowned Warbler, Tropical Parula, Yellow-rumped Warbler.

Spicebush *(Lindera benzoin)* – Native shrub; widely scattered through the interior portions of various forested habitats statewide – including mixed pine-hardwood, upland hardwood, and even in elevated portions of bottomland hardwoods – but nowhere common. Absent from coastal forests. (August-October). **Observed:** White-eyed Vireo, Philadelphia Vireo, Veery, Swainson's Thrush, Gray-cheeked Thrush, Wood Thrush, Gray Catbird, Northern Mockingbird, Brown Thrasher. **Literature:** Northern Flicker (Beal 1911), Great-crested Flycatcher, Eastern Kingbird (Beal 1912), Red-eyed Vireo (Chapin 1925), Hermit Thrush (Beal 1915b), American Robin (Beal 1915a), Mourning Dove, White-throated Sparrow, Northern Cardinal (Baird 1980).

Red Bay *(Persea borbonia/palustris)* – Native evergreen tree; uncommonly distributed within moist sites of pine, mixed pine-hardwood, and hardwood forests, including riparian forest habitats. Most common in spoilbank forests within the coastal parishes. (September-November). **Observed:** Eastern Kingbird. **Literature:** Wild Turkey (Martin et al. 1951), Red-eyed Vireo (Chapin 1925), Eastern Bluebird, American Robin (Beal 1915a), Northern Bobwhite (Halls 1977).

Sassafras *(Sassafras albidum)* – Native; scattered widely throughout many forest types statewide; most common in Mixed Pine-

Hardwood Forests and Upland Hardwood Forests in northern half of the state; more scantily distributed southward into the upper portions of the coastal zone. (July-October). **Observed:** Red-bellied Woodpecker, American Robin. **Literature:** Yellow-bellied Sapsucker, Pileated Woodpecker (Beal 1911), Eastern Phoebe, Great-crested Flycatcher, Eastern Kingbird (Beal 1912), Red-eyed Vireo (Chapin 1925), Hermit Thrush (Beal 1915b), Wild Turkey, Northern Bobwhite (Halls 1977), Northern Mockingbird (Martin et al. 1951), Downy Woodpecker, Northern Flicker, Gray Catbird (Sullivan 1993).

MAGNOLIACEAE

Southern Magnolia *(Magnolia grandiflora)* – Native to most upland forest types statewide; widely planted in gardens/landscapes. (August-December). **Observed:** Mourning Dove, White-winged Dove, Red-headed Woodpecker, Red-bellied Woodpecker, Yellow-bellied Sapsucker, Hairy Woodpecker, Pileated Woodpecker, Scissor-tailed Flycatcher, Eastern Kingbird, Red-eyed Vireo, Blue Jay, American Crow, Wood Thrush, American Robin, Gray Catbird, Northern Mockingbird, Northern Cardinal, Rose-breasted Grosbeak.

Big-leaf Magnolia *(Magnolia macrophylla)* – Native deciduous tree sparsely distributed along higher sandy-loam creek banks of Mixed Pine-Hardwood Forests in Florida parishes and the northern half of the state. (August-November). **Observed:** Blue-headed Vireo. **Literature:** Note: The following citation uses "Magnolia sp." presumably because seeds of all deciduous magnolia species are indistinguishable from one another. Northern Flicker (Beal 1911).

Sweetbay Magnolia *(Magnolia virginiana)* – Native to open boggy woodlands within Mixed Pine-Hardwood Forests statewide; widely planted elsewhere. (July-October). **Observed:** White-eyed Vireo. **Literature:** Eastern Kingbird, Red-eyed Vireo, Wood Thrush, American Robin, Northern Mockingbird (Gucker 2008).

MALVACEAE

Turk's Cap *(Malvaviscus arboreus drummondii)* – Understory shrub native to Chenier Forests and other coastal woodlands; widely planted in gardens statewide. (September-October). **Observed:** Northern Mockingbird, Brown Thrasher, Northern Cardinal.

MELIACEAE

Chinaberry Tree *(Melia azedarach)* – Oriental native, once widely planted throughout the southeastern U.S. including statewide in Louisiana; escapes into the wild, but generally not invasively so. (October-January). **Observed:** Couch's/Tropical Kingbird, American Robin, Northern Mockingbird, Northern Cardinal. **Literature:** Gray Catbird (Martin et al. 1951).

MENISPERMACEAE

Carolina Moonseed or Snailseed *(Cocculus carolinus)* – Native evergreen vine, widely distributed through many forest types statewide, including bottomland hardwood forests of the coastal zone. (October-January). **Observed:** Eastern Phoebe, Northern Mockingbird, Brown Thrasher, Cedar Waxwing, Summer Tanager, White-throated Sparrow.

MORACEAE

Mulberry spp. *(Morus rubra/alba/nigra)* – Includes native Red Mulberry (dull/rough leaves) along with the exotic White Mulberry (shiny/smooth leaves) and Black Mulberry (shiny/smooth leaves). Both Red and White Mulberries – along with hybrids thereof – are widely distributed through many forest types statewide; widely planted and frequently occurring in urban waste areas as well. (April-July). **Observed:** Red-headed Woodpecker, Red-bellied Woodpecker, Great-crested Flycatcher, Eastern Kingbird, Mourning Dove, White-winged Dove, Inca Dove, Eurasian Collared-Dove, American Crow, Red-eyed Vireo, Eastern Bluebird, Gray-cheeked Thrush, Swainson's Thrush, Gray Catbird, Northern Mockingbird, European Starling, Cedar Waxwing, House Sparrow, House Finch, Yellow-rumped Warbler, Tennessee Warbler, Blackpoll Warbler, Yellow Warbler, Prothonotary Warbler, Yellow-breasted Chat, Chipping Sparrow, White-throated Sparrow, Summer Tanager, Scarlet Tanager, Northern Cardinal, Rose-breasted Grosbeak, Common Grackle, Orchard Oriole, Baltimore Oriole,

Brown-headed Cowbird, Painted Bunting, Indigo Bunting. **Literature:** Northern Flicker (Beal 1911), Tufted Titmouse (Beal and Kalmbach 1927), Wood Thrush (Beal 1915b), American Robin (Beal 1915a), Wild Turkey, Northern Bobwhite (Halls 1977), Red-cockaded Woodpecker, Eastern Towhee, Brown Thrasher (Hunter 1995), Yellow-bellied Cuckoo, Warbling Vireo, Cape May Warbler, Bay-breasted Warbler, Song Sparrow (Merriam 1890).

OLEACEAE

American Fringetree *(Chionanthus virginicus)* – Native to Mixed Pine-Hardwood Forests statewide; widely planted in landscapes statewide. (August-October). **Observed:** Northern Cardinal. **Literature:** Wild Turkey, Northern Bobwhite (Halls 1977), American Robin, Northern Mockingbird (Hunter 1995).

Wax-leaf Ligustrum *(Ligustrum japonicum/lucidum)* – Widely planted Oriental exotic tree within the coastal zone; frequently escapes into bottomland hardwood forest habitats within this region. (October-February). **Observed:** Ash-throated Flycatcher, Rose-breasted Grosbeak.

Chinese Privet *(Ligustrum sinense)* – Widely planted Oriental shrub statewide. Invasive exotic throughout most pine and hardwood forests statewide. (October-March). **Observed:** Yellow-bellied Sapsucker, Ash-throated Flycatcher, White-eyed Vireo, Hermit Thrush, American Robin, Cedar Waxwing, Yellow-rumped Warbler, Western Tanager, Harris's Sparrow, White-throated Sparrow, White-crowned Sparrow, Northern Cardinal, Purple Finch, House Finch, American Goldfinch. **Literature:** Northern Mockingbird, Eastern Bluebird (Miller and Miller 1999)

Devilwood *(Osmanthus americanus)* – Native only to the eastern Florida parishes, but planted in other parts of the state by native plant enthusiasts. (September-December). **Observed:** Yellow-bellied Sapsucker.

PHYTOLACCACEAE

Pokeberry *(Phytolacca americana)* – Native to the woodland edges of most forest types statewide; also roadsides, hedgerows, fallow fields, and other waste areas. (July-September). **Observed:** Eastern Kingbird, Eastern Bluebird, American Robin, Gray Catbird, Northern Mockingbird, Brown Thrasher, House Sparrow, Nashville Warbler, Yellow-breasted Chat, Summer Tanager, Northern Cardinal, Chipping Sparrow, Painted Bunting, Indigo Bunting, Baltimore Oriole, House Finch. **Literature:** Mourning Dove, Warbling Vireo (Martin et al. 1951), Red-bellied Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Northern Flicker (Beal 1911), Eastern Wood-Pewee, Eastern Phoebe, Great-crested Flycatcher (Beal 1912), Blue Jay (Beal 1896), American Crow (Beal and Kalmbach 1927), Gray-cheeked Thrush, Swainson's Thrush (Beal 1915b).

PODOCARPACEAE

Japanese Yew *(Podocarpus macrophyllus)* – Exotic Oriental evergreen tree; planted in gardens statewide. (October-January). **Observed:** Eastern Kingbird, Summer Tanager, Northern Cardinal. **Literature:** (as "Yew sp.") Veery, Wood Thrush (Beal 1915b).

RHAMNACEAE

Supplejack/Blackjack Vine *(Berchemia scandens)* – Native vine widely distributed throughout most forest types statewide. (September-December). **Observed:** Yellow-bellied Sapsucker, White-eyed Vireo, Eastern Bluebird, Hermit Thrush, Cedar Waxwing, Purple Finch, House Finch. **Literature:** Northern Bobwhite, Wild Turkey (Halls 1977, Seidenberg 1995), Rose-breasted Grosbeak (McAtee 1908), Mallard (Halls 1977, Hunter 1995), Wood Duck (Hunter 1995).

Carolina Buckthorn *(Frangula caroliniana)* – Native small deciduous tree distributed in mixed pine-hardwood forests statewide. (August-November). **Observed:** American Robin, Northern Mockingbird, Northern Cardinal, Purple Finch. **Literature:** Pileated Woodpecker, Gray Catbird (Hunter 1995).

ROSACEAE

Hawthorn spp. *(Crataegus spp.)* – A large North American genus of small trees which includes 13 species native to Louisiana. Most of Louisiana's species are restricted in distribution to the northern half of the state. Parsley Haw *(C. marshallii)* and Green Haw *(C. viridis)* extend well south, with the latter reaching the coastal parishes, mostly associated with bottomland hardwood forests. Found in open woodlands, woodland edges, roadsides, fallow fields, and other sunny locales. (October-January). **Observed:** Least Flycatcher, Hermit Thrush, American Robin, Gray Catbird, White-throated Sparrow, Northern Cardinal. **Literature:** Blue Jay (Beal 1896), Eastern Bluebird (Beal 1915a), Northern Bobwhite, Northern Mockingbird (Seidenberg 1995), Rose-breasted Grosbeak (McAtee 1908), Fox Sparrow (Martin et al. 1951), Cedar Waxwing, Wild Turkey, Wood Duck (Halls 1977), Northern Flicker (Hunter 1995).

Loquat or Japanese Plum *(Eriobotrya japonica)* – Small exotic evergreen tree planted ornamentally throughout the southern half of the state. (February-May). **Observed:** Cedar Waxwing, Rose-breasted Grosbeak, Baltimore Oriole.

Red-tip Photinia *(Photinia glabra)* – A native Japanese evergreen shrub once widely planted in hedge configuration. Diseases have caused it to fall out of favor and it is not presently used as often; however old/healthy specimens persist in various places. (September-December). **Observed:** Cedar Waxwing.

Common Pear *(Pyrus communis)* – Also known as "cooking pear" in the South. Traditionally planted around many rural homesites, urban/suburban plantings of this Eurasian species are presently increasing as a result of "edible landscaping" and "permaculture" enthusiasts. Trees are long-lived in Louisiana, often persisting at abandoned rural homesites. (July-September). **Observed:** Ruby-throated Hummingbird, Red-bellied Wookpecker, Downy Woodpecker, Northern Flicker, Pileated Woodpecker, Carolina Chickadee, Tufted Titmouse, Pine Warbler, Northern Cardinal.

Black Cherry *(Prunus serotina)* – Medium to large deciduous tree widely distributed in various (mostly upland) forested habitats throughout the state, including the coastal parishes. (March-July). **Observed:** Red-headed Woodpecker, Red-bellied Woodpecker, Pileated Woodpecker, Eastern Kingbird, American Crow, Swainson's Thrush, Gray Catbird, European Starling, Cedar Waxwing, Yellow-breasted Chat, Summer Tanager, Rose-breasted Grosbeak. **Literature:** Northern Bobwhite (Seidenberg 1995), Northern Flicker (Beal 1911), Great-crested Flycatcher (Beal 1912), Blue Jay (Beal 1896), Eastern Bluebird, American Robin (Beal 1915a), Veery, Gray-cheeked Thrush, Wood Thrush (Beal 1915b), Northern Cardinal (Beal and Kalmbach 1927), Baltimore Oriole (Martin et al. 1951), Willow Flycatcher, Brown Thrasher, Common Grackle (Morden-Moore and Willson 1982), Eastern Phoebe, Brown-headed Cowbird (Hunter 1995).

RUBIACEAE

Firebush *(Hamelia patens)* – A Caribbean native shrub planted in gardens as a hummingbird nectar plant throughout the lower Gulf Coastal Plain. In mid to late-winter it produces clusters of dark, flattened, oval-shaped fruits. (November-January). **Observed:** Blue Jay, Northern Mockingbird, Northern Cardinal.

RUTACEAE

Prickly Ash *(Zanthoxylum clava-herculis)* – Also known as "Toothache Tree" this small native deciduous tree is locally common statewide in sunny locales of many forested habitats, roadsides, and hedgerows. A major component of coastal forests, especially along Louisiana's southwestern coast. (July-September). **Observed:** Eastern Wood-Pewee, Willow Flycatcher, Great-crested Flycatcher, Eastern Kingbird, White-eyed Vireo, Philadelphia Vireo, Red-eyed Vireo, Swainson's Thrush, Northern Cardinal. **Literature:** White-winged Dove (Martin et al. 1951).

SMILACACEAE

Catbrier *(Smilax spp.)* – Also known as "Greenbrier" this genus of evergreen vines includes 10 species native to Louisiana, most of

which are widely distributed throughout the state throughout many forested habitats. (August-February). **Observed:** Ash-throated Flycatcher, Blue-headed Vireo, Hermit Thrush, Cedar Waxwing, Green-tailed Towhee, White-throated Sparrow. **Literature:** Wild Turkey, Fox Sparrow (Martin et al. 1951), Red-headed Woodpecker, Red-bellied Woodpecker, Yellow-bellied Sapsucker, Northern Flicker, Pileated Woodpecker (Beal 1911), Eastern Phoebe (Beal 1912), Eastern Bluebird, American Robin (Beal 1915a), Veery, Gray-cheeked Thrush, Swainson's Thrush (Beal 1915b), Northern Mockingbird (Beal and Kalmbach 1927), Northern Bobwhite (Halls 1977), Northern Cardinal, Gray Catbird (Hunter 1995).

SOLANACEAE

Bird Pepper *(Capsicum annuum glabriusculum)* – Small native perennial shrub limited in natural Louisiana distribution to coastal forests. Gaining popularity among "bird gardeners" and native plant enthusiasts statewide. (August-January). **Observed:** Ash-throated Flycatcher, Northern Mockingbird, Northern Cardinal.

Night-blooming Jessamine *(Cestrum nocturnum)* – A semi-tropical shrub native to the West Indies, widely planted in garden settings within the coastal zone; has exhibited invasiveness in New Orleans (horticultural zone 9), but no such reports from other urban areas in which it is used. (August-December). **Observed:** Northern Mockingbird.

Salt-matrimony Vine *(Lycium carolinianum)* – Also known as "Carolina Wolfberry" and "Carolina Desert Thorn" this native perennial decumbent shrub is restricted to dune and coastal forest edge habitats along the beaches of the coastal parishes. (September-December). **Observed:** Great-crested Flycatcher, Eastern Kingbird, Hermit Thrush, White-crowned Sparrow, Black-headed Grosbeak. **Literature:** Whooping Crane (Chavez-Ramirez 1996, Butzler and Davis 2006).

ULMACEAE

Hackberry *(Celtis laevigata)* – Also known as "Sugarberry" this native tree is distributed across many forested habitats statewide, especially moist hardwood-dominated floodplain habitats including bottomland hardwood forests and coastal forests. (July-February). **Observed:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Acadian Flycatcher, Least Flycatcher, Eastern Phoebe, Ash-throated Flycatcher, Great-crested Flycatcher, Eastern Kingbird, Couch's/Tropical Kingbird, Loggerhead Shrike, Red-eyed Vireo, Carolina Chickadee, Tufted Titmouse, Blue-gray Gnatcatcher, Eastern Bluebird, Mountain Bluebird, Hermit Thrush, American Robin, Gray Catbird, Northern Mockingbird, Sage Thrasher, Brown Thrasher, European Starling, Cedar Waxwing, Nashville Warbler, Magnolia Warbler, Yellow-breasted Chat, Summer Tanager, Spotted Towhee, White-throated Sparrow, Dark-eyed Junco, Northern Cardinal, Rusty Blackbird, Common Grackle, Purple Finch, House Finch, American Goldfinch. **Literature:** Northern Flicker, Pileated Woodpecker (Beal 1911), Swainson's Thrush (Beal 1915b), Eastern Towhee (Martin et al. 1951), Wild Turkey (Halls 1977).

VERBENACEAE

American Beautyberry *(Callicarpa americana)* – Also known as "French Mulberry" or "Inkberry" this native deciduous shrub is widely distributed throughout most forested habitats statewide, including natural levees, ridges, spoilbanks, and other elevated areas of bottomland hardwood forests. Mostly absent from coastal forests. (July-November). **Observed:** Eastern Kingbird, Red-eyed Vireo, Carolina Chickadee, Ruby-crowned Kinglet, Swainson's Thrush, American Robin, Gray Catbird, Northern Mockingbird, Brown Thrasher, Cedar Waxwing, Summer Tanager, Scarlet Tanager, White-throated Sparrow, Dark-eyed Junco, Northern Cardinal, Rose-breasted Grosbeak. **Literature:** Wood Thrush (Beal 1915b), Eastern Towhee (Martin et al. 1951), Northern Bobwhite (Halls 1977), Purple Finch (Miller and Miller 1999).

Mexican Beautyberry *(Callicarpa mexicana)* – Exotic. From one specimen growing

in Lafayette parish. (August-October). **Observed:** Gray Catbird.

Lantana *(Lantana camara/urticoides)* – Two species of exotic/tropical shrubs which have naturalized throughout the Louisiana coastal zone; planted as "hummingbird/butterfly" specimens in the southern half of the state as well. (August-November). **Observed:** Gray Catbird, Northern Mockingbird.

VISCACEAE

Mistletoe *(Phoradendron leucarpum/tomentosum)* – Native throughout numerous wooded habitats statewide; more abundant in northern half of the state. (September-January). **Observed:** Eastern Bluebird, Northern Mockingbird, Cedar Waxwing.

VITACEAE

Sorrelvine or Ivy Treebine *(Cissus trifoliata)* – Widely distributed but only locally common within dry/sandy habitats statewide. Most commonly encountered within coastal Chenier habitats and other sandy coastal woodlands. (July-October). **Observed:** Northern Mockingbird.

Peppervine *(Nekemias arborea)* – Abundantly distributed native vine. Most common along woodland edges, hedgerows, roadsides. (July-November). **Observed:** Red-bellied Woodpecker, Veery, Swainson's Thrush, Brown Thrasher, Summer Tanager, Northern Cardinal.

Virginia Creeper *(Parthenocissus quinquefolia)* – Abundantly distributed native vine throughout most forested habitats statewide. (August-November). **Observed:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Downy Woodpecker, Northern Flicker, Eastern Kingbird, Eastern Phoebe, White-eyed Vireo, Philadelphia Vireo, Red-eyed Vireo, American Crow, Fish Crow, Eastern Bluebird, Veery, Swainson's Thrush, Hermit Thrush, Wood Thrush, American Robin, Gray Catbird, Northern Mockingbird, Brown Thrasher, European Starling, Orange-crowned Warbler, Summer Tanager, Scarlet Tanager, Northern Cardinal, Common Grackle. **Literature:** Red-headed Woodpecker, Pileated Woodpecker (Beal 1911), Hairy Woodpecker, Tufted Titmouse, Fox Sparrow (Martin et al. 1951), Great-crested Flycatcher (Beal 1912), Tree Swallow (Beal 1918), Carolina Chickadee (Miller and Miller 1999).

Wild Grape spp. *(Vitis spp.)* – Eight native species distributed throughout most forested habitats statewide. *V. mustangensis* is an important component of coastal forests. (July-December). **Observed:** Blue-headed Vireo, Blue Jay, Carolina Chickadee, American Robin, Gray Catbird, Northern Mockingbird, Cedar Waxwing, Yellow-rumped Warbler, Summer Tanager, Northern Cardinal, Rose-breasted Grosbeak, Orchard Oriole, Baltimore Oriole. **Literature:** Red-bellied Woodpecker, Yellow-bellied Sapsucker, Pileated Woodpecker (Beal 1911), Great-crested Flycatcher, Couch's/Tropical Kingbird, Eastern Kingbird (Beal 1912), White-eyed Vireo, Philadelphia Vireo, Red-eyed Vireo (Chapin 1925), Gray-cheeked Thrush, Swainson's Thrush, Hermit Thrush (Beal 1915b), Wild Turkey, Red-headed Woodpecker, Northern Flicker, Warbling Vireo, American Crow, Fish Crow, Tufted Titmouse, Brown Thrasher, Sage Thrasher, Scarlet Tanager, Eastern Towhee, Fox Sparrow, Pine Warbler, Rusty Blackbird, Purple Finch (Martin et al. 1951), Wood Duck, Northern Bobwhite (Halls 1977).

DISCUSSION

Frugivory studies should adopt systematic sampling methods that avoid the biases associated with casual observation (Snow and Snow 1988). For example, fruit in the diet of birdws is now routinely detected via various analyses of excreta (Strong et al. 2005). Frugivory studies employing casual observation, such as the present study, tend to be biased toward common bird and fruit species and species associated with humans and disturbance, and biased against rare and less conspicuous bird and fruit species (Snow and Snow 1988). The causal and opportunistic sampling methods of the current study produced results which are strongly biased toward Louisiana's most ubiquitously

distributed and commonly observed bird species (e.g., Northern Mockingbird, American Robin, Northern Cardinal). Similarly, data on fruiting plants are heavily skewed toward the most commonly-occurring and easily-observable species such as Poison Ivy, Elderberry, Southern Magnolia, Pokeberry, and Hackberry. It is most unfortunate that after 22 years of bird frugivory record-compilation in Louisiana, usage involving many important native fruit-bearing plants remains under-reported (e.g., Sassafras, Red Bay, native hawthorns, Arrowwood Viburnum, native hollies, Flowering Dogwood, American Fringetree, Carolina Buckthorn, native blueberries), and in many cases not reported at all (e.g., Devil's Walkingstick [*Aralia spinosa*], Swamp Privet *[Forestieria acuminata*], Chokeberry [*Aronia arbutifolia*], Strawberry Bush [*Euonymus americana*], native Dewberries/Blackberries [*Rubus* spp.]). Thus the results of the current study should only be considered while keeping observer biases in mind.

Over half (at least 32 of the 57 total species, excluding horticultural cultivars) of the plant species involved in avian frugivory observations in Louisiana are ubiquitously distributed amongst most forested habitats throughout the state. All of these plants are widely and heavily distributed by both birds and mammals, with the former over much greater distances and in much greater numbers. Of the remainder, a substantial number are comprised of horticultural cultivars (e.g., 'Savannah' Holly, Firebush, Japanese Yew, Loquat) as well as some native species (e.g., Sassafras, Arrowwood Viburnum, American Fringetree, Southern Magnolia) grown on or near human habitation. Bird usage of a number of escaped exotic species such as Chinaberry Tree, Camphor Tree, Wax-leaf Ligustrum, and especially the highly invasive Chinese Privet was noteworthy.

As a guide to bird conservationists and wildlife managers, I categorized the relative importance of Louisiana's native fruiting plants based on the diversity of bird species (both observed and from the literature) attracted to them.

"Highly Important" plants are those species for which frugivory involved 30 or more species of birds (total bird species in parentheses): Mulberry spp. (54), Elderberry (45), Hackberry (42), Wild Grape spp. (42), Rough-leaf Dogwood (34), Virginia Creeper (34), Poison Ivy (34), Black Gum (30).

"Important" plants are those species for which frugivory involved 20-29 species of birds: Pokeberry (29), Black Cherry (28), Flowering Dogwood (27), Blueberry spp. (25), Catbrier spp. (23), Sumac spp. (23), American Beautyberry (20), Huckleberry spp. (21).

"Moderately Important" plants are those species for which frugivory involved 10-19 species of birds: Southern Magnolia (18), Spicebush (18), Eastern Red Cedar (17), Hawthorn spp. (16), Sassafras (15), American Persimmon (15), Arrowwood Viburnum (13), Supplejack (12), American Holly (10), Dwarf Palmetto (10), Prickly Ash (10).

Note that this ranking does not take into account differences in nutritional value or digestibility of fruits, timing of fruiting or how these factors relate to the energetic needs of birds. Nonetheless, in support of my rankings, Smith and McWilliams (2015) also recommended a number of these plants based on their nutritional content, including: Arrowwood Viburnum, Elderberry, Spicebush, Pokeberry, Flowering Dogwood, and Virginia Creeper, for conservation plantings in the northeastern U.S.

Mulberry spp. (including Red Mulberry, White Mulberry, and hybrids thereof), ranked as "Highly Important" in this report, may be of special interest to bird conservationists. The present study identified this species complex as a focal point of a number of species-rich bird assemblages. In the literature, most tree-focused species-rich bird assemblages have involved reports of 10–20+ bird species feeding on one to a few trees in a limited area (Rybczynski and Riker 1981). In Louisiana, mulberries routinely attracted simultaneous fruit usage by similar numbers of bird species. In one case a single Red Mulberry tree in Iberia Parish attracted 33 species of birds during a five day period (22–26 April 2003).

Similarly, Virginia Creeper, a common deciduous woody vine statewide, and ranked as "Highly Important" in this study, was reported by many Louisiana observers as possessing high feeding rates by numerous birds species – often on a near-simultaneous basis. For example, observations on a single Virginia Creeper vine at the Acadiana Park Nature Trail (Lafayette, Louisiana) within a one-week span (03–10 October 1994) revealed fruit consumption by 15 different species of birds (Fontenot 1998). These high rates of use by diverse bird species are comparable with those reported for some of the frugivorous plants noted in tropical species-rich assemblage investigations by Beebe (1916), Willis (1966), Leck (1969), and Kantak (1979). They also far exceed the temperate species-rich assemblage on the fruit of Southern Arrowwood (*Viburnum recognitum*) reported by Rybczynski and Riker (1981).

Over the past 35 years, avian frugivory studies have increasingly focused on bird habitat loss, conservation, and restoration issues. Most recently, much avian frugivory research has centered around nutritional/energetics requirements of birds (Borowicz 1988, Bairlein 1996, Zurovchak 1997, Lepczyk et al. 2000, Smith et al. 2007, Greenberg and Walter 2010, Alan et al. 2013, Smith and McWilliams 2015). In Louisiana, bird ecologists Wylie Barrow and Michael Baldwin (unpublished data) have recently estimated energetics values and nutrient break-downs of ca. 70 fruit-producing plant species. From bird habitat conservation and restoration perspectives, the ultimate purpose of these contemporary efforts is to construct avian energetics requirement models able to predict optimum levels of plant species compositions across the many different habitat types used annually by nesting, migrating, and wintering birds (Rosenberg et al. 2016).

In a recent conversation, Barrow lamented that with recent increases in funding for bird habitat conservation and restoration, managers still "have no idea what to plant." Thus, it is hoped that the casual observations presented in this report will provide some baseline value to Louisiana bird habitat researchers, land managers, and habitat restorationists, as well as to private landowners and even backyard gardeners trying to attract birds. My general recommendations for creating or restoring bird habitat are to give priority to the ranked plants and to consider plant selections which are native to the generalized habitat types or remnants (Thompson and Willson 1979). Several works provide guidance for backyard gardening and other smaller-scale operations in the Gulf Coast region (Fontenot 1992, Seidenberg 1995, Vermillion 1997).

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COMMENTARY

Crawfish cultivated with rice: the net economic impact of waterbirds needs assessment

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ABSTRACT

Waterbirds are attracted to rice fields because the shallow water/moist soil habitat provides food in the form of rice seed, weed seeds, roots, and corms, macro-invertebrates and small vertebrates. The addition of crawfish cultivation to the rice landscape ensured that shallow water/moist soil habitat was available year round. The absolute amount of animal food resources available to waterbirds was dramatically increased because fields that would otherwise not hold water were filled from fall into the following spring. Predaceous wading birds – herons, egrets, ibises, spoonbills and storks – benefitted greatly from this energy-rich animal prey. In Louisiana, much of the crawfish is cultivated in rice fields in some rotation with rice. In 2013, 162,088 ha of rice and 73,295 ha of crawfish were cultivated. We quantified the association of crawfish and rice for 2013 and found that the area devoted to crawfish based on forage management consisted of: 11,725 ha where crawfish was the sole crop (no rice association); 10,995 ha where crawfish was the sole crop and rice was provided as forage but not harvested; 10,260 ha where the rotation was rice-crawfish-rice-crawfish; and 40,315 ha where the rotation was rice-crawfish-fallow or crop. Thus, 84 % of crawfish was cultivated with rice and 69% of this rice was harvested. While conservationists recognize the value of crawfish culture impoundments for waterbirds, farmers have been long concerned about the negative impact of birds on their crops. Birds not only directly prey on crawfish, but they also reduce of food resources for crawfish, degrade crawfish habitat, and dislodge traps used to harvest crawfish. Definitive studies to determine the impact of birds on crawfish crops are lacking and future studies should take into account the various methods of crawfish cultivation.

Keywords: waterbirds, working wetlands, crawfish aquaculture, rice cultivation, conservation, depredation

Waterbirds are attracted to Louisiana's rice fields because the shallow water/moist soil habitat provides food in the form of rice seed, weed seeds, roots, corms, macro-invertebrates including crawfish, and small vertebrates, especially amphibians and fishes (Huner et al. 2002). Historically, rice crops were only flooded from early spring into mid-summer. The addition of crawfish cultivation into the rice landscape in the 1950s ensured that shallow water/moist soil habitat was available year-round. The amount of aquatic animal prey available to waterbirds increased dramatically when rice fields became filled with water from fall into the following spring. Wading birds such as herons, egrets, ibises, spoonbills and storks have benefitted greatly from this addition of energy-rich prey (Fleury and Sherry 1995, Fleury et al. 1999). Louisiana crawfish farmers have raised considerable concern about the impact of large concentrations of waterbirds on their crops (Martin and Hamilton 1985, Huner et al. 2002, Huner and Jeske 2010). Herein, we provide information on those aspects of crawfish-and-rice aquaculture and crawfish life history that are pertinent to assessing bird impact. We also outline types of economic costs and benefits of waterbirds to crawfish aquaculture and make recommendations for future research to determine the net impact.

Crawfish have always been a part of the South's rice landscape, including southeastern Texas, southwestern and northeastern Louisiana, northwestern Mississippi and southeastern Arkansas. Initially, native crawfish opportunistically perpetuated themselves in these managed wetlands and were harvested when fields were dewatered in late summer/early fall for rice harvests (Huner 2002). As the demand for crawfish began to increase, farmers intentionally re-flooded fields in the fall following rice harvests and harvested crawfish during the cool season prior to spring planting of rice. Rice stubble and ratoon (the second rice crop) re-growth served as the basis for the food web that sustained crawfish growth.

Because crawfish are important food resources for birds, especially wading birds, farmers' concerns about the impact of birds on crawfish crops quickly became an issue. Brood female crawfish are especially vulnerable to bird predation, while burrowing and when emerging from burrows (McClain et al. 2007). Brood females construct burrows at the water's edge and spawn in those simple burrows. Eggs are incubated and hatch in the burrows. Females emerge with young mostly during fall and early winter. Crawfish yield depends heavily on how many females successfully burrow, produce young, and emerge with them into open water.

The economic value of rice as waterfowl habitat has been quantified for the Gulf Coast from Texas to Alabama, but the contribution of crawfish cultivated with rice has rice has as of yet been overlooked (Brasher et al. 2012, Petrie et al. 2014). Petrie et al. (2014) noted, in particular, the significance of winter flooded rice lands as waterfowl habitat in Louisiana. They reported that "rice" generated $3.5 billion worth of waterfowl (and, presumably, waterbird) habitat in the U.S. In Louisiana, much of the crawfish is cultivated in rice fields in rotation with rice (Table 1), and much of the winter-flooded habitat consists of rice fields managed for crawfish production.

Table 1. Timing of the various scenarios for cultivating rice and crawfish in the southern Louisiana and southeastern Texas.

Month	Rice as Crawfish Forage	Rice/Crawfish	Rice/Crawfish Rotation
Apr.	---	---	R
May	R/C	R1/C	R/C
Jun.	R/C	R1/C	R/C
Jul.	R/C	R1/C	R/C
Aug.	R/C	R1/C	R/C
Sep.	C	R2?/C	R2?/C
Oct.	C	R2?/C	R2?/C
Nov.	C	C	C
Dec.	C	C	C
Jan.	C	C	C
Feb.	C	C	C
Mar.	C	C	C
Apr.	C	C	C
May	Repeat	Repeat	C
Jun.			Fallow/Crop/Pasture

R1- Rice planted and cultivated, one crop.
C – Crawfish stocked in May/July and harvested Nov./May periods.
R2? – Second rice crop or “ratoon” may or may not be cultivated.

While crawfish and rice production are often intertwined in Louisiana, rice-crawfish management methods have not been quantified. In 2013, 162,088 ha of rice and 73,295 ha of crawfish were cultivated, but the extent of co-production and management was not reported (LSU Ag Center 2013). Therefore, we canvassed Louisiana State University area Cooperative Extension Agents to ascertain that relationship within Louisiana. We found that in 2013, of the estimated 73,295 ha devoted to crawfish, 84% was cultivated with rice as forage and 69% of the rice was harvested (Table 2).

The various approaches for growing rice and crawfish should be taken into account in designing future studies on the impact of bird predation (Table 1). A rice-crawfish rotation involves stocking of mature crawfish in the spring after the planted rice crop is permanently flooded (Huner et al. 2002, McClain et al. 2007). Subsequently, mature crawfish burrow into levees where they reproduce. Females, with newly hatched young, emerge from burrows in the fall following rice harvest when the fields are refilled with water. Some farmers raise rice and crawfish continuously in each year, and this referred to as "rice-crawfish-rice double-cropping." With this method, restocking of crawfish is often not necessary. Most farmers, however, do not follow crawfish with rice crops: instead fields are fallowed or planted with a crop like soybeans or sorghum, a system referred to as "rice-crawfish-field rotation or crop." When fields are fallowed, shallow water often remains into August and September to the benefit of migrant and resident waterbirds. Rice will be planted the following spring and crawfish restocked. This management practice is favored because crawfish densities tend to be low enough to ensure growth to larger, more valuable sizes.

Even when crawfish are cultivated in monoculture, rice is often involved: "crawfish rice" may be planted as a forage in late July or August to reduce oxygen depletion that would otherwise occur when rice straw is flooded in harvested rice fields, and the late planting extends the availability of forage into late spring. There is no intention to harvest the rice grain. This management scenario produces moist soil/shallow water habitat for migrant and resident waterbirds.

The importance of working wetlands as waterbird habitat in south-central and southwestern Louisiana is increasing as natural wetlands are lost. The southwestern Louisiana's working rice-crawfish wetland comprises a substantial portion of the Chenier Plain Important Bird Area, recognized by the National Audubon Society (2007) as globally important because it supports over 70 species of resident, seasonal, and migratory waterbirds, many of which are species of conservation concern (Huner et al. 2002). Examples include Mottled Duck (*Anas fulvigula)*, Northern Pintail (*Anas acuta*), Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), White Ibis (*Eudocimus albus*), Roseate Spoonbill (*Platalea ajaja*), Greater Yellowlegs (*Tringa solitaria*), Dunlin (*Calidris maritime*), Bonaparte's Gull (*Chroicocephalaus Philadelphia*), and Forster's Tern (*Sterna fosteri*). Over 65% of the state's 479 recorded bird species have been documented in the region (Huner et al. 2009, Dittmann 2013, Dittmann and Cardiff 2013). The dramatic loss of adjacent coastal wetlands over the past half century emphasizes the critical importance of the region's working wetland landscape for waterbird conservation (Covillion et al. 2011). For this reason, reduction in rice cultivation in the region from 213,600 ha to 164,400 ha over the past decade, a reduction of 23%, is especially disturbing (see LSU Ag Center Annual Agricultural Statistics 2004-2013). Clearly rice farming is important to crawfish cultivation, and crawfish is important to waterbird conservation.

Table 2. Estimated area devoted to crawfish production in Louisiana in 2013, according to crawfish forage management.

Management Practice	Forage Crop	Hectares
Crawfish Sole Crop	Some Other Forage[1]	11,725
Crawfish Sole Crop	Rice Forage	10,995
Rice-Crawfish-Rice-Crawfish	Rice Forage	10,260
Rice-Crawfish—Fallow or Crop	Rice Forage	40,315

[1]Other Forage – volunteer vegetation, sorghum-sudan grass, sorghum, or millet.

The Impact of Waterbirds on Crawfish Production

Controlled studies are needed to quantify both the positive and negative economic impacts of predaceous and omnivorous birds on crawfish aquaculture. Despite the obvious value of the rice-crawfish working wetland landscape as waterbird habitat, there is concern amongst crawfish farmers about the economic impact of those birds on their crops (Fleury and Sherry 1995, Huner et al. 2002, McClain et al. 2007, Huner et al. 2008, Huner and Jeske 2010). To date, only one study (Martin and Hamilton 1987, discussed below) has attempted to demonstrate the impact, positive, negative, or neutral, of birds foraging in crawfish harvest.

The direct impact that bird predation has on crawfish production can be substantial, especially if predation rates are high at times when crawfish are particularly vulnerable. Most prominently, birds may depredate crawfish during the production season and consume brood crawfish before the females burrow when fields are drained, or birds may consume females bearing young after fields are flooded. Molting crawfish become vulnerable to avian predation because they must move away from non-molting crawfish to avoid intraspecific predation. Avoiding one predator forces the crawfish to the surface: as they climb upward on vegetative substrate into the upper water column during the daytime to molt they become more accessible to birds (Huner et al. 2002). Crawfish are also more vulnerable to bird predation during periods of hypoxia (low dissolved oxygen). Hypoxia is the result of the massive biomass of decomposing vegetation in impoundments, and it is a major management issue in crawfish cultivation. During hypoxia events, crawfish move to the surface to use atmospheric oxygen.

There are many indirect ways that birds can impact crawfish production and cash value. Predatory wading birds and herbivorous birds may compete with crawfish for the macro-invertebrate and small vertebrate and vegetative foods, and especially seeds, including un-harvested rice where rice is cultivated for crawfish forage. When species such as geese and coots dislodge emergent vegetation, they are destroying cover for crawfish. Emergent vegetation also serves as a substrate critical to reducing the absolute crawfish density per unit area (McClain et al. 1996, D'Abramo et al. 2006). An abundance of emergent vegetation allows crawfish to disperse vertically in the water column, reducing crawfish densities, which in turn allows the crawfish to survive better and grow larger. Thus, crawfish growth is density dependent, and crawfish density cannot be readily controlled because there is no absolute control of the number of young crawfish entering ponds after the fall re-flooding (McClain et al. 1997). Premium prices are paid for the largest crawfish.

Birds also negatively impact crawfish production during harvesting operations. Losses of traps, crawfish and bait have obvious impacts on the profitability of a crawfish operation but

this has never been quantified (Huner and Jeske 2010). Crawfish are harvested with wire mesh traps that extend from impoundment bottoms to the surface where they can be readily accessed by harvesters (McClain et al. 2007). Rods are used to keep the traps vertical, but larger birds can create several problems with traps. When they rest on traps they may dislodge them. Since the tops of traps are open, dislodging them allows crawfish to escape, and, where the water is deep enough, the traps can be lost. During the cool months of the year, farmers use cut rough fish for bait. Herons, egrets and cormorants will filch bait from traps, reducing the catch. Those species as well as gulls will filch crawfish from traps.

Even small numbers of birds present daily have been shown via modeling to impact crawfish numbers (Huner and Jeske 2010). Large flocks of hundreds or even thousands of birds can have a more immediate impact on crawfish numbers. Yet some will argue that, when crawfish are present in overly high densities, bird predation may provide economic benefit to the farmer through density reduction with resultant larger, more valuable crawfish being harvested.

We need to understand how bird predation impacts crawfish density and ultimately yield, body size, and cash value. Reducing crawfish density in over-populated impoundments generally has a positive impact on crawfish growth (McClain et al. 1999, 2007). In fact, "relaying" is a practice whereby small crawfish are removed from a high density impoundment, where stunting at small sizes is sure to occur, to an impoundment with few crawfish. The crawfish that are moved to a low density environment grow to large sizes. However, those remaining in the donor impoundment seldom show compensatory growth, suggesting that bird predation does not benefit crawfish production (Huner 2002). In such systems, substrate is depleted. One may speculate that some combination of reduction in food resource, substrate, and, perhaps, pheromones explain lack of response to density reduction (J. Huner personal observation). Provisioning of food in high density populations without substrate has experimentally increased crawfish survival rates and harvest yields but not crawfish size (D'Abramo et al. 2004, 2006). These results suggest that density still impacts growth.

Crawfish density and size are directly related to how many female crawfish burrow, reproduce and emerge from the burrows with young (McClain et al. 2007). These life history stages are especially vulnerable to predation, yet the impact of vertebrate predators is unknown (Huner and Jeske 2010). It is well known, however, that the density of crawfish is normally low during the first season that a crawfish pond is stocked and the resultant crawfish tend to be large. When impoundments are used in consecutive years for crawfish production, whether or not rice is planted and harvested, "overpopulation" typically occurs by the second season. In the case of rice-crawfish rotations, ponds are restocked with each crawfish cycle, and the size of harvested crawfish is normally large (Huner 2002, McClain et al. 2007).

Resolution of Problems and Research Recommendations

The net impact that the various suites of waterbirds have on crawfish production in managed impoundments is generally unknown and will be condition dependent (Huner et al. 2009, Huner and Jeske 2010). Controlled studies involving captive birds held in situations with known populations of crawfish coupled with field studies with systems including and excluding various avian predators would go far in explaining the impact of birds in these complex, quasi-managed crawfish impoundment ecosystems. Future studies need to measure female burrowing success, reproduction within burrows, numbers emerging with young, growth rate and harvest size.

Future researchers can learn from shortcomings of the Martin and Hamilton (1985) study design. Martin and Hamilton examined wading bird foraging and its apparent impact on crawfish production at one crawfish farm complex at one location in the alluvial valley region of the Atchafalaya Basin. Future studies could avoid sampling biases by incorporating at least several farms from different geographic areas and that are using different rice-crawfish cultivation methods. While Martin and Hamilton

attempted a controlled experiment, the study's short-comings rendered their conclusions dubious. The units sampled were small (less than 4% of the total pond area), and key details about study design (e.g., exclosure design, timing of sampling) were not provided. The study design failed when wading birds did not use the control units, probably due to their location. Because of this they pooled the crawfish harvest data for their analysis.

The authors suggested that wading birds did not negatively impact the commercial harvest, basing their conclusions on a hypothetical, unrealistic harvest of 1,000 kg per ha. This harvest quantity is rarely achieved in commercial crawfish pond systems, and, in fact, about half of this (400-500 kg per ha) is normal (Huner 2002). Thus, their estimated reduction of approximately 150 kg per ha from predation would be clearly equate to significant losses for farmers.

Martin and Hamilton (1985) also failed to address the impact that a suite of predaceous, omnivorous, and herbivorous waterbirds can have on a crawfish production systems (i.e., consuming crawfish, competing for food resources, and removing physical substrate). They noted that the farmers surveyed about various management problems considered bird predation to be a major problem with special reference to Yellow-crowned Night-Heron (*Nyctanassa violacea*) and White Ibis but dismissed their concerns based on their own results. However, both species can be especially numerous in crawfish complexes (Huner et al. 2002, 2009, Huner and Jeske 2010). These species are attracted to dense crawfish populations and move on in a few days once densities decline or when harassed by farmers.

Martin and Hamilton (1985) recommended raising the water depth to reduce wading bird access to crawfish, but this is only a partial solution appropriate for certain areas. It creates no impediment to several other predaceous birds. Diving birds such as waterfowl, coots, grebes, cormorants, and pelicans are not impeded. Nor are gulls and terns that glean crawfish, especially molting crawfish from emergent vegetation at the surface (Huner et al. 2009, Huner and Jeske 2010). Furthermore, crawfish ponds associated with the alluvial valley region are substantially deeper, 0.5 m versus 0.25 m, on average, than shallow ponds associated with the loessal prairie region of southwestern Louisiana (Huner 2002). Therefore, increasing water depths is not an option in such areas.

Studies targeting avian use of crawfish production units in the southern U.S. should consider sampling times carefully. In Marty's (2013) study, of waterbird abundance in rice fields, waterbird concentrations were not especially high in the crawfish systems, probably because the study was limited to December-April.

At least some of the avian surveys at crawfish impoundments should be conducted during drawdown (draining) periods because this is when there are likely to be the largest aggregations of waterbirds (Martin and Hamilton 1985, Huner 2002, Huner et al. 2009, Huner and Jeske 2010, Folley 2015**)**. Drawdowns typically occur from April to June, and less often during November through March. Management negligence can also lead to accidental draining (e.g., damage by burrowing mammals, especially nutria (*Myocastor coypus*), or from crawfish burrowing). Alternatively, managers may intentionally drain impoundments because it is not economical to harvest the crawfish because of small size or low density, and the water may be better used elsewhere. These are especially bird friendly environments, both before draining and as ponds are being drained. The manager absorbs the losses associated with the costs incurred from managing the unit for crawfish production. In some cases, impoundments are allowed to dewater naturally, creating temporary shorebird habitat.

Research should also be directed at developing effective management practices to mitigate losses due to birds. Lethal means provide poor options because many of the birds cannot be killed legally without a depredation order, some are of conservation concern, and hunting of game species is restricted to limited seasons and harvests. Non-lethal harassment applied at the appropriate time might resolve specific problems. Crawfish trap design and

stabilization might be improved. Farmers should consider sustaining the highest water levels possible in their ponds. When management practices prove to be ineffective, perhaps farmers could be compensated for their losses, especially in light of the habitat and food resources their impoundments provide for birds of conservation concern. However, determining actual losses will be a challenge.

While farmers complain about the obvious presence of flocks of predaceous, omnivorous and/or herbivorous waterbirds, the modern crawfish industry in the U.S. is over 70 years old and accounts for at least 73,000 ha of managed impoundments, with crops exceeding 50,000 metric tons annually. These metrics suggest that waterbird predation does not have a substantial, industry-wide economic impact.

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RESEARCH ARTICLE

Evaluation of migratory and resident bird populations in the Mouton Cove area, Vermilion Parish, Louisiana, pre- and post-Hurricane Rita saltwater surge, 2004 versus 2007

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ABSTRACT

In coastal areas, hurricanes impact avian habitat through wind damage, storm surge often with dramatic increases in salinity, and flooding. Working wetlands are agricultural lands used to cultivate rice and crawfish (and other aquaculture species) and provide many of the habitat services of natural wetlands. We surveyed the Mouton Cove area of lower Vermilion Parish, Louisiana in 2004 and 2007, prior to and after the passing of Hurricane Rita in early October 2005. While we found large numbers of bird species in surveys following the hurricane, changes in species composition reflected the reduction in working wetland habitat as a result of salt contamination of soils. Forested areas were impacted by winds and flooding with an apparent reduction in species associated with that habitat. It appeared to us that the avian diversity was not permanently impacted and was well on the way to recovery by 2007. We recorded 225 species of birds in 2004 and 231 species in 2007 with the core species remaining the same. The most obvious changes in abundance (percentage +/-) were: -15.1% for wading birds, +7.1% for shorebirds, and +5.8% for blackbirds and allies.

Keywords: waterbirds, crawfish, hurricane, weather effects, working wetlands, conservation

The working wetland landscape in southwestern Louisiana is an important habitat for waterbirds in general (Huner et al. 1999, Musumeche et al. 2002, Huner et al. 2002, 2009). Studies specific to wading birds, secretive marsh birds, especially rails, and shorebirds also document the value of this habitat (Remsen et al. 1991, Fleury and Sherry 1995, Fleury et al. 1999, Perlussi and King 2008, Bradley et al. 2012, Valente et al. 2012, Norling et al. 2013, Marty 2013).

Working wetlands, formerly referred to as agricultural wetlands, include rice and crawfish impoundments as well as impoundments designated for culturing finfishes, especially catfish. There is little finfish culture in southwestern Louisiana but there are approximately 157,895 hectares dedicated to rice culture and approximately 72,875 hectares dedicated to crawfish culture (LSU Ag Center 2012). Rice and crawfish are often integrated into the same impoundments with rice raised in warm months and crawfish raised in cool months (Saichuk 2006, McClain et al. 2007). Thus, shallow water and moist soil habitats favored by waterbirds are available throughout the year.

Intense rice culture began in the southwestern Louisiana around 1880 (Babineaux 1967, Dethloff 1997)). After harvest, those fields attracted wintering waterfowl especially when water accumulated. Other waterbirds, including wading birds and shorebirds, used these intensively managed wetlands as well. Crawfish, especially the red swamp crawfish, *Procambarus clarkii*, were always present in the landscape but farmers began to cultivate them in rice impoundments in the 1950s. There was a dramatic increase in acreage from 1970-1980, and farmers noticed increasing concentrations of wading birds where crawfish were being cultivated. The relationship between animal food resources in crawfish ponds and a dramatic increase in wading bird populations has been established (Fleury and Sherry 1995, Fleury et al. 1999).

Working wetlands are becoming increasingly important to waterbirds as natural wetlands degrade and disappear. Over the past 80 years, there has been a massive loss of Louisiana's coastal wetlands including the southern fringe of the working wetlands in southwestern Louisiana. Couvillion et al. (2011) reported a total loss for coastal Louisiana of 4,875 sq. km. from 1932–2010. The Chenier Plain region has been designated as an Important Bird Area of Global Priority primarily because of the wealth of bird life and eminent treats posed by wetland loss (National Audubon Society 2007). At least a portion of this wealth of birdlife is due to the working wetland habitats (Huner et al. 2002, J. Huner and M. Musumeche personal observation).

Working wetlands also provide habitat for other types of birds. Riparian areas associated with working wetlands are important songbird habitat for breeding birds, birds in migration, and wintering birds (Huner et al., 2002, 2009). Typical crop rotations in working wetlands involve rice, soybeans, crawfish, hay, and pasture (Huner et al. 2002). Fields managed for hay and pasture provide habitat that is especially attractive to Eastern Meadowlark and Loggerhead Shrike, species whose populations have declined dramatically throughout their North American ranges (North American Bird Conservation Initiative, U.S. Committee 2013).

Hurricanes and tropical storms cause significant changes to the coastal landscape of the northern Gulf of Mexico (Capibianco and Davis 2008, Dobbs et al. 2009, Dobbs 2010, O'Connell and Nyman 2011) and can severely impact working wetlands. High winds topple trees opening canopies and dislodge lower story vegetation. Winds and rains denude most vegetation. Storm surges are physically destructive to vegetation and ground topography, natural and manmade. Flood waters with elevated salinities impact lower salinity and freshwater wetlands and forested areas.

We documented the avifaunal use of working wetlands in Louisiana from the 1990s through 2005 (Musumeche 2000, Musumeche and Huner 2003, 2004). We conducted surveys in St. Martin, St. Landry, and Vermilion parishes – eastern, northern, and western areas of the state's working wetlands landscape. From September 2002 through April 2005, we surveyed bird species and numbers in the working wetlands, pastures, and riparian forests in the Mouton Cove

area of Vermilion Parish, Louisiana, several times monthly. We generated a seasonal bird checklist with 236 species (Musumeche and Huner 2004), 72 of which either nested or were probable nesters at or near the study area.

In early October 2005, Hurricane Rita generated a storm surge that inundated the study area south of and in some places north of Louisiana Highway 82 with full strength sea water (Hymel 2005). Vegetation was significantly damaged (J. Huner personal observation, Saichuck 2007). Crawfish and rice fields that were flooded with salt water could not be used for their intended crops. Sharks and sting rays were found in some fields when they were drained. In areas spared from the surge, crawfish fields that would have been filled in the fall of 2005 could not be filled because farmers depended on surface waters that were too saline to pump into ponds. The problem was exacerbated by a drought in the winter of 2005-06 so that rainfall was insufficient to fill ponds unaffected by the surge or flush ponds from which salt waters had been drained in October or November.

Preliminary survey data following Hurricane Rita indicated that the avifauna was dramatically reduced in terms of numbers of species and individuals per species compared to our baseline data, so we investigated the matter further.

METHODS

The Mouton Cove study area was roughly circular, having a diameter of about 8 km. The approximate center of the study area was the intersection of LA Route 82 and LA Route 690 (Latitude: 29.888369 N, Longitude: -92.169578 W). LA Route 82 essentially bisected the survey area. The primary road into the western half of the survey area was Marsh Road. Other roads included Prairie, Elk, and Sweetbay roads and the first 1.6 km of LA Route 693 west of LA Route 82. The primary road into the eastern half of the survey area was Pleasant Road. Other roads included Agnes Plantation and Audubon roads. When possible, we also surveyed fields by driving on earthen, interior roads.

Approximately 70% of the habitat was agricultural, with the dominant crops being rice, crawfish, cattle, and hay, generally in rotation. Approximately 25% of the habitat consisted of riparian and bottomland hardwood forest, mostly located within Palmetto Island State Park. Dwellings, farm buildings, and commercial structures accounted for the remainder of the habitat in the survey area. The survey area was generally low elevation and flat, being mostly less than a meter above sea level.

Major waterways included the Vermilion River on the eastern side of the survey area and 7th Ward Canal on the western side. Several drainage/water supply canals were also located within the survey area.

The study area included three sites on the coastal birding trail developed by the State of Louisiana's "America's Wetland Birding Trail" (Louisiana Department of Culture, Recreation and Tourism 2013): Gladu Road, Site 4-3; Palmetto Island State Park/Pleasant Road, Site 4-6; and Mouton Cove Area/Prairie Road, Site 4-7.

From January through December we conducted monthly field surveys: 54 surveys in 2004 and 72 in 2007. A typical survey route covered 46 km and involved 5–7 hours of effort, generally beginning around dawn. Each survey was conducted by one individual. The route was driven with stops when birds were visually detected along the roadside and in fields and wooded habitat. Periodic stops were also made with use of screech-owl playback to detect songbirds not otherwise detected by ear.

In comparing the numbers of birds pre- and post-Hurricane Rita, we calculated relative numbers based on the average number of birds encountered per survey because the numbers of surveys were greater in 2007 than 2004 and because some individuals were encountered on multiple surveys.

We classified bird species on the basis of widely accepted abundance classifications with some modification of the terms Abundant and Common (Lowery 1974). Abundant species are widespread and easily found in proper number in "large" numbers. Common species are widespread and easily found in proper habitat but generally not in "large" numbers. Uncommon

species are widespread and present, but in "low" numbers in proper habitat. Rare species are those found most years in very low numbers. These classifications are relative and thus somewhat arbitrary because, for example, 100 Red-winged Blackbirds might be classified as Uncommon while 50 Northern Mockingbirds might be classified as Abundant, because the former is a flocking species while the latter is not. All species in a category such as waterfowl were used in composite analyses.

RESULTS AND DISCUSSION

Pre- and post-Hurricane Rita, we found similar bird numbers and diversity, with 231 species in 2007 as compared to 225 species in 2004. Common and scientific names of the Abundant, Common, Uncommon species encountered are provided in Table 4. Post-hurricane, we found eight bird species new to our long-term, cumulative species list for the area, bringing the total to 238 species at that time. A comprehensive regional list of birds includes 312 species (Dittmann and Cardiff 2013). This compares favorably to the entire state's bird list of over 479 bird species including six species that are either extinct or thought to be extinct (Dittmann 2013).

While the core of birds remained the same, there were 28 bird species found prior to the storm that were not found during 2007 but eight that were new in 2007. These represented species that were out of their normal ranges or out of their normal habitats, something to be expected in any survey area.

The mean number of birds encountered per survey differed pre- and post-Hurricane Rita. In 2004, we counted an average of 6,210 birds per survey (N = 335,321 birds, range = 749–20,288, S.D. = 6,404) for 54 surveys, while in 2007 we counted an average of 7,444 birds per survey (N = 535, 945, range = 1,054–31,017, S. D. = 7,203) for 72 surveys (Table 1). While the mean number of birds per survey increased in magnitude by a factor of 1.60, based on the number of surveys, our survey effort increased by only a factor of 1.33. Thus there may have been a moderate increase in the numbers of birds using working wetlands in 2007, a little over a year post hurricane. However, one way analysis of variance shows no significant difference between the two years ($P = 0.67$).

There was a lack of surface freshwater to fill fields for crawfish production and flush salt in areas impacted by the salt water surge that reached LA Route 82. The area experienced a severe drought in the fall and winter of 2005-06 and salt water lingered for a long time in the normally freshwater canals used for irrigation. While most rice crops had been harvested prior to Hurricane Rita, at least 20% of the parish's fields were not used for crawfish production for lack of surface water to fill them or their inundation by salt water from the hurricane surge (Hymel 2005, Saichuck 2007).

Many of the impoundments—rice, rice/crawfish, or rice—that were dry during the fall-winter-spring of 2005-06 or that had been flooded by Hurricane Rita's salt water surge were flooded in the fall of 2006. However, there was a dramatic decrease in rice cultivation from the 2005 season to the 2006 season, 30,865 ha versus 13,580 ha (Table 2). Farmers flooded the fields

Table 1. Comparison of pre- (2004) and post- (2007) Hurricane Rita bird surveys: mean number of birds recorded per survey by month, and number of species recorded per month.

Month	Mean Number of Birds (Number of Surveys)		Number of Species	
	2004	2007	2004	2007
January	14,251 (3)	14,051 (6)	93	103
February	11,921 (3)	5,071 (5)	100	113
March	6,362 (6)	3,405 (7)	124	133
April	1,251 (5)	3,990 (7)	129	133
May	922 (5)	2,627 (6)	119	120
June	1,052 (4)	1,054 (5)	79	79
July	1,541 (7)	1,054 (5)	104	89
August	3,288 (5)	3,114 (6)	92	101
September	2,484 (4)	1,753 (7)	97	113
October	8,291 (4)	4,436 (7)	108	132
November	10,772 (4)	19,222 (5)	115	112
December	20,071 (4)	31,017 (6)	110	115

Table 2. Comparison of rice and crawfish crop areas in Vermilion Parish in hectares, 2004–2007[1].

Year	Rice	Crawfish
2004	33,700	4,860
2005	30,865*	4,050*
2006	13,580	5,265
2007	19,720	5,670

*There was virtually no second crop rice in 2005 because Hurricane Rita damaged that crop. Much of the crawfish area was adversely impacted by the hurricane storm surge and lack of freshwater to fill ponds.

[1] Source: LSU Ag Center 2004, 2005, 2006, 2007.

to leach accumulated salt from the substrate and/or to produce crops of crawfish. Crawfish production was generally poor for the 2006-07 season even though there was a modest increase in area, 5,670 ha versus 5,265 ha (Table 2, LSU Ag Center 2004, 2007).

By 2007, rice cultivation had recovered to about 19,700 ha—approximately half the area cultivated pre-Hurricane Rita (Table 2). The overall reduction of rice area created, in effect, a significant amount of prairie-type habitat with a major reduction in wetland-type habitat. Shrub and forest habitat was recovering from storm damage by 2007.

The full complement of waterbirds, especially waterfowl, associated with the area in our past survey work was well represented in the fall and winter of the year following Hurricane Rita's passage (2007, Tables 3 and 4). Despite reduction in working wetland habitat, we noted the continued presence of large numbers of scaup, primarily Lesser Scaup, joined by unexpected Redhead (*Aythya americana*) as we had rarely encountered this species in the shallow (15-25 cm deep) fields in past surveys throughout the region. The shorebirds present during spring migration seemed typical with respect to species and numbers.

In contrast to waterfowl, wintering wading birds were clearly impacted immediately following the hurricane because much of the working wetland habitat was dry for lack of rain water to fill fallow fields. Egrets and ibises, usually present in large flocks, were conspicuously absent from the area (Tables 3 and 4).

Numbers of resident, wintering, and neotropical nesting birds, especially passerines such as flycatchers, vireos, jays, crows, and warblers, and woodpeckers (Order Piciformes) were reduced in the 12 month period immediately following Hurricane Rita. Direct mortality of resident birds and damage to shrub and forest habitat probably explains these observations (Tables 3 and 4); however, we did not visit the area in the time frame soon enough after the hurricane to observe storm related mortality. Dobbs (2010) recorded similar responses of this compliment of birds in coastal chenier habitat about 75 km to the southwest of our study site. Habitat damage probably also had a post-hurricane, negative impact on small species of birds present only in winter (e.g., several species of sparrows).

As of 2004, we had classified 22 species as Abundant, 55 species as Common, and 64 species as Uncommon in at least one of the recognized bird seasons of Spring (March-May), Summer (June-July), Fall (August-October), and Winter (November-February) (Table 4). Abundant birds are generally species that form large flocks at various times of year, often in winter (Kaufman 1996, Elphick et al. 2001). These include geese, ibises, shorebirds, swallows, and "blackbirds." We recorded thousands of these birds in both 2004 and 2007.

Abundant bird species accounted for most of the birds recorded in 2004 (86.3 %, N = 335,321) and 2007 (74.2 %, N = 535,945) (Table 3). Among the most abundant species, obvious post-hurricane declines were observed in White-faced Ibis (18.1 % to 5.7 %) and Boat-tailed Grackles (9.2 % to 1.2 %). Overall, more bird species were recorded in 2007 than 2004. However, Abundant species that accounted for 86.3 % of all birds recorded in 2004 only accounted for 74.2% of the birds recorded in 2007. This meant that the numbers of bird species considered to be Common or Uncommon increased by 12%.

Caution is advised when comparing the overall percentage composition of the birds because dramatic increases in some species may reduce the percentage composition of others even though their numbers, on average, have not greatly changed from one period to another. A case in point is the reduced percentage of wading birds from 2004 to 2007. Therefore, we also reported relative percentages of bird species and bird groups (Table 4).

To evaluate possible changes in abundance due to Hurricane Rita, we calculated the 2007 to 2004 ratios of the 125 species of birds identified as Abundant, Common, and Uncommon using the mean number for each year because the number of surveys differed between years (Table 5). We arbitrarily applied the following criteria to the ratios: increasing was >1.10, neutral was 1.10–0.90, and decreasing was <0.90. Thirty-four percent of populations were increasing, 18% were not changing or recovered, and 48% were decreasing (Table 5). The significance of these ratios is emphasized by the increased effort we made in 2007 over 2004. That is, an increase in effort should generate greater numbers and increases in ratios. Thus, the declines reported here are more likely to be significant than they would be if the survey effort been equal for both years.

Wading bird numbers decreased from 2004 to 2007. We feel that this was the result of reduction in working wetland habitat, especially that devoted to crawfish production. In addition, local rookeries may have been disrupted as a consequence of storm-related habitat damage to rookery sites and mortality.

We noted a major increase in the numbers of swallows from 2004 to 2007. Wintering Tree Swallows may have accounted for this increase. Alternatively, this could have been an artifact of the increased number of surveys in 2007.

Conservation Concerns

We found that 51 of the 231 birds recorded in 2007 were ranked by some agency as being of moderate to high conservation concern with four additions from the overall checklist (Table 4; Kushlan et al. 2002, Butcher et al. 2007, Gulf Coast Joint Venture 2007, Huner et al. 2008). Most of those 55 species were waterbirds (n = 40). Twenty-eight were found to be Abundant, Common, or Uncommon in the appropriate season. Four of these were passerines, including the Loggerhead Shrike and Eastern Meadowlark—two common birds that are declining (Butcher and Niven 2007). The conservation status of shorebirds has been an especially worrisome problem for conservation agencies. We recorded 29 species in 2007 and 31 overall. Some 21 of these species are listed as being of moderate to high concern. The reliance on working wetlands by this diverse array of sensitive species stresses the importance of the study area and the greater landscape of working wetlands and riparian forests in the region to bird conservation.

CONCLUSION

Hurricane Rita's effects on the avifauna of the Mouton Cove area, Vermilion Parish, Louisiana, were positive, neutral, and negative in the short term. Short term effects included both habitat alteration as well as direct mortality of resident species. The fauna is rich and diverse and is responding to habitat changes as the agricultural community recovers from hurricane damage to fields and pastures. Crawfish acreage is important to predaceous bird species because it provides a rich food resource of small vertebrates and macro- and micro-invertebrates. This component of the agricultural landscape has recovered (LSU Ag Center 2012). The ricefield component of the agricultural landscape is

showing a movement toward pre-Hurricane Rita production levels but rice has shown an overall reduction in cultivated area region wide over the past decade because of unfavorable economic considerations. We feel that it is important to encourage rice production in our study area and that an increase would benefit all waterbird species. This management recommendation applies especially to wading birds whose numbers declined following Hurricane Rita, apparently because of the loss of shallow water habitat and, perhaps, dislocation of nearby rookeries immediately following the storm.

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Table 3. Pre- and post-Hurricane Rita contributions (%) of Abundant birds by species, to the total number of birds recorded in 2004 (N = 335,321) and 2007 (N = 535,945).

Species	Percent by Year 2004	2007
Greater White-fronted Goose	3.0	1.9
Snow Goose	10.2	10.8
Northern Shoveler	4.2	5.0
Great Egret	0.9	0.7
Snowy Egret	0.6	0.3
Cattle Egret	2.5	1.6
White Ibis	2.5	0.9
White-faced Ibis	18.1	5.7
Black-necked Stilt	1.3	0.5
Lesser Yellowlegs	1.3	1.0
Western Sandpiper	1.5	0.3
Least Sandpiper	0.6	0.9
Dunlin	2.1	1.5
Long-billed Dowitcher	3.3	2.3
Ring-billed Gull	1.2	0.7
Tree Swallow	0.7	1.9
Savannah Sparrow	0.7	0.9
Northern Cardinal	0.4	0.3
Red-winged Blackbird	18.8	29.0
Common Grackle	2.7	4.8
Boat-tailed Grackle	9.2	1.2
Brown-headed Cowbird	0.5	2.0
Totals	86.3	74.2

Taxon	Percent by Year 2004	2007	Change in Contribution
Waterfowl	17.4	17.7	+0.3
Wading Birds	24.6	9.2	-15.4
Shorebirds	10.1	17.2	+7.1
Gulls & Terns	1.2	0.7	-0.5
Swallows	0.7	1.9	+1.2
Sparrows	0.7	0.9	+0.2
Cardinals	0.4	0.3	-0.1
Blackbirds & Allies	31.2	37.0	+5.8

Table 4. Ratios of 2004 versus 2007 survey results for Abundant, Common, and Uncommon species of birds.

Abundance Category	Species	Ratio 2004 to 2007
Abundant	Greater White-fronted Goose, *Anser albifrons*	0.57
	Snow Goose, *Chen caerulescens*	1.27
	Northern Shoveler, *Anas clypeata*	1.00
	Great Egret, *Ardea alba*	0.93
	Snowy Egret, *Egretta thula*	**0.61**
	Cattle Egret, *Bublcus ibis*	0.79
	White Ibis*, *Eudocimus albus*	**0.41**
	White-faced Ibis, *Plegadus chihi*	0.38
	Black-necked Stilt***,** *Himantopus mexicanus*	0.49
	Lesser Yellowlegs, *Tringa flavipes*	0.94
	Semipalmated Sandpiper, *Calidris pusilla*	**1.00**
	Western Sandpiper, *Calidris mauri*	**0.21**
	Least Sandpiper, *Calidris minutilla*	**2.10**
	Dunlin, *Calidris alpine*	**0.56**
	Long-billed Dowitcher, *Limnodromus scolopaceus*	0.88
	Ring-billed Gull, *Larus delawarensis*	0.61
	Tree Swallow, *Tachycineta bicolor*	3.05
	Savannah Sparrow, *Passerculus sandwichensis*	1.08
	Northern Cardinal*, *Cardinalis cardinalis*	0.85
	Red-winged Blackbird*, *Agelaius phoneniceus*	1.86
	Boat-tailed Grackle*, *Quiscalus major*	0.23
	Brown-headed Cowbird*, *Molothrus ater*	4.76
Common	Fulvous Whistling-Duck*, *Dendrocygna bicolor*	0.46
	Gadwall, *Anas strepera*	1.10
	Mallard, *Anas platyrhynchos*	1.13
	Mottled Duck, *Anas fulvigula*	**0.40**
	Blue-winged Teal, *Anas discors*	5.67
	Northern Pintail, *Anas acuta*	**0.80**
	Green-winged Teal, *Anas crecca*	2.18
	Lesser Scaup, *Aythya affinis*	**1.16**
	Neotropic Cormorant, *Phalacrocorax brasilianus*	**2.64**
	Great Blue Heron, *Ardea herodias*	0.75
	Little Blue Heron, *Egretta caerulea*	**0.89**
	Green Heron, *Butorides virescens*	1.43
	Yellow-crowned Night-Heron, *Nycticorax violacea*	**0.75**
	Roseate Spoonbill, *Platelea ajaja*	**1.50**
	Turkey Vulture, *Caragyps atratus*	0.54
	Red-shouldered Hawk*, *Buteo lineatus*	0.96
	American Coot, *Fulica americana*	3.20
	Black-bellied Plover, *Pluvialis squatarola*	0.72
	Semipalmated Plover, *Charadrius semipalmatus*	0.72

Table 4. Continued.

Abundance Category	Species	Ratio 2004 to 2007
Common	Killdeer*, *Charadrius vociferous*	1.36
	Greater Yellowlegs, *Tringa melanoleuca*	**1.00**
	Willet, *Tringa semipalmata*	**1.07**
	Whimbrel, *Numenius phaeopus*	**4.04**
	Ruddy Turnstone, *Arenaria interpres*	**1.80**
	Pectoral Sandpiper, *Calidris melanotos*	0.20
	Wilson's Snipe, *Gallinago delicate*	**0.41**
	Bonaparte's Gull, *Chroicocephalus philadelphia*	**0.12**
	Laughing Gull, *Leucophaeus atricilla*	3.41
	Mourning Dove*, *Zenaida macroura*	2.55
	Chimney Swift, *Chaetura pelagic*	0.89
	Red-bellied Woodpecker*, *Melanerpes carolinus*	1.19
	White-eyed Vireo*, *Vireo griseus*	1.03
	Red-eyed Vireo*, *Vireo olivaceus*	1.03
	Blue Jay*, *Cyanocitta cristata*	0.75
	American Crow*, *Corvus brarchyrhynchos*	0.76
	Fish Crow*, *Corvus ossifragus*	1.10
	Purple Martin*, *Progne subis*	1.75
	Bank Swallow, *Riparia riparia*	1.16
	Carolina Chickadee*, *Poecile carolinensis*	0.83
	Tufted Titmouse*, *Baeolophys bicolor*	0.80
	Carolina Wren*, *Throthorus ludovicianus*	0.87
	Blue-gray Gnatcatcher*, *Polioptila caerulea*	1.29
	Gray Catbird, *Dumetella carolinensis*	0.72
	Northern Mockingbird*, *Mimus polyglottos*	1.02
	European Starling*, *Sturnus vulgaris*	0.72
	Prothonotary Warbler, *Protonotaria citrea*	**2.64**
	Hooded Warbler*, *Setophaga citrine*	0.28
	Northern Parula*, *Setophaga americana*	0.96
	Yellow-rumped Warbler, *Setophaga coronate*	0.94
	White-throated Sparrow, *Zonotrichia albicollis*	1.55
	Indigo Bunting*, *Passerina cyanea*	0.54
	Eastern Meadowlark*, *Sturnella magna*	**1.41**
	Common Grackle*, *Quiscalus quiscula*	2.02
	House Sparrow*, *Passer domesticus*	0.40
Uncommon	Wood Duck*, *Aix sponsa*	1.20
	Ring-necked Duck, *Aythya collaris*	6.50
	Greater Scaup, *Aythya marila*	**1.74**
	Hooded Merganser, *Lophodytes cucullatus*	**0.36**
	Pied-billed Grebe*, *Podilymbys podiceps*	0.36
	Double-crested Cormorant, *Phalacrocorax auritus*	0.27
	Black-crowned Night-Heron, *Nycticorax nycticorax*	**0.35**

Table 4. Continued.

Abundance Category	Species	Ratio 2004 to 2007
Uncommon	Black Vulture, *Coragyps atratus*	1.13
	Mississippi Kite*****, *Ictinia mississippiensis*	1.56
	Sharp-shinned Hawk, *Accipiter striatus*	1.00
	Red-tailed Hawk, *Buteo jamaicensis*	1.02
	King Rail*, *Rallus elegans*	**1.23**
	Sora, *Porzana carolina*	7.00
	Common Gallinule*****, *Gallinula galeata*	0.61
	American Avocet, *Recurvirostra americana*	**2.50**
	Solitary Sandpiper, *Tringa solitaria*	**0.92**
	Buff-breasted Sandpiper, *Calidris subruficollis*	**7.00**
	Herring Gull, *Laurus argentatus*	1.63
	Gull-billed Tern, *Gelochelidon nilotica*	**1.97**
	Forster's Tern, *Sterna fosteri*	**2.20**
	Rock Pigeon*****, *Columba livia*	0.75
	Eurasian Collared-Dove*****, *Streptopelia decaocto*	0.92
	Inca Dove*****, *Columbina inca*	0.76
	Yellow-billed Cuckoo*****, *Coccyzus americanus*	0.98
	Barred Owl*****, *Strix varia*	1.18
	Ruby-throated Hummingbird*****, *Archilochus colubris*	0.83
	Belted Kingfisher, *Megaceryle alcyon*	0.70
	Yellow-bellied Sapsucker, *Sphyrapicus thyroideus*	0.98
	Downy Woodpecker*****, *Picoides pubescens*	0.73
	Pileated Woodpecker*****, *Dryocopus pileatus*	1.57
	American Kestrel, *Falco sparverius*	0.85
	Acadian Flycatcher*****, *Empidonax virescens*	0.51
	Eastern Phoebe, *Sayornis phoebe*	1.45
	Great Crested Flycatcher*****, *Myiarchus nuttingi*	0.67
	Eastern Kingbird*****, *Tyrannus tyrannus*	1.21
	Loggerhead Shrike*, *Lanius ludovicianus*	**0.75**
	Yellow-throated Vireo*****, *Vireo flavifrons*	1.00
	Blue-headed Vireo, *Vireo solitaries*	0.78
	Northern Rough-winged Swallow, *Stelgidopteryx serripennis*	3.29
	House Wren, *Troglodytes aedon*	1.25
	Ruby-crowned Kinglet, *Regulus calendula*	1.55
	Eastern Bluebird*****, *Sialia sialis*	0.45
	Hermit Thrush, *Catharus guttatus*	0.92
	Wood Thrush*****, *Hylocichla mustelina*	0.29
	American Robin, *Turdus migratorius*	0.56
	Brown Thrasher*****, *Taxstoma rufum*	0.83
	American Pipit, *Anthus rubescens*	0.79
	Cedar Waxwing, *Bombycilla cedrorum*	1.55
	Black-and-white Warbler, *Mniotilta varia*	0.56

Table 4. Continued.

Abundance Category	Species	Ratio 2004 to 2007
Uncommon	Tennessee Warbler, *Oreothlypis peregrine*	1.00
	Orange-crowned Warbler, *Oreothypis celata*	0.78
	Common Yellowthroat*****, *Geothlypis trichas*	0.47
	American Redstart, *Setophaga ruticilla*	0.85
	Magnolia Warbler, *Setophaga magnolia*	0.40
	Yellow Warbler, *Setophaga petechia*	2.00
	Pine Warbler, *Setophaga pinus*	0.38
	Yellow-breasted Chat*****, *Icteria virens*	0.75
	Song Sparrow, *Melospiza melodia*	1.00
	Swamp Sparrow, *Melospiza Georgiana*	1.23
	Summer Tanager*****, *Piranga rubra*	0.71
	Blue Grosbeak, *Passerina caerulea*	0.77
	Brewer's Blackbird, *Euphagus cyanocephalus*	2.50
	Orchard Oriole*****, *Icterus spurious*	0.43
	American Goldfinch, *Spinus tristis*	0.55

Bolded – Status of Conservation Concern.
* - Breeder in Area.

Table 5. Comparisons of bird responses based on habitat and/or lifestyle groupings; the 2007 to 2004 ratios of mean numbers of birds. Only bird species recorded as Abundant, Common, or Uncommon are included here. We arbitrarily rate ratios of 1.10 to 0.90 as no change; >1.10 as increasing; and <0.90 as decreasing. Species may contribute to more than one category.

Habitat/Lifestyle Grouping	2007 to 2004 Ratio	Response
Human Associated:	0.78	decreasing
Eurasian Collared-Dove, Blue Jay, Northern Mockingbird, European Starling, Northern Cardinal, and House Sparrow		
Field Associated:	1.63	increasing
Cattle Egret, Turkey Vulture, Red-tailed Hawk, American Kestrel, Killdeer, Mourning Dove, Tree Swallow, Barn Swallow, American Pipit, Savannah Sparrow, Red-winged Blackbird, Eastern Meadowlark, and Brown-headed Cowbird		
Waterfowl:		
15 Species	1.73	increasing
Wading Birds:		
11 Species	0.80	decreasing
Raptors:		
8 Species	1.03	no change
vultures, kites, accipiters, buteos, falcons		
Shorebirds:		
19 Species	1.48	increasing
Gulls and Terns:		
6 Species	1.66	increasing
Doves:		
4 Species	1.25	increasing
Woodpeckers:		
4 Species	1.12	increasing
Corvids:		
3 Species	0.87	decreasing
Swallows:		
5 Species	2.43	increasing
Woodland – Flycatchers, Vireos, Warblers, etc.:		
30 Species	0.84	decreasing
True Sparrows:		
4 Species	1.21	increasing
Blackbirds and Allies:		
7 Species	1.89	increasing

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SHORT COMMUNICATION

American Robin feeds Great Crested Flycatcher nestlings

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Keywords: interspecific feeding, diet, American Robin, *Turdus migratorius*, Great Crested Flycatcher, *Myiarchus crinitus*, cavity nester

Interspecific feeding in birds (i.e., one species of bird feeding another) has been recorded in a wide array of species, including American Robin (*Turdus migratorius*, Shy 1982). Instances of interspecific feeding usually involve one or several of the following circumstances: a mixed clutch; the nest and brood of one species were destroyed; close proximity of nests; food-begging by nestlings or fledglings stimulated another species; temporary or permanent adoption of orphaned birds; a male bird fed another species while his mate incubated; or an unmated bird joined a heterospecific individual or pair with young (Shy 1982).

On 9 June 2010, Larry Savage observed a pair of Great Crested Flycatchers (*Myiarchus crinitus*) carrying food to a gourd nest box on his property. A brief inspection of the gourd's contents revealed six nestlings near fledging age (Figure 1). The gourd was approximately 1.7 m above the ground, hanging under the roof edge of a gazebo in a relatively low-traffic area of the backyard. The location is in western Ouachita Parish in Louisiana, approximate coordinates: 32° 33.2′ N, 92° 13.9′ W. The general region is a developed suburban area with lawns and landscaping, plus numerous large trees and shrubs. The adjoining property nearest the gourd nest was a heavily wooded vacant lot with a closed-canopy forest of 50 – 60 year old pines and hardwoods. The mid-story contained various species including huckleberries (*Vaccinium* sp.), flowering dogwoods (*Cornus florida*), fringe trees *(Chionanthus virginicus*) and paw paws (*Asimina triloba*).

As Larry continued to check on the activities around the gourd, he saw that an American Robin was also visiting the nest. The robin would look into and occasionally partially enter the opening, and on one occasion it was seen removing something from the gourd. Larry reported this activity to me, and we agreed to set up a time to more thoroughly observe this unusual situation as soon as possible.

The goal of our hastily arranged observation efforts was to understand the behavior of the robin, using direct observations of its activities and taking photographs which could be examined later. On 10 June, we mounted a digital SLR camera equipped with an 18 megapixel sensor onto a tripod and set this up near the gourd. A 300-mm lens and a wireless remote

shutter control were attached to the camera. The first photograph was taken at 10:46 AM CDT. Observations and photography continued until 3:05 PM. Of the 519 photos taken, 387 were retained and 132 were deleted because of missed targets, poor focus, or blurring due to motion of the subjects. We photographed activities of both the robin and the flycatchers. Written notes or exact counts of the visits were not taken. The comments, numbers and other data presented here are based on the retained photographs and associated metadata recorded by the camera, and to a lesser extent, on our memories of the occasion. Thus, this report may not include all of the activities that occurred during the period of observation, although it is believed a majority of the visits by flycatchers and the robin are recorded in the retained photos.

By watching the activity at the nest with binoculars and by using the camera review screen to examine the photos of the robin's visits, we were able to ascertain that the robin was usually bringing food items to the nest and leaving without them. In one photograph, the beak of the robin can be seen inserted into the open mouth of a nestling (Figure 2). On one visit, the robin delivered a food item, backed out of the entrance, partially reentered the cavity, and finally withdrew while apparently making swallowing motions. On two visits, the robin approached with no visible food and simply clung to the entrance hole, watching the surroundings or looking into the nest.

Larry had observed on 9 June that the robin seemed to wait until the adult flycatchers were absent before it would go to the nest. That also seemed to be the pattern early in our photography session. Later, however, direct encounters between the flycatchers and the robin occurred, resulting in some interspecific aggression (Figure 3). Initially, one of the flycatchers attacked the robin. The first attack by a flycatcher was recorded at 11:34 A.M. A second attack by a flycatcher on the robin occurred at 11:44 A.M. Then at 1:30 P.M., the robin approached the nest with an offering of earthworms. It attempted to deliver them for the next three minutes. During that time, a flycatcher was photographed attacking the robin four times. The photos do not show whether the worms were finally delivered or if the robin carried them away. Later in the observation period, the robin become more aggressive and on more than one occasion the robin attacked the flycatcher. All of the robin's attacks happened outside the camera's view and were not recorded.

Figure 1. Great Crested Flycatcher adult and nestling, Ouachita Parish, Louisiana.

Figure 2. American Robin feeding Great Crested Flycatcher nestling.

The photographs suggest that two adult Great Crested Flycatchers tended the nest, based on plumage differences. One bird had a noticeably bent rectrix and a slightly bent greater covert in the right wing, whereas the other flycatcher had no obvious feather anomalies. We believe that only one adult American Robin visited the gourd nest. No feather anomalies were

recognized and the color markings observed in the photos were consistent with a single bird. The head of the robin was black and the back and wings were uniformly dark grey, lacking molt limits and retained juvenal plumage, suggesting it was an after-second-year (ASY) male.

The primary goal of these observations, to understand the robin's activities, was accomplished early in the session. When we examined the photos after the session, we were able to extract more information about the number of visits and the nature of the food items that were brought by the parent birds and by the robin. The metadata recorded by the camera for each photograph included a time value to the nearest second. This plus observation of the beak contents of the bird allowed us to identify individual visits with a fair degree of confidence. Using these methods, 38 visits (8.8 visits/hour) by the flycatchers and 11 visits (2.5 visits/hour) by the robin were identified. The flycatchers brought in 13 cicadas (Family Cicadidae), 4 horseflies (Family Tabanidae), 3 grasshoppers (order Orthoptera, suborder Caelifera), three caterpillars (order Lepodoptera), 2 black-winged insects that may have been a species of wasp or fly, 1 green stink bug (*Chinavia halaris*), 1 robber fly (Family Asilidae), 1 brown moth, 1 underwing moth (*Catocala* sp.), and 1 dragonfly (order Odonata, suborder Anisoptera) tail. On three visits, no food was delivered, and on five visits, the bird entered the nest before the camera caught the beak contents. The cicadas were considerably smaller than the "dog day" cicadas (*Tibicen* spp.), which are locally common later in summer.

The robin on two visits brought clusters of earthworms (Class Oligochaeta) to the nest. (Figure 4). During other visits, food items were difficult to identify. One was a badly mangled insect, one appeared to be either a grub or caterpillar, and two items were unidentifiable. On three visits, the robin flew in quickly and placed its head in the opening or turned its head away from the camera, making it impossible to get a look at any prey item. On two visits, it appeared to bring no food item.

Figure 3. Great Crested Flycatcher attacks American Robin at the flycatcher's nest.

Figure 4. American Robin delivering earthworms to the flycatcher's nest.

In twelve photos taken near 12:10 PM, the head and neck of a begging nestling can be clearly seen in the gourd opening. In two photos taken at approximately 3:00 PM, one nestling is perched in the entrance of the gourd (Figure 5). The latter bird was simply sitting in the opening. In each case, the nestling was clearly a flycatcher. No nestling was observed that could have been a robin. When Larry checked the nest on 11 June, it contained no birds. If they fledged, they could have departed after we had ended our observations on 10 June, or they may have fledged on 11 June. They apparently left the immediate area and were not seen again.

Figure 5. Great Crested Flycatcher nestling near fledging age.

Interspecific feeding has been documented in American Robin for both open-cup and cavity nesting species (Shy 1982, McNair and Duyck 1991). Regarding open-cup nesters, American Robins have engaged in interspecific feeding of Mourning Dove (*Zenaida macroura*, Raney 1939), Gray Catbird (*Dumetella carolinensis*, Benton 1961), Brown Thrasher (*Toxostoma rufum*, Warren 1930), House Finch (*Carpodacus mexicanus*, Bailey and Niedrach 1936) and Northern Cardinal (*Cardinalis cardinalis*, Govoni et al. 2009). At least three of these instances involved nest sharing (Shy 1982). McNair and Duyck (1991) observed an American Robin feeding Eastern Bluebird (*Sialia sialis*) nestlings at a nest box. The robin was too large to enter the nest box, so this example did not involve nest sharing. Ours may be the second report of an American Robin engaged in interspecific feeding with a cavity-nesting species (McNair and Duyck 1991), and possibly the first report involving Great Crested Flycatcher as the foster species.

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SHORT COMMUNICATION

Tree Swallow mortality in southwest Louisiana coincident with a winter storm

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Keywords: Tree Swallow, *Tachycineta bicolor*, nest box, mortality, weather, cold snap

Tree Swallows (*Tachycineta bicolor*), common cavity seeking birds that tend to use nest boxes for roosting and nesting sites, have been found to inhabit coastal areas of Louisiana during the overwintering period (Lowery 1974). Tree Swallows typically prefer foraging for flying insects over water. Environmental conditions, and cold temperatures in particular, have been known to compromise this foraging strategy by reducing insect abundance, therefore resulting in minimal foraging opportunities for this species (Weatherhead et al. 1985, Hess et al. 2008, Winkler et al. 2013). Although previous studies have focused on the influence of insect abundance on body condition in these aerial insectivores within their breeding range, our observations provide insight into swallow mortality in an overwintering area.

Weatherhead et al. (1985) focused their study on the mortality risk associated with clustering for thermally stressed swallows. They found that sudden climatic change influenced mortality rates of swallows due to foraging habits being subdued, therefore reducing body condition and the ability to thermoregulate. Hess et al. (2008) also documented mortality of 216 Tree Swallows in western New York due to a period of unseasonably cold temperatures in the spring of 2007. Furthermore, Winkler et al. (2013) documented the influence of climate change on food supply and fledgling production in Tree Swallows. Winkler et al. found that cold temperatures below the critical temperature of 18.5 °C, within the breeding range of the Tree Swallow, have a major impact on fledgling production and daily brood survival rates.

During the monitoring of Wood Duck (*Aix sponsa*) boxes located throughout the White Lake Wetlands Conservation Area, Vermilion Parish, Louisiana, we incidentally

observed Tree Swallow mortality. We conducted weekly box inspections for nesting Wood Ducks for two consecutive years, from early spring throughout summer, monitoring 20 Wood Duck boxes in 2013 and 44 in 2014. Habitat within the study site consists primarily of freshwater marsh, heavily wooded spoil banks, and adjacent agricultural lands. Vast, open bodies of water around the study site consist of oil and gas location canals and White Lake, which is approximately five miles to the south.

From 18–20 February 2014, we observed a total of 57 dead Tree Swallows in 16% of Wood Duck boxes (N = 44): three boxes contained one dead swallow, two boxes contained two, one box contained three, and another box contained 47 dead swallows (Figure 1). We did not necropsy the specimens. We never observed Tree Swallow using the boxes until the mortality event in February 2014.

A late-winter storm bringing high winds, freezing rain and a dramatic drop in temperatures swept across coastal Louisiana approximately five days before we conducted our weekly check on the Wood Duck boxes. Temperatures remained at a mean temperature of 0°C for approximately 61 hours between 10 and 13 February 2014. We suspect that Tree Swallows responded to the dramatic decrease in temperature by huddling within the Wood Duck boxes, and that the swallows died there due to several days of freezing temperatures and a lack of foraging opportunities. Our observations suggest that harsh late-winter storms in overwintering areas of southwestern Louisiana pose a potential threat for aerial insectivores such as Tree Swallows.

Figure 1. Tree Swallow mortality probably due to freezing temperatures and associated reduced foraging opportunities at White Lake Wetlands Conservation Area on 20 February 2014. Photo credit: Schuyler F. Dartez.

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SHORT COMMUNICATION

First successful Great Kiskadee nest documented in Louisiana

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Keywords: Great Kiskadee, *Pitangus sulphuratus*, breeding record, Calcasieu Parish, Louisiana

The Great Kiskadee (*Pitangus sulphuratus*) is a large, resident flycatcher that ranges throughout much of the New World tropics and subtropics. Its distribution extends from central Argentina in the south to its northern breeding limits in south Texas (Brush and Fitzpatrick 2002). Although the first definitive Louisiana record dates back to a specimen collected in 1930, Great Kiskadees were found infrequently until the past decade (Lowery 1974, Dittmann et al. 1998). In fact, after no Louisiana records between 1978 and 1992, only four birds were found between 1992 and 2005 (Stedman 1993, Muth 1993, Dittmann et al. 1998, Cardiff 1999, Cooley 2004). We provide the first evidence of a pair of Great Kiskadees nesting successfully in Louisiana and, to the best of our knowledge, in the United States outside of Texas.

On April 28, 2015, CLR received word that birders Tom and Jane Clay had recently seen a single Great Kiskadee at the Hidden Ponds RV Park in Sulphur, Calcasieu Parish, roughly 10 miles west of Lake Charles, Louisiana. Interestingly and unbeknownst to us at the time, there had already been a prior report submitted to the Louisiana Bird Records Committee of an apparent adult Great Kiskadee at this location from February 4–5, 2013 (Dittmann and Cardiff 2015). SRW and CLR visited the site on May 5, 2015, and observed a Great Kiskadee near the entrance to the campground (Figure 1). Much to their surprise, a second individual joined the first and proceeded to bring food to a nest. Straddling the boundary between a rural suburban neighborhood and a sparsely vegetated recreational vehicle campground,

the apparent territory consisted of numerous concrete campsites, two rather large slender ponds, and trees that surround the ponds and campground. The birds also commuted between the campground and the mature deciduous trees on the properties of neighboring homeowners, which bordered the recreational vehicle park to the south of Ravia Road.

Figure 1. An adult Great Kiskadee perched in the nest tree after it was observed feeding the nestlings and removing a fecal sac. Photo credit: Cameron Rutt (5 May 2015).

The nest was 12 m high in the center of a 15.5 m tall southern live oak (*Quercus virginiana*) that stands over the main entrance to the park off of Ravia Road (30° 11' 28.6296" N, 93° 21' 16.1964" W). The bulky, globular nest was situated within a sturdy fork near the center of the uppermost branches of the tree's crown. The exterior of the nest primarily consisted of Spanish moss (*Tillandsia usneoides*), but also included fine, dried grasses (particularly around the entrance and over the roof of the nest), vine tendrils, frayed rope, and a small swatch of fish netting (Figure 2). The large, mature nest tree also provided several perches which the adults appeared to use for sentinel purposes, to dispatch food items prior to feeding nestlings, and to deposit fecal sacs after departing the nest.

Figure 2. Adult feeding nestlings; showing the location, structure, and composition of the nest. Photo credit: Cameron Rutt (5 May 2015).

TJF and BJ monitored the nest daily (except for on May 9) from May 7–15, 2015 to determine the contents and outcome of the nest. We first observed a nestling on May 10 and on May 12 photographs revealed that the nest contained at least three nestlings. During the afternoon and evening of May 13 (Figure 3), the nestlings appeared "anxious" and "brazen," at times sitting on the edge of the nest and stretching their wings at the nest opening (D. Bosler personal communication).

By 0750 hours on May 14 – nine days after the nest was discovered – all three young had fledged and were observed and photographed perched in the nest tree (Figures 5 and 6). However, we lost sight of the kiskadee family after mid-morning on May 14 and could not find them on the morning of May 15. We last observed the fledglings on May 20, when TJF found them

Figure 3. Two (of three) advanced nestlings are visible at the edge of the nest cup on the day before fledging. Photo credit: Thomas Finnie (13 May 2015).

perched in a live oak adjacent to the nest tree. Subsequent visits to the park indicated that the kiskadees were using the same nest for a second brood, and food was observed being delivered to nestlings as early as June 24 (BJ) and again on June 28 (R. Dobbs personal communication). It is unknown whether this second nesting attempt also succeeded in fledging offspring.

During the initial nest observation, SRW and CLR observed the nest continuously for approximately 35 min while the adults completed five feeding trips and removed fecal sacs. The identified food items included three Green Treefrogs (*Hyla cinerea*; Figure 4) and dry, commercial dog food. Of the eight additional identified food items brought to the nestlings/fledglings on subsequent days, there were three frogs, one Green Anole (*Anolis carolinensis*), one arthropod, two deliveries of dry dog food, and a Northern Brown Snake (*Storeria dekayi*) that an adult dispatched but then dropped and fell to the ground and was not observed being fed to the young. The published food habits of the Great Kiskadee illustrate that these are highly opportunistic birds, and, although they predominantly eat arthropods and small vertebrates, they have been reported to consume dog food (Brush and Fitzpatrick 2002).

Figure 4. One of three Green Treefrogs (*Hyla cinerea*) fed to the nestlings during the initial 35-minute nest observation. Photo credit: Cameron Rutt (5 May 2015).

Figure 5. All three fledglings perched in the nest tree on the morning that they fledged. Photo credit: Thomas Finnie (14 May 2015).

Prior Breeding Evidence in Louisiana

Lowery (1974) reported that the species nested at Gum Cove, Cameron Parish, and that a nest was built in Hackberry, Cameron Parish, in 1968, although no outcome was reported for the former nest and only a single bird was observed attending the latter nest. More recently, a single Great Kiskadee constructed a nest in the cross arm of a utility pole south of Venice, Plaquemines Parish, during the summer of 1999, but like the aforementioned Hackberry bird, a pair was never observed (Dittmann and Cardiff 2003, B. Mac Myers III personal communication). Presumably this same Venice bird returned the following year (2000) and built another nest at this location (B. Mac Myers III personal communication); after an apparent hiatus during which no nest was found (2001), two years later (2002), a kiskadee was again present with a nest at Venice (Purrington 2001, S. W. Cardiff personal communication). Additionally, a pair was found with a nest at Nunez Woods (Cameron Parish) in May 2009. However, this nest was later presumed to be abandoned (June/July 2009). Although a second nest was discovered on July 26, this nest, too, appeared to have been abandoned as it was found damaged on the subsequent visit (Dittmann 2010). Furthermore, there was no ensuing indication of fledglings as only a pair of molting adults was observed at Nunez Woods in early to mid-September (Dittmann 2010). In addition to the pair at Nunez Woods, the most promising location for successful breeding has been White Lake Wetlands Conservation Area, Vermilion Parish, where one or more kiskadees have been present since 2009 (Dittmann 2012, eBird 2015). A pair was found with a nest on April 7, 2011 and one of these birds, presumably the female, entered the nest and remained there for more than an hour, possibly indicating incubation or brooding (Dittmann 2012, Toddy Guidry personal communication). Notably, three birds have been reported there on multiple occasions: April 16, 2011 by Caroline Duffie and February 16, 2012 by Bill Baddley (eBird 2015). However, neither Michael Seymour (personal communication), the nongame avian biologist at the Louisiana Department of Wildlife and Fisheries (LDWF), nor Schuyler Dartez (personal communication), one of the LDWF site managers, could confirm whether this pair had fledged offspring. Restricted site access has likely limited the ability of birders and biologists to adequately monitor this pair's breeding efforts.

Figure 6. An adult feeds dry dog food to one of the newly-fledged offspring. Photo credit: Thomas Finnie (14 May 2015).

Great Kiskadees have undergone a range expansion during the past century following human alteration of habitats in South America, Central America, and northward into Texas (Brush and Fitzpatrick 2002). Confirmed breeding attempts at the frontier of their Texas range during the end of the last century suggested that the species' northern limits continued to advance (Brush and Fitzpatrick 2002). Likewise, the surge of sightings in Louisiana during the past nine years – the entire state had only 8 records prior to 2006 (Cardiff 2007, Dittmann 2012, Dittmann and Cardiff 2015) – and multiple breeding attempts (6 locations), culminating with the successful nesting attempt described here, provide further evidence that a northward range expansion may be occurring. Indeed, this species may be poised to colonize the state as a regular breeder, at least in small numbers in southwestern Louisiana.

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SHORT COMMUNICATION

First record of Ladder-backed Woodpecker (*Picoides scalaris*) from Louisiana

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Keywords: Ladder-backed Woodpecker, *Picoides scalaris*, Louisiana, extralimital

On 14 May, 2011, David Muth, B. Mac Myers III, Dave Patton, R. Dan Purrington, Curt Sorrells, Phillip Wallace, and I were birding coastal woods in extreme southwestern Cameron Parish, Louisiana. The site, unofficially known as the "Lighthouse Woods," is about 15 km WSW of the town of Johnsons Bayou, Louisiana, less than 1 km east of the Sabine River, and about 3 km north across marsh from the Gulf of Mexico. Lighthouse Woods is on a slightly elevated area surrounded by miles of marsh. The plant community is typical of coastal spoil bank woods, with hackberry (*Celtis laevigata*) the dominant tree species, and prickly pear cactus (*Opuntia* sp.), giant ragweed (*Ambrosia trifida*), and gaura (*Gaura lindheimeri*) dominating the understory and open areas. Lighthouse Woods had recently suffered hurricane damage and most of its trees had dead limbs.

After thoroughly surveying Lighthouse Woods for about two hours, we noted a woodpecker flying to the southwest along the edge of the woods. This was notable because we had not seen a woodpecker in these woods yet that day, nor could I recall having seen one there for several years. The bird landed in the woods where we were all able to view it. Myers, Patton, Purrington, and I photographed it, and Wallace videotaped it. Several observers heard the bird call in response to playback of Ladder-backed Woodpecker (*Picoides scalaris*) calls. Within minutes, the bird resumed its path to the southwest, moving to a patch of woods surrounded by marsh on the east bank of the Sabine River. We could not access these woods, and we did not see or hear the bird again.

The size of the woodpecker was difficult to assess in isolation, but my perception was

that it was larger than Downy Woodpecker (*Picoides pubescens*). Wavy lateral black and white barring extended from the base of the nape onto the mantle (Figure 1). The white and black bars were roughly equal in width. The flight feathers of the wings had similar striping (Figures 1, 3). The central rectrices were black, whereas the outer rectrices were distinctly and evenly barred black and white. The somewhat dingy white underparts were weakly spotted or barred on the flanks (Figure 2).

Figure 1. Dorsal view of woodpecker. Photo credit: Paul Conover.

The bird's head was white with black and red markings (Figures 1, 2). The forecrown was black, joining a bright red mid- and hindcrown whose leading edge was about even with the position of the eye. Distally, the red area was joined by a black stripe that ran down the center of the nape to the barred mantle. White speckles were mixed into the red of crown. The auriculars were blackish, and a white rictal stripe separated the blackish auriculars from a black malar stripe that extended back to about the rear edge of the auriculars (Figure 2). The black auricular and malar stripes were not connected along their rear edge, although there was slight black flecking between their distal ends. The supercilia were white and about as wide as the auricular, rictal, and malar stripes. There was a pale yellowish or buffy tuft at the base of the bill. The black bill appeared longer than in Downy Woodpecker.

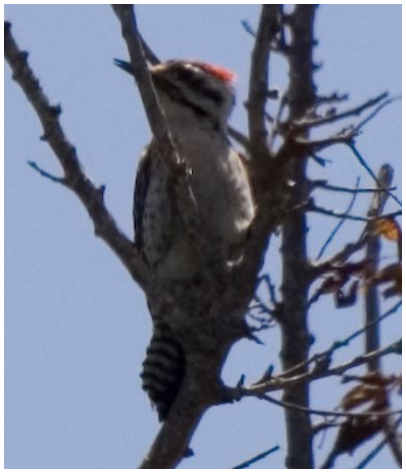

Figure 2. Ventral view and facial pattern of woodpecker. Photo credit: Paul Conover.

The shape and relative length of the reduced 10th primary (Figure 3) and the molt schedule of this species (Pyle 1997) indicate that the bird was an adult in at least in its second calendar year. The extensive red on the crown indicates that it was male (Pyle 1997, Dunn and Alderfer 2011).

The only local woodpeckers that approach this bird in general color and pattern are Downy Woodpecker and Hairy Woodpecker (*Picoides villosus*). Both lack a solidly ladder-barred mantle, instead having large solid white areas dorsally. Nuttall's Woodpecker (*Picoides nuttallii*), a West Coast species, differs only subtly from Ladder-backed in having a broad black bar where the nape meets the mantle, spotted rather than barred outer rectrices, broader black auricular, and white nasal tuft and

whiter underparts in most cases (Short 1971, Dunn and Alderfer 2011).

Figure 3. Bird in flight. Note the size and shape of the reduced 10th primary. Photo credit: Dave Patton.

Myers described the voice of the bird as "lower than Downy, different from Hairy" in his report to the Louisiana Bird Records Committee. This description agrees with the description of the Ladder-backed call by Sibley (2000).

With out-of-range species, possible hybridization can complicate identification. Although hybridization of Ladder-backed with other *Picoides* woodpeckers is known, it is restricted to the few small areas or habitats where these species are sympatric (Short 1971, Lowther 2001). Ladder-backed hybridizes occasionally with Nuttall's Woodpecker (Lowther 2001), and hybridization with Hairy Woodpecker has been reported once (Miller 1955, Lowther 2001). The only published report of a putative hybrid with Downy Woodpecker, a sight record from Austin, Texas, may have simply been a molting juvenile Downy Woodpecker (Sexton 1986). However, photos from Lafitte's Cove, Texas, appear to show Ladder-backed X Downy Woodpecker hybrids (S. Kroeger personal communication 2014). In terms of physical appearance, known or suspected Ladder-backed hybrids show characters intermediate between suspected parent species (Short 1971).

All characters of the Cameron Parish bird were consistent with pure Ladder-backed Woodpecker. Only one character, the lack of a rear connection between the black auricular and malar stripes, was not entirely typical of field guide descriptions. However, a somewhat similar pattern is shown for the adult male in the National Geographic field guide (Dunn and Alderfer 2011), and an internet review of Ladder-backed Woodpecker images from areas where Ladder-backed is the only resident *Picoides* woodpecker reveals a number of images of birds with similarly weak facial patterns. *The Birds of North America* description states that malar and auricular regions are "usually connected" (Lowther 2001).

Ladder-backed Woodpecker is a non-migratory resident species that occupies a wide range in North America from southwestern Kansas and southeastern Colorado and Utah in the north, south to Nicaragua, west to central California, and east to east-central Texas (Lowther 2001). The breeding range of Ladder-backed Woodpecker in Texas extends east to Matagorda County on the Gulf coast (Lowther 2001, Tizard 2006). In Texas, breeding dates for the species extend from April 22 to June 22 (Tizard 2006). Thus, our observation occurred during the Texas nesting season.

Whether the breeding range of Ladder-backed Woodpecker is expanding is unclear. Breeding bird atlas data suggest that the range of the Ladder-backed Woodpecker in Texas remained stable between that reported by Oberholser (1974) and atlas data through 1992 (Tizard 2006), although Lockwood and

Freeman (2014) report possible range expansion northeastward along the Gulf coast. Long-term climate change leading to a drier climate has been given as a cause for a possible expansion in California (Unitt 2004) and Texas (Rappole et al. 2007).

The Cameron Parish sighting may have been related to the unprecedented drought that gripped Texas in 2010-2011. The period from October 2010 through September 2011 surpassed the previous record for low rainfall set in 1956 (Nielsen-Gammon 2011).

The Ladder-backed Woodpecker exhibits a limited pattern of short-distance extralimital movement. In California the species has been reported north and west of its breeding range in fall and winter (Jongsomjit and Arata 2008). There are several Kansas records outside of the resident range of the species, including an extraordinary record of a bird that apparently remained on site for 7 years almost 500 km from the nearest known nesting area (Johnson 2008). Additionally, there have been a growing number of extralimital records of individual birds along the Upper Texas Coast at least as far east as Galveston County (Lockwood et al. 2007), a straight-line distance of about 120 km from Louisiana.

This sighting of an adult male Ladder-backed Woodpecker in Cameron Parish represents the first record of the species for Louisiana and evidently the easternmost U.S. record for the species.

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