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Foraging Habitat Use by Breeding Wood Storks and the Core Foraging Area Concept

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Abstract.—Wood Stork (*Mycteria americana*) foraging flight studies at 20+ colonies throughout the US range were reviewed to summarize foraging ranges and compared to 20, 25 and 30 km-wide regulatory buffers ("core foraging areas") created to provide sufficient foraging habitats for breeding storks. Mean (per colony) direct distances to foraging sites ranged from 2.7 to 18.1 km, and between 75-100% of all follow flights went to foraging sites within 20 km of their colony. Overall, reviewed follow flight data suggested that the 20-km buffer would be sufficient for all breeding colonies in the US. However, such a reduction is not supported at this time due to limited recent data for certain regions of the Wood Stork breeding range (e.g. central and southern Florida). Additional, preferably multi-year, foraging habitat use studies are needed to fill data gaps for these areas to better assess the validity of the CFA buffers. *Received 22 August 2011, accepted 1 December 2011.*

Key words.—CFA, core foraging area, follow flights, foraging, *Mycteria americana*, Wood Stork.

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The Wood Stork (*Mycteria americana*) is a large wading bird that breeds in the Southeastern United States and feeds by tactilocation in shallow wetlands (Kahl 1964). Wood storks forage in a variety of aquatic habitats including forested wetlands, fresh- and saltwater marshes, ditches and impoundments (Coulter and Bryan 1993; Coulter *et al.* 1999). With a tactile foraging behavior, the species is most efficient when its aquatic prey is concentrated in shrinking wetlands due to seasonal or tidal drawdowns (Coulter *et al.* 1999; Odum *et al.* 1995). Many of these wetlands are ephemeral, maintaining fish and other prey for a period of months prior to localized extinctions due to wetland drying. However, wetlands of varying hydroperiod are typically needed to provide sufficient food resources for parent storks and their young during the 85-105 day breeding season (Fleming *et al.* 1994).

The Wood Stork is federally listed as an Endangered Species and hence the species and its required habitats are subject to protection under the Endangered Species Act (USFWS 1986). Critical habitat has never been defined for this species.

One approach used to delineate necessary habitat for Wood Storks during the breeding season is the "core foraging area" (hereafter CFA) concept, which was originated by the State of Florida to document wetlands important as foraging areas for wading bird species during the breeding season (Cox *et al.* 1994). CFAs, fixed width buffers around colony sites, were based on a limited number of foraging range studies and were developed for nesting wading bird species in Florida, The CFA for a Florida Wood Stork colony was defined as the wetland habitats within a 30-km radius around the colony and the buffer width was based on studies of foraging flights by Wood Storks in Georgia (Bryan and Coulter 1987) and studies in southern Florida (Kahl 1964; Browder 1984; Frederick and Collopy 1988). In 2002, the US Fish and Wildlife Service (USFWS) recommended this concept of habitat protection (a 30 km CFA) for south Florida stork colonies. In 2008 the USFWS recommended

smaller CFA buffers in the central (25-km) and northern (20-km) portions of their Florida breeding range. Larger buffers for more southern portions of Florida were due to the greater traveling distances reported for storks from these more southerly colonies (Browder 1984; Frederick and Collopy 1988; Ogden *et al.* 1978).

In this manuscript, we review Wood Stork foraging range and foraging habitat use throughout their U.S. breeding range, based on follow flight studies involving > 20 colonies. Our review of foraging range primarily examined distances from the colonies, but also included the distribution of foraging sites around the colony and potential seasonal shifts in distance since these factors could influence overall foraging range. Our habitat use review focused on the use of forested wetlands, a habitat not generally perceived as suitable for stork foraging habitat. We then discuss foraging distances relative to the CFA buffers employed by the USFWS as a conservation tool, to determine if recent studies support the widths of those buffers.

METHODS

A series of studies involving follow flights of breeding Wood Storks to foraging sites were reviewed and summarized to compare to the CFA buffers. These studies (see Table 1) included multiple projects designed to document foraging range and habitat use at the colony scale in various regions of the breeding range of this federally endangered species.

Study Area

Wood Stork foraging flight studies from most regions within the U.S. breeding range of the Wood Stork were reviewed (Fig. 1). Foraging habitat types within the breeding range obviously vary greatly, including tidal marshes and river drainages in some coastal set-

Table 1. Mean Wood Stork foraging site distances during the breeding season.

STATE/COLONY	REGION[a]	WHEN	DISTANCES (km) TO SITES mean + std dev; range (n)	Ref[b]
South Carolina				
Jacksonboro	coastal	1995	13.3 ± 13.7; NA (16)	1
Donnelly WMA	coastal	2009	11.5 ± 5.5; 1.2 - 18.9 (11)	2
Pon Pon Lake	coastal	2009	8.3 ± 6.4; 1.3 - 22.3 (16)	2
White Hall 2	coastal	2009	11.0 ± 7.8; 1.4 - 29.3 (21)	2
Georgia				
Birdsville	inland: east-central	1984-89	12.0 ± 10.6; 0.3 - 63.0 (269)	3-5
Chew Mill	inland: east-central	2005	11.8 ± 7.7; 0.4 - 37.3 (27)	6
Red Rock	inland: south-central	2005	9.7 ± 11.1; 0.6 - 46.0 (22)	6
Blackwater	inland: south-central	1999	15.2 ± ; 0.9 - 47.5 (56)	7
Harris Neck	coastal	1995-97	7.6 ± 6.7; 0.4 - 38.5 (38)	8-9
St. Simons Is.	coastal	1995-97	10.5 ± 9.4; 0.3 - 34.9 (37)	8-9
Black Hammock	coastal	1995-96	6.8 ± 9.1; 0.8 - 24.1 (28)	8-9
Florida				
Chaires	inland: north	2006	14.8 ± 14.6; 0.7 - 70.3 (24)	10
DeeDot	coastal: north	2006	18.1 ± 11.8; 0.6 - 44.0 (25)	10
Lake Russell	inland: central	2009	4.7 ± 2.3; 0.6 - 10.4 (30)	11
SE Lakeland Airport	inland: central	2009	5.8 ± 4.7; 0.9 - 10.8 (10)	11
Ayers Point	coastal: central	2009	2.7 ± 2.8; 0.5 - 8.3 (28)	11
Greenbrooke	coastal: central	2009	4.2 ± 3.1; 1.0 - 8.6 (6)	11
Seven Springs	coastal: central	2009	2.5 ± 0.6; 2.0 - 8.6 (5)	11
Corkscrew	inland: southern	2009	7.5 ± 5.3; 2.0 - 20.6 (15)	12
Tamiami West	inland: southern	2006	6.9 ± 7.1; NA (27)	13
Cuthbert Lake	inland: southern	1986-1987	max. average of 28 km	14
Paurotis Pond	coastal: southern	2006	12.8 ± 17.2; NA (30)	13
Rogers River	coastal: southern	2006	11.3 ± 5.3; NA (16)	13

[a]Region: Coastal colonies were < 20 km from tidal wetlands.
[b]REF - referenced studies: 1- Bryan 1996, 2-Tomlinson 2009, 3-Bryan and Coulter 1987, 4-Bryan *et al.* 1995, 5-Coulter and Bryan 1993, 6-Bryan and Stephens 2006, 7-Bryan and Gaines 1999, 8-Gaines *et al.* 1998, 9-Gaines *et al.* 2000, 10-Bryan and Stephens 2007, 11-Meyer 2010, 12-Lauritsen *et al.* 2011, 13-Herring 2007, 14-Frederick and Collopy 1988.

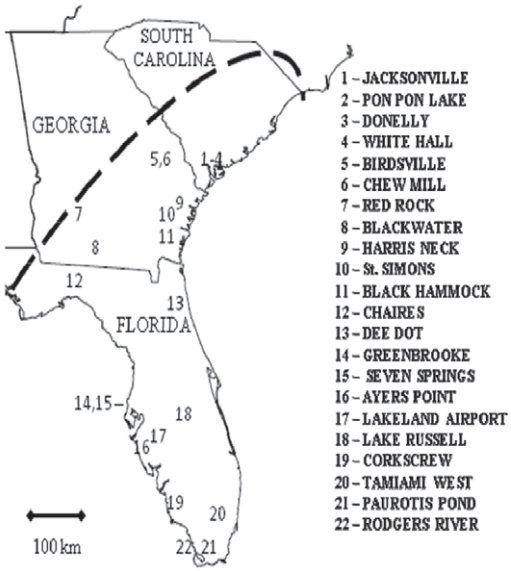

Figure 1. Distribution of Wood Stork study colonies in the southeastern U.S. Dashed line indicated extent of current breeding range.

tings and use of seasonally-available freshwater wetlands (e.g. Carolina bays and other depression wetlands, "wet-weather creeks", marshes) and man-made aquatic features (e.g. ditches, ponds, impoundments) throughout their range (Coulter and Bryan 1993; Coulter *et al.* 1999). Within this breeding range, availability and quality of tidal wetlands can vary regionally with the tidal amplitude, which is as great as 2.5 m in NC, SC, and GA, but typically only 0.5-1.2 m in FL.

Flight Following

The follow flight studies reviewed here typically employed methods similar to those of Bryan and Coulter (1987), which utilized an observer in a fixed-wing aircraft. The aircraft circled the colony at an altitude of approximately 300 m and then followed an individual stork to a location where the bird was observed to forage. Foraging site distances were reported as straight-line distances between colonies and feeding sites. Habitat types of the foraging sites were typically recorded, although these habitat type designations have utilized a variety of classification schemes (e.g. NWI classification, GIS coverage, observer-assessment, etc.).

Early studies (Ogden *et al.* 1978; Browder 1984) in South Florida used a combination of follow flights and opportunistic surveys; the latter method involved surveys of areas previously used by storks and/or observed "flight lines" of storks traveling to or from a site. Whereas these studies have strongly influenced foraging range assumptions for South Florida, they are not directly comparable to follow flight studies and are referred to in the Discussion section of this paper.

Analysis

We summarized the studies by state (SC, GA, FL), since Wood Storks are protected by both federal and state regulations, and then discussed the results relative to region within each state: coastal or inland. Coastal colonies were arbitrarily defined as those in SC, GA and FL within 20-km of tidal wetlands, whereas inland colonies were greater than 20-km from tidal wetlands (definitions used in Bryan and Robinette 2008). For Georgia, we also categorized inland colonies relative to position in the state due to possible differences in habitat types in the east-central and south-central regions. For Florida, we subdivided studies relative to the USFWS-specified CFA regions (north, central and southern), specifically isolating the south Florida studies (below Lake Okeechobee) due to the uniqueness of the Everglades and Big Cypress ecosystems and the different hydrologic regimes affecting them.

When data were available, we also summarized potential seasonal trends in foraging site distance as well as directionality of sites for some studies in that both are related to foraging habitat availability and thus foraging range. Seasonality was either measured relative to monthly periods (e.g. April-May vs. June-July) or breeding stage of nesting attempts (e.g. incubation vs. young chick vs. old chick). Both measures essentially differentiate between early breeding periods when nest attendance constraints could limit foraging travel and later periods when nestlings are sufficiently large enough to be independent and parents can devote greater effort to food acquisition (Bryan *et al.* 1995; Kahl 1964).

RESULTS

South Carolina

There have been two single-year studies of Wood Stork foraging flights within South Carolina, both involving coastal colonies. Nesting storks from the Jacksonboro colony in Colleton County were followed in the early half of the 1995 breeding season by Bryan (1996) who reported foraging distances averaging 13 km (Table 1). In 2009, Tomlinson (2009) followed storks from three coastal colonies (Donnelly WMA, Pon Pon Lake and White Hall). Mean foraging site distances ranged from approximately 8 to 12 km (Table 1) and were not different among the three colonies (Tomlinson 2009). Distances did not differ among breeding stages (incubation, early nestling, late nestling), although sample sizes were low (Tomlinson 2009). Approximately 94% of the foraging sites (N = 64) for the combined SC studies were within 20 km of their respective colonies.

Georgia

There are follow flight studies for seven Wood Stork colonies in three regions of Georgia: east-central, south-central and coastal. Two studies involved colonies in the east-central region (inland) of the state. The Birdsville study occurred from 1984-1989, and included a range of hydrological conditions and resulting varied breeding success. There were no annual differences in foraging distance among the six study seasons (see Table 1, Coulter and Bryan 1993), with an overall average of approximately 12 km. Overall, followed storks flew greater distances to foraging sites in the latter portion of the breeding season, although this trend was not significant every year (Bryan *et al.* 1995). Examination of directionality of foraging sites relative to the colony suggested a random distribution around the colony in most years, but significant directionality during a dry year (Bryan and Coulter 1987). In 2005, a single-year study of the nearby Chew Mill Pond colony in east-central Georgia colony resulted in a similar average foraging distance to that of Birdsville (Bryan and Stephens 2005). Approximately 86% of the foraging sites (N = 296) for the combined Birdsville and Chew Mill Pond studies were within 20 km of their respective colonies.

Two single-year studies in south-central Georgia involved the Blackwater and Red Rock colonies (Fig. 1; Table 1). Direct distances of foraging flights from the Blackwater Colony in Brooks County were monitored in 1999, a drought year. Fifty-six follow flights averaged approximately 15 km in direct distance (Table 1). The Red Rock colony in Worth County was studied in 2005, a year with heavy rains occurring during the breeding season. Direct distances to foraging sites averaged approximately 10 km (Table 1). Over 86% of the foraging sites (N = 78) for the combined Blackwater and Red Rock studies were within 20 km of their respective colonies.

In the coastal zone of Georgia, three colonies (Black Hammock, Harris Neck NWR, St. Simons Island) were studied from 1995-1997 (Fig. 1), including breeding seasons with varied hydrological conditions. Distances associated with coastal colonies appeared slightly shorter than inland averages (Table 1). Stork foraging site distances for a dry year were not significantly different from those of wetter years, but storks did shift to greater use of estuarine habitats during the dry year presumably due to reduction of available freshwater habitat (Gaines *et al.* 2000). Over 90% of the foraging sites (N = 103) for the combined Georgia coastal studies were within 20 km of their respective colonies.

North Florida

There has been only one follow flight study for northern Florida, involving the Chaires colony in northwest Florida and the coastal Dee Dot colony in the northeast (Fig. 1; Table 1). Both colonies were studied during a single, dry breeding season (2005), with the Chaires area experiencing severe drought conditions that year (Bryan and Stephens 2007). The average foraging distance for Chaires was slightly greater than those reported for east-central GA but was similar to that reported for nearby Blackwater in south-central Georgia (Table 1). Follow flights from the coastal Dee Dot colony (mean = 18 km) had nearly twice the average distance reported for coastal GA and SC colonies (Table 1). Examination for potential directionality indicated that foraging sites associated with both the Chaires and DeeDot colonies were not randomly distributed around the colony. Approximately 75% of the foraging sites (N = 49) for the combined Chaires and Dee Dot studies were within 20 km of their respective colonies.

Central Florida

In the central section of Florida, two inland colonies and three coastal colonies were briefly studied in 2009 (Fig. 1; Table 1). The inland colonies were the Lake Russell colony in Osceola County and the SE Lakeland Airport colony (SLA) in Polk County. Thirty foraging sites found for Lake Russell averaged less than 5 km in distance from the colony and ten sites for SLA averaged

less than 6 km in distance (Table 1). For the coastal colonies, Ayers Point was located on an estuarine island in Manatee County and the Greenbrooke and Seven Springs colonies were located in an urban area of Pasco County. Twenty-eight flights from Ayers Point averaged less than three km in distance from the colony whereas flights from both Greenbrooke (n = 5) and Seven Springs (n = 6) averaged less than 5 km (Table 1). All (100%) of the foraging sites (N = 79) for the combined central Florida studies were within 20 km of their respective colonies and most (95%) were within 10 km.

South Florida

Foraging habitat use by Wood Storks from the Corkscrew Sanctuary colony in Collier County (southwest Florida; Fig. 1) has been studied in historical and recent studies. Early foraging studies for the Corkscrew colony employed a variety of methods and their conclusions are referred to in the Discussion section. In 2009, Lauritsen *et al.* (2011) followed 15 storks from the inland Corkscrew colony in southwestern Florida, resulting an average foraging distance of only 7.5 km, with a maximum of 20.6 km (Table 1; but see Discussion below).

Frederick and Collopy (1988) reported foraging distances of a small number of stork follow flights for the Cuthbert Lake colony in the extreme southern Everglades for 1986 and 1987 (Table 1). Annual averages were approximately 4 and 28 km for 1986 and 1987, respectively, although these distances were based on low sample sizes.

In 2006, Herring (2007) followed breeding storks to foraging sites from the Tamiami West and Paurotis Pond colonies in Miami-Dade County (southeast FL) and the Rodgers River Colony in Monroe County (southwest FL), the latter two colonies being classified as coastal. Follow flights were further categorized by approximate stage of breeding: incubation, early nestling, and late nestling. For Tamiami West, the average foraging distance was approximately 7 km (Table 1) and potential seasonal differences in foraging distance were not determined (Herring 2007). For Paurotis Pond, the overall average distance was approximately 13 km (Table 1), but average distances increased as the season progressed from an average 7 km during incubation to 12 km during the young chick stage to 21 km during the old chick stage (Herring 2007). Similarly, the Rogers River Bay colony had an average foraging site distance of approximately 11 km (Table 1), but again the distances increased as the season progressed from an average of 5 km during incubation to 10 km during the early nestling stage to 20 km during the late nestling stage.

Use of Forested Wetlands as Foraging Habitat

Review of the follow flight studies indicated that forested wetland habitats were utilized as foraging habitat at varying levels (16-76%) by breeding storks throughout most of their U.S. breeding range (Table 2), with the possible exception being colonies located in the Everglades region in southern Florida. Herring (2007) did not find use of forested wetlands in the study of foraging habitat use of three Everglades region stork colonies.

DISCUSSION

The chick-rearing and food acquisition activities of parent Wood Storks are strongly influenced by the distribution and availability of prey within the landscape surrounding their colony (Bryan *et al.* 1995; Coulter *et al.* 1999). Parental behavior is further influenced by their need to attend the nest and protect their young during the early nestling stages and to acquire sufficient food to allow full development of their rapidly growing nestlings (Kahl 1964). Once the nestlings reach approximately four weeks of age, nearly all parental activities are devoted to food acquisition as the nestlings grow to adult size (Kahl 1964). During peak nestling growth, multiple trips are required each day to fulfill the needs of the young (Bryan *et al.* 1995, 2005). Foraging distances and foraging habitat quality obviously influence parental ability to successfully fledge their young (Bryan and Robinette

Table 2. Use of forested wetlands as foraging habitat by nesting Wood Storks as documented in follow flight studies.

Region	Year	Study Colony	Total No. Sites	Percent Forested Wetland	Study
Coastal South Carolina	2008	Dungannon	11	36%	Tomlinson 2009
	2008	PonPon Lake	16	38%	Tomlinson 2009
	2008	White Hall II	21	48%	Tomlinson 2009
	1995	Jacksonboro	16	37%	Bryan 1995
Coastal Georgia	1995-1997	Harris Neck	58	16%	Gaines *et al.* 1998, 2000
	1995-1997	St. Simons Is.	51	25%	Gaines *et al.* 1998, 2000
	1995-1997	Black Hammock	51	16%	Gaines *et al.* 1998, 2000
East-central Georgia	2005	Chew Mill	27	48%	Bryan and Stephens 2006
	1984-1989	Birdsville	192	46%	Coulter and Bryan 1993
Central Georgia	2005	Red Rock	22	41%	Bryan and Stephens 2006
South-central Georgia	1999	Blackwater	59	69%	Bryan and Gaines 1999
Northern Florida	2006	Chaires	24	50%	Bryan and Stephens 2007
	2006	Dee Dota	25	76%	Bryan and Stephens 2007
Central Florida[b]	2009	Lake Russell	30	42%	Meyer 2010
	2009	Ayers Pointa	28	42%	Meyer 2010
	2009	Lakeland Airport	10	42%	Meyer 2010
	2009	Greenbrook[a]	11	42%	Meyer 2010

[a]Coastal colony in Florida.
[b]Percent forested wetlands for all Central Florida colony sites combined.

2008). The use of follow flights to document foraging range and habitat use by nesting Wood Storks was our method to assess needed buffers around stork nesting sites.

Average foraging distances of follow flight studies ranged from approximately 2 to 18 km for individual colonies throughout the US breeding range of Wood Storks, with the majority of foraging locations occurring within 20 km of their respective colonies. Generally, foraging distances for coastal colonies were shorter than inland averages, likely due to the proximity of estuarine habitats (e.g. tidal creeks) and their ability to renew prey populations. The Dee Dot colony in northeast FL appears as an exception to the coastal trends exhibited by colonies in SC and GA, possibly due to the lack of extensive estuarine marshes similar to those of the GA and SC coastal zones. Also, Dee Dot is located south of the Jacksonville metropolitan area and wetland habitats were sparse in the developed urban areas immediately to the north and west of the colony, resulting in the storks foraging within a band of habitat extending south from the colony (Bryan and Stephens 2007). Finally, our arbitrary definition of coastal (20 km) may not be appropriate and instead the distance of the colony to tidally-influenced wetlands may be a better metric for coastal classification.

Average foraging distances for central Florida colonies were the shortest of the colonies and regions observed (Table 1). Such may reflect abundant nearby foraging habitat, the follow flight method employed, or both. Foraging sites for these colonies were located during only two days of flight following, with little separation (10-20 days) between the two study days (Meyer 2010). A broader distribution of data collection through the entire breeding season may have generated greater distance means by including seasonal or rainfall-related habitat shifts. Regardless, the observed wetland usage suggests an abundance of nearby foraging habitat for central Florida colonies.

Historical studies of Wood Stork foraging habitat use and distances in southern Florida employed multiple methods including follow flights, flight lines and opportunistic regional surveys, and typically resulted in maximum foraging range rather than average distances. Kahl (1964) suggested that parent storks often flew as far as 40 km to feeding grounds and dramatic shifts in foraging habitat use often occurred in response to localized heavy rain (no method given).

Browder (1984) employed a combination of follow flights and opportunistic surveys (see Methods) and documented feeding areas thought to be associated with the Corkscrew colony during the 1973-1974 breeding season. The approach resulted in an estimated maximum of 97 km distance from a colony to foraging areas (Browder 1984). Ogden *et al.* (1978) also used a combination of survey methods to document foraging areas associated with three stork colonies (East River, Lane River, Madeira) in the southern Everglades in 1974, a very dry year. This study reported extensive foraging area shifts in response to drying conditions and a maximum foraging distance of 130 km.

The apparent foraging distance differences in historical and more recent foraging studies for the south Florida region may be the result of methodological differences or possibly landscape-level changes in habitat availability and/or quality. Opportunistic surveys may incorrectly include foraging sites occupied by Wood Storks from non-focal colonies. Changes in water management strategies in regions of southern Florida could greatly influence prey availability and stork foraging range. Potential prey production and/or availability have not been assessed or compared throughout the range of the Wood Stork, as a possible link to foraging range, although differences in prey density and size for two disjunct regions (southern Florida and east-central Georgia) were suggested in one study (Depkin *et al.* 1992). Unfortunately, we did not have historical average distances to compare to more recent studies. Maximum distances recorded in recent south Florida studies (Table 1) were far less than the 97 km and 130 km maximums reported by Browder (1984) and Ogden *et al.* (1978), respectively.

Seasonal shifts in foraging range and directionality of foraging sites were occasionally observed. Foraging distance differences relative to the breeding season occurred at some colonies during specific years, and was likely an indication of shifts in habitat availability associated with rainfall (or lack thereof) around these colonies (Bryan *et al.* 1995; Herring 2007). Directionality of foraging sites relative to the colony has been studied on a few occasions and appeared to occur when (1) foraging sites were limited (e.g. drought conditions) resulting in repeated use of one or more wetlands (Bryan *et al.* 1995; Bryan and Stephens 2007), and/or (2) when landscape level features (e.g. urban development, mature pine plantations) precluded the occurrence of suitable wetlands in certain directions (Bryan and Stephens 2007).

Wood Storks are often perceived as a wading bird associated with relatively open aquatic (non-forested) habitats, perhaps due to their greater visibility in those settings. Our review contradicts that perception. Where present, various types of forested wetlands often provide a major component of the foraging habitats used by breeding storks (see Table 2).

The foraging distances (20-30 km) employed by USFWS as CFAs attempt to delineate/define a sufficient area with the habitats needed for nesting Wood Storks to successfully produce and fledge offspring. Initially, these distances were based on early foraging habitat use studies and more recently tested with additional studies provided in the current document. The variation of distances employed (20, 25, 30 km) as buffers was an attempt to acknowledge the presumably shorter flights used by storks in the central and northern portions of their breeding range as compared to greater distances for southern Florida associated with the historical foraging studies . The difference in amount of area protected by the range of distances is not trivial, with the 30-km range including > 1,500 km^2 (> 550 miles2) more area than the 20-km range.

Given the available data in the reviewed studies, we believe the suggested buffer (20 km) is reasonable for the northern part of the Wood Stork breeding range (SC, GA and northern FL). The reviewed foraging distance data suggested that recommended buffers in central and southern Florida could be reduced to the 20 km buffer. However, until additional studies are conducted in central and south Florida, we recommend a conservative approach and do not support such a reduction at this time due to the lack of

sufficient recent data from the two regions. Possibly, landscape-level changes in habitat availability and/or quality and stork population shifts in southern Florida over the last half century have resulted in the need for designation of a smaller core foraging area for this region. However, given the historical significance of this region for storks and the recovery tasks directly linked to recovery in this region (USFWS 1996), a protective approach must be taken regarding this portion of the population until additional assessments occur, particularly the analyses of satellite telemetry data for adult Wood Storks in this region. Also, we recommend additional studies of foraging habitat use and range throughout their U.S. breeding range, particularly in Florida and South Carolina, as well as the new population in North Carolina.

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