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## SHOREBIRD AND LARID USE OF MUDFLATS AT LAKE OKEECHOBEE, FLORIDA, DURING DROUGHT CONDITIONS

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**Abstract.**—Few data have been published on the use of mudflats in Lake Okeechobee, Florida by shorebirds, larids, or other birds. In five airboat surveys along the northwestern shore of the lake during drought conditions in mid-2007, we observed 24 species of shorebirds and 11 species of larids, with a maximum one-day total of more than 20,000 individuals. Among these observations were several that represented first reports for Lake Okeechobee and/or Okeechobee County.

At approximately 187,000 ha, Lake Okeechobee is the largest lake in the southeastern United States. It is managed for multiple purposes, among these water storage for flood relief, water supply for agriculture and millions of residential customers, recreation, and as wildlife habitat. Management is facilitated by the Central and Southern Florida for Flood Control and Other Purposes (C&SF) project, a vast network of canals, water control structures, and levees, including the 240-km-long Herbert Hoover Dike that encircles the lake (Steinman et al. 2002). The C&SF project grants agencies a great amount of latitude over management of the lake's water levels, but conflicts between management goals create constraints often contrary to "natural" ecological functioning.

Lake Okeechobee provides large areas of wildlife habitat. About 38,000 ha of littoral-zone marshes fringe the lake, and these have been

deemed large enough to support regionally significant populations of wading birds (Smith et al. 1995). Extreme weather patterns periodically overwhelm C&SF management goals, creating widely fluctuating water levels. Lake Okeechobee recently has experienced both high-water and low-water impacts to the littoral zone. These severe fluctuations in water levels have reduced fish stocks (Johnson et al. 2007), extirpated the Snail Kite (*Rostrhamus sociabilis*) as a breeding species (Bennetts et al. 2002), and limited use of the lake by waterfowl and other aquatic birds (David 1994, Havens and Gawlik 2005).

In the absence of volatile weather, C&SF management goals enacted in 2000 maintain water levels deeper than those needed to provide optimal wildlife habitat (LOLZTAG 1988, Johnson et al. 2007). Approximately 95% of the rooted aquatic vegetation in the lake grows at lake-bottom elevations between 3.4-4.6 m NGVD (National Geodetic Vertical Datum, i.e., elevation above mean sea level) and optimal water level range is generally considered between 3.7 to 4.6 m NGVD (Johnson et al. 2007). However, the highest planned water levels were 4.7-5 m NGVD in October (the end of the wet season in south Florida), flooding the shallowest areas of the littoral zone with 15-45 cm of water. The lowest planned water levels were 4.0-4.7 m in May (the end of the dry season), exposing no more than 19% of the marsh area (USACE 1999). These target water levels kept most of the marsh inundated for long periods, which greatly restricted available habitat for shorebirds and other mudflat specialists.

Although a moderate-sized body of literature exists for use of Lake Okeechobee habitats by waterfowl, wading birds, and Snail Kites, there are few data for use by shorebirds and larids (see Havens and Gawlik 2005 for summaries). An 18-month wildlife survey of Lake Okeechobee between May 1997 and November 1998 (USACE 1999) detected only 12 species of charadriiforms: one plover (two individuals); six sandpipers (maximum of 111 individuals), two gulls (maximum of seven individuals), and three terns (maximum of 26 individuals). Water levels were maintained at or above 4.0 m, flooding more than 80% of the littoral zone during this period.

Due to drought conditions during 2006 and 2007, water levels in Lake Okeechobee dropped to a record low of 2.7 m in July 2007, and reduced the size of the lake to only 118,500 ha (SFWMD 2008). The drought exposed the entire littoral zone and portions of the unvegetated lake bottom, and some of these habitats remained unflooded for several months. In this note, we document use of these ephemeral habitats for foraging, roosting, or breeding by large numbers of shorebirds and larids.

#### METHODS

We surveyed Lake Okeechobee one day per month, April-August 2007. PNG and BP participated on all five surveys, while JWT and GRS missed one or two surveys each. Sur-

veys were restricted to the northwestern portion of the lake in Okeechobee County, from Taylor Creek to Tin House Cove (Glades County), and were always within 6 km of the Herbert Hoover Dike (Fig. 1). The primary survey sites were around Eagle Bay Island and islands off the mouth of the Kissimmee River (the latter are normally inundated year-round), but we surveyed other flats and coves along the shoreline as time and conditions allowed. We used a portable GPS (Global Positioning System) unit to map our survey routes. Sites were surveyed from the airboat and on foot. We concentrated on shorebirds and larids, but we recorded other significant bird observations as encountered. We searched Stevenson and Anderson (1994) and the Field Observations reports in *Florida Field Naturalist* (1992-2007) to determine which observations were “new” to Lake Okeechobee and/or Okeechobee County. We obtained water levels at Lake Okeechobee from SFWMD (2008) for each of our survey days (Table 1).

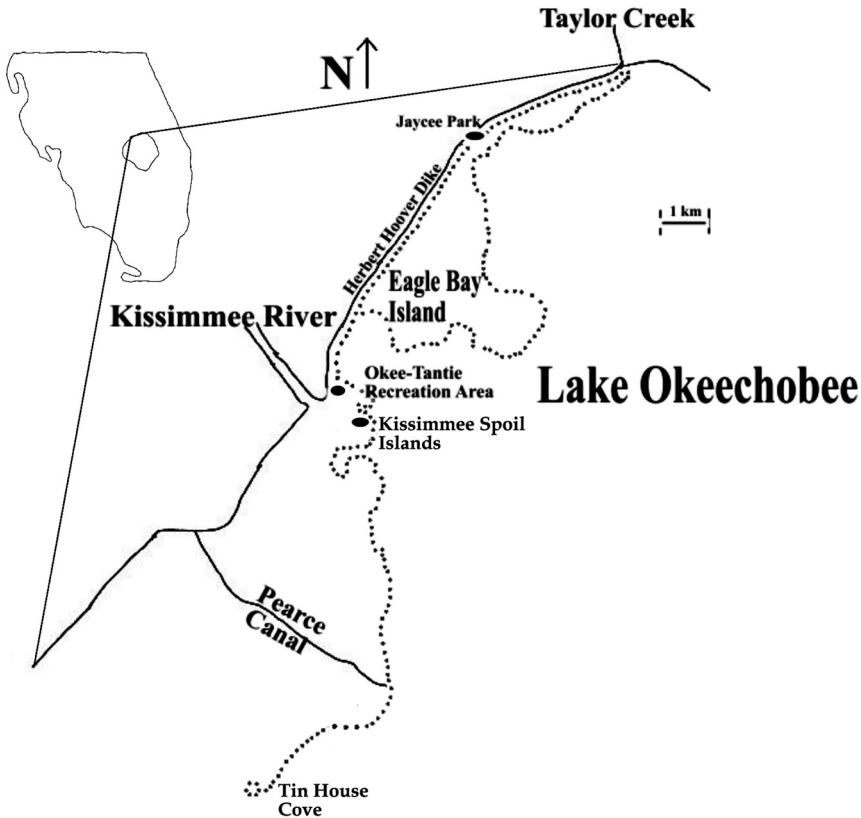


Figure 1. Northwest shore of Lake Okeechobee in Okeechobee County, Florida, showing general airboat routes (dotted lines) during bird surveys, April-August 2007. Most routes ranged from 40-50 km and generally followed “shore-lines” and adjacent flats, varying with water levels and the amount of unvegetated habitats available.

Table 1. List of shorebirds, larids, and selected other species found during surveys of the northwestern portion of Lake Okeechobee, Okeechobee County, Florida, April-August 2007. We did not record numbers of American Coots on 13 April (only). \*Species for which breeding was confirmed. Numbers of Black-necked Stilts and Least Terns in parentheses refer to chicks observed on 8 June. The survey on 27 July was severely truncated due to airplane engine problems. We provide water levels of Lake Okeechobee for each of our survey days.

Species	13 Apr	8 May	8 Jun	27 Jul	19 Aug
Blue-winged Teal ( <i>Anas discors</i> )	—	—	—	—	5
Lesser Scaup ( <i>Aythya affinis</i> )	—	—	1	—	—
American White Pelican ( <i>Pelecanus erythrorhynchos</i> )	64	—	10	—	—
Roseate Spoonbill ( <i>Platalea ajaja</i> )	—	—	—	65	—
American Coot ( <i>Fulica americana</i> )	n/c	5	1	—	—
Limpkin ( <i>Aramanus guarauna</i> )	—	—	—	—	3
Black-bellied Plover ( <i>Pluvialis squatarola</i> )	53	265	2	—	—
Semipalmated Plover ( <i>Charadrius semipalmatus</i> )	51	251	10	—	2
Killdeer ( <i>Charadrius vociferus</i> )	—	4	8	8	3
*Black-necked Stilt ( <i>Himantopus mexicanus</i> )	238	406	235 (31)	149	235
Spotted Sandpiper ( <i>Actitis macularius</i> )	—	18	—	1	5
Solitary Sandpiper ( <i>Tringa solitaria</i> )	—	—	—	1	2
Greater Yellowlegs ( <i>Tringa melanoleuca</i> )	131	25	74	113	19
Willet ( <i>Tringa semipalmata</i> )	—	1	—	—	1
Lesser Yellowlegs ( <i>Tringa flavipes</i> )	630	49	—	60	305
Yellowlegs species ( <i>Tringa</i> spp.)	185	44	—	305	425
Ruddy Turnstone ( <i>Arenaria interpres</i> )	—	10	—	—	—
Red Knot ( <i>Calidris canutus</i> )	1	1	—	—	—
Sanderling ( <i>Calidris alba</i> )	—	2	—	—	—
Semipalmated Sandpiper ( <i>Calidris pusilla</i> )	17	21	110	—	43
Western Sandpiper ( <i>Calidris mauri</i> )	3	—	1	4	10
Least Sandpiper ( <i>Calidris minutilla</i> )	600	156	2	3	130
*Peep* species ( <i>Calidris</i> spp.)	16,000	6650	—	21	48
White-rumped Sandpiper ( <i>Calidris fuscicollis</i> )	—	3	2	—	—

Table 1. (Continued) List of shorebirds, larids, and selected other species found during surveys of the northwestern portion of Lake Okeechobee, Okeechobee County, Florida, April-August 2007. We did not record numbers of American Coots on 13 April (only). \*Species for which breeding was confirmed. Numbers of Black-necked Stilts and Least Terns in parentheses refer to chicks observed on 8 June. The survey on 27 July was severely truncated due to airplane engine problems. We provide water levels of Lake Okeechobee for each of our survey days.

Species	13 Apr	8 May	8 Jun	27 Jul	19 Aug
Pectoral Sandpiper ( <i>Calidris melanotos</i> )	1	—	—	—	32
Dunlin ( <i>Calidris alpina</i> )	21	10	—	—	—
Stilt Sandpiper ( <i>Calidris himantopus</i> )	455	17	—	—	—
Buff-breasted Sandpiper ( <i>Tryngites subruficollis</i> )	6	—	—	—	—
Short-billed Dowitcher ( <i>Limnodromus griseus</i> )	—	—	7	—	1
Long-billed Dowitcher ( <i>Limnodromus scolopaceus</i> )	1180	—	—	—	—
Dowitcher species ( <i>Limnodromus</i> spp.)	—	40	1	—	64
Wilson's Snipe ( <i>Gallinago delicata</i> )	1	—	—	—	—
Red-necked Phalarope ( <i>Phalaropus lobatus</i> )	—	1	—	—	—
Laughing Gull ( <i>Larus atricilla</i> )	14	10	20	2	53
Bonaparte's Gull ( <i>Larus philadelphia</i> )	1	—	—	—	—
Ring-billed Gull ( <i>Larus delawarensis</i> )	30	17	4	1	5
Herring Gull ( <i>Larus argentatus</i> )	73	—	—	—	—
Lesser Black-backed Gull ( <i>Larus fuscus</i> )	2	—	—	—	—
*Least Tern ( <i>Sterna antillarum</i> )	14	13	20 (2)	65	34
Gull-billed Tern ( <i>Gelochelidon nilotica</i> )	2	1	—	—	1
Caspian Tern ( <i>Hydroprogne caspia</i> )	24	11	1	—	2
Black Tern ( <i>Chlidonias niger</i> )	—	—	—	—	13
Forster's Tern ( <i>Sterna forsteri</i> )	18	10	3	1	8
Black Skimmer ( <i>Rynchops niger</i> )	1000	124	169	—	—
Belted Kingfisher ( <i>Ceryle alcyon</i> )	—	—	—	1	—
*Gray Kingbird ( <i>Tyrannus dominicensis</i> )	—	—	—	5	2
Water Level (in meters) NGVD	2.80	2.90	2.74	2.85	3.07

**Table 1. (Continued) List of shorebirds, larids, and selected other species found during surveys of the northwestern portion of Lake Okeechobee, Okeechobee County, Florida, April-August 2007. We did not record numbers of American Coots on 13 April (only). \*Species for which breeding was confirmed. Numbers of Black-necked Stilts and Least Terns in parentheses refer to chicks observed on 8 June. The survey on 27 July was severely truncated due to airboat engine problems. We provide water levels of Lake Okeechobee for each of our survey days.**

Species	13 Apr	8 May	8 Jun	27 Jul	19 Aug
Total Shorebirds	19,573	7974	442	665	1485
Total Individuals (of species included here)	20,751	8165	660	805	1606

## RESULTS

We spent a total of 28 hours in five days surveying aquatic birds at Lake Okeechobee. Surveys lasted 4-9 hours and covered 40-50 linear km each, except on 27 July, when airboat engine problems limited the survey to 100 minutes. Survey effort varied according to water conditions, bird abundance, and the amount of unvegetated habitats available. Extensive mudflats were present during our first three surveys, but nearly all of these flats were covered by 1-2-m tall vegetation by 27 July and 19 August. We present data for 43 bird species and three species-groups, with shorebirds accounting for 24 species and larids 11 species. We observed several species that are rare inland, such as the Willet, Red Knot, Buff-breasted Sandpiper, Red-necked Phalarope, Lesser Black-backed Gull, and breeding Gray Kingbird (scientific names are presented in Table 1). Owing to the paucity of shorebird and larid reports in the region, we documented 10 "firsts" for Okeechobee County and six "firsts" (plus two breeding "firsts") for Lake Okeechobee.

We provide details for noteworthy sightings; a *report* is any observation, while a *record* is documented by photographic evidence (ph.) taken by BP. We copied our digital photos onto a compact disk sent to the Florida Ornithological Society Archives (FOSA 132) at the Florida Museum of Natural History, Gainesville.

**Lesser Scaup:** one adult male at Eagle Bay Island 8 June (ph.) was presumed to be a hunting cripple; PNG often saw this bird during spring and summer 2007.

**Roseate Spoonbill:** a flock of ca. 65, with no adults in alternate plumage, roosted off the mouth of Taylor Creek 27 July (ph.).

**Semipalmated Plover:** observed at Eagle Bay Island (ph.) and south of the Kissimmee River on every survey except 27 July, with as many as 251 birds 8 May; these furnished the first reports and records for Okeechobee County.

**Black-necked Stilt:** common breeding resident (ph.), with >100 observed each day.

**Willet:** singles in basic plumage, presumably of the western subspecies *inornatus* due to the inland location, south of the Kissimmee River 8 May (ph.) and at Eagle Bay Island 18 August (ph.) furnished the first records for Okeechobee County.

**Red Knot:** one in basic plumage at Eagle Bay Island 13 April and one in alternate plumage south of the Kissimmee River 8 May furnished the first reports for Okeechobee County.

**Sanderling:** two in basic plumage at Eagle Bay Island 8 May furnished the first report for Okeechobee County and Lake Okeechobee.

**Western Sandpiper:** as many as 10 observed at Eagle Bay Island on four surveys furnished the first reports for Okeechobee County.

**White-rumped Sandpiper:** three at Eagle Bay Island 8 May and two there 8 June furnished the first reports for Okeechobee County.

**Pectoral Sandpiper:** one at Eagle Bay Island 13 April, and 16 there 19 August furnished the first reports for Okeechobee County.

**Dunlin:** a flock of 17, with some molting into alternate plumage, at the mouth of the Kissimmee River 13 April (ph.), and 10 mostly in alternate plumage south of there 8 May (ph.) furnished the first records for Lake Okeechobee.

**Stilt Sandpiper:** many of the 455 at Eagle Bay Island 13 April were molting into alternate plumage.

**Buff-breasted Sandpiper:** one single and a flock of five—presumed to be different individuals—including one engaged in courtship display at Eagle Bay Island 13 April (Fig. 2) furnished the first record for Okeechobee County and Lake Okeechobee. Furthermore, the courtship display had apparently never been observed previously in Florida.



**Figure 2.** Two Buff-breasted Sandpipers, including one in courtship display, at Lake Okeechobee, Okeechobee County, Florida on 13 April 2007. The courtship display has apparently never been observed previously in Florida. Photograph by Bill Pranty.



- Long-billed Dowitcher:** 1180 in alternate plumage 13 April furnished the first report for Lake Okeechobee!
- Red-necked Phalarope:** one female in alternate plumage at Eagle Bay Island 8 May furnished the first report for Okeechobee County and Lake Okeechobee.
- Lesser Black-backed Gull:** one adult and one in third-summer plumage at Eagle Bay Island 13 April (ph.) furnished the first record for Okeechobee County and Lake Okeechobee. Both birds were of the gray-backed subspecies *graellsii*.
- Gull-billed Tern:** two in basic plumage were at the mouth of the Kissimmee River 13 April (one ph.), with singles in basic plumage at Eagle Bay Island 8 May and 19 August. Those seen 13 April were within 30 m of the Least Tern colony (see below) but we did not observe any indication of breeding. Sprunt (1940) was shown a colony of 100 pairs of Gull-billed Terns off the mouth of the Kissimmee River in June 1939, a colony also present in previous years (Sprunt 1954).
- Least Tern:** a small colony on an island off the mouth of the Kissimmee River furnished the first breeding record for Lake Okeechobee (N 27°08.441' W 080°51.060'). Thirteen adults were present 13 April, 10 adults and at least one nest with two eggs were found 8 May (ph.), and 16 adults, one juvenile, and one large chick were there 8 June (Fig. 3).
- Caspian Tern:** 10, with 7 in alternate plumage, were within 30 m of the Least Tern colony on 13 April (ph.), but we observed no evidence of breeding.
- Black Skimmer:** a large flock winters at Jaycee Park (PNG pers. obs.); we estimated 1000 birds 13 April (ph.), and 169 remaining to 8 June (ph.).
- Gray Kingbird:** a family group of five at Okee-Tantie Campground 27 July, with at least two birds 19 August, furnished the first breeding report for Lake Okeechobee.

## DISCUSSION

Shorebird and larid species richness during our five surveys of Lake Okeechobee during mid-2007 was impressive: 24 shorebirds and 11 larids. Daily counts of some shorebirds seemed high for an inland site: 455 Stilt Sandpipers, 1180 Long-billed Dowitchers, and 16,000 “peeps” 13 April; and 265 Black-bellied Plovers and 251 Semipalmated Plovers 8 May (Table 1).

Published data documenting shorebird and larid species richness at interior sites in Florida are limited. Sykes and Hunter (1978) observed 22 species of shorebirds and 8 larids (and a maximum count of 59,174 individuals) in eight surveys of the Everglades Agricultural Area (EAA), Palm Beach County, during August 1976 and July-Sep-



**Figure 3. Least Tern nestling on an island in Lake Okeechobee off the mouth of the Kissimmee River, Okeechobee County, Florida on 8 June 2007. This documents the first breeding record of Least Terns at Lake Okeechobee. Fossilized clam shells reveal the island's origin as dredge spoil from the Kissimmee River channel. Photograph by Bill Pranty.**

tember 1977. Townsend et al. (2006) surveyed 14 rice fields in the EAA during March-November 1998, and detected 13 shorebird and one larid species, with no more than 400 individuals of any species. Pranty and Basili (1998) summarized 30+ years of bird use of flooded farm fields on the north side of Lake Apopka, Lake and Orange counties, since the 1960s, reporting 38 species of shorebirds and 14 of larids. Chimney and Gawlik (2007) surveyed marshes in two Stormwater Treatment Areas in Hendry and Palm Beach counties during 1995-1997 and 2004-2006 and detected 21 shorebirds and 10 larids. Long-distance migrants such as shorebirds and larids are known opportunists of ephemeral habitats, as they require ample resources to complete their energetically demanding migrations (Helmert 1992). Lake Okeechobee does not provide areas of extensive shorebird habitat every year due in part to manipulation of water levels.

In 2008, a new management plan for lake levels was adopted that is projected to keep lake levels an average of 0.3 m lower (USACE

2007), which could increase the number of years when suitable shorebird habitat occurs on the lake. Previously, drought conditions were required to create expanses of mudflats that could support large numbers of shorebirds and larids, as we documented during 2007. Ephemeral wetlands surrounding Lake Okeechobee were primarily dry during our surveys, thus the habitats created in Lake Okeechobee may have provided considerable benefits to migrant shorebirds and larids throughout the region. Furthermore, our surveys covered less than 10% of available habitats in the lake, which suggests that Lake Okeechobee may have supported hundreds of thousands of shorebirds and larids between spring and fall 2007.

*2008 postscript.*—The drought continued into 2008 and Lake Okeechobee's water levels remained between 2.8 and 3.4 m until August, as much as a meter below average levels. These levels were comparable to 2007 levels, but remained higher than the lowest 2007 level that had facilitated plant colonization of the mudflats, reported during the July and August 2007 surveys. PNG was on parts of the survey area six times in 2008, 8 March-27 June. Mudflats were densely covered with vegetation 1 m tall or greater, and no unvegetated mudflats were observed. No large flocks (>30 individuals) of shorebirds were observed. A notable exception to these observations was a 10 ha area of lake bottom near Okeechobee's Jaycee Park that was scraped in June 2007 with heavy equipment to remove organic material. This area subsequently remained sparsely vegetated, and PNG frequently observed flocks of several hundred shorebirds during spring 2008. The island that hosted nesting terns in 2007 also became heavily vegetated and had no signs of nesting. Thus, barring mechanical treatment, optimal conditions for shorebirds and nesting terns on Lake Okeechobee likely are associated with declining water levels over areas unvegetated, or sparsely vegetated with emergent vegetation.

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