
DISTRIBUTION AND ABUNDANCE OF WADING BIRDS IN THE BIG CYPRESS NATIONAL PRESERVE, 2002



water color by Dinah Lazor

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Prepared for U. S. Army Corps of Engineers, Jacksonville District and South Florida Water Management District

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EXECUTIVE SUMMARY

Major changes in water management that are currently being proposed or implemented that will alter the hydrology of the Everglades/South Florida Ecosystem and, consequently, the use of these areas by wading birds. Because these areas support huge concentrations of foraging wading birds (Hoffman et al. 1994) and the largest percentage of the remaining nesting wading birds in the Everglades (Ogden 1994), monthly systematic reconnaissance flights (SRF) were conducted to investigate and monitor the relationship between modified hydrologic patterns in the Everglades system and the distribution and abundance of these wading birds.

Surveys were flown with a fixed winged aircraft at an altitude of 60 meters along 29 parallel transects with 2 km spacing in the Big Cypress National Preserve. Wading birds were enumerated, their positions recorded, entered into a database, and summarized into tables. Densities of each species were separated into 4 km² cells and plotted onto maps of the study area.

In Big Cypress National Preserve the monthly percent of wet cells declined from 48 % wet cells in February 2002 to 6 % in April 2002 then increased in June 2002 to 100 %. 2001 was generally dry from January (18 % wet cells) to June (14 % wet cells). In 2000, the percent of wet cells decreased from 72 % in January 2000 to 13 % in March 2000. Water levels were higher in 2002 than 2001. In 2002, water levels declined from October/November 2001 until June 2002. In June 2002 water levels begin to increase with the influx of rain. In 2001, water levels followed the same pattern as surface water declining to April 2001. Water levels were lower from January to April in 2001 than the same months in 2000.

The population estimates for wading birds while higher in 2002 than 2001 followed a similar pattern as 1999, 2000 and 2001 declining from highs in

January/February to lows in May/June (Appendix J)(Nelson and Theriot, 2000).).

Wading bird average monthly relative abundance was much higher in 2002 (14,325) than in 2001 (9,189). Wading bird average monthly relative abundance was much lower in 2001 (9,189) than in 2000 (18,774) and 1999 (20,412). Great Blue Herons had average monthly relative abundance in 2002 lower in value than as 2001. While Great Egrets, White Ibises, Glossy Ibises, Wood Storks, Cattle Egrets, small dark herons and small white herons had higher average monthly relative abundance in 2002 than in 2001. Great Egret average monthly relative abundance in 2002 was over twice the average in 2001.

The areas with greatest densities of wading birds in Big Cypress National Preserve were the southeast corner, the southwest corner, and east-central (L28 Gap area). These areas tended to remain wet longer than other areas. The average monthly density of wading birds in Big Cypress National Preserve for 2002 (4.45 birds/km²) was lower than average monthly densities for WCA 1 (20.58 birds/km²), WCA 2A (26.70 birds/km²), WCA 2B (28.41 birds/km²), WCA 3A (15.52 birds/km²) and WCA 3B (5.51 birds/km²) (Nelson and Metzger, 2002). Extensive areas of dry habitat in central and northern Big Cypress were not used by wading birds.

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INTRODUCTION

Major changes in water management that are currently being proposed or implemented will alter the hydrology of the Water Conservation Areas and, consequently, the use of these areas by wading birds. The Water Conservation Areas support huge concentrations of foraging wading birds (Hoffman et al. 1994) and the largest percentage of the remaining nesting wading birds in the Everglades (Ogden 1994). Since it is critical that we investigate and monitor the relationship between modified hydrologic patterns in the Everglades system and the distribution and abundance of these wading birds, monthly systematic reconnaissance flights (SRF) were conducted in the Big Cypress National Preserve from February to June 2002. This document presents the results of these surveys. These data, when combined with survey data from other parts of the Everglades/South Florida Ecosystem, will provide a synoptic view of distribution and abundance of wading birds.

BACKGROUND

The Everglades ecosystem originally extended from the southern shore of Lake Okeechobee south and west to the coastal mangrove forests and estuaries of the Gulf of Mexico and Florida Bay, and consisted of a complex vegetation mosaic (Davis et al. 1994). Water levels within this marsh system rose and fell with the annual rain cycle (Walters et al. 1992). The majority of rain in this ecosystem generally occurs between late May and early November (Bancroft 1989, Duever et al. 1994).

The original Everglades marsh ecosystem provided abundant primary and secondary production during the wet summer and fall months (Holling et al. 1994), and this productivity was concentrated during the dry winter and spring when water levels receded. The concentrations of food provided ideal foraging habitats for numerous wetland species, especially large flocks of wading birds (Bancroft 1989, Ogden 1994). However, the hydrology of the Everglades has been severely altered (Light and Dineen 1994) by extensive draining and the construction of canals and levees. The resulting system is not only spatially smaller, but also drier than historical levels (Walters et al. 1992). Moreover, the timing and distribution of water flow have been highly altered.

Breeding populations of wading birds have responded negatively to altered hydrology (Ogden 1994, Bancroft 1989, Kushlan and Fohring 1986) as numbers of breeding wading birds in the Everglades have decreased by more than 90%. During favorable years in the 1930s, up to 250,000 wading birds, including White Ibises (*Eudocimus albus*), Wood Storks (*Mycteria americana*), Great Egrets (*Casmerodius albus*), Snowy Egrets (*Egretta thula*), and Tricolored Herons (*E. tricolor*) nested in the central and southern Everglades (Ogden 1994). Maximum numbers had decreased to

54,000 by the 1970's and further to 22,000 by the 1980's (Ogden 1994). During the 1930s approximately 90% of the wading birds nested along the interfaces between the freshwater Everglades and the mangrove-estuaries (Ogden 1994). By the 1980s, the majority of nesting wading birds had shifted to nesting in the interior freshwater Everglades, principally in the Water Conservation Areas (WCA) (Ogden 1994). These changes were presumably the result of extensive hydrological alterations (water flow and volume) in the Everglades system (Ogden 1994, Bancroft 1989).

Significant declines in the numbers of wading birds have contributed to the movement toward restoring the hydrologic conditions of the Everglades to more historic patterns. The South Florida Water Management District (SFWMD) and the U.S. Army Corps of Engineers (USACE) are currently evaluating and implementing water requirements that would restore the Water Conservation Areas (WCA) and Everglades National Park (ENP) in ways that improve and restore the natural conditions of south Florida's Everglades. One goal of this process is to improve conditions for wading birds within the remaining Everglades system.

In 1993, the Florida Legislature passed the Everglades Forever Act which calls for the construction of 34,000 acres of wetland treatment marshes along the northern edge of the Water Conservation Areas. Loxahatchee National Wildlife Refuge has proposed increasing water depths and hydro-periods within the refuge. The US Army Corps of Engineers, South Florida Water Management District, and Everglades National Park are initiating modified water deliveries for Northeast Shark Slough and Shark Slough in Everglades National Park, and the South Florida Water Management District is attempting to restore natural hydrologic conditions within the Water Conservation Areas.

METHODS

Systematic Reconnaissance Flights

Similar to Bancroft and Sawicki (1995), we examined the effect that changes in hydrology in the Big Cypress National Preserve may have on the distribution and abundance of wading birds. We estimated the number and distribution of foraging wading birds using a systematic aerial transect method (Norton-Griffiths 1978) as modified by the National Audubon Society (Bancroft and Sawicki 1995). Using identical survey parameters (height, ground speed, strip width, transect spacing) as Bancroft and Sawicki (1995), we flew surveys in the areas consisting of east-west transects spaced at 2 km intervals. Transects were flown in a Cessna 182 at 61 m (200 ft) altitude and a ground speed of 145-185 km/h (80-100 nautical mph)(Figures 1 and 2). Two observers, one on each side of the airplane recorded all wading birds observed within 150 m wide strips paralleling the plane's path (Figure 3). When birds were sighted in the strips, the longitude was recorded from a Global Positioning System receiver. The species, number, behavior, and longitude were recorded for all sightings within the strips.

We identified to species Great Blue Herons (*Ardea herodias*), Great Egrets, Wood Storks, White Ibises, and Glossy Ibises (*Plegadis falcinellus*)(Figure 4-6). Because of the difficulty of identifying Tricolor herons (*Egretta tricolor*) and Little blue herons (*Egretta caerulea*) within a large mix flock, these species were identified as "small dark herons". Snowy Egrets (*Egretta thula*) and first-year Little Blue Herons that could not be correctly identified were classified into a group called "small white herons" (Bancroft and Sawicki 1995). Small white herons and small dark herons were then grouped together into a third category called "small herons". The small heron category was used to compare estimated



Figure 1. Cessna 182 aircraft flown at 60 m elevation for the systematic aerial surveys.

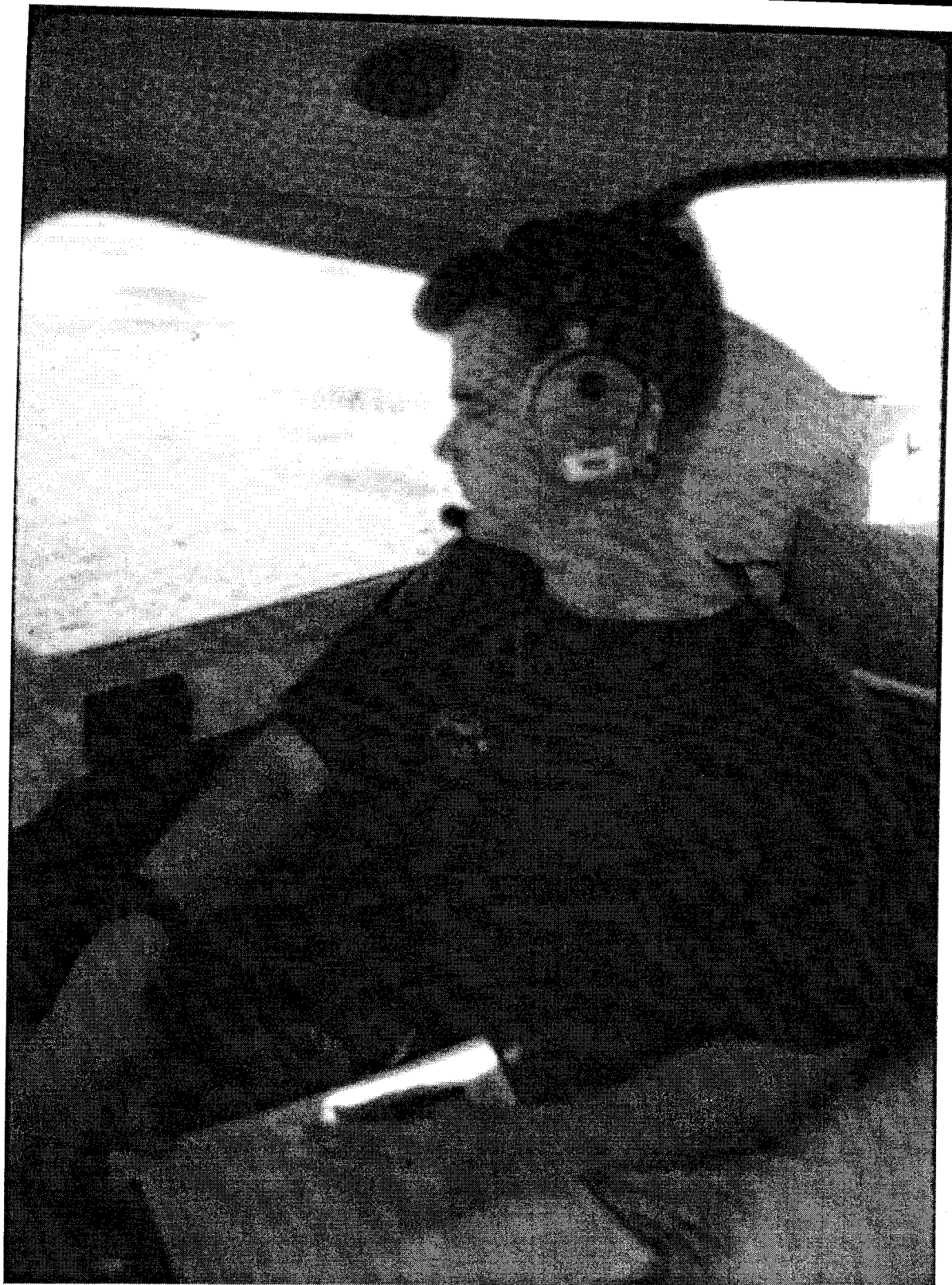


Figure 2. Wading birds were counted along transects out of each side of the aircraft.

abundance to past surveys (Appendix J). We grouped these species because at times they were difficult to identify to species from a moving airplane. In addition, small herons usually are seen in low numbers and would not show a pattern when analyzed and mapped as separate species (Bancroft and Sawicki 1995).

Water Analyses

During the surveys, surface water coverage was recorded. Bancroft and Sawicki (1995) classified water coverage into four categories; (1) *wet* conditions were defined as having water completely covering the ground surface, (2) *wet transitional* conditions had partially exposed ground, but more than 50% of the ground surface flooded, (3) *dry transitional* conditions for areas less than 50% flooded, and (4) *dry conditions* where surface water appeared only in ponds, canals, and alligator holes. These water conditions were recorded on a broad scale, such that each 2-km x 2-km cell was assigned a single value in a given month. The water data recorded during the surveys was coded numerically and transferred to computer files for mapping.

Study Areas

During 2002 systematic transects were flown in Big Cypress National Preserve from February to June (Figure 3). McPherson (1973) described nine habitats based on vegetation for Big Cypress National Preserve. These included the dominant habitats: cypress, prairies, pine forests, mixed swamp forests and inland marshes. He also identified the less dominant habitats: hammock forests, coastal forests, coastal marshes, and agricultural/disturbed areas.

Cypress habitats which cover the greatest portion of Big Cypress National Preserve were often dominated by large bald cypress before logging reduced their numbers. Removal of this shading cypress canopy left a mixed swamp forest of pond cypress

(*Taxodium ascendens*), maple (*Acer rubrum*), pop ash (*Fraxinus caroliniana*), dahoon holly (*Illex casine*), myrsine (*Myrsine guianensis*), willow (*Salix caroliniana*), and swamp bay (*Persea palustris*) (Duever et al., 1986). The pine forest habitats have an overstory predominantly of slash pine (*Pinus elliotii*) with understory species dominated by either saw palmetto (*Serenoa repens*) or mixed grasses (Duever et al. 1986). The dry prairie habitats usually have saw palmettos and wire grass (*Aristida* spp.). They may also contain wax myrtle, gallberry, and staggerbush shrubs. The marsh habitats contain a large variety of species but a location may be dominated by pickerel weed (*Pontederia spp*), arrowhead (*Sagittaria spp.*), sawgrass, fire flag (*Thallia geniculata*), cattail (*Typha spp.*) and/or bulrush (*Scirpus spp.*)(Duever et al. 1986). For a more detailed description of the vegetation and vegetation associations see Duever et al. (1986).

Big Cypress

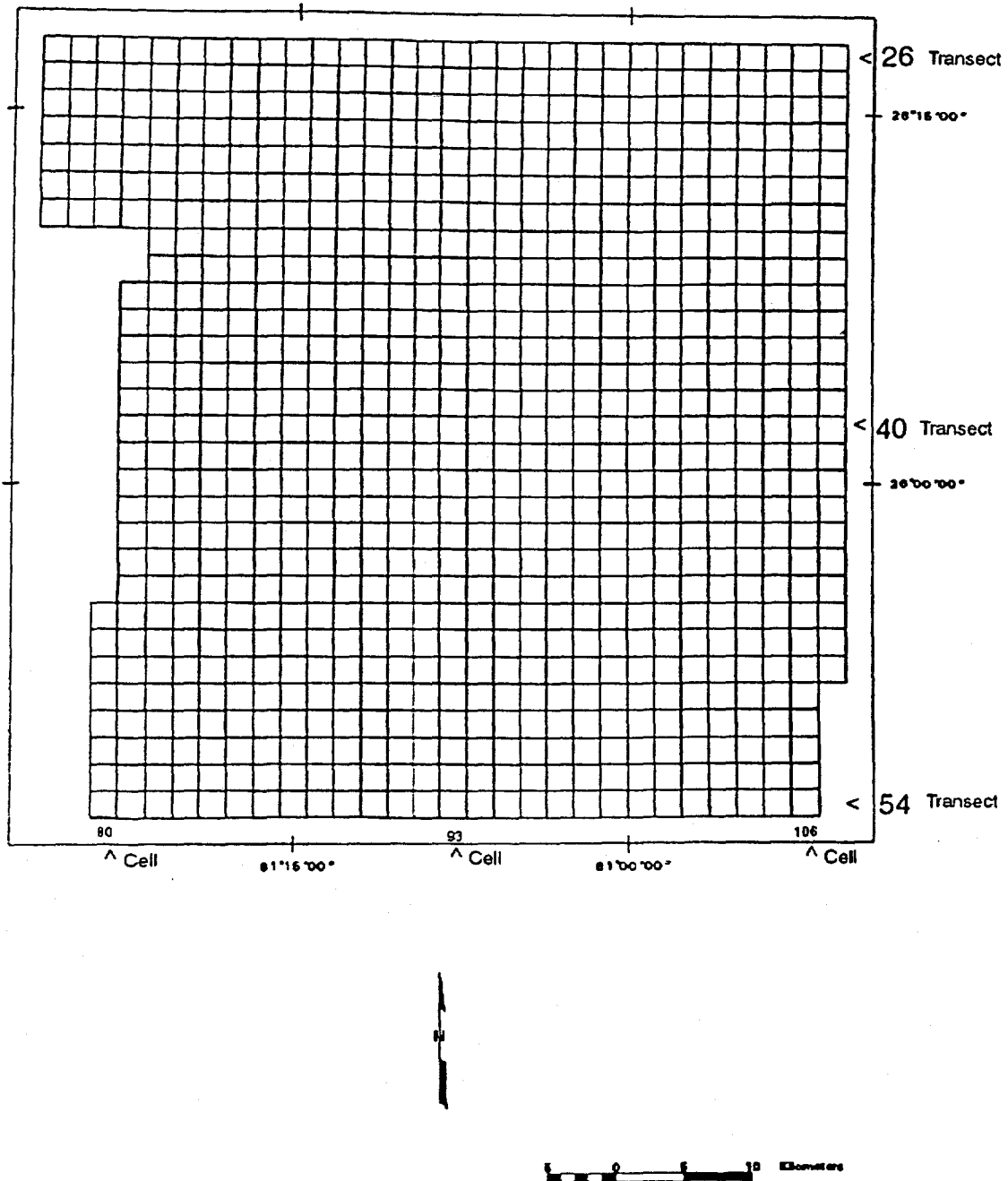


Figure 3. Study area consisting of transects and cells.

Table 1. Dates and completed transects for 2002.

Month	Dates WCAs/ Holey Land	Transects WCAs	Transects Holey Land	Dates Big Cypress	Transects Big Cypress
Feb	11-13	5-54	18-23	26-28	26-54
Mar	20-25	5-54	18-23	27-29	26-54
Apr	4/30-5/3	5-54	18-23	18-20	26-54
May	21-23	5-54	18-23	29-31	26-54
Jun	19-25	5-54	18-23	19-21	26-54

Survey Personnel

In 2002, Dr. David Nelson occupied the right front seat of the airplane, counted birds, and recorded water conditions on the right side of the plane. Mr. Bob Metzger occupied the left rear seat and counted birds on the left side of the plane. The pilot for the surveys was Mr. Ken Poteet .

Data Management

Data were entered into handheld computers during the flights. The data was then entered from the computer into spreadsheet software and corrected for entry errors. The data were then entered into a data management system developed by Mr. Dave Buker of ENP and modified by Mr. Chuck Dickerson. For a more detailed description of the database see Sawicki et al. (1995).

A video recording was made of each transect, each month and archived for future reference.

Data Analysis

We used the database analysis program developed by Mr. Dave Buker and modified by Chuck Dickerson. Each observation was sorted by species and assigned to the correct 4 km² cell. Total population estimates of each species were tabulated for each area and each cell. The density data for each 4 km² cell was stored in a dBase file format and transferred to the ARCINFO Geographic Information System for plotting of density maps.

Map Production

ARCINFO Geographic Information System was used to produce maps of the relative density for each species/species category and for all species combined. The relative density categories were scaled from five categories: 1) 1.67 birds per km² (one bird observed); 2) greater than 1.67 birds per km² but less than 1/10 of the overall (6 month) maximum density; 3) 1/10 to 3/10 maximum density; 4) 3/10 to 7/10 maximum density; and 5) 7/10 to maximum density (Sawicki et al., 1995). These density categories were represented on the maps by dots that increased in size with density. Water maps for each group were calculated by coding the water data from 1 to 4, where 1 was wet and 4 was dry.

RESULTS

Water Conditions for the Big Cypress National Preserve

The water conditions in Big Cypress National Preserve decreased from 47.8 % wet cells during February to 6.3 % wet cells during May. With an influx of rain during June 2002 the percent of wet cells increased to 100 %.

Water Levels for the Big Cypress National Preserve

Water level data was provided by US Geological Survey (Figures 4-7). In general water levels increased from June 2001 to a high in September 2001. From September 2001 water levels decreased until May 2002 and then increased in June 2002. Water levels were slightly lower in January to April 2001 than the same period for 2002.

Gauge BCN-A5 located in northeast Big Cypress National Preserve had water levels that increased from June 2001 to a high in October 2001. From October 2001 water levels decreased until June 2002.

Gauge BCN-A12 located in north-central Big Cypress National Preserve had water levels that increased from June 2001 to a high in October 2001. From October 2001 water levels decreased slightly until February 2002 and then declined rapidly until May 2002 than remained low and stable through June 2002.

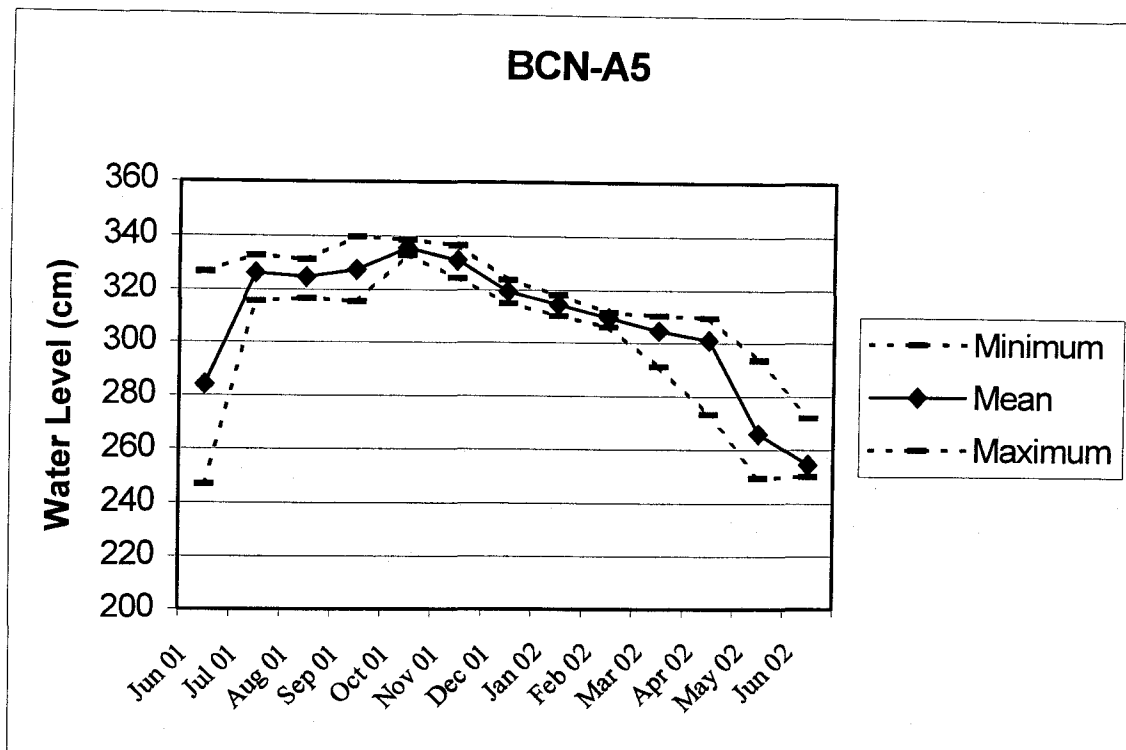


Figure 4. Mean, minimum and maximum water levels for Gauge BCN-A5 within the Big Cypress National Preserve January 2000 to June 2001 (data from USGS).

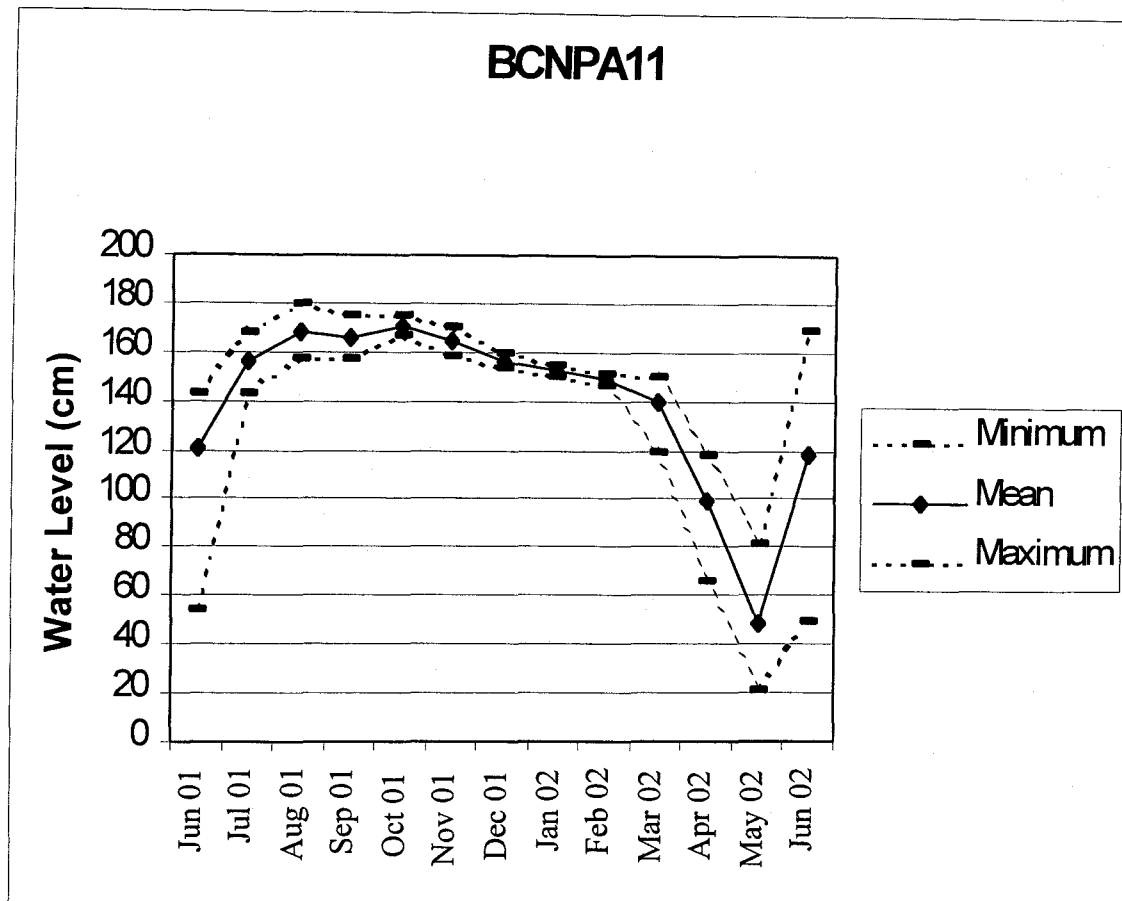


Figure 5. Mean, minimum and maximum water levels for Gauge BCN-A11 within the Big Cypress National Preserve January 2000 to June 2001 (data from USGS).

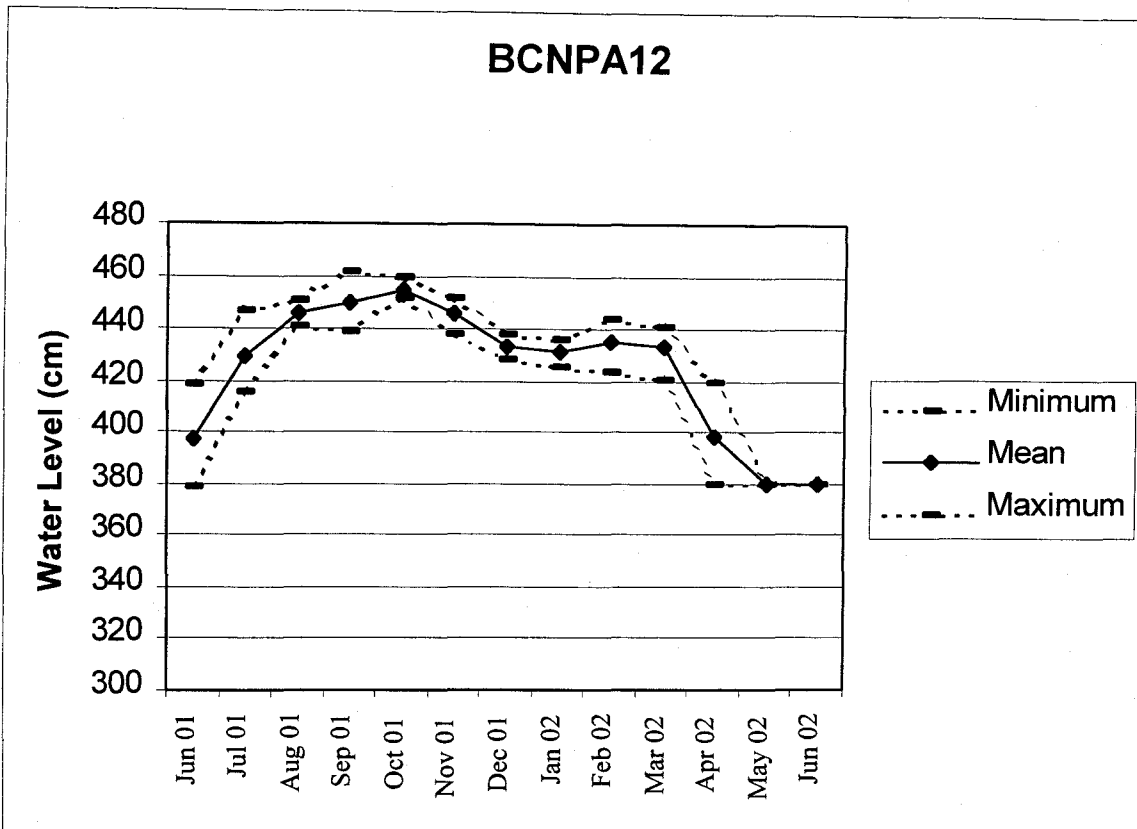


Figure 6. Mean, minimum and maximum water levels for Gauge BCN-A12 within the Big Cypress National Preserve January 2000 to June 2001 (data from USGS).

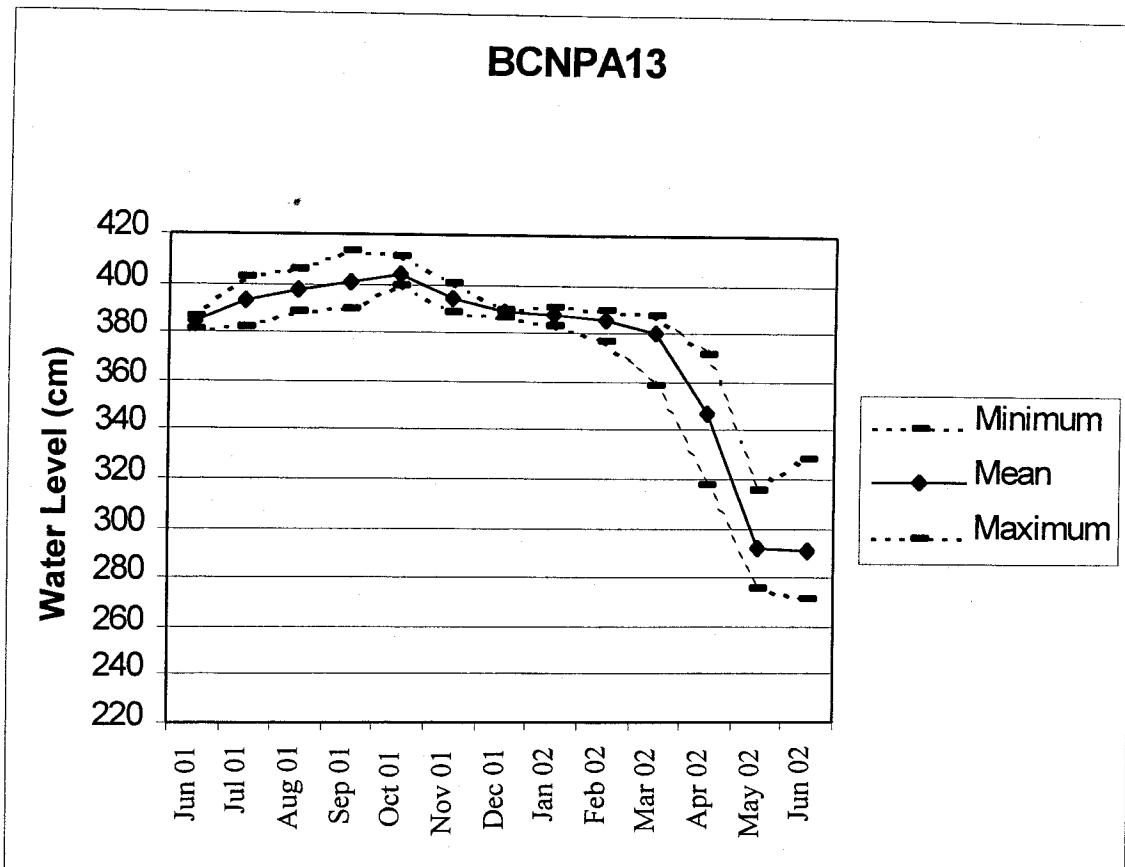


Figure 7. Mean, minimum and maximum water levels for Gauge BCN-A13 within the Big Cypress National Preserve January 2000 to June 2001 (data from USGS).

Gauge BCN-A13 located in central Big Cypress National Preserve had water levels that increased from June 2001 to a high in October 2001. From October 2001 water levels decreased until May 2002 and then increased slightly in June 2002.

Gauge BCN-A11 located in southwest Big Cypress National Preserve had water decrease steadily until March 2002 and then declined rapidly until May 2002 and then begin to increase in June 2002.

Wading Bird Abundance and Distribution for the Big Cypress National Preserve

In 2002, the survey was not conducted during the month of January, however the population estimates for wading birds in the Big Cypress National Preserve during 2002 followed a somewhat similar pattern as surveys during 1999, 2000, and 2001. However, in 2002, the population estimates for wading birds declined from a high in February (31,513) to a low in June (7,233) (Table 2, Figure 8). When the population estimates of wading birds were adjusted for area (relative densities), the highest relative density was in February (9.79 birds per square km) (Table 3). The lowest relative density was in June (2.25 birds per square km).

For comparison, the same density categories for the Water Conservation Areas were used for Big Cypress National Preserve. Wading bird (species combined) distribution maps were scaled to a maximum 3417 birds per square km which provided the highest density category of 2393 to 3417 birds per km² (Appendix B). The highest density category (2393 to 3417) was observed in Big Cypress National Preserve during March and May 2002. The greatest densities of birds were generally observed in north-central and east-central (gap) areas of the preserve.

Table 2. Estimated abundances of wading birds within Big Cypress from February to June 2002.

Species	Feb	Mar	Apr	May	Jun
Great Blue Herons	233	133	73	7	40
Great Egrets	14,693	2,280	2,413	3,253	3,573
Small Dark Herons	107	33	133	7	73
Small White Herons	600	260	820	40	140
White Ibises	13,173	6,973	3,980	4,720	487
Glossy Ibises	20	0	0	0	153
Wood Storks	2,347	1,680	1,953	1,580	127
Cattle Egrets	193	440	1,906	87	2,273
Great White Herons	147	60	33	13	367
Totals	31,513	11,859	11,311	9,707	7,233

Table 3. Estimated densities of wading birds within Big Cypress from February to June 2002 (birds/sq. km).

Species	Feb	Mar	Apr	May	Jun
Great Blue Herons	0.07	0.04	0.02	0.00	0.01
Great Egrets	4.56	0.71	0.75	1.01	1.11
Small Dark Herons	0.03	0.01	0.04	0.00	0.02
Small White Herons	0.19	0.08	0.25	0.01	0.04
White Ibises	4.09	2.17	1.24	1.47	0.00
Glossy Ibises	0.01	0.00	0.00	0.00	0.05
Wood Storks	0.73	0.52	0.61	0.49	0.04
Cattle Egrets	0.06	0.14	0.59	0.03	0.71
Great White Herons	0.05	0.02	0.01	0.00	0.11
Totals	9.79	3.68	3.51	3.01	2.25

*Small dark herons includes those identified as small dark herons, Little Blue Herons and Tricolored Herons.

**Small white herons includes those identified as small white herons and Snowy Egrets.

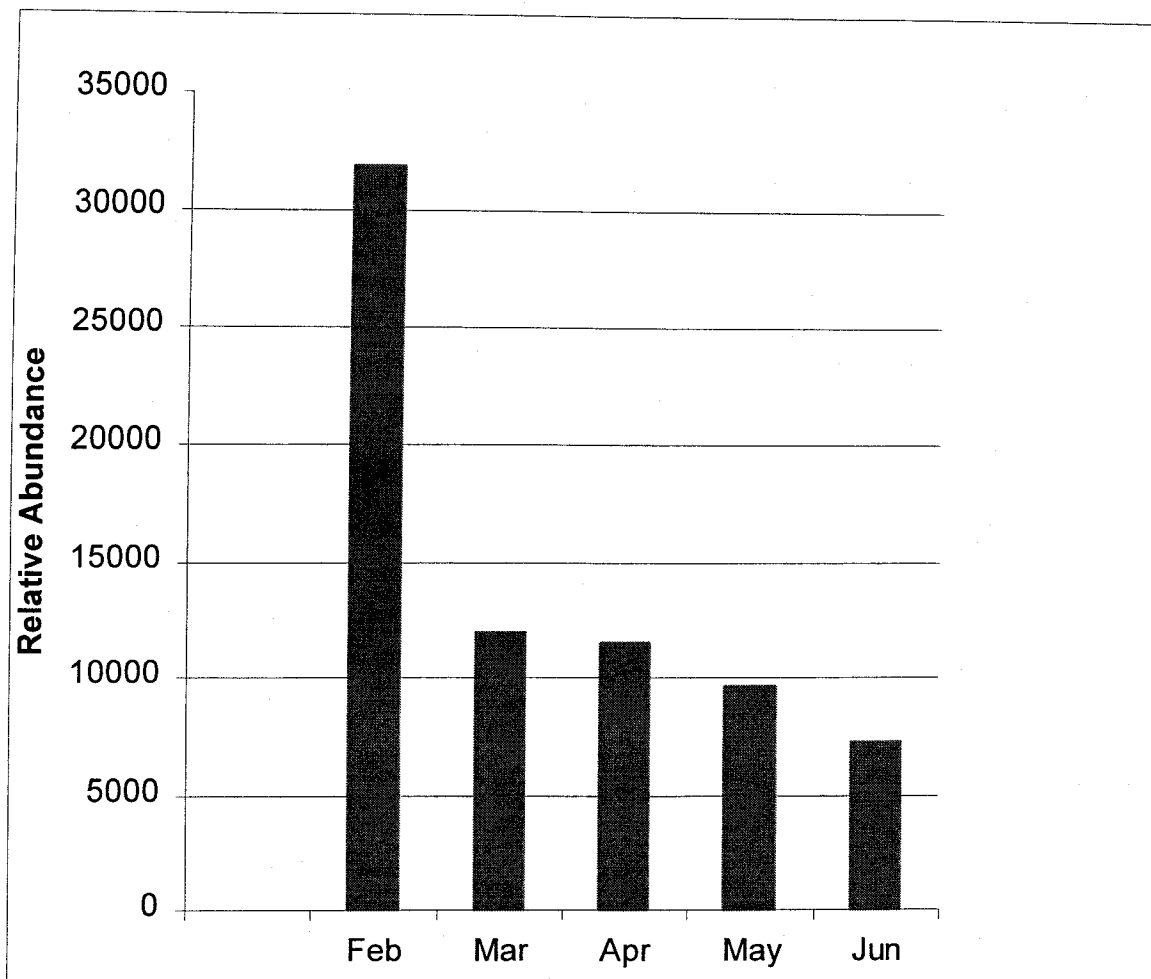


Figure 8. Estimated abundance of wading birds (species combined) in the Big Cypress National Preserve 2002.

Species Accounts for the Big Cypress National Preserve

Great Blue Heron (*Ardea herodias herodias*). Great Blue Herons were generally observed singularly when feeding, roosting, and nesting. Overall Great Blue Heron numbers are very low in the Big Cypress National Preserve. The average relative abundance was 97 Great Blue Herons per month in 2002, 187 Great Blue Herons per month in 2001, 185 Great Blue Herons per month in 2000, and 113 Great Blue Herons per month in 1999. In 2002, estimated abundance of Great Blue Herons decreased from a high in February to a low in May (7) then increased again in June (40). In 2001, estimated abundance of Great Blue Herons increased from January (427) to a high in February (487) then decreased each month to a low in May (13) then increased in June (40). In 2002, Great Blue Heron numbers were lower in February, March, April and May than comparable months in 2001.

The relative density of Great Blue Herons for 2001 was highest in February (0.07 birds/km²) and lowest in May (0.00 birds/km²). The relative density of Great Blue Herons for 2001 was highest in February (0.13 birds/km²) and lowest in May (0.004 birds/km²). The highest density category for Great Blue Herons in Big Cypress National Preserve was 13-17 birds/km². The 13-17 birds/km² category was observed during March, 2002.

Great Egret (*Casmerodius albus*). Great Egrets were the most commonly observed individual bird and the second most abundant bird observed. White ibises were more abundant but were usually observed in large flocks. While Great Egrets were often observed singularly when feeding, groups of 3 or more individuals were also observed feeding, at times, in close proximity to each other. In 2001, the estimated abundances for Great Egrets were at their highest during February (14,693) decreasing to a low in March (2,280) then increased each month through June (3,573). In 2001, the estimated abundances for Great Egrets were at the highest during January (6,153) decreasing each month of the survey to a low in May (147) then increased in June (587). Great Egret

average monthly relative abundance was 5,242 in 2002, 2,244 in 2001, 7,646 in 2000 and 5,178 in 1999.

The relative density of Great Egrets for 2002 was highest in February (4.56 birds/km²) and lowest in March (0.71 birds/km²). The relative density of Great Egrets for 2001 was highest in January (1.91 birds/km²) and lowest in May (0.05 birds/km²). The highest density category of Great Egrets in Big Cypress National Preserve was 594-847 birds/km². The 594-847 birds/km² category was observed during February 2002. The higher densities of Great Egrets tended to be found in the east-central areas (Gap Area) of Big Cypress Preserve.

Small Dark Herons. Small dark herons included Tricolored Herons (*Egretta tricolor*) and dark colored Little Blue Herons (*E. caerulea*). These herons sometimes were not distinguishable from each other when observed from an airplane. This was particularly true if the birds were standing. These two species were observed singularly and in mixed flocks with other individuals and species when feeding and flying.

The estimated abundances for the small dark herons were at relatively low levels during all months of the survey in Big Cypress National Preserve. During the 2002 surveys, small dark heron numbers were highest in April (107) and lowest in May (7). During the 2001 surveys, small dark heron numbers were highest in January (200) and lowest in March (7) and April (7). Small dark heron average monthly relative abundance was 71 in 2002, 25 in 2001, 90 in 2000 and 75 in 1999.

The relative density of small dark herons for 2002 was highest in May (0.04 birds/km²) and lowest in May (less than 0.0 birds/km²). The relative density of small dark herons for 2001 was highest in January (0.02 birds/km²) and low all other months (less than 0.0 birds/km²). The highest density category of small dark herons in Big Cypress National Preserve was 13-17 birds/km². The 13-17 birds/km² category was observed

during April 2002.

Small White Herons. Small white herons included Snowy Egrets (*Egretta thula*) and white (immature) Little Blue Herons (*E. caerulea*). These two smaller, white herons sometimes were not distinguishable from each other when observed from an airplane. This was particularly true if the birds were standing. These birds were observed singularly and in mixed flocks with other individuals and species when flying and feeding.

The estimated abundances of small white herons in 2002 were highest in April (820) and lowest in May (40). The estimated abundances of small white herons in 2001 were highest in January (160) and April (227) and lowest in May (20). Small white heron average monthly relative abundance was 372 in 2002, 128 in 2001, 270 in 2000 and 613 in 1999.

The relative density of small white herons for 2001 was highest in April (0.25 birds/km²) and lowest in May (0.01 birds/km²). The relative density of small white herons for 2001 was highest in January (0.05 birds/km²) and April (0.07 birds/km²) and lowest in May (0.01 birds/km²). The highest density category of small white herons in Big Cypress National Preserve was 141-200 birds/km². The 141-200 birds/km² category was not observed in Big Cypress National Preserve during 2002.

White Ibis (*Eudocimus albus*). White Ibises were most commonly observed in large flocks roosting, feeding and flying. These birds were commonly observed in mixed flocks with Glossy Ibises, Little Blue Herons, and/or Tricolored Herons. White ibises were the most abundant birds observed during the surveys. White Ibises used the trees in Big Cypress extensively for roosting. In 2002, the population estimates for White Ibises was highest in February (13,173) and lowest in June (487) (Table 3.). In 2001, the population estimates for White Ibises was highest in January (25,080) and lowest in May (80). White Ibis average monthly relative abundance was 5,867 in 2002, 5,301 in 2001

8,435 in 2000 and 12,111 in 1999.

The relative density of White Ibis for 2002 was highest in February (4.09 birds/km²) and lowest in June (0.15 birds/km²). The relative density of White Ibis for 2001 was highest in January (7.79 birds/km²) and lowest in May (0.02 birds/km²). The highest density category of White Ibis in Big Cypress National Preserve was 2,334-3,334 birds/km². The 2,334-3,334 birds/km² category was not observed in 2002. The higher densities of White Ibises tended to be found in the northwest and east-central areas of Big Cypress National Preserve.

Glossy Ibis (*Plegadis facinellus*). Glossy Ibises were the least abundant species observed in the Big Cypress National Park. In 2002, the population estimates for Glossy Ibises was highest in June (67) and lowest March to May (0) (Table 3.). In 2001, the population estimates for Glossy Ibises was highest in February (67) and lowest March to June (0) (Table 3.). Glossy Ibis average monthly relative abundance was 34.6 in 2002, 12.3 in 2001, 54.3 in 2000 (54.3), and 1.2 in 1999.

The relative density of Glossy Ibis for 2002 was highest in June (0.05 birds/km²) and low the other months (less than 0.01 birds/km²). The relative density of Glossy Ibis for 2001 was highest in February (0.02 birds/km²) and low the other months (less than 0.00 birds/km²). The highest density category of Glossy Ibis in Big Cypress National Preserve was 55-77 birds/km². The 55-77 birds/km² category was not observed during 2002. The densities of Glossy Ibis were very low in Big Cypress National Preserve.

Wood Stork (*Mycteria americana*). Wood Storks were observed roosting and feeding singularly or in small groups and sometimes flying in mixed flocks with other individuals and species. In 2002, the estimated abundance for the Wood Storks was highest in February (2,347) and lowest in June (127) (Table 3.). In 2001, the estimated abundance for the Wood Storks was highest in January (1,733) and lowest in May (7)

(Table 3.). Wood Stork average monthly relative abundance was 1537 in 2002, 566 in 2001, 837 in 2000 and 1,037 in 1999.

The relative density Wood Storks for 2002 was highest in February (0.73 birds/km²) and lowest in June (0.04 birds/km²). The relative density Wood Storks for 2001 was highest in January (0.54 birds/km²) and lowest in May (less than 0.00 birds/km²). The highest density category of Wood Stork in Big Cypress National Preserve was 293-417 birds/km². The 293-417 birds/km² category was not observed during 2002.

Other Species of Wading Birds. Cattle Egrets were observed during all months of the survey in 2002 and 2001. Cattle Egrets were most commonly observed in the agricultural areas in the north-west and north-central border of Big Cypress National Preserve. In 2002, the estimated abundance for Cattle Egrets was highest in June (2,273). The least number of Cattle Egrets were observed during May (87). Cattle Egret average monthly relative abundance was 980 in 2002, 684 in 2001, 1,251 in 2000 and 1,283 in 1999. In 2002, Great White Herons were observed during all months (range, 367 in June to 13 in May).

DISCUSSION

In Big Cypress National Preserve the monthly percent of wet cells declined from 48 % wet cells in February 2002 to 6 % in April 2002 then increased in June 2002 to 100 %. 2001 was generally dry from January (18 % wet cells) to June (14 % wet cells). In 2000, the percent of wet cells decreased from 72 % in January 2000 to 13 % in March 2000. Water levels were higher in 2002 than 2001. In 2002, water levels declined from October/November 2001 until June 2002. In June 2002 water levels begin to increase with the influx of rain. In 2001, water levels followed the same pattern as surface water declining to April 2001. Water levels were lower from January to April in 2001 than the same months in 2000.

The population estimates for wading birds while higher in 2002 than 2001 followed a similar pattern as 1999, 2000 and 2001 declining from highs in January/February to lows in May/June (Appendix J)(Nelson and Theriot, 2000).). Wading bird average monthly relative abundance was much higher in 2002 (14,325) than in 2001 (9,189). Wading bird average monthly relative abundance was much lower in 2001 (9,189) than in 2000 (18,774) and 1999 (20,412). Great Blue Herons had average monthly relative abundance in 2002 lower in value than as 2001. While Great Egrets, White Ibises, Glossy Ibises, Wood Storks, Cattle Egrets, small dark herons and small white herons had higher average monthly relative abundance in 2002 than in 2001. Great Egret average monthly relative abundance in 2002 was over twice the average in 2001.

The areas with greatest densities of wading birds in Big Cypress National Preserve were the southeast corner, the southwest corner, and east-central (L28 Gap area). These areas tended to remain wet longer than other areas. The average monthly density of

wading birds in Big Cypress National Preserve for 2002 (4.45 birds/km²) was lower than average monthly densities for WCA 1 (20.58 birds/km²), WCA 2A (26.70 birds/km²), WCA 2B (28.41 birds/km²), WCA 3A (15.52 birds/km²) and WCA 3B (5.51 birds/km²) (Nelson and Metzger, 2002). Extensive areas of dry habitat in central and northern Big Cypress were not used by wading birds.

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D2. Density maps of Great Egrets in the Big Cypress National Preserve, March 2002.

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- E3. Density maps of small dark herons in the Big Cypress National Preserve, April 2002.
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**APPENDIX A: Transect latitudes and west and
east boundary latitudes in the Big Cypress
National Preserve, 2002.**

Appendix A. Transect latitudes, western-and eastern-most cell longitudes^a (see Fig. 3).

Transect	Latitude ^b (Deg/Min)	W. Longitude ^c (Min)	E. Longitude ^c (Min)
26	26° 17.40	81° 26.46	80° 50.41
27	16.31	26.46	50.42
28	15.23	26.46	50.42
29	14.15	26.46	50.42
30	13.06	26.46	50.42
31	11.98	26.43	50.42
32	10.90	26.43	50.42
33	09.81	22.00	50.43
34	08.73	22.00	50.43
35	07.65	22.25	50.43
36	06.56	22.50	50.43
37	05.48	22.50	50.43
38	04.40	22.30	50.43
39	03.31	22.25	50.43
40	02.23	22.50	50.43
41	01.15	22.50	50.44
42	00.06	22.30	50.44
43	25° 58.98	22.30	50.44
44	57.90	22.50	50.44
45	56.81	22.70	50.44
46	55.73	22.50	50.44
47	54.65	23.50	50.45
48	53.56	23.50	50.45
49	52.48	23.50	50.45
50	51.40	23.50	51.65
51	50.31	23.50	51.65
52	49.23	23.50	51.65
53	48.15	23.50	51.65
54	47.06	23.50	51.65

^a Longitudes listed are western edge of the western-most cell and eastern edge of the eastern-most cell. It should be noted that only birds within the perimeter levees of Big Cypress were counted (see Fig. 3).

^b Transect latitudes pass through the center of each cell.

^c All Western boundary longitudes contained within the 81° meridian and all Eastern longitudes contained within the 80° meridian.

APPENDIX B: Monthly density maps of wading birds (species combined) in the Big Cypress National Preserve, February to June 2002.

B1. Density maps of wading birds (species combined) in the Big Cypress National Preserve, February 2002.

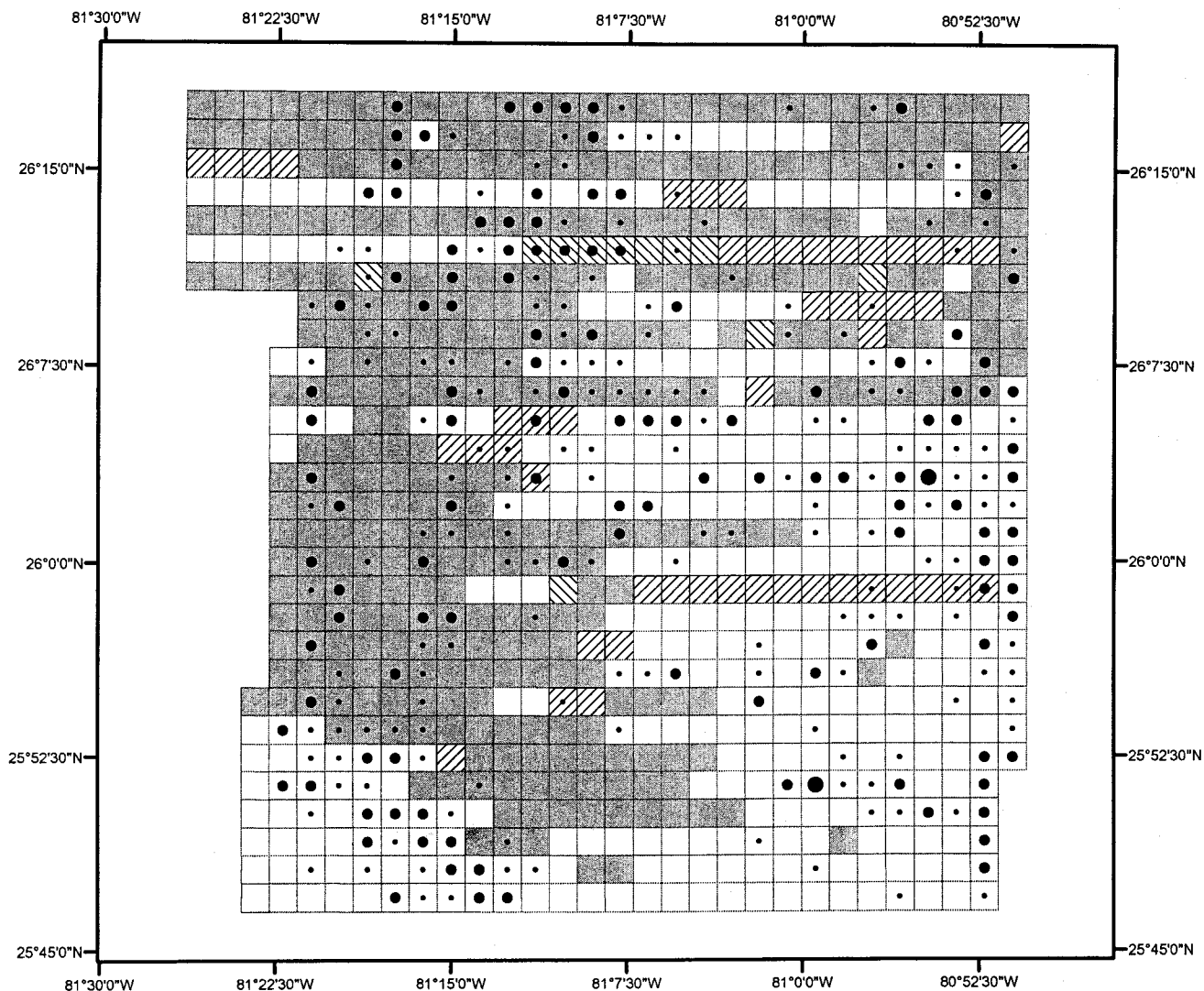
B2. Density maps of wading birds (species combined) in the Big Cypress National Preserve, March 2002.

B3. Density maps of wading birds (species combined) in the Big Cypress National Preserve, April 2002.

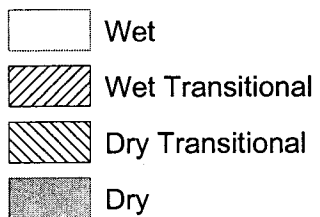
B4. Density maps of wading birds (species combined) in the Big Cypress National Preserve, May 2002.

B5. Density maps of wading birds (species combined) in the Big Cypress National Preserve, June 2002.

Combined Species Big Cypress February 2002



Water Conditions

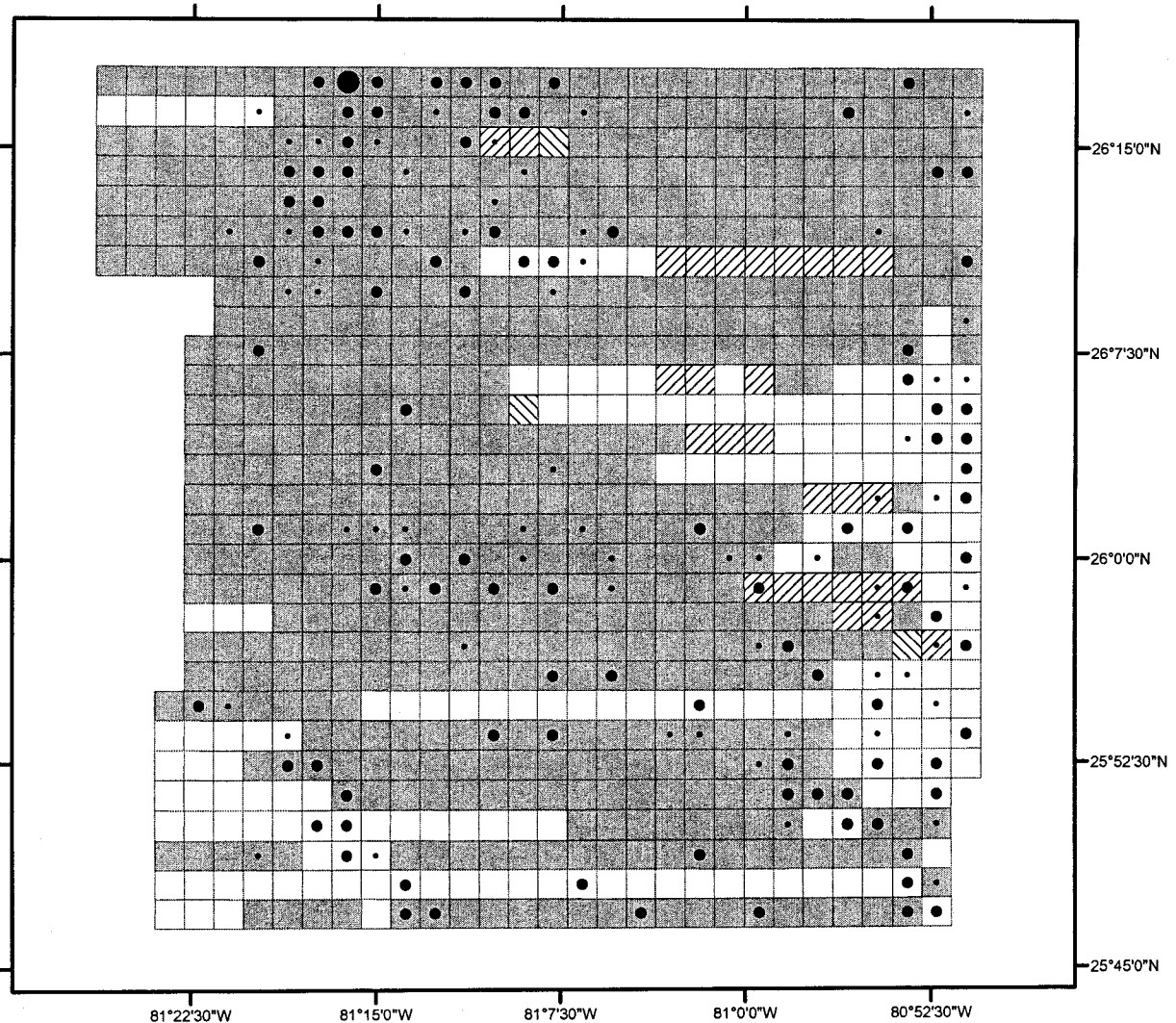


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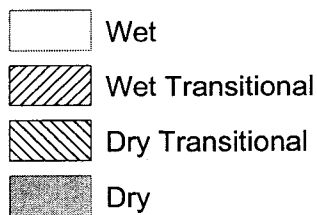
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- 1.68 - 342
- 343 - 1025
- 1026 - 2392
- 2393 - 3417



Combined Species Big Cypress March 2002

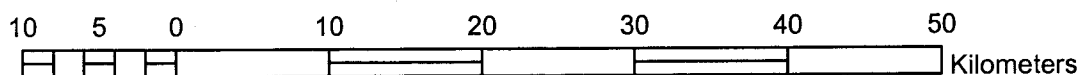


Water Conditions

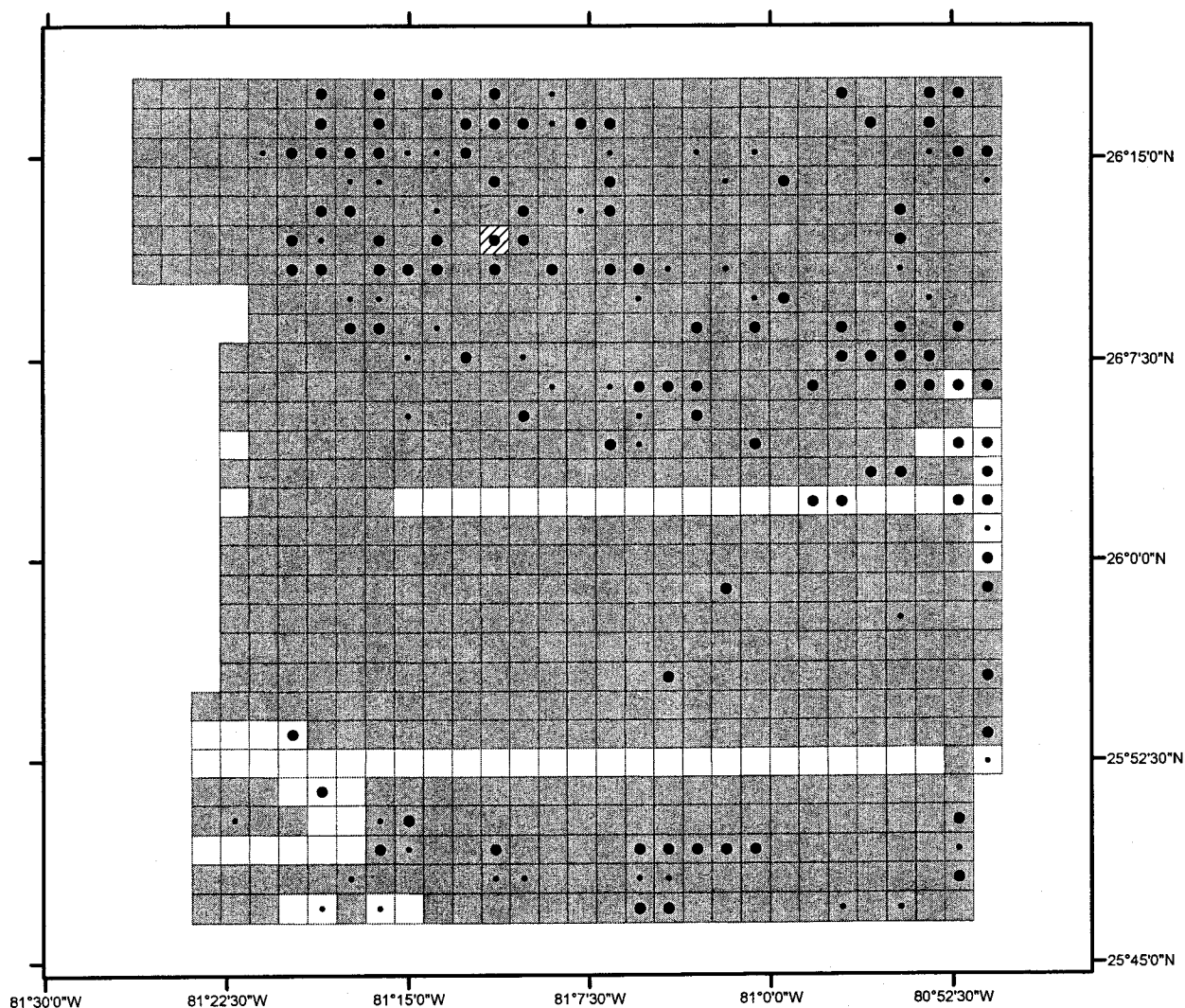


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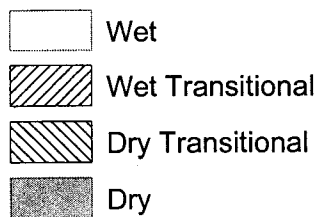
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- 2393 - 3417



Combined Species Big Cypress April 2002



Water Conditions

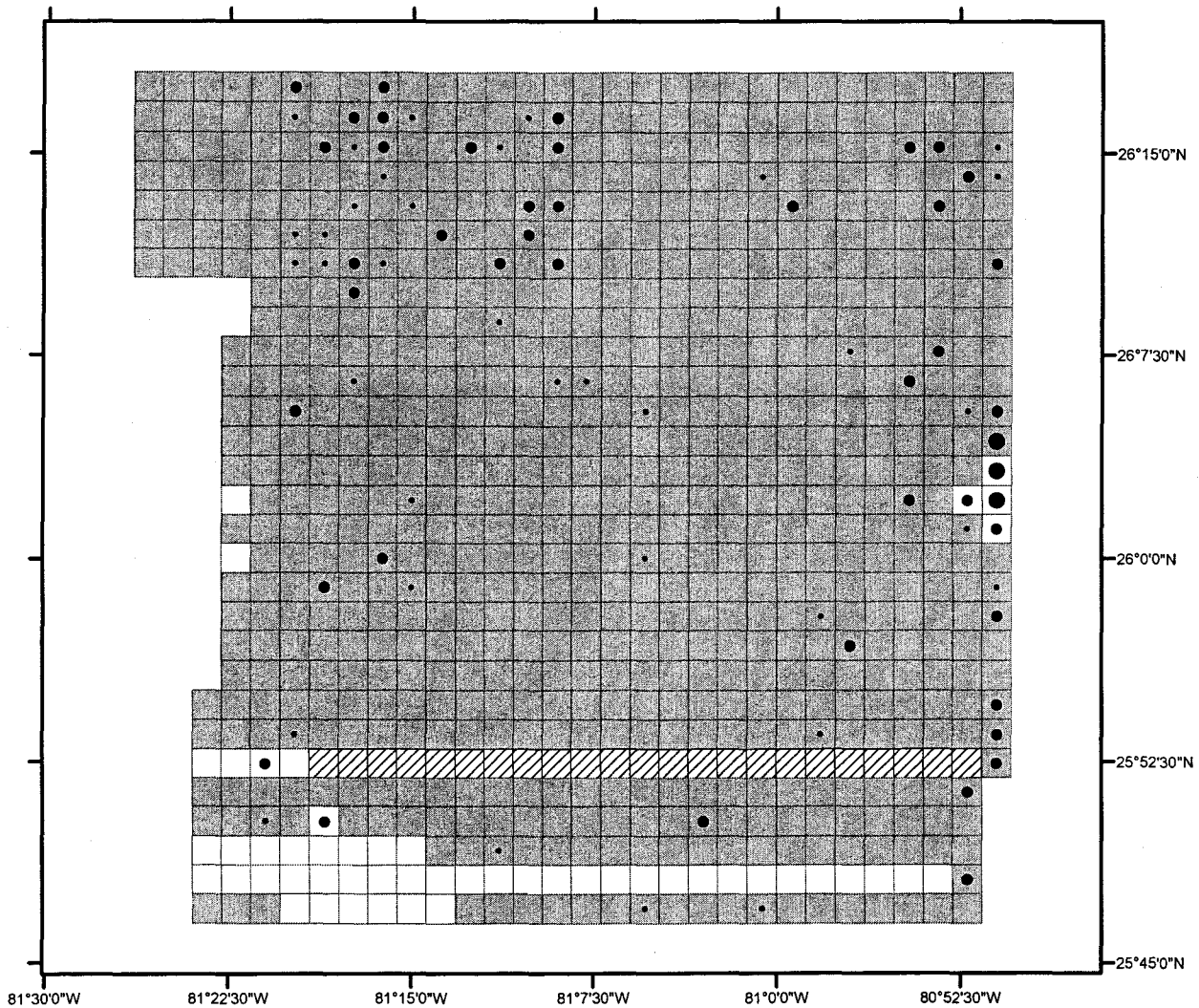


Density Categories Birds Per Square Km

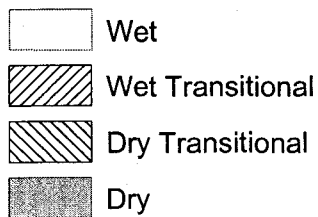
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- 1.68 - 342
- 343 - 1025
- 1026 - 2392
- 2393 - 3417



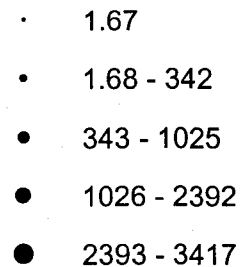
Combined Species Big Cypress May 2002



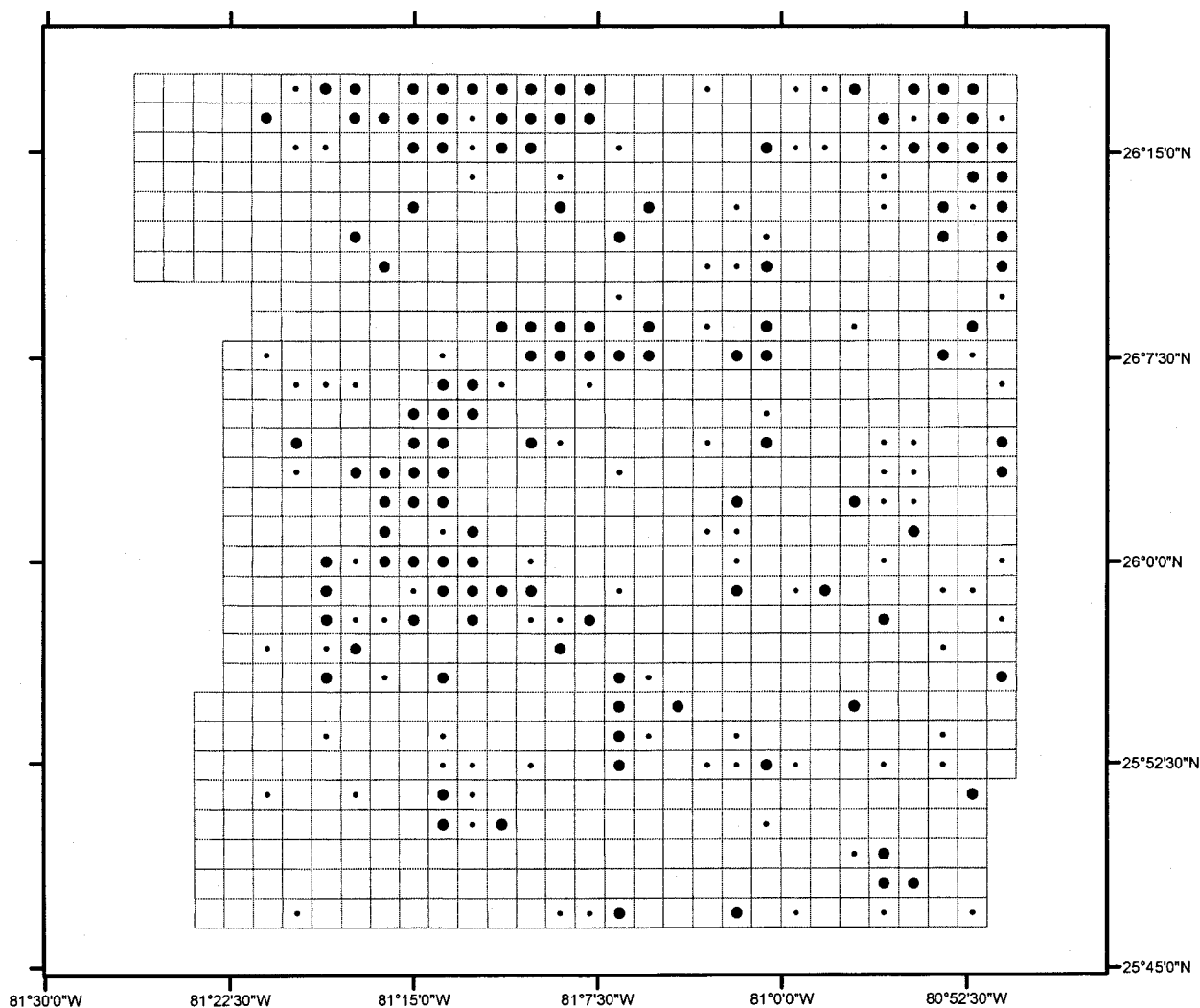
Water Conditions



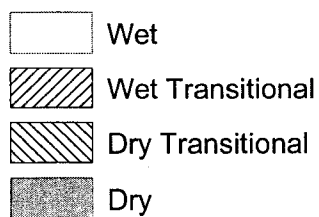
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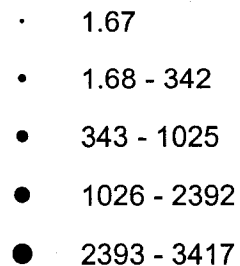
Combined Species Big Cypress June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX C: Monthly density maps of Great Blue Herons in the Big Cypress National Preserve, February to June 2002.

C1. Density maps of Great Blue Herons the Big Cypress National Preserve, February 2002.

C2. Density maps of Great Blue Herons in the Big Cypress National Preserve, March 2002.

C3. Density maps of Great Blue Herons in the Big Cypress National Preserve, April 2002.

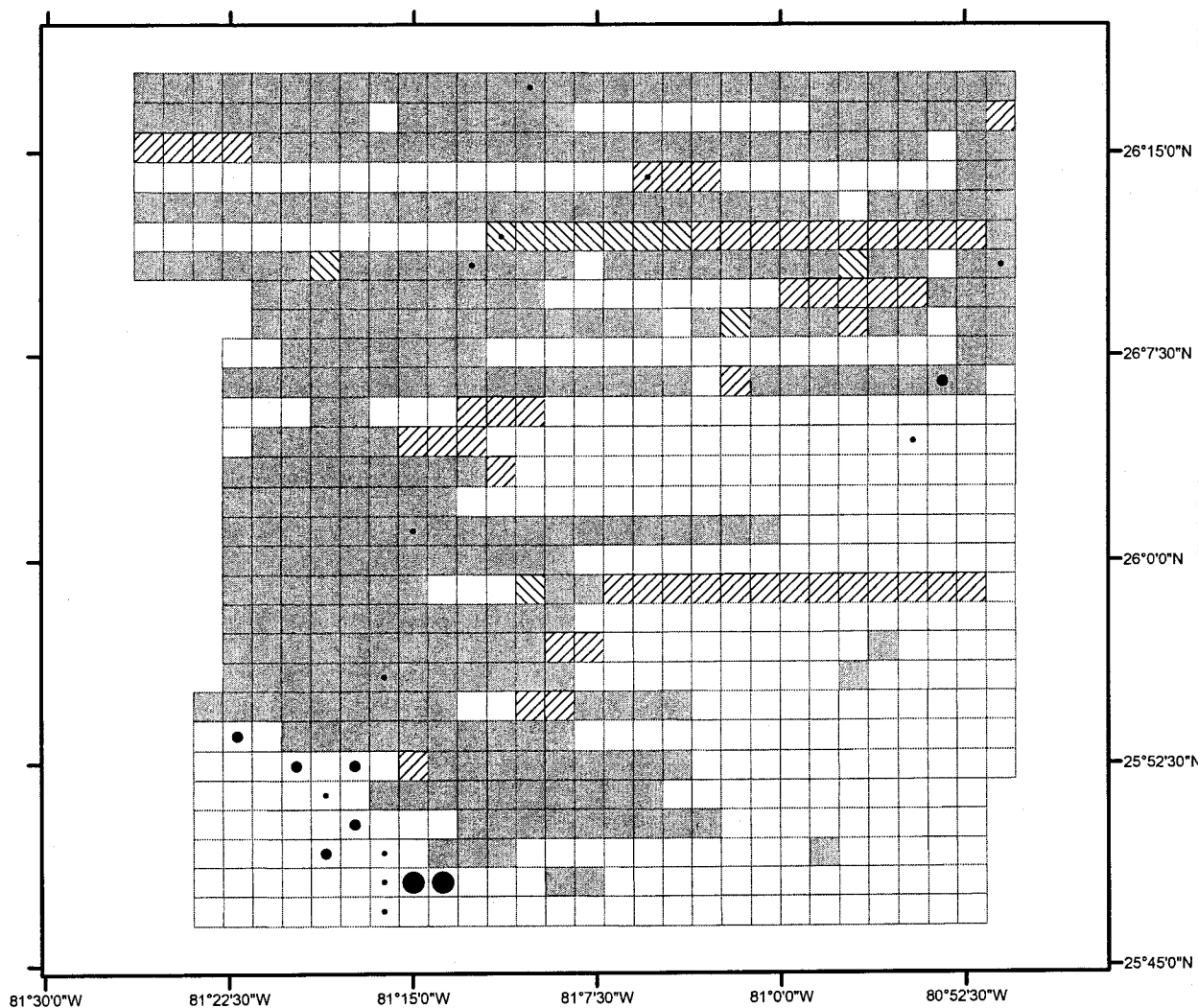
C4. Density maps of Great Blue Herons in the Big Cypress National Preserve, May 2002.

C5. Density maps of Great Blue Herons in the Big Cypress National Preserve, June 2002.

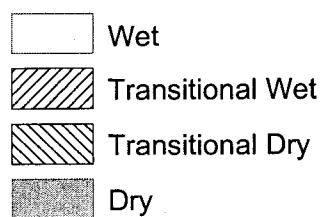
Great Blue Herons

Big Cypress

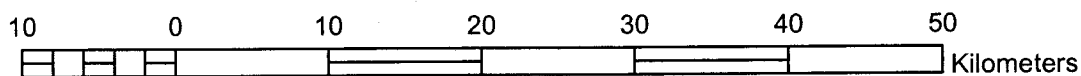
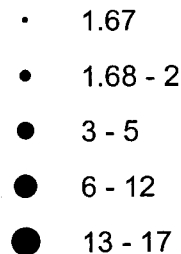
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Water Conditions



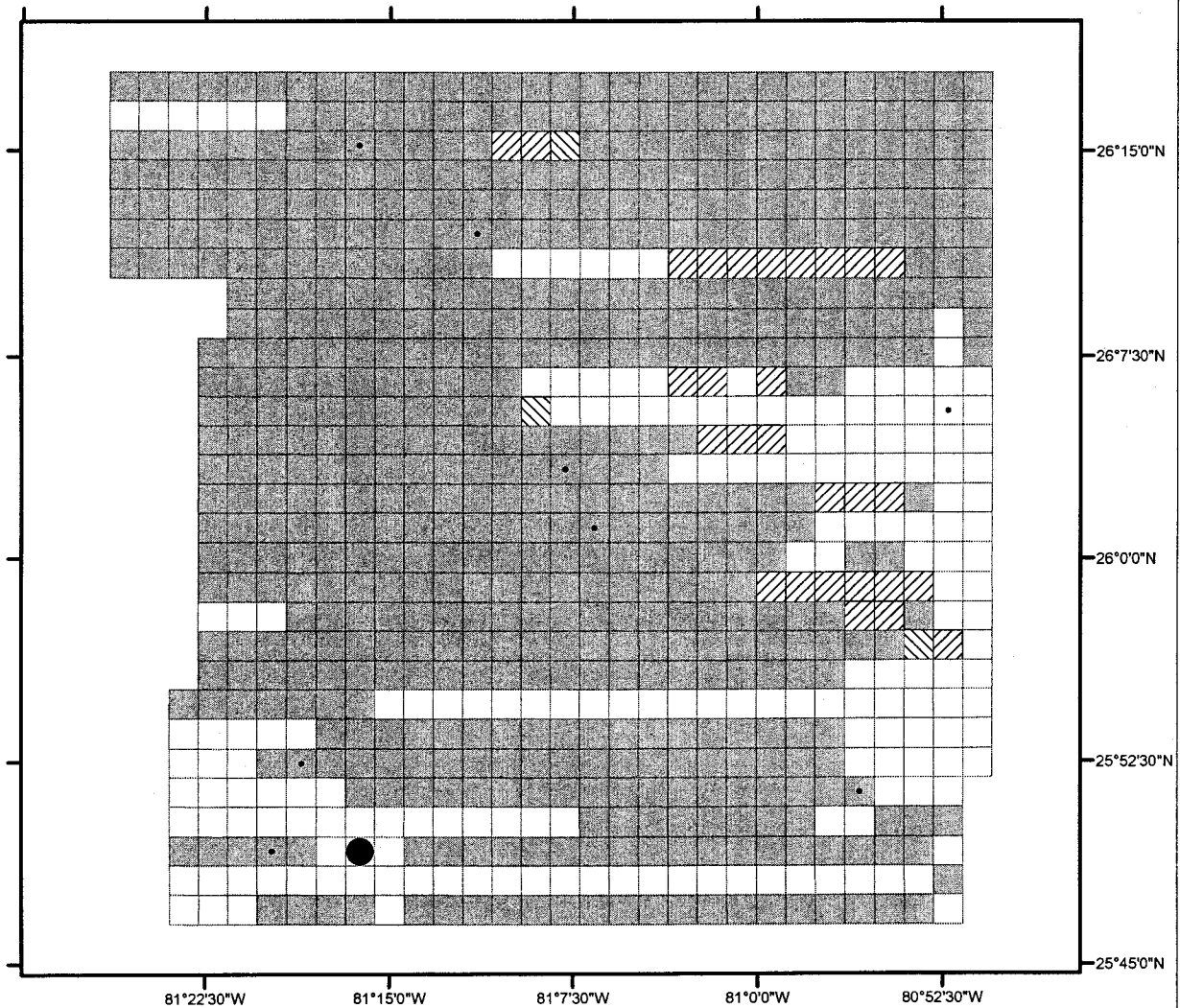
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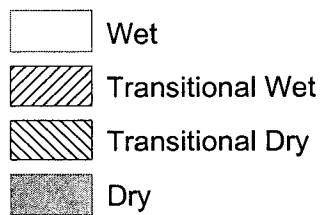
Great Blue Herons

Big Cypress

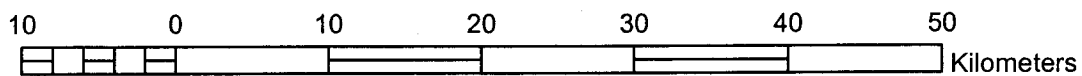
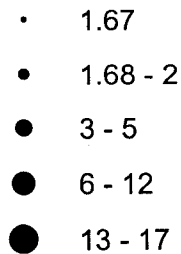
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Water Conditions



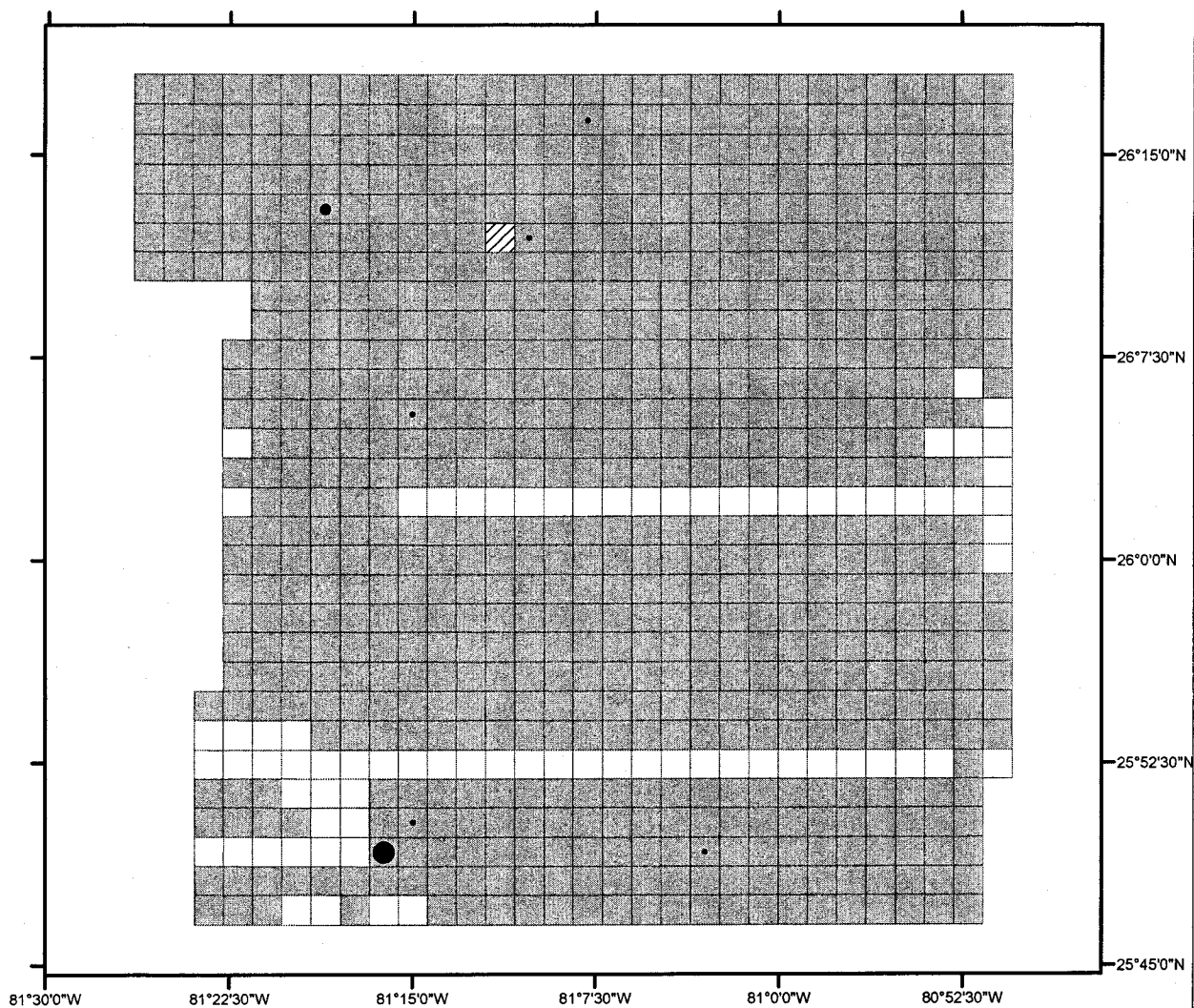
Density Categories Birds Per Square Km



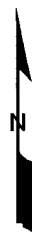
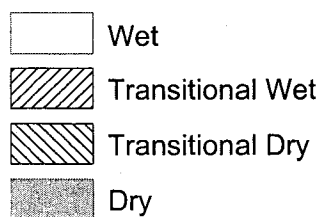
Great Blue Herons

Big Cypress

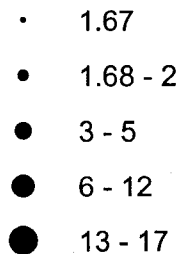
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Water Conditions



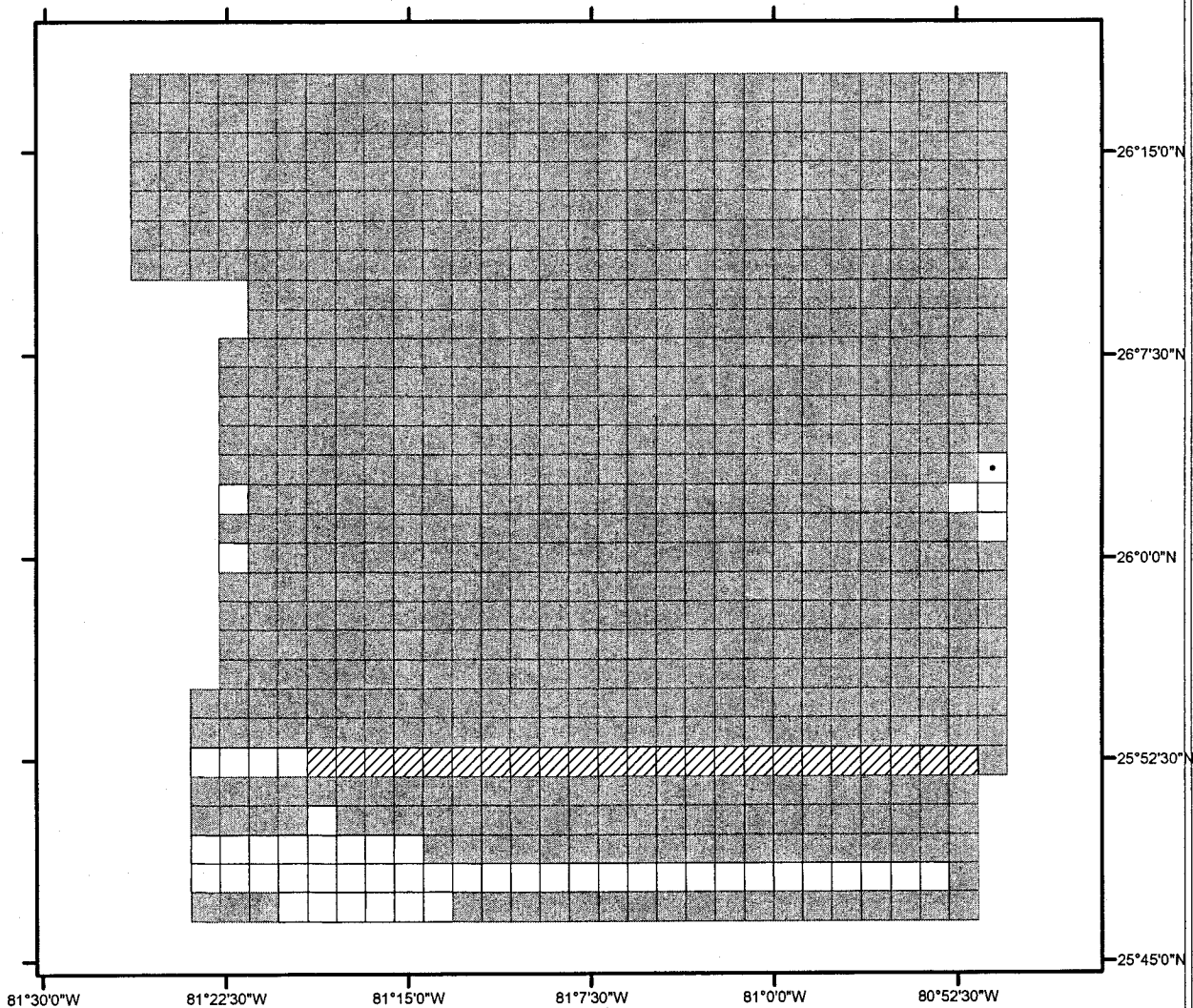
Density Categories Birds Per Square Km



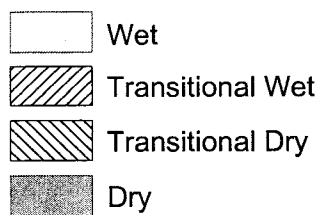
Great Blue Herons

Big Cypress

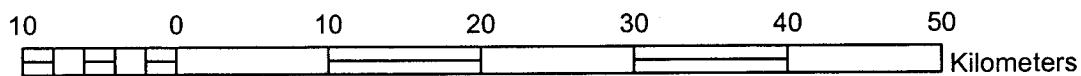
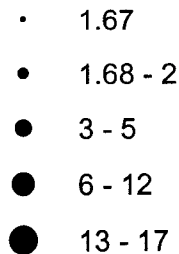
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Water Conditions



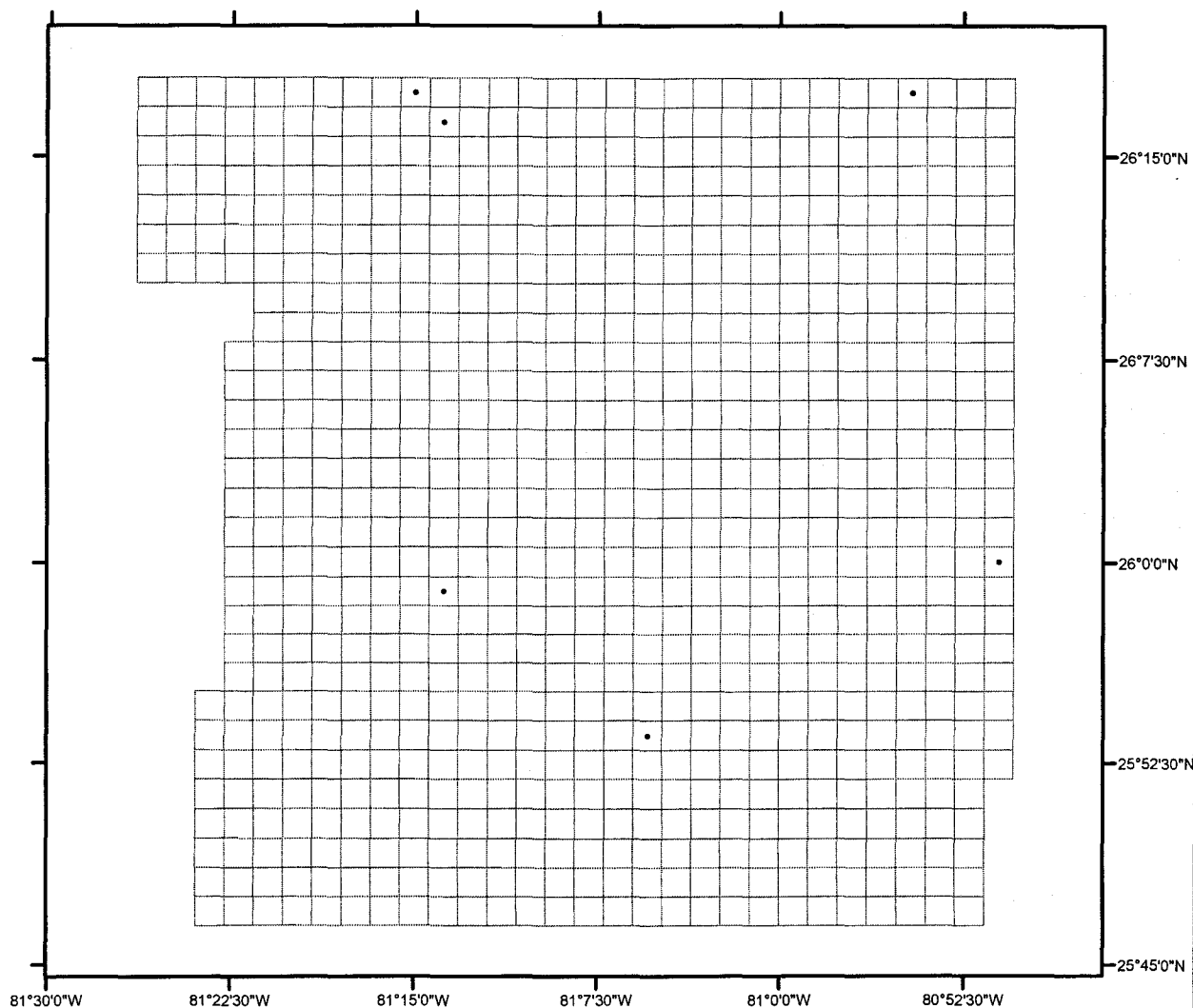
Density Categories Birds Per Square Km



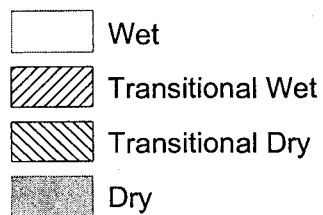
Great Blue Herons

Big Cypress

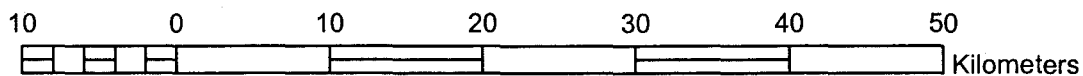
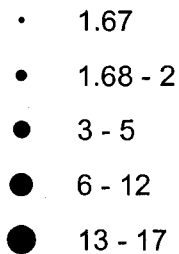
June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX D: Monthly density maps of Great Egrets in the Big Cypress National Preserve, February to June 2002.

D1. Density maps of Great Egrets in the Big Cypress National Preserve, February 2002.

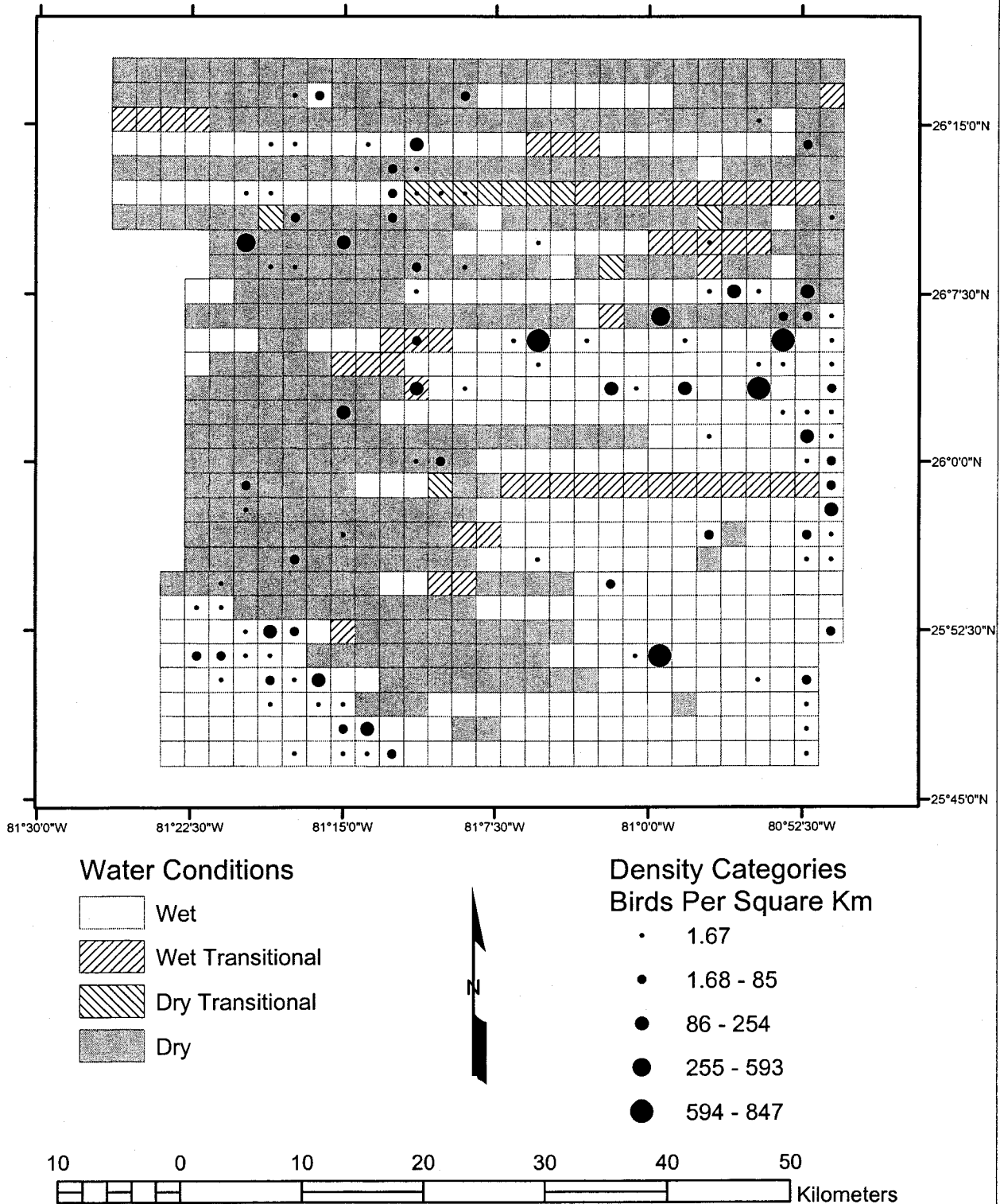
D2. Density maps of Great Egrets in the Big Cypress National Preserve, March 2002.

D3. Density maps of Great Egrets in the Big Cypress National Preserve, April 2002.

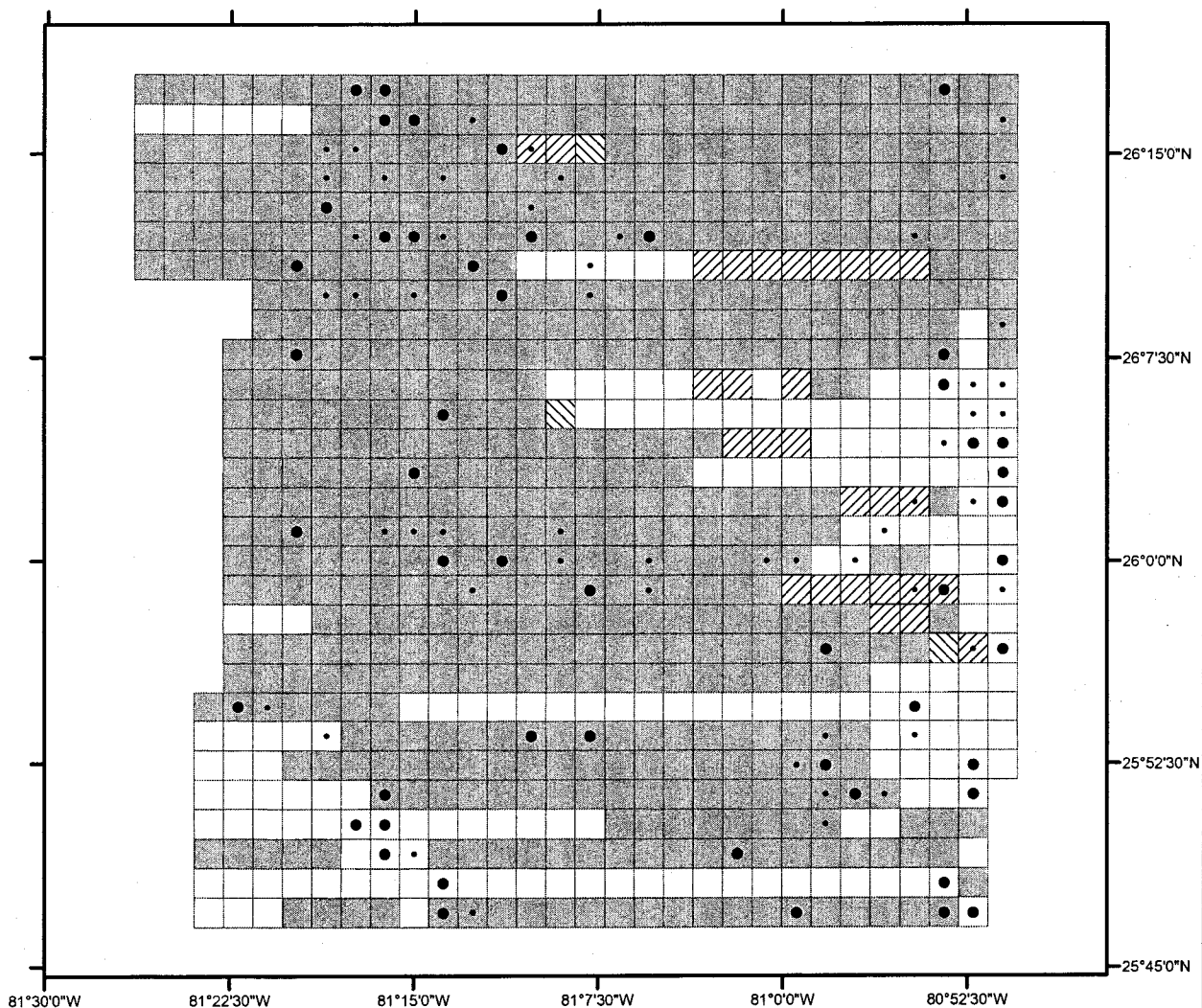
D4. Density maps of Great Egrets in the Big Cypress National Preserve, May 2002.

D5. Density maps of Great Egrets in the Big Cypress National Preserve, June 2002.

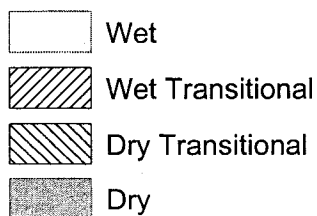
Great Egrets Big Cypress February 2002



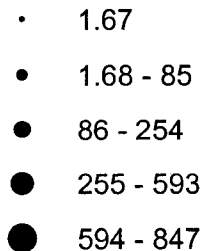
Great Egrets Big Cypress March 2002



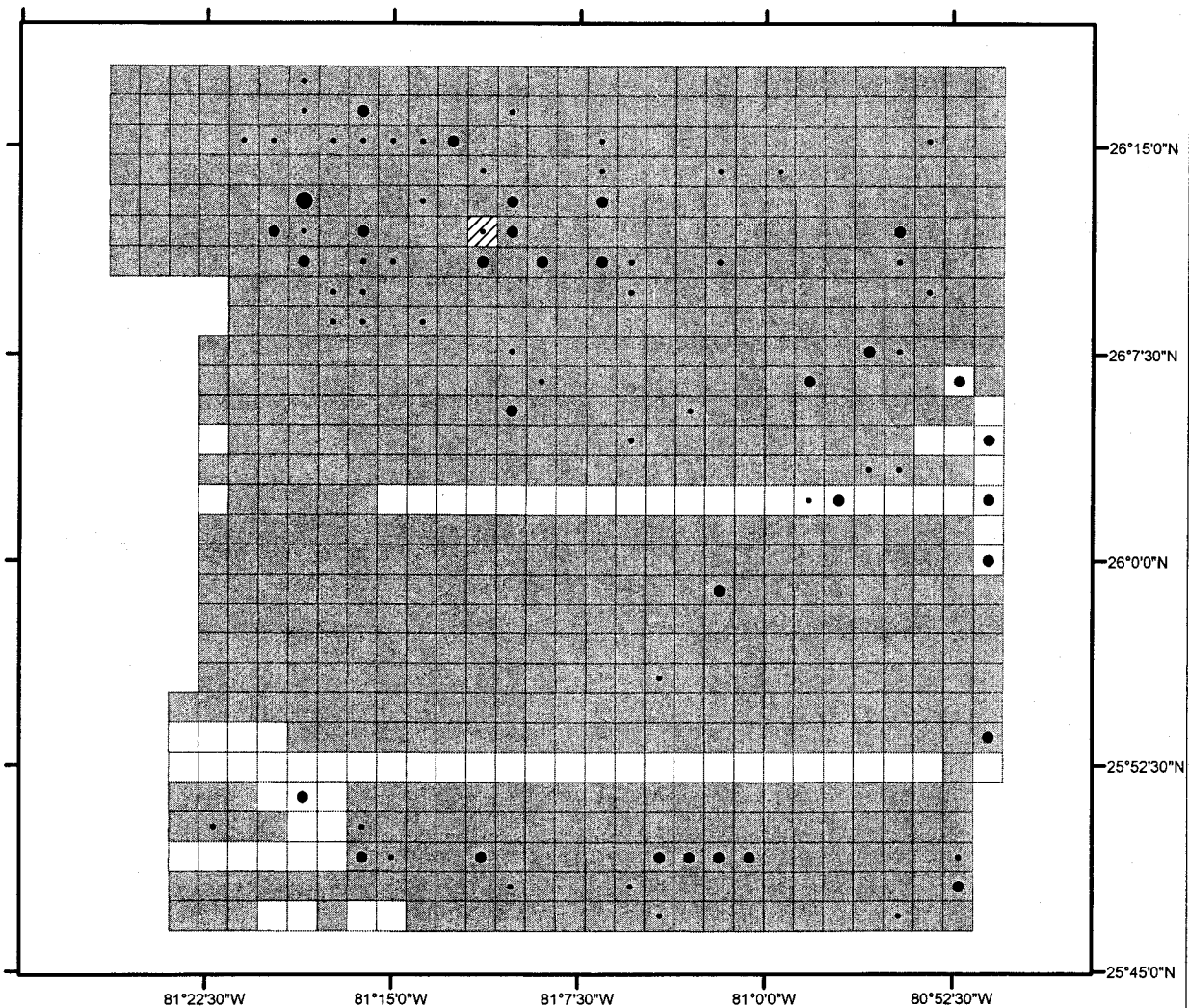
Water Conditions



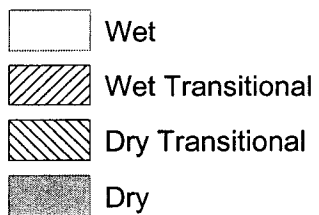
Density Categories Birds Per Square Km



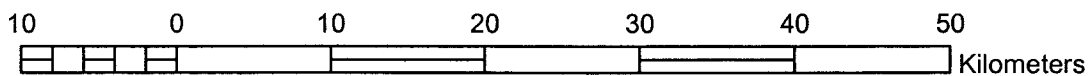
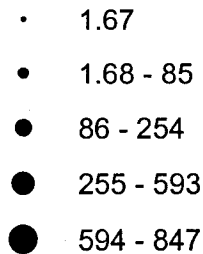
Great Egrets Big Cypress April 2002



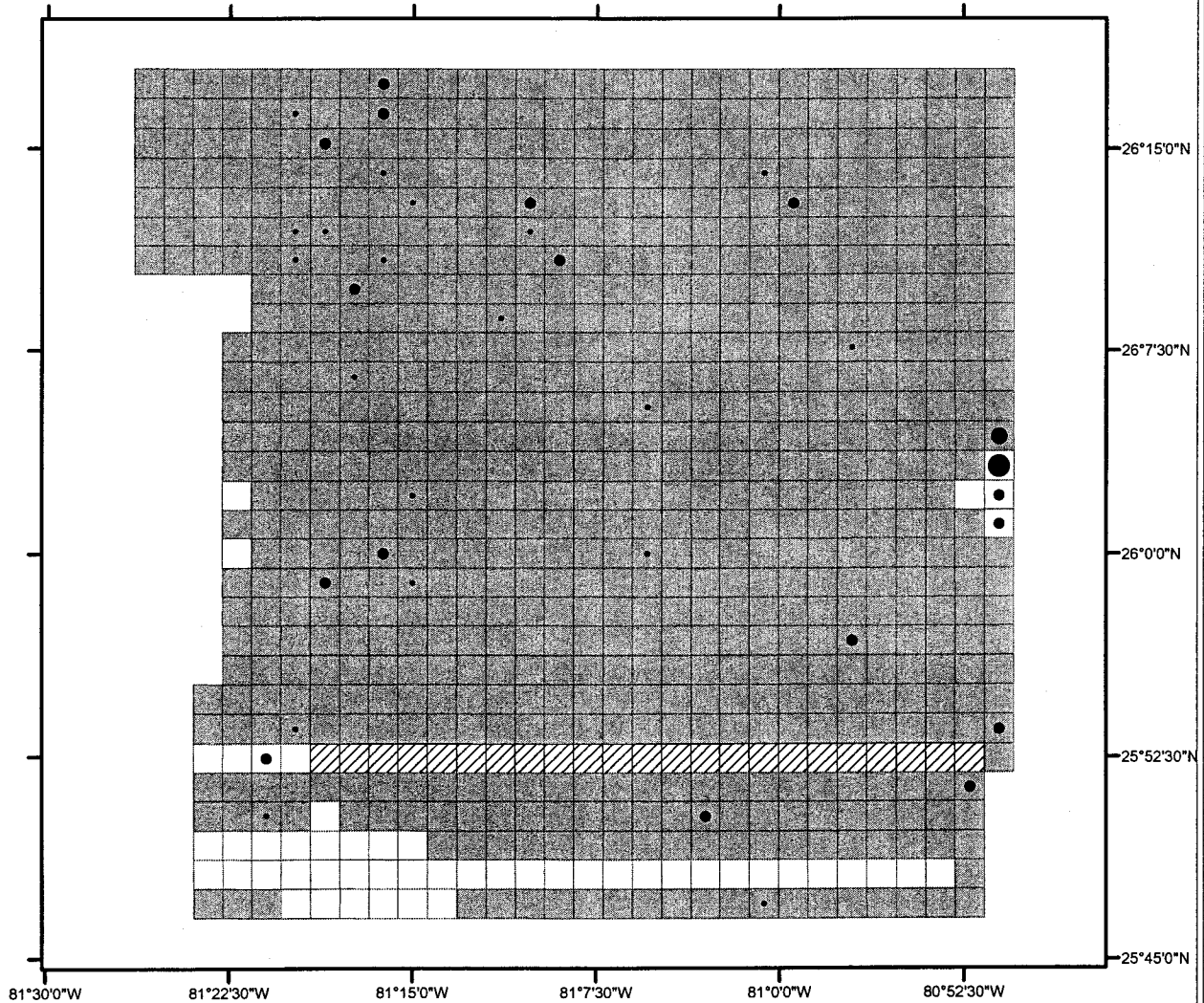
Water Conditions



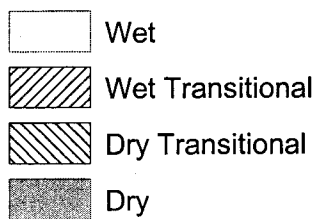
Density Categories Birds Per Square Km



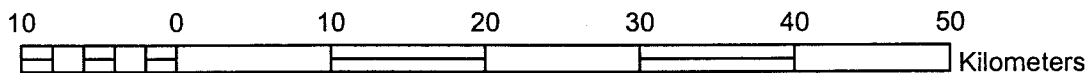
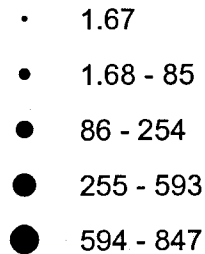
Great Egrets Big Cypress May 2002



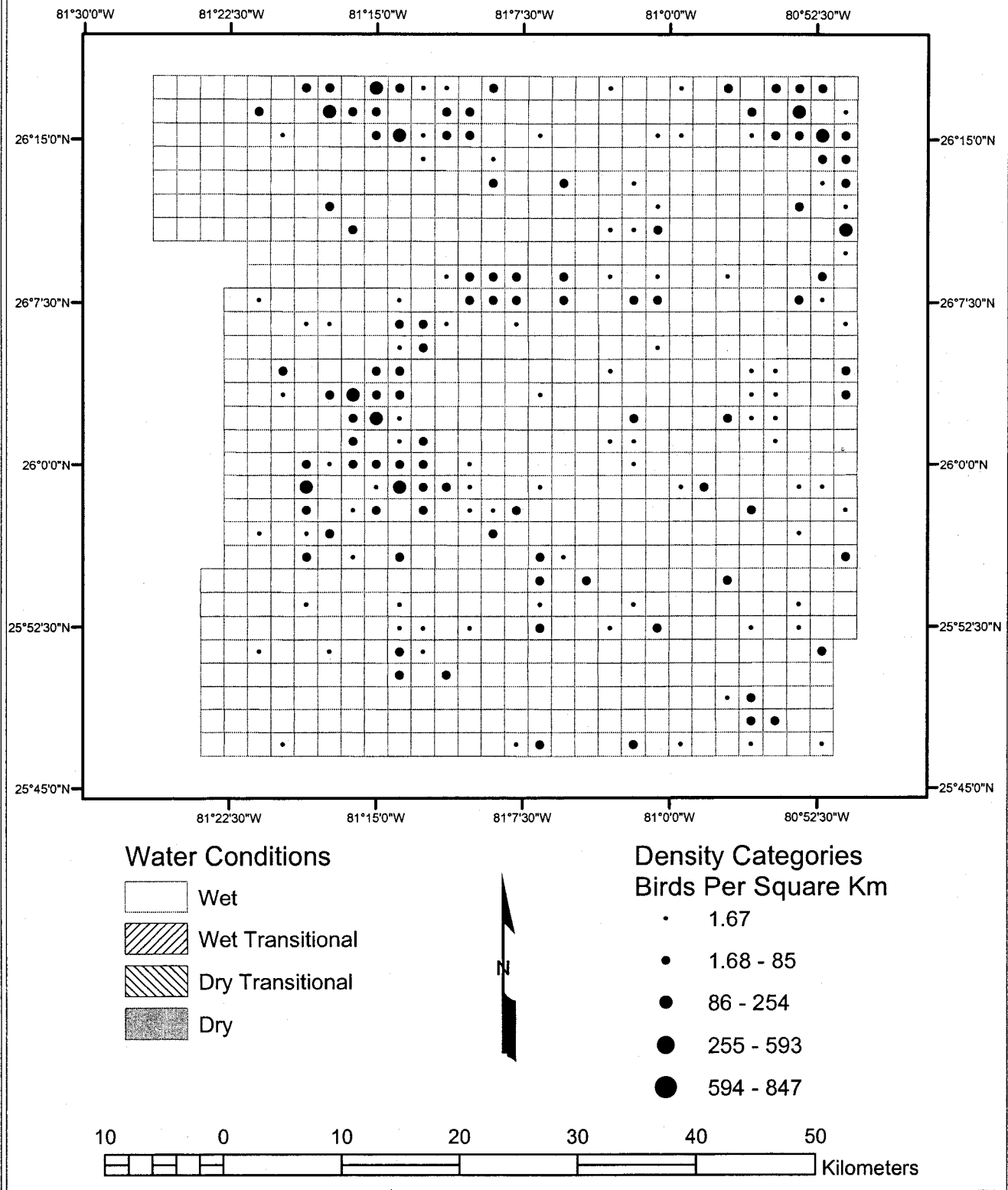
Water Conditions



Density Categories Birds Per Square Km



Great Egrets Big Cypress June 2002



APPENDIX E: Monthly density maps of small dark herons in the Big Cypress National Preserve, February to June 2002

E1. Density maps of small dark herons the Big Cypress National Preserve, February 2002.

E2. Density maps of small dark herons in the Big Cypress National Preserve, March 2002.

E3. Density maps of small dark herons in the Big Cypress National Preserve, April 2002.

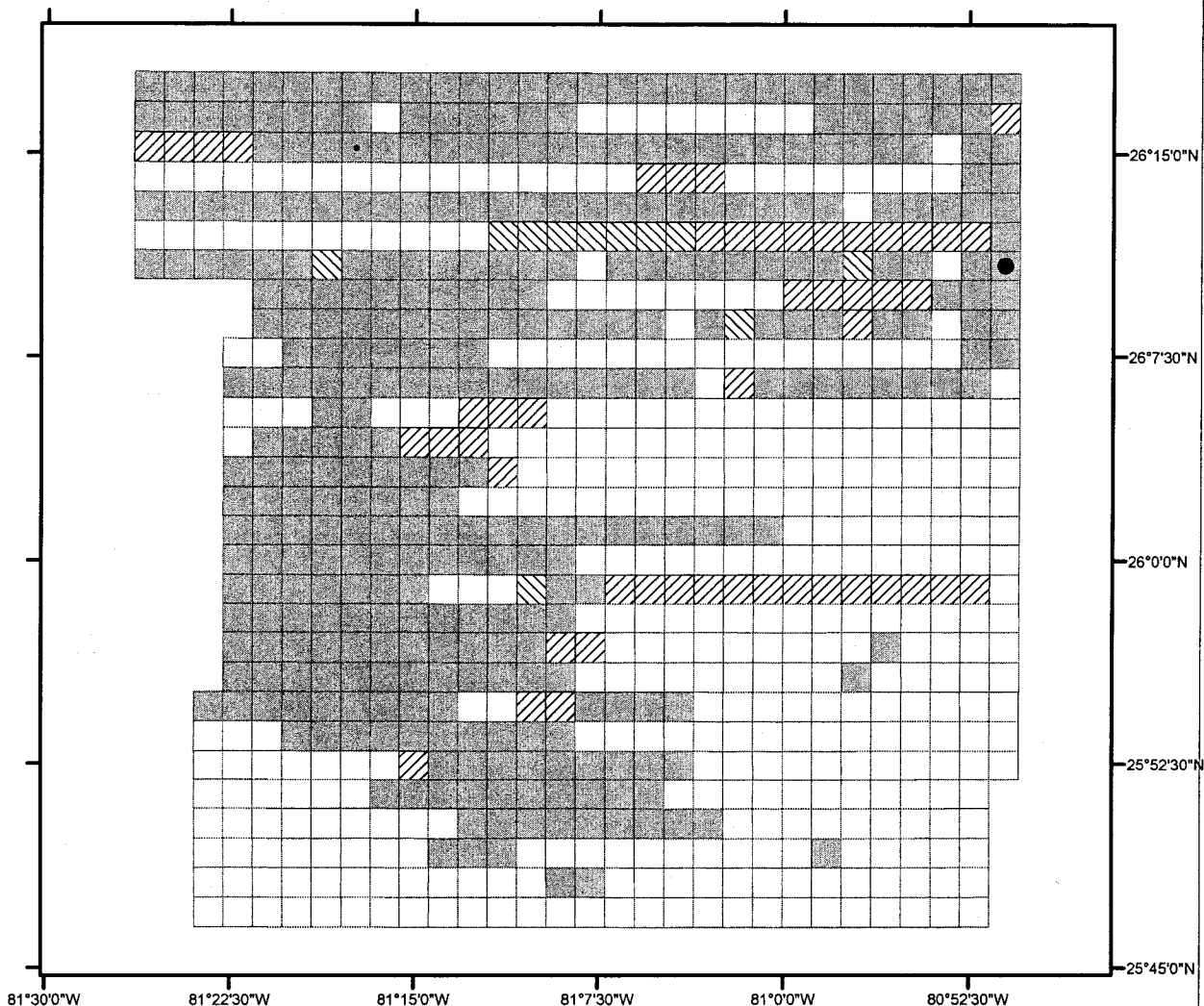
E4. Density maps of small dark herons in the Big Cypress National Preserve, May 2002.

E5. Density maps of small dark herons in the Big Cypress National Preserve, June 2002.

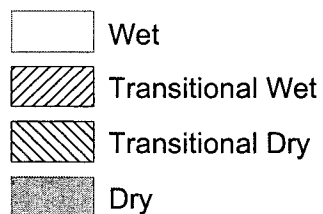
Small Dark Herons

Big Cypress

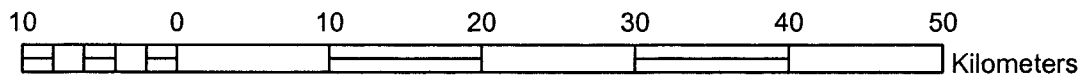
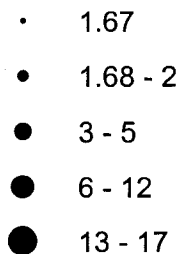
February 2002



Water Conditions



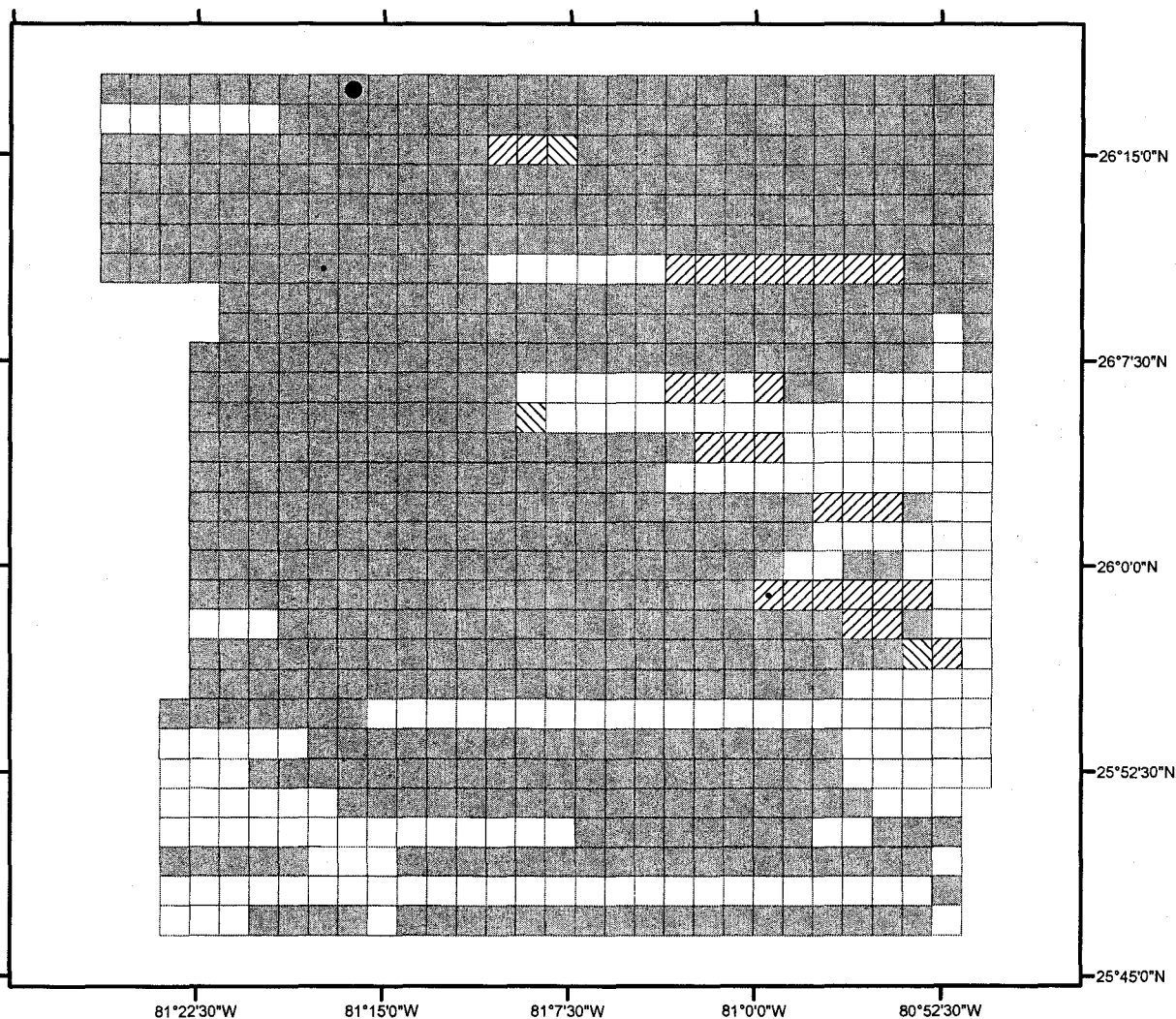
Density Categories Birds Per Square Km



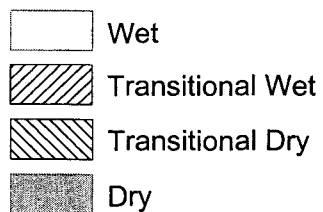
Small Dark Herons

Big Cypress

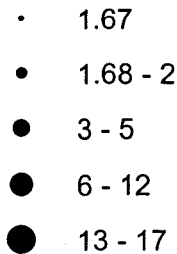
March 2002



Water Conditions



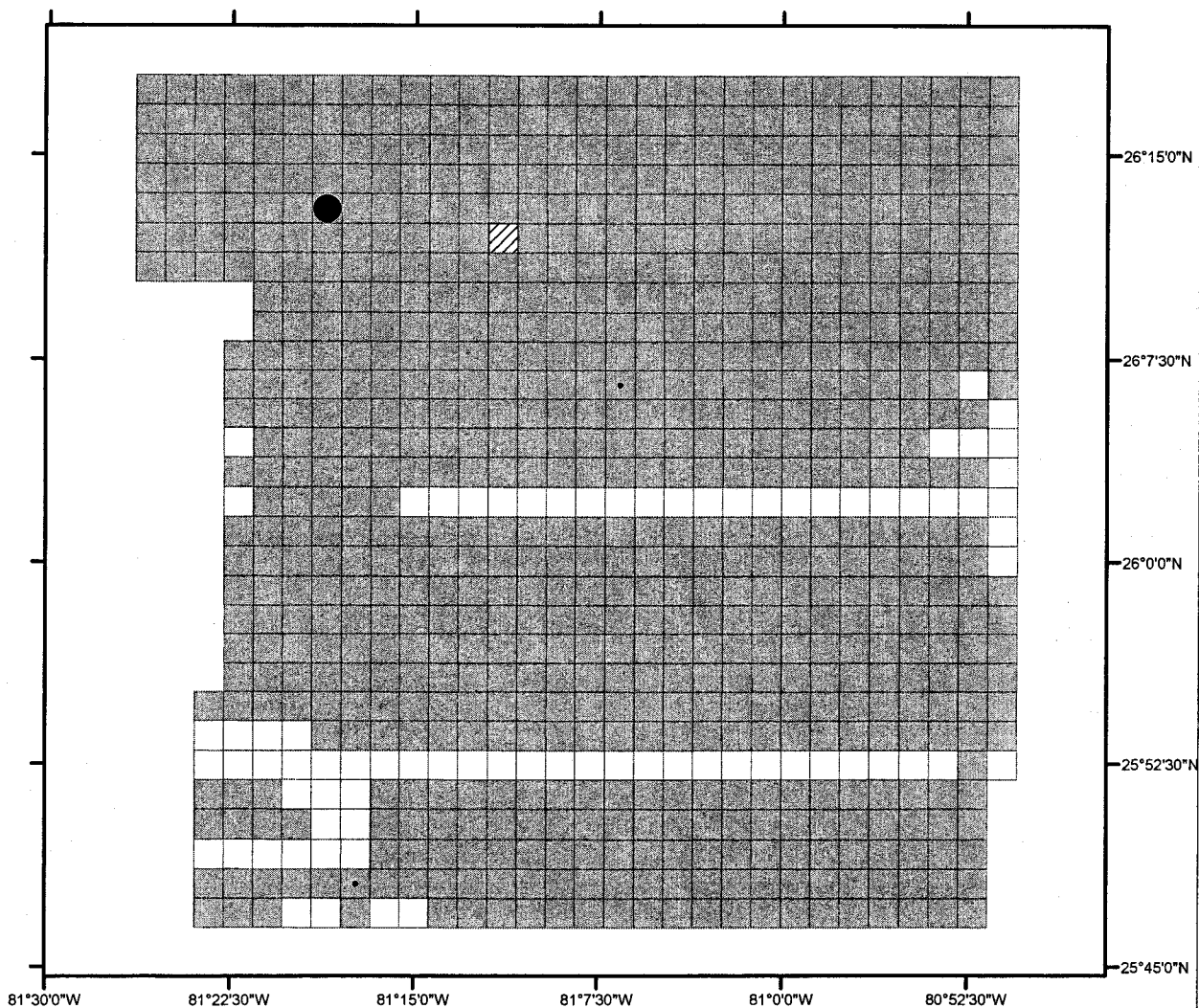
Density Categories Birds Per Square Km



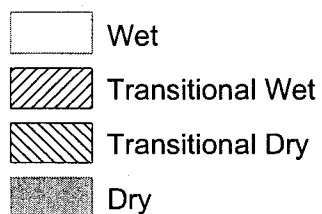
Small Dark Herons

Big Cypress

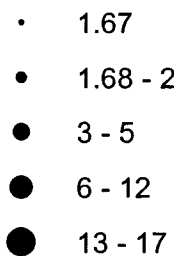
April 2002



Water Conditions



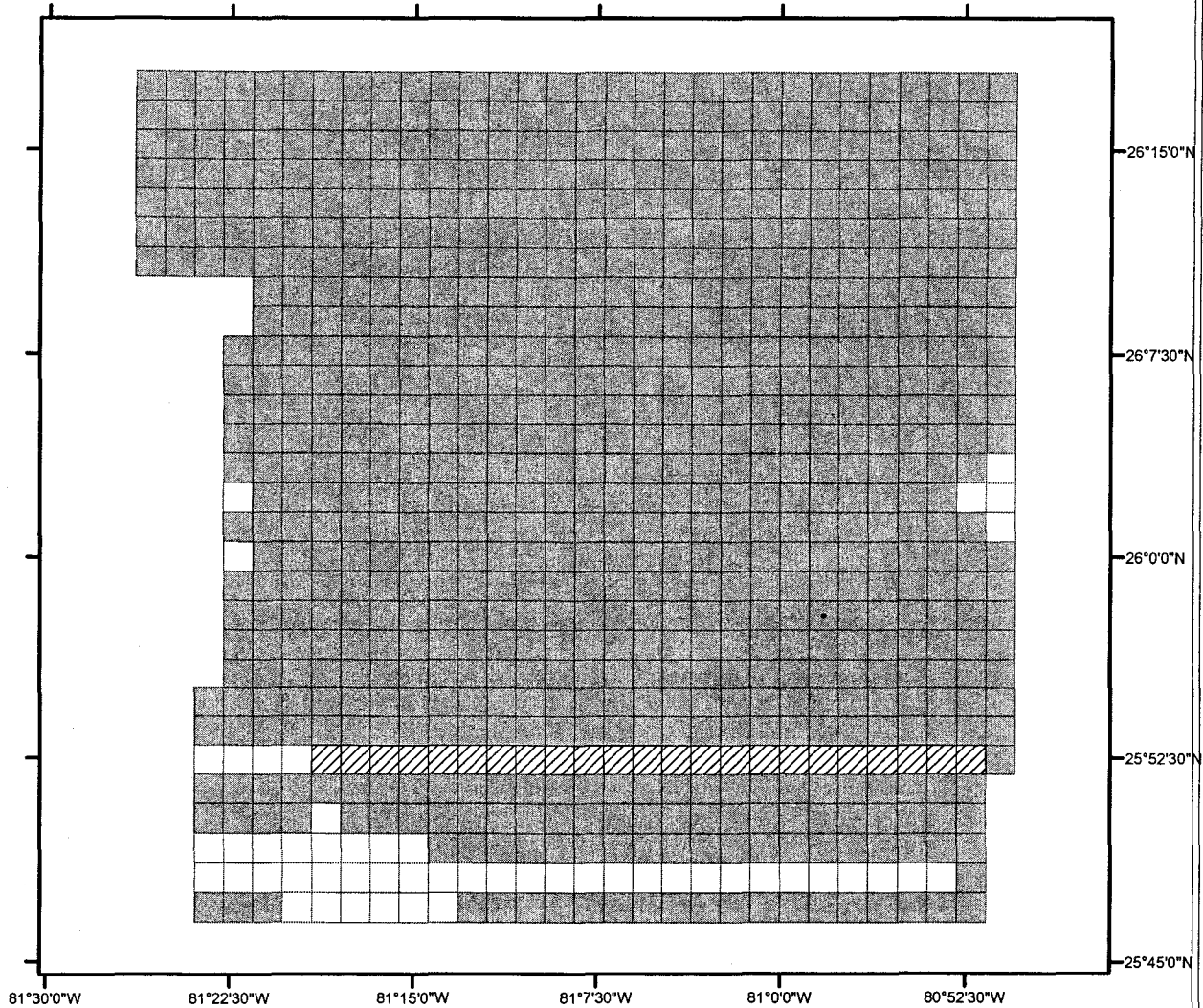
Density Categories Birds Per Square Km



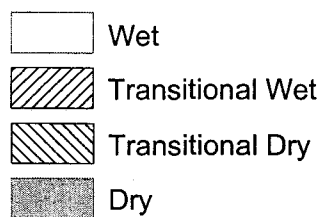
Small Dark Herons

Big Cypress

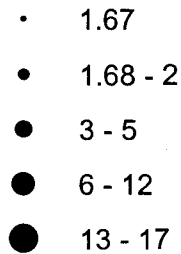
May 2002



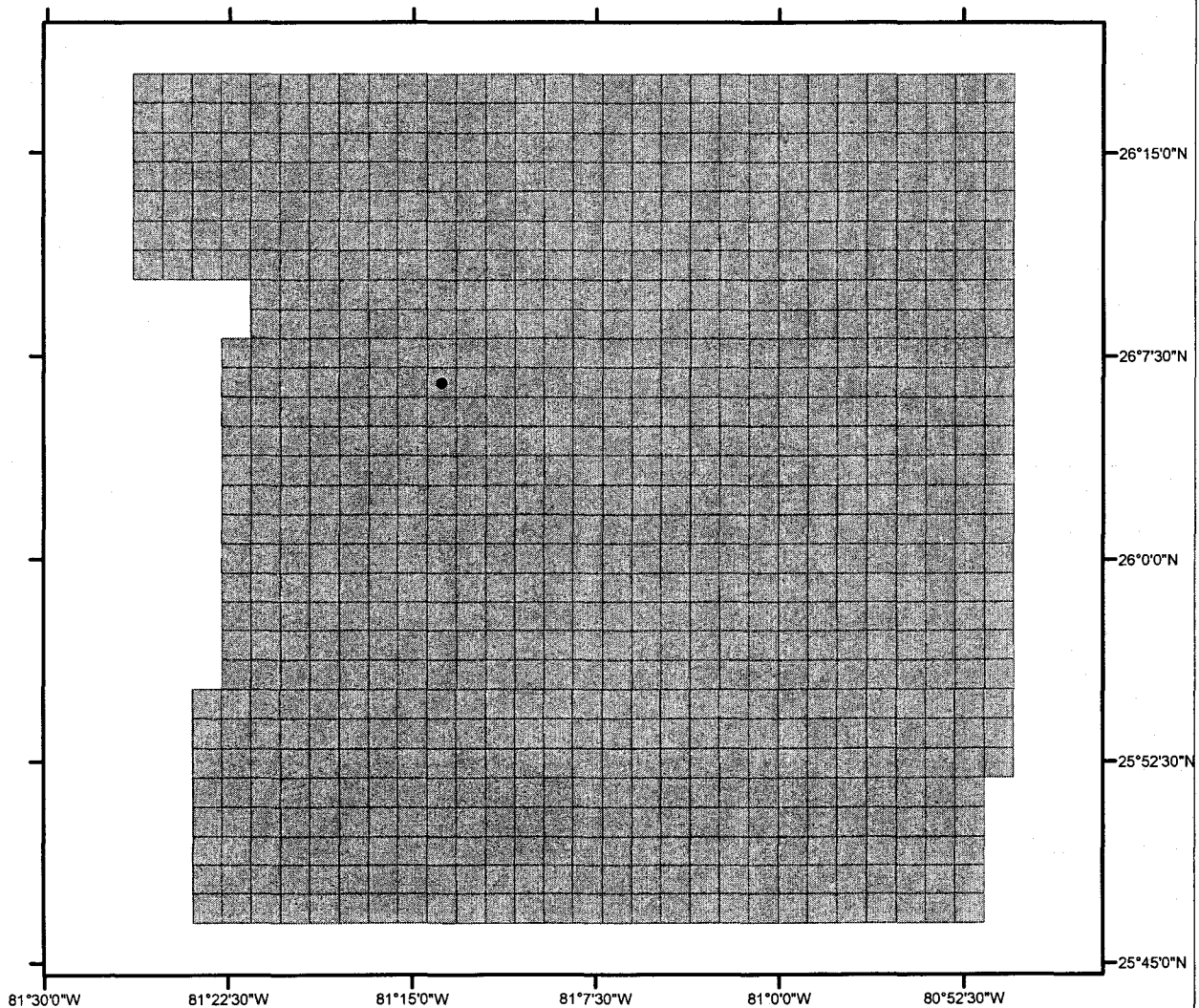
Water Conditions



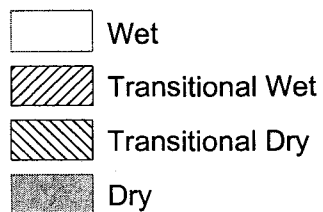
Density Categories Birds Per Square Km



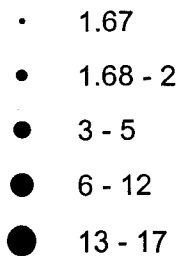
Small Dark Herons Big Cypress June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX F: Monthly density maps of small white herons in the Big Cypress National Preserve, February to June 2002.

F1. Density maps of small white herons the Big Cypress National Preserve, February 2002.

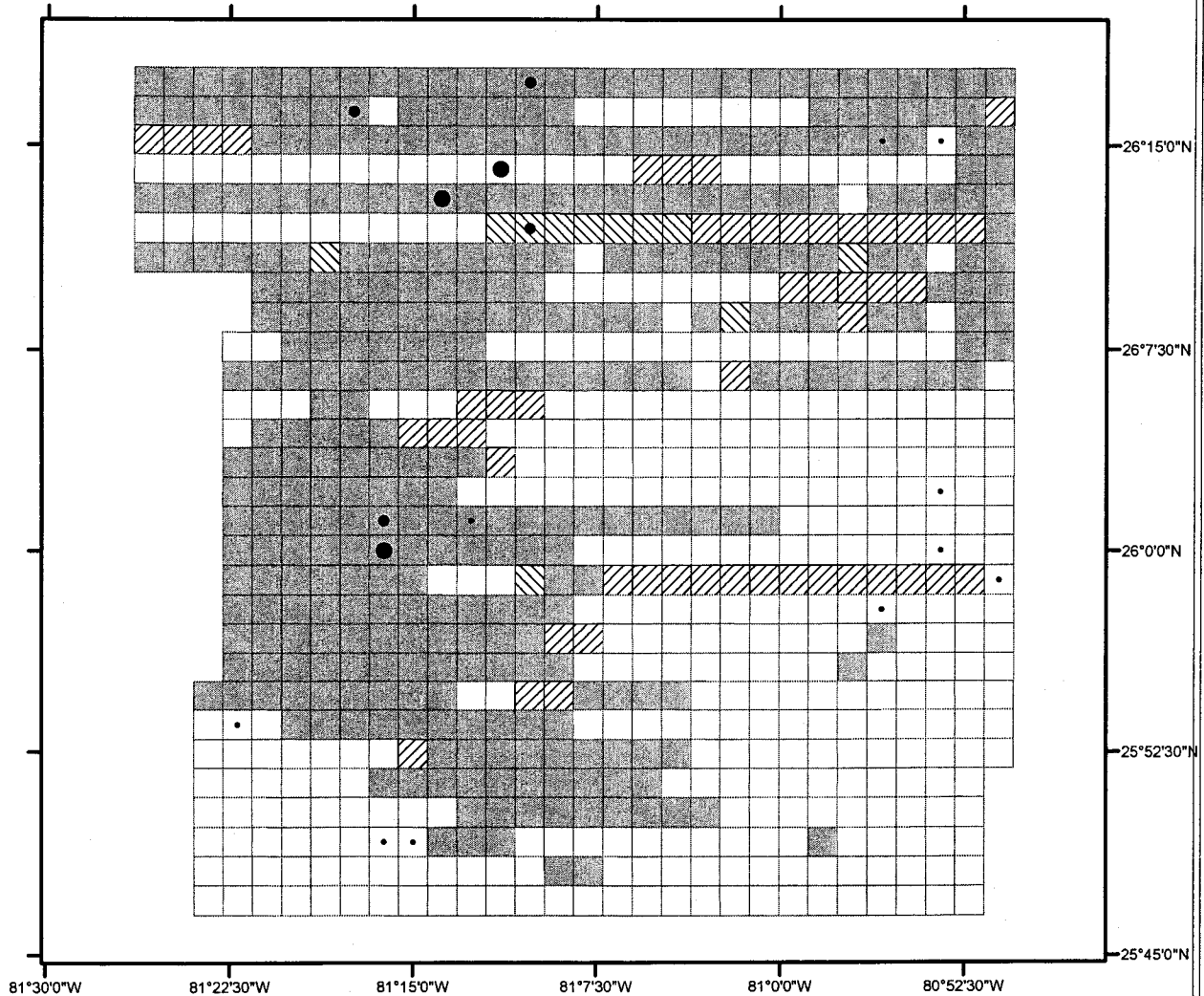
F2. Density maps of small white herons in the Big Cypress National Preserve, March 2002.

F3. Density maps of small white herons in the Big Cypress National Preserve, April 2002.

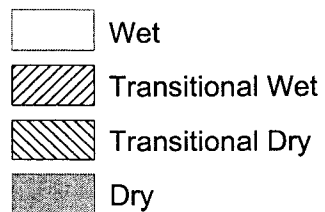
F4. Density maps of small white herons in the Big Cypress National Preserve, May 2002.

F5. Density maps of small white herons in the Big Cypress National Preserve, June 2002.

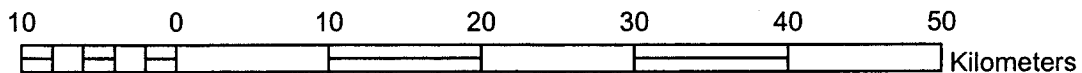
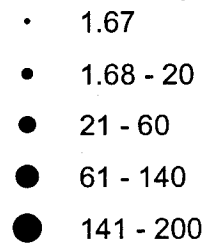
Small White Herons Big Cypress February 2002



Water Conditions



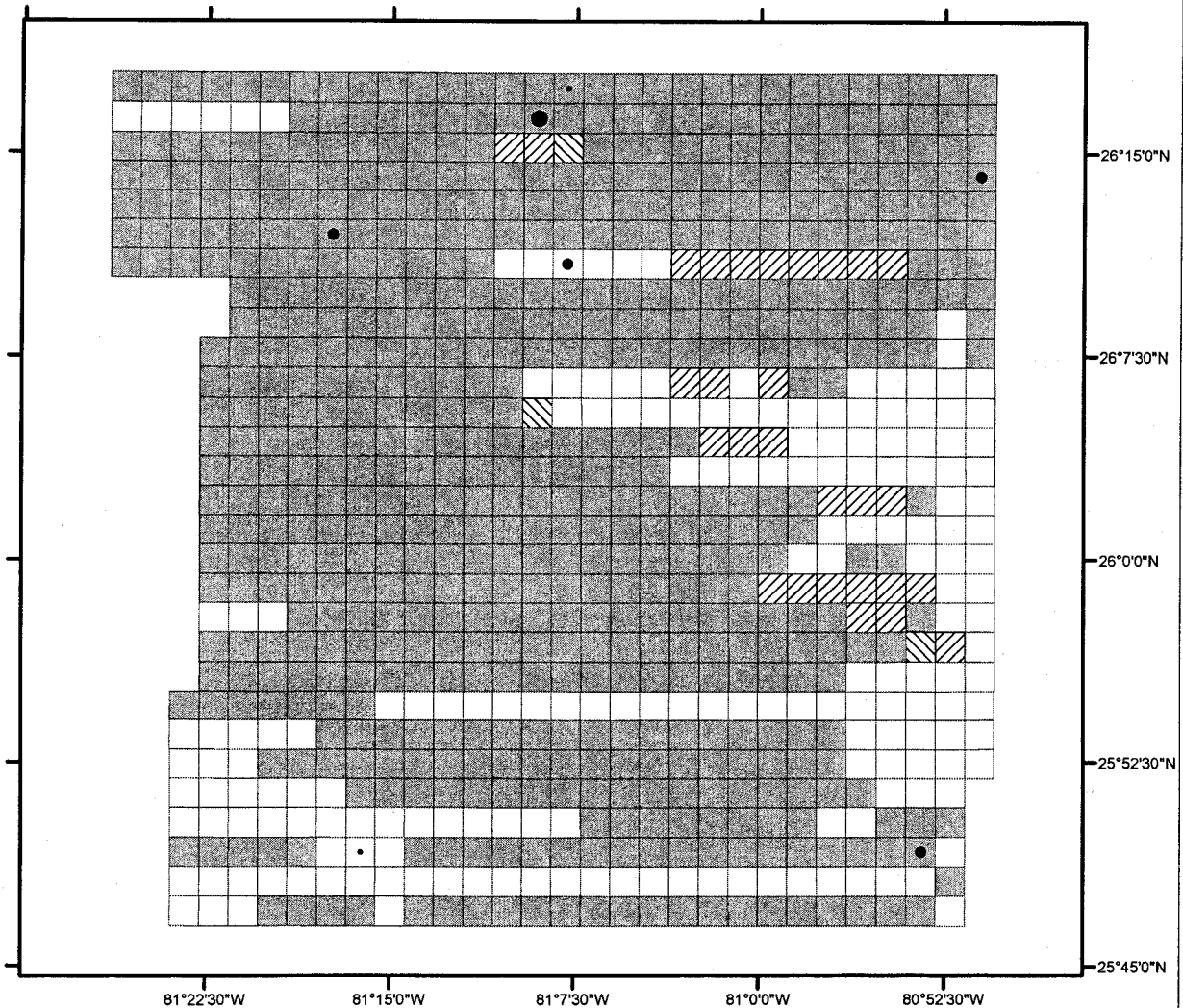
Density Categories Birds Per Square Km



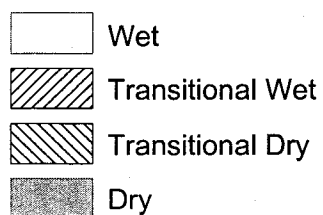
Small White Herons

Big Cypress

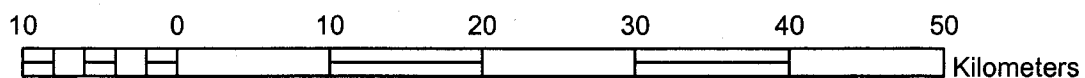
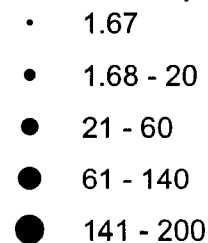
March 2002



Water Conditions



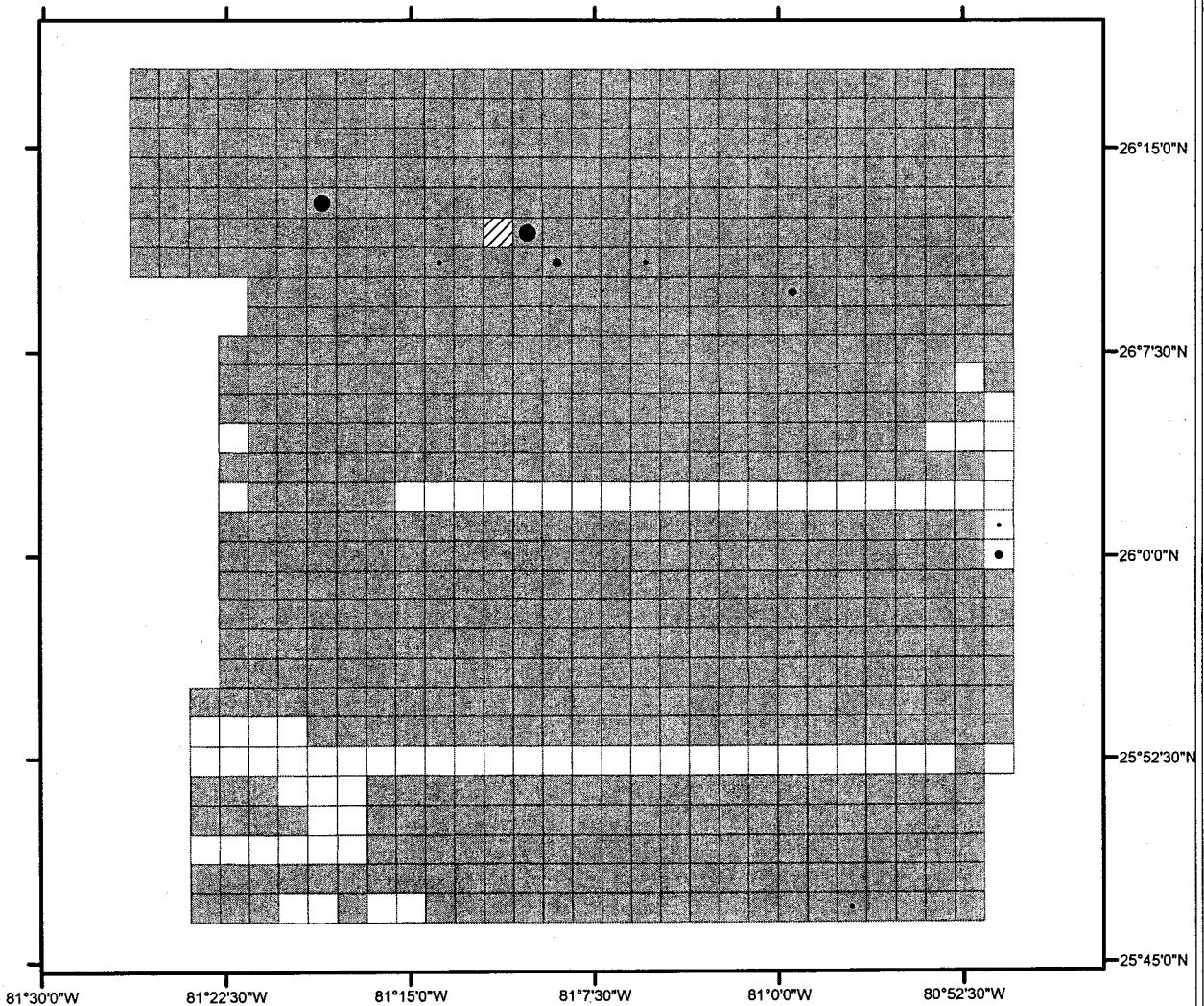
Density Categories Birds Per Square Km



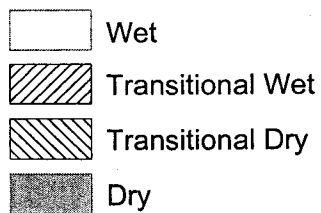
Small White Herons

Big Cypress

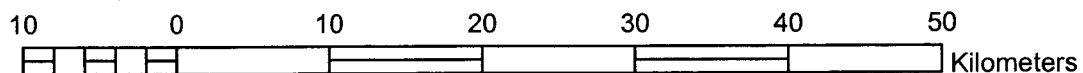
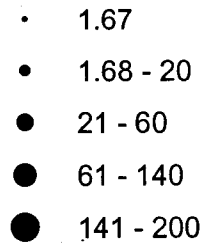
April 2002



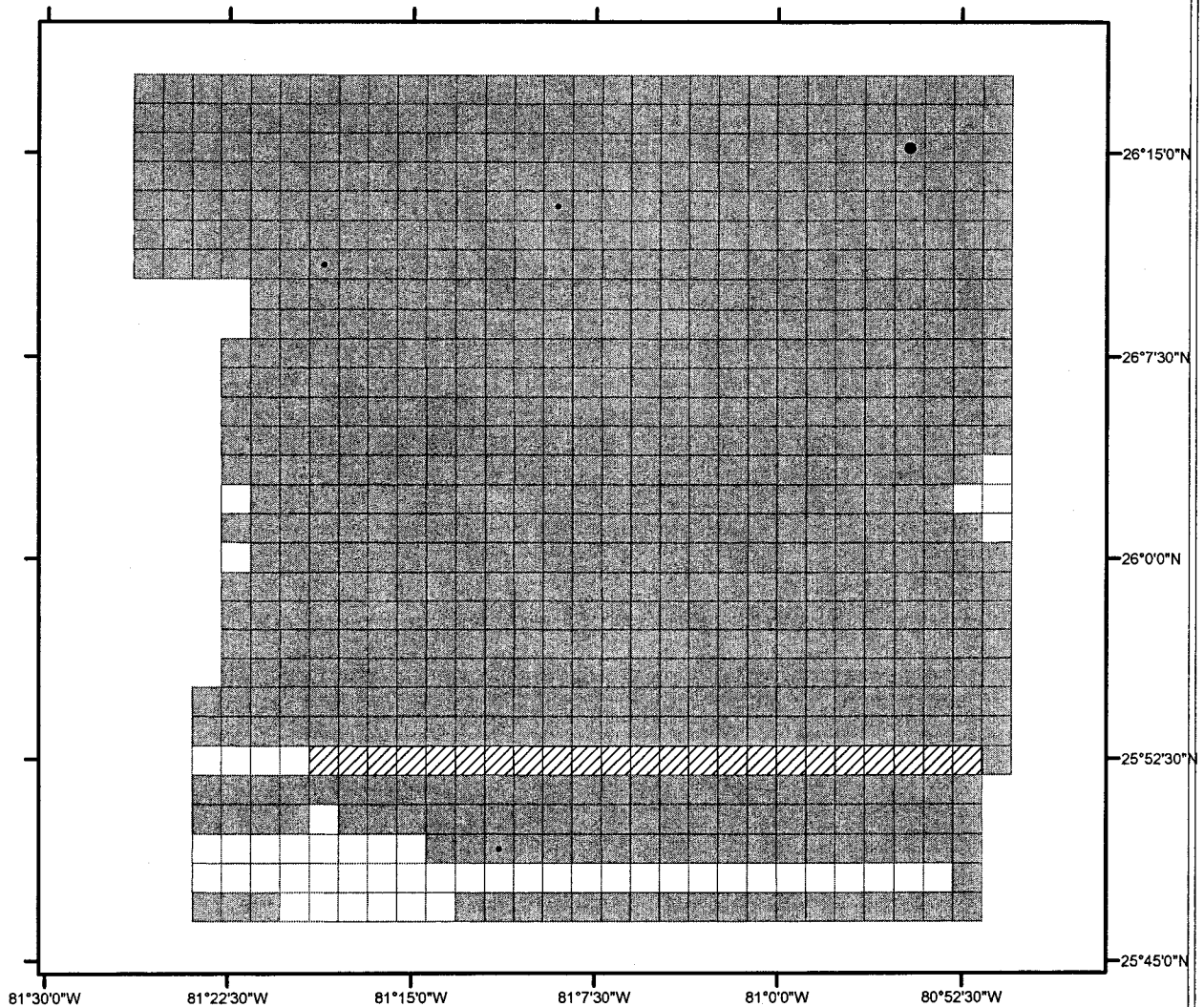
Water Conditions



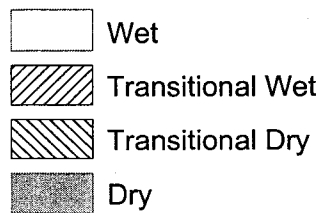
Density Categories Birds Per Square Km



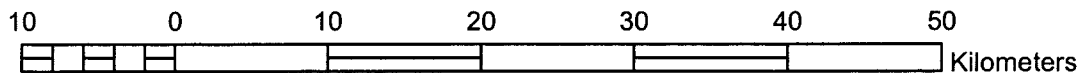
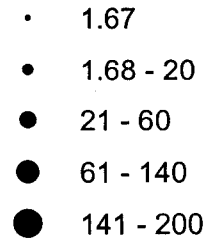
Small White Herons Big Cypress May 2002



Water Conditions



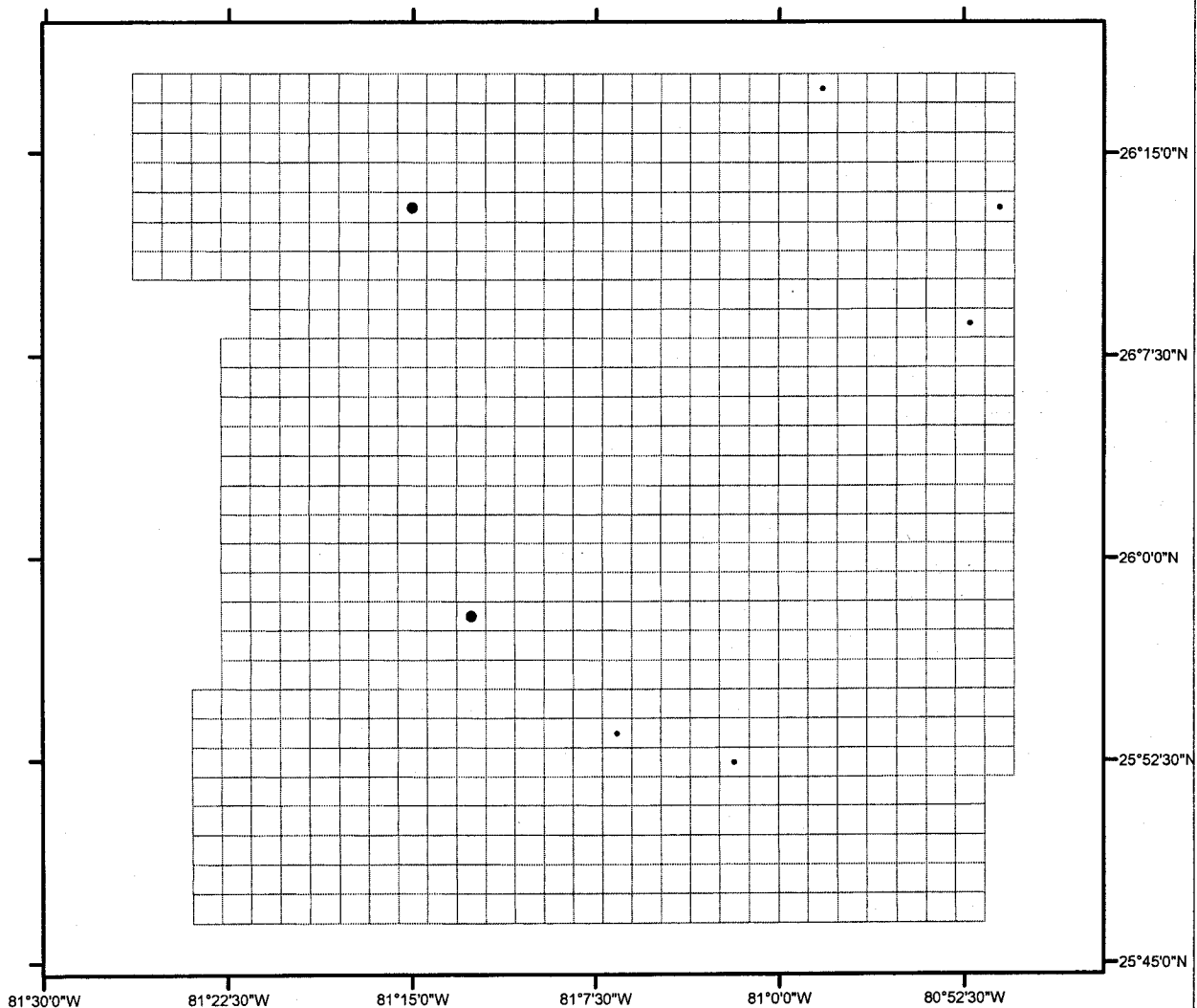
Density Categories Birds Per Square Km



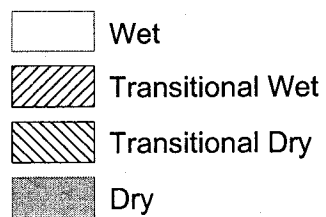
Small White Herons

Big Cypress

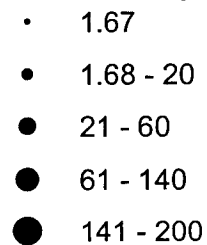
June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX G: Monthly density maps of White Ibis in the Big Cypress National Preserve, February to June 2002.

G1. Density maps of White Ibis in the Big Cypress National Preserve, February 2002.

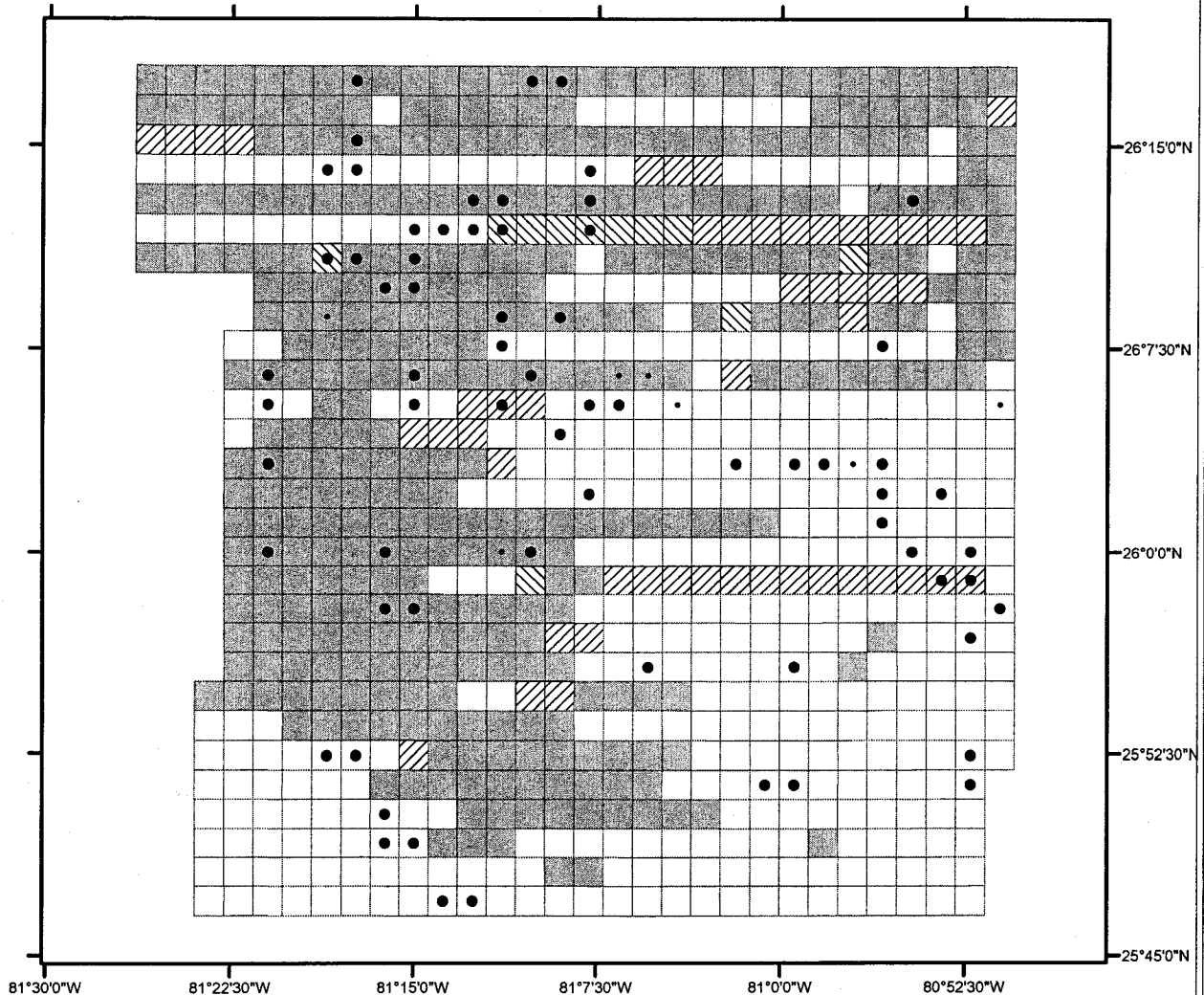
G2. Density maps of White Ibis in the Big Cypress National Preserve, March 2002.

G3. Density maps of White Ibis in the Big Cypress National Preserve, April 2002.

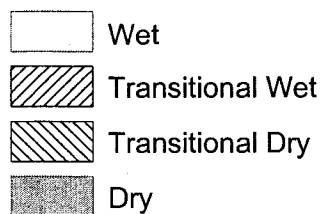
G4. Density maps of White Ibis in the Big Cypress National Preserve, May 2002.

G5. Density maps of White Ibis in the Big Cypress National Preserve, June 2002.

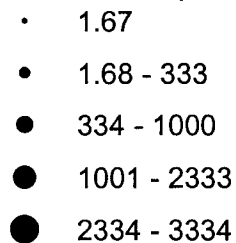
White Ibises Big Cypress February 2002



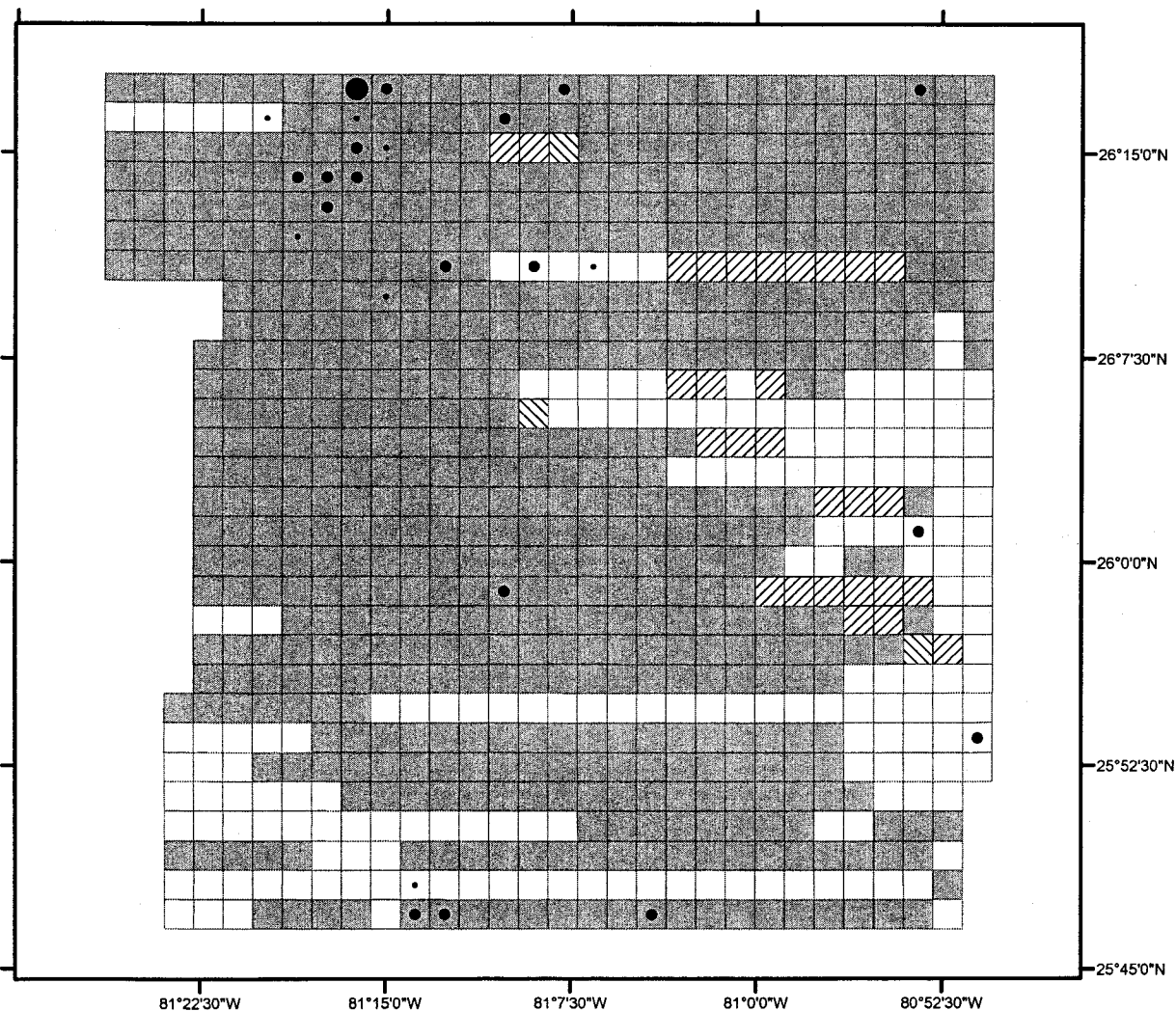
Water Conditions



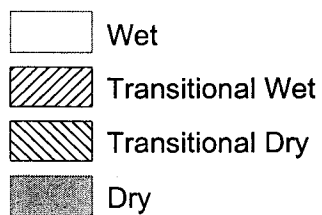
Density Categories Birds Per Square Km



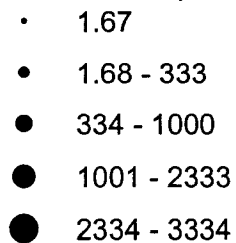
White Ibises Big Cypress March 2002



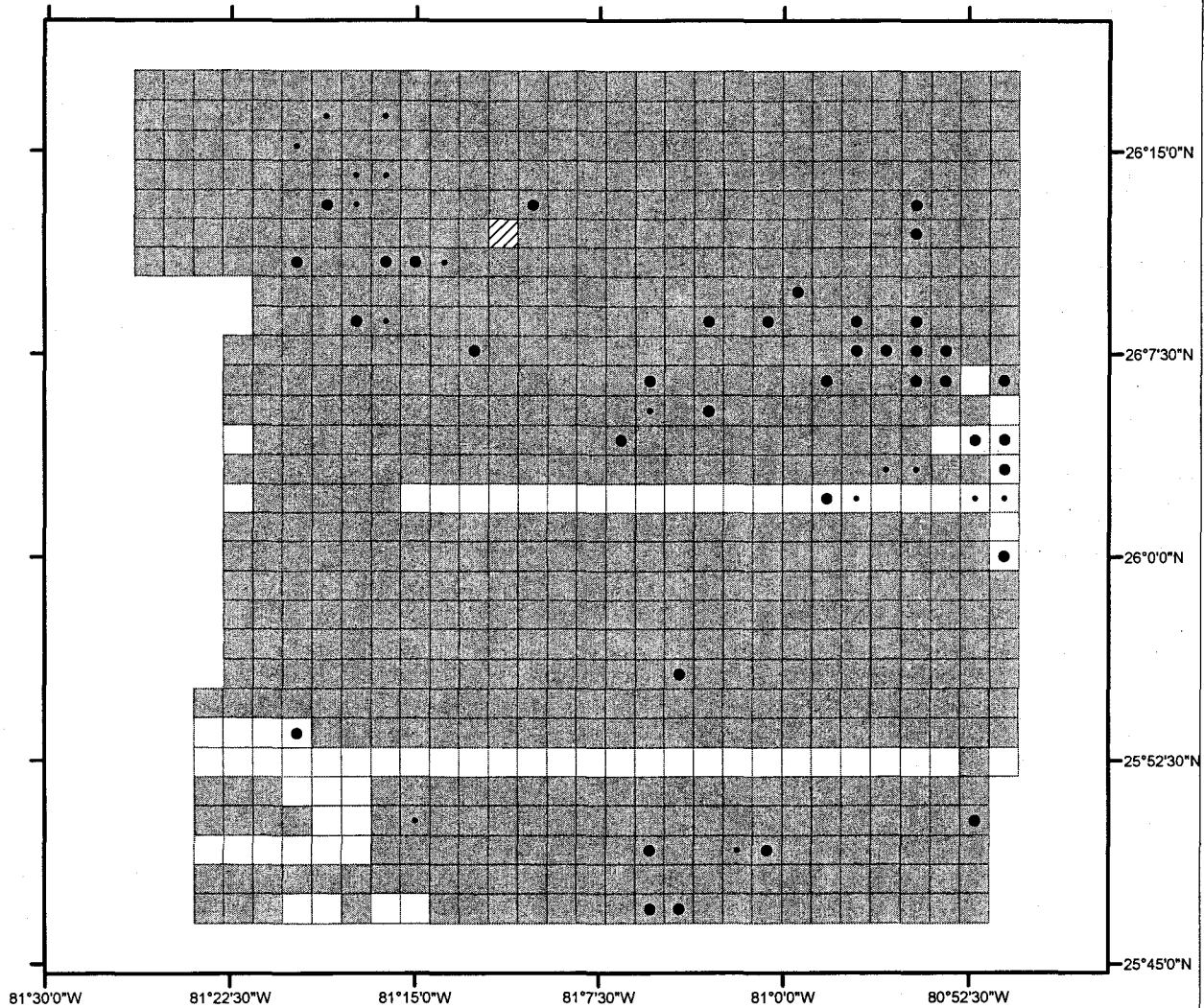
Water Conditions



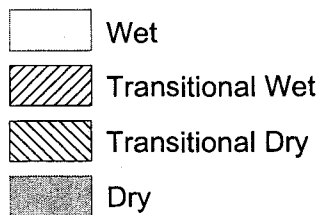
Density Categories Birds Per Square Km



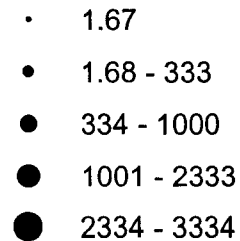
White Ibises Big Cypress April 2002



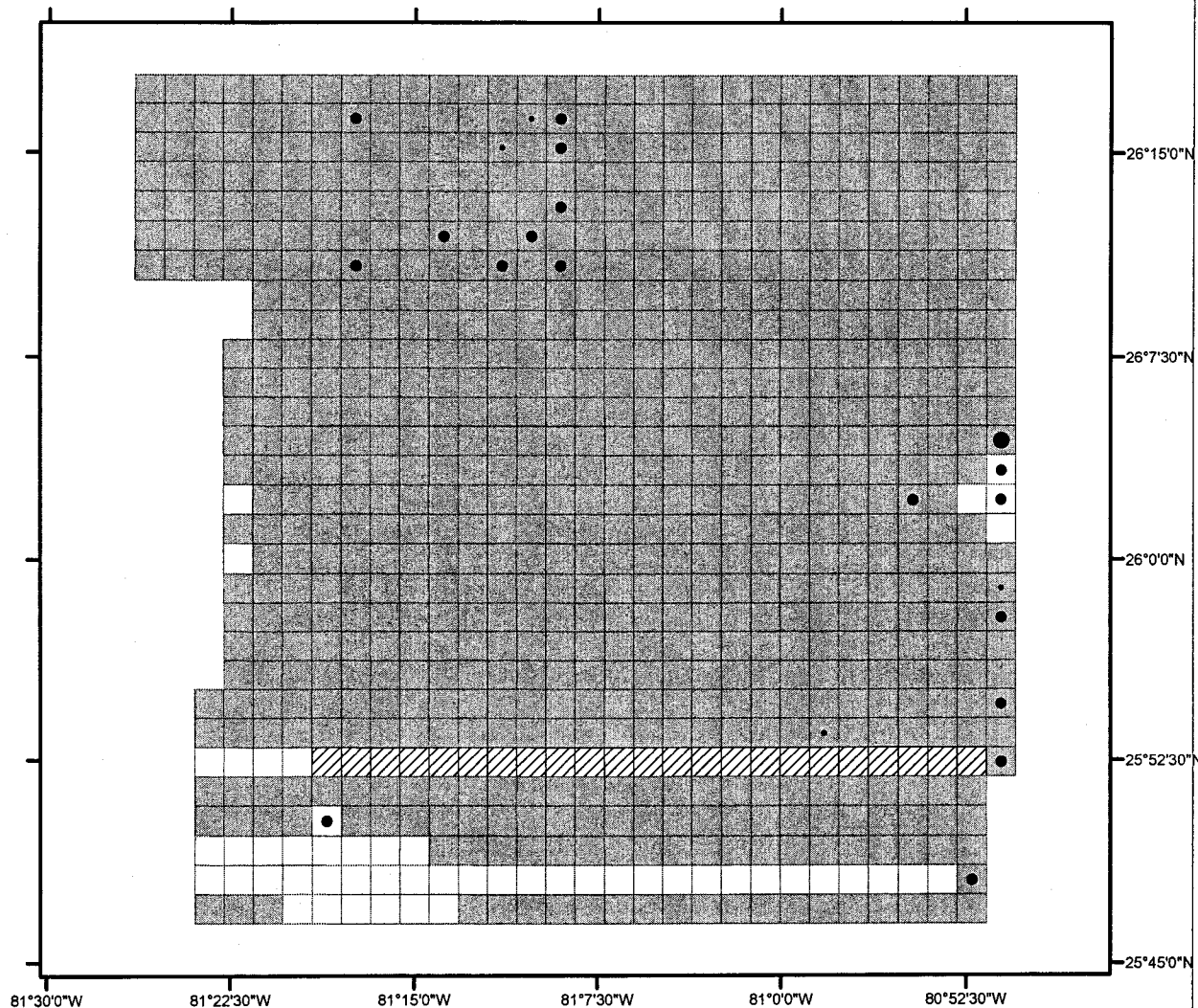
Water Conditions



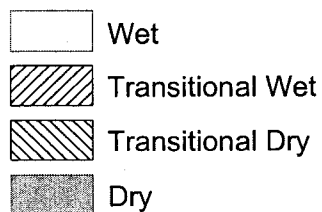
Density Categories Birds Per Square Km



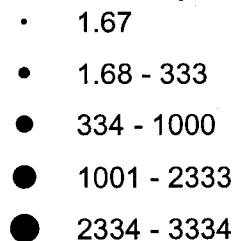
White Ibises Big Cypress May 2002



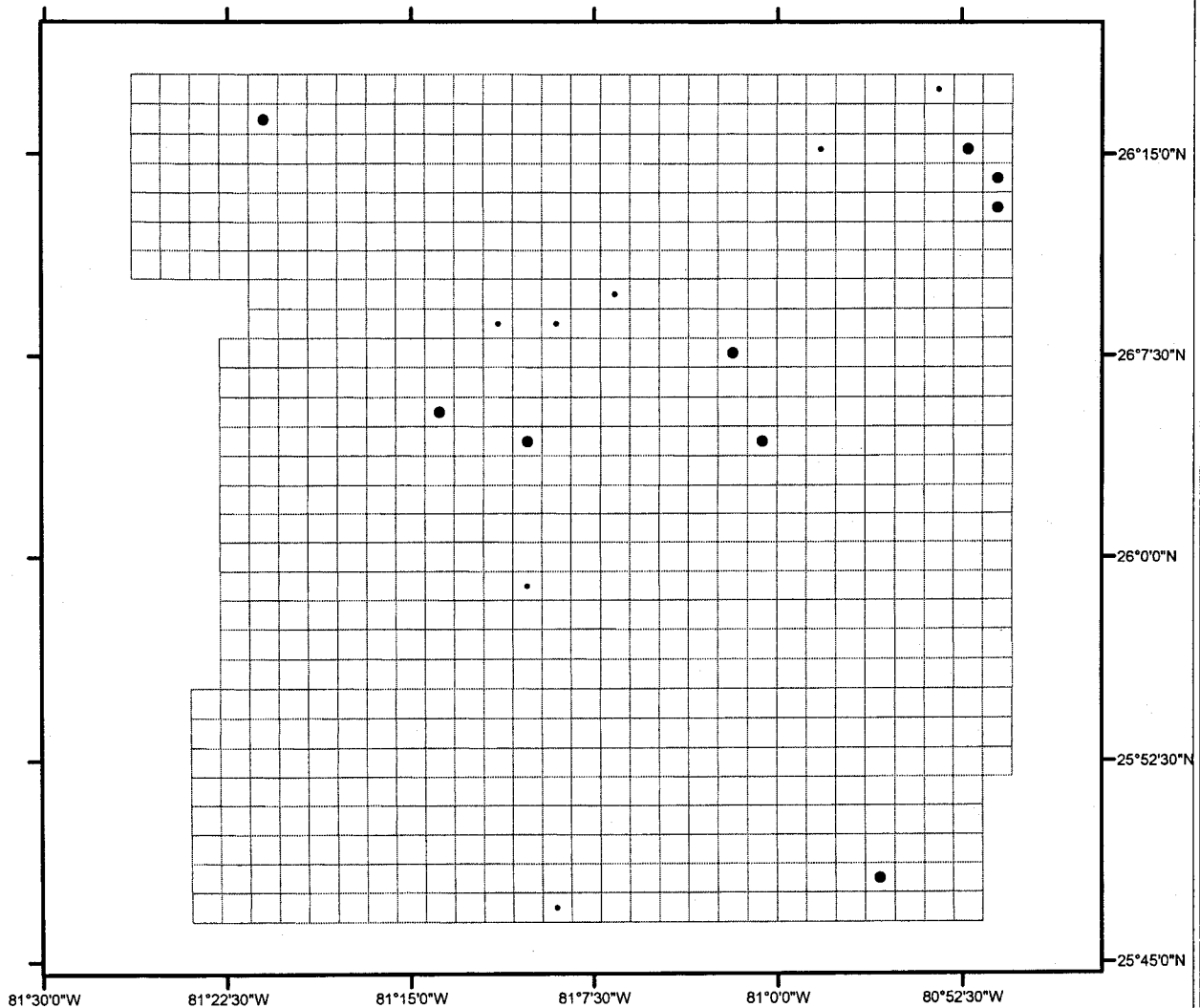
Water Conditions



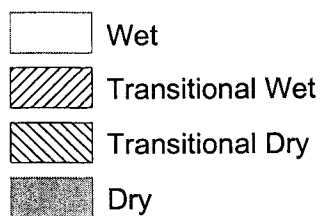
Density Categories Birds Per Square Km



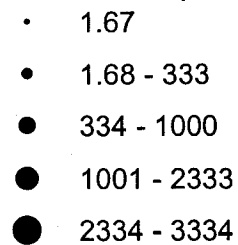
White Ibises Big Cypress June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX H: Monthly density maps of Glossy Ibis in the Big Cypress National Preserve, February to June 2002.

H1. Density maps of Glossy Ibis in the Big Cypress National Preserve, February 2002.

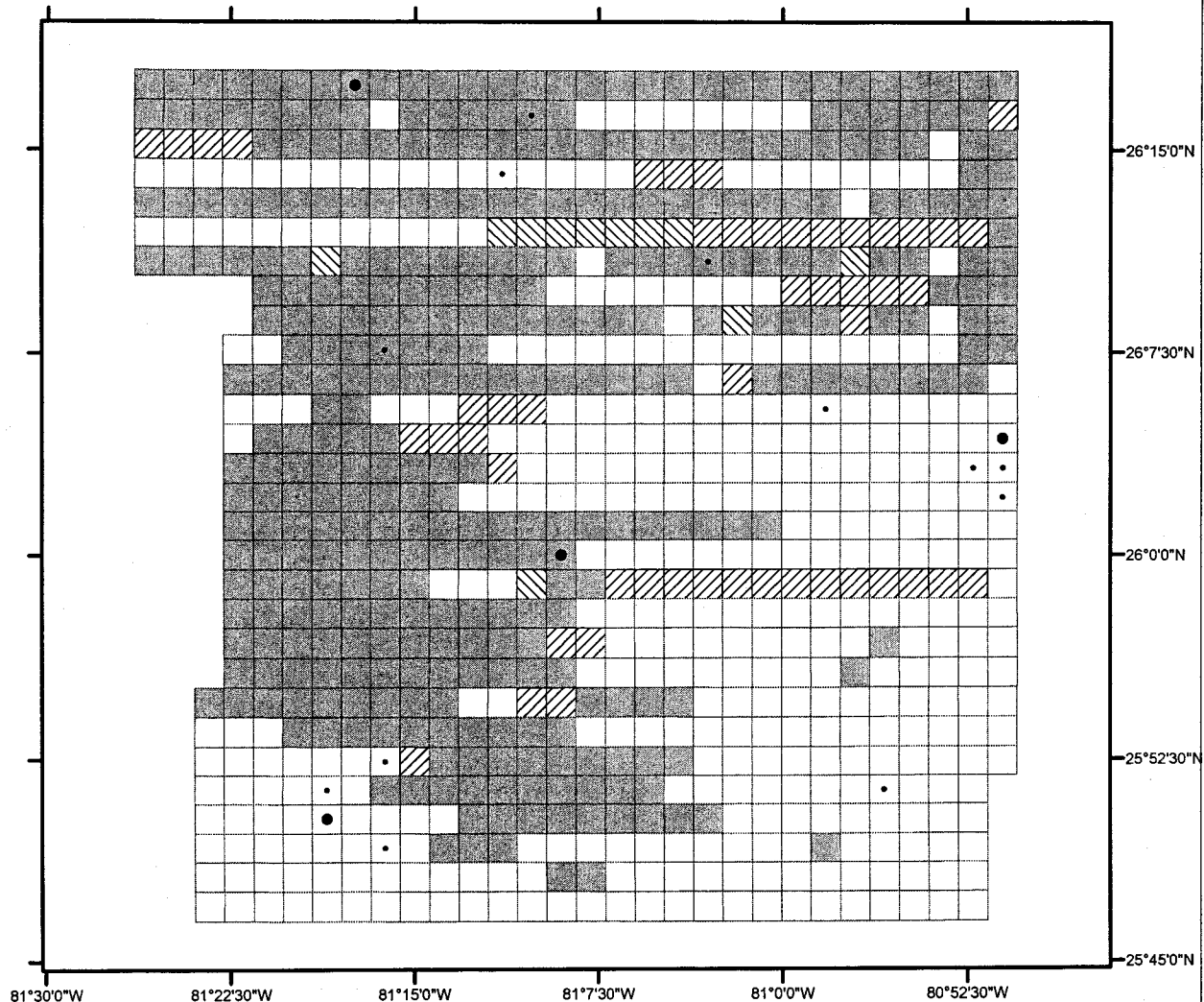
H2. Density maps of Glossy Ibis in the Big Cypress National Preserve, March 2002.

H3. Density maps of Glossy Ibis in the Big Cypress National Preserve, April 2002.

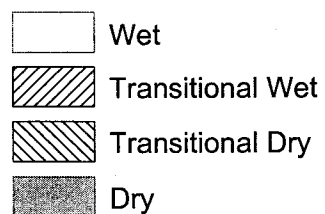
H4. Density maps of Glossy Ibis in the Big Cypress National Preserve, May 2002.

H5. Density maps of Glossy Ibis in the Big Cypress National Preserve, June 2002.

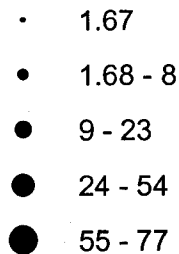
Glossy Ibises Big Cypress February 2002



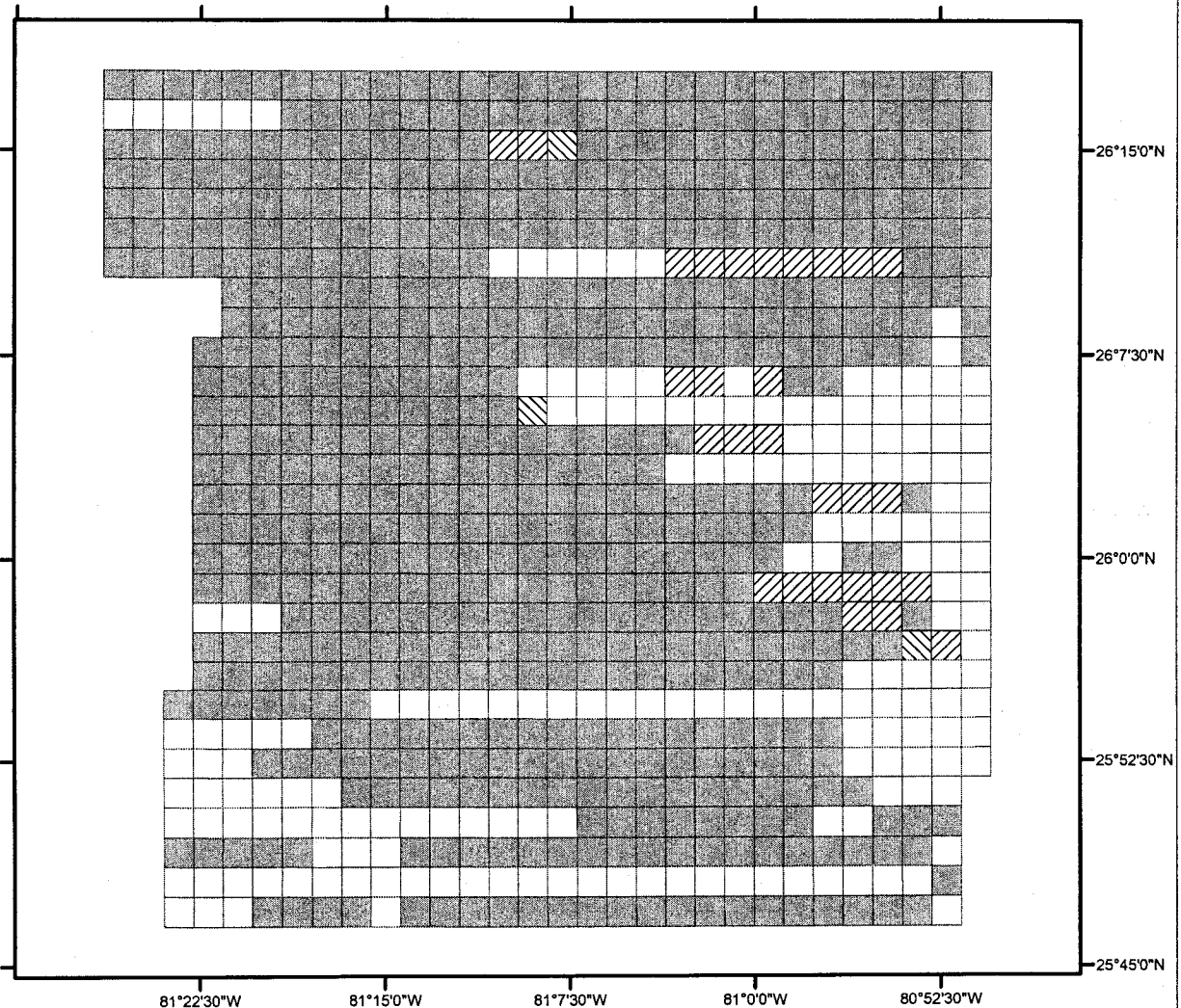
Water Conditions



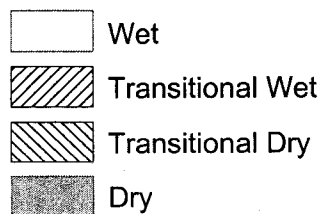
Density Categories Birds Per Square Km



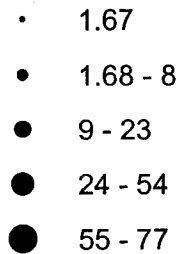
Glossy Ibises Big Cypress March 2002



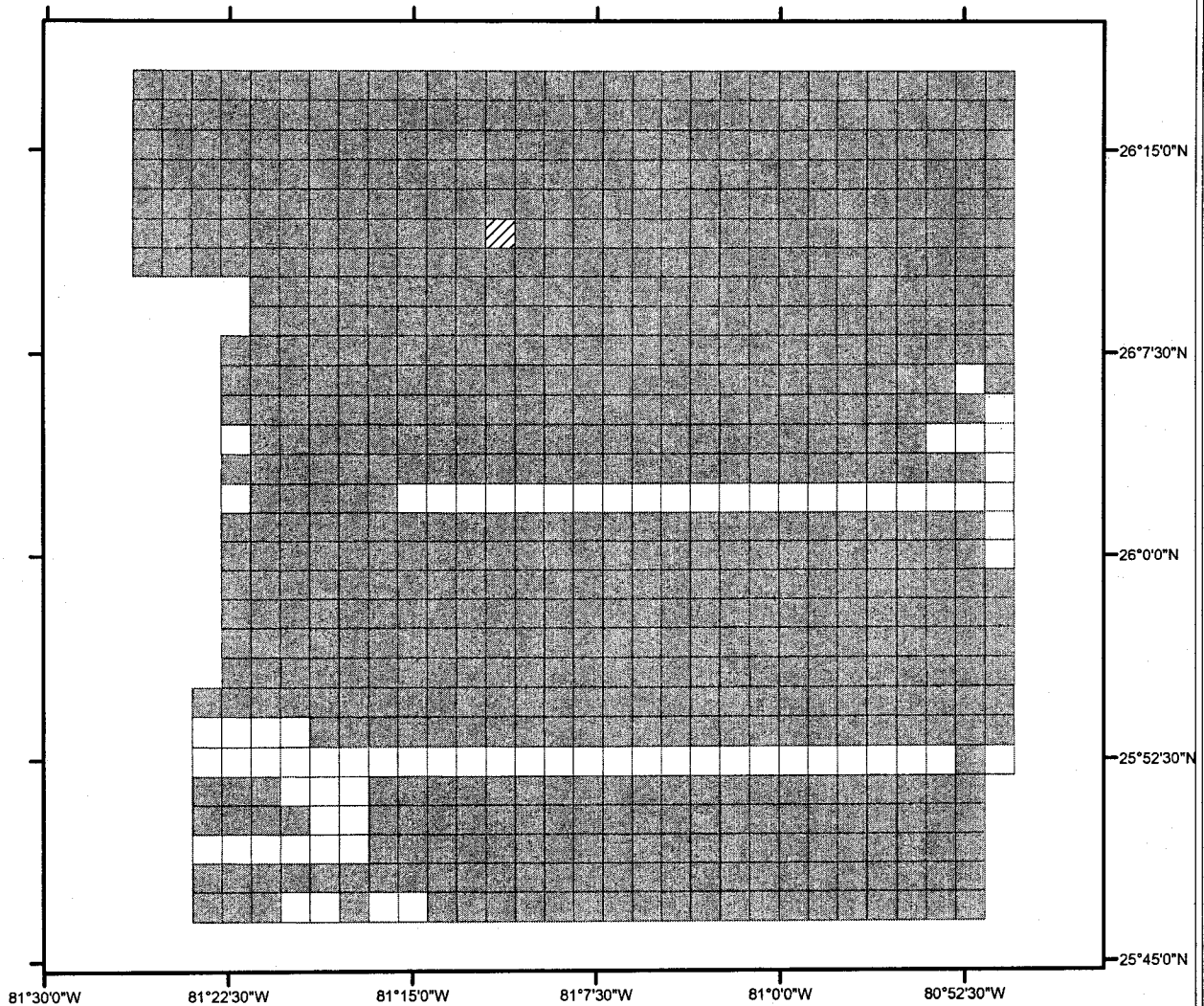
Water Conditions



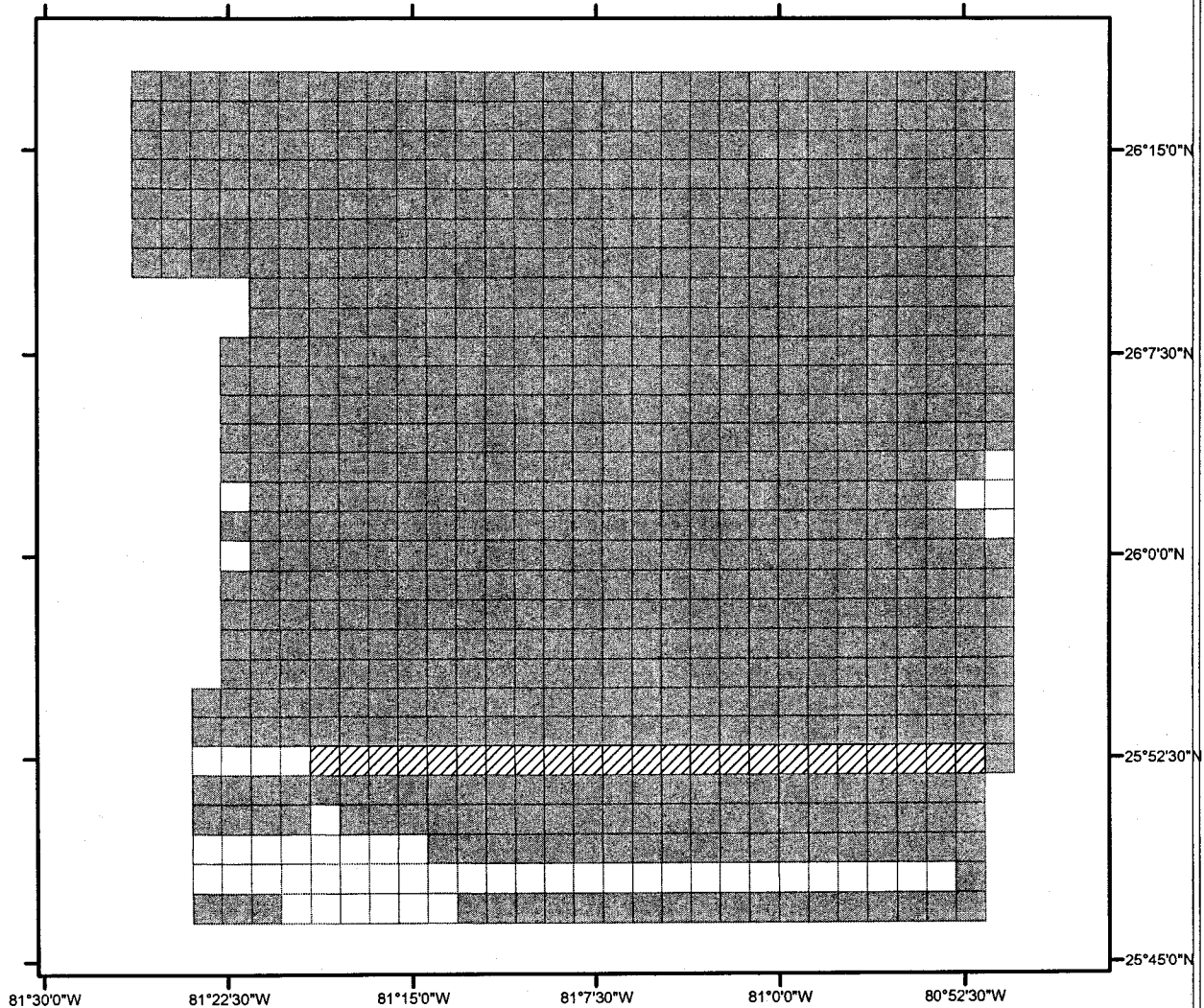
Density Categories Birds Per Square Km



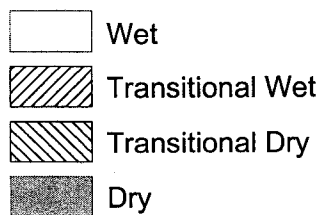
Glossy Ibises Big Cypress April 2002



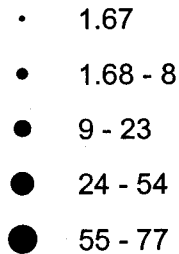
Glossy Ibises Big Cypress May 2002



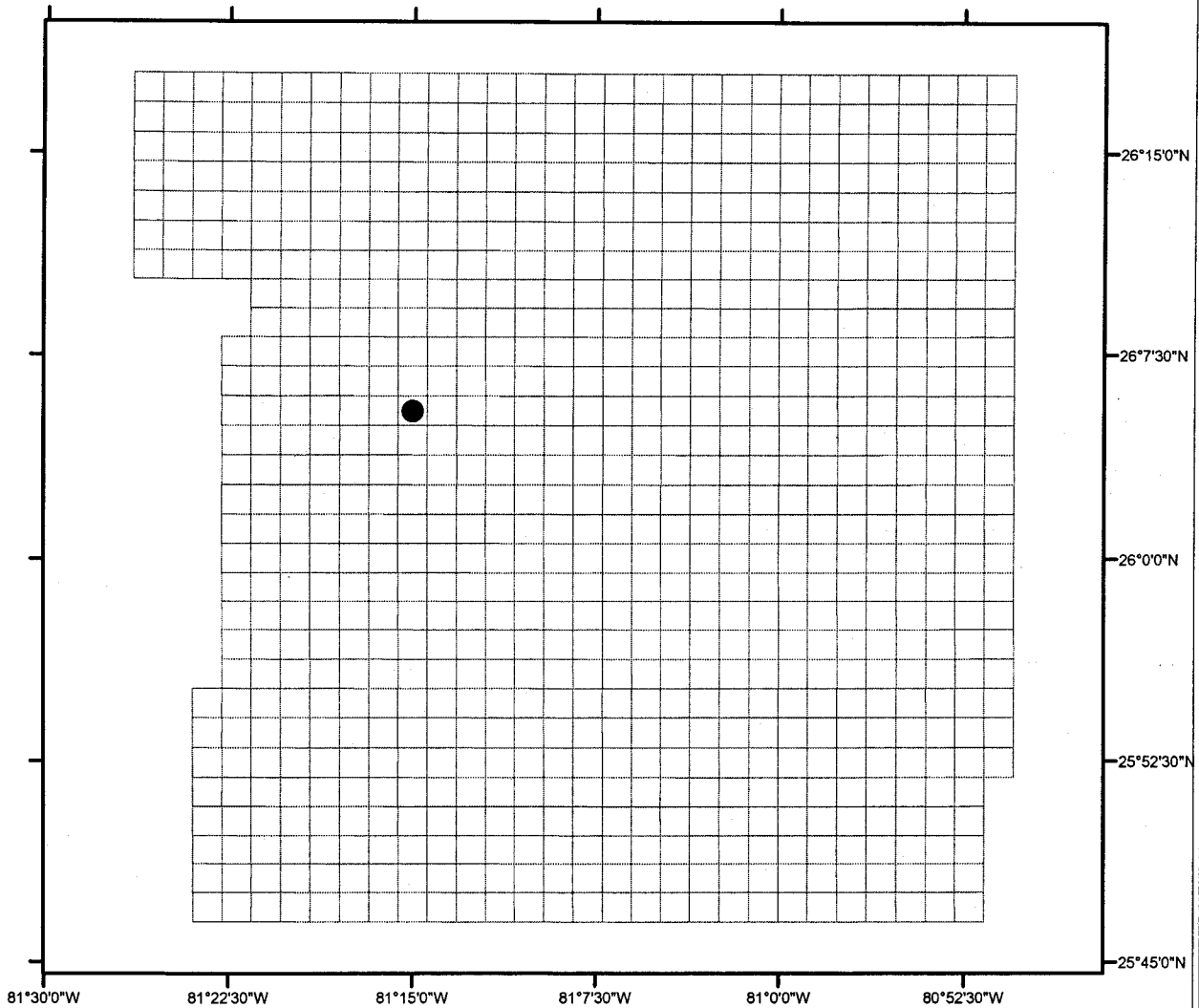
Water Conditions



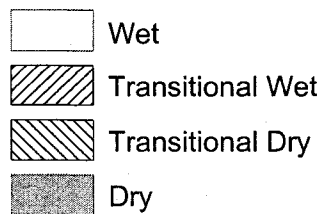
Density Categories Birds Per Square Km



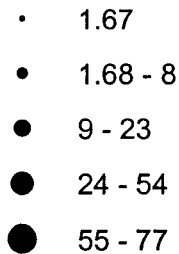
Glossy Ibises Big Cypress June 2002



Water Conditions



Density Categories Birds Per Square Km



APPENDIX I: Monthly density maps of Wood Stork in the Big Cypress National Preserve, February to June 2002.

I1. Density maps of Wood Stork in the Big Cypress National Preserve, February 2002.

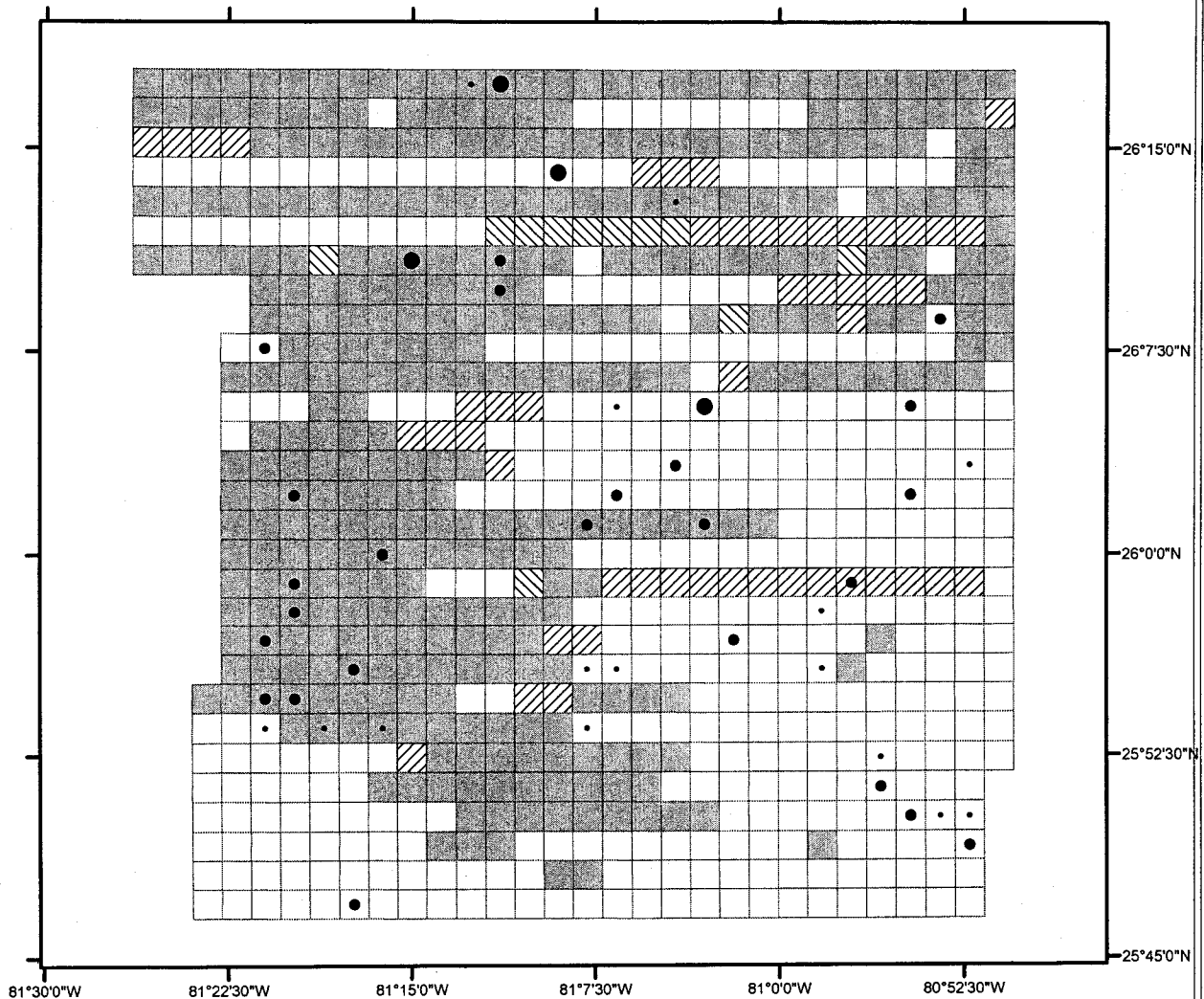
I2. Density maps of Wood Stork in the Big Cypress National Preserve, March 2002.

I3. Density maps of Wood Stork in the Big Cypress National Preserve, April 2002.

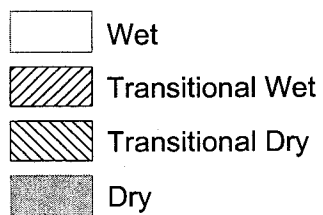
I4. Density maps of Wood Stork in the Big Cypress National Preserve, May 2002.

I5. Density maps of Wood Stork in the Big Cypress National Preserve, June 2002.

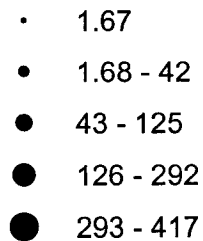
Wood Stork Big Cypress February 2002



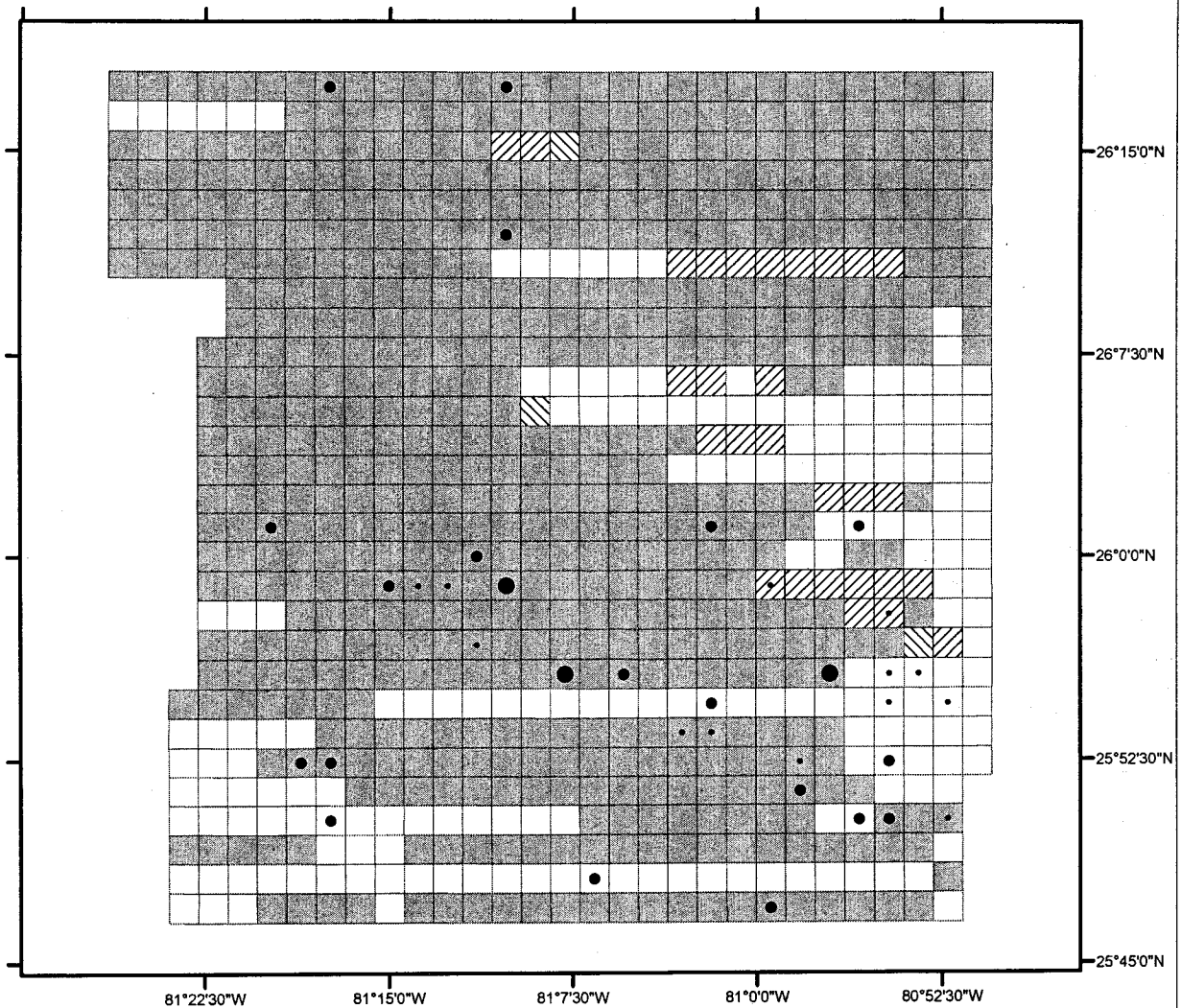
Water Conditions



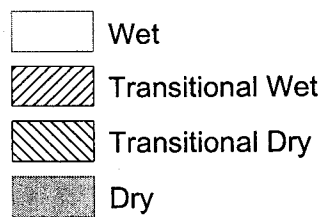
Density Categories Birds Per Square Km



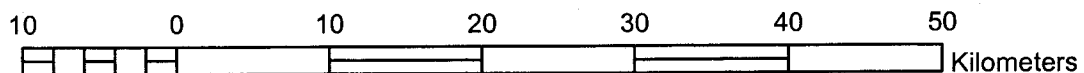
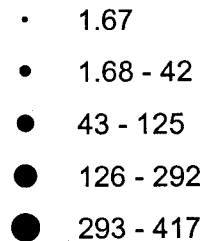
Wood Stork Big Cypress March 2002



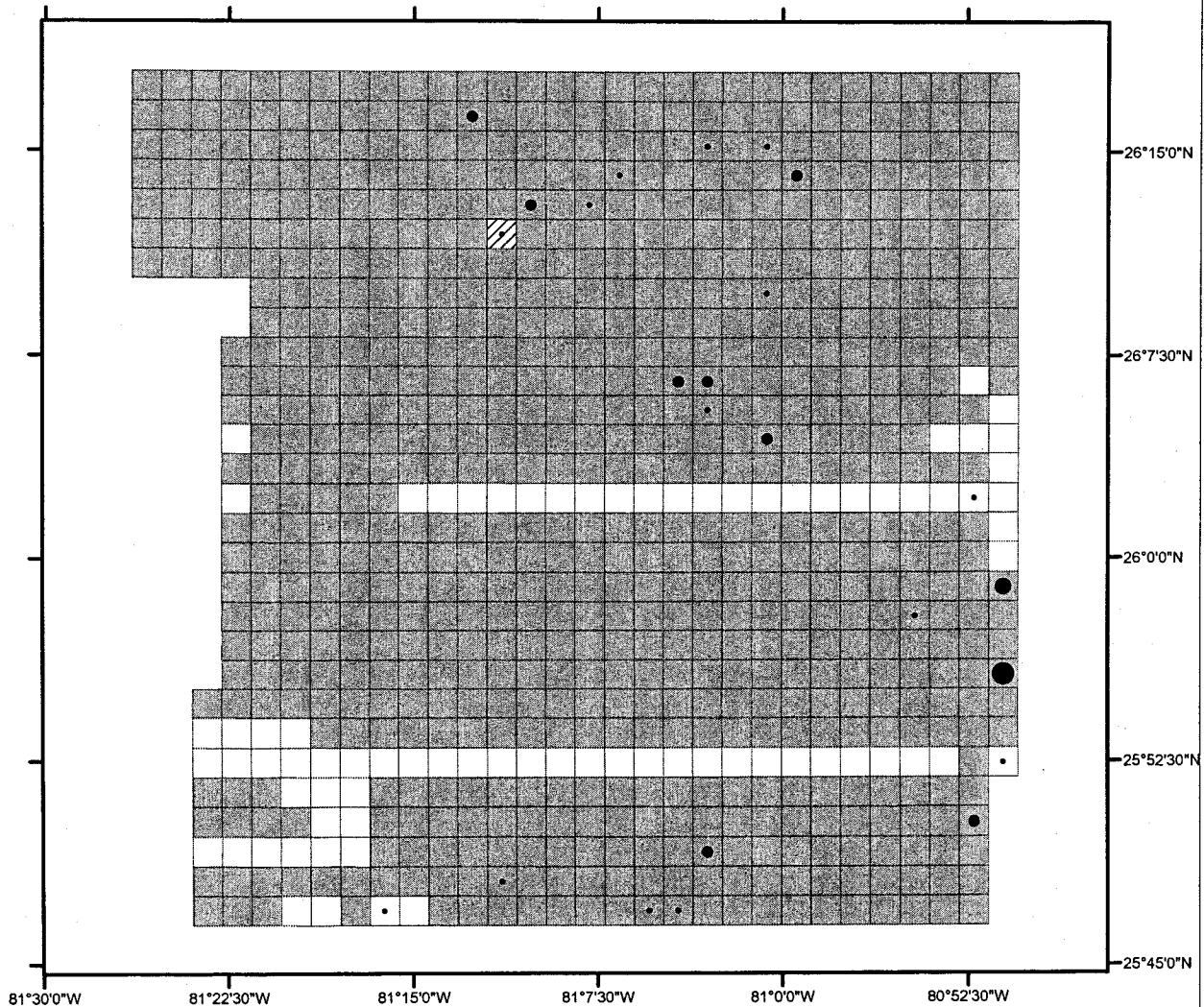
Water Conditions



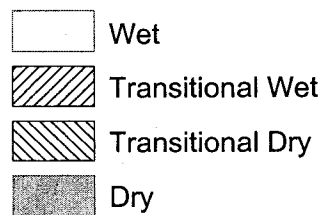
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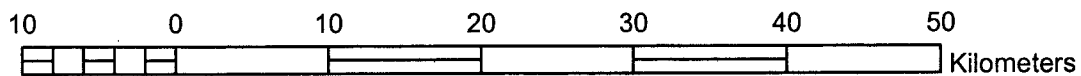
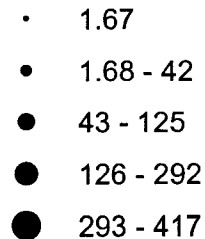
Wood Stork Big Cypress April 2002



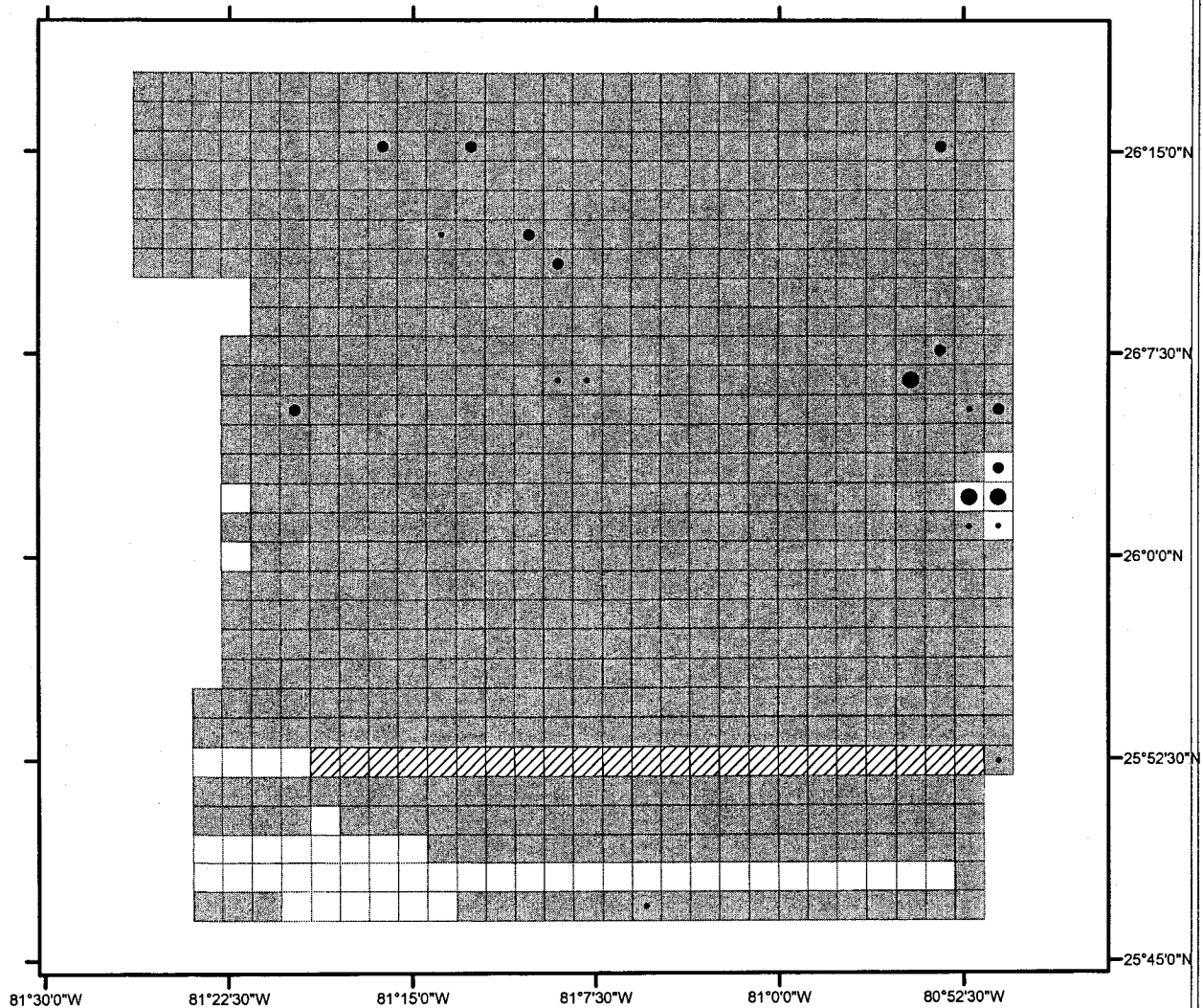
Water Conditions



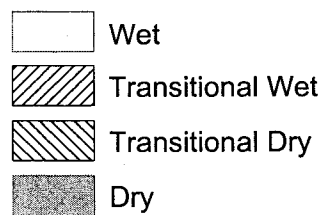
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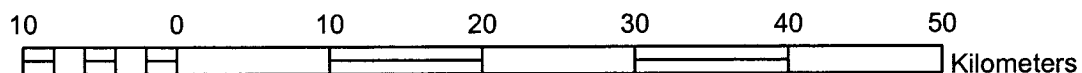
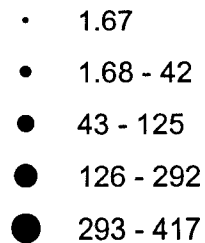
Wood Stork Big Cypress May 2002



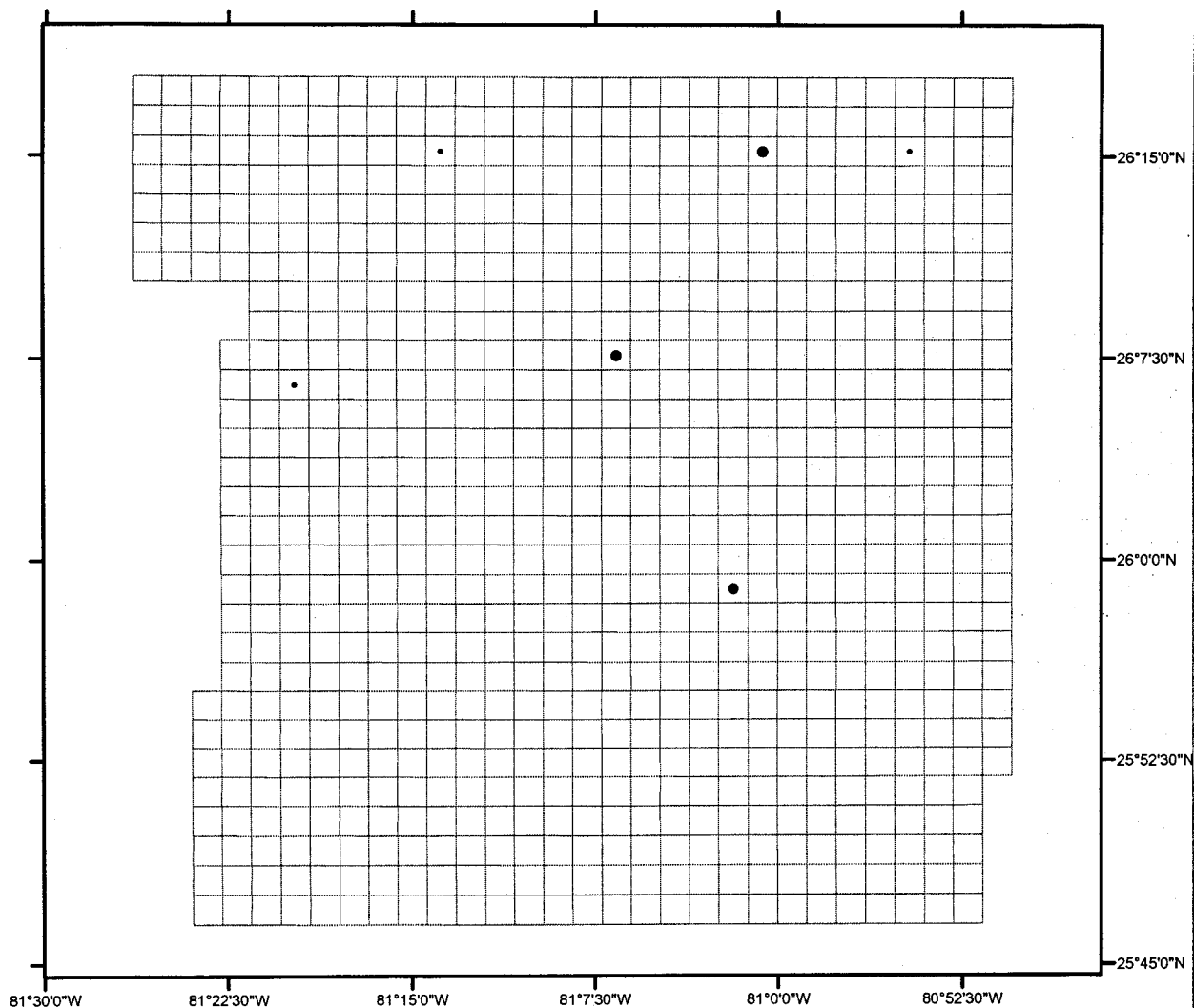
Water Conditions



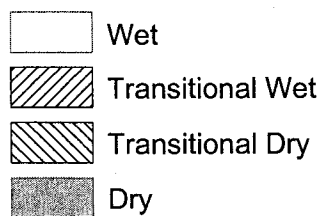
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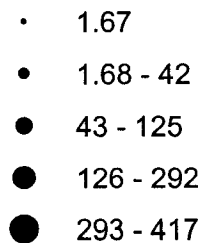
Wood Stork Big Cypress June 2002



Water Conditions



Density Categories Birds Per Square Km



**APPENDIX J: Wading Bird Relative Abundance
and Densities in the Big Cypress National
Preserve for 1999, 2000 and 2001.**

Table J3. Estimated abundances of wading birds within Big Cypress from January to June 2000 (foraging birds).

Species	Jan	Feb	Mar	Apr	May	Jun
Great Blue Herons	247	353	313	107	73	20
Great Egrets	16,920	13,773	9,733	3,520	1,260	673
Small Dark Herons	200	73	40	167	60	0
Small White Herons	533	160	233	407	287	0
White Ibises	29,493	7,960	2,620	4,507	1,720	4,313
Glossy Ibises	67	113	13	113	0	20
Wood Storks	1,180	773	1,647	133	1,253	40
Cattle Egrets	793	1,507	1,380	2,340	767	720
Totals	49,433	24,732	15,979	11,294	5,420	5,786

Table J4. Estimated densities of wading birds within Big Cypress from January to June 2000 (foraging birds).

Species	Jan	Feb	Mar	Apr	May	Jun
Great Blue Herons	0.08	0.11	0.10	0.03	0.02	0.01
Great Egrets	5.25	4.28	3.02	1.09	0.39	0.21
Small Dark Herons	0.06	0.02	0.01	0.05	0.02	0.00
Small White Herons	0.17	0.05	0.07	0.13	0.09	0.00
White Ibises	9.16	2.47	0.81	1.40	0.53	1.34
Glossy Ibises	0.02	0.04	0.00	0.04	0.00	0.01
Wood Storks	0.37	0.24	0.51	0.04	0.39	0.01
Cattle Egrets	0.25	0.47	0.43	0.73	0.24	0.22
Totals	15.35	7.68	4.96	3.51	1.68	1.80

*Small dark herons includes those identified as small dark herons, Little Blue Herons, and Tricolored Herons

**Small white herons includes those identified as small white herons and Snowy Egrets.

Table J5. Estimated abundances of wading birds within Big Cypress from February to June 2001 (foraging birds).

Species	Jan	Feb	Mar	Apr	May	Jun
Great Blue Herons	427	487	87	67	13	40
Great Egrets	6,153	4,233	1,133	1,213	147	587
Small Dark Herons	67	40	7	7	13	13
Small White Herons	160	127	87	227	20	147
White Ibises	25,080	3,493	687	173	80	2,293
Glossy Ibises	7	67	0	0	0	0
Wood Storks	1,733	947	327	213	7	167
Cattle Egrets	300	240	120	953	927	1,567
Totals	33,927	9,721	2,475	2,880	1,207	4,927

Table J6. Estimated densities of wading birds within Big Cypress from February to June 2001 (foraging birds).

Species	Jan	Feb	Mar	Apr	May	Jun
Great Blue Herons	0.13	0.15	0.03	0.02	0.00	0.01
Great Egrets	1.91	1.31	0.35	0.38	0.05	0.18
Small Dark Herons	0.02	0.01	0.00	0.00	0.00	0.00
Small White Herons	0.05	0.04	0.03	0.07	0.01	0.05
White Ibises	7.79	1.08	0.21	0.05	0.02	0.71
Glossy Ibises	0.00	0.02	0.00	0.00	0.00	0.01
Wood Storks	0.54	0.29	0.10	0.07	0.00	0.05
Cattle Egrets	0.09	0.07	0.04	0.30	0.29	0.49
Totals	10.54	3.02	0.77	0.89	0.37	1.53

*Small dark herons includes those identified as small dark herons, Little Blue Herons, and Tricolored Herons

**Small white herons includes those identified as small white herons and Snowy Egrets