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FISH/WILDLIFE HABITAT ASSESSMENT OF THE LAKE GEORGE BASIN (CONTRACT No. 90G201)

Presented to:
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TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES - Continued

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1.0 INTRODUCTION

The Lake George Basin (Basin) is situated in the St. Johns River Water Management District in the northern part of the Florida peninsula (Figure 1). Located primarily on the eastern side of the Central Florida Ridge, Basin soils are mostly Entisols with level to sloping, excessively drained thick sands, (Fernald and Patton, 1984). Historically, most of the upland area was dominated by sandhill vegetation of longleaf pine (*Pinus palustris*) and turkey oak (*Quercus laevis*) and sand pine scrub (Myers and Ewel, 1990), but has been extensively converted to agricultural use. Wetland areas, including lake fringe swamps and blackwater river swamps, are extensive within the Basin and are among the most productive habitats present (Ewel, 1990). State-wide almost 60 percent (%) of marshlands have been drained for other uses. The Basin, however, retains a high percentage of marsh habitat. Presently there are 22 habitat types in the Basin ranging from freshwater aquatic habitat such as Lake George, to the upland xeric oak scrub. There are four man-made habitats including such areas as grassland and barren habitat which did not occur in the Basin prior to the arrival of early European settlers. Upland habitats such as scrub and sandhill are used by several endangered and threatened species and serve as recharge areas. Wetlands also include endangered and threatened wildlife. Scrub and sandhill habitats of the central Florida ridge support one of the highest rates of endemism in continental United States. The native habitats within the Basin contain more protected wildlife and plant species than any other area of similar size in Florida.

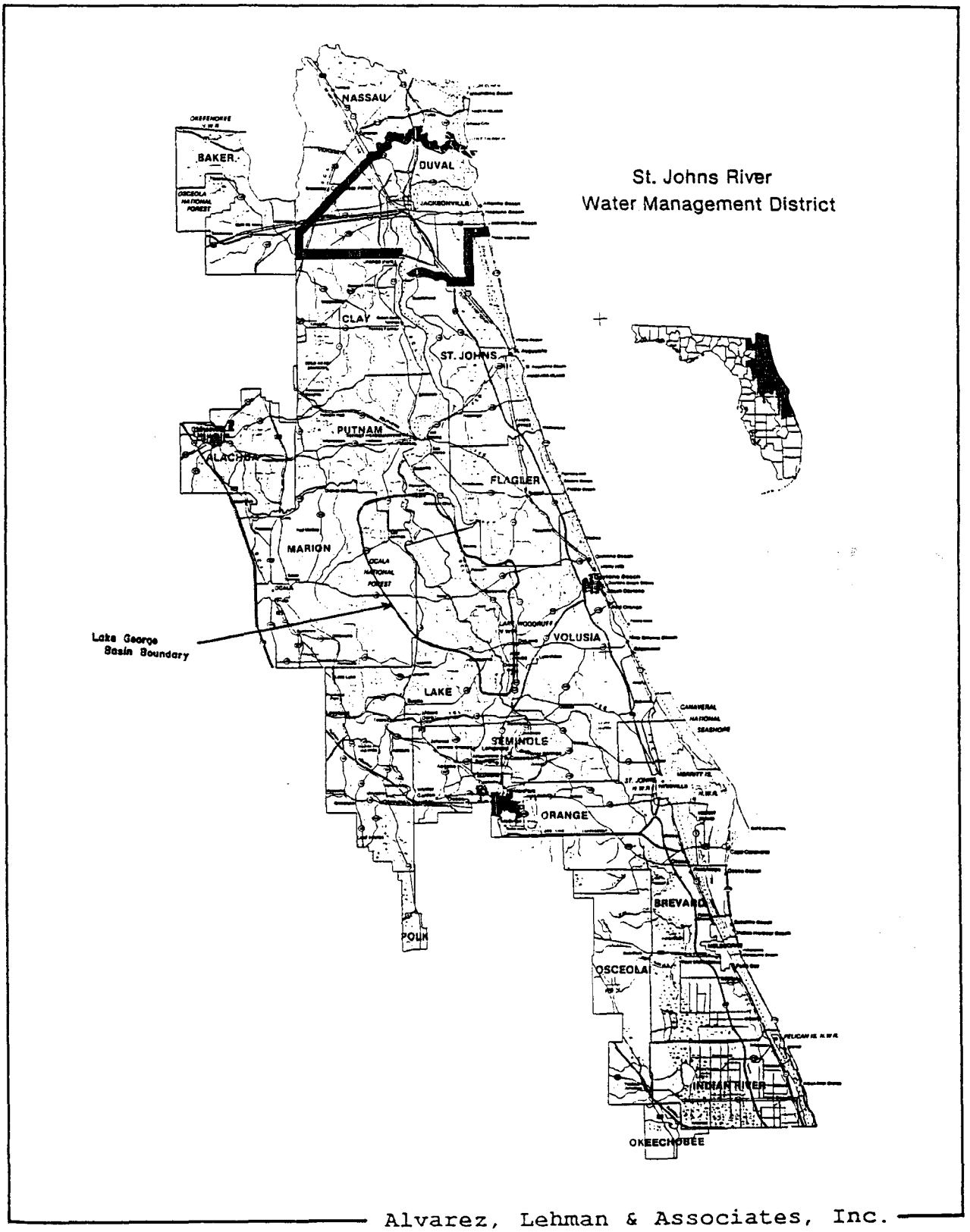

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FIGURE 1 - Location of the Lake George Basin St. Johns River Water Management District, Florida, 1991

Several large and diverse habitat areas exist within the State of Florida including the Big Cypress/Everglades area, Coastal Gulf Hammocks area, and the Apalachicola Drainage/National Forest area. The Lake George Basin encompasses almost every central Florida upland and fresh water wetland habitat. The interspersion of these various types of upland, wetland, and transition vegetation, and the sheer size of the Basin, make it one of the most important areas for fish and wildlife in Florida, and comparable to those areas mentioned above. There have been and are presently, however, substantial impacts imposed on this productive habitat area. These impacts are mainly associated with forestry, agricultural, industrial, and other development activities. Many of the impacts on aquatic systems (e.g., the St. Johns River) are associated with water quality effects originating from upstream of the Basin [e.g., the Big Econolockhatchee River (Big Econ) (East Central Florida Regional Planning Council, 1985).

The St. Johns River Water Management District (District) has the responsibility under the State Water Resource Plan to "preserve natural resources, fish, and wildlife" (Chapter 373.016(e) Florida Statutes) within its district. In order to meet this responsibility in the Lake George Basin, the District must have accurate and detailed baseline information for future monitoring of natural systems, regulatory review and decision making, and assessment of impacts. The following report provides basic information on many of the above tasks including the following:

1. Fish and Wildlife Species and Their Habitats in the Basin;
2. Special and Important Habitats in the Basin;

3. Past and Ongoing Impacts on the Habitats in the Basin;
4. Local, Regional, State, and Federal Regulatory Framework for Jurisdiction over Basin Resources; and
5. Summary of Recommendations.

One important subtask of the study was to identify important corridors of the Basin. However, as would be the case with many such studies, corridors occur not only within the Basin but extend well outside the study area.

The approach to address the above tasks was to assign two highly skilled and experienced professional ecologists to the tasks. In addition to published and unpublished literature sources for the area, field work by both the consulting team and District personnel provided the basic information for this report.

1.1 Description of the Area

Millions of years ago, the lower St. Johns River was an estuary of a shallow sea extending nearly as far southward as Lake Harney. As the ocean level dropped, barrier islands formed between the estuary and what is now the east coast of Florida. The river basin was a vast plain covered by sea water. Presently, the submerged plains are at a higher level than the estuary which now forms the river valley; consequently the river flows northward (Moody, 1963). North of Lake Harney the river curves westward across the eastern end of Lake Jessup and through Lake Monroe at Sanford. North of Lake Monroe the Wekiva River enters from the west forming the southern boundary of the Lake George Basin. From Lake Monroe to Lake George, four lakes adjoin the river from the

east: Lakes Beresford; Woodruff; Dexter; and Spring Garden. Several of these lakes are mainstem (i.e., outflow and inflow of the river at opposite ends of the lake) such as Monroe, Harney, and Lake George, while others are dead end lakes and include Lake Jessup and Lake Dexter. Several springs discharge flow into the river in this area: Blue Springs; DeLeon Springs; and Alexander Springs.

The drainage basin of Lake George is 782 square miles and represents about 9% of the St. Johns River drainage basin (Bass, 1983). Elevation in the basin extends from almost zero to 180 feet above mean sea level (MSL). The Ocala National Forest borders the lake on its western shore and includes an extensive area of upland scrub oak and sand pine scrub (Snedaker and Lugo, 1972). Lake Woodruff National Wildlife Refuge is in the southern part of the drainage basin. The confluence of the St. Johns and Oklawaha rivers forms the northern boundary of the Basin.

Lake George, a major feature of the Basin, is located approximately mid-way between the headwater of the St. Johns River and its discharge point to the Atlantic Ocean (Figure 2). The lake is influenced by tidal flow and includes a number of salt water species. The flow of water in the St. Johns River is sluggish with an average fall of less than 0.1 foot per mile (Fernald and Patton, 1984). Elevation at the lake is nearly at MSL and the overall gradient change over the length of the St. Johns River is very small. Characteristics of the river are sluggish currents, shallow depths, and a relatively broad basin (Bass, 1983). Discharge from the river to the Atlantic Ocean is only 156 cubic meters per second (m^3/s) (Bass and Cox, 1985). During unusual drought conditions, the elevation of the lake at times may be

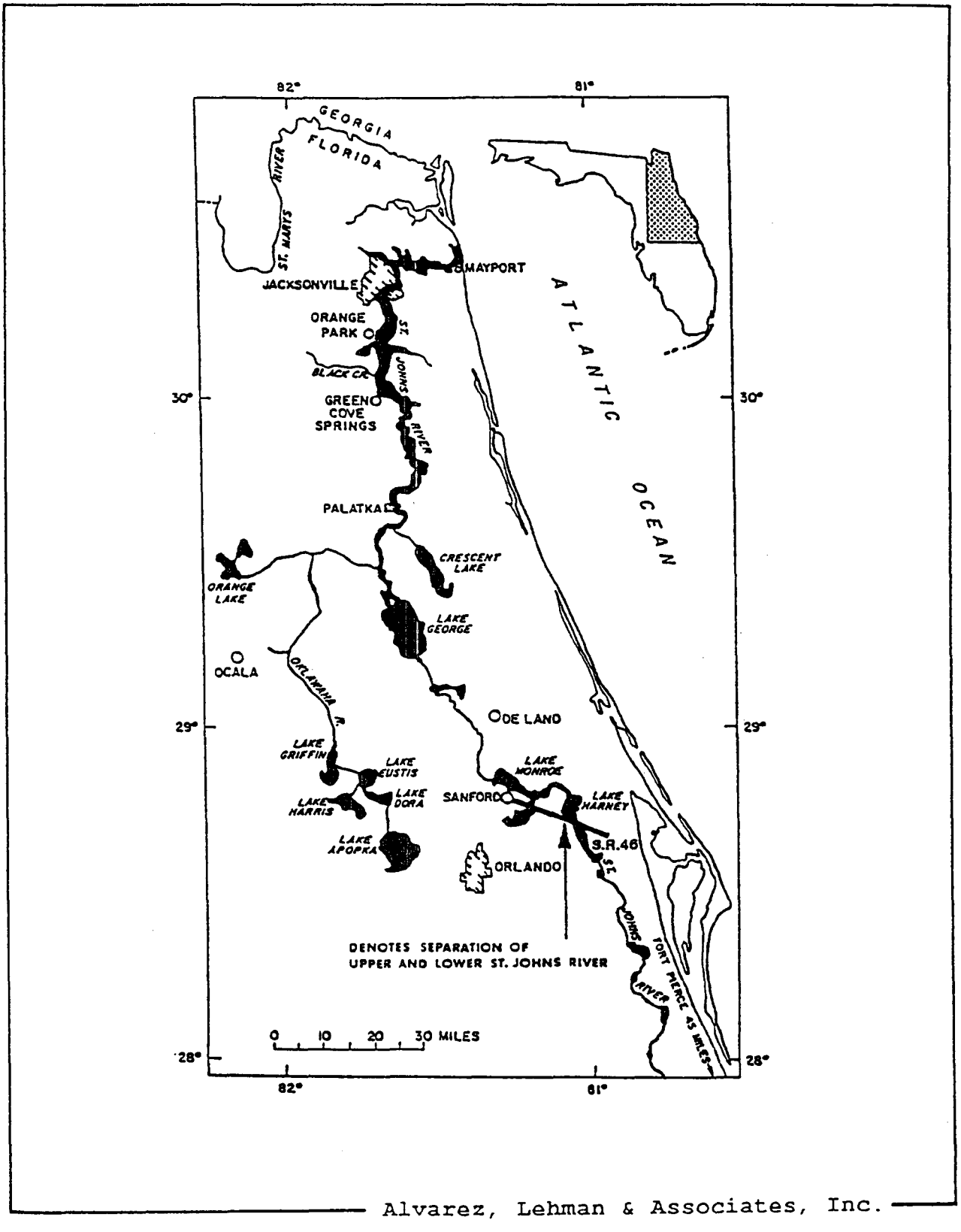

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FIGURE 2 - Location of Lake George, St. Johns River Water Management District, Florida, 1991

slightly less than MSL. The river is confined to its channel by relict dunes and barrier islands (now part of the mainland). These relic dunes block the water from flowing eastward to the ocean and form extensive upland habitat areas on the east and west sides of the basin. The river connects several large lakes that are really wide reaches in its channel. Lake George, with an area of 73 square miles, is the largest of these lakes.

Lake George is approximately 20 feet deep and predominantly sand bottom and is the second largest lake in Florida. The lake is moderately eutrophic and includes nutrient loadings from both man-made and natural sources (Baker et al., 1984). Upland areas to the west (Ocala), and to the south and southeast of the Basin (Orlando and DeLand) support major metropolitan areas. Lake George is bordered on the west shore by high ancient dunes of the Ocala National Forest and on the east by low-lying swamp and marshes. A large finger of upland habitat on the east side of the Basin extends down from the north above Barberville. This upland area grades off to wetland areas of marsh, swamp, and primarily low flatwoods to the east (Dickinson et al., 1982). Just south of Barberville there is another upland ridge extending toward Orlando with large expanses of wetland on either side of the ridge. Three springs discharge flow into Lake George from the west: Salt; Silver Glen; and Juniper. The water from these springs has high salt content derived from the old marine deposits through which they flow (Moody, 1963). These springs and the ocean tides, which reach daily 120 miles upstream from the mouth of the river, cause Lake George to be slightly brackish. However, water immediately downstream of the confluence of the St. Johns and Oklawaha Rivers is fresher than the waters in Lake George.

From Lake George, the river narrows until it reaches Little Lake George where it widens again. Croaker Hole, a submerged spring, discharges brackish water to the river. The juncture of the Oklawaha River with the St. Johns River marks the northern boundary of the Lake George Basin. The large volume of fresh water from the Oklawaha River dilutes the salt content of the St. Johns River. The gradient from the river source to its mouth some 300 miles north is less than 20 feet. The rate of flow is slow and dependent upon rainfall (Moody, 1963).

1.2 Upland and Wetland Relationship

Uplands and wetlands in the Basin are linked via the movement of many wildlife species between uplands and lowlands, and the overall movement of both ground water and surface water from uplands to lowlands. The many wildlife species occurring in the area such as the black bear (*Ursus americanus*), river otter (*Lutra canadensis*), and bobcat (*Lynx rufus*) often move between the various upland and lowland habitats and may use either type extensively depending on seasonal and other factors (Wooding and Hardisky, 1988; Brady, personal communication, 1991; and Snedaker and Lugo, 1972). Other wildlife may be tied to both uplands and wetlands by requiring breeding sites in wetlands and use of upland habitats as adult forms. The movement of water is more directional and moves from upland to lowland. Surface water often moves overland to lowland or through the surficial sands of sandhill and scrub vegetation into sinkholes or solution basins thereby providing water sources for springs, rivers, and wetlands of swamps, bays, and marshes. The surficial water table is the water source for most wetland systems. This movement of water may act to

store and release, and to filter the water and provide a nutrient input in some cases (Snedaker and Lugo, 1972). A spring is a break in the confining layer and deeper aquifers, thus providing water to the surface. A number of the springs in the area also carry a heavy salt content as a result of fresh water being forced through old sea beds. These salt springs and their discharge water enable a variety of salt water fish species to survive in the springs, lakes, and the rivers of the area. Some species, such as mullet, shad, and eels, are present because part of their life cycle revolves around freshwater systems. Nutrient loads, water quality aspects, and wildlife diversity of the Basin wetlands are all dependent upon the extent, nature, and quality of the surrounding uplands.

Presently, water quality in the Basin is usually good although periodic algae blooms occur in Lake George (East Central Florida Regional Planning Council, 1985). These blooms, if extensive and of long enough duration, will restrict available light to submerged macrophytes, thus causing a reduction in the extent and coverage of these important fish habitats. These blooms may also deplete oxygen levels or, in some cases, release toxins. The major source of nutrient loading in Lake George comes from the upstream portion of the St. Johns River. Much of the turbidity associated with the incoming St. Johns River flow will settle out in the Basin prior to the water flowing on downstream. Segments of the Basin are controlled by the U.S. Forest Service, U.S. Fish and Wildlife Service, the District, and other agencies. These agencies maintain large tracts of land and habitats within the Basin which provide protection of the watershed, thus, ensuring good water quality in those reaches. However, water quality impacts may arise in other

portions of the Basin and upstream of the Basin from agricultural, industry, and other non-point sources. A water quality monitoring program, including the investigations into the causes of algae blooms in Lake George, should be conducted (East Central Florida Regional Planning Council, 1985).

2.0 METHODS

The basic approach to assessing fish and wildlife resources of the area was to establish three sources of information based on the following:

1. Literature, including published and unpublished sources;
2. Aerial photographs, habitat maps, and other figures showing the resources of the Basin; and
3. Aerial flyover and ground truthing of specific areas and habitats.

The literature review was conducted by the consulting team and the District staff. Other literature was surveyed from the Florida Game and Fresh Water Fish Commission (FGFWFC), U.S. Fish and Wildlife Service, Florida Natural Areas Inventory, and other applicable services. Numerous telephone contacts were made with biologists or agencies working in the Lake George Basin.

Infra-red aerial photographs from the 1988 series were reviewed and field verified. Color habitat maps, based on the FGFWFC Landsat program, were obtained and reviewed and compared to other mapping efforts. Aerial photographs from 1979 from the Soil Conservation Service were reviewed to determine trends in habitat acreage.

Two aerial flyovers were conducted with District personnel. Each flight consisted of reconnaissance trips over the entire Basin. Aerial photographs were taken during these flyovers and compared to existing aerial photographs. Specific areas were checked for the extent of particular

habitat types such as sandhill, and to assess the recent impact on the particular area of investigation. Ground reconnaissance consisted of reviewing aerial photographs, driving to specific locations for habitat assessment and comparing conditions of the present situation to unaltered conditions or previous conditions. Specific habitat types such as sandhill, dry prairie, and scrub were checked in this manner.

Specific data for the Lake George Basin were developed from the above task and applied in describing the fish and wildlife resources of the area. Species lists were developed for each habitat type identified from the FGFWFC Landsat map. The species lists developed for each habitat type are more habitat specific than many such lists. First hand knowledge of the Basin and the Ocala area was used in some cases for developing trends on wildlife population information and habitat conditions.

3.0 RESULTS

3.1 Fish and Wildlife Species of Lake George Basin and Their Habitat Requirements

The Lake George Basin like many other large land areas in Florida has undergone extensive modification of habitats, mostly caused by mans' activities. These modifications of habitats have simplified biological systems and caused changes in many plant communities and a subsequent reduction in faunal diversity, in addition to the elimination of some of the more habitat-specific forms and animals more endangered by large land use changes. Species such as the red-cockaded woodpecker (*Picoides borealis*) have declined from what may have been populations in the hundreds to no more than eight breeding groups in 1991 (Cockerham, personnel communication, 1991). Other species such as the Florida panther (*Felis concolor coryi*) and red wolf (*Canis rufus*) have been eliminated entirely from the area (Beldon, personal communication, 1990 and Parker, 1987). There are, however, large areas within the Basin in which major alterations to habitats and extensive fragmentation of habitats has not been pronounced enough to disrupt the support of many wide ranging Florida wildlife. Animals, including the Florida black bear, bald eagle (*Haliaeetus leucocephalus*), Florida scrub jay (*Aphelocoma C. coerulescens*), limpkin (*Aramus guarauna pictis*), and the manatee (*Trichechus manatus*), are surviving and using habitats in the Basin. It is a common experience to observe limpkins foraging for apple snails (*Pomacea paludosus*) and other invertebrates along the run from Alexander Springs. The Florida black bear, although scarce in many other parts of the state, is still a relatively conspicuous part of the wildlife in the Basin (Brady, personal communication, 1991). Other animals are recent

arrivals in the Basin and include such predators as the coyote (*C. latrans*) (Wooding and Hardisky, 1990) and insectivores such as the nine-banded armadillo (*Dasypus novemcinctus*).

The Basin includes a diversity of habitats that provide a balance of aquatic, wetland, and associated upland habitats. Extensive swamps, freshwater marsh, and prairies occur in the central part of the Basin, while upland forest consisting of scrub and other forest types occur to the east and west of the swamp forest and riverine habitat (Figure 3a). Because of the surrounding buffer of upland communities, water quality within the major rivers and streams of the basin is generally good, which enhances wildlife occurrence and use of the area.

3.1.1 Wildlife Communities

The following narratives and tables describe the various habitat types and wildlife communities. Names of habitat types follow those outlined by the FGFWFC for their Landsat maps (Figure 3b).

Habitat and wildlife species diversity on the eastern side of the Basin appears to be higher than that of the western side of the Basin. The eastern side of the Basin, however, has more extensive impacts and has a greater percentage of marshland habitat. The east side includes more extensive areas of swamps, hammock, pinelands and less extensive areas of sandhill and scrub vegetation. The habitat diversity on the east side of the Basin could be enhanced by land acquisition to provide a better balance of unaltered upland and wetland habitats, thereby providing

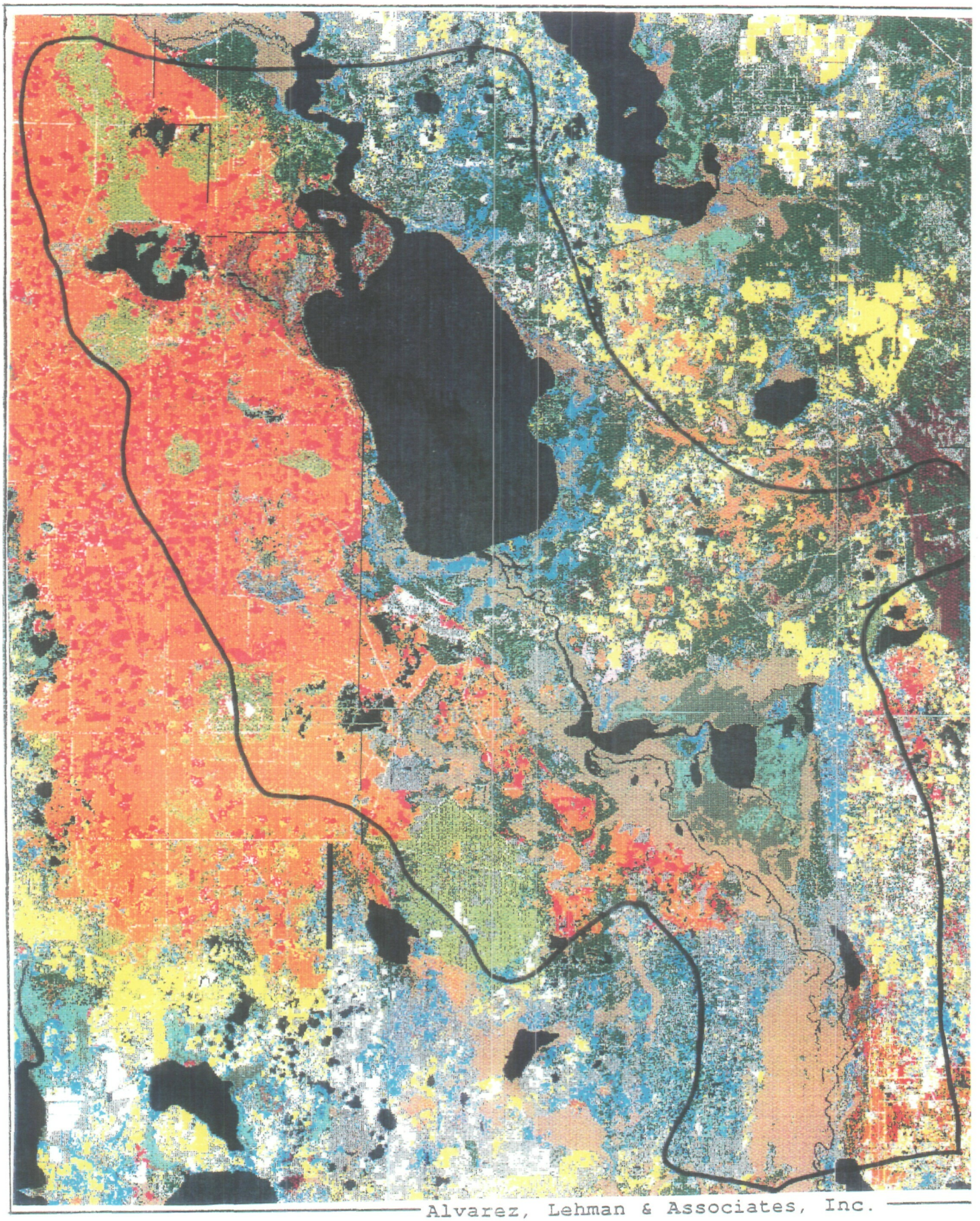

FIGURE 3a. Habitats of the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Source: Florida Game and Fresh Water Fish Commission, 1991

Compiled by: Alvarez, Lehman & Associates, Inc., 1991

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FIGURE 3b. Habitat Codes of the Lake George Basin, St. Johns River Water Management District, Florida, 1991

improved conditions for wildlife as well as better watershed protection. The southern portion of the Basin is less broad and is bordered by areas more influenced by urban development.

Within the mix of this varied landscape, a total of 22 different habitat types occur within the Basin (Table 1 and Figure 3). The broad category of hardwood hammock forest could be further broken down to hydric hammock, mesic hammock, and xeric hammock (Tables 1 and 2). The format was followed as defined by the Landsat habitat mapping of the FGFWFC. In addition, all pinelands were similarly lumped into one category but could include pine plantation, pine flatwoods, and other breakdowns of the flatwoods (slash, longleaf, scrubby, or other categories of flatwoods).

Important habitats in the Basin including the naturally occurring systems such as hammocks, swamps, freshwater marsh, sandhills, and scrub communities support 100% of the native wildlife species of the Basin. These habitats provide nesting, foraging, and escape cover for all species. Each habitat may support a different assembledge of wildlife, some of which are habitat specialists (e.g., scrub jay) and only occur in one or two habitat types. Isolated cypress domes, flatwood ponds or marshes, bayheads and willow heads, which do not contain predatory fish often serve as breeding sites for at least 19 species of amphibians. Small, isolated ponds that are ephemeral may be the single most important habitat to amphibians, including frogs and salamanders, and include a greater number of amphibian species than larger wetlands (Moler and Franz, 1987). Ponds as small as half an acre or less may be the exclusive breeding site of many of these smaller animals. These amphibians may be significant links

TABLE 1. Number of Wildlife Species Associated With Habitats Occurring in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

	Habitat Type*																Total Species
	741	641	621	615	611	520	550	510	438	427	421	413	412	410	320	210	
Amphibian	4	19	27	23	13	3	6	10	9	11	10	9	12	14	4	7	33
Reptiles	10	26	32	35	15	13	16	14	19	26	23	30	30	26	16	15	59
Birds	15	71	77	74	61	34	39	50	51	72	66	104	77	90	58	48	190
Mammals	6	19	25	19	16	3	9	10	16	21	23	24	29	26	19	13	49
Total	35	135	161	151	105	53	70	84	95	130	122	167	148	156	97	83	331

*741 = Barren, 641 = Freshwater marsh, 621 = Cypress swamp, 615 = Hardwood swamp; 611 = Shrub/Bayswamp; 520 = Open water, 550-510 = Spring runs and rivers; 427 = Mixed Hardwood and pine; 438 = Mixed hardwoods; 421 = Xeric oak scrub; 413 = Sand pine scrub; 412 = Sandhill; 410 = Pine lands; 320 = Shrub and brushland; 210 = Grassland; Codes follow those used in Habitat Mapping of Area by Florida Game and Fresh Water Fish Commission.

Sources: Lugo and Snedaker, 1972; Brown et al., 1989; Florida Committee on Rare and Endangered Plants and Animals Series; Florida Game and Fresh Water Fish Commission, 1976; 1989; Volusia County, 1990

Compiled by: Alvarez, Lehman & Associates, Inc., 1991

TABLE 2. Wildlife Habitats in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Habitat Type	Code	Occurrence Basin	Occurrence State	Habitat Trend*	Number of Wildlife Species	%
Barren	741	A	C	Increasing	35	(11)
Shrub and Brushland	320	U	C	Increasing	97	(29)
Grassland	210	C	C	Increasing	83	(25)
Open Water	520	C	C	Stable	53	(16)
Spring Run and River	550/510	U	U	Stable	91	(27)
Shrub Swamp	611	C	U	Increasing	105	(32)
Hardwood Swamp	615	A	C	Stable	151	(46)
White Cedar Swamp	623	R	R	Stable	?	(?)
Cypress Swamp	621	R	U	Stable	161	(49)
Bay Swamp	611	U	R	Stable	105	(32)
Fresh Water Marsh and Prairie	641	C	A	Stable	135	(41)
Pinelands	410	C	A	Decreasing	156	(47)
Dry Prairie	310	R	R	Stable/Unknown	?	(?)
Hardwood Hammock Forest	427	C	C	Stable/Decreasing	130	(39)
Mixed Hardwood Pine Forest	438	U	U	Stable	95	(29)
Xeric Oak Scrub	421	C	R	Decreasing	122	(37)
Sandhill	412	U	U	Decreasing	167	(50)
Sand Pine Scrub	413	A	U	Decreasing	148	(45)
				Total Species	331	

* = Trends are based on the last 10-20 years and represent a qualitative assessment.
% = Percentage of Total Species Complement
? = Species assembled not determined
A = Abundant; C = Common; R = Rare; U = Uncommon

Source: Alvarez, Lehman & Associates, Inc., 1991

in the vertebrate food chain and support such species as indigo snakes (*Drymarchon corais couperi*). Isolated ponds may be important over the entire watershed with each pond potentially influencing the amphibian population over nearly 3000 acres of upland habitat. Actions that affect the hydroperiods of such ponds, including "improved hydroperiod", may affect these breeding sites in an ill-defined manner (Moler and Franz, 1987).

Ten other species of amphibians reside in and breed in a variety of wetlands with permanent water. Approximately 16 species of primarily aquatic reptiles, including both turtles and snakes, lay their eggs on the fringes of upland hammocks or other dry habitats associated with wetland areas. Other species occur in a variety of habitat types. Scrub and hammock may support over 100 species of wildlife each, while the habitats that have replaced these areas (e.g., grasslands) will only support a limited number of wildlife species. These replacement habitats, which include the barren, grassland, and shrub and brushland habitats, are in an early successional stage and are generally limited to ground cover vegetation. These disturbed habitats may occur on many former native habitat sites, but are found most frequently in pine flatwoods, sandhill, and scrub sites. These altered habitats are often maintained in an early successional stage by mechanical means and grazing by livestock. Vegetation in these areas is often limited to such species as bahia grass (*Paspalum notatum*) and wax myrtle (*Myrica cerifera*). Wildlife use of these habitats is limited, but to a certain degree depends on surrounding vegetation types. Generalist and ground nesting species such as the eastern meadowlark (*Sturnella magna*), northern mocking bird (*Mimus polyglottos*), and cottontail rabbit (*Sylvilagus*

floridanus) are common. Habitat specialists such as scrub jays and sand skinks (*Neoseps reynoldsi*) are usually eliminated.

The 22 habitats, which consist of 3 aquatic, 6 wetland, 12 upland forest, and 4 man-modified and created habitat types, support a total of 331 different wildlife species (Appendix A). These wildlife species include 33 amphibians, 59 reptiles, 190 birds, and 49 mammals (Table 2). Seasonal influences result in dramatic changes in the wildlife, notably among the bird fauna. Summer bird residents include 95 species and a minimum of 53 species move through the area or reside there during the winter. Somewhere between 60 and 65 upland breeding bird species occur in the area (Emlin, 1978). Of the 331 wildlife species, 38% are known to breed or reproduce in aquatic habitats in the area.

3.1.2 Endangered and Threatened Wildlife Species

A total of 33 wildlife species, which are considered endangered, threatened, or species of special concern, reside within the boundaries of the Lake George Basin (Table 3). These groups of animals include 2 amphibians, 7 reptiles, 14 birds, and 10 mammal species. In addition, there are 9 species that reside or possibly reside in the Basin which have been listed as imperiled animals by Millsap et al., 1990 (Table 4). This diverse group of wildlife species includes a number of animals which occur in or use all types of natural habitats within the Basin. Several animals with historic ranges that included the Basin, such as the Florida panther, were not included in the list. Including Federal, State, and imperiled species, the Lake George Basin contains 37% of

TABLE 3. Endangered and Threatened Wildlife Species of the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Species		Status** Federal	State	Comments
AMPHIBIANS				
Ambystoma cingulatum Flatwoods tiger salamander	20*	C2		Flatwoods
Rana areolata Gopher frog	25	C2	SSC	Resides in gopher tortoise burrows - breeds in cypress domes and other wetlands
REPTILES				
Alligator Mississippiensis American alligator	17	T(S/A)	SSC	Common in wetlands
Drymarchon corais couperi Eastern indigo snake	25	T	T	Varied habitats, use gopher tortoise burrows
Gopherus polyphemus Gopher Tortoise	27	C2	SSC	Dry uplands, abundant in area
Ophisaurus compressus Island glass lizard		C2		Dry uplands
Neoseps reynoldsi Sand skink	36	T	T	Sand pine scrub, Ocala National Forest
Pituophis melanoleucus mugitus Florida pine snake	24	C2	SSC	Pine Forests
Sceloporus woodi Scrub lizard	27	C2		Scrub habitat
Stilosoma extenuatum Short-tailed snake	30	C2	T	Sandhill-sand pine scrub

--Continued--

TABLE 3 - Continued

Species	Status** Federal	State	Comments
BIRDS			
Ajaia ajaja Roseate spoonbill	25	SSC	Very rare migrant, freshwater/marsh
Aimophila aestivalis Bachman's sparrow	12 C2		Sandhill-pine flatwoods
Aphelocoma c. coerulescens Florida scrub jay	30 T	T	Scrub oak-sandhill, large population in the N.F.
Aramus guarauna pictus Limpkin	22	SSC	Fresh water swamp and marsh
Athene cunicularia floridana Florida burrowing owl	24	SSC	Sandhill - upland pasture large population west of Ocala
Egretta caerulea Little blue heron	23	SSC	Wetlands - breeding in area
Egretta thula Snowy egret	17	SSC	Wetlands - breeding in area
Egretta tricolor Tricolor heron	17	SSC	Wetlands
Falco sparverius paulus Southeastern kestrel	23 C2	T	Sandhill, sand pine scrub, nesting in snags - large population west of Ocala
Grus canadensis pratensis Florida sandhill crane	31	T	Freshwater marsh-nesting, primarily on south and east part of area
Pelecanus occidentalis Brown pelecan		SSC	Open water

--Continued--

TABLE 3 - Continued

Species	Status** Federal	State	Comments
Haliaeetus leucocephalus Bald eagle	26	E	T	Open water - most large pines - State nuclear population
Sterna antillarum Least tern			T	
Mycteria americana Wood stork	23	E	E	Wetlands
Picoides borealis Red-cockaded woodpecker	30	E	T	Sandhill, population declining
MAMMALS				
Mustela frenata peninsulae Florida long-tailed weasel	18	C2		Variety of habitats - status unknown
Myotis austroriparius Southeastern bat	23	C2		Marsh and lake - old growth forests
Neofiber alleni Round-tailed muskrat	22	C2		Shallow freshwater marshes
Podomys floridanus Florida mouse	22	C2	SSC	Associated with gopher tortoise
Plecotus rafinesquii Southeastern big-eared bat	21	C2		Lakes, streams
Sciurus niger shermani Sherman's fox squirrel	24	C2	SSC	Sandhill - pine flatwoods
Sorex longirostris longirostris Southeastern shrew	5	C2	SSC	Forested wetlands

--Continued--

TABLE 3 - Continued

Species	Biological Vulnerability*	Status** Federal	Status** State	Comments
Trichechus manatus Manatee	32	E	E	Open water, freshwater marsh
Ursus americanus floridanus Florida black bear	33	C2	T	Sand pine scrub, flatwoods, swamp

* Biological vulnerability (higher score=higher vulnerability), Millsap et al., 1990
**Protected status under Federal and State regulations, respectively.

C2 = under review for federal listing;
T = threatened;
E = endangered;
SSC = state species of special concern.
See Wood (1990) for definitions of these terms.

Source: Alvarez, Lehman & Associates, Inc., 1991

TABLE 4. Animals Listed as Imperiled as Indicated by Biological Scores from Millsap et al., 1990, Lake George Basin, St. John River Water Management District, Florida, 1991

Species	Biological Score*	Comments
Notophthalmus perstriatus Striped newt	29	Pine flatwoods, cypress dome, marshes
Eumeces e. onocrepsis Peninsula mole skink	24	Scrub
Tantilla r. relicta Peninsula crowned snake	33	Scrub
Tantilla r. neilli Central Florida crowned snake	31	Scrub, sandhills, mesic habitats
Crotalus adamanteus Eastern diamondback rattlesnake	24	Pine flatwoods, upland habitats
Buteo brachyurus fuliginosus Short-tailed hawk	36	Variety of habitats
Elanoides f. forficatus Swallow-tailed kite	30	Forest edge
Mustela vison lutensis Florida mink	33	Variety of habitats
Lutra canadensis vaga River otter	26	Wetlands

*Biological Score: higher score = higher vulnerability

Source: Alvarez, Lehman & Associates, Inc., 1991

these types of wildlife occurring in the state. Twelve and 15 of the birds and herps, respectively, listed as threatenedand endangered species, use cypress and hardwood swamps as their preferred habitat.

The Lake George Basin is an important area for many of these protected and imperiled species as several of these populations represent the largest in the state. The scrub jay population in the Ocala National Forest is estimated between 2000 to 3000 breeding pairs (Cockerham, personal communication, 1991 and Cox, 1984) and is probably the largest in the state (approximately 25% of the estimated population based on Cox, 1984). Fitzpatrick et al., (1991) provides further discussion on scrub jay populations in the state and the Lake George Basin. The bald eagle nesting density around Lake George is high and may be the highest density in the state (Peterson, 1978) (Figure 4). This large nesting eagle population is primarily dependent on the Lake George fisheries for its nesting success. Other notable concentrations of protected species include the southeastern kestrel (*Falco sparverius paulus*), the sand skink. Populations of many of the latter species (i.e., the scrub lizard) are associated with scrub habitats and are more common in the Ocala National Forest than elsewhere.

Acquisition of additional habitats of sandhill, sand pine scrub, and xeric oak scrub in areas surrounding the National Forest which are managed in the appropriate fashion (i.e., protection from disturbance and maintenance of the proper fire schedule) will greatly enhance the chances of increasing the population size of endangered and threatened species in the Basin. Many of these species, such as the Sherman's fox squirrel (*Sciurus niger shermani)* and the Florida pine snake

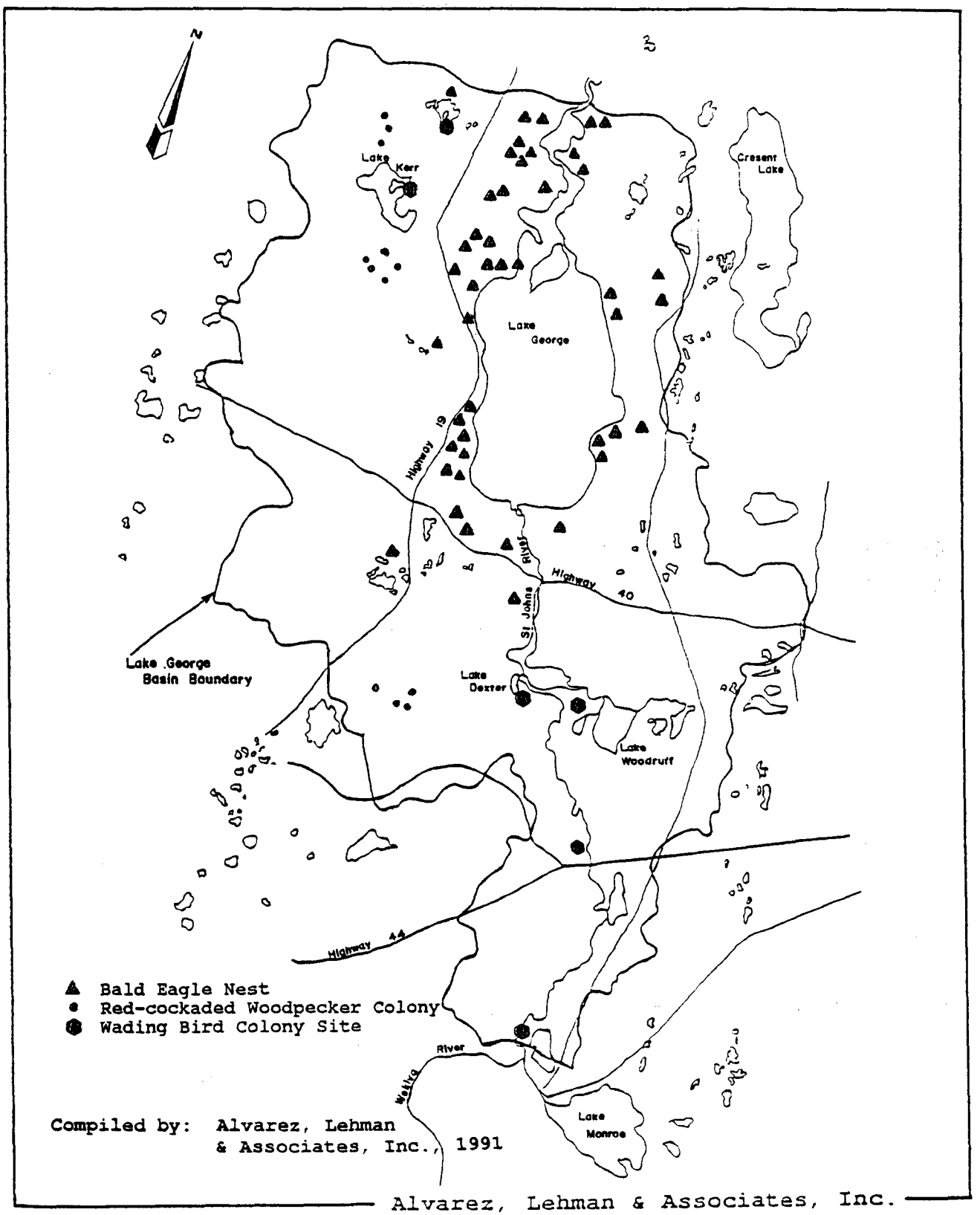

FIGURE 4. Approximate Location of Selected Endangered and Threatened Species in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

(*Pituophis melanoleucus mugitus*) do not receive nearly the attention that some species do, such as the red-cockaded woodpecker (Bondurant, 1991).

In the following narrative, the discussion is focused on several representative and characteristic species of habitats and ecosystems found in the Basin. The habitat requirements necessary to support many of these species discussed below will be similar to many other wildlife in general and other threatened species in particular. Conservation efforts for these species will thus provide habitat for other species.

3.1.2.1 Florida Black Bear

The Florida black bear population is now primarily restricted to large undeveloped forested habitats around the Apalachicola, Osceola, and Ocala National Forests (NF) and the Big Cypress Preserve (Brady and Maehr, 1985). Human population growth in Florida, which has resulted in the clearing and fragmentation of most Florida forest, has restricted the total black bear population and geographically isolated a large portion of these smaller subpopulations mentioned above. The relatively small number of bears in each of these subpopulations, and the fact that there is probably only four major subpopulations within the state, indicates the continued survival of bears will depend on careful and thoughtful management and protection.

The distribution of the black bear in the Basin was based on available data from road kill information and discussion with personnel of FGFWFC. The Ocala NF bear population apparently extends throughout the Lake George Basin, south through the Black Water and Seminole Swamps, to the Wekiwa

Springs State Park, and west to the Oklawaha River. The bear population apparently extends east and north and has some connection with the population in the Osceola National Forest. The Tomoka Wildlife Management area has black bears which are part of this large (area only) population of bears. The black bear population in the Ocala National Forest is estimated at 125 bears.

Black bear movements may be affected by food availability, mating behavior, dispersal behavior, and home range use. Black bears have relatively large home ranges and use a variety of habitat types. In the Ocala NF, male bears have an average home range of 56 square miles while females average 12 square miles. Habitat use includes scrub (52%), pine flatwoods (39%), sandhill (2%), and hardwood swamp (7%). The pine flatwoods habitat was the most used for bedding areas and, overall habitat use changed depending on mast availability. Bear movements usually occur in the edge between pine flatwoods and hardwood swamps. Habitat preference of feeding bears shifts from pine flatwoods during the winter to sand pine scrub in the summer and fall (Wooding and Hardisky, 1988). Bear movements may also be influenced by mating and establishment of home range. During the home range monitoring study by Wooding and Hardisky (1988) one adult male was observed about 14 miles away from his home range in search of breeding females. Young bears usually disperse between the age of 1 and 2 years and travel up to 22 miles in establishing a home territory. All of these movement patterns may bring bears in contact with humans, particularly when crossing highways.

In the central Florida area, which includes the Lake George Basin, there were 129 recorded bear kills from 1980-

1990 (Florida Game and Fresh Water Fish Commission, 1991b). Of these, 85% were killed on Florida highways; about 11 bears are killed annually on the central Florida highways. Road kills appear to be increasing with a greater number recorded over the last three years compared to previous counts. More specifically, 43% of these road kills were in the Lake George Basin (Figure 5). In addition, the junction of State Route 46, 46A, and County Road 433, which is just south of the Basin, accounted for 15% of all road kills. In each area it appeared that most bears were struck while crossing roads in the vicinity of major swamp systems, usually in the fringe habitat of either flatwoods or scrub. Apparently because of the more extensive and frequent movement by males, the sex ratio of road kills is biased toward males (70/30%), but also included a greater percentage of young, dispersing males (Wooding and Brady, 1987). Several corridor crossings in the Basin may be important to bears and are discussed further in Section 5.4. Wooding and Hardisky (1988) outline three factors which might reduce road kills of black bears in the area:

1. Construct underpasses including fencing of nearby habitat to funnel bears to the underpass on new highway projects;
2. Post warning signs which alert motorists to recognize bear crossing areas; and
3. Educate drivers about ways to reduce bear collisions.

In addition, it might be important to construct underpasses in areas on existing roads which had reported high number of road kills. Although warning signs about bear crossings exist along State Highway 42, none were observed

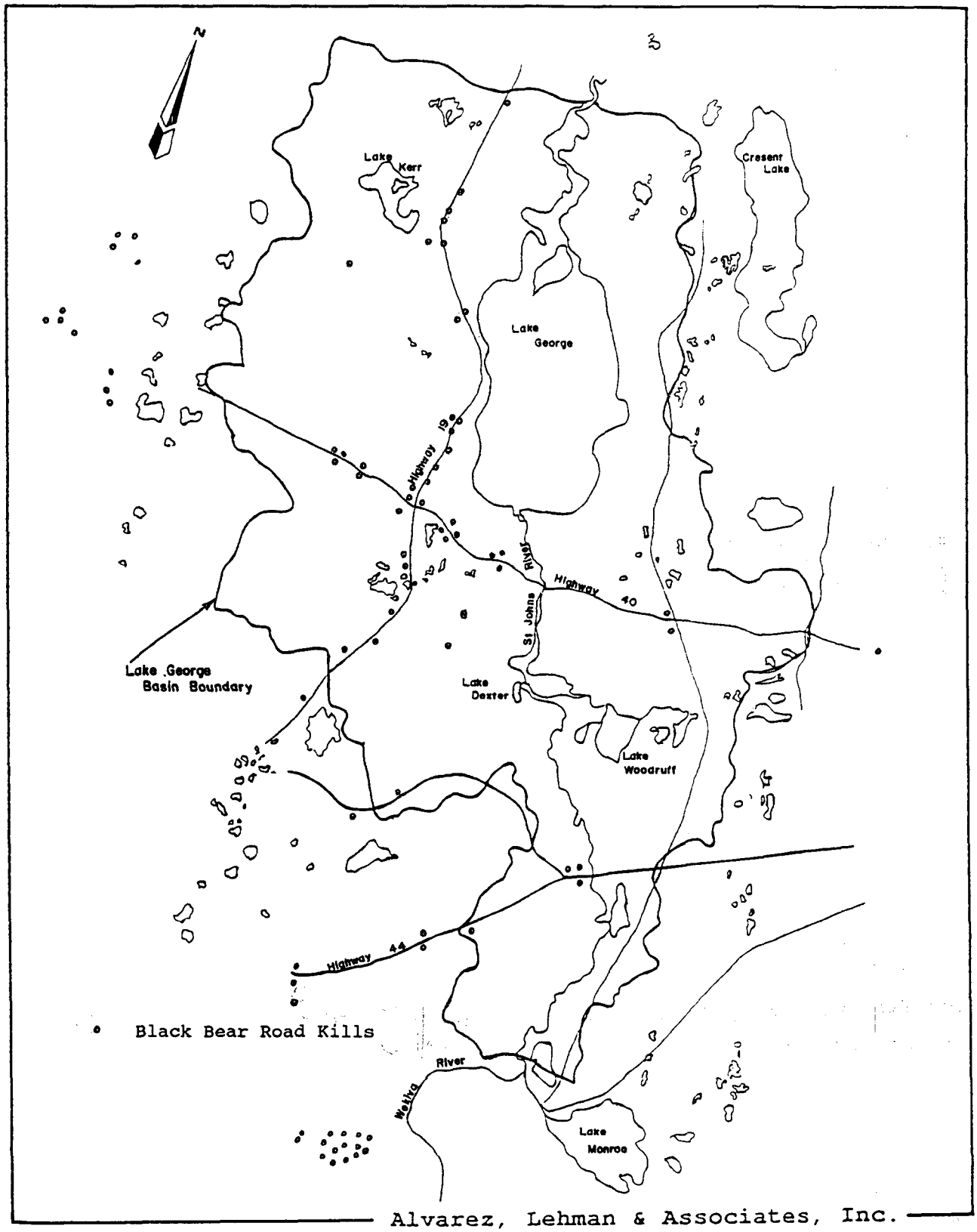

FIGURE 5. Locations of Black Bear Road Kills in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

during the present study along State Highway 19, 40, or 44 or other county roads in the area with high ratios of bear kills. Recent proposals to expand State Highway 40 to a four-lane could pose significant risk to the Ocala NF bear population (Palmer, personal communication).

Ocala NF bears appear to be primarily centered in the west side of Lake George. Road kills are much less frequent on the east side of the lake (Figure 5). Simons (1990) indicated bears occurred in the Lake George Seminole Forest property and suggested that with better management and reduced human disturbance in the area, the east side of the lake could become an important part of the Ocala NF bear population. Additional land area of contiguous native habitat and restriction of human disturbance within the area would make the entire east side of the lake an important portion of the habitat for the Ocala NF bears.

Recommendations by Wooding and Hardisky (1988) for best management practices on areas to support bear should include the following:

1. Protection of mast producing trees;
2. Conducting a regular burning program that favors soft mast production;
3. Maintenance of densely vegetated areas needed for year-round cover as well as for winter bedding habitat;
4. Limiting or prohibiting development activities; and
5. Prohibit road construction.

Additionally, any efforts to help sustain bears in the Basin should focus on acquiring lands currently not

controlled by federal or state agencies but, which based on available data, are important to bears in the Lake George Basin and surrounding areas and provide continuous habitat with no major breaks in forest cover. In some cases this may involve land acquisition and habitat development, and management of lands that do not presently provide optimum conditions as bear habitat. Several large and small forested corridors exist within the basin which, based on road kill data, are important to some segment of the bear population (Figure 5). The extension and protection of the portion of the population on the east side of Lake George appears to be of importance in the overall long-range protection of this animal in the Basin.

3.1.2.2 Red-Cockaded Woodpecker

The red-cockaded woodpecker is a cooperative breeder that lives in groups of 2-7 individuals consisting of 2-4 adults and 1-3 young of the year. Average group size in central Florida is about 3.4 birds following nesting (DeLotelle and Epting, In press). Average territory size in sparse foraging habitat may extend to near 300 acres (DeLotelle et al., 1987) while territories in denser habitat may average near 125 acres (Hooper et al., 1982). Red-cockaded woodpeckers have the unique habit of constructing cavities in living pine trees that are 60 years old or older (DeLotelle and Epting, 1988 and Hooper, 1988). In Florida, cavities are sometimes constructed in slash pine (*P. elliotti*) but most are in longleaf pine with a substantial number in loblolly pine (*P. taeda*). Red-cockadeds forage predominantly in pine trees which are usually older than 20 years. In the Ocala NF, the red-cockaded woodpecker is restricted to sandhills with a predominant longleaf pine overstory. Elsewhere this

woodpecker occurs in old pine stands of longleaf pine flatwoods and other upland pine forest.

The red-cockaded woodpecker population is distributed throughout the southeastern United States within an area from Texas to Florida and north through Oklahoma to Kentucky and Virginia. Major concentrations of red-cockadeds in Florida occur in Apalachicola National Forest (684 active colonies) and Englin Air Force Base (243 active colonies) (U.S. Forest Service, 1991; Wood and Wenner, 1983). In 1983, the known distribution of red-cockaded woodpeckers in the Basin included an estimated 41 active colonies in the Ocala NF and an unknown number of colonies in the eastern portion of the Basin just south of U.S. Highway 11 (Wood and Wenner, 1983 and Lennartz et al., 1983). Since that time the number of active colonies has declined to 12. During the 1991 breeding season, however, only 1 of 8 pairs that attempted breeding was successful (Cockerham, personal communication, 1991). These 12 active colonies are widely distributed in the Ocala NF with no more than 5 occurring within any one locale (Figure 4). Although field surveys were limited by the amount of time available, it is doubtful that any other red-cockadeds occur within the Basin (also see Simons, 1990). One old aged longleaf pine stand occurring in the area supposedly contained red-cockadeds (Wood and Wenner, 1983), however, the original field surveyor (Baker, personal communication, 1990) could not confirm the presence of red-cockadeds in the area. The area still contains the relative large stand of old aged longleaf pine, however, the area continues to be converted to agricultural lands.

Because of recent population declines throughout most of this species range, efforts have been made to determine the factors affecting population declines (see Costa and Escano, 1989) and include the following:

1. Fragmentation of habitat;
2. Habitat destruction;
3. Deterioration of habitat quality by invasion of hardwoods into otherwise pine dominated forests; and
4. Competition from other species for cavity space.

Apparently many of the same factors, particularly 1 and 2 and possibly 4 from above, have affected the Ocala NF red-cockadeds.

Lands presently controlled or potential further acquisition of lands by the District could support red-cockadeds. This undoubtedly would require a long-term commitment as no old and large stands of longleaf pines were identified on any of the lands in the Basin not managed by the U.S. Forest Service or other groups. Blocks of lands with suitable habitats capable of supporting up to 20 or more breeding pairs have a high probability of maintenance for a 100 years or more (Florida Game and Fresh Water Fish Commission, 1990). However, managing and producing the required habitat and then ensuring that red-cockadeds find or are introduced into the habitat would be a difficult and long-term process. Presently, the District is reviewing the possibility of acquiring suitable but unoccupied red-cockaded habitat along the Big Econ adjacent to an existing population which would appear to have a much better chance of success in supporting red-cockaded woodpeckers.

3.1.2.3 Florida Scrub Jay

The Florida scrub jay is strongly associated with scrub habitats including xeric oak scrub, sand pine scrub (immature stages usually), and other habitat with one or more species of scrub oaks (*Quercus spp.*) (Fitzpatrick et al., 1991). The recognized distribution of the scrub jay includes western North America and the eastern population is restricted to peninsular Florida (Figure 6). The range of the scrub jay in Florida extends from near Lake Okeechobee to Clay County. The Florida scrub jay population in the Basin is near the northern extent of the Florida population. Interestingly, recent genetic studies on wild populations of scrub jays suggest the Florida scrub jay is a different species from the western forms of the scrub jay. If the Florida scrub jay were reclassified as a distinct species, the Federal status might be changed from a Threatened Species to an Endangered Species.

The scrub jay is a cooperative breeder that lives in groups consisting of 2-8 adults and 2-5 young of the year depending on the season (Woolfendon and Fitzpatrick, 1984). Territories average about 25 acres and should contain 15% of the area in scrub oaks. Most dispersal of young jays is within one mile of the natal territory. The scrub jay feeds on a variety of foods, but acorns are the most important item. Predators include large snakes, bobcats, and raccoons. In urban environments, predation on nestlings from domestic cats may cause a substantial reduction in population size (Tolan, Personal Communication 1991). Fitzpatrick et al., (1991) suggest population size should include at least 30 groups within a dispersal distance of each other of 1-2 miles and within 3-5 miles of a larger population. As shown in

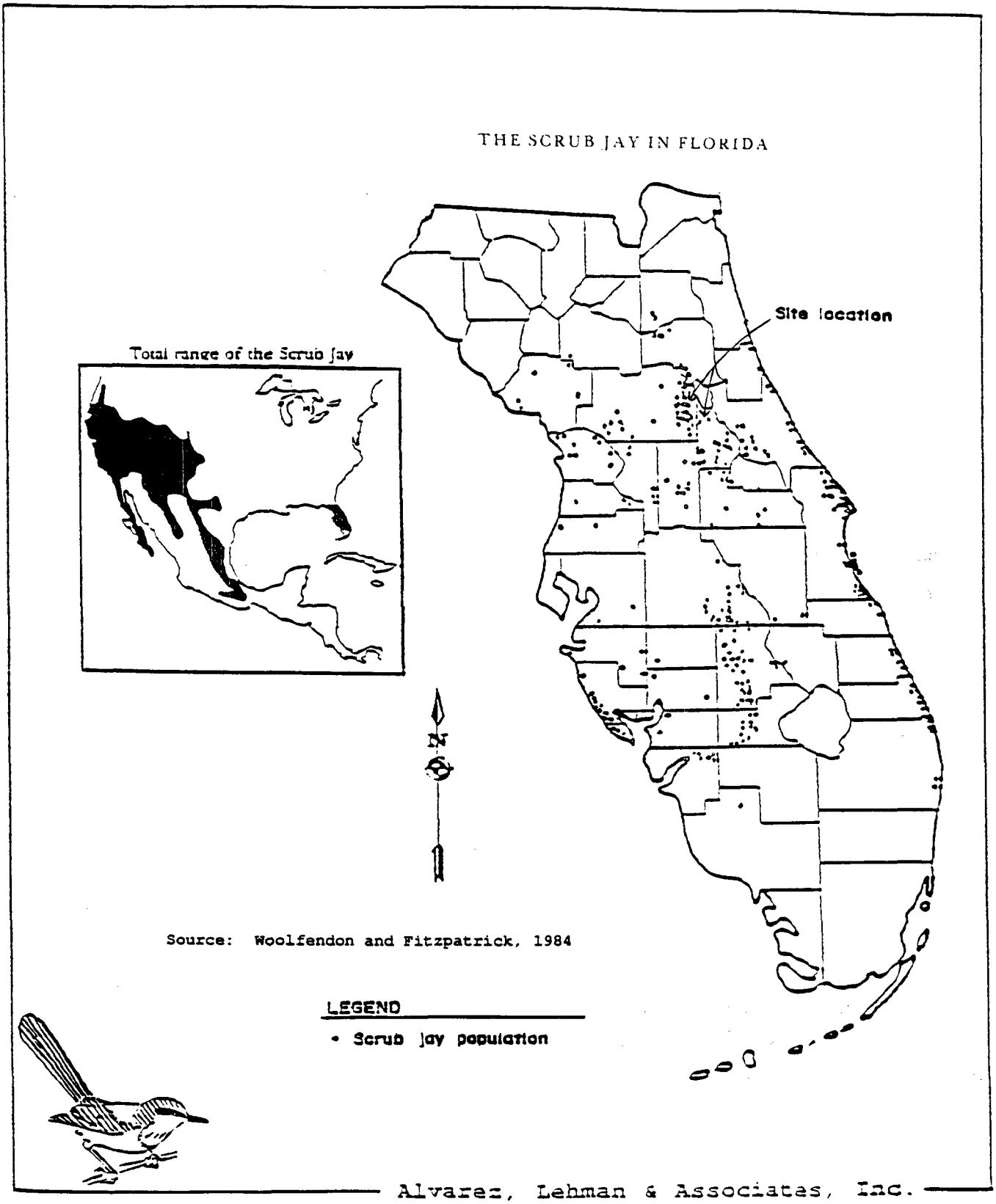

FIGURE 6 - Distribution of Scrub Jay Populations Including the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Figure 6, scrub jays are distributed primarily along the east and west coast and along the central ridge. These are, historically, the major areas of scrub habitat and presently are still intact although they have been greatly reduced (see Fernald, 1989). Also see discussion on special habitats (Section 3.5). The number of scrub jays in the Ocala NF is quite large, but based on habitat loss, the population is declining in surrounding areas particularly those areas east of the St. Johns River. Also, fire restriction, which is required to keep the scrub at a low height (less than 10 feet), has resulted in the loss of habitat in many lands outside the Ocala NF. The number of scrub jays and scrub jay habitat in the eastern and southeastern part of the basin is substantially reduced compared to the past.

In order to increase or stabilize the apparent population decline in scrub jays, at a minimum the following practices should be followed:

1. Return scrub areas to historic fire frequencies (i.e. 8-20 year frequency);
2. Eliminate or reduce off-road travel of motorbikes and other off-road vehicles through prime scrub habitat;
3. Stabilize or reduce habitat fragmentation; and
4. Limit highway construction through known territories of scrub jays.

Fitzpatrick et al., (1991) provides the basic framework for developing habitat and population management guidelines for scrub jays. While these guidelines contain much of the most recent information on scrub jays, other studies suggest the scrub jays occur under a broader range of habitat

conditions and fire histories than suggested by Fitzpatrick et al., (1991). A number of population studies have observed scrub jays in predominantly sandhill or under other habitat conditions than the xeric scrub systems described by Woolfendon and Fitzpatrick (1984) (Tolan, personal communication, 1991; and DeLotelle, personal observation, 1991). Scrub jays may occur in a variety of situations that include some form of scrub oaks in the habitats. In some areas, golf courses in sandhill habitats or other situations may be conducive to supporting scrub jays.

Because of the large population of scrub jays in the Ocala NF lands, it may be easier to establish new territories in surrounding lands when the habitat conditions become suitable for scrub jays. In many areas on the eastern side of the basin which contained scrub habitat, fire has apparently been restricted for a number of years thereby reducing its suitability as potential scrub jay habitat (see Simons, 1990).

3.1.2.4 Bald Eagle

The southern bald eagle (*Haliaeetus l. leucocephalus*) was formerly distributed across the North American continent although most populations in the lower United States were eliminated, except for Florida. Reintroduction in several states using the Florida population as the donor has been very successful (Murphy et al., 1989). The Basin contains one of several nuclear groups of eagles located in Florida which are very important to this reintroduction process. Any action which negatively affects this nuclear group of eagles in the Basin would substantially influence the overall success of the reintroduction program (Murphy et al., 1989).

As a top predator of aquatic habitats, bald eagles are an excellent indicator of the overall productivity of aquatic systems such as Lake George. Cumulative impacts which negatively affect feeding habitat by physical degradation or pesticide poisoning will limit, if not suppress, local eagle population.

Bald eagles feed on a variety of foods but fish, water birds, medium-sized herons, and turtles comprise the bulk of the diet (Peterson, 1978). Most of these food animals are associated with aquatic habitats such as Lake George, the St. Johns River or other major marshes and waterways of the area. Any action which substantially affects the productivity of these aquatic environments would substantially affect this population of eagles.

Bald eagles nest in live, tall, slash pine, longleaf pine, or loblolly pine within about 2 miles of the lake or river. A few nests are found in cypress trees. Eagle nests within the Basin are concentrated on the shores of Lake George and upstream and downstream of the river (Figure 4). Two-thirds of the nests are located in the NF while most of the remaining nest trees are on the east shore of the lake. Density of eagle nests was greatest for pine flatwoods within 0.62 miles of water, followed by prairie in the 0.62 to 1 mile zone, and hardwood swamp within 0.62 miles of water. Nest trees are usually taller than the surrounding forest (McEwan and Hirth, 1979).

In 1991 there were 72 nest trees observed in the Basin near Lake George (Cockerham, personal communication, 1991). Of these nests, 40 were active during this nesting season. These nests fledged 45 young or 1.89 fledgling per successful

nest (16 nests failed). The NF nests fledged 24 young birds and the remaining areas including the east side of the lake, fledged 20 birds. Observations on nesting attempts and other observations suggest there were 45 pairs present in the Basin in 1991.

Nest sites in this region are most affected by timber practices. These areas in the past have been managed for pine production on a 30 to 100 year rotation. Loss of suitable nest trees is one of the greatest dangers to bald eagle nesting populations (Wood et al., 1989). Timber harvesting and other activities should be prohibited within 1 mile of nest trees during the nesting season. In addition, habitat management should focus on producing stands of pine trees within the primary lake zone nesting habitat and allowing them to mature and develop as future nest sites. Suitable nest trees often include a well formed crown structure with large branches forming a strong crotch beneath the canopy. Perch sites in the form of old pines with substantial large limbs for roosting should also be protected. Feeding habitat should also be protected.

3.1.2.5 Southeastern Kestrel

In addition to occurring in the NF, large populations of the Southeastern kestrel occur in sandhill and pasture habitat to the north and west of the Basin (Figure 7). Scattered populations occur elsewhere in the state. The southeastern kestrel requires dead snags of isolated longleaf pines in sandhills, fields, or pastures for nesting. Breeding populations of kestrels were once very numerous in sandhills of Lake, Orange, and Seminole County (Hoffman and Callopy, 1988). While nesting kestrels are still common in

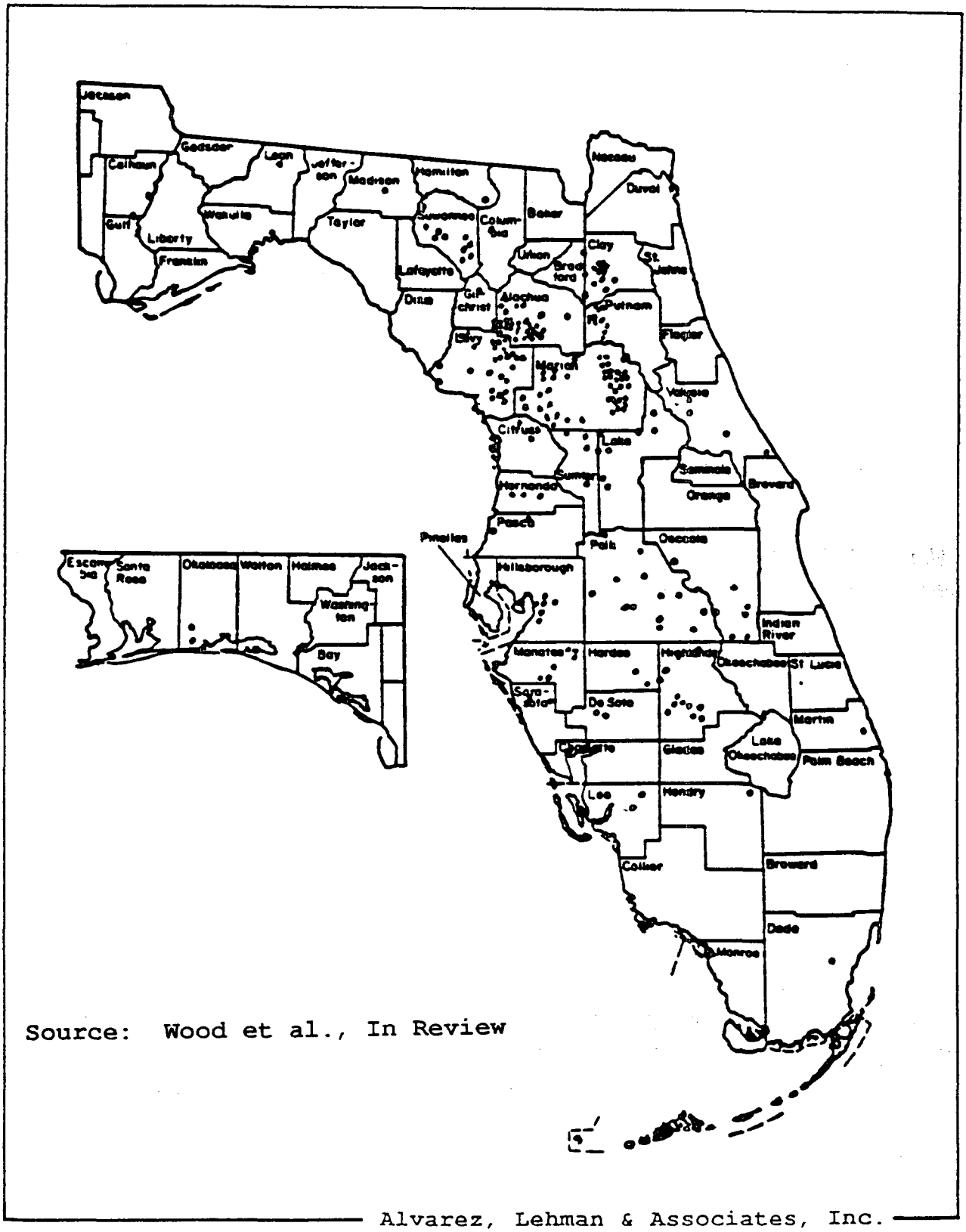

FIGURE 7 - Distribution of the Southeastern Kestrel in Florida, Lake George Basin, St. Johns Water Management District, Florida, 1991

portions of the Ocala National Forest in Marion and Lake County, populations to the east and south appear to have declined because of habitat loss. They can nest in cut-over pine forests as long as the understory is not too thick for successful foraging. Populations are usually limited by availability of nest sites and can be increased by use of artificial nest boxes (Wood et al., In review). Suitable poles, dead snags, or other widely distributed perch locations, increase the foraging range.

Although the past practice in the Ocala NF was to eliminate dead snags during clear cutting, more recently this valuable nesting and perching habitat is retained (Cockerham, personal communication, 1991). Apparently the population has increased in response to this change in Forest Service management practices. On large pine forest bordering upon pasture and other grasslands, population increases may be obtained by retaining snags and increasing the burning frequency in sandhill habitat.

3.1.2.6 Sherman's Fox Squirrel

Sherman's fox squirrel *(Sciurus niger shermani)* is found in mature longleaf pine sandhills and pine flatwoods (Kantula, 1986). Abundance of mast from longleaf pine and turkey oaks that inhabit the sandhill is variable between years and is an important food source. Proximity of live oak provides a fall-back food source. Kantula (1986) reported that fox squirrel ranges in north central Florida were approximately 106 acres for males and 41.2 acres for females during a one-year period of observation. The fox squirrels utilize canopy nests made of leaves more than tree cavities. Old growth longleaf pine forests provide food and nests.

Nests were observed in all oak species and in slash and longleaf pine. There were 100-200 animals within a 4.6-square mile area in this region. Preserved areas for the fox squirrel should be several square miles in size and should include a regular fire maintenance schedule.

3.1.2.7 Florida Mouse

The Florida mouse (*Podomys floridanus*) occurs in sand pine scrub, sandhills, and scrubby flatwoods association. Habitat conditions are xeric environment, scattered trees and clumps of scrubby oak and other shrubs, patches of bare ground, and well-drained sandy soils. The mouse typically lives in burrows and is a commensal of the gopher tortoise. It forages on seeds, nuts, fungi, and other plants as well as small invertebrates. Acorns are an important part of its diet. Extensive areas of suitable habitat occur in the Ocala National Forest (Layne, 1978). Management may include mechanical or fire treatment of habitat.

3.1.2.8 Gopher Tortoise

The gopher tortoise (*Gopherus polyphemus*) is locally distributed in the southeast United States from South Carolina and Florida to eastern Louisiana. In Florida, the gopher tortoise may be encountered widely in northern sections of the state with scattered populations in the south. The Basin contains high concentrations of gopher tortoise (Figure 8) and includes many commensal organisms such as the eastern indigo snake, Florida mouse, sand skink, mole skink (*Eumeces egregius*), and many other species (Campbell and Christman, 1987).

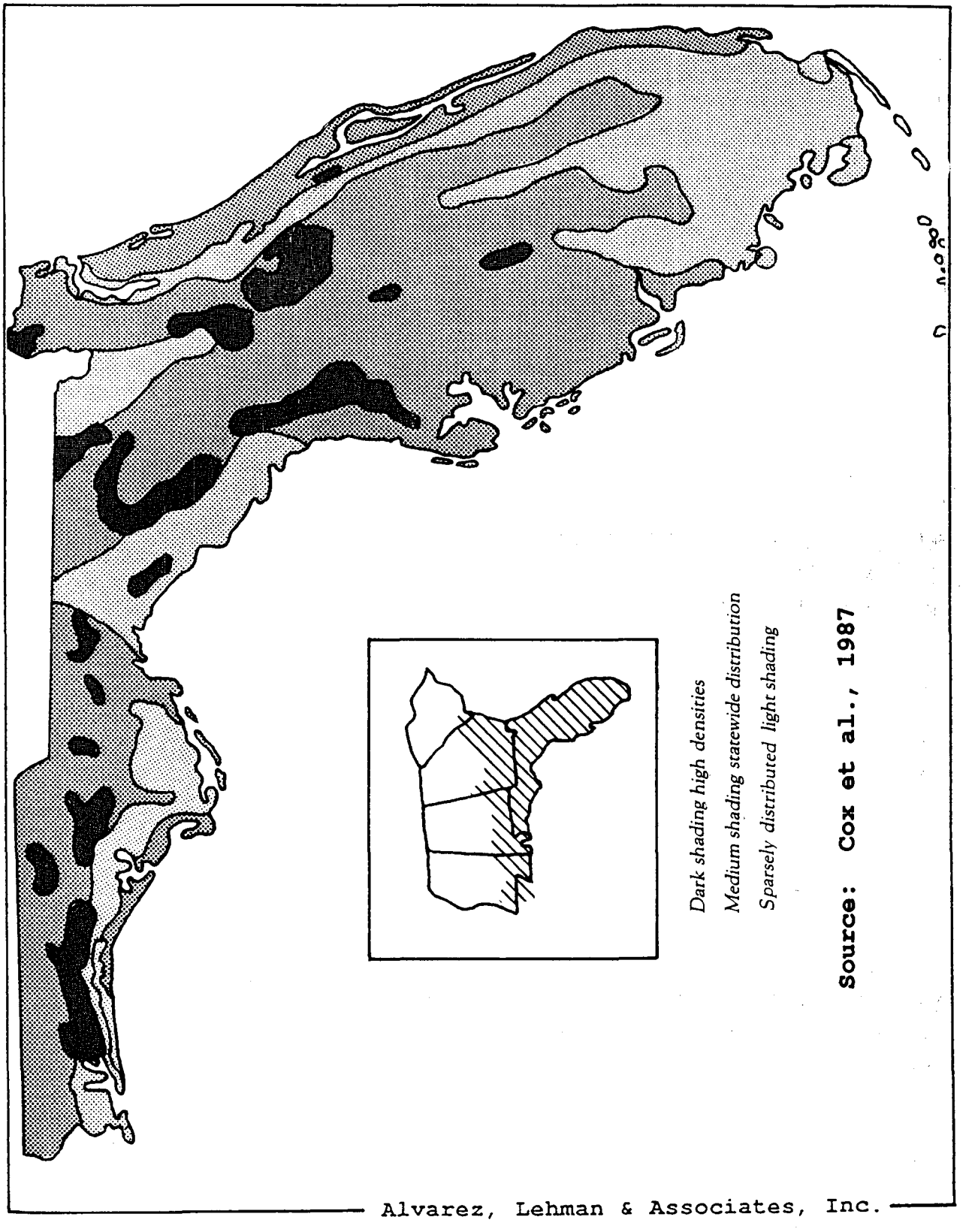

FIGURE 8 - Major Population Areas of the Gopher Tortoise in Florida, St. Johns River Water Management District, Florida, 1991

Gopher tortoise population densities are usually highest in sandhill habitats that are burned frequently with densities approaching 6 to 8 per acre. Open habitats of sand pine scrub, xeric oak scrub, scrubby flatwoods, and other open habitats with well drained soils and herbaceous vegetation and the lack of dense canopy all may support good populations of gopher tortoise (Diemer, 1986). Soil conditions are important in burrowing habitat which also is required by many of the skinks and lizards associated with gopher tortoise.

The FGFWFC has developed a number of criteria that are important for evaluating gopher tortoise population densities, conservation goals, and other regulatory requirements (Cox et al., 1987). A frequent burning program is the best method for maintaining the desired habitat features for gopher tortoise as well as conditions for the other species associated with the burrows in the xeric habitats of oak and pine scrub. Good sites should contain at least 40-50 individuals on about 35 acres. The fire maintenance should be conducted every 2-4 years on most sites, but may require longer rotation on sterile soils with reduced herbaceous vegetation or shorter rotation on rather fertile, densely vegetated sites. Fire not only opens the habitat and makes travel easier but also stimulates new growth for many herbaceous plants. Most burning schedules now include a summer rotation once heavy vegetation is eliminated by a winter burn.

3.1.2.9 Wading and Other Aquatic Birds

A variety of wading birds occur within the Basin and may use shallow water areas of lake, marsh, or river habitat for

feeding. Nesting sites may include shrub and other swamp habitats, and sometimes upland pines. Five wading bird nesting areas are located within the Basin. Two nest sites occur northwest of Lake George, two near Lake Woodruff, and one along the St. Johns River near the SR 44 bridge (Figure 4). These nesting areas average three species per season with a total of nine species observed. These species include the great egret (*Egretta alba*), snowy egret (*E. thula*), cattle egret (*Bubulcus ibis*), great blue heron (*Ardea herodias*), little blue heron (*E. caerulea*), black-crowned night heron (*Nycticorax nycticorax*), white ibis (*Eudocimus albus*), and double-crested cormorant (*Phalacrocorax auritus*). Most of the colonies appear to be relative small with no more than 80 nests counted per season. Many of the observations, however, did not include actual counts of the nest. Other wading birds occur in the Basin primarily as transients or migrants after the nesting season (Tables 3 and 4). Most of these long-legged waders require good feeding sites in the littoral zone of lakes, marshes, or along the rivers such as the St. Johns River.

3.2 Special Wildlife and Habitat Areas of the Lake George Basin

Special habitats are defined as any area that supports wildlife species identified as needing special protection by the U. S. Fish and Wildlife Service, FGFWFC, Florida Department of Natural Resources, or the District. Special habitats defined by the Forest Service in Ocala National Forest are also included.

Special habitats support unique functions related to breeding, spawning, migration, dispersal, travel corridors,

nesting, etc. of protected species. Examples of such habitats include red-cockaded woodpecker colonies, heronries, eagle nests, and such areas as high concentrations of gopher tortoises or fox squirrels. Migration and dispersal corridors used by wide-ranging species such as the black bear are included. Also included in the special habitat category are habitats found in the Basin that are unique or rare within the Basin or within the State of Florida. Under this classification, five habitat types were listed as unique habitats including:

1. White Cedar Forests;
2. Lake, River, and Floodplain Association;
3. Spring runs;
4. Cypress; and
5. Sandhill pines/scrub.

Before beginning the discussion on the above unique habitats and special areas, there are several points that should be discussed about the methods used in developing this list. A review of the habitat types found in the Basin by the District and the consulting team personnel was conducted. Qualitative comparisons on the availability, uniqueness, distribution, and support of important wildlife species by the habitats found in the Basin were performed by the study team. Certain habitat types such as sand pine scrub and xeric oak were included or not included as the list was developed. Although scrub habitat is very abundant in the Basin, this habitat type is being greatly impacted throughout the state and in certain local areas (Hartman, personal communication, 1990; Fernald, 1989; and DeLotelle, personal observation, 1991). In fact, Fernald (1989) found that over 95% of the scrub habitats in Palm Beach County have been

destroyed by human activities since the turn of the century. Likewise, mature longleaf and slash pine flatwoods are the most widespread communities in Florida, but are being greatly reduced in areal coverage and the quality of the system by human disturbance and the lack of an adequate burning program. Longleaf pine flatwoods, however, are still common in the Big Econo River Basin and are being maintained on several small areas (Brown et al., 1989; DeLotelle and Newman, 1981; and Exum, personal communication, 1988), and may be included in more extensive protection plans in the future (proposed acquisition by the District). These facts need to be kept in mind while reviewing the following discussion. This does not lessen the importance, in our opinion, of those areas designated below.

3.2.1 Special Wildlife Areas

As previously discussed under the Endangered and Threatened Species section (3.1.2), there are a number of sites that are extremely important to wildlife nesting and roosting areas (Figure 4). As identified previously, these sites occur in a variety of habitats including both wetland and upland types. Two of the species, the bald eagle and red-cockaded woodpecker, require long range planning to provide adequate nesting habitat. Both species use mature pines for nesting which may take from 50 to 80 years to develop the right structure, density, and form. Wading birds nest in swamp forest of willow, bayheads, and other forested wetlands. These wetland resources appear to be available in the Basin in sufficient quantity.

Of primary importance to black bears as well as other medium-sized mammals, such as river otter and bobcat, are

travel corridors which extend through otherwise open habitat areas or areas of limited wildlife use. One definition of a wildlife corridor can be a narrow parcel of land which allows safe passage of wildlife between larger blocks of more extensive and better quality wildlife habitat (e.g., mature pine flatwoods versus open grasslands) (Brown et al., 1989). In a broader sense, corridors are areas of habitat containing permanent individuals of a population, connecting larger areas which contain larger subpopulations of the total (Brady, personal communication, 1991). The entire St. Johns River and swamp serve both functions for large mammals as well as aquatic species.

There are two subpopulations of black bears, including one in the Ocala National Forest and one in the Osceola National Forest. These two subpopulations appear to be connected via the bears that occur in Tomoka Wildlife area and extending north through the vicinity of Palatka. Thus the black bear population in central Florida might have two levels of corridors that are important to their survival based on road kill data. The small and large travel corridors are important for movement during daily or seasonal activities (Figure 9). Both corridor areas A and C (Figure 9) appear to be important, at least for bear movement, and are not on protected lands. These same corridor areas are undoubtedly important to other wildlife species, such as bobcat and river otter which move long distances between large habitat blocks. These corridors are primarily associated with wetland areas such as hardwood swamps and pineland fringes. Corridor C is a large string of wetlands but ends near Lake Destin. The corridor (B) located near Barberville, Florida serves both as a travel lane and a population corridor, and is primarily pinelands with some

FIGURE 9 - Travel Corridors for Black Bears and Other Wildlife Species in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

areas of habitats of hardwood swamp and bay head swamp forest (Figure 9). The larger type of corridor area discussed above extends between the two subpopulations of bears in Ocala and Osceola National Forests and may be important for maintaining genetic diversity and recruitment of young bears. This larger corridor area could be expanded and better protected by land acquisition which would extend the public ownership to the Tomoka Wildlife management area. Also, the bear population could be enhanced by providing better quality bear habitat on the east side of Lake George and by maintaining a less perilous habitat corridor between the Wekiva River area and the Lake George Basin area.

3.2.2 Special Habitats

3.2.2.1 White Cedar

White cedar forests (*Chamaecyparis thyoides*) are a unique resource in the Basin and the State of Florida. One such forest occurs in the Ocala NF and is currently protected by the Forest Service. The area is small (200-300 acres) and is located on a seepage area with little organic accumulation. The area apparently burns very infrequently and is maintaining itself as young white cedar were observed in the understory. Other unique flora and fauna may occur there.

3.2.2.2 Lake, River, and Floodplain Association

Lake, river, and floodplain association provide a valuable habitat area for many wildlife communities. In addition, the extensive swamp, marsh, and other upland forest surrounding these areas make them some of the most productive in the state. The lakes and rivers of the Basin support a

wide variety of recreational and commercial fisheries as well as manatees, limpkins, wading birds, and bald eagles. Osprey are frequent in the area and fish the open water areas and nest in the fringing cypress swamp areas. The marshes and prairies of Lake Woodruff, as well as Lake George, provide habitat for blue-winged teal (*Anas discors*), 20 other species of migratory ducks, and resident wood ducks (*Aix sponsa*). Ring-necked ducks (*Aythya collaris*) comprise more than half of the wintering waterfowl population during most years. The Lake Woodruff National Wildlife Refuge includes a 12,400-acre waterfowl management area that supports an estimated fall/winter population of 6,000 birds (Goodwin, 1979).

The aquatic portion of this habitat area includes open waters of Lake George, other lakes in the area, and the St. Johns River. The St. Johns River is in fact a large corridor of aquatic habitat that extends to the upper and lower reaches of the river (Figure 2). Thus, any impact, particularly above the Basin, will have substantial influence on aquatic resources of the study area.

Floodplain vegetation of the lower river includes prairies and marshes dominated by grasses, herbs and sedges, and hardwood forest (Snyder et al., 1990). Aquatic macrophytes include water hyacinth (*Eichhornia crassipes*), coontail (*Ceratophyllum demersum*), eelgrass (*Vallisneria americana*), yellow water-lily (*Nymphea mexicana*), spatterdock (*Nuphar luteum*), bullrushes (*Scirpus spp.*), and hydrilla (*Hydrilla verticillata*). The Basin includes an extensive littoral zone of eelgrass, coontail, and yellow water-lily. The lake and river are euryhaline (Tagatz, 1968) and support 170 fish species with 68% of those being salt water forms (Snyder et al., 1990). A multimillion dollar commercial

fishery using catfish (*Ictalurur spp.*), American eel (*Anguilla rostrata*), and blue crab (*Callinectes sapidus*) exist in the lower St. Johns (Hale et al., 1984). Freshwater recreational species include the largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), red-eared sunfish (*L. microlophus*), and several others.

Thousands of anglers come to the area for recreational fish such as largemouth bass, bluegill, and black crappie (Hayes and Snyder, 1990). Success rates for largemouth bass (0.41 bass/man-hour), bream (2.42 bream/man-hour), and black crappie (2.87 crappie/man-hour) are good. It is the opinion of many of these returning anglers that the overall size of the bass and the number of trophy bass has declined. Recent studies, however, on length frequency of bass indicate a good population of fish from about 4 to 20 inches in length. All three species are supported in the Basin by excellent spawning and nursery habitat. The littoral zone, which supplies both the above functions, accounts for 9% (4,270 acres) of Lake George. The littoral zone is primarily composed of eelgrass, yellow water-lily, and coontail. Nuisance species include water hyacinth, water lettuce (*Pistia stratiotes*), and hydrilla (Cross et al., 1990). Comparison during certain seasonal sampling indicates that an eelgrass/pondweed mix has more fish (3.0 bass per hour of electrofishing) than areas with a substantial hydrilla mix (1.3 bass per hour of electrofishing). Hydrilla and other nuisance species tend to concentrate around boat ramps and large tributary inflows. The growth and expansion of nuisance species such as hydrilla needs to be monitored.

Lake George water quality is usually good. However, primarily because of changes in the Basin, water quality can degrade under rapid increases in waterflow. Dissolved oxygen (DO) decreases occur as a result of increased turbidity associated with higher suspended solids and increased phytoplankton growth. These factors lower DO, inhibit sunlight, and restrict expansion of the eelgrass dominated littoral zone. Headwaters of the river have been diked and drained, while excessive nutrient and organic loading from urban and agricultural areas has occurred (Snyder et al., 1990). These effects are occurring throughout the St. Johns River drainage, although overall water quality in the Basin is good. Further reduction in watershed protection would result in a more pronounced negative impact.

Freshwater marsh and prairie occur as fringing habitat along rivers, springs, and streams and as isolated ponds in some of the upland habitats. The freshwater marsh is more extensive in the Lake Woodruff region of the St. Johns River. Lake Woodruff marshes include a 12,400-acre area managed primarily for waterfowl. Water levels are artificially controlled and burning is conducted periodically to create conditions favorable for waterfowl foods and feeding habitat. Other marshes in the area include sites with vegetation such as pickerelweed (*Pontederia cordata*), coontail, and hydrilla.

A variety of wildlife use marsh areas including 19 amphibians, 20 reptiles, 48 birds, and 19 mammal species. Twelve of these species are considered endangered, threatened, or species of special concern. Depending on hydroperiod and vegetation types, the species assembledges of wildlife can change substantially. Densely vegetated marshes of primarily emergent vegetation will include a greater

variety of the smaller birds such as common yellowthroat (*Geothylpis trichas*), sparrows, and red-winged black bird (*Agelaius phoeniceus*). Marshes with more open water will include a greater variety of ducks and wading birds.

3.2.2.3 Spring Runs

Large spring runs are productive and valuable habitat unique to the Florida landscape. Significant features of spring runs are high mineral content and constant annual temperatures. Springs provide nutrients and minerals to receiving waters (Bass, 1983). The Salt Springs area includes a large concentration of bald eagle nests, while limpkins occur along the shores of Alexander and Salt Springs. Apparently the limpkins are foraging on apple snails, crabs, and other aquatic invertebrates associated with these areas. These runs also include a number of alligators, turtles, and support several marine species. Large schools of striped bass (*Morone saxatilis*) and other marine forms were observed. Blue crabs are in Lake George and their presence may be partially the result of high salt content associated with the discharge of the springs in the area. Spring runs also provide aquatic resources and increase floodplain diversity with floodplain vegetation in areas often dominated by upland, dry habitats.

3.2.2.4 Cypress Forest

Cypress forest is a relative limited resource in the area. Cypress (*Taxodium spp.*) trees still occur in the fringes of swamps along the east shore of Lake George from near the northern end to about two-thirds of the way down the lake. Cypress trees were apparently more common in these

areas as large stumps occur in the interior of the swamp, but no reproduction was evident. Other cypress forest occurs as cypress domes and cypress strands on the east side of the St. Johns River above Lake Woodruff, extending to east of SR 11. A few smaller cypress domes occur in the new land acquisition of the Seminole Forest property. These cypress areas are important habitat as breeding sites for upland and pine flatwood forms such as gopher frogs (*Rana areolata*), pine-woods tree frogs (*Hyla femoralis*), eastern spadefoot toad (*Scaphiopus holbrooki*), and other amphibians. Cypress swamps serve other functions such as water storage, purification, and flood control. These areas may also be used as refuges for upland wildlife during drought conditions.

3.2.2.5 Sandhill/Longleaf Pine

Xeric communities of the Basin such as xeric oak scrub, sandhill, and sand pine scrub occur on high, dry infertile sands that are fire maintained systems (Myers, 1990). All three types share many common plant species such as longleaf pine, turkey oak, bluejack oak, and other oaks in various combinations (Table 5). Fire frequency apparently is a major determinant of the community types. In scrub communities of the Ocala NF, fire has been replaced with mechanical treatment by the U.S. Forest Service. The Ocala National Forest contains the largest scrub community in Florida.

The longleaf pine/turkey oak association (high pine) formerly extended from southeastern Virginia to east Texas (Myers, 1990). The sandhill type occurred in the Florida peninsula and parts of the panhandle. This community occurred on rolling hills of dry, infertile, excessively

TABLE 5. Comparison of Important Plant Species of Scrub and Sandhill Communities, Lake George Basin, St. Johns River Water Management District, Florida, 1991

	Scrub	High pineland
Pines	*Pinus clausa* (Sand pine)	*Pinus palustris* (Longleaf pine)
Hardwoods	*Quercus myrtifolia* (Myrtle oak)	*Qercus laevis* (Turkey oak)
	Q. geminata (Sand live oak)	*Q. incana* (Bluejack oak)
	Q. chapmanii (Chapman's oak)	*Q. margaretta* (Sand post oak)
	Lyonia ferruginea (Rusty lyonia)	
	Ceratiola ericoides (Rosemary)	
	Persea humilis (Silk bay)	
Hardwood foliage	Evergreen or persistent	Decidous
Herbs	Sparse	Abundant
Ground cover	Litter, lichens, bare sand	Grasses, forbs
Aspect	Dense thicket	Open woodland
*Fire frequency	Infrequent (15-100 years)	Frequent (1-15 years)
Fire intensity	High	Low
Surface soils	White or light-colored sands	Yellow, buff, or gray sands

*Mechanical treatment used in scrub by U.S. Forest Service

Source: Adapted from Myers, 1990

Compiled by: Alvarez, Lehman & Associates, 1991

drained sands. Although once abundant throughout the southeast, logging, development, and agricultural activities have greatly reduced its areal extent. This community, although common in the Basin and other parts of central Florida, has been greatly impacted and continues to be developed (Hartman, personal communication, 1990, and DeLotelle, personal observation, 1991). In many areas, this community has been further degraded by the removal of the longleaf pine overstory component.

This is a fire subclimax community maintained by low-intensity fires every 2-4 years. A summer burn schedule is the best fire management. Because of continued development pressure, greater restriction of wildfire, and logging and timber practices, this community will continue to disappear from the Florida landscape and the Basin.

With the decline of these habitat types, animals such as the gopher tortoise, red-cockaded woodpecker, brown-headed nuthatch (*Sitta pusilla*), red-headed woodpecker (*Melanerpes erythrocephalus*), eastern coachwhip (*Masticophis flagellum*), southeastern kestrel (*Falco sparverius paulus*), and many other species will suffer population declines. A number of endangered and threatened species associated with the gopher tortoise burrows also occur in this habitat type.

Amphibians such as the pinewoods tree frog, spadefoot toad, and gopher frog use this habitat but breed in wetlands such as cypress domes, freshwater marshes, and prairies. Important wildlife of this habitat includes the gopher tortoise which provides habitat for 60 vertebrate and 302 wildlife species (Jackson and Milstrey, 1989). Red-cockaded and other woodpecker species also provide cavities in trees

that are used by a host of other nesting birds and some mammals and reptiles.

The sandhill community is common in the Ocala NF but is scarce and disappearing on the east side of the Basin. Large areas of land near Barberville have been converted from sandhills and scrub to agricultural land such as pasture, citrus, or other uses. Any land activities that would allow the native sandhill vegetation to develop in this area would increase habitat diversity and provide required habitats for a number of upland associated wildlife. The areas are also important for recharge.

3.3 Impacts on Fish and Wildlife Habitats in the Lake George Basin

The condition of the fish and wildlife species and their habitats within the Basin was evaluated with respect to impacts from land and other habitat use changes within the Basin. Evaluation of fish species included the St. Johns River and its associated lakes, tributaries, wetlands, and isolated wetlands in the Lake George Basin. Evaluation of wildlife included all wetland, transitional, and upland habitats in the Basin.

In order to evaluate these impacts it was essential to know what the habitats and species populations were like historically and to assess the dynamics of change due to impacts through time. The evaluation identified past and current changes, project trends, and potential cumulative impacts.

Impacts in the Basin include sedimentation, pollution, and eutrophication of surface water near agricultural and

developed areas; fragmentation, isolation, and reduction of habitats due to fire exclusion and disturbance; changes in hydrology due to channelization, draining, and increase in impervious surfaces; mortality due to automobile and boat traffic patterns; and replacement of natural habitats by citrus, pasture, urban development, and pine plantation. Wetland destruction within the District's jurisdiction includes substantial effects from residential development. Habitat degradation or impacts are divided into two main categories and their subcategories, as follows:

1. Aquatic
   - A. Runoff (Agricultural);
   - B. Floodplain Displacement;
   - C. Septic Tank;
   - D. Wastewater Disposal; and
   - E. Habitat Loss.
2. Terrestrial
   - A. Loss of Habitat;
   - B. Habitat Fragmentation;
   - C. Habitat Conversion; and
   - D. Ditching and Channelizing of Wetlands.

3.3.1 Aquatic Resources Impact

In order to view the impacts on water quality aspects of the Basin it is important to consider Lake George, the river, and the other lakes in the Basin, with respect to the total habitat quality of the St. Johns River. The quality of water in the upper St. Johns River basin has been significantly reduced by the loss of associated freshwater marshes and other wetlands through extended agricultural practices (Bass, 1983). This process is continuing within the Basin and

upstream in the St. Johns River. The result of this floodplain encroachment is reduction of water levels in the river, lower water tables, and altered hydroperiods (Bass, 1983). Specific flooding events are also less frequent but respond more rapidly to rainfall patterns (Cox, 1971). Although these factors most influence the upper reaches of the river, they undoubtedly have some influence on the lower reaches of the river.

Major pollution sources in this reach of the river are agricultural and urban runoff. In the upper St. Johns River area above the Basin, an estimated 2.3 million pounds of pesticide were used in 1988 (Cerulean, 1990). The fraction of these pesticides that entered the river is unknown. One research effort classified streams in the Atlanta area and, using a discriminant function analysis, found degraded streams were associated with high percentages of land in residential use, low area of green space, and house density (Benke et al., 1981). Further, although not conclusive, the study suggests that leakage of old sanitary sewers may also have been responsible for water quality degradation. Wetland destruction within the District includes substantial direct impacts (Dean, 1991), but also includes indirect impacts from water quality or other similar effects.

In the lower reaches of the St. Johns River basin, water quality has the greatest impact on ecological production, but quantity will have an effect here also. In the river and Lake George, 95% of the fish include gizzard shad (*Dorosoma cepedianum*), black crappie, white catfish (*Ictalurus catus*), channel catfish (*I. punctatus*), bluegill, largemouth bass, red-eared sunfish, brown bullhead (*I. nebulosus*), blue-backed herring (*Alosa aestivalis*), American shad (*A. sapidissima*),

hickory shad (*A. mediocris*), long-nosed gar (*Lepisosteus osseus*), striped mullet (*Mugil cephalus*), red-breasted sunfish (*Lepomis auritus*), Florida gar (*Lepisosteus platyrhincus*), red drum (*Sciaenops ocellata*), striped bass, and southern flounder (*Paralichthys lethostigma*). As indicated, the lake is dominated by rough fish species, but fish production is high (Bass, 1983). The St. Johns River is nationally famous for its bass fishing, although this has apparently declined in recent years.

The pollutant loading sources that have the greatest impact on the water quality of Lake George and the portion of the St. Johns River that is within the Lake George Basin are upstream of the lake. The river probably contributes the highest pollutant loading to the Basin (East Central Florida Regional Planning Council, 1985). Concentrations of total phosphorus, nitrogen, and suspended solids decrease as it flows through various points upstream and within the Basin. Much of this is diluted and assimilated by Lake Harney before the water reaches the Lake George Basin. Lake Jessup also receives much of the urban runoff from Orlando. The Wekiva River did not appear to import phosphorus or nitrogen to the St. Johns River in 1985 (East Central Florida Regional Planning Council, 1985). However, the Wekiva River area will experience rapid growth for some time to come. Urban runoff, thus, will likely increase in the Wekiva River area. Within the Basin, Deland is expected to expand but much of the Lake George Basin is publicly owned land, and most of it will be managed to retain the natural state of vegetation.

Lake George is vulnerable to pollutants because the river water slows as it drains into the large shallow lake, increasing the retention time of the water in the Basin. Total suspended solids peak just downstream of Lake Monroe, and then begin to decrease until SR 40, just upstream of Lake George. Total suspended solids rise again in Lake George, due to the shallow water which promotes algal growth and resuspension of bottom sediments (East Central Florida Regional Planning Council, 1985). Dissolved oxygen increases in Lake George compared to the narrower river channel, probably due to oxygenation from wave action. Agricultural runoff within the Basin includes pesticides from farmers and ferneries, particularly in the upper reaches of the Basin. In 1988, approximately 0.7 million pounds of pesticides were used in the central Florida area near the Basin. Other intensive agricultural activities do not appear to be drastically affecting water quality.

Overall water quality could be improved most in the Basin by reducing the nutrient load from upstream sources. To a certain extent the impacts from the Big Econ were substantially reduced when Iron Bridge and the new Orange County Wastewater Treatment plant went on line. However, nutrient loading and other polluting materials are likely to increase in the upper St. Johns basin as the population growth continues in the area.

3.3.2 Ecosystem Resource Impacts

As indicated in the Econolockhatchee River Basin Natural Resource Development and Protection Plan, there are 5 issues affecting wildlife population in central Florida:

1. Habitat fragmentation;
2. Wildlife corridor problems;
3. Deterioration of habitat quality;
4. Impact of adjacent and related competing land use; and
5. Impacts of public recreation.

These issues are driven by population growth resulting in increased development and use of the rural landscapes and urbanization of a significant part of the landscape. As an example, major highways cross the Basin including Highways 19, 40, 42, and 44. These highways and the substantial public use result in not only black bear road kills, but also many other wildlife road kills. Public recreation such as fishing, boating, and hunting within the Ocala NF, the lake, river, and springs is substantial and all of these actions affect wildlife to a certain degree. There are other wildlife issues such as loss of habitat, corridor size, habitat patch size, minimum population size, habitat diversity, and reduction of habitat quality. All of these present difficult, if not almost impossible, problems to separate out in the effort to provide acceptable wildlife habitat and solutions in these problem areas.

One way to focus on a number of these problems, such as fragmentation, is to review Figure 10 with its graphic presentation of ecosystems in the Basin. The figure presentation has been converted to a tabular form which also includes the long-term trends in available habitats (Table 6). In Figure 10 and Table 6, large ecosystems such as upland scrub including predominantly sand pine scrub, scrub oak, and smaller areas of prairie, pinelands, bayhead or cypress dome have been combined into one type. Likewise

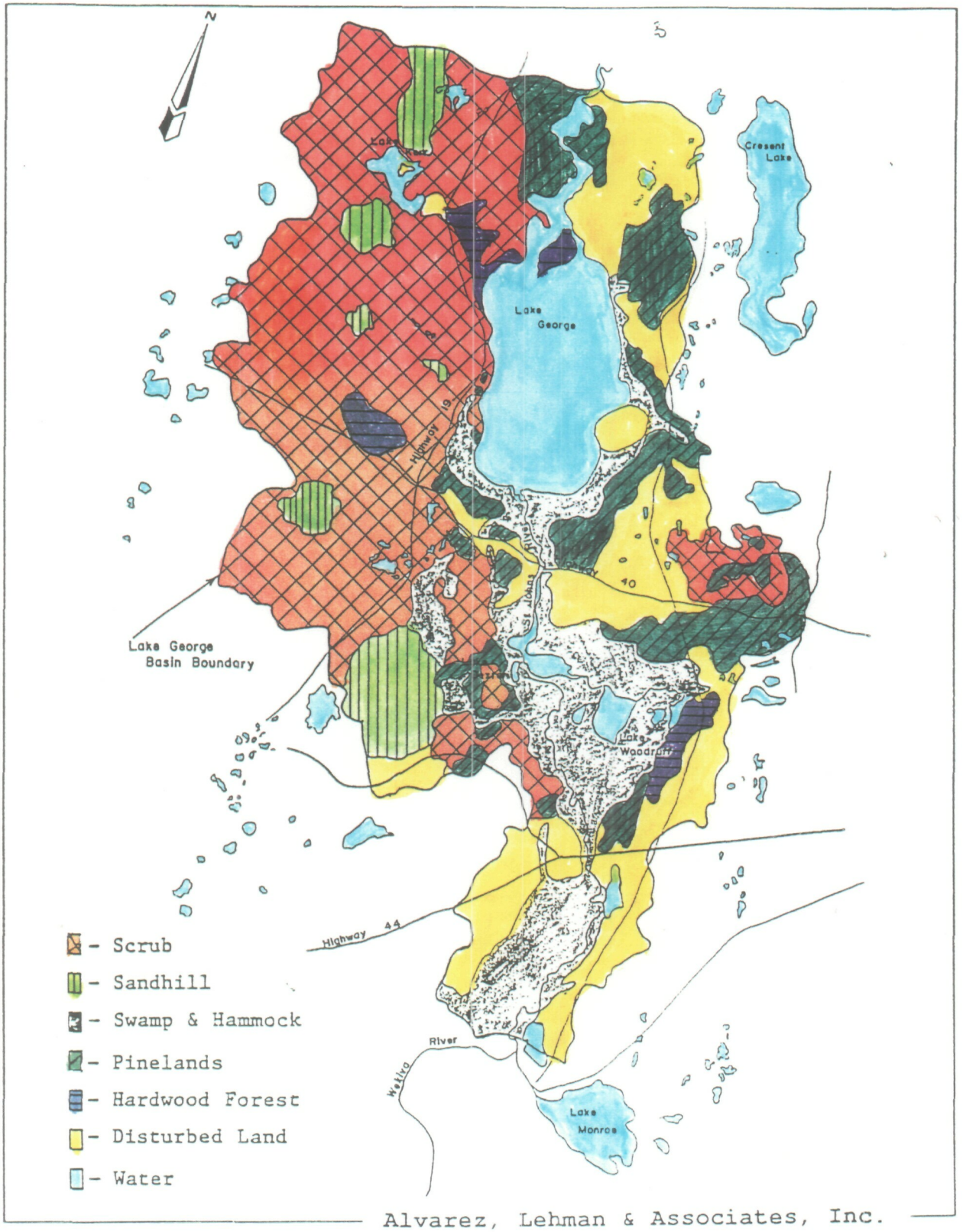

FIGURE 10 - Major Ecosystems of the Lake George Basin, St. Johns River Water Management District, Florida, 1991

TABLE 6. Areas and Trends of Major Ecosystems in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Ecosystem	Area (Square Miles)	Percentage	Trend
Scrub	258	33	Stable, decreasing slightly
Sandhill	48	6	Decreasing
Hardwoods	25	3	Decreasing
Pinelands	101	13	Decreasing
Swamp and Hammock	102	13	Stable/decreasing
Lake and River	123	16	Stable
Disturbed	125	16	Increasing
Total	783	100	

Source: Alvarez, Lehman & Associates, Inc., 1991

disturbed habitat dominated by grasslands and barren habitat with smaller areas of natural habitats such as hammock or flatwoods, are shown as one type. Swamp and hydric hammock forest were considered one ecosystem as were lake and riverine habitat. Pinelands was a separate system.

Disturbed habitat accounts for 16% of the Basin and is increasing, particularly in the eastern part (Table 6). This impact is most pronounced in the uplands of sand pine scrub, oak scrub, and pinelands on the eastern side of the Basin. Sandhill is also decreasing in the Basin as well as the pinelands. While impacts are greater on the eastern side of the Basin, particularly those sections north of the Lake Woodruff marsh, that area probably presents the greatest opportunity for public land acquisition and the greatest opportunity for creating a balance of habitat types assuming proper long-term habitat management.

As these habitat loss trends have continued to impact the resources of the Basin, there have been changes in some aspects of the wildlife community while others have remained relatively stable during such times (Table 7). Most of the animals utilizing large ecosystem components, such as the Florida panther, have been extirpated or appear to be declining (e.g., the black bear). Aquatic animals such as largemouth bass have suffered a slight decline in population levels because of reduced water quality, however, most populations of aquatic or wetland species in the Basin have remained relatively stable during recent years. Wetlands and aquatic habitats have received greater regulatory protection (Section 4.0).

TABLE 7. Population Trends for 20 Wildlife Indicator Species in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Species or Group	Habitat Use	Habitat Trend	Population Trend	Causative Factors	Long Range Management
Red Wolf	Ecosystem	Decreasing	Extirpated	Hunting, Loss of habitat	None
Florida Panther	Ecosystem	Decreasing	Extirpated	Hunting, Loss of habitat	None
Black Bear	Ecosystem	Decreasing	Decreasing	Road kill, Habitat degradation	Reduce road kills, Habi-improvement
Bald Eagle	Ecosystem	Stable	Stable	Habitat still suitable	Maintain habitat condition
Largemouth Bass	Aquatic	Decreasing	Decreasing	Water quality impacted	Improve water quality, Maintain
Alligator	Aquatic	Stable	Increasing	Regulated hunting	Maintain
Wading Birds	Wetlands	Stable	Decreasing	Habitat stable	Maintain
Wood Duck	Wetlands	Stable	Stable	Habitat stable	Maintain
Ducks	Wetlands	Stable	Decreasing	Short stopping up north	Manage wetlands for ducks
Everglades Kite	Wetlands	Stable	Decreasing	Population decline in south	None
Sand Skink	Scrub	Decreasing	Decreasing	Habitat loss	Land acquisition
Gopher Tortoise	Open up-land, Sandy	Decreasing	Decreasing	Habitat loss	Land acquisition
Diamondback Rattlesnake	Upland forest	Slightly Decreasing	Decreasing	Human intolerance	Education
Scrub Jay	Scrub	Decreasing	Decreasing	Habitat loss	Land acquisition
Florida Burrowing Owl	Open Pasture, Sandhill	Stable	Stable	No change	None
Kestrel	Sandhill, Open	Decreasing	Decreasing	Habitat loss	Habitat management
Red-cockaded Woodpecker	Sandhill	Decreasing	Decreasing	Habitat loss, Degradation	Manage else-where in District
Fox Squirrel	Flatwoods, Sandhill	Decreasing	Decreasing	Habitat Degradation	Habitat improvement
Red Fox	Open Upland	Increasing	Increasing	Habitat Increase	None
Coyote	Open Upland	Increasing	Increasing	Habitat Increase	None

Source: Alvarez, Lehman & Associates, Inc., 1991

More specialized species which reside in the upland habitats of scrub or sandhills have declined in recent years. The red-cockaded woodpecker population, even with all the efforts by the U.S. Forest Service, is in very serious trouble. Other populations such as the scrub jay appear more stable in the NF but some research biologists disagree. Population trends for wetland-dependent breeding amphibians are difficult to determine, however, worldwide these animals are declining (Flam, 1991). Amphibian species within the coastal plain habitats including the Lake George Basin appear to be declining because of habitat loss and not some overall climatic influence (Moler, personal communication, 1991). Recent arrivals to the Basin, such as the coyote, appear to be expanding and increasing in population size.

3.3.3 Recommendation for Habitat Protection

The significant land holdings by several agencies (e.g., U.S. Forest Service) within the Basin provides some unique opportunities to improve and/or restore habitats. Due to the large population of endangered and threatened aquatic-associated and upland species, the protection and restoration of habitats in most cases should be a high priority. Habitat improvements should focus on three main elements and include:

1. Habitat management;
2. Habitat acquisition; and
3. Habitat protection.

Aquatic habitat management should focus on reducing pollutants, control of nuisance plant species, and specific actions to promote better duck habitat or other desired species. Better control of the upper St. Johns River runoff

problems will reduce nutrient loads that enter the Lake George Basin through the St. Johns River. Habitat management on uplands should focus on practices such as increased fire frequency to reduce hardwood invasion in upland pine forest, to reduce overgrowth of hardwoods in xeric oak habitats, and to maintain low ground cover in pine forest. Fire frequency in systems such as pine flatwoods and sandhill should be on a 2-4 year cycle while an 8-20 year cycle is acceptable in sand pine/xeric oak communities. Logging practices such as clear-cutting are generally not recommended, but thinning, seed tree, and shelterwood cuts are best for maintaining sustained wildlife use.

To enhance travel corridors, decrease habitat fragmentation, and increase habitat diversity, land acquisition programs should focus on completing the upland wetland interface on the east side of Lake George and St. Johns River (Figure 11). Small, less prominent land parcels will complete wetland/upland corridors for black bear and other species. In some cases the condition of these potential acquisition areas is not of good wildlife habitat quality but because of its location should be viewed as an important part of the program. This program could be used for further acquisition and management of the entire area east of Lake George, north of Highway 40, and west of U.S. 17, thus tying this whole area in as substantial bear and other wildlife habitat. Areas which are not of high habitat quality (e.g., pasture) could be managed for re-establishment of natural vegetation which will also enhance watershed protection. These pasture areas, however, could also be managed as sandhill crane, southeastern kestrel and burrowing owl habitat.

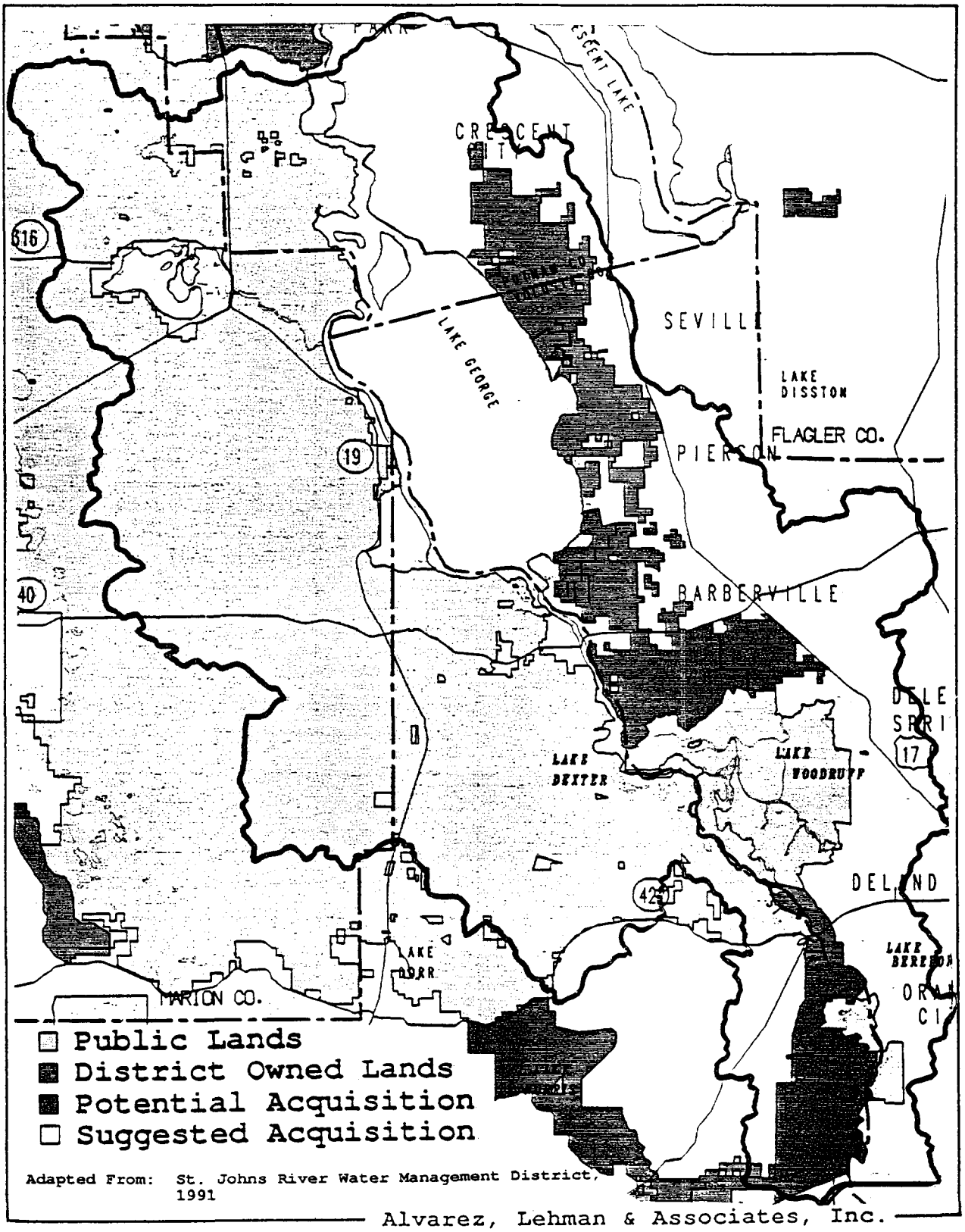

FIGURE 11 - Public, District Owned Lands and Potential Acquisition in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Habitat protection in the form of wetland regulation to ensure that existing wildlife corridors are maintained is important. The St. Johns River is a significant wildlife corridor and no action should be allowed that would disrupt this corridor that does not properly mitigate for such action. Similarly, smaller corridor areas crossing highways should be protected by placing crossing structures similar to those used for the Florida panther in south Florida.

3.4 Regulatory Framework

Many federal, state, regional, and local agencies have regulatory or management jurisdiction over the natural resources of the Lake George Basin with respect to protection of habitat and wildlife values. These agencies are described below and, in a following section, the specific authority that each agency has with regard to the special habitats in the Lake George Basin are summarized (Table 8).

Attempts to coordinate agency actions to better protect two other river basins in Florida are examined. Recommendations to improve gaps in regulatory and management protection are provided.

3.4.1 Federal Agencies

3.4.1.1 U.S. Department of the Army, Corps of Engineers (COE)

The Corps of Engineers is authorized by Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) to regulate dredging of obstructions and to review proposals for channel construction and improvements in navigable waterways.

TABLE 8. Agencies with Regulatory or Management Authority Over Land Use and Resources in the Lake George Basin, St. Johns River Water Management District, Florida, 1991

Agency	Wetland/ Surface Water	Upland Habitat	Threatened & Endangered Species
	FEDERAL		
Army Corps of Engineers			
Discharge of fill	X		
	X		
Environmental Protection Agency			
NEPA	X		
	X		
Section 404 Overview	X		
	X		
Pollutant discharge	X		
	X		
Fish and Wildlife Service			
Endangered Species Act	X[1]	X[1]	X
National Wildlife Refuge	X	X	X
Forest Service			
Ocala National Forest	X	X	X
Soil Conservation Service			
Technical assistance and subsidies to agriculture for BMP[2] (e.g.Conservation Reserve Program)	X	X	
	STATE		
Department of Environmental Regulation			
Dredge and Fill	X		X[3]
Pollutant Discharge	X		

--Continued--

TABLE 8 - Continued

Agency	Wetland/ Surface Water	Upland Habitat	Threatened & Endangered Species
	STATE		
Department of Natural Resources			
Management State Lands	X	X	X
Submerged lands permitting	X		X[4]
CARL Acquisition Program	X	X	X
Florida Game and Fresh Water Fish Commission			
Physical taking of species			X
Wildlife Management Areas	X	X	X
Department of Community Affairs			
Development of Regional Impact Overview	X	X	X
Comprehensive Plan Overview	X	X	X
	REGIONAL AND LOCAL		
St. Johns River Water Management District			
MSSW and Stormwater Systems	X		X[3]
Consumptive Use Permitting	X		
Save Our Rivers	X	X	X
East Central Florida Regional Planning Council			
Development of Regional Impact	X	X	X
Regional Comprehensive Plan	X	X	X
Marion, Lake, Volusia, and Putnam County Comprehensive Plans and Ordinances[5]			
Comprehensive Plan	X	X	X
Zoning Ordinances	X	X	
Land Development Regulations	X	X	
Wetland Ordinances	X		
Wildlife Protection Ordinances	X	X	X

[1]Critical habitat only
[2]Best Management Practices
[3]Surface water or wetland-related only
[4]Marine species only; FGFWFC is responsible for upland and freshwater species

--Continued--

TABLE 8 - Continued

[5]Counties have authority to protect habitats and protected species through land development regulatory powers. However, at this time only Volusia County has Comprehensive Plan policies to use this authority. Putnam County has not completed its Comprehensive Plan. Most of the portions of Lake and Marion County that are in the Lake George Basin are on publicly-owned land.

Source: Alvarez, Lehman & Associates, Inc., 1991

Section 404 of the Clean Water Act of 1972 (33 USC 1344 as amended) gives the COE the authority to regulate discharge of fill into waters of the United States, which includes both wetlands and surface water bodies.

During its review of permit applications, the COE must consider such factors as water quality, wetland values, conservation, economics, aesthetics, general environmental concerns, historic values, navigation, fish and wildlife values, endangered and threatened species, and flood damage prevention. Normal agricultural and silvecultural activities are exempt from COE jurisdiction.

The COE and its consulting agencies have potential power to control the cumulative effects of permitting the typical small projects that are involved in the majority of permit applications. The COE Regulatory Program, 33 CFR Part 320.4, states:

> "...the district engineer may undertake, where appropriate, reviews of particular wetland areas in consultation with the Regional Director of the U.S. Fish and Wildlife Service, the Regional Director of the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, the Regional Administrator of the Environmental Protection Agency, the local representative of the Soil Conservation Service of the Department of Agriculture, and the head of the appropriate state agency to assess the cumulative effect of activities in such areas."

However, the U.S. General Accounting Office (1988) investigated the COE's administration of Section 404 and

concluded that the COE does not consider cumulative impacts of individual permitting decisions. Moreover, the COE sometimes ignores recommendations by the Environmental Protection Agency, National Marine Fisheries Service, and the Fish and Wildlife Service; does not always consider practicable alternatives to filling wetlands; and usually does not pursue monitoring or enforcement for unpermitted discharges. The COE, generally, concurred with the report, citing limitations of staffing and funding. There may be, however, better coordination by the COE on these recommendations from the consulting agencies on a local level than nationwide.

3.4.1.2 U.S. Environmental Protection Agency (EPA)

The National Environmental Protection Act of 1969 makes the EPA responsible for control and abatement of environmental pollution. It directs that all agencies of the Federal Government shall insure that "environmental amenities and values"...be given appropriate consideration in decision-making along with economic technical considerations. Section 402 of the Clean Water Act authorizes the EPA to issue permits to implement the National Pollutant Discharge Elimination System; in Florida this authority has not been delegated to the State. The EPA overviews the COE Section 404 permit process, but rarely intervenes in permit decisions.

3.4.1.3 U.S. Fish and Wildlife Service (FWS)

The Clean Water Act authorizes the FWS to participate in the review of COE dredge and fill permit applications. However, their recommendations are advisory only.

The FWS administers the Endangered Species Act of 1973 (16 USC 1531 as amended). Under Section 7 of the Act, federal agencies on federally funded projects must include consultation with the FWS whenever the resultant actions may jeopardize the continued existence of threatened and endangered species as listed under the Act or result in the destruction or adverse modification of habitat of such species which is determined to be critical. However, the FWS recommendations are not mandatory and the final decision on how an action should proceed is left to the lead agency. Coordination on these issues between the COE and FWS appears to function well, at least within the Basin. However, agency actions that are challenged in court by environmental groups are often decided in favor of species protection. Some cases have resulted in significant policy changes by agencies such as the COE and the Forest Service. For example, Sierra Club v. Lyng, 1988, changed Forest Service clearcutting practices to afford better protection to the red-cockaded woodpecker in some National Forest in Texas. Similar challenges have resulted in better protection of some of Florida's protected wildlife.

Section 9 of the Endangered Species Act makes it unlawful for any person to "take" (i.e., harass, kill, harm, capture, or collect, etc.,) an endangered fish or wildlife species. Section 10 allows a landowner to engage in activities (e.g., habitat clearing) that "incidentally" take protected species through a consultation process with the FWS. The landowner submits a conservation plan that demonstrates that the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild. This provision may weaken the protection given by the Endangered Species Act, since most protected species in Florida are threatened by

habitat destruction, not hunting. However, it may prevent the Act from being held in violation of the constitutional provision that prevents property from being taken without just compensation.

The FWS also manages National Wildlife Refuges (NWR) such as the Lake Woodruff NWR. Management plan objectives include protection of endangered and threatened species, provision for a natural diversity of wildlife species and optimum habitat for migratory birds, particularly waterfowl.

3.4.1.4 U.S. Forest Service, Southern Region

The Forest Service is responsible for managing the land and resources of the National Forest System. Under the Multiple-Use Sustained Yield Act of 1960 (916 USC 528, et seq) and the National Forest Management Act of 1976 (16 USC et seq), these lands are managed for a variety of uses on a sustained basis to ensure a continued supply of goods and services to the American people in perpetuity. Land and resource management plans are developed for the various national forests.

The Forest Service is not a regulatory agency. But since most of the Lake George Basin on the west side of the Lake is part of the Ocala National Forest, Forest Service management practices have significant effects on the Basin's resources. These practices have often been challenged as favoring timber production at the expense of threatened and endangered species habitat, but the Forest Service has been working with groups such as The Nature Conservancy to improve its protection of wildlife and special habitats. Some activities, such as mechanical treatment of scrub areas

instead of regular fire management, have been challenged by some biologists (Cockerham, personal communication, 1991).

3.4.1.5 Soil Conservation Service (SCS)

The Soil Conservation Service was established by the Soil Conservation Act of 1935 (16 USC 590 A-F) to carry out nationwide soil and water conservation, execute watershed protection and flood protection projects in coordination with other agencies, and help local sponsors develop multi-county resource conservation efforts. It is authorized to train, educate, and seek the cooperation of landowners in watersheds on the use of Best Management Practices. The SCS is not a regulatory body, but is the only federal agency that exercises substantial influence over agricultural activities that affect wetlands such as draining, excavation, filling, and pollution due to soil erosion. Their activities are mostly advisory, but the SCS has good rapport with farmers, and can offer limited financial and technical assistance for practices that protect natural resources.

3.4.2 State Agencies

3.4.2.1 Florida Department of Environmental Regulation (DER)

DER is designated by the Water Resources Act of 1972 as the lead agency in water management. Chapter 403, Florida Statutes (FS) provides for maintenance and enhancement of water quality and wetland protection through programs administered by DER. DER regulates water quality through control of pollutant discharges into surface waters [Chs. 17-4 and 17-302, Florida Administrative Code (FAC)] and issues permits for dredge and fill activities in waters of the state

which includes wetlands (Chapter 17-312, FAC). Only wetlands which are connected to surface water bodies are defined as "waters of the state"; therefore, isolated wetlands are not protected by the State's dredge and fill permitting process. The Warren S. Henderson Wetlands Protection Act of 1984 (FS 403.91-.929) spells out DER's authority to protect wetlands.

Many of DER's rules affect water quality and therefore indirectly influence the water quality of the St. Johns River and its associated lakes. Examples are rules that involve wastewater discharges and sludge spreading on agricultural lands.

An interagency agreement has transferred many of DER's permitting responsibilities to the St. Johns River Water Management District, including stormwater, agricultural discharge, and portions of the wetland resource (dredge and fill) program.

3.4.2.2 Florida Department of Natural Resources (DNR)

Chapter 258, FS authorizes DNR's Division of Recreation and Parks to manage State-owned parks and recreation areas and to adopt rules for managing these areas. Section 258.037 declares that the policy of the Division is to acquire typical portions of the State's original environment for access by the general public, and to manage these areas so as to conserve the natural values which derive from them. In implementing this policy, the Division is authorized to cooperate with county governments in park and recreation matters and to negotiate interagency agreements with water management districts to manage district lands reserved for recreational purposes. Since so much of the Lake George

Basin consists of publicly-owned lands, acquired to preserve natural habitat, DNR's policies will influence the Basin's natural resources to the extent that the agency participates in management of these lands.

DNR also manages the State-owned sovereignty tidal and submerged bottom lands of freshwater navigable waters (Chapters 253, 370, 372 FS). DNR regulates speed zones to protect manatees, permitting of structures such as docks, and similar regulatory matters that affect the resources of the St. Johns River and associated lakes. DNR also implements the Florida Endangered Species Act of 1977 with regard to marine species.

3.4.2.3 Florida Game and Fresh Water Fish Commission (FGFWFC)

Article IV, Section 9 of the Florida Constitution and Chapter 372, FS vests the FGFWFC with administrative, management, and enforcement authority with respect to the state's freshwater fish and wildlife. FGFWFC enforces hunting and fishing regulations, conducts research and management of fresh water/upland species, and implements wildlife restoration projects. It also provides some protection for other wildlife, and law enforcement and management of certain state wildlife management areas.

Under the Florida Endangered Species Act of 1977, the FGFWFC is charged with protection and management of freshwater and upland endangered and threatened animal and fish species. Although the law protects listed species from being taken or directly killed, it does not prevent clearing and development of habitat necessary to the survival of these species. Recommendations are provided to DER, the District,

and COE for wetland permit applications and to the Regional Planning Councils for Development of Regional Impacts (DRI) (see below). These recommendations are not mandatory, but are usually followed. The FGFWFC is notified by the District with receipt of a Management and Storage of Surface Water (MSSW) (Ch 40C-4 FAC) permit application for agricultural activities or DRI which involve losses of 10 acres or more of wetland, involve mosquito impoundments, or involve threatened or endangered species.

The Department of Agriculture and Consumer Services lists threatened and endangered plant species, but does not protect these species from destruction by landowners.

3.4.2.4 Florida Department of Community Affairs (DCA)

Chapter 380.045, 380.05, and 380.06 authorize the DCA to establish resource planning and management committees. DCA overviews the regional planning council's reviews of DRI applications. Chapter 163.361 FS authorizes the DCA to review local government comprehensive plans and ensure that the plans are consistent with the State Comprehensive Plan.

3.4.3 Regional and Local Agencies

3.4.3.1 St. Johns River Water Management District

The Florida Water Resources Act of 1972 (Chapter 373, FS) is the source of authority for the five water management districts in the state to acquire land, regulate surface water and ground water management, and regulate water consumption. The Act also creates the Water Management Lands Trust Fund which is the source of funding for the Save Our

Rivers Program. In addition, the District has been granted the authority to regulate some dredge and fill activities and to design and implement stormwater management programs within the district.

Permitting under the Water Resource Management program (dredge and fill) is coordinated with other agencies. The COE is notified within 24 hours, and FDER, DNR, FGFWFC, and Bureau of Historical Resource, and State Land Management are notified within 10 days of receipt of a Water Resource Management permit. The MSSW regulations provide some protection to wildlife values and regulates impacts to both isolated and non-isolated wetlands. The primary function of isolated wetlands is to provide wildlife habitats. Isolated means any wetlands not within the jurisdiction of DER for regulating dredge and fill activities.

MSSW regulatory program requires permits for projects that are either: greater than 40 acres in size; include more than 12 acres of impervious surface which is 40 or more percent of the total land area; traverse a stream or other watercourse with more than five square miles of upstream watershed; traverse an impoundment greater than 10 acres in size; that affects a 5-acre or greater wetland which is not wholly owned by the applicant; or projects which are wholly or partially located within any isolated wetland.

District approval of permits for wetland impacts may be granted when no net adverse impacts occur which are not offset by mitigation. Mitigation can be wetland creation, enhancement, restoration to create functional values to replace those lost by the impact to the wetlands or land acquisition. These programs still may not provide the

mechanism or the analysis required to protect the small (0.5 acre or less) wetlands, which are important as wildlife habitat, particularly as breeding sites for amphibians.

FS 373.036(7) states that "The department shall give careful consideration to the requirements of public recreation and the protection and procreation of fish and wildlife". This subsection affords some protection to wildlife values.

3.4.3.2 East Central Florida Regional Planning Council (ECFRPC)

The ECFRPC reviews Developments of Regional Impact (DRI) applications and sets conditions for their approval. Developments are considered to come under DRI rules if "because of ..character, magnitude, or location (they) would have a substantial effect upon the health, safety or welfare of citizens of more than one county" (F.S. 380.06). These include large housing developments, shopping centers, and mines. Development orders usually contain stipulations for protection of natural resources in the design of the development. The application must describe the wildlife and vegetation, threatened and endangered species, and wetland resources on the site proposed for development.

3.4.3.3 Local Government

The Local Government Comprehensive Planning and Land Development Regulation Act (Section 163.3167) requires each County to prepare and adopt a comprehensive plan as scheduled by the Florida Department of Community Affairs. The Comprehensive Plan includes elements that relate directly to natural resource protection. These elements are

conservation, recreation and open space, and potable water and natural groundwater aquifer recharge. Counties can enact ordinances to protect natural resources in compliance with Comprehensive Plan policies.

The Lake George Basin lies within Volusia, Putnam, Lake, and Marion Counties. Virtually all the land in Lake County and Marion County that lies in the Basin is part of the Ocala National Forest and is under management of the National Forest Service. A 144-acre parcel of property between Lake Kerr and Little Lake Kerr in Marion County is proposed for purchase under the CARL program.

Putnam County's Comprehensive Plan is being reviewed by DCA (Peter Brown, County Planner, personal communication, 1990). When the DCA review is complete, the County's policies and guidelines regarding the Conservation Element will be finalized and a consultant will be hired to bring the Land Development Regulations into compliance with the Plan. Measures being considered that will protect natural resources in the Basin include a setback buffer from wetlands and water bodies (width to be determined) and waterfront setbacks for septic tanks. At present, upland buffers, 20 feet in width, are encouraged around wetlands for large scale developments. There is a conservation designation around Little Lake George which limits residential density to one unit per 5 acres. However, there is some existing development that exceeds this density.

The Future Land Use Element of the Volusia County Comprehensive Plan designates Natural Resource Management Areas (NRMA), which are defined as "expanses of relatively uninterrupted environmentally sensitive areas which need to

be managed as part of a system". The NRMA's are to support a wide range of wildlife species, help recharge groundwater supply, ensure high quality surface waters, and provide recreation, aesthetic areas, and open space areas. Development standards are more restrictive than in areas outside the NRMA. The eastern side of the St. Johns River and Lake George floodplain is included within a NRMA.

The NRMA will create an environmental system corridor of interconnected wetland areas with buffers of upland habitat and possibly ridges with high groundwater recharge capabilities or unique wildlife habitat. Allowed land uses will include silveculture, compatible agricultural activities, and house density will be no more than one single family dwelling per 25 acres. Public and private land areas that have been acquired or reserved by agreement with the owner for preservation of natural resources are included in the NRMA.

Other comprehensive plan policies that protect natural resources include: criteria for mitigation of environmentally sensitive lands and critical habitats which are destroyed or altered; natural buffer zones or setbacks for wetlands (although isolated wetlands have less set back protection than wetlands connected to surface water bodies); adoption of management plans for protected species; protection of fisheries; and adoption of Best Management Practices for agricultural and silvecultural activities.

3.4.4 Regulatory and Management Protection for Lake George Special Habitats

3.4.4.1 Lake, River, and Associated Floodplain

This system is under the regulatory authority of the COE, DER, and the District with regard to excavating and filling wetlands, discharge of pollutants, water use, and water quality. Protected species come under the authority of FWS and the FGFWFC. If the species are wetland-related, their protection may be considered by the District, COE, and DER. The systems may receive more protection in the future as counties in the Lake George Basin implement their Comprehensive Plan policies.

In the past, a cumulative impact review during the permitting procedure was a significant gap in the protection of wetland areas. Fortunately, much of the floodplain swamp in the Basin is on public lands where protection of surface waters and associated floodplain was part of a management policy. FS 403.919 now requires an assessment of cumulative impacts in reviewing dredge and fill permits.

3.4.4.2 Cypress Swamps

Discharge of fill is discouraged if the cypress swamps are connected to a water of the state. Mitigation is usually required to offset impacts. If the swamps are isolated, the DER has no jurisdiction. The COE often allows fill under a general permit unless the wetland is greater than 10 acres in size. The District requires permits for work in isolated cypress domes that are part of surface water or stormwater management projects.

3.4.4.3 Spring Runs

The larger springs on the west side of the Lake George Basin are in the Ocala National Forest. Blue Springs, on the east side of the Basin, is a publicly owned area. Spring runs are under the same protection afforded other surface water drainages. These have been described previously for the St. Johns River.

3.4.4.4 Longleaf Pine-Sandhill and Scrub Ridges

These upland systems are grouped together because their protective status is similar. Both these habitats are in serious jeopardy in Florida. They receive little protection unless they are on publicly owned land that is managed to protect natural habitat. If a sandhill or scrub is inhabited by a protected species such as the endangered red-cockaded woodpecker or threatened scrub jay, it is afforded the protection that can be provided by the FWS. The FGFWFC can also provide some protection in those habitats through the Endangered Species Act during the review process for DRI's or other review of permits. FWS can provide only limited habitat protection, however.

These uplands do receive priority for public acquisition under the CARL program if they are relatively undisturbed and support protected species. They are also eligible for acquisition by the District if they are located so as to protect groundwater or surface water resources.

In 1988, Florida passed by referendum a "blue belt" amendment. The state was authorized to provide for reduced property taxes on lands that are identified as important to

aquifer recharge. Scrub and sandhill sites that are recharge areas would receive this limited form of protection; however, the enabling legislation has not been enacted. Moreover, if development of these areas is more profitable than the value received from reduced property taxes, blue belt designation may not offer much protection.

3.4.5 Recommendations for Protection of Natural Resources in Lake George Basin

The Volusia County Comprehensive Plan calls for coordination with appropriate federal, state, regional, and local governmental bodies for the establishment of multi-jurisdictional task forces devoted to the protection of the St. Johns River (and other rivers).

Management by a coordinating body of representatives from various agencies and interests is often recommended to overcome problems of fragmented jurisdictions as well as gaps and overlaps in effective management of rivers. Two recently formed management councils in Florida are the Myakka River Coordinating Council and the Wekiva River Basin Resources Council.

3.4.5.1 Myakka River Coordinating Council

In 1985 the Myakka River Wild and Scenic Designation and Preservation Act (Section 258.501 FS) designated the 34-mile segment of the Myakka River within Sarasota County as a "Florida wild and scenic river". The act required that a management plan be developed to provide for the permanent preservation and enhancement of the river and its resource values. It called for a permanent council to provide interagency and intergovernmental coordination for management

of the river. Representatives to the Council consist of one representative each from the DER, Department of Transportation, FGFWFC, DCA, Division of Forestry, Division of Archives, History and Records Management, Tampa Bay Regional Planning Council, Southwest Florida Water Management District, Southwest Florida Regional Planning Council, Manatee County, Sarasota County, agricultural interests, and environmental interests.

The Council meets once a month and has 29 members, not including alternates. Their purpose is to review and make recommendations on all proposals for amendments or modifications to the act and to the permanent management plan, as well as on other matters which may be brought before the council.

The management plan was prepared jointly by DNR and the Council. However, DNR took a strong lead in developing a Myakka River Rule enacted in July 1991, which authorizes DNR to review and issue permits for some activities on the River. Activities are regulated within the river segment and the bordering wetlands. This regulatory authority is new for DNR and the effectiveness of the rule remains to be seen.

A 220-foot buffer adjoining the riverine wetlands, which was defined as the watershed of the river, was recommended for protection by the Council, but it is up to Sarasota County government to determine whether to protect the buffer by ordinance.

The Myakka River Coordinating Council has been established recently to assess its performance in protecting the river. One potential problem is that the upstream

portions of the Myakka River in Manatee County are not regulated by the rule, nor are the Sarasota County tributaries that drain into the Myakka River.

3.4.5.2 Wekiva River Basin Resource Council

The Council, established in 1988, received legislative funding to: collect and disseminate information on basin resources and to develop recommendations; and improve communication and encourage cooperation among agencies, organizations, and individuals concerned with economic development and environmental protection of the Wekiva River Basin. According to the bylaws, the steering committee is to be composed of 16 members; at least three each representing development, environment, education government, and citizens of the Wekiva River Basin. An executive director was appointed by the University of Central Florida, which houses the Council's offices in its Engineering Department and acts as a parent group.

The Council has no management or regulatory authority. In 1991 its funding was drastically cut by the legislature, including support for the Executive Director. One staff member remains to maintain the office in hopes that funding may eventually be restored.

3.4.5.3 Summary

The effectiveness of interagency and citizen's councils for comprehensive management and protection of river basins has not been proved in Florida and may depend very much on organizational structure and funding. These councils may, at least, focus continued attention of agencies and other

interested parties on problems affecting a river basin through periodic meetings and reviews of activities that alter its natural resources. They also offer a forum for public education and support.

The District has more authority than any other one agency to provide comprehensive system-wide management of the Lake George Basin. The Basin and the entire St. Johns River are within its boundaries and it exercises control over water use and some aspects of water quality and fish and wildlife protection. The District has little control over upland land uses, although it can acquire uplands under the Save Our Rivers program that can be shown to influence water-related features. Its geographic jurisdiction is based on resource, not political boundaries. In addition the District is supported by ad valorem taxes which allows the agency to raise money for adequate staffing, a major problem with federal, state, and local government entities.

Counties have the most authority to regulate upland land uses and also to coordinate upland and wetland land uses due to their control over land development regulation. Water quality and wildlife habitat protection are often more influenced by land uses and development regulations controlled by local government than by state and federal permitting practices. Local governments can limit urban densities, regulate impervious surfaces, designate areas as conservation zones, and set upland buffers that filter stormwater runoff and provide wildlife corridors. Local government policies will reflect the interest of its citizens in natural resource protection and any direction given by the DCA. Jurisdiction, however, is limited only to the portion of a river basin that is included within the county.

This review has shown that protective provisions written into law are not effective if agencies do not have the will or political support to enforce these provisions. It is not the scope of this report to recommend an organizational or political structure for an interagency council that would most effectively protect natural resources in the Basin. However, before any such council is organized, various options should be studied to determine the structure that would lead to the most effective natural resource protection. It should be done, preferably, by a consultant with expertise in political and organizational science who researches examples of successful councils and determines the reasons for their success.

Without this sort of analysis and implementation, an interagency council can be yet another overlay of government that does not lead to greater protection of regional resources. It may be that the laws are sufficient to protect the resources, but that public support for resource protection has to be mobilized politically to overcome the influence and power that special interest groups exert on public agencies.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The Basin is located in the lower reaches of the St. Johns River and represents 9% of the total drainage basin. The Lake George Basin contains 22 wildlife habitats which supports 279 wildlife species. Because of this diversity and overall good quality of many of these habitats, the Basin supports relatively large populations of several threatened and endangered species and important recreational and commercial aquatic species. Overall habitat quality is generally good within the Basin because of five factors, which include the following:

1. Large amounts of the habitat and watershed within the Basin are controlled by Federal and State agencies;
2. Floodplain swamps and other wetlands have been protected because of the past difficulty in developing many of these areas and because of the protection afforded to wetlands by several regulatory agencies and mechanisms;
3. The large diversity of aquatic and upland habitats within the Basin;
4. Some water quality impacts imposed on the aquatic system are filtered out in upstream lakes such as Jessup and Monroe; and
5. Habitat management practices used by some controlling agencies, such as the U.S. Forest Service, are sometimes controversial, however, these management programs are much better than the

wildlife management practiced elsewhere in the vicinity.

For the most part, wildlife and some important fish populations in the Basin will probably continue to decline with increased urbanization and development in the Basin. Species such as the Florida black bear may be eliminated unless proper management and land acquisition programs are successful. Other protected species such as the scrub jay should continue to survive in the Basin, at least on the Ocala NF lands. Effects on the eagle population from feeding resource availability are difficult to predict because of unknown trends in water quality degradation in the St. Johns River, but should not be drastically altered in the near future.

Land acquisition opportunities and proper habitat management of areas in the east-central and northeast part of the Basin provide interesting opportunities for the continued development of a large regional block of high quality fish and wildlife habitat. With proper development, these land acquisitions will increase the wildlife value of the area and also enhance watershed protection. Uplands can be protected through endangered species occurrence, watershed protection, and land acquisition.

4.2 Recommendations

The following recommendations are summarized from the proceeding text. Several of these recommendations will, by necessity, require a multi-agency response in order to fully attain the desired results.

1. A water quality program should be initiated to investigate the cause of algal blooms in Lake George;

2. Programs to reduce road kills of black bears should have support from the District;

3. Implement best bear management practices on lands controlled by the District;

4. Support acquisition of important bear corridors even though habitat conditions may not be optimum;

5. Preservation and management of red-cockaded woodpecker habitat may be best on the Ocala NF and in other drainage basins regulated by the District;

6. Help to expand the existing scrub jay population by proper fire management of upland xeric oaks and other types of scrub habitat;

7. Protect nesting and feeding sites of the nuclear population of bald eagles in the Basin;

8. Manage District controlled lands to increase habitat quality for species such as kestrels, gopher tortoise, and other upland wildlife;

9. Support protection of unique habitat areas such as White Cedar Forest and other special habitats;

10. Protection of water quality in the upper reaches of the St. John River Basin is one important measure to protect the Lake George Basin;

11. Habitat fragmentation, corridor problems, and other related wildlife issues can best be addressed by proper land acquisition and habitat management. These actions, if fully implemented, may result in the reversal of declining wildlife population trends;

12. Support of an interagency and citizens' council for river basin management is not advised unless the various options are studied to determine the optimum structure and organization;

13. The District may have the best opportunity to provide watershed protection through regulation and land acquisition; and

14. Develop evaluation procedures for determining significant wildlife values for small isolated wetlands.

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APPENDIX A

FISH AND WILDLIFE SPECIES OF LAKE GEORGE BASIN
AND THEIR HABITAT REQUIREMENTS

UNLISTED SPECIES

		Breeding Areas	Cover
AMPHIBIANS			
Bufo quercicus Oak toad	20*	Pools, swamps	621, Uplands
Bufo terrestris Southern toad	11	Pools, swamps	Uplands
Eleatherodactylus planirostris Greenhouse frog	NS+	Wetlands	741, 320, 210
Acris gryllus dorsalis Florida cricket frog	4	Pools	641,621,615,611, 410
Hyla chrysoscelis Gray treefrog	13	Domes, prairies	621, 615, 438
Hyla cinerea Green treefrog	6	Swamps	621,615,611,438,427, 413,412,410
Hyla femoralis Pinewoods treefrog	14	Wetlands, Domes	641,621,615,438, 421,412,410
Hyla gratiosa Barking treefrog	17	Wetlands, Domes	641,621,615,611, 427,421,413,412
Hyla squirella Squirrel treefrog	8	Ponds	621,611,438,421,413, 412,410
Pseudacris crucifer Spring peeper	15	Domes	641,621,615,611
Pseudacris ocularis Little grass frog	9	Ponds	741,641,621,615,611, 427,412,410,210
Pseudacris nigrita verrucosa Florida chorus frog	14	Ponds, Domes	641,621,615,510, 438,427,410,

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Pseudacris ornata Ornate chorus frog	16	Domes	641,621,615,611
Gastrophryne carolinensis Narrowmouth toad	22	Pools	741,427,421,413,412, 410,320,210
Scaphiopus holbrookii holbrookii Eastern spadefoot toad	16	Domes, Ponds	741,438,427,421,413, 412,410,320,210
Rana areolata Gopher frog	25	Ponds, Domes	421,412,410,413
Rana catesbeiana Bullfrog	5	Wetlands	641,621,615,550,510
Rana clamitans Bronze frog	6	Wetlands	641,621,615,611,550, 520,510
Rana heckscheri River frog	6	Wetlands	621,615,550,510
Rana grylio Pig frog	4	Wetlands	641,621,615,611,550, 520,510
Rana utricularia Southern leopard frog	4	Ponds, Domes	641,621,615,611,550, 510,438,427,412,410, 320,210
Ambystoma talpoideum Mole salamander	17	Ponds	621,615,611,427,421, 413,412
Ambystoma tigrinum tigrinum Eastern tiger salamander	18	Ponds	621,615,427,410
Ambystoma opacum Marbled salamander	16	Ponds	621,615,438

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Amphiuma means Two-toed amphiuma	7	Wetlands	641,621,615,550,520, 510,
Desmognathus auriculatus Southern dusky salamander	7	Creeks	621,615,611,550
Eurycea quadridigitata Dwarf salamander	6	Creeks	641,621,615,550
Notophthalmus viridescens Eastern newt	7	Wetlands	641,621,615,611,550, 438,427
Notophthalmus perstriatus Striped newt	29	Wetlands	641,621,550,438, 427,421,413,412
Plethodon grobmani Slimy salamander	7	Uplands	621,615,438,427,413, 410
Pseudotriton montanus floridanus Rusty mud salamander	9	Creeks	641,615
Pseudobranchus striatus axanthus Narrow-striped dwarf siren	7	Wetlands	641,621,615,510
Siren intermedia intermedia Eastern lesser siren	10	Wetlands	641,621,510
Siren lacertina Greater siren	6	Wetlands	641,621,615,510

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
REPTILES			
Alligator mississippiensis Alligator	17	Marsh, Swamp	Wetlands
Apalone ferox Florida softshell turtle	7	Wetland	641,621,615,520, 550/510
Clemmys gutta Spotted turtle	19	Wetlands	641,621,615,550,520, 510
*Chelydra serpentina osceola*Fringing Florida snapping turtle	9	Uplands	641,615,621,520, 550/510
Deirochelys reticularia chrysea Florida chicken turtle	12	Fringing uplands	641,621,615, 520,550/510
Pseudemys floridana peninsularis Peninsula cooter	12	Fringing uplands	641,621,615,520, 550/510
Pseudemys nelsoni Florida redbelly turtle	10	Fringing uplands	641,621,615,520, 550/510
Terrapene carolina bauri Florida box turtle	20	Uplands	438,427,421,413, 412,410,320,210
Trachemys s. scripta Slider	7	Fringing uplands	641,621,615,520, 550/510
Kinosternon baurii palmarum Striped mud turtle	9	Fringing uplands	641,621,615,550, 520,510

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Kinosternon subrubrum steindachneri Florida mud turtle	12	Fringing uplands	641,621,615,550, 520,510
Sternotherus minor minor Loggerhead musk turtle	13	Fringing Uplands	641,621,615,550, 520,510
Sternotherus odoratus Common musk turtle	8	Fringing uplands	641,621,615,550, 520,510
Gopherus polyphemus Gopher tortoise	27	Uplands burrows	Open upland
Rhineura floridana Florida worm lizard	23	Uplands	427,421,413,412, 320.210
Ophisaurus attenuatus longicaudus Eastern slender glass lizard	15	Uplands	438,427,421,413,412, 320,210
Ophisaurus compressus Island glass lizard	19	Dry uplands	438,413,412,421,210
Ophisaurus ventralis Eastern glass lizard	11	Dry uplands	438,427,413,412,421 410,210
Anolis carolinensis Green anole	8	Forest	621,615,611,427,421 412,410,320,413
Anolis sagrei Brown anole	NS	Forest	Varied
Sceloporus undulatus undulatus Southern fence lizard	6	Sandhill, Uplands	741,438,427,413, 412,427,412,413, 410,320,210
Neoseps reynoldsi Sand skink	36	Sandhill, Scrub	438,421,413,412, 320,210

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Eumeces egregius Mole skink	14	Sandhill, Scrub	438,421,413,412,410
Eumeces inexpectatus Five-lined skink	5	Forest	427,421,412,413
Eumeces laticeps Broadhead skink	5	Hammock	621,615,438,427
Scincella lateralis Ground skink	5	Varied	Varied
Cnemidophorus sexlineatus sexlineatus Six-lined racerunner	8	Sandhill, Scrub	741,427,421,413, 412,410,320,210
Cemophora coccinea Scarlet snake	23	Forest	621,615,438,427,421, 412,413,410,210
Coluber constrictor priapus Southern black racer	7	Varied	Varied
Diadophis punctatus punctatus Southern ringneck snake	9	Varied	621,615,611,438, 421,413,412,410, 210
Drymarcon corais couperi Eastern indigo snake	25	Varied	Most natural habitats
Elaphe guttata guttata Corn snake	7	Uplands, Forest	438,427,412,410 320,210
Elaphe obsoleta quadrivittata Yellow rat snake	9	Forest	641,621,611,427,413, 412,410,320,210
Farancia abacura abacura Eastern mud snake	16	Fringing uplands	641,621,615,611, 550

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Farancia e. erytrogramma Rainbow snake	10	Fringing uplands	621,615,611
Heterodon platyrhinos Eastern hognose snake	15	Uplands	741,438,427,413, 412,410
Heterodon simus Southern hognose snake	20	Uplands	741,438,421,413, 412,410,320
Lampropeltis calligaster rhombomaculata Mole kingsnake	16	Uplands	427
Lampropeltis getula floridana Florida kingsnake	18	Uplands	641,621,615,611, 438,427,421,413, 412,410
Lampropeltis triangulum elapsoides Scarlet kingsnake	15	Sandhill, Scrub	438,427,413,412, 410
Masticophis flagellum flagellum Eastern coachwhip	13	Upland, Forest	741,427,413,412, 410
Nerodia fasciata pictiventris Florida banded water snake	5	Fringing uplands	641,621,615,611, 550
Nerodia floridana Florida green water snake	5	Fringing uplands	641,621,615,611, 520,510
Nerodia taxispilota Brown water snake	8	Fringing uplands	641,621,615,410
Opheodrys aestivus Rough green snake	9	Uplands	641,621,615,611, 438,427,412,410

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Regina alleni Striped crayfish snake	16	Wetland	641,615
Regina rigida Glossy crayfish snake	10	Wetlands	641,615
Rhadinaea flavilata Pine woods snake	19	Pine forest	615,438,427,413, 412,410
Pituophis melanoleucus mugitus Pine snake	24	Pine forest	741,438,427,421,413, 412,410,320,210
Seminatrix p. pygaea Swamp snake	9	Wetlands	641,621,615,611, 550
Stilosoma extenuatum Short-tailed snake	30	Sandhill, Scrub	421,412,413
Storeria dekayi vieta Brown snake	7	Varied	741,621,611,615, 410
Storeria occipitomaculata obscura Florida redbelly snake	7	Varied	Varied
Tantilla relicta Florida crowned snake	33	Sandhill, Uplands	438,427,421,413, 412,410
Thamnophis sauritus Ribbon snake	6	Varied	641,621,615,438, 427,410,210
Thamnophis sirtalis Eastern garter snake	4	Marsh	741,641,621,615, 410
Virginia v. valeriae Eastern earth snake	9	Disturbed	741,320,210

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Micrurus fulvius Coral snake	15	Uplands	741,615,611,438,427, 413,412,410
Agkistrodon piscivorus Cottonmouth	9	Wetlands	641,621,615,611, 550,510,410
Crotalus adamanteus Eastern diamondback rattlesnake	24	Upland, Forest	741,427,421,413, 412,410,320
Sistrurus miliarius barbouri Dusky pygmy rattle-snake	9	Uplands, Forest	741,438,427,421,413, 412,410,320,210
BIRDS			
Gavia immer Common loon	25	w	641,520,510
Podilymbus podiceps Pie-billed grebe	9	Marsh	641,550,520,510
Pelicans occidentalis Brown pelican	24	Marine	520
Phalacrocorax auritus double-crested cormorant	11	Wetlands	520,550,510
Accipiter cooperii Cooper's hawk	15	Upland, Forest	641,621,438,427,421, 413,412,410,320
Accipiter striatus Sharp shinned hawk	12	w	741,641,438,421,413, 412,410,320,210
Buteo jamaicensis Red-tailed hawk	4	Pinelands, Sandhill	641,421,412,410, 210,320,

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Buteo lineatis Red-shouldered hawk	16	Hammock	641,621,615,611,438, 427,210
Buteo platypterus platypterus Broad-winged hawk	14	Forest	438,427,412
Buteo brachyurus Short-tailed hawk	36	Forest	621,412
Cathartes aura Turkey vulture	13	Varied	Varied
Circus cyaneus Northern harrier	15	w	641,412,410,320, 210
Coragyps atratus Black vulture	11	Varied	Varied
Elanoides forficatus Swallow-tailed kite	30	Forest	Varied
Falco columbarius Merlin	10	w	421,412,410,320
Falco peregrinus paulus Peregrine falcon	24	w	412,410
Falso sparverius paulus American kestrel	23	w	741,641,421,412,410, 320,210
Haliaeetus l. leucocephalus Southern bald eagle	26	Pinelands, Swamps	520,510,413,412,410
Ictinia mississippiensis Mississippi kite	22	Forest	438,427,421
Pandion haliaetus Osprey	17	Cypress, Upland	Varied

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Bubo virginianus Great horned owl	8	Swamps	741,621,615,611,427, 410,320,210
Otus asio Screech owl	19	Forest	621,615,427,412,410
Athene cumicularia floridana Florida burrowing owl	24	Sandhill, Pasture	741,421,413,412, 410,320,210
Strix varia Barred owl	14	Forest, Swamp	621,615,611,427,410
Tyto alba Barn owl	18	Forest, Dwellings	621,615,611,427, 421,413,410
Aramus quarauna pictis Limpkin	22	Swamps	641,550
Anhinga anhinga Anhinga	17	Willow & bay heads	Wetlands
Ardea herodias Great blue heron	15	Swamps	Wetlands
Botaurus lentiginosus American bittern	18	w	Wetlands
Bubulcus ibis Cattle egret	8	Swamps	741,641,621,611,427, 421,412,410,320,210
Butorides striatus Green-backed heron	13	Willow head	Wetlands
Casmerodius albus Great egret	19	Swamps	Wetlands
Egretta thula Snowy egret	17	Swamps	Wetlands
Egretta tricolor Tricolored heron	17	Swamps	Wetlands

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Ixobrychus exilis Least bittern	15	w	Wetlands
Eudocimus albus White ibis	13	Swamps	Wetlands
Mycteria americana Wood stork	23	Swamps	Wetlands
Nycticorax nycticorax hoactli Black-crowned night-heron	13	Swamps	Wetlands
Nyctanassa violacea Yellow-crowned night-heron	21	Swamps	Wetlands
Plegadis falcinellus Glossy ibis	15	Marshes	Wetlands
Pelecanus erythrohynchos White pelican	20	w	520,510
Egretta caerulea Little blue heron	23	Swamps	Wetlands
Aix sponsa Wood duck	18	Swamps	621,615,611
Anas acuta Pintail	18	w	641,520,510
Anas clypeata Northern shoveler	12	Marshes	641,550,520
Anas creca Green-winged teal	15	w	641,520,510
Anas discors Blue-winged teal	23	w	641,520,510

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Anas fulvigula Mottled duck	19	Swamps, marshes	641,520,510
Anas platyrhynchos Mallard	16	w	641,520,510
Anas rubripes Black duck	23	w	641,520,510
Anas strepera Gadwall	7	w	641,520,510
Anas americana American wigeon	23	w	641,520,510
Aythya collaris Ring-necked duck	15	w	520,510
Aythya marila Greater scaup	16	w	520,510
Aythya affinis Lesser scaup	15	w	520,510
Aythya american Redhead	13	w	520,510
Aythya valisineria Canvasback	23	w	641,520,510
Hystrionicus hystrionicus Harlequin duck	NS	w	520,510
Branta canadensis Canada goose	13	w	641,520,510,210
Bucephala clangula Common goldeneye	12	w	520,510
Bucephala albeola Buffle head	12	w	520,510

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Melanitta fusca White-winged scoter	NS	w	520,510
Mergas serrator Red-breasted merganser	16	w	520,510
Lophodytes cucullatus Hood merganser	17	w	520,510
Oxyura jamacicensis Ruddy duck	18	w	520,510
Larus atriella Laughing gull	8	Coastal	541,520,510
Larus delawarensis Ring-billed gull	6	Coastal	641,520,510
Larus argentatus Herring gull	21	Coastal	641,520,510
Larus philadelphia Bonaparte's gull	9	w	641,520,510
Himantopus mexicanus Black-necked stilt	18	w	Open wetlands
Charadrius semipalmatus Semipalmated plover	22	W	641,510
Charadrius vociferus Killdeer	3	Sandy Flats	741,421,412,410, 210
Pluvialis squatarola Black-bellied plover	24	w	641,510
Numenius phaeopus Whimbrel	34	w	641,510
Tringa melanoleuca Greater yellowlegs	14	w	641,510

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Tringa flavipes Lesser yellowlegs	15	w	641,510
Gallinago gallinago Common snipe	11	w	641,410,210
Actrtis macular Spotted sandpiper	9	w	641,510
Calidris alpina Dunlin	17	w	641,510
Calidris mauri Western sandpiper	24	w	641,510
Calidris minutilla Least sandpiper	15	w	641,510
Rallus limicola Virginia rail	18	w	641
Coturnicups noveborecensis Yellow rail	35	w	641
Fulica americana American coot	17	w	641,520,510
Porphyrula martinica Purple gallinule	19	Marsh	641,550,520,510
Gallinula chloropus Common moorhen	17	Marsh, Lakes	641,550,510
Laterallus jamaicensis Black rail	31	2	641
Porzana carolina Sora	18	w	641,210
Grus canadensis Sandhill crane	33	Marshes, Prairie	641,410,320,210

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Rallus elegans elegans King rail	22	Marsh	641,621,615
Sterna antillarum Least tern	24	Beach	641,550,520,510
Sterna forsteri Forster's tern	11	w	550,520,510
Sterna caspia Caspian tern	21	w	550,520,510
Sterna hirundo Common tern	18	w	550,520,510
Scolopax minor American woodcock	12	w	641,621,615,611,438, 427,410,320 210
Meleagris gallopavo Wild turkey	10	Forest	621,615,438,427,421, 412,410,320,210
Colinus virginianus Bobwhite	11	Uplands	438,427,421,412, 410,320,210
Archilochus colubris Ruby-throated hummingbird	13	Forest	438,427,421,413, 412,410
Chaetura pelagica Chimney swift	15	Cliffs, trees	Airborne
Ceryle alcyon Belted kingfisher	10	w	Open wetlands
Sphyrapicus varius Yellow-bellied sapsucker	18	w	621,615,611,438,427, 421,413,412,410,
Picoides borealis Red-cockaded woodpecker	30	Sandhill	621,412,410

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Picoides pubescens Downy woodpecker	9	Forest	621,615,438,427,421, 413,412,410
Picoides villosus Hairy woodpecker	17	w	621,615,438,427,421, 413,412,410
Drycopus pileatus Pileated woodpecker	18	Forest, Hammock	621,615,611,438,427, 421,413,412,410
Melanerpes erythocephalus Red-headed woodpecker	20	Sandhill, Flatwoods	621,427,421,413, 412,410,320
Melanerpes carolinus Red-bellied woodpecker	8	Forest	621,615,611,438,427, 421,413,412,410
Colaptes auratus Common flicker	23	Forest	621,615,438,427,421, 413,412,410
Aimophila aestivalis Bachman's sparrow	12	Flatwoods	421,412,410,320,210
Caprimulgus vociferus Whip-poor-will	9	w	Uplands
Caprimulgus carolinensis Chuck-will's widow	9	Upland	641,438,427,421,413, 412,410,320
Chordeiles minor Nighthawk	23	Sandhill, Flatwoods	421,412,410,741,210
Cardinalis cardinalis Cardinal	11	Upland, Forest	621,615,611,438,427, 421,413,412,410,320
Lanius ludovicianus Loggerhead shrike	18	Sandhill, Pasture	421,413,412,410,320, 210
Coccyzus americanus Yellow-billed cuckoo	7	Forest	621,615,438,427,413, 412,410,

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Columbina passerina Ground dove	17	Open ground	741,421,413,412, 410,320,210
Columbia livia Rock dove	NS	Buildings	741,320,210
Cyanocitta cristata Blue jay	7	Forest	621,615,611,427, 421,413,412,410
Contopus virens Eastern wood pewee	8	Migrant	Forests
Corvus brachyrhynchos American crow	9	Varied	Varied
Corvus ossifragus Fish crow	8	Varied	Varied
Agelaius phoeniceus Red-winged blackbird	9	Marsh	Varied
Aphelocoma c. coerulescens Florida scrub jay	30	Scrub	421,413,412
Bombycilla cedrorum Cedar waxwing	10	w	621,615,611,438,427, 421,413,412,410,320
Dendroica coronata Yellow-rumped warbler	8	w	621,615,611,438,427, 421,413,412,410,320, 210
Dendroica discolor Prairie warbler	8	w	621,413,412,410
Dendroica dominica Yellow-throated warbler	8	w	621,615,427,412,410
Dendroica caerulescens Black-throated blue warbler	8	w	621,615,438,427, 413,412,410

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Dendroica palmarum Palm warbler	8	w	621,615,611,427, 421,412,410
Dendroica pinus Pine warbler	8	Pine, Sandhill	421,413,412, 410
Dendroica virens Black-throated green warbler	8	w	Forest
Dumetella carolinensis Catbird	3	w	621,615,611,438,427, 421,413,412,410,320
Empidonax virescens Acadian flycatcher	8	Swamp, forests	621,615
Geothlypis trichas Common yellowthroat	8	Thicket	641,621,615,611,438, 427,421,413,412, 410,320
Hirundo rustica Barn swallow	8	w	741,210
Icteria virens Yelllow-breasted chat	16	w	615,438,427,421, 413,412,320
Guiraca caerulea Blue grosbeak	5	Open habitat	427,421,413,412,410, 320,210
Limnothlypis swainsonii Swainson's warbler	15	w	621,615,611,438, 427
Melospiza georgiana Swamp sparrow	5	w	641,621,615,611, 410,320,210
Melospiza melodia Song sparrow	15	w	641,615,611,438, 427,412,320,210
Mimus polyglottos *polyglottos* Northern mockingbird	11	Thicket	741,438,427,421, 413,412,410,320, 210

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Molothrus ater Brown-headed cowbird	8	Varied	621,615,611,438, 427,421,413,412, 410,320,210
Mniotilta varia Black-and-white warbler	8	w	621,615,611,438,427, 421,413,412,410
Myiarchus crinitus Great crested flycatcher	12	Sandhill, Dry forest	621,615,611,438, 427,421,413,412,410
Parula americana Northern parula	12	Forest	621,615,611,438,427, 421,412
Parus bicolor Tufted titmouse	12	Forest	621,615,611,438,427, 421,413,412,410
Parus carolinensis Carolina chickadee	6	Forest	621,615,611,438,427, 421,413,412,410
Passerina cyanea Indigo bunting	7	Sandhill, Flatwoods	413,412,410,320,210
Passer domesticus English sparrow	NS	Varied	741,320,210
Seirus novebaracensis Northern waterthrush	10	w	621,615,611
Passerculus sandwichensis Savannah sparrow	7	w	741,641,413,412,410, 320,210
Pipilo erythrophthalmus Rufous-sided towhee	5	Sandhill, Flatwoods, Scrub	621,438,427,421, 413,412,410,320
Piranga rubra Summer tanager	7	Upland Forest	438,427,412,410

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Poecetes gramineus Vesper sparrow	19	w	641,410,320,210
Polioptila caerulea Blue-gray gnatcatcher	5	Forest	621,615,611,438, 427,421,412,410
Progne subis Purple martin	14	Disturbed	641,427,412,410, 210
Protonotaria citrea Prothonatary warbler	8	Swamp	621,615,611
Euphagus carolinus Rusty blackbird	16	W	621,615,611,320
Quiscalus major Boat-tailed grackle	6	Varied	Varied
Quiscalus quiscula Common grackle	7	Varied	621,615,611,427, 421,412,410,320,210
Regulus calendula Ruby-crowned kinglet	5	w	621,615,611,438, 427,421,412,410
Tyrannus tyrannus Eastern king bird	16	Sandhill	438,427,412
Sayornis phoebe Eastern phoebe	12	w	641,621,615,611,438, 421,413,412,410,
Setophaga ruticilla American redstart	6	w	621,615,611,438,427, 413,412,410,320
Seiurus aurocapillus Ovenbird	8	w	621,615,611,438,427, 421,413,412
Sialia sialis Eastern bluebird	16	Sandhill, Flatwoods	621,427,421,413, 412,410,320,210
Sitta puslia Brown-headed nuthatch	9	Pinelands	413,412,410

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Ammodramus savannarum Grasshopper sparrow	13	w	421,413,412,410,320
Spizella passerina Chipping sparrow	5	w	641,413,412,410, 320,210
Spizella pusilla Field sparrow	5	w	421,413,412,410,320
Stelgidopteryx serripennis Rough-winged swallow	14	w	741,641,611,550,510, 421,412,410,320,210
Sturnella magna Meadowlark	7	Grassy areas	641,421,412,410,320, 210
Sturnus vulgaris Starling	NS	Urban	741,320,210
Carduelis tristis American goldfinch	18	w	621,421,413,412,410, 320,210
Tachycineta bicolor Tree swallow	12	w	641,412,410,320, 210
Cistothorus palustris Marsh wren	20	w	641
Toxostoma rufum Brown thrasher	5	Thicket	427,421,412,410, 320
Thryothorus ludovicianus Carolina wren	3	Forest	621,615,611,438,427, 413,412,410,320
Troglodytes aedon House wren	8	w	Brushy uplands
Cistothorus platensis Sedge wren	9	w	641

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Hylocichta mustelina Wood thrush	5	w	615,438,427
Turdus migratorius American robin	5	w	741,621,615,611,438, 427,421,413,412,410, 320,210
Catharus gullatus Hermit thrush	5	w	615,438,427
Vireo griseus White-eyed vireo	8	Forest	621,615,611,438,427, 421,412,410
Vireo olivaceus Red-eyed vireo	16	Forest	621,615,611,438,427, 412
Vireo flavifrons Yellow-throated vireo	16	w	621,615,438,427
Vireo solitarius Solitary vireo	8	w	438,427,412,410
Icterus spurius Orchard oriole	13	w	Edge
Icterus galbula Northern oriole	3	w	Edge
Zenaidura macroura Mourning dove	13	Open ground	741,621,427,421,412, 410,320,210
Wilsonia citrina Hooded warbler	8	w	621,615,611
Vermivora celata Orange-crowned warbler	8	w	438,427,421,413,412, 410,320

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
MAMMALS			
Didelphis virginiana Virginia opossum	1	Varied	Varied
Blarina carolinensis Southern short-tailed shrew	11	Uplands	621,615,611,438,427, 413,412,410,320
Cryptotis parva Least shrew	7	Uplands	438,427,421,413, 412,410
Scalopus aquaticus Eastern mole	7	Uplands	438,427,413,412,410, 320,210
Sorex longirostris Southeastern shrew	5	Swamp	621,615,611
Plecotus rafinesquei macrotis Eastern big-eared bat	21	Protected areas	621,550,427,413, 412
Eptesicus fuscus Big brown bat	14	Protected areas	621,615,611,550,438, 427,421,413,410
Lasiurus borealis Red bat	13	Protected areas	Forest
Lasiurus cinereus Hoary bat	15	Protected areas	Forest
Lasiurus intermedius Yellow bat	21	Protected areas	Forest
Lasiurus seminolus Seminole bat	16	Protected areas	Open areas
Myotis austroriparius Southeastern bat	23	Protected areas	Open areas
Nycticeius humeralis Evening bat	14	Protected areas	621,550,

UNLISTED SPECIES – Continued

		Breeding Areas	Cover
Pipistrellus subflavus Eastern pipistrelle	15	Protected areas	621,550,410
Tadarida cynocephala Florida freetail bat	19	Protected areas	621,550
Dasypus novemcinctus Nine-banded armadillo	9	Varied	Varied
Sylvilagus floridanus Eastern cottontail	11	Uplands	741,421,413,412, 320,210
Sylvilagus palustris Marsh rabbit	14	Wetlands, Pinelands	641,611,410,210
Geomys pinetis Southeastern pocket gopher	18	Sandhill	421,413,412,410, 320,210
Glaucomys volans Southern flying squirrel	10	Forest	438,427,421, 413,412,410
Myocastor coypus Nutria	NS	Marsh	641
Neofiber alleni Round-tailed muskrat	22	Marsh	641
Neotoma floridana Eastern woodrat	7	Swamp	621,615,611,438, 427
Peromyscus floridanus Florida mouse	22	Sandhill, Scrub	421,413,412,320,210
Ochrotomys nuttalli Golden mouse	9	Wetland	621,615,611,438, 427,410
Oryzomys palustris Marsh rice rat	11	Marsh	641,621,615,611, 410,320

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Peromyscus gossypinus Cotton mouse	12	Varied	641,621,615,611,438, 427,412,410,413, 320,210
Peromyscys polionotus Old-field mouse	6	Fields	Fields
Microtus pinetorum Pine vole	7	Pineland	410
Reithrodontomys humulis Eastern harvest mouse	6	Sandhill	412
Sciurus carolinensis Gray squirrel	16	Forest	621,615,611,427,421, 413,412,410
Sigmodon hispidus Hispid cotton rat	3	Varied	641,621,615,611,413, 412,421,410,320,210
Rattus rattus Black rat	NS	Disturbed	Disturbed
Rattus novegieus Norway rat	NS	Disturbed	Disturbed
Mus musculus House mouse	NS	Disturbed	Disturbed
Mustela frenata Long-tailed weasel	18	Swamp	Varied
Felis rufus Bobcat	14	Varied	641,621,615,611,438, 427,421,413,412,410 320,210
Lutra canadensis River otter	26	Wetland	641,621,615,611, 550,520,510,410
Mephitis mephitis Striped skunk	5	Varied	Varied
Spilogale putorius Eastern spotted skunk	15	Uplands	421,413,412,410, 320

UNLISTED SPECIES - Continued

		Breeding Areas	Cover
Procyon lotor Raccoon	5	Varied	Varied
Urocyon cinereoargenteus Gray fox	5	Uplands	641,438,427,413,412, 421,410,320,210
Vulpes vulpes Red fox	11	Uplands	641,438,427,421,413, 412,320,210
Odocoileus virginianus White-tailed deer	8	Varied	741,641,621,615, 427,421,421,412, 413,320,210
Sus scrofa Wild pig	NS	Varied	641,621,615,438,412, 410,320,210
Trichechus manatus Manatee	32	Coastal Marine	641,520,510
Ursus americanus Florida black bear	33	Varied	621,615, Varied
Canis latrans Coyote	3	Open areas	413, Open habitats

FISH

Acantharchus pomotis Mud sunfish	12
Acipenser brevirostrom Shortnose sturgeon	NS
Acipenser oxyrhynchus Atlantic sturgeon	NS
Agonostomus monticola Mountain mullet	NS
Alosa sapidissima American shad	9
Amiacalva Bowfin	3
Anchoa mitchilli Bay anchovy	NS
Anguilla rostrata American eel	20
Aphredoderus sayanus Pirate perch	6
Anchoa hepsetus Striped anchovy	NS
Archosargus probatocephalus Sheepshead	NS
Awaous taiasica River goby	NS
Bairdiella chrysura Silver perch	NS
Bagre marinus Gafftopsail catfish	NS

Brevoortia smithi Yellowfin menhadden	NS
Bogionellus shufeldti Freshwater goby	NS
Caranx hippos Crevalle jack	NS
Centrarchus macropterus Flier	13
Centropomus undecimalis Common snook	NS
Citharicthys spilopterus Bay whiff	NS
Cynoscion nebulosus Spotted sea trout	NS
Cyprinodon variegatus Sheepshead pupfish	6
Dasyatis americana Southern sting ray	NS
Dasyatis sabina Atlantic sting ray	NS
Diapterus olisthostomus Irish pompano	NS
Dormitator maculatus Fat sleeper	6
Dorosoma cepedianum Gizzard shad	2
Dorosoma petenense Threadfin shad	0
Elassoma evergladei Everglades pygmy sunfish	10

Ellassoma okefenokee Okefenokee pygmy sunfish	13
Alassoma zonatum Banded pygmy sunfish	10
Elops saurus Ladyfish	NS
Enneacanthus gloriosus Blue spotted sunfish	4
Enneacanthus obesus Banded sunfish	8
Enneacanthus chaetodon Black-banded sunfish	12
Erimyzon sucetta Lake chubsucker	4
Esox americanus Redfin pickerel	6
Esox niger Chain pickerel	6
Etheostoma edwini Brown darter	15
Etheostoma fusiforme Swamp darter	9
Etheostoma olmstedi Tessellated darter	10
Eucinostomus argenteus Spotfin moiarra	NS
Fundulus chrysotus Golden topminnow	6
Fundulus cingulatus Banded topminnow	15

Fundulus confluentus Marsh killifish	6
Fundulus seminolis Seminole killifish	13
Fundulus lineolatus Southern lined minnow	9
Galeicthys felis Sea catfish	NS
Gambusia affinis Mosquitofish	0
Gobiosoma bosci Naked goby	NS
Gobiosoma robustum Code goby	NS
Gobiodes brousonneti Violet goby	NS
Harengula pensacolae Scaled sardine	NS
Heterandria formosa Least killifish	6
Hybopsis harperie Red-eyed chub	NS
Ictalurus catus White catfish	2
Ictalurus natalis Yellow bullhead	3
Ictalurus nebulosus Brown bullhead	3
Ictalurus punctatus Channel catfish	1

Jordanella floridae Flagfish	7
Labidesthes sicculus Brook silverside	13
Leiostomus xanthurus Spot	NS
Lepisosteus osseus Long-nosed gar	5
Lepisosteus platyrhincus Florida gar	NS
Lepomis auritus Red-breasted sunfish	2
Lepomis gulosus Warmouth	2
Lepomis macrochirus Southern bluegill	0
Lepomis marginatus Dollar sunfish	5
Lepomis microlophus Red-eared sunfish	4
Lepomis punctatus Spotted sunfish	3
Leptolucania ommata Pygmy killifish	10
Logodon rhomboides Pinfish	6
Lucania goodei Bluefin killifish	6
Lucania parva Rainwater killifish	4

Lutjanus griseus Gray snapper	NS
Megalops atlantica Tarpon	NS
Membras martinica Rough silverside	NS
Menidia beryllina Tidewater silverside	4
Microgobius gulosus Clown goby	NS
Micropogon undulatus Atlantic croaker	NS
Micropterus salmoides Largemouth bass	7
Morone saxatilis Striped bass	22
Mugil cephalus Striped mullet	3
Mugil curema White mullet	NS
Notemigonus crysoleucas Golden shiner	2
Notropis chalybaeus Iron-colored shiner	9
Notropis maculatus Tail-light shiner	5
Notropis hypselopterus Sailfin shiner	8
Notropis welaka Blue-nosed shiner	22

Notropis petersoni Coastal shiner	5
Noturus gryinus Tadpole madtom	4
Noturus ledtacanthus Speckled madtom	13
Opisthonema oglinum Atlantic thread herring	NS
Paralichthys lethostigma Southern flounder	NS
Pecina nigrofasciata Black-banded darter	8
Petromyzon marinus Sea lamprey	NS
Poecilia latipinna Sailfin molly	3
Pomoxis nigromaculatus Black crappie	0
Sciaenops ocellata Redfish	NS
Strongylura marina Atlantic needlefish	3
Syngnathus scovelli Gulf pipefish	NS
Tilapia aurea Blue tilapia	NS
Trinectes maculatus Hogchoker	4
Umbra pygmea Eastern mudminnow	5

w = winter resident & migrant

*Biological Vulnerability (higher score = higher vulnerability,
Millsap et al., 1990

+Not Scored by Millsap et al., 1990

Source: Alvarez, Lehman & Associates, Inc., 1991