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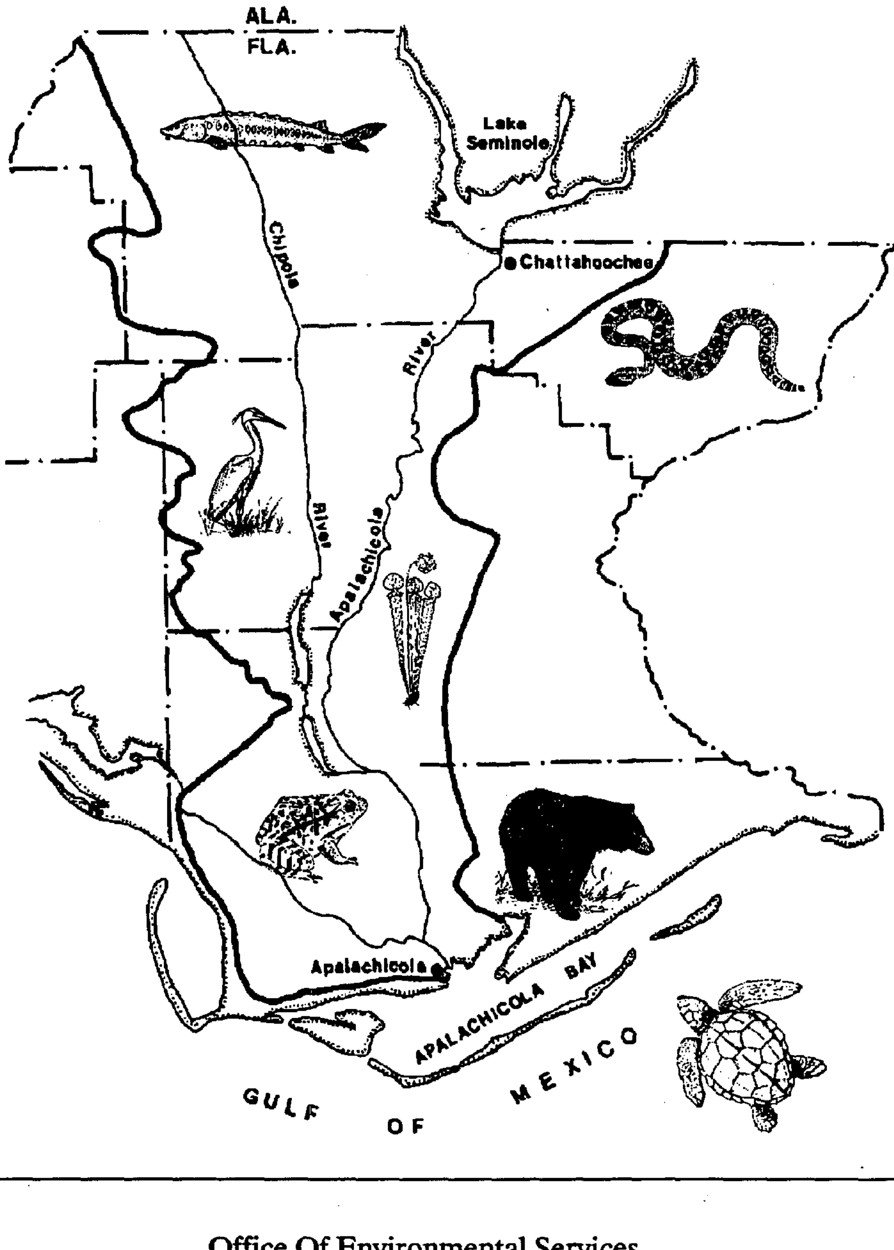
RESOURCE INVENTORY OF THE APALACHICOLA RIVER AND BAY DRAINAGE BASIN



Office Of Environmental Services
FLORIDA GAME AND FRESH WATER FISH COMMISSION

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RESOURCE INVENTORY OF THE APALACHICOLA RIVER AND BAY DRAINAGE BASIN

by

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Florida Game and Fresh Water Fish Commission

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I. INTRODUCTION

The Apalachicola River and Bay drainage basin encompasses what can be considered one of the least polluted, most undeveloped, resource rich systems left in the United States. Through geological, chemical, physical and biological interactions, this system has evolved a river with the largest flow in Florida, the most extensive forested floodplain in Florida, and the most productive bay in Florida. There are increasing pressures on the system from development, navigational interests, population increases, and timber and agricultural interests. All these interests can coexist with the natural resources in the system, which currently dominate economics in the region, if adequate plans for protection of these resources are developed.

Because of its uniqueness, numerous designations have occurred to note the importance of and help protect the Apalachicola system. Not only have state and federal agencies been involved, but local participation has also been a key ingredient. In 1979, the lower river and Apalachicola Bay system was designated a National Estuarine Research Reserve by the National Oceanic and Atmospheric Administration (NOAA). One of 17 reserves in the country, the designation confers protection and management benefits to help ensure the long-term endurance of the system. The State of Florida designated the lower Apalachicola River an Outstanding Florida Water in 1979 and included the upper river in 1983. Thus the ambient water quality of the river, at the time of designation, is used as the standard which cannot be degraded; instead of allowing degradation to prescribed statewide values. In 1984 the United Nations Education, Scientific, and Cultural Organization (UNESCO) accepted the Reserve into the International Man and the Biosphere (MAB) program. In 1985 the State of Florida declared Franklin County an Area of Critical State Concern due to the developmental pressures being exerted in order to help protect the bay system. All these designations, from state, national, and international agencies, recognize the Apalachicola River and Bay system as a unique and environmentally sensitive resource which deserves protection.

The Apalachicola drainage basin includes upland, floodplain, riverine, estuarine, and island environments which are closely correlated and influenced by each other. In order to understand how the bay functions, the other components of the system must also be understood. This document has been prepared to identify the biological habitats which make up this important system. It does not include a detailed discussion of the hydrologic links within the system or chemical and physical processes which are important to the productivity of the system. These issues have been dealt with previously by other authors mentioned in this document. This report, instead, deals with habitats and the plants and animals that define and differentiate them. The location, basin-wide distribution, and importance of these habitats has also been included in most instances.

It is important that this report be recognized for what it is. This document is part of an ongoing effort which involves private citizens, fishermen, researchers, and local, state, and federal agencies in an effort to understand, protect, and manage an important and unique natural resource. Hopefully, this report adds another important piece of information concerning this system and should be recognized not as an end product in itself. The information provided has been designed to be useful in helping to implement long-term management goals for the system. In order to plan and implement these type of goals; however, all components of the system must be known and understood which is the reason for this document.

II. CHARACTERISTICS OF THE SYSTEM

The Apalachicola drainage basin is located within one of the most sparsely populated regions of Florida. Even so, there has been a tremendous amount of interest in the system. This has resulted in a large body of research being done within the last 15 years on the system. However, many gaps exist either from lack of study or lack of a cohesive union of this information.

Physiography of the Apalachicola-Chattahoochee-Flint River System

The Apalachicola River basin is only a small part of the much larger Apalachicola-Chattahoochee-Flint River system (ACF). The ACF basin covers the north-central and southwestern part of Georgia, the southeastern part of Alabama, and the central part of the Florida panhandle. It drains an area covering approximately 19,600 square miles (Figure 1). The Chattahoochee flows 436 miles from its source in the Blue Ridge Mountains of northern Georgia, drains a land area of 8,650 square miles, and has 13 dams located on the river. The Flint flows 350 miles from its source south of Atlanta, drains a land area of 8,494 square miles, and has 2 dams affecting streamflow. The Apalachicola is formed by the confluence of the Chattahoochee and Flint rivers, flows 107 miles to Apalachicola Bay, and drains a land area of approximately 2,400 square miles (COE, 1978). Prior to the construction of Jim Woodruff Dam, the Apalachicola River formed above the dam's present location. The river now begins below the dam which forms Lake Seminole and which is shared by all three state borders.

There are three principal physiographic provinces traversed by the Apalachicola River and Bay drainage basin. These are the Tallahassee Hills, the Marianna Lowlands, and the Gulf Coastal Lowlands (Figure 2). The Tallahassee Hills occur on the eastern side of the river from the Georgia border southward to the Gulf Coastal Lowlands. These two provinces are separated from each other by the prominent Cody Scarp. The Tallahassee Hills

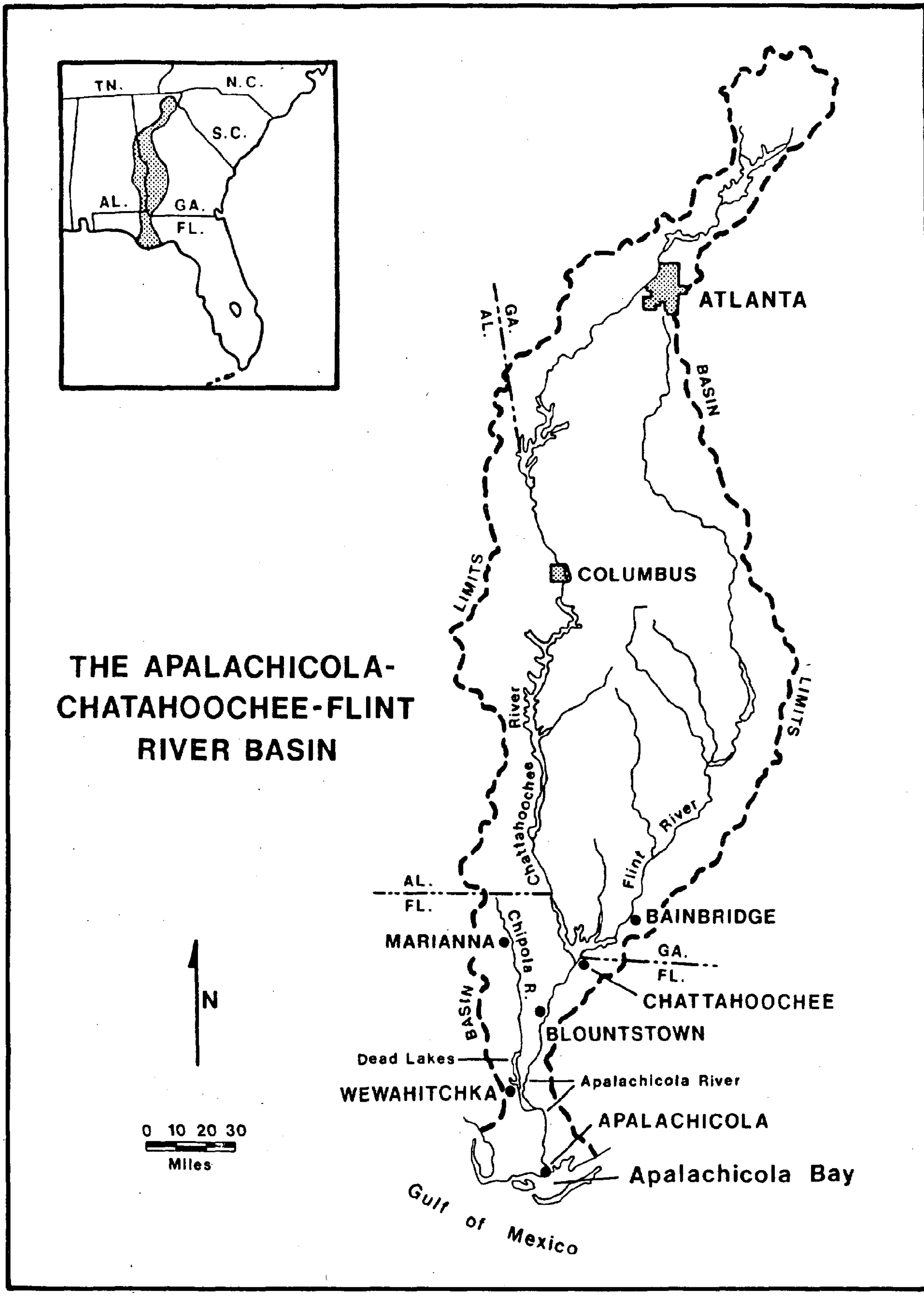


FIGURE 1. GENERAL LOCATION OF APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN.

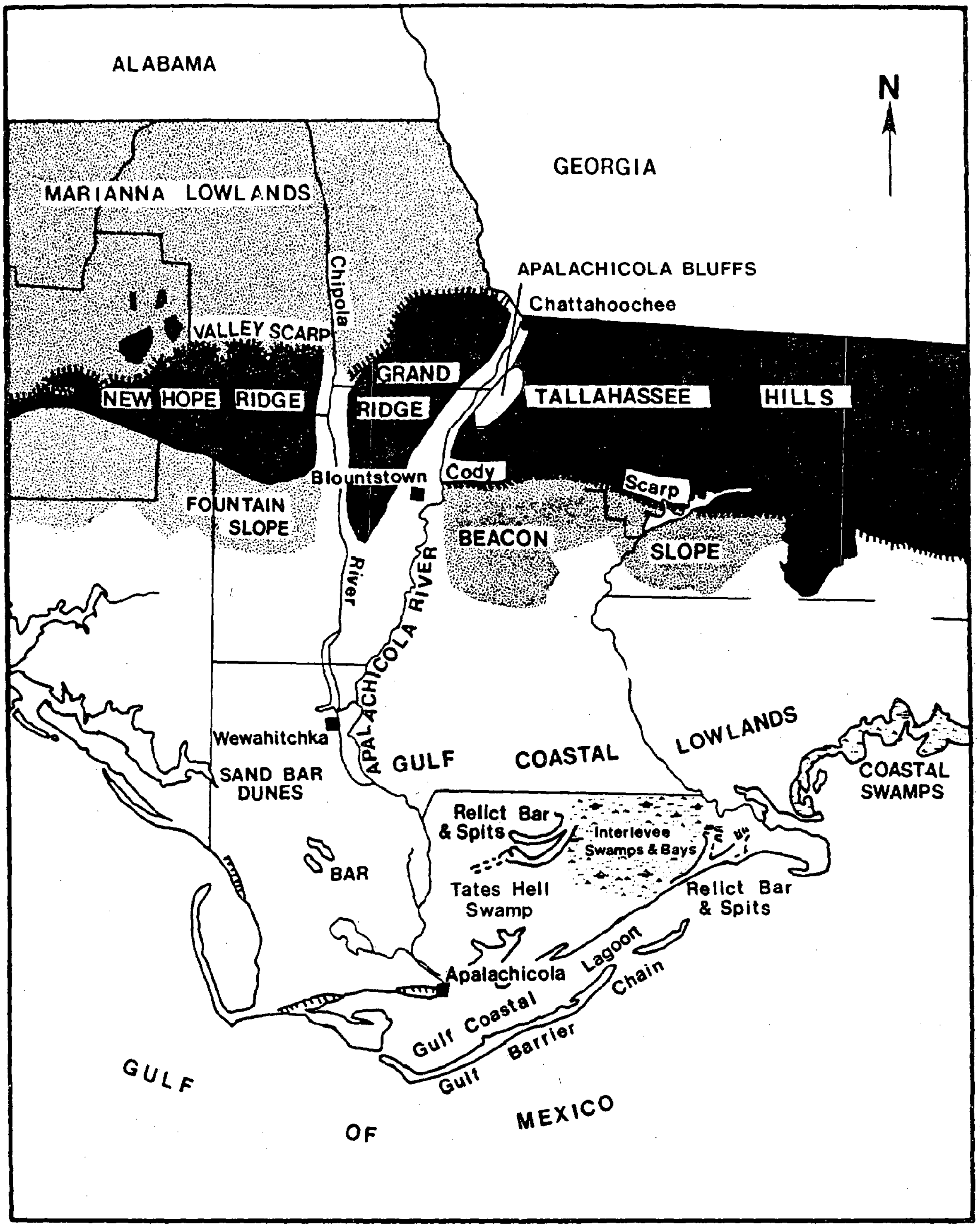


FIGURE 2. PHYSIOGRAPHY OF THE APALACHICOLA (modified from Leitman et al., 1983.)

are characterized by long, gentle slopes with round summits. The western boundary is characterized by steep bluffs overlooking the river with elevations as high as 325 feet (COE, 1978; Clewell, 1986; Leitman et al, 1983).

The Marianna Lowlands extend from the western bank of the river westward and are generally north of the Tallahassee Hills region. They were once highlands but have been eroded substantially by streams and are now a highly fertile area supporting considerable agriculture. The Chipola River primarily drains this region. The Gulf Coastal Lowlands are generally flat and sandy representing uplifted sea bottom, and are below 100 feet in elevation. The topography and underlying soils which control internal drainage in this region tend to create either excessively dry or excessively wet swampy conditions. Numerous relict bars and dunes are also associated with this province indicating great historic fluctuations in sea level (COE, 1978; Clewell, 1986).

Surface Water Classification Within the Apalachicola Basin

All surface waters of the State have been classified by the Florida Department of Environmental Regulation (DER) according to their designated use. Five classes have been designated with water quality criteria designed to maintain the minimum conditions necessary to assure the suitability of water for its designated use (DER, 1985). In the Apalachicola drainage basin three of the five classes of water are present and include:

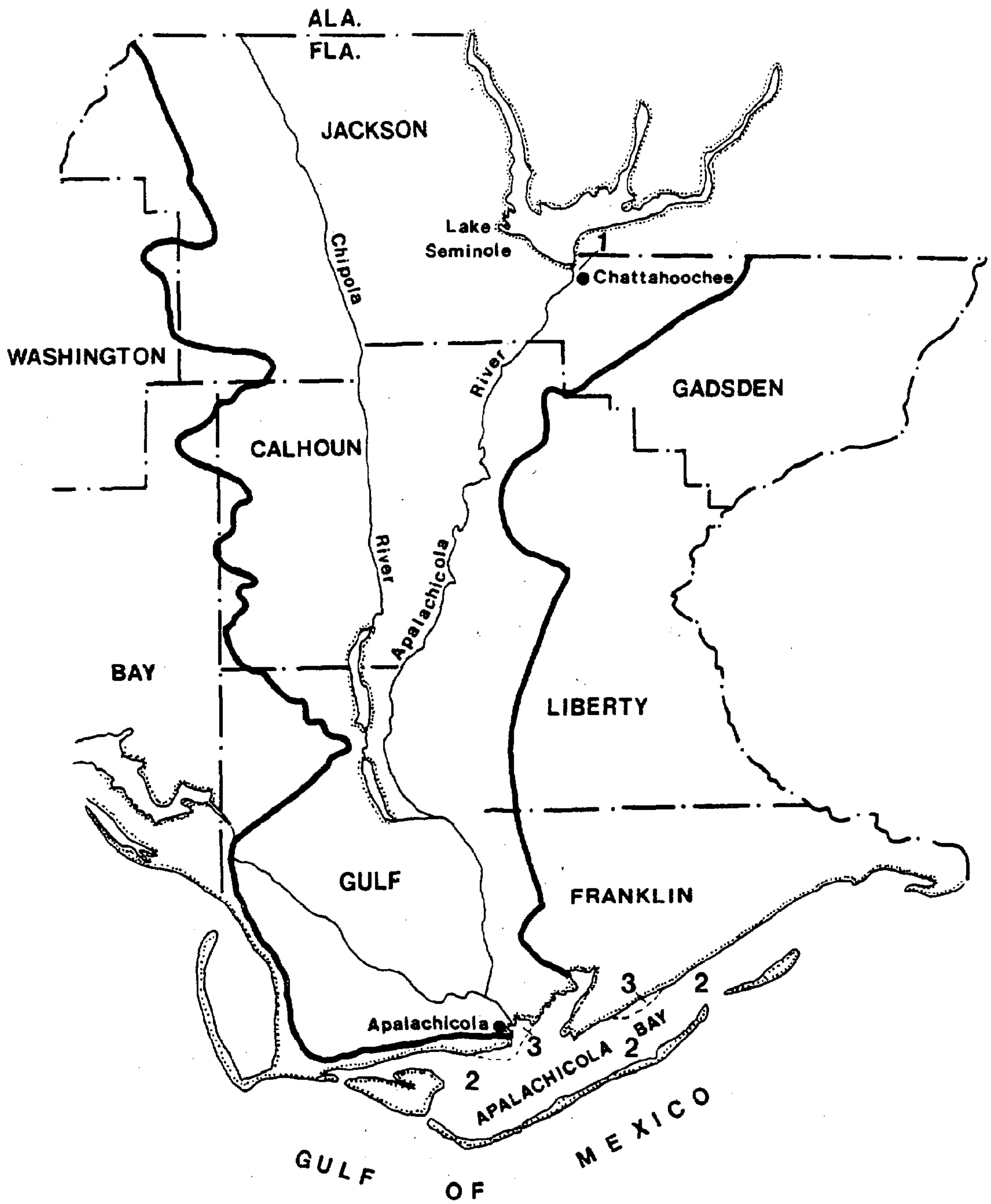
- Class I - Potable Water Supplies
- Class II - Shellfish Propagation or Harvesting
- Class III - Recreation, Propagation and Maintenance of a Healthy, Well-balanced Population of Fish and Wildlife.

Each of these classes have specific water quality standards for parameters such as bacterial levels, metals, pesticides and herbicides, dissolved oxygen, etc., designed to protect and maintain the use of the water body. The degree of protection is variable with Class I waters having the most stringent standards and Class V waters the least. All surface waters of the State are classified as Class III waters except those specifically described in Chapter 17-3.161, F.A.C.

There is only one Class I water located within the entire Apalachicola River and Bay drainage basin. Mosquito Creek in northwestern Gadsden County is used by the City of Chattahoochee as a drinking water source and therefore is classified as a Class I water from U.S. Highway 90 north to the State line (Figure 3). As mentioned earlier, Class I waters, those used as potable water supplies, are afforded the most protection of any waters in the State due to their designated use.

Class II waters, those used for shellfish propagation or harvesting, include the majority of the brackish water areas in the estuary (Figure 3). The entire bay system from Alligator Harbor thru St. George Sound, Apalachicola Bay, East Bay and tributaries, St. Vincent Sound, and Indian Lagoon are Class II waters with the exception of a two-mile radius near Apalachicola and the area north of the Eastpoint Breakwater. This area has been closed to shellfishing for years due to pollution from the City of Apalachicola and runoff from Eastpoint. Class II water standards are more stringent concerning bacteriological quality than any class due to the fact that shellfish, oysters and clams that are consumed uncooked by man can concentrate pathogens in quantities significantly higher than the surrounding waters. The Florida Department of Natural Resources (DNR) maintains a lab in Apalachicola and conducts surveys to determine water quality in shellfish waters. All Class II waters are additionally classified by DNR as approved, conditionally approved, or prohibited based upon these surveys. As conditions change areas are closed or opened based on bacterial surveys and major rainfall events which increase bacterial levels due to runoff.

All other waters in the Apalachicola River and Bay drainage basin are Class III waters. This includes the Apalachicola and Chipola Rivers, Dead Lake, Lake Wimico, Lake Seminole, and all other creeks, ponds, or surface



ALL WATERS CLASS III

EXCEPT WHERE NOTED

1-CLASS I MOSQUITO CREEK

2-CLASS II APALACHICOLA BAY SYSTEM

3-CLASS III

FIGURE 3. SURFACE WATER CLASSIFICATION IN APALACHICOLA BASIN.

waters. Class III water standards are less stringent than the other two classes but are intended to protect recreation and the propagation and maintenance of a healthy well-balanced population of fish and wildlife (DER, 1985).

Another important designation used by DER is that of "Outstanding Florida Water (OFW)." There are 15 designated OFWs located within the Apalachicola River and Bay system (Table 1, Figure 4). These waters are afforded special protection by the State due to their high quality, recreational or ecological significance, or their location within state- or federally owned lands. This designation is intended to preserve the ambient water quality at the time of designation and not allow any degradation. Stringent standards are applied regarding proposed alterations or potentially damaging activities planned for these waters.

Table 1. Outstanding Florida Waters located within the Apalachicola River and Bay drainage basin.

Map location	Waters within	County
1.	St. Vincent Island Wildlife Refuge	Gulf
2.	Cape St. George State Preserve	Franklin
3.	Dr. Julian G. Bruce, St. George Is. St. Pk.	Franklin
4.	Apalachicola Bay	Franklin
5.	Alligator Harbor	Franklin
6.	St. Vincent Sound	Franklin
7.	East Bay	Franklin
8.	Western St. George Sound	Franklin
9.	Lower Apalachicola River Basin (EEL)	Franklin/Gulf
10.	Dead Lakes State Recreation Area	Gulf
11.	Apalachicola River (with 2-1/2 mile exceptions)	Jackson/Gadsden Calhoun/Liberty
12.	Chipola River	Gulf/Calhoun/Jackson
13.	Florida Caverns State Park	Jackson
14.	Three Rivers State Recreation Area	Jackson
15.	Torreya State Park	Liberty

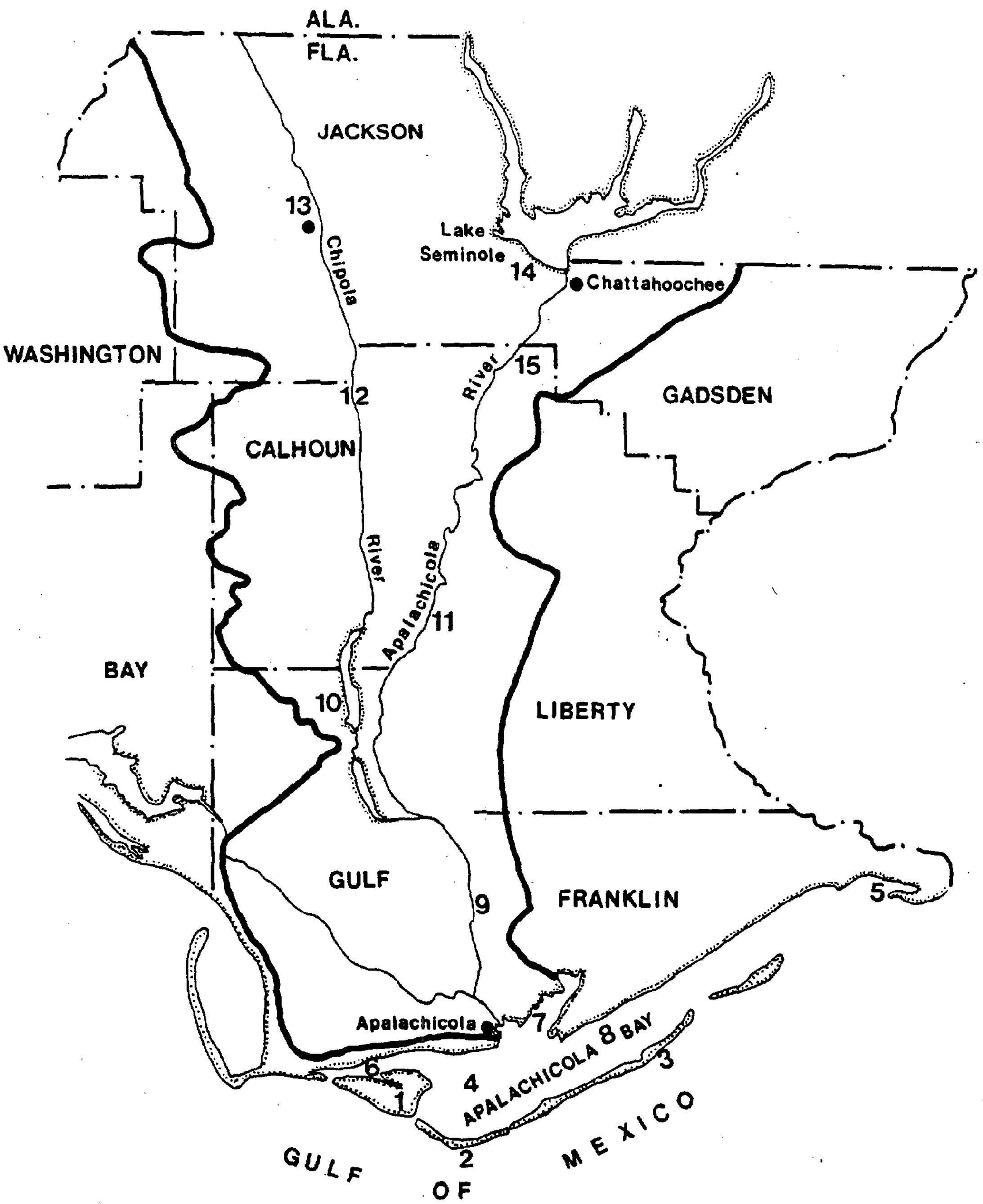


FIGURE 4. OUTSTANDING FLORIDA WATERS IN THE APALACHICOLA BASIN [see table 1].

III. HABITATS WITHIN THE APALACHICOLA BASIN

This section describes the Apalachicola River and Bay system physically and biologically by dividing it into its various components. These parts include barrier islands, bays, rivers, floodplains, uplands, and the various habitats which make them both similar and different, and simple and complex.

Barrier Island System

A well developed barrier island system exists at the mouth of the Apalachicola River. This barrier island complex lies roughly parallel to the mainland and is composed of four islands: Dog, St. George, Cape St. George, and St. Vincent islands (Figure 5). In their natural state barrier islands play a crucial role in the formation of estuaries, lagoons, bays, and sounds. Barrier islands also provide protection to the coastal mainland which they border by providing a "first line of defense" to destructive hurricanes.

Three hurricanes impacted the islands of the Apalachicola Bay system in 1985. The foredunes have been almost completely destroyed and it will take several years for them to rebuild. In some cases up to 100 feet of beach have been lost. Many trees along the Gulf side are down and the intrusion of saltwater into freshwater ponds has occurred on St. Vincent Island. Scientists are presently studying the effects hurricanes are having on various aspects of these barrier islands.

The terrestrial (vertebrate) fauna (excluding birds) is often relatively depauperate on some barrier islands. The species are associated in site-specific assemblages in the terrestrial, freshwater, and saltmarsh habitats present. Most terrestrial vertebrates are effective colonizers and are tolerant of a variety of habitat types, but they are dependent on enough native terrestrial vegetation to maintain a given population. The importance of barrier islands to various bird species should not be underestimated.

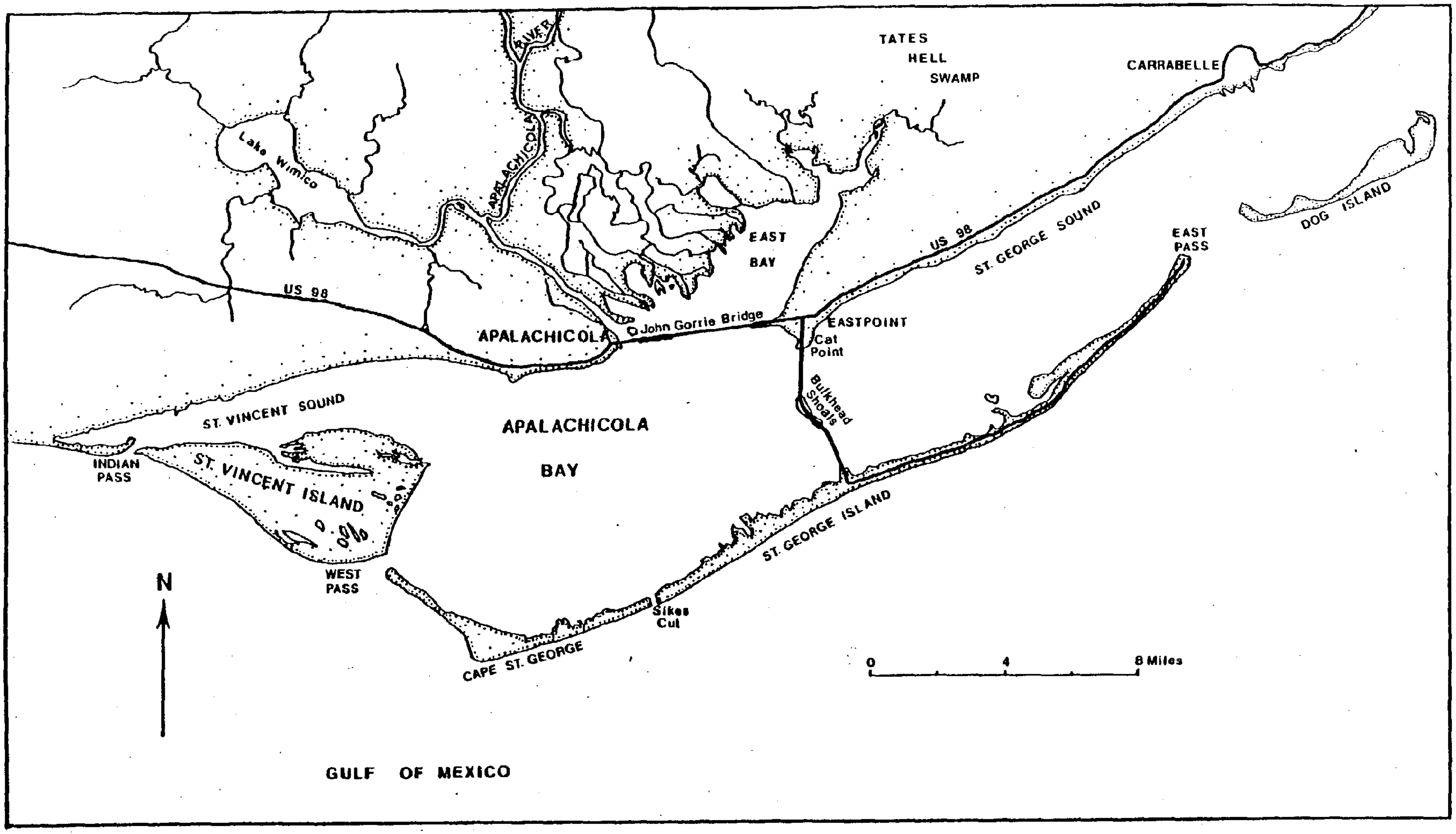


FIGURE 5. MAJOR FEATURES OF THE APALACHICOLA ESTUARY.

Sedentary types such as woodpeckers, chickadees, and titmice are not usually found but various trans-Gulf migratory species on spring flights use the islands during unfavorable weather conditions. Birds are also associated with different habitats, with some species being restricted to one particular habitat (Livingston and Thompson, 1975).

The various plant communities of barrier islands are dependent on geological formations and soil moisture gradients. Each barrier island has a unique plant community profile and structure. Profiles of the four barrier islands are illustrated in the island descriptions.

Physiography

Dog Island, approximately 1,842 acres in size, is located about 4.3 miles offshore from Carrabelle in the Gulf of Mexico. The island is approximately 6.8 miles long with a maximum width of 1 mile in the area just west of Tyson Harbor. Narrow parts of the island range from 328 to 459 feet in width. To the east, a broad inlet approximately 10.3 miles wide separates Alligator Spit from Dog Island to the west. East Pass, 2.2 miles wide, separates St. George Island from Dog Island (Spicola, 1983).

The Island is approximately 4000 years old (Spicola, 1983) and has one of the few well-developed beach ridge plains of late Holocene age in the state. Fluctuations in sea level (range of 10 feet) in the last 5000 to 6000 years combined with coastal shoreline processes have created "beach ridge plains" on the washover barrier. These ridges were built by intermittent deposition, receiving sand from longshore drift and from offshore material moving directly to the beach (Stapor, 1973). There are five sets of beach ridges (Figure 6). Four of these, located on the northeastern end of the island, are alternating recurved then parallel ridges which indicate changes in the offshore wave conditions. The fifth set can be found on the southwestern tip of the island, and as the most recent ridge on the northeastern tip, is recurved and now being formed through littoral drift (Spicola, 1983). Among these ridges are intervening swales, depression marshes, or seasonal wetlands. These intervening wetlands are perennially or seasonally inundated, depending on rainfall.

Dog Island contains 690 acres of fresh water wetlands and 352 acres of intertidal wetlands. Three community types (marine, terrestrial and palustrine) and their natural communities, as defined by the Florida Natural Areas Inventory, are mapped for Dog Island (Figure 7). Transects of plant community development found in the wider parts of the island are similar to that of a "typical barrier island" as defined by Livingston (1983).

Dog Island has been divided into four major areas: East End, Mid-Island, Cannonball Acres and West End (Figure 6). Elevations tend to vary somewhat among and within the four distinct physiographic units of the island. The East End has low, broad dune ridges and over the past few years has been accreting. The Mid-Island Unit varies in elevation. The beach dune ridge runs the length of the central gulf beach and is generally 10-20 ft. high. Interior scrub dunes behind this ridge are 3-10 feet above mean sea level (MSL). "The Interior" is the local name for the flatwoods west of Tyson Harbor. Moccasin Creek is a man-made canal which drains portions of "The Interior." "The Mountains" refer to those dunes supporting sand pine scrub and represent the highest in elevations (13-49 ft. above MSL). Cannonball Acres is generally low in elevation (3-10 ft. above MSL) with no clearly developed coastal dunes. Wetlands are present in this area and plant communities are poorly delimited. The freshwater areas have a shallow profile with a more brackish underlayment (as much as 20 ppt). Some of the largest coastal dunes on the island are found on the West End (16-33 ft. MSL). These are derived from recent deposition of sediments and are usually barren and unconsolidated by vegetation (Anderson and Alexander, 1985).

Dog Island experiences alternating periods of deposition and erosion. Erosion is directed from the beaches toward the island's interior. The central shoreline of Dog Island is presently eroding with the sediment being moved to either end of the island (Stapor, 1971). This accumulation at both ends has not produced an equal amount of new surface because of the greater water depths (Tanner, 1975). Winds have moved sediments inland along the

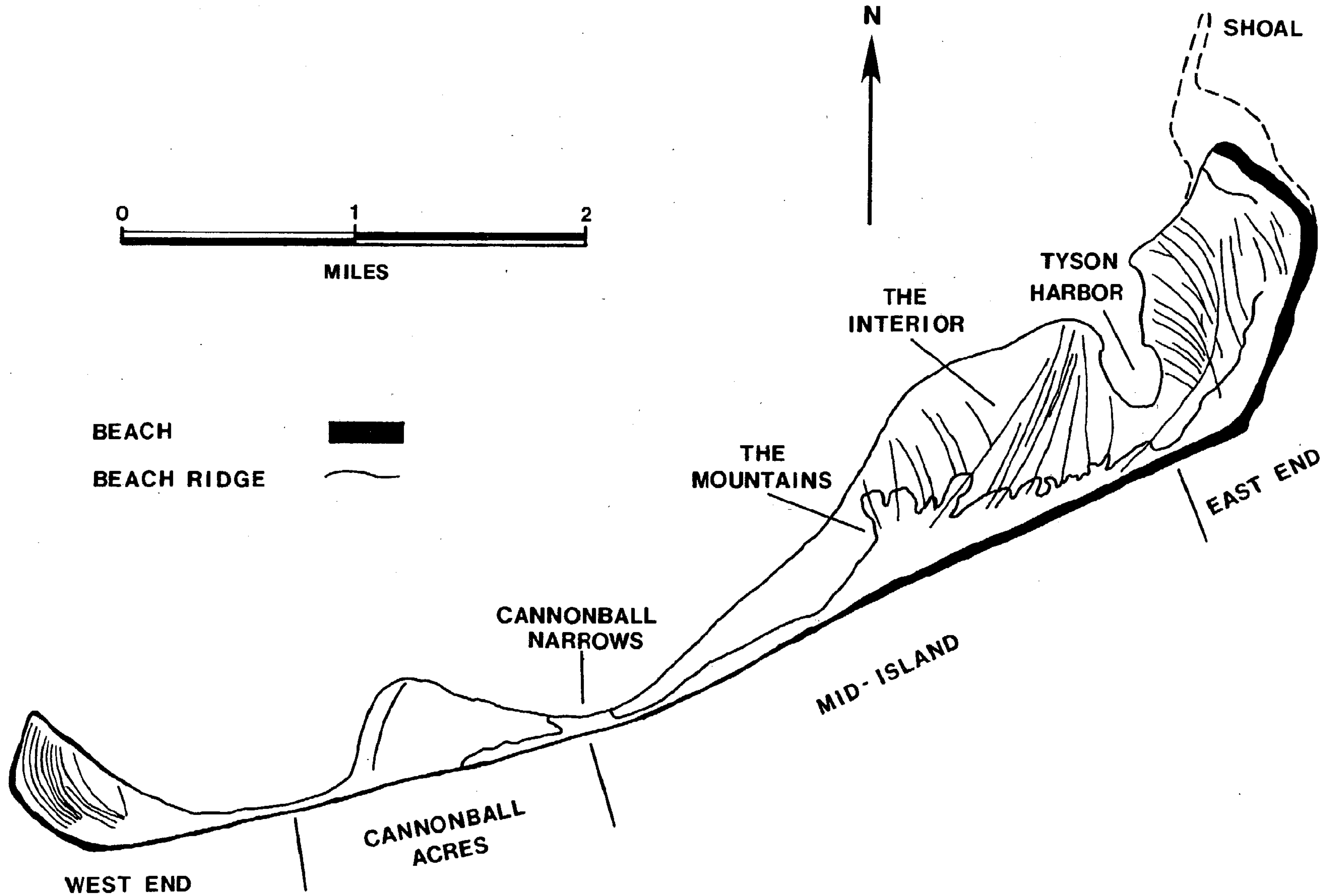


FIGURE 6.MAJOR FEATURE AND BEACH RIDGES OF DOG ISLAND(modified from Spicola,1983).

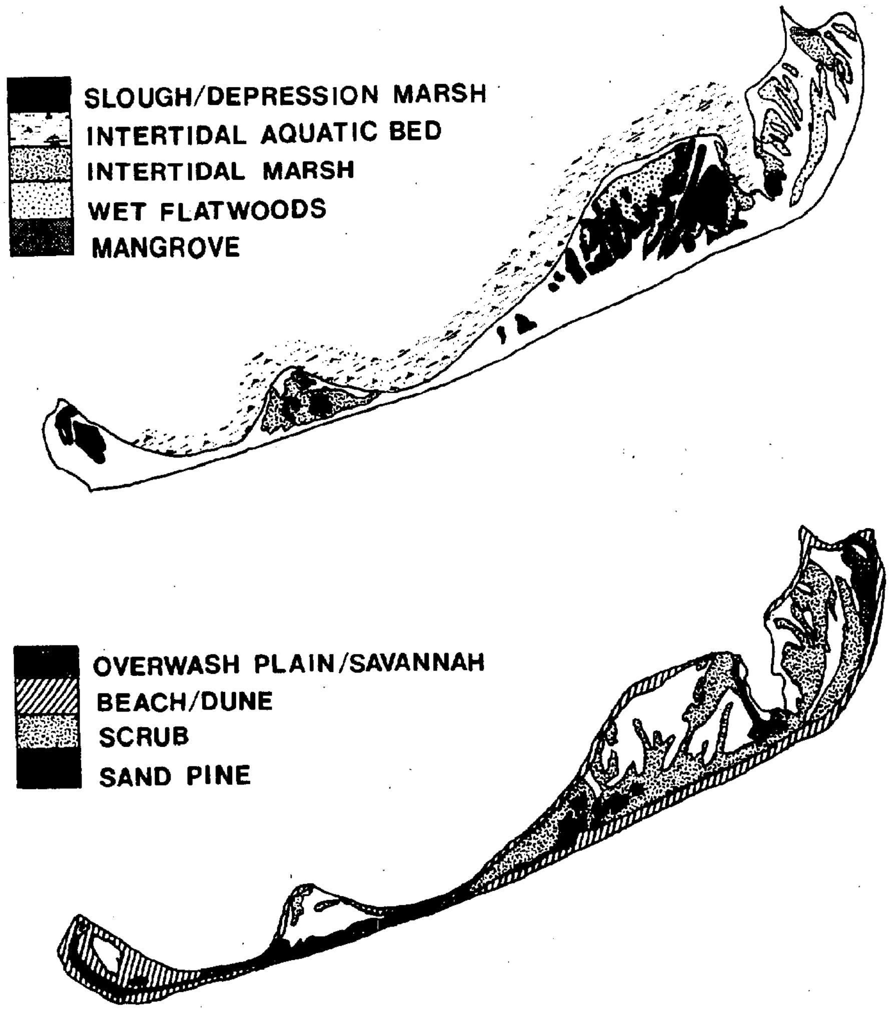


FIGURE 7. DISTRIBUTION OF MAJOR HABITATS OF DOG ISLAND[modified from Anderson & Alexander,1985].

central beach which has resulted in formation of a long, more or less continuous beach dune ridge approximately 2.5 miles long. These dunes are thought to be no more than 3,000 years old (Gorsline, 1963). Overwash zones also occur in the two narrows of the island as well as on the East End.

St. George Island lies adjacent to the mouth of the Apalachicola River and is connected to the mainland by the Bryan Patton Toll Bridge (Figure 8). The island is 30 miles long and is quite narrow, averaging less than one-third mile in width. It contains approximately 7,340 acres of land and 1,200 acres of marshes. On the Gulf side there is a narrow band of beaches and low-lying sand dunes that grade into mixed woodland grass, palmetto, and bayside marshes (Livingston et al, 1975). St. George Island State Park is located on the east end of the island and consists of approximately 1,750 acres. Bob Sikes Cut separates the west end of the island from Cape or Little St. George Island. This channel was constructed in 1957. St. George Island appears to have formed in its present location between 4,000 and 4,500 years ago. The ridges on the island tend to have an east-west trend and are predominately parallel, indicating a transverse or offshore drift system. According to Stapor (1973) St. George Island has been accreting sediment at its northeastern tip at about 64 ft/yr. The beach face in the same area has been retreating 4 ft/yr. for the interval 1934 - 1970. Of all the islands St. George is the most easily accessible and has been modified the most by road building and development pressures.

Cape St. George Island, or Little St. George Island is approximately 9 miles south of Apalachicola. The island is 9 miles long and varies in width from 1/4 mile to a maximum width of one mile. The island was acquired by the State of Florida in 1977, and has been designated as a "state reserve". The reserve consists of approximately 2,300 acres at mean high tide. An additional 400 acres of perimeter tidal marshlands and lower beach areas which are inundated by high tidal waters are present. Elevations range from sea level to 26 feet, but the bulk of the island lies between 3 and 12 feet above mean sea level (DNR, 1983). Cape St. George is separated from St. George by Bob Sikes Cut, about 500 feet wide and St. Vincent Island by West Pass, a

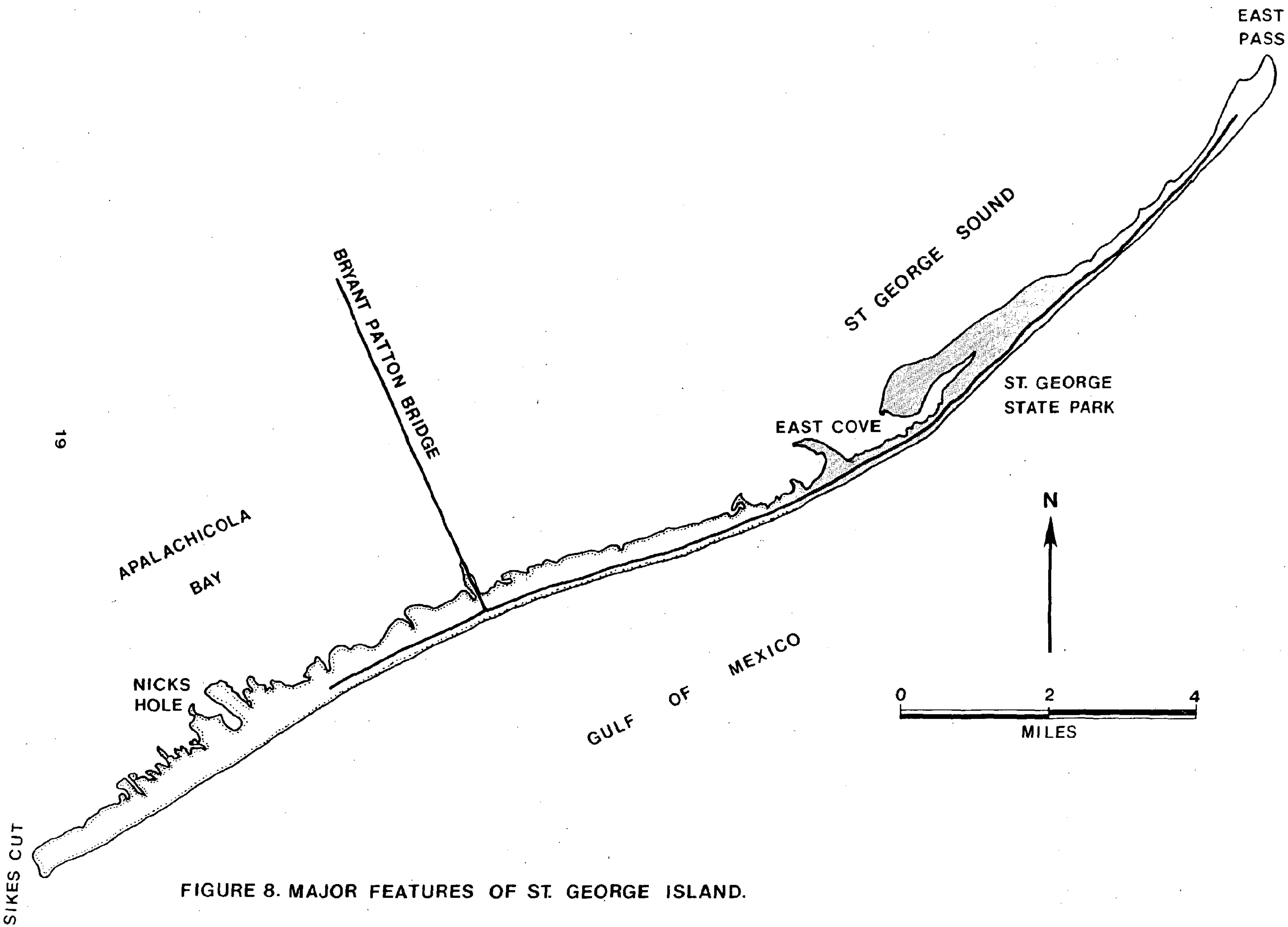


FIGURE 8. MAJOR FEATURES OF ST. GEORGE ISLAND.

natural inlet averaging slightly more than 1/2 mile wide. The only access to Cape St. George is by boat.

Cape St. George Island is a coastal dune/dune flat/washover barrier formation of recent geologic origin (DNR, 1983). The western and eastern sections of the island are narrow terraces subject to occasional overwash by storm surges. The western section is also a drift spit, the westernmost portion of which is known as "Sand Island." Nautical charts of 1858 show the presence of two natural passes through the island. These passes, New Inlet (east of the Cape), and Sand Island Pass (west of the Cape), were probably opened by hurricane overwash in the 1840s. By 1930, these were closed by gradual coastal deposition, thus forming one island. The ephemeral inlets are characteristic of powerful overwash events. Relic inlets become protected coves (Godfrey and Godfrey, 1976) and new bayshore marshes form on the substrate created by overwash sediments and relic inlet shoals. This is the case with the relic New Inlet where prominent marshes and Pilot's cove exist today (DNR, 1983).

The dune ridges are oriented from northwest to southeast paralleling the present shoreline west of the Cape. The shoreline east of the Cape runs northeastward. A dune strand truncates the relic dune ridges of the interior, blocking swales between the dune ridges. Plant communities of Cape St. George State Reserve are illustrated in Figure 10. Cross sectional profiles of the island at representative points are shown in Figure 11.

St. Vincent Island National Wildlife Refuge was acquired by the U. S. Fish and Wildlife Service, U. S. Department of the Interior in 1968. The island is triangular in shape, approximately 9 miles long and 4 miles wide (Spicola, 1983). It consists of approximately 12,358 acres. West Pass separates the island from Cape St. George and Indian Pass (approximately 400 yards wide) separates the island from Indian Peninsula.

St. Vincent is somewhat atypical of the barrier islands found along North Florida, Alabama and Mississippi. Instead of a simple beach and dune structure, there exists a highly complex topographic and physiographic makeup

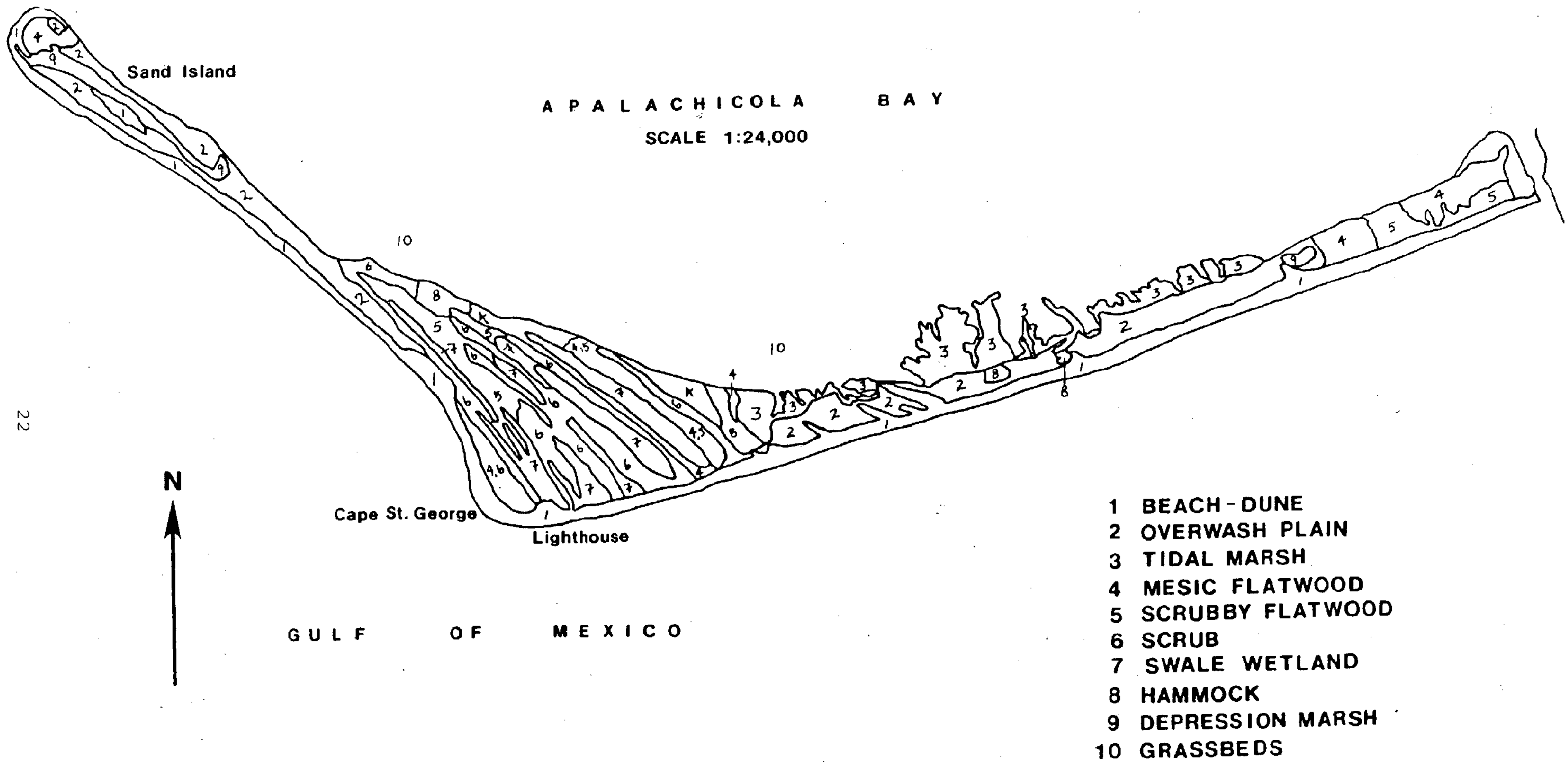


FIGURE 10. MAJOR PLANT COMMUNITIES OF CAPE ST. GEORGE ISLAND (DNR, 1983)

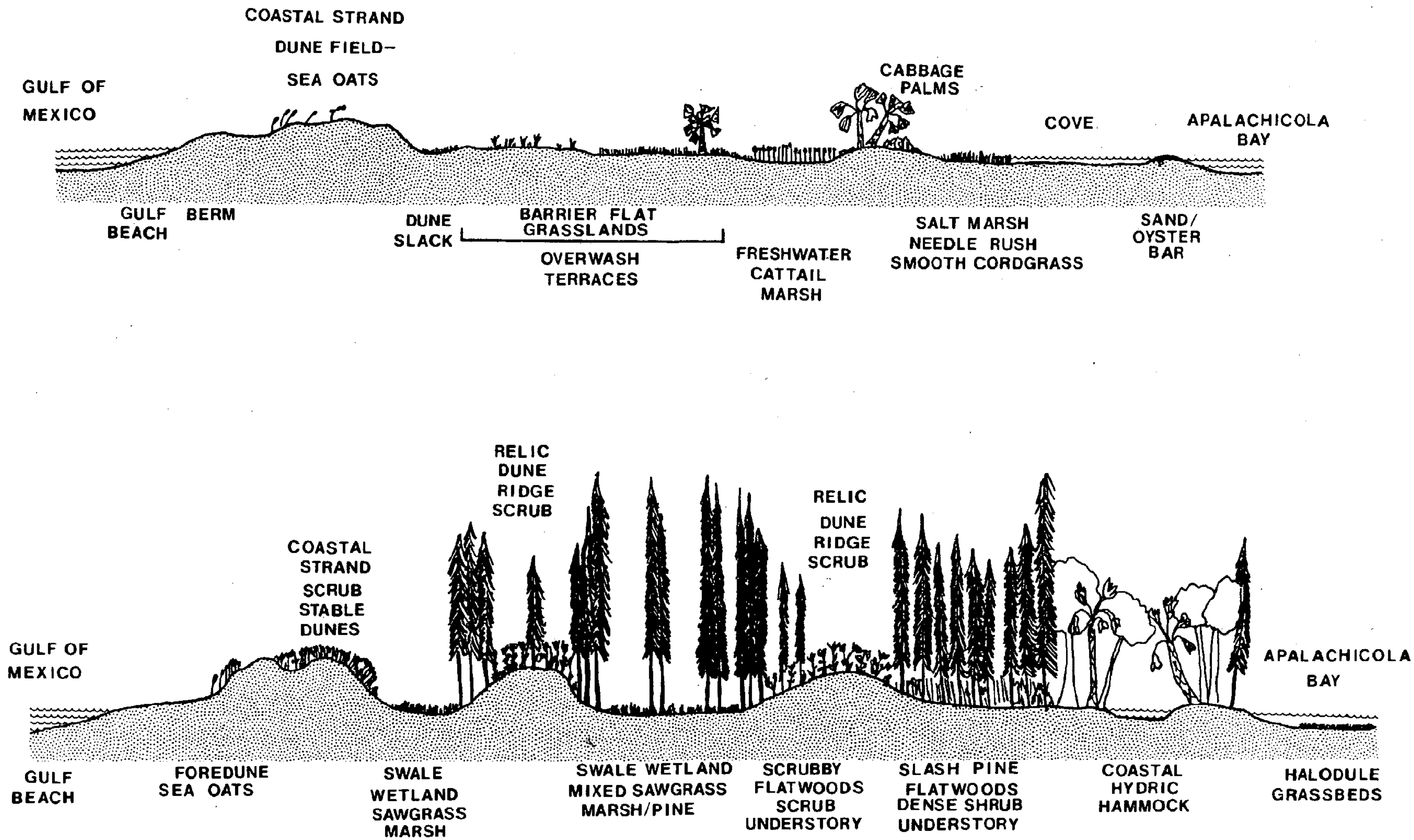
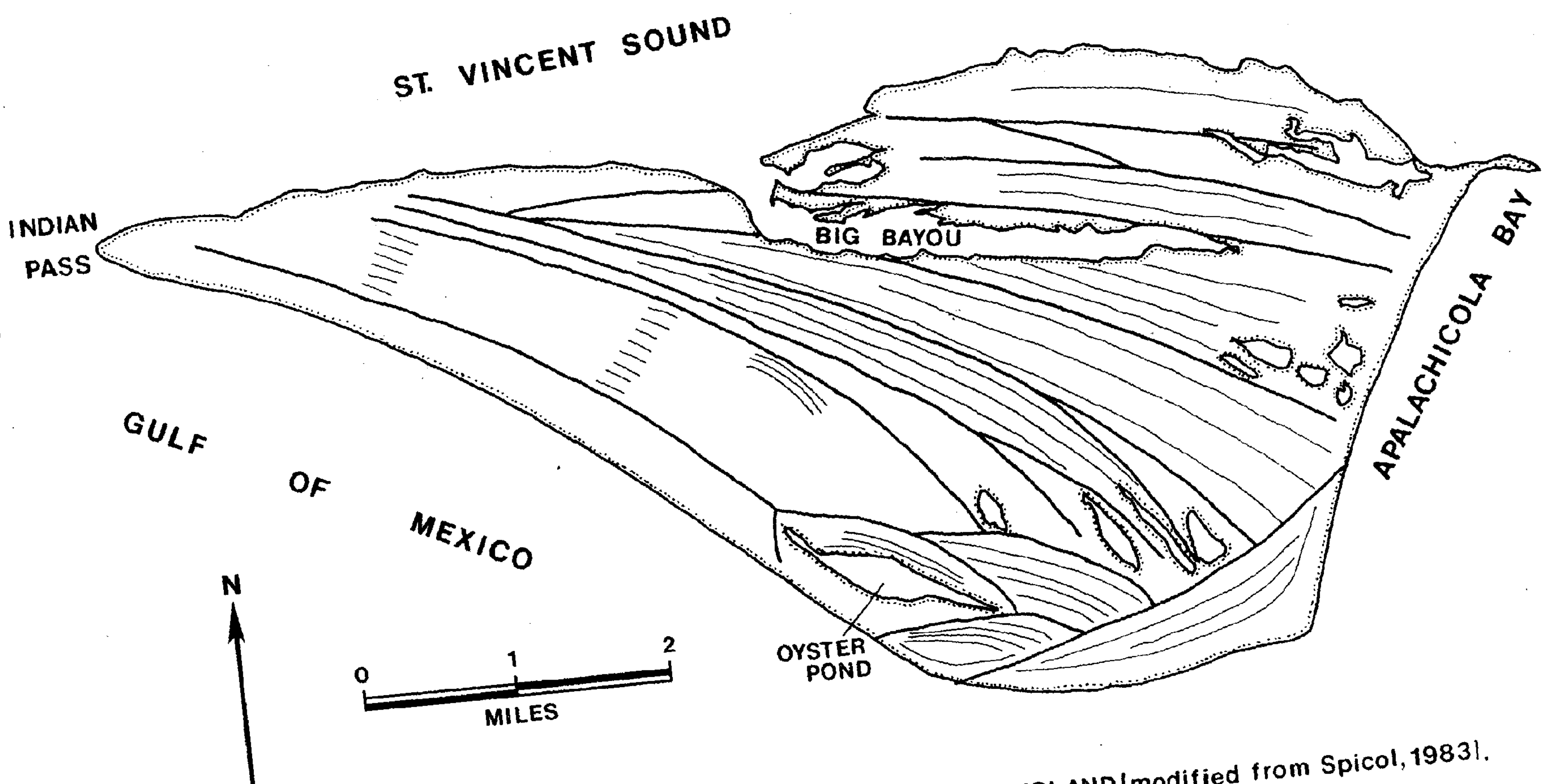


FIGURE 11. TYPICAL PROFILES OF HABITATS OF CAPE ST. GEORGE ISLAND (DNR, 1983).

(Thompson, 1970). Beach ridges run east to west and are predominately parallel, indicating a transverse or offshore drift system. In the southeastern corner of the island there are at least four beach ridge sets which are thought to have been formed by a westerly longshore drift system (Figure 12). The island is thought to have been formed slightly more than 3,500 years ago. There is a complex ridge and swale topography. Typical ridges range three to seven feet high and measure 100 feet or more from crest to crest (Miller et al, 1980). Generally, dunes are highest on the south side and the very west end of the island. Interdune areas are lowest near the center and east end of the island (Thompson, 1970). Sets of ridges are frequently truncated by new deposition leaving a complicated pattern of ponds and sloughs. Most of the island has been stable up until a few decades ago. Since 1970, erosion has been quite spectacular at certain localities. Many trees have been left standing in the surf zone, but erosion rates have not been determined for this time interval (Tanner, 1975).

The vegetation from the Gulf side to the interior consists of scrub oak ridges, slash pine timberlands, sawgrass marshes and tide marshes. The vegetative composition grades from west to east where, for example, live oak replaces the scrub oak complex and open water replaces sawgrass marshes (Thompson, 1970). A file report entitled "Vegetative Cover Types of St. Vincent National Wildlife Refuge" prepared by the Refuge Biologist, delineates and describes 17 major plant communities on St. Vincent Island as determined by a field survey, a published report (McAtee, 1913), and planimetric analysis of 1:10,000 aerial photography. These 17 communities have been combined into five landscape categories (Table 2). Typical island profiles, one from east to west, and the other from north to south, show the general distribution of plant communities and their relation to topography (Figure 13). One favorable aspect of the islands' rolling dunes is the interspersion of pine lands with hardwoods. This provides a dispersion of habitat favorable for wildlife.

A variety of mostly xeric communities is found on island ridges. Interspersed with these ridges are xeric to hydric communities consisting of pine flatwoods, hammocks, marshes, ponds, and sloughs. A general description



MAJOR FEATURES AND BEACH RIDGES OF ST. VINCENT ISLAND (modified from Spicol, 1983).

Table 2. Basic Vegetative Cover Types of St. Vincent Island (modified from Thompson, 1970)

Community Type	Vegetation Type	Acreage	% of Island	Dominant Sp.	Notes
DUNES	Scrub Oak Dune	1,202	9.7	Rosemary Myrtle Oak Dwarf Live Oak Chapman's Oak Live Oak	Reported to be a consistent and heavy mast producer; probably frequented by deer during fall months.
	Mixed Live Oak - Scrub Oak Dune	201	1.6	As above with less Rosemary, more Live Oak	Intermediate seral stage in succession from Scrub Oak to Live Oak dune.
	Live Oak Dune	505	4.1	Live Oak Laurel Oak Cabbage Palm	Located on eastern, higher dunes. Source of acorn mast and palmetto berries.
	Live Oak - Grass	155	1.3	As above with grass rather than Saw Palmetto	Located on eastern side near shore dunes. Minor occurrence.
	Sand Pine - Scrub	7	0.5	Like Scrub Oak with addition sand pine	Very minor occurrence, widespread on mainland.
	Hardwood Hammock	185	1.5	Water Oak Live Oak Hickory Cabbage Palm Magnolia Cedar	Good species diversity restricted to rich midden soils along north shoreline. Much of the apparent elevation from midden accumulation.

Table 2 continued.

Community Type	Vegetation Type	Acreage	% of Island	Dominant Sp.	Notes
CABBAGE PALM	Cabbage Palm	221	1.8	Cabbage Palm alone or mixed with Hardwood Hammock	Limited distribution as pure type. No understory vegetation.
PINELANDS	Slash Pine - Mixed Understory	2,332	18.81	Slash Pine Magnolia Gallberry *Lyonia sp.*	Most common upland type. Varies in composition depending upon drainage; usually found on slopes between swales and crests. All second growth after logging.
	Slash Pine - Cabbage Palm Hammock	1,234	10	Slash Pine Magnolia Saw Palmetto Grape	Wetter than Slash Pine - Mixed Understory. Source of palmetto berries, grapes.
	Slash Pine - Saw Palmetto - Ilex	1,040	8.4	Slash Pine Yaupon Grasses	Restricted to northeast part of island. Mixed grasses from understory. Source of Yaupon.
	Slash Pine - Grass	145	1.2	Slash Pine Grasses	Restricted to Gulf shore. Minor occurrence.
FRESH WATER	Sawgrass - Emergent Marsh	792	6.4	Sawgrass St. John's-Wort Buttonbush Willow	Occupies lower interdune swales in vicinity of freshwater ponds. Occasionally with cordgrass. Colonial bird nesting area.
	Cattail Marsh	660	5.3	Cattail	Utilized by marsh birds.
	Fresh Water Pond	269	2.2	*Saggittaria* *Nymphaea*	Freshwater fish, reptiles, amphibians, and edible plants. Wood duck nesting area, waterfowl wintering area. Mostly previously brackish.

Table 2 continued.

Community Type	Vegetation Type	Acreage	% of Island	Dominant Sp.	Notes
TIDAL AREAS	Tidal Marsh	2,899	23.4	*Spartina* *Juncus* *Disticalis*	Most common vegetation type. Probably important source of shellfish.
	Salt Water Pond	148	1.2	Chara Widgeon Grass	May be useful for fishing or tide netting.
	Beach	377		Sea Oats	Shell collecting, surf fishing, sea turtle nesting.

of barrier island plant communities, wildlife importance and utilization follows.

Beach and Berm

Beaches are semiterrestrial habitats that are subject to constant high energy forces of wind and wave action. It is a detrital based community in which primary productivity in the intertidal zone is limited to unicellular algae. Animals consist of burrowers and interstitial amphipods and isopods. Many shorebirds, gulls, and terns use the beach for feeding, nesting, and loafing throughout the year. Plovers, turnstones, and sandpipers are constantly present at the surf line. Raccons and ghost crabs, along with other nocturnal visitors, scavenge along the beach drift lines (DNR, 1983).

Berms exist slightly above the elevations of the nomal tide range and are constantly being altered by storms and wave action. Storm washes deposit shell fragments on the landward slope of the berm. Vegetation is sparse. Annual plants commonly found in this zone include sea-rocket, sea purslane, Russian thistle, and the seaside spurge.

The relatively undisturbed miles of Gulf beach and berm of the barrier islands provide essential habitats for a number of endangered and rare birds. Beaches provide nesting sites for such species as the threatened least tern, royal tern, sandwich tern, black skimmer, and oystercatcher, a species of special concern. All of these plus the Caspian tern, and the Eastern brown pelican, a species of special concern, use sand spits and beach bars for loafing and roosting (DNR, 1983; Livingston et al, 1975). The threatened Southeastern snowy plovers and least terns are present on St. George and Cape St. George. Snowy plovers require expansive open, dry, sandy beaches for breeding, and both dry and tidal sand flats for foraging. They are the only Florida bird species which feed and breed on open, dry sandy beaches. Least terns also nest here but feed in nearby waters. The numbers occurring in Franklin County have declined sharply with human exploitation of the beaches

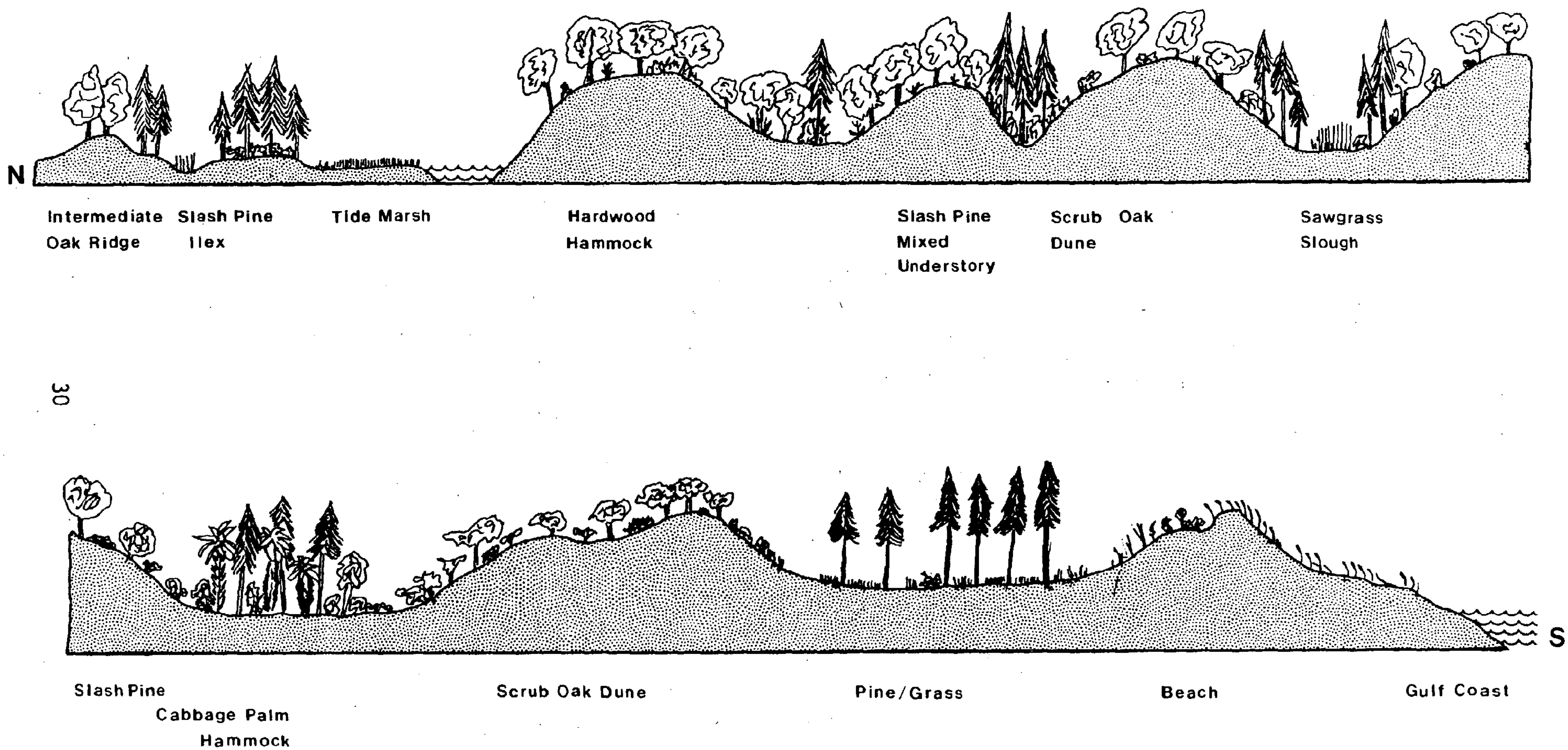


FIGURE 13. PROFILE OF TYPICAL HABITATS OF ST. VINCENT ISLAND (THOMPSON, 1970).

(Livingston et al, 1975). The beaches and berms of the barrier islands are used in the summer as some of the most important rookery grounds for the threatened Atlantic loggerhead turtle (DNR, 1983).

Dune Fields

Primary dunes or the foredunes are the first dunes on the seaward side of the islands. They provide protection for the other dune ridges and plant communities that lie behind them. Because dunes are subject to daily exposure of salt spray and sandblast, and the major shifts and wash down of storm surges, they are considered to be harsh environments. This dune system is unstable and constantly being altered, and therefore does not provide a permanent or continuous barrier to storm surges (DNR, 1983).

The predominant plant found in the dune plant community is sea oats. They are very effective in building and stabilizing dunes. Sea oats also provide food for the red-winged blackbird and other species of birds. Other plants of the dune community include the railroad vine, beach morning glory, evening primrose, bluestem, and sand coco-grass (DNR, 1983; White, 1977; Livingston et al, 1975). The roots and rhizomes of dune vegetation help to bind the sand and thereby stabilize the land.

In areas where water has ceased to wash through, a stabilized coastal dune strand has developed (for example, some areas of Cape St. George). Overwash in this stabilized strand is restricted to the foredune zone, although all of the other stresses (salt spray, etc.) still exist. Dunes of the stabilized strand are larger than those of the overwash dune field and tend to align in a continuous ridge form. With the stabilizing of the seaward ridge, succession is allowed to proceed behind the dune with scrub thickets replacing grasslands (DNR, 1983).

Behind the primary dune is usually a wide, relatively flat sandy plain, containing some small windblown dunes. This interdunal zone is mostly devoid of larger woody plants found in more established scrub areas towards the interior of the island. Plant species of this zone include saw palmetto, yaupon, wax-myrtle, salt-myrtle, goldenrod, marsh elder, and marshhay cordgrass (White, 1977).

Only a few very rare faunal species are known to require the coastal strand habitat. The Southeastern snowy plover forages on dry, interdune flats of the overwash dune field. The endangered peregrine falcon migrates through the islands in the fall and spring. The threatened Southeastern American kestrel is also an open habitat bird (DNR, 1983).

Scrub

Behind this dune system a zone of more dense vegetation can be found. The understory vegetation of this zone includes mostly scrub species with a few scattered slash pines occurring. This scrub community is generally found on higher, well-drained sites corresponding to old dune ridges (White, 1977) and is excellent for stabilizing dunes. Dominant plant species found in this zone are saw palmetto, rosemary, buckthorn, staggerbush, Chapman oak, myrtle oak, sand live oak, and live oak. Various herbs, lichens and grasses often cover the open areas (Livingston et al, 1975).

Slash pine scrub grades into a broad vegetation zone with a more dense cover of slash pine and an understory consisting of scrub species. This slash pine-scrub community generally occupies flat ground on drier sites. Saw palmetto tends to form much broader patches (Livingston et al, 1975). Myrtle oak and sand live oak also form large patches as they do in the scrub on dunes. Chapman oak and rosemary are present but are not as common as in the dune scrub communities. The open areas located in the slash pine-scrub communities are also covered with herbs, grasses, lichens or low, semi-woody species such as _Aristida spiciformis_, _Rhynchospora megalacarpa_, _Polygonella polygama_, and _Hypericum reductum_.

The dunes of Dog Island that are dominated by sand pine are locally known as "The Mountains." This scrub community is on some of the higher elevations of the island. The sand pine community of Dog Island represents an uneven aged community of sand pine. Several sand pines in "The Mountains" are 100 - 125 years old, whereas the older trees on the adjacent mainland near Carrabelle are mostly around 80 years old. The understory consists of relatively few species of plants including rosemary and *Cladonia* sp. (Anderson and Alexander, 1985).

Only one sand pine has been found on Cape St. George (W. Miley, pers. comm.) and a few exist on St. George Island. Sand pine scrub exists in one area of St. Vincent Island. It is limited to about 6.8 acres (Table 2). Understory species are similar to the scrub oak type except the overstory is sand pine. Sand pine is limited on these barrier islands but is common in the older dunes on the mainland between Lanark and East Point. Why they are not very extensive or even occur on these islands is uncertain (Thompson, 1970).

Pine Flatwoods

Slash pine also dominates pine flatwoods. The slash pine-scrub community usually grades into pine flatwoods which tend to occur on poorly drained or wet sites. The major associates include a dense understory of fetterbush, saw palmetto, gallberry, *Lyonia ligustrina* and *Lyonia mariana* (Cape St. George). Palmettos form a more dense cover than in the scrub communities. Minor associates include sundew, St. John's-wort, mint, blueberry, and huckleberry. Pine flatwoods bordering salt marshes take on a tall understory of live oaks and occasional cedars and cabbage palms (DNR, 1983).

Flatwood species are fire adapted. This community is susceptible to frequent and often intense fires because of the dense vegetation and heavy accumulation of litter (particularly during the dry season). The integral role which fire plays in arresting succession in flatwoods is widely recognized in the Southeast today.

Pinewoods provide food, as well as nesting and escape cover for a variety of wildlife species. The brown-headed nuthatch and pine warbler are restricted to pines in the breeding season and the red-breasted nuthatch is restricted to such areas in the winter. Mature slash pines are important nesting and perching sites for a few rare and endangered species (Livingston et al, 1975). The Southern bald eagle and osprey nest in pines close to the bayshore because of feeding habitats. The Southern bald eagle prefers trees that provide a large expansive view of the surroundings while the migrating Cooper's hawk prefers more densely wooded areas along with open habitat for hunting prey. They may be found in scrubby flatwoods. The Southeastern kestrel nests in cavities of live pines or snags which are present in the woodland communities (DNR, 1983).

Salt Marshes

Salt marshes are found on the bay side where they are protected by the barrier islands and are associated with the shallow, low-energy (wave, tide, etc.) areas (Livingston et al, 1975). Salt marshes act as filters for land runoff, removing sediments and pollutants. They transfer nutrients from upland areas to adjoining aquatic systems. Marshes are also important in their relationship to land surfaces in the overall system of water movement involving runoff, tidal currents and wind and storm activities (White, 1977). Overwash sediments and inlet shoals have been shown to be excellent substrates for tidal marsh development (DNR, 1983).

Sloughs gradually merge with the salt marshes on the bay side of St. George island. Livingston and Thompson (1975) attribute plant zonation of such marshes to salinity gradients due to differential evaporation. Brackish or landward areas of marshes are dominated by needlerush. <u>Juncus</u> is joined by saltmeadow cordgrass, perennial glasswort, three-square bullrush, saltmeadow grass, sand sedge, and the shrubs sea myrtle and groundsel in the high brackish or transitional zone. Waterward of the transitional zone, <u>Juncus</u> dominates exclusively to an elevation near mean high water (DNR, 1983). Waterward of the mean high water line and the brackish zone lies the salt marsh community dominated exclusively by smooth cordgrass. This community requires regular tidal inundation and attains its best development on Cape St.

George behind protective sand/oyster bar barriers which have been deposited by bay wave action offshore in the Pilot's Cove area (DNR, 1983). The most landward extent of smooth cordgrass is the margins of small tidal creeks meandering into the Juncus marsh. The smooth cordgrass of Cape St. George marshes is short and lacks vigor. Mesohaline estuarine waters of Apalachicola Bay account for this contrast in community vigor, as smooth cordgrass prefers tidal environments approaching sea water salinity (DNR, 1983). Barrens also exist in salt marshes. These barrens are devoid of vegetation and are covered by tides. As the water evaporates from these areas the salinity rises several times greater than that of the open sea. Peat deposits, which have built up after several thousand years of occupation by marsh plants, slow the percolation rate of water and thus help to increase salinity. These deposits may become several feet deep (Livingston et al, 1975).

Tidal marshes (2,898.5 acres) and associated ponds make up the largest vegetative type on St. Vincent Island. There are also eight or nine saltwater ponds on the island. They consist of approximately 147.9 acres. Chara and widgeon grass are present in varying quantities in these ponds (Thompson, 1970). Tidal marshes on Dog Island cover approximately 352 acres. These marshes are composed primarily of needlerush and smooth cordgrass. Black mangrove is listed as part of the intertidal marsh community. The Dog Island populations represent the northernmost occurrence for this species in the Gulf of Mexico. Herbaceous associates in the mangrove-dominated community include perennial glasswort and sea lavender. Submerged aquatic beds consist of close inshore areas of Syringodium, Halodule, and Thalassia (Anderson and Alexander, 1985).

Salt marshes are breeding and nursery grounds for many organisms. Omnivores and detritivores have been sampled in nearby marshes of Cape St. George and include Gammarus mucronatus, Neritina reclivata, Melitta spp., Corophium louisianum, Munna reynoldsi, and Gitanopsis sp. (Livingston, 1983). The more common larval and juvenile fishes that seek out tidal marshes for shelter and feed on the litter fauna are the anchovy, spot, redfish, croaker, silver-sides, gobies, sea trout, and Gulf menhaden (DNR, 1983). This habitat is also important to mammals, reptiles and wading birds of the islands. The rare Florida mink and the common raccoon are aggressive predators of the marshes. The mink and the rare Gulf salt marsh snake occur exclusively in this habitat, as does the Wakulla seaside sparrow, a species of special concern.

Several species of special concern frequent the tidal marshes, including the little blue heron, great egret, snowy egret, tricolored heron, black-crowned and yellow-crowned night herons, and the Eastern least bittern. The American oystercatcher feeds around the mud flats and bars associated with tidal marshes (DNR, 1983). Other species of birds associated with salt marshes include the clapper rail, seaside sparrow, long billed marsh wren and the sharp-tailed sparrow (Livingston, 1976). The diamondback terrapin is also adapted to life in salt marshes (White, 1977). The alligator, eastern glass lizard and the cottonmouth are found in salt marshes but their main populations occur elsewhere (White, 1977).

Sloughs, Freshwater Marshes and Ponds

Sloughs, freshwater marshes, and ponds are fresh water unless overwash or extreme high tides occur, which then turn them brackish temporarily. Sloughs on the barrier islands transport runoff from the dune system northward into the salt marshes. In low areas sloughs may contain standing water even during the drier seasons. The areas with standing water support various freshwater marsh vegetation types including saw grass, water lilies and *Fuirena scirpoides* (Livingston et al, 1975).

Sloughs on St. George tend to be flanked by pine flatwoods and delimited by a dense zone of medium-sized oaks. Laurel oak and live oak occur more often. Sand live oak may also be among them. Tall slash pines are also scattered about. Woody plants making up the understory include gallberry, wax-myrtle, greenbriar, bamboo vine, poison oak, muscadine grape, wild olive, yaupon, buttonwood, royal fern, and sawgrass.

Freshwater sloughs of hydric hammocks on Cape St. George have become freshwater lagoons. Sawgrass and seashore marsh-mallow line the margins of these duckweed covered sloughs where sunlight penetrates the hammock canopy (DNR, 1983).

St. Vincent National Wildlife Refuge has approximately 1,404.7 acres of sawgrass/emergent marsh which occupies the lower elevations of the interdune area. Species composition varies from area to area but the dominant species found is generally sawgrass. An association of *Hypericum* sp. occupies some low sites, while willow, *Baccharis*, and buttonbush may occupy other sites. Occasional remnants of more salt tolerant plants such as *Spartina* and *Juncus* are also scattered throughout (Thompson, 1970). Cattail marshes cover another 58 acres of St. Vincent Island (Table 2). Cattails generally occupy a zone of deeper, more permanent water than that tolerated by sawgrass. These marshes are situated around freshwater ponds and connecting waterways.

Sloughs found on Dog Island are generally dominated by sawgrass or cattail. Cattail tends to dominate in human-disturbed sites. Margins of these communities are characterized by the woody species gallberry, fetterbush, *Persea* and willow. Predominant smaller herbs include *Eleocharis cellulosa*, *Fuirena scirpoides*, and *Phyla modiflora*. The extensive sloughs of "The Interior" have considerable amounts of *Eriocaulon compressum*, *Hypericum fasciculatum*, and *Lachnanthes caroliniana*. These species are not frequently found elsewhere on the island (Anderson and Alexander, 1985).

Freshwater ponds comprise approximately 245 acres on St. Vincent Island. They occupy the lowest elevation into which most drainage of the sawgrass sloughs terminate. Species found in these ponds include *Scirpus californicus*, *Sagittaria latifolia*, *Nelumbo lutea*, *Nymphaea odorata*, *Ceratophyllum demersum* and *Vallisneria americana* (Thompson, 1970).

Sloughs, freshwater marshes and ponds support a wide variety of fish, birds, reptiles and amphibians. Cape St. George has one man-made pond. On Cape St. George the fish fauna is sparse and is dominated by topminnows which are usually well adapted for the stress of low dissolved oxygen and extreme (periodic) fluctuations in the physico-chemical environment (White, 1977). Freshwater species found on Cape St. George include mosquito fish, least killifish and sailfin molly. Also present are the largemouth bass, warmouth and bluegill (W. Miley, personal communication). Freshwater marshes and ponds are important habitats for the feeding and breeding habits of many species of birds. They include species such as the green heron and rails (White, 1977).

The existence of many vertebrates on barrier islands is threatened by developmental pressures. Vertebrates on St. George Island are more vulnerable than those found elsewhere because:

1) freshwater communities are minimal in areal extent;

2) small changes in physical parameters can cause rapid and widespread species compositional changes ultimately affecting vertebrates occupying upper positions in the food web; and

3) the perched, highly localized water tables forming ponds and other freshwater sites can be easily drained and are abnormally lowered by nearby wells (Livingston et al, 1975).

Wildlife other than fish and birds whose existence on St. George Island is dependent upon continued persistence of freshwater bodies include the Southern toad, cricket frog, green tree frog, squirrel tree frog, leopard frog, narrow-mouthed toad, American alligator, mud turtle, Eastern glass lizard, green snake, banded water snake, ribbon snake, garter snake, and cottonmouth (Livingston et al, 1975).

Hammocks

Cabbage palm hammocks make up approximately 221 acres of St. Vincent Island (Table 2). As a pure type it occupies some of the relatively higher sites such as the Tahiti area where it is associated with live oak and cedar or as a pure stand. Elsewhere cabbage palm occurs in lower sites. Understory species in the hammocks on St. Vincent Island are nearly absent. This could be due to hog rooting or the dense canopy that is formed by the palms (Thompson, 1970).

Hardwood hammocks are also present on St. Vincent Island. This community consists of approximately 185 acres and is located along one ridge (dune) on the north edge of the island (Table 2). This community generally occupies sites that are quite high and contains a significant amount of litter. The overstory includes water oak, live oak, pignut hickory, magnolia, cabbage palm, mulberry, laurel oak, and myrtle oak. The understory includes *Yucca*, American beautyberry, *Vitus* sp., poison ivy, trumpet vine, Virginia creeper, Hercules club, smilax and wax-myrtle (Thompson, 1970).

Most of the hammocks of Cape St. George Reserve are localized hydric environments of the Cape region. These fairly small communities are dominated by live oak and cabbage palm, with conspicuous slash pine and an occasional southern red cedar and southern magnolia as associates. Shrubs consist of yaupon, wax-myrtle, and Spanish bayonet. Epiphytes, except for the resurrection fern, are conspicuously absent on the Cape. Lichens are common, especially the crutose wedding ring. The southern red cedar becomes increasingly dominant on calcareous substrates such as in midden hammocks. Xeric hammocks on the island are dominated by scrub live oak (DNR, 1983).

Overwash Zones and Grasslands

Storm surges inundate berms destroying those dunes closest to the Gulf, and then flow between the remaining dunes into the almost-level grasslands behind. Sand and shell are deposited in these areas called overwash zones by the surge. The overwash energy rapidly dissipates as it crosses the barrier island. The changes in elevation from the dune field to the rear of the barrier reveal the lateral extent of overwash deposition. Most of the eastern and western sections of Cape St. George consist of low terraces subject to storm overwash. These sections support grassland communities which are adapted to various environmental stresses such as salt spray, shifting sand, lack of nutrients, excessive evapotranspiration, overwash flooding and burial by sediments (DNR, 1983). The salt and sand deposition on the grasslands create a stress that often results in the destruction of invading trees and shrubs. Only those species adapted to such conditions survive.

Barrier flat grasslands are savannah-like communities that occur on the flats behind the strand dune field and usually extend to the bayshore and salt marshes at the rear of the barrier. Vegetative cover is rapidly reestablished after overwash burial, primarily through the upward growth of rhizomes (particularly saltmeadow cordgrass), and rerooting near the surface (Godfrey and Godfrey, 1976). The barrier flat grassland community consists of grasses, forbs and sedges that persist as long as overwash continues. The grassland is more sparse closer to the dune field where overwash is more frequent and becomes denser towards the backshore (DNR, 1983). The dominant species found is saltmeadow cordgrass. Important associates include needlerush, *Solidago sempervirens* var. *mexicana*, love grass, Gulf muhly, broomsedge, *Fimbristylis castanea*, three-square bullrush, foxtail, sea pink, white-top sedge, finger grass, and nodding ladies' tresses.

When enough sand is deposited to raise the stabilized dune strand above flood level the dune may become covered by lush grass or by a thicket. Trees and shrubs which begin invading the barrier flat grassland include Southern red cedar, cabbage palm, slash pine, yaupon, wax-myrtle, groundsel, marsh elder, and the Spanish bayonet. Frequent overwash and kill back must occur on Cape St. George grasslands because with the exception of cabbage palm, only young forms of these invading species are found (DNR, 1983).

Apalachicola Bay System

The Apalachicola Bay system is one of the most productive and undeveloped estuarine systems remaining in the United States. Commercial fisheries in this area are the lifeblood of the local economy. Approximately 90 percent of Florida's oyster catch and 10 percent of that in the United States comes from the Apalachicola Bay system. The annual shrimp harvest is worth even more in terms of dollar value than the oyster catch. The entire estuarine system is currently under pressure from upstream water users, increasing development on the barrier islands, overfishing, and an increasing potential for pollution. The following section is an attempt to describe the system by dividing it into its component habitats. These individual habitats are all interrelated and form the complex system known as the Apalachicola Bay system.

Physiography

The Apalachicola Bay system is a wide, shallow estuary located along the northwest Florida gulf coast that covers an area of approximately 210 square miles behind a chain of barrier islands (Gorsline, 1963). Its primary source of fresh water is the Apalachicola River. The bay system may be divided into four sections based on both natural bathymetry and man-made structural alterations: East Bay, St. Vincent Sound, Apalachicola Bay, and St. George Sound (Figure 5).

East Bay, north and east of the Apalachicola River delta, is surrounded by extensive marshes and swamps, and has an average depth of three feet (Dawson, 1955). The bay receives fresh water from the numerous distributaries of the Apalachicola River and Tate's Hell Swamp. The John Gorrie Memorial Bridge is considered its southern limit. A causeway extending west from Eastpoint, and a causeway island near the river mouth form partial barriers between East Bay and Apalachicola Bay.

To the west is St. Vincent Sound, which is also shallow with an average depth of four feet, and contains numerous oyster bars and lumps (Gorsline, 1963). It separates St. Vincent Island from the mainland and is linked to the gulf by Indian Pass. The maximum water depth in Indian Pass is 24 feet near its entrance.

Apalachicola Bay is the central and widest portion of the estuary. It is separated from St. Vincent Sound by shoal areas and oyster bars. To the north it is separated from the river mouth, delta, and East Bay by the John Gorrie Memorial Bridge. The western and southern land boundaries of Apalachicola Bay are St. Vincent Island, Cape St. George Island, and St. George Island. The bay is connected to the Gulf of Mexico through West Pass, a deep tidal inlet, and Sikes Cut, a man-made navigation channel which cuts through St. George Island and divides it into Cape St. George or Little St. George Island to the west, and St. George Island to the east. Depths in Apalachicola Bay average six to nine feet at mean low tide. The bay floor slopes toward the barrier islands where depths increase to 10 to 12 feet (Gorsline, 1963). Oyster lumps are scattered throughout the central bay area and near the Gorrie bridge. There is a major submerged oyster reef, St. Vincent Bar or Dry Bar, which extends in a north-south direction from St. Vincent Island's eastern edge towards Cape St. George. To the east Apalachicola Bay is bounded by Bulkhead Shoal, a natural submerged bar that extends from Cat Point on the mainland to East Hole on St. George Island. Construction of a causeway island in the center of the bar and a causeway extension at St. George Island raised two portions of this barrier above water level.

St. George Sound extends from Bulkhead Shoal to the Carrabelle River and East Pass. Numerous oyster bars, lumps, shoal areas, and channels fill St. George Sound. Its average depth is about nine feet and like Apalachicola Bay gets deeper toward the barrier islands with a maximum depth of 20 feet. East Pass, a broad opening between St. George Island and Dog Island, has an average depth of 14 feet and connects St. George Sound with the Gulf of Mexico (Gorsline, 1963). Dog Island Sound and Alligator Harbor are included in the geographical boundaries of the estuary, yet are influenced minimally by the Apalachicola River due to distance, current direction, and submerged shoals. Table 3 gives the areas of the major water bodies in the Apalachicola Bay system.

Several navigation projects in the Apalachicola estuary have resulted in alterations to the natural environment apart from the previously mentioned bridges, causeways, and Sikes Cut. These include the Gulf Intracoastal Waterway Channel, the Two-Mile Breakwater and Extension Channel, the Eastpoint Breakwater and Channel, and the Scipio Creek Boat Basin Channel. All these alterations contribute to the present configuration of the Apalachicola Bay system. Their effects on bathymetry have primarily been increasing depth in areas of channels, decreasing depth in areas of open-water spoil placement, and removal of bay bottom area with the creation of the Two Mile and Eastpoint Breakwater and spoil islands. Other man-made changes in bay topography include the creation of oyster reefs by the planting of cultch in many areas of the bay (Leitman et al, 1986).

Oyster Bars

Oysters are important and common inhabitants in Apalachicola Bay. Aggregations of live oysters and empty shells are called oyster bottoms, beds, banks, reefs, or bars although these expressions are not well defined biologically and are used interchangeably. Oyster bars referred to in this system are subtidal and form raised aggregations covering thousands of acres of bay bottom (Table 3). The American oyster is the dominant component on the bars, and growth occurs horizontally and vertically because of surfaces provided by dead shells for larval settlement. This new recruitment guarantees the survival of the bar as long as environmental conditions remain favorable.

Galtsoff (1964) divides environmental factors into positive and negative categories based upon whether they are favorable or unfavorable to the growth and productivity of the oyster community. The principal positive factors are bottom substrate, water movements, salinity, temperature, and food. Negative factors include sedimentation, pollution, competition, disease, and predation. The interaction of these factors determines the utilizable productivity of the oyster community. St. Vincent Sound, Apalachicola Bay and the western portion of St. George Sound (Figure 14) apparently provide the best habitat for oysters in the system since the main concentrations of commercially important bars are located in these areas. The entire Apalachicola Bay system provides many of the necessary requirements, as evidenced by the fact that approximately 7 percent of the entire aquatic area in the estuary is covered by oyster bars (Livingston, 1984). Approximately 40 percent of the aquatic area has been estimated as suitable for oyster bar development with substrate type being the limiting factor (Whitfield and Beaumariage, 1977).

Table 3. Distribution and area of major bodies of water along the coast of Franklin County (North Florida) with areas of oysters, grassbeds, and contiguous marshes (Livingston, 1984).

Water body	Area (ha)	Oysters (ha)	Grassbeds (ha)	Marshes (ha)
St. Vincent Sound	5,539.6	1,096.5	---	1,806.9
Apalachicola Bay	20,959.8	1,658.5	1,124.7	703.4
East Bay	3,980.6	66.6	1,433.5	4,606.1
St. George Sound (West)	14,746.8	1,488.8	624.3	751.9
St. George Sound (East)	16,015.5	2.6	2,767.3	810.8
Alligator Harbor	1,637.0	36.7	261.3	144.3
Total	62,879.3	4,349.7	6,211.1	8,850.4
Percent of total water area	100	7	10	14

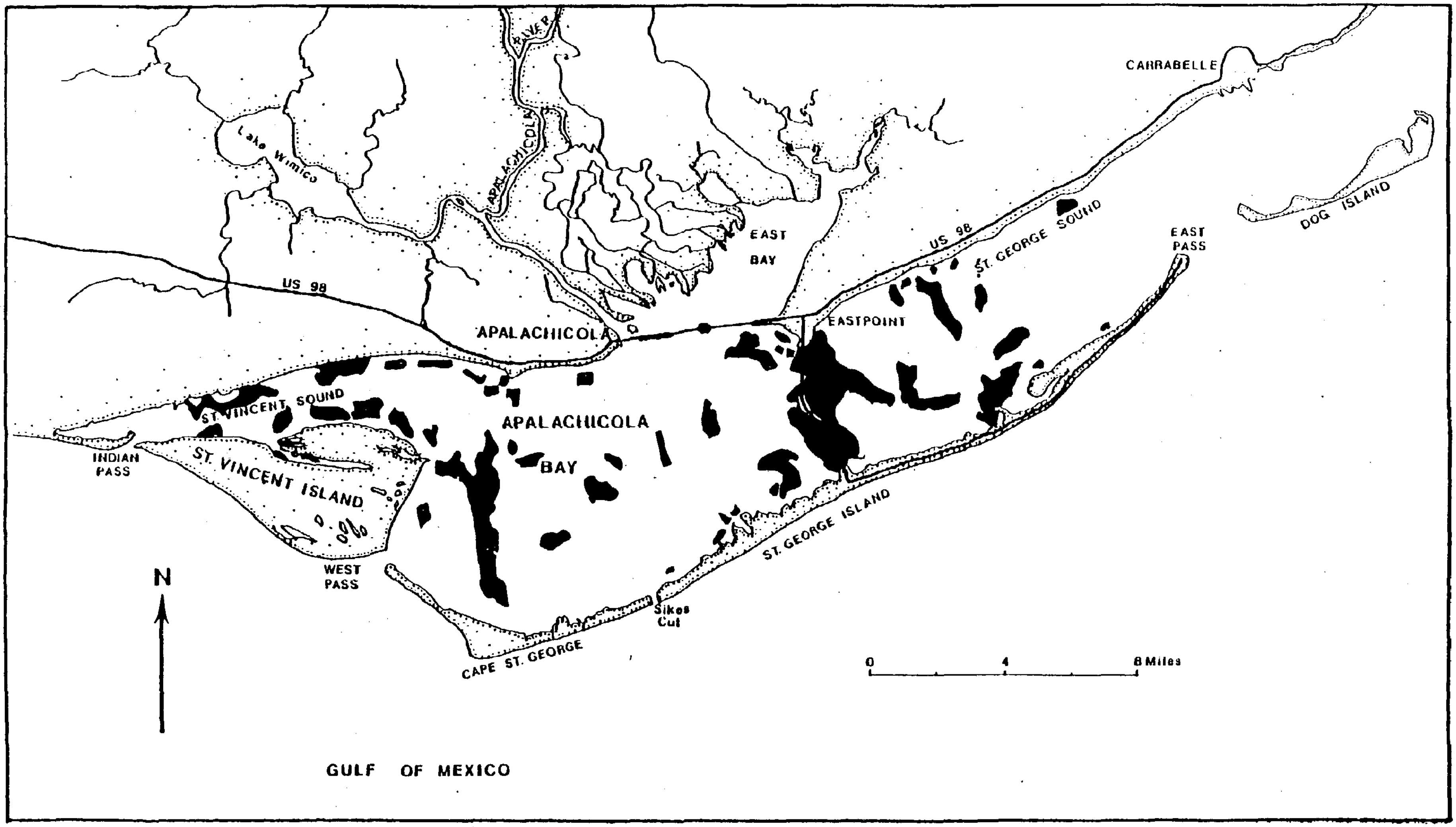


FIGURE 14. MAJOR OYSTER BARS OF THE APALACHICOLA ESTUARY [Livingston, 1983].

Production on the commercial bars has been estimated at between 400 to 1,200 bushels/acre/year (Ednoff, 1984; DNR, personal communication). Because of the relatively mild temperatures in the area, oyster growth is continuous throughout the year and has been estimated to be among the fastest in the United States. Harvestable oysters, those larger than three inches, have been known to be produced from spat in as little as 39 weeks (Ingle and Dawson, 1952). The spawning season is also one of the longest in the United States. The usual pattern in the bay requires approximately 18 months from planting dead shell cultch to commercial harvest (Ingle and Dawson, 1953). The Department of Natural Resources (DNR) has been planting cultch in Apalachicola Bay since 1949 and estimates over 750 acres of bars have been constructed since then (Futch, 1983). Relaying programs, moving small intertidal oysters known as coon oysters to areas more conducive to growth, and moving oysters from polluted to unpolluted areas have also been in effect since 1982. Coon oysters are not included in this discussion of subtidal oyster bars, but will be included in the tidal flats section.

Because of the abundance of cavities and food and the optimal conditions on oyster bars, they provide a significant habitat for a variety of organisms. The oyster-associated community varies somewhat due to the salinity regime, which is the most important limiting factor on the bar itself (Menzel et al, 1966). Prolonged high salinities (i.e., drought) allow predators to infiltrate the bars and also are indicative of lower food supplies due to decreased river flow. Prolonged low salinities (i.e., flood) eliminates many of the predators but also stresses the oyster and can cause mortality (Menzel and Cake, 1969). Significant predators which are associated with Apalachicola Bay oyster bars include the boring sponge, southern oyster drill, flatworm (oyster leech), mudworm, stone crab, blue crab, crown conch, snail, and the boring clam (Pearse and Wharton, 1938; Menzel et al, 1966). The pathogen, Perkinsus marinus also causes significant mortality to adult oysters during times of stress (Menzel, 1983). Other organisms which inhabit the bars include the mussel, mud crab, flat crab, horse oyster, gastropods, blennies, and the toadfish. This is only a partial list and does not include commerically important temporary residents or transitory organisms such as shrimp, crabs, and fish.

While predators and environmental changes can alter the productivity of the oysters and the composition of the associated community, these effects are often slow and variable. Swift (1897) listed three natural conditions which can do significant harm to Apalachicola Bay oyster bars: severe freezes, prolonged freshets (floods), and hurricanes. He also mentioned the harm overharvesting of bars by man can cause. Almost 90 years later two of these conditions, hurricanes and overharvesting, are causing problems for the oyster bars of Apalachicola Bay. The 1985 season saw an unusual number of hurricanes (three) impact this system. Some of the most productive commercial bars in the bay, Cat Point and East Hole, were 80 to 100 percent destroyed (DNR, 1986; Livingston, personal communication). This caused the bay to be closed for six months while research and replanting efforts continued. The bars appear to be coming back as limited harvesting has been allowed, but full recovery will take time. Unfortunately, a severe drought in 1986 has followed the hurricanes of 1985. Although the full effects are unknown at this time, the lack of fresh water in the bay means a reduction in the supply of river derived nutrients and an increase in predation on the bars by species intolerant of reduced salinity. The other significant condition, a man-made threat, is overfishing. This controversy is ongoing, and whether or not sound resource management techniques will prevail is unknown at this time.

Submerged Vegetation

The submerged vegetation found in the Apalachicola Bay system includes fresh water, brackish water, and marine species. Their distribution is confined to the shallow perimeters of the system (Livingston, 1980; CSA, 1985) because of high turbidity and color values which limit the depth of the photic zone. Salinity is also an important variable and determines the type of vegetation present throughout the estuary. High sedimentation rates may also affect distribution (Livingston, 1984), although the continued resuspension of silt and clay particles from the sediment layer may be a more important factor due to the associated decrease in depth of light penetration. Submerged vegetation covers approximately 10 percent of the aquatic area in the

Apalachicola Bay system (Livingston, 1984) with the majority of it located in regions of high salinity and low turbidity (Table 3).

The shallow bayside regions of Cape St. George Island, St. George Island and the mainland areas of St. George Sound support the largest assemblages of submerged vegetation in the estuarine system (Figure 15). *Halodule wrightii*, *Syringodium filiforme*, and *Thalassia testudinum* are the only true seagrasses in the Apalachicola Bay system and are limited to these areas. *Syringodium* appears to be the least represented having been found by Livingston (1980) but not by CSA (1985), although they did not sample the eastern St. George Sound area. *Thalassia* has only been located in small areas of St. George Sound associated with *Halodule*. By far the most dominant species is *Halodule*, occurring in narrow bands on the bayside of the barrier islands in shallow waters. The densest grassbeds are located along the northeast shoreline of St. George Island and consist of *Halodule* and *Thalassia*.

Seagrass beds are important habitats in the marine environment not only for their high primary productivity but also for the role they play in sediment accretion, substrate stabilization, and as a nursery, feeding ground, and permanent home to numerous associated organisms (Phillips, 1980). *Halodule* is not only the most tolerant seagrass to variations in temperature and salinity but also is known as the early colonizer, or pioneer, of disturbed or unvegetated areas (Zieman, 1982). It can also survive in shallower water than *Thalassia* or *Syringodium* because its shallow, surficial root system can colonize the sediments within areas of minimal hydraulic stability such as shorelines. The flexibility of *Halodule* leaves also allows it to conform to the damp sediment thereby allowing it to survive during times of exposure (Fonseca et al, 1981). These factors combined with the limited availability of suitable areas where seagrasses can develop in this dynamic system explain the distribution and dominance of *Halodule* in the Apalachicola Bay system (Table 4). The benthic red algae *Gracilaria* has also been found in significant numbers associated with the *Halodule* grassbeds. No grassbeds or submerged vegetation have been found in St. Vincent Sound (Livingston, 1984; CSA, 1985).

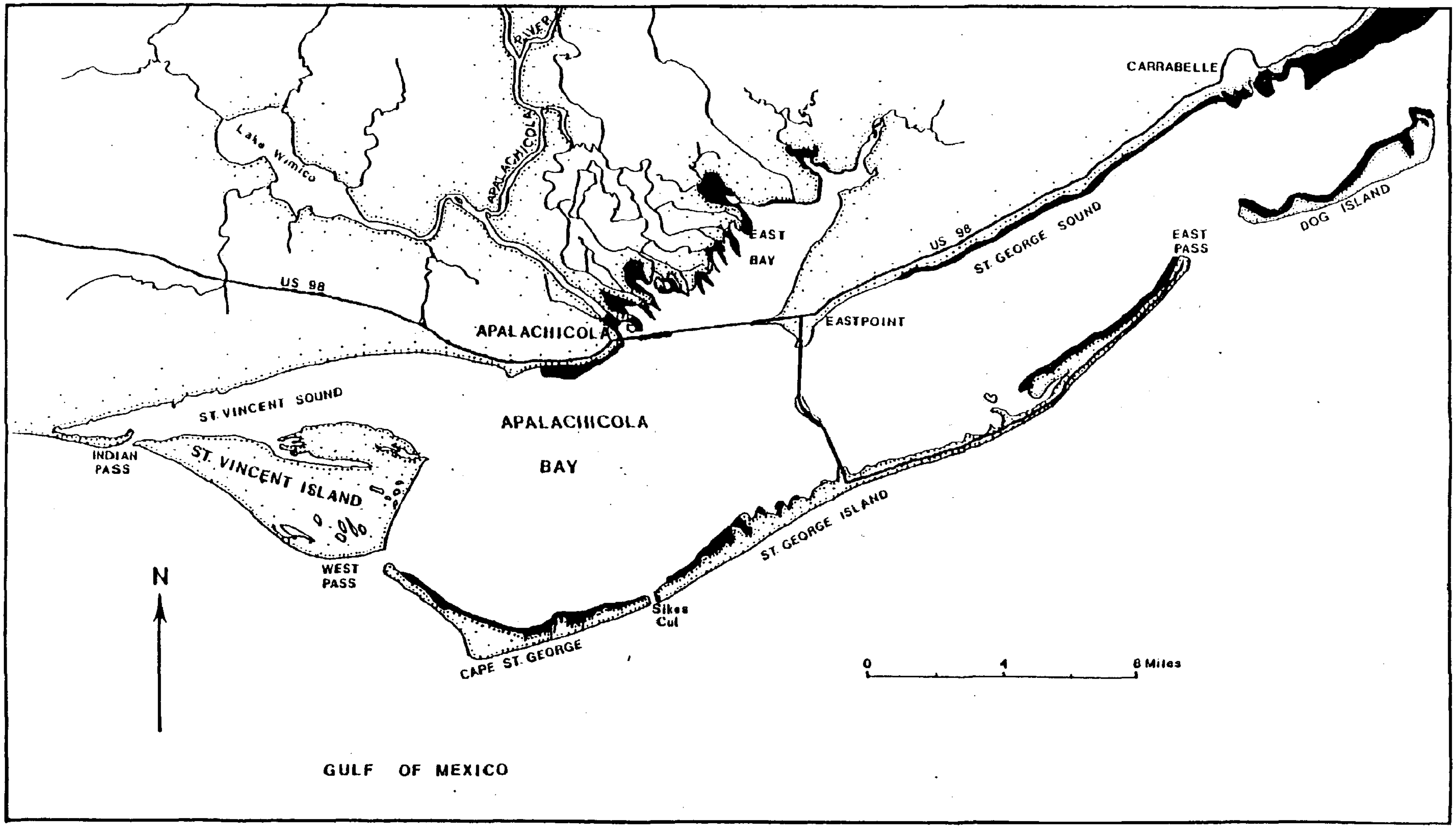


FIGURE 15. SUBMERGED VEGETATION OF THE APALACHICOLA ESTUARY (Livingston,1983).

Seagrass ecosystems create a diversity of structured habitats composed of diverse and interrelated groups of benthic and epiphytic micro and macro algae, sessile and motile epifauna, benthic infauna, and transient motile fauna (Phillips, 1980). Sheridan and Livingston (1983) measured one of the highest infaunal densities recorded in the literature, 104,338 organisms per m^2, working in a Halodule grassbed in Apalachicola Bay. The dominant infaunal organisms found are tanaids, polychaetes, amphipods, and oligochaetes. Major biomass contributors of the community are bivalves, gastropods, and polychaetes. Blue crabs, pink shrimp, and grass shrimp are the dominant macroinvertebrates in the grassbed community and vary in numbers significantly during the year. Sheridan and Livingston (1983) also found that the arrival of juvenile fish and macroinvertebrates on the grassbed in summer corresponds to the rapid decline in infaunal densities, thereby showing the importance of the grassbeds as a nursery and food source. The dominant fishes utilizing the grassbed are silver perch, pigfish, pinfish, and spotted seatrout in the summer, and spot in the late winter and spring.

The John Gorrie Bridge and causeway generally acts as a barrier to the true seagrasses and none are found north of the bridge because of low salinities. The only submerged vegetation found south of the bridge besides the seagrasses already mentioned are Ruppia maritima and Vallisneria americana. Ruppia, which is typically found alongside Halodule, although not usually in Apalachicola Bay, is not a true seagrass but rather a freshwater plant that has developed an extreme salinity tolerance (Zieman, 1982). These two species are found together only in dense beds near the mouth of the river in Apalachicola Bay (Figure 15).

The area to the north of the causeway, East Bay, supports extensive beds of fresh and brackish water species of submerged macrophytes. There appears to have been a significant species change within East Bay from 1980 to 1984. Livingston (1980) found the exotic pest Myriophyllum spicatum covering approximately 30 percent of the bays on the west side of East Bay. In 1984, CSA (1985) found Myriophyllum covering 90 percent of those bays and extending

Table 4. Acreage of submerged vegetation assemblages in the Apalachicola Bay system (CSA, 1985).

Location	Species/Assemblages	Area (Acres)
Apalachicola Bay	*Halodule wrightii*	1,145
	Ruppia maritima	282
	Vallisneria americana	
	R. maritima	50
St. Vincent Sound		0
St. George Sound	*H. wrightii*	711
	H. wrightii	277
	Thalassia testudinum	
East Bay	*R. maritima*	166
	V. americana	
	Myriophyllum spicatum	1,179
	Potamogeton pectinatus	
	V. americana	
	R. maritima	
	Najas guadalupensis	187
	R. maritima	25
	R. maritima	55
	P. pectinatus	

along the river channels into East Bay itself. This species will probably continue to spread in East Bay and will probably prevent the expansion of natural species. Other macrophytes that are found associated with Myriophyllum include Vallisneria, Ruppia, and Potamogeton pectinatus. The other macrophyte associates that occur in East Bay are Ruppia and Vallisneria, on the eastern side, and Najas quadalupensis, in East and West bayous. The surveys of submerged vegetation listed by Livingston (1980) and CSA (1985) show significant differences in acreages between them (Table 5). These differences are caused by mapping methods, calculation techniques, changes in species (Myriophyllum), absence of data from eastern St. George Sound (CSA survey), and possibly the actual loss of submerged vegetation in the bay.

The fresh and brackish water submerged species also provide habitat and nursery areas for numerous organisms. Dominant organisms associated with these beds include polychaetes, amphipods, chironomid larvae, snails, amphipods, mysids, crabs and shrimp, rainwater killifish, pipefish, silversides, and gobies (Livingston, 1984).

Because of its position located between upland and offshore habitats, submerged vegetation links dissimilar ecosystems. It tends to act similarly to salt marshes in this respect, and is important to the productivity of estuarine systems because of its function as nursery areas, food sources, and diverse habitats.

Tidal Flats

On the bayward sides of the barrier islands, along the mainland, and in shallow water areas associated with salt and freshwater marshes are located tidal flats, of which little is known in Apalachicola Bay. These unvegetated expanses of mud or sand are exposed at low tide and submerged at high tide. Tidal flats or mud flats are often unappreciated or ignored because their values are not visible (Clark, 1974). As habitats they are subjected to one of the most variable environments in the aquatic system. Organisms inhabiting

Table 5. Distribution and area in acres of submerged vegetation in the Apalachicola Bay system--1980 and 1984 compared (Livingston, 1980; CSA, 1985).

Location	Ground-Truthing Data Summer 1980	Summer 1984
Apalachicola Bay	2,778	1,477
St. Vincent Sound	0	0
St. George Sound	1,542	988
East Bay	3,541	2,153
Total	7,861	4,618

tidal flats must not only cope with extremes of salinity and temperature (heating and freezing) but also with exposure and desiccation.

The Apalachicola Bay system experiences normal tidal fluctuations of 1.5 to 2 feet, with a maximum range of approximately 3 feet (Livingston et al, 1974). The extent of tidal flats therefore covers most nearshore areas shallower than 2 feet at mean high water that are unvegetated. The tidal flats located in the Apalachicola Bay system can be subdivided into two categories: the higher salinity areas in St. George Sound and bayward of the barrier islands, and the low salinity areas near the mouth of the river and in East Bay. Along the length and width of the estuary, all gradations and mixtures of bottom sediments are found which further differentiate the flats and the organisms able to live on them. St. George Sound tidal flats are primarily sand while areas bayward of the barrier islands in Apalachicola Bay range from sand to clay as the dominant sediment type. Areas of tidal flats in East Bay are primarily clay sediments while St. Vincent Sound flats contain more clay than sand (Isphording, 1985).

Organisms associated with tidal flats vary with the salinity regime and the type of substrate, as well as depth of water and time of exposure. The most visible organisms associated with tidal flats behind the barrier islands are oysters. Because of the increased stress in the "flat" environment, these oysters remain small and do not reach the large size of those growing subtidally on bars. They are commonly called "coon oysters" and have been used in replanting programs on the subtidal bars. Tidal flats provide important feeding grounds for finfish at high tide, as well as habitat for a wide variety of crabs, snails, worms and algae. They also provide important feeding and loafing areas for plovers, sandpipers, gulls, ducks, and other birds which find a wide variety of food to eat left by the tide (Taylor et al, 1973).

Soft Sediment

The largest benthic habitat type found in the Apalachicola Bay system is soft sediment, comprising approximately 70 percent of the estuarine area

(Livingston, 1984). This habitat is devoid of vegetation due to high turbidity and color values that limit light penetration. Its composition varies considerably depending on location in the bay (Figure 16). The sediments in East Bay are primarily sandy clay and clayey sand while Apalachicola Bay sediments range from clay and silty clay to clayey sand. St. George Sound sediments are primarily sand with some clayey sand found in the western regions. St. Vincent Sound sediments are composed of clay in the west and sandy clay in the east. The entire habitat is subtidal with the majority of the silt and clay component being river borne and from adjacent upland areas. Many areas also have up to 2 percent shell fragments associated with the bottom sediment (Isphording, 1985).

The soft sediment habitat in Apalachicola Bay provides an important source of food for some of the more dominant fish in the system. Many benthic invertebrates also use this habitat as a burrowing and feeding substrate. The associated community is determined by sediment composition, organic content, and water quality parameters. Biological activity can also affect the sediment composition and animal community. Polychaetes and amphipods are the numerically dominant organisms of this community. The number and diversity of organisms present varies considerably, both seasonally and spatially throughout the estuary. Low salinity areas typically are characterized by high dominance, low diversity, and variable numerical abundance; while high salinity areas are characterized by lower numerical abundance, low dominance, and higher diversity.

Many of the commercially important benthic invertebrates are harvested from this habitat (Table 6). Shrimp and blue crabs are not restricted to this environment but feed and burrow extensively here when they leave the protection of the marshes as they mature. The soft sediments contain nutrients and detritus brought in from the river as well as providing an ideal substrate for bacteria. The Atlantic croaker and spot also feed extensively in this habitat. Most of the other important benthic invertebrates and epibenthic fishes are also associated with this habitat at one time during their life cycle. For a more detailed description of the soft sediment community consult Livingston (1984).

Table 6. Summary of Selected Franklin County Shellfish Landings (1974-1985)

	Blue Crabs	Oysters	Shrimp	Total Shellfish
1974				
Quantity[1]	1,444	2,454	3,964	7,874
Value[2]	180	1,371	2,681	4,235
1975				
Quantity	1,659	2,033	4,486	9,000
Value	224	1,107	4,300	6,061
1976				
Quantity	1,742	2,503	3,160	9,679
Value	300	1,591	4,570	7,837
1977				
Quantity	1,106	3,894	4,420	9,822
Value	214	2,820	5,051	8,305
1978				
Quantity	888	5,566	4,931	11,885
Value	189	4,222	5,786	10,441
1979				
Quantity	1,219	5,810	2,714	9,883
Value	243	4,869	5,260	10,464
1980				
Quantity	1,313	6,410	2,890	11,163
Value	280	5,739	4,690	11,077
1981				
Quantity	1,640	6,617	4,788	13,764
Value	374	6,463	7,983	15,307
1982				
Quantity	1,011	4,153	3,047	8,319
Value	275	4,150	6,399	10,933
1983				
Quantity	984	3,936	3,621	8,541
Value	343	4,158	7,956	12,466
1984				
Quantity	1,287	6,199	4,164	11,650
Value	372	6,803	7,985	15,160
1985				
Quantity	1,433	3,786	3,873	9,092
Value	527	4,311	7,154	11,992

Source: Florida Department of Natural Resources, Summary of Florida Commercial Marine Landings.

[1] Quantity: in 1,000s of pounds.
[2] Value: in 1,000s of dollars.

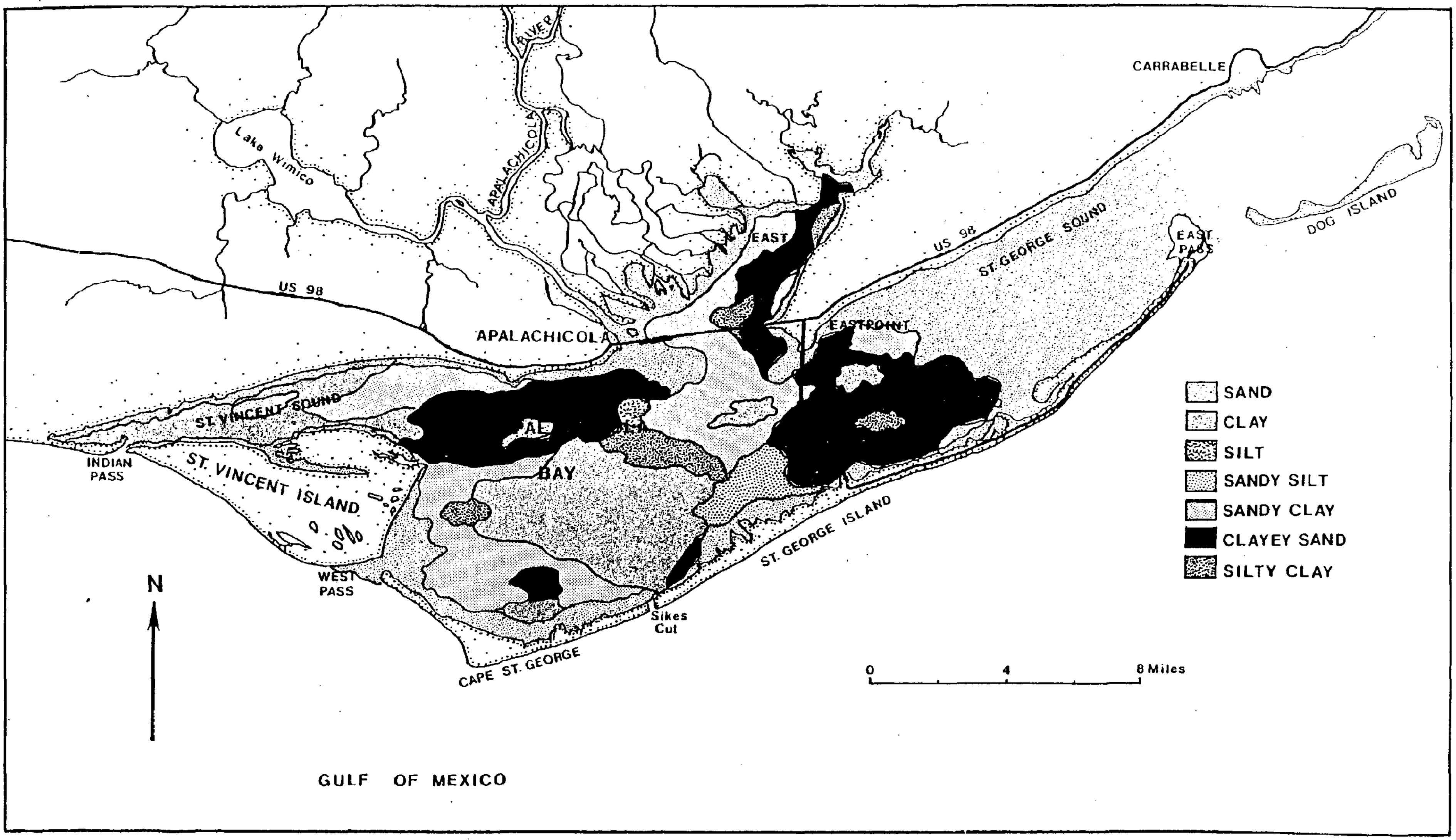


FIGURE 16. BOTTOM SEDIMENTS OF THE APALACHICOLA ESTUARY (Isphording,1985).

Marshes

Marsh systems are among the most productive in the world and are vital habitats for important sport and commercial species. Marshes found in the Apalachicola Bay system include fresh, brackish, and salt marshes and cover approximately 14 percent of the total aquatic area (Livingston, 1980). Their distribution is mainly limited to the intertidal areas along the perimeter of the bay and the delta area of the lower river and East Bay (Figure 17). Since the amount of organic material exported out of the marsh into the estuary is still being debated (de la Cruz, 1980), the most important function of marshes may be as a nursery habitat. Marshes fulfill the three general criteria that characterize a nursery ground: 1) an area must provide some protection from predators; 2) it must provide an abundant food supply; and 3) it must be physiologically suitable in terms of physical and chemical features (Joseph, 1973).

The most developed marsh systems are found in East Bay and along the lower reaches of the Apalachicola River (Table 3, Figure 17). An extensive system of tidal creeks and bayous extends northward increasing shoreline area and suitable regions for marsh development. The marshes here support predominantly fresh to brackish water vegetation consisting primarily of bullrushes, cattails, and sawgrass. Black needlerush and cordgrasses are also present in the more brackish areas of East Bay (Livingston, 1983). St. Vincent Sound also supports a large brackish and salt-marsh system, primarily located along the northeastern areas of St. Vincent Island. The dominant species are black needlerush, cordgrass, and saltgrass. Freshwater marshes also occur on St. Vincent Island with sawgrass being the dominant feature (Thompson, 1970). A survey conducted by Miller et al, (1980) found a shift in the composition of the freshwater marshes from mostly sawgrass to a sawgrass and cattail dominated system. Refuge personnel have also recently seen an increase in cattail coverage with a subsequent decrease in other species which are more beneficial to wildlife (Terry Carroll, personal communication). The lagoon and tidal creeks of Cape St. George, St. George, and Dog islands also support narrow bands of brackish and salt marshes. These

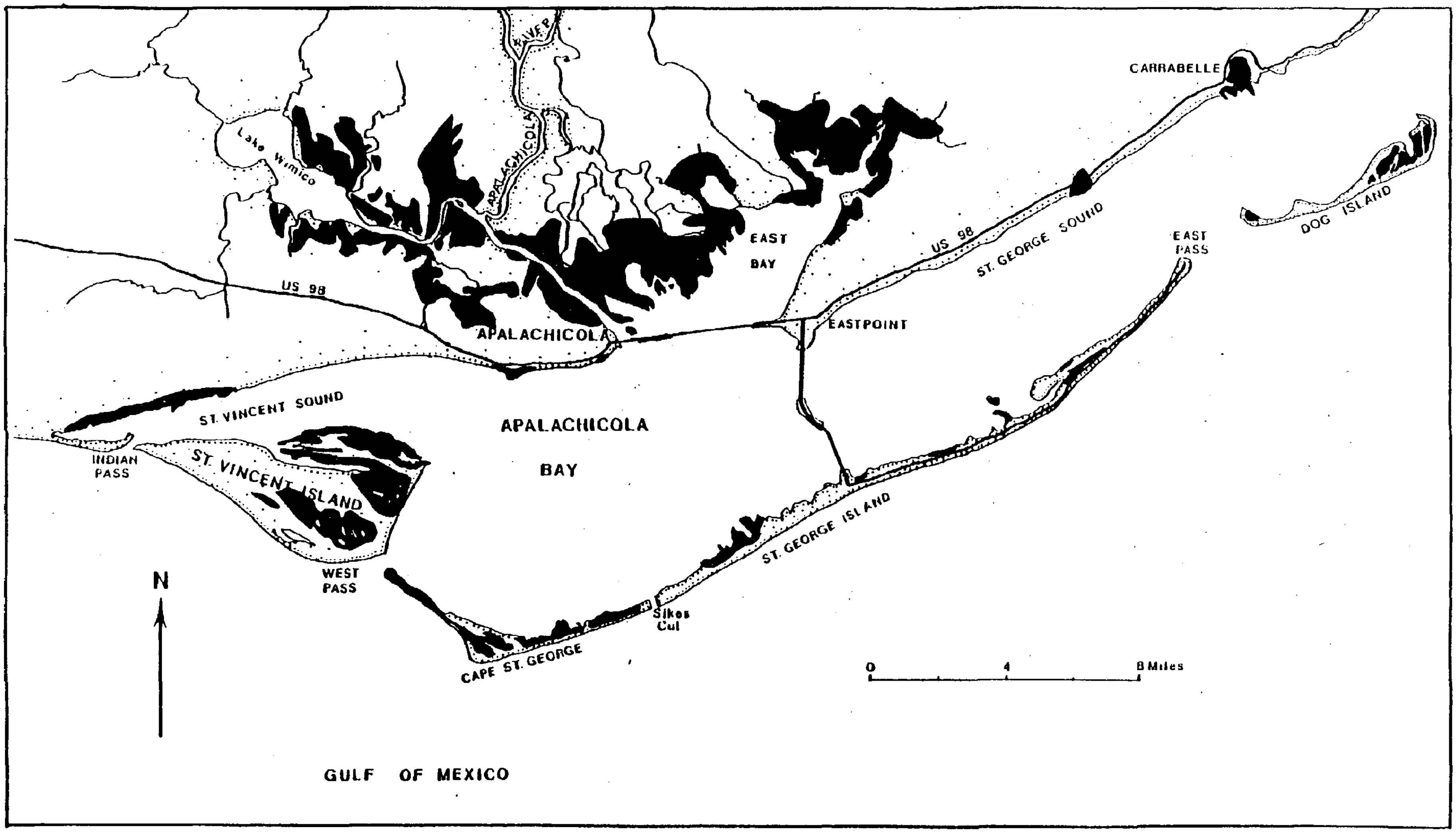


FIGURE 17. MAJOR MARSHES OF THE APALACHICOLA ESTUARY [Livingston,1983].

are generally dominated by black needlerush with lesser amounts of cordgrass and saltgrass also present (Livingston, 1984).

Plants associated with marshes must contend with rapid changes in environmental conditions, which restrict the number of species found in these habitats. Because of stressful conditions, salt marshes typically exhibit low plant diversity and in many instances consist of one or two species, with black needlerush and cordgrass dominating in this area. Occupying a vertical gradient of approximately 3-5 feet, the vegetation is not organized into integrated communities but, instead, the species occur in zones defined by salinity, tides, and the soil moisture regime. Brackish marsh habitats are usually not as stressful as salt marshes and therefore the number of species found is usually greater (Clewell, 1986). The paucity of species is usually offset by the extremely dense concentrations of those present. Brackish marsh vegetation is also more variable spatially than salt marshes due to the differing salinity regimes encountered as the distance from the estuary increases. Eventually the brackish marsh vegetation is replaced by less tolerant species and becomes a freshwater marsh when salinities average less than 0.5 ppt (parts per thousand). The freshwater marsh system will be further discussed in the river floodplain section.

Animals associated with marsh systems must also withstand the rapid changes in environmental conditions. Since only about 10 percent of vascular plant material produced in the marsh is consumed directly by herbivores (Heard, 1982), most organisms found in the marsh are predators and detritivores. Because of the importance of this habitat as a nursery area, organisms are typically grouped into permanent and transitory categories. Permanent residents include invertebrates such as insects, polychaete worms, amphipods, mollusks, larger crustaceans, and other omnivorous groups which play an important role in the breakdown of organic matter. Year-round residents also include mammals such as muskrats, and birds such as the clapper rail and great blue heron. Transitory residents include such species as blue crabs, penaeid shrimp, anchovies, largemouth bass, striped mullet, spotted and sand seatrout, and lepomids (Livingston, 1984). These and other important estuarine organisms use the marsh habitat as either a nursery ground, breeding area, or feeding zone. The summer and fall in Apalachicola Bay is the most critical period when the marsh is used as a nursery area. The marsh is also important to wildlife such as river otters, raccoons, alligators, and turtles. Transitory birds in marshes comprise one of the larger herbivorous groups and are also significant top carnivores in the system. Northeastern Gulf of Mexico marshes support summer nesting species, migrants, casual feeders, and summer visitors (Stout, 1984). Birds of prey that utilize the marsh system include hawks, owls, ospreys, and bald eagles which not only feed on fish but also small rodents found in the marsh.

Marshes are unique, multifaceted natural systems which are valuable for food and nutrient sources, faunal habitats, water purification, shoreline stabilization, storm buffers, and recreation. These systems have been viewed as having little value or use until recent times; therefore, many thousands of acres have been "enhanced" over the years to more "productive" uses by dredging and filling to convert them to open water or upland areas. The Apalachicola Bay system has escaped major alteration of the marsh system so far, although threats from pollution, watershed modification, construction, and dredge and fill activities continue to destroy small parcels of this important habitat even as regulatory measures to protect these areas are implemented.

Open Water

The simplest habitat to physically define and one of the hardest to measure is the open water. This habitat is simply the water which occupies the estuarine basin and is in contact with the Gulf and the river. Depths in Apalachicola Bay average six to nine feet and all major water bodies in the estuary combined cover an area of approximately 63,000 hectares (Table 3). This makes the open water the largest habitat in the system. All the habitats previously described are similar in that type of substrate is an important component of the habitat, influencing its character and associated community. Since there is no substrate associated with the open water habitat, it is mainly influenced by depth, salinity, temperature, currents, and other parameters such as turbidity and color. Turbidity and color limit light penetration, therefore, the upper layer of this habitat is in the photic zone while the remainder is below it.

Organisms associated with the open water habitat include planktonic forms (weak swimmers at the mercy of currents), and nektonic forms (strong swimmers). Most planktonic forms are microscopic and are important in the pelagic food chain. Numerous studies have been conducted on phytoplankton (Estabrook, 1973; Myers and Iverson, 1977), zooplankton (Edmiston, 1979), and ichthyoplankton (Blanchet, 1979) and these will not be discussed in this report. In the Apalachicola Bay system, the majority of organisms which comprise the sport and commercial fisheries are nektonic (Livingston, 1984). Important commercial species such as shrimp and crabs have limited swimming ability and also utilize the water column. The larva of shrimp, crab, oysters, and fish are also planktonic and utilize the water column for food, protection, and distribution purposes.

The major component of the nekton in Apalachicola Bay is dominated by estuarine dependent fish. Menzel and Cake (1969) estimate that three-fourths of the commercial catch in Franklin County is dependent on the estuarine habitat and condition of Apalachicola Bay. These species include true estuarine forms, those that use the estuary part of their life cycle for feeding and as a nursery ground; migratory forms (i.e. anadromous and catadromous species); and fresh and salt water forms which enter the estuary when conditions are appropriate. Data supplied to the National Marine Fisheries Service (NMFS) by local seafood dealers in Franklin County is summarized in Table 7. These data show that mullet, flounder, and spotted seatrout (speckled trout) are the three most important commercial species of fish, both in terms of numbers and dollar value, in the Apalachicola Bay system. It can also be seen from this table that there has been an overall decline in estuarine landings from 1971 to 1982, while the percentage catch of offshore landings has increased. Although this decline is unexplainable at the present time, fishing pressure is believed to be a major cause. The Florida Marine Fisheries Commission has imposed a minimum size limit of 16 inches for redfish caught in Franklin County due to declining numbers, and

Table 7. Summary of Selected Franklin County Finfish Landings (1971-1985)

	Mullet	Flounder	Spotted Seatrout	Redfish	Croaker	Spot	Total Estuarine Finfish	Total Finfish
1971								
Quantity[1]	916	91	107	21	27	42	1,204	2,156
Value[2]	92	26	32	3	3	3	159	252
1972								
Quantity	1,146	97	124	20	6	29	1,422	2,054
Value	115	29	39	3	1	2	189	257
1973								
Quantity	1,214	79	96	26	6	25	1,446	2,216
Value	158	27	34	4	1	2	226	376
1974								
Quantity	645	55	76	28	11	19	834	1,413
Value	91	19	28	6	1	2	147	343
1975								
Quantity	984	71	74	36	14	13	1,192	1,679
Value	154	23	29	8	<	1	215	400
1976								
Quantity	745	66	101	40	4	4	960	1,472
Value	132	23	43	9	1	<	208	431
1977								
Quantity	539	59	48	22	1	4	673	878
Value	103	25	22	5	<	<	155	268
1978								
Quantity	670	40	49	10	10	3	782	1,060
Value	134	6	25	3	1	<	184	327
1979								
Quantity	645	56	53	11	2	7	774	1,331
Value	118	29	32	4	<	1	184	634

Table 7 continued.

	Mullet	Flounder	Spotted Seatrout	Redfish	Croaker	Spot	Total Estuarine Finfish	Total Finfish
1980								
Quantity	722	90	29	9	3	6	859	1,642
Value	140	47	18	3	1	1	210	954
1981								
Quantity	659	68	51	10	6	4	798	1,663
Value	144	37	33	4	1	1	220	1,164
1982								
Quantity	653	95	55	7	4	10	820	1,907
Value	151	50	38	3	1	2	245	1,414
1983								
Quantity	920	88	55	14	3	13	1,093	2,120
Value	210	47	40	6	1	3	307	1,508
1984								
Quantity	896	86	51	9	1	17	1,060	1,585
Value	209	49	39	4	<	3	305	961
1985								
Quantity	482	78	47	8	3	4	622	1,103
Value	116	49	38	4	1	1	209	816

Source: Florida Department of Natural Resources, Summaries of Florida Commercial Marine Landings.

1. Quantity: in 1,000s of pounds.
2. Value: in 1,000s of dollars.

Table 8. Seasonality of Important Apalachicola Bay Fishes (modified from Leitman et al, 1986)

Anchovy	Year-round residents. Spawn from spring to fall with a peak in May. Highest population in summer and fall, lowest in winter.
Mullet	Migrate and spawn offshore October to February. Highest population in bay in summer and fall. Many young overwinter in deep holes.
Southern Flounder	Present year-round. Many migrate offshore to spawn in winter. Juveniles arrive in bay in spring and summer.
Gulf Flounder	Migrate offshore in winter. Juveniles return February through April.
Croaker	Adults migrate offshore summer to fall. Juveniles return in October. Juveniles remain in bay their first summer and migrate offshore in winter.
Spot	Juveniles and adults migrate offshore from late summer to winter and return in later winter, early spring. Post-larvae return in January.
Spotted Seatrout	Generally, year-round residents but may migrate offshore during low salinity or temperature. Most abundant in spring. Spawn in spring and summer, sometimes even until October. Also spawn offshore of barrier islands.
Sand Seatrout	Migrate to spawn just offshore of barrier islands from October to March. Most abundant in summer and early fall.
Redfish	Spawn offshore from September to February. Post-larvae arrive in bay September to December. Remain in or near estuary for two years then spend more time at sea.

is considering imposing size limits on spotted seatrout as well. In addition, the Commission has drafted a new rule that would make redfish a gamefish in Florida by prohibiting its sale and raising the statewide minimum size limit to 18 inches. Several other species, both estuarine and marine, are currently being investigated for regulation due to their declining numbers. An interesting item in Table 7 is that while landings have decreased, the value of the landings have almost doubled, thereby increasing fishing pressure. It should be realized that the NMFS data is biased toward commercially important species due to the desirability of these species by the consumer.

A long-term monitoring program by Dr. R. J. Livingston and the Florida State University Aquatic Study Group takes into account fish species in the bay which are numerous and are also important in the food chain. Studies by Livingston (1980, 1983, 1984) and Livingston et al (1974, 1976, 1977) show that the four most numerous fish in the Apalachicola Bay system are bay anchovy, Atlantic croaker, sand seatrout, and spot. While croaker and spot are commercially fished, neither contributes significantly to total landings. They are important however in the estuarine food chain. The numerical abundance of fish in the estuary is dependent on the seasons. Low temperatures and salinities force many species offshore during winter while others migrate for spawning or nursery reasons. Table 8 lists the important fish species in Apalachicola Bay and their seasonality in the system. All of these fish are found in the open water habitat at some time in their life cycle, even those which use the marshes and seagrass beds as nursery areas.

Apalachicola River Floodplain System

The floodplain of the Apalachicola River is the largest in Florida and one of the larger floodplains on the Gulf Coast. Floodplains in the Southeastern United States are in many instances the last refuge for rare and endangered plants and animals. Although floodplain land, like swampland or marsh land, is usually considered the least desirable in terms of real estate value, it is probably some of the most valuable land around considering the natural benefits derived from it.

Physiography

The Apalachicola River floodplain encompasses approximately 15 percent of its drainage area in Florida, about 144,000 acres. The Chipola River, about which little is known, drains the same area as the Apalachicola, but its floodplain encompasses only 27,000 acres (Wharton et al, 1977; Elder and Cairns, 1982). Alluvial river floodplains, like the Apalachicola, have broad flat floodplains due to their annual high water levels (Figure 18). In order to describe the floodplain, it has been divided into three sections, upper, middle and lower; in a manner similar to the riverine section to take advantage of the naturally occurring divisions.

The upper river floodplain, from Chattahoochee to Blountstown, is the narrowest ranging from one to two miles wide. It is limited on the eastern side by the steep bluffs of the Tallahassee Hills where elevations up to 325 feet occur (Figure 2). The western side of the floodplain is bounded by the Grand Ridge province, a gently rolling region which gradually rises to elevations as high as 125 feet. Natural riverbank levees are higher and wider here than the rest of the river ranging up to 15 feet above the surrounding floodplain and from 400 to 600 feet wide. Since the river is more "contained" in this section than in others, the fluctuation in water level is also greater, ranging from 19 to 24 feet.

The middle river floodplain from Blountstown to Wewahitchka varies from two to three miles wide. The Gulf Coastal Lowlands bound both sides of the floodplain in this section except for the upper reaches which are bordered by Beacon Slope and Grand Ridge. Generally upland elevations are less than 100 feet throughout this section. The natural riverbank levees are smaller than in the upper river ranging from eight to 12 feet higher than the surrounding floodplain and from 200 to 400 feet wide. Water level fluctuations are also less, ranging from 11 to 19 feet above low stage during flood stage.

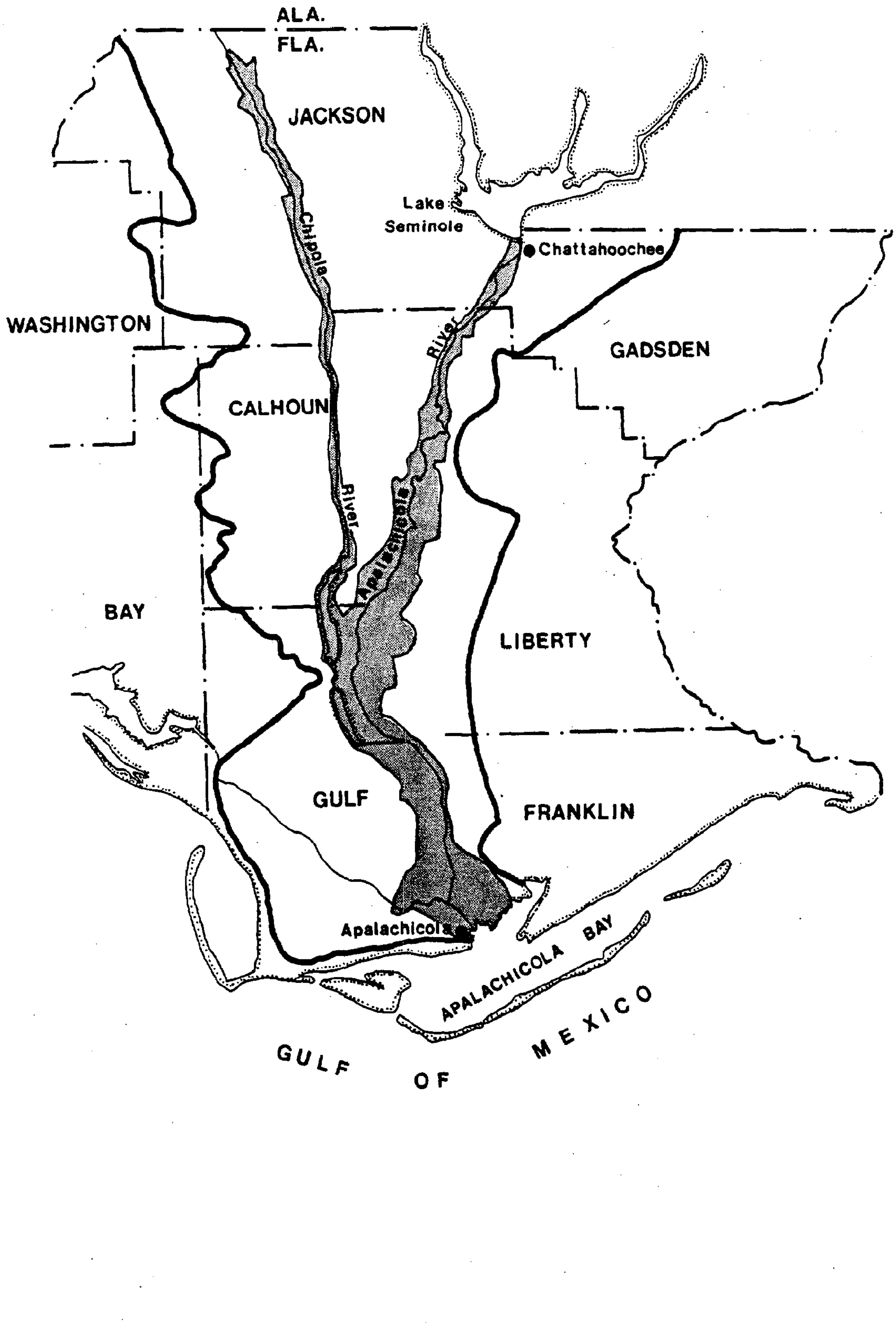


FIGURE 18. APALACHICOLA & CHIPOLA RIVER FLOODPLAINS (Wharton et al,1977)

The lower river floodplain from Wewahitchka to Apalachicola exhibits the greatest width ranging from 2.5 to 4.5 miles across. It is completely within the Gulf Coastal Lowlands and surrounding uplands do not exceed 50 feet in elevation. The natural riverbank levees vary from 2 to 8 feet higher than the surrounding floodplain and are 50 to 150 feet wide on the average. Water level fluctuations throughout the year range from 7 feet at Sumatra to 11 feet at Wewahitchka (Leitman et al, 1983; Leitman, 1983).

Very little seems to be known concerning the floodplain of the Chipola River. Spring fed streams like the Chipola typically have narrow floodplains due to less flow variability and low sediment loads (Figure 18). The upper Chipola River water level only fluctuates approximately 1 to 2 feet, caused mainly by heavy rainfall which keeps the width of the floodplain small. Lower river water level fluctuation normally ranges from 4 to 6 feet and again is mainly dependent on runoff for this variation (FGFWFC, 1959). Part of the floodplain in the river was permanently inundated and became Dead Lakes when high floodplain deposits of the Apalachicola River blocked off the Chipola River north of Wewahitchka (Vernon, 1942). The water level in this natural lake has since been maintained by an artificial weir. The dead stumps of cypress and gum attest to the fact that this area was once part of the floodplain. The Northwest Florida Water Management District has decided to remove the weir to let the water levels return to naturally controlled conditions but has been held up by a lawsuit filed by property owners on the lake.

Floodplain Dynamics

Floodplains represent a zone of transition between upland and aquatic systems and; therefore, have characteristics of both. In order to understand the biota of floodplains, an understanding of how floodplains are formed, their features, and how they are maintained is necessary. The two most important parameters responsible for floodplain characteristics are river flow and sediment load carried by the river. The type of river, the river's characteristics, determines the type of floodplain that will develop. As mentioned previously, the Apalachicola is an alluvial river originating in the Piedmont and, therefore, its floodplain is typical of alluvial river floodplains that are continually reworked by the river.

Alluvial rivers characteristically have a variable seasonal flow, substantial annual flooding, and a heavy sediment load. The continual erosional and depositional processes acting within the river causes the river channel to be in a constant state of change, even during low flow. The deposition and erosion of material in the river eventually creates meanders which widens the river valley, decreases slope, slows down water velocity, and allows more sediments to be deposited; thereby continuing the movement of the river channel laterally. During high flow, rivers not only erode and deposit sediments on the floodplain, but they are also capable of creating new channels by cutting off meanders or blocking mouths of tributaries forcing them to create new channels (i.e. Dead Lake and the Chipola Cutoff). As the river adjusts and stabilizes, floodplain features are formed which can be discerned by topography and soil characteristics.

The river channel is the most prominent floodplain feature and its morphology is dependent on long-term flow patterns (Blench, 1972). The river channel moves laterally within the floodplain by eroding the concave bank (outside bank) of a meander and depositing material on the convex bank (inside bank). The Corley Slough reach of the Apalachicola River has moved approximately 300 feet from 1959 to 1982 by meandering. It is estimated that the west bank has been eroding at a rate of 16 feet per year since 1982. Some of this has been caused by maintenance of the navigational channel; however, this area has historically been an area of active meandering. Stream bed degradation due to the Jim Woodruff Dam has been documented by the COE, especially in the upper reaches. Since 1957, the channel bed has been degraded from three feet at Chattahoochee to 1.4 feet at Blountstown (COE, 1986). As the bed degrades, the flow of water needed to inundate the floodplain increases and the exchange of water between the river and tributaries is also affected. Any change in the channel characteristics has the potential to impact the floodplain and alter habitats which have developed in response to the channel.

The natural levees of the Apalachicola River play an important role in determining the amount of time the floodplain is inundated by maintaining the river within its channel until overbank stage is reached. Natural levees are formed on the banks of rivers as water spreads out over the floodplain during periods of overbank flow. As the water spreads out, the velocity decreases and suspended sediments are deposited parallel to the channel. These natural levees create a diversified habitat due to their height above the surrounding floodplain. Old levees can be seen scattered throughout the floodplain denoting previous river channel locations and meanders (Figure 19). Levees on the Apalachicola range from 2 to 15 feet in elevation and from 50 to 600 feet wide, depending on location. Levees not only keep water in the channel during rising water but they also keep the floodplain inundated longer during decreasing water levels. During periods of low flow levees are important features which help keep the backswamps of the Apalachicola floodplain wet by preventing local rainfall from draining into the river immediately (Leitman et al, 1983).

Backswamps or flats refer to those areas between the valley wall and the natural levee which are low in elevation (Figure 19). Small changes in elevation in these areas, especially in the lower river, create different soil conditions and help increase the diversity of the floodplain. Backswamp soils stay wet, saturated or inundated most of the year and are almost impermeable, due to their high percentage of fine silts and clays. Backswamps are also known as peat-forming environments.

Point bars form on the convex (inside) bank of bends by aggradation of sediments (Figure 19). During floods, small ridges are formed which act as temporary levees. As aggradation continues, interspersed with periodic flooding, a series of ridges with swales in between are formed. Because material eroded from one bend (meander) is usually deposited on the next point bar downstream, the floodplain is continually reworked (Wharton et al, 1982). Due to the elevational differences, which cause velocity changes, sand is usually deposited on the ridges and silts and clays in the swales. These sediment differences influence not only water retention but also vegetational

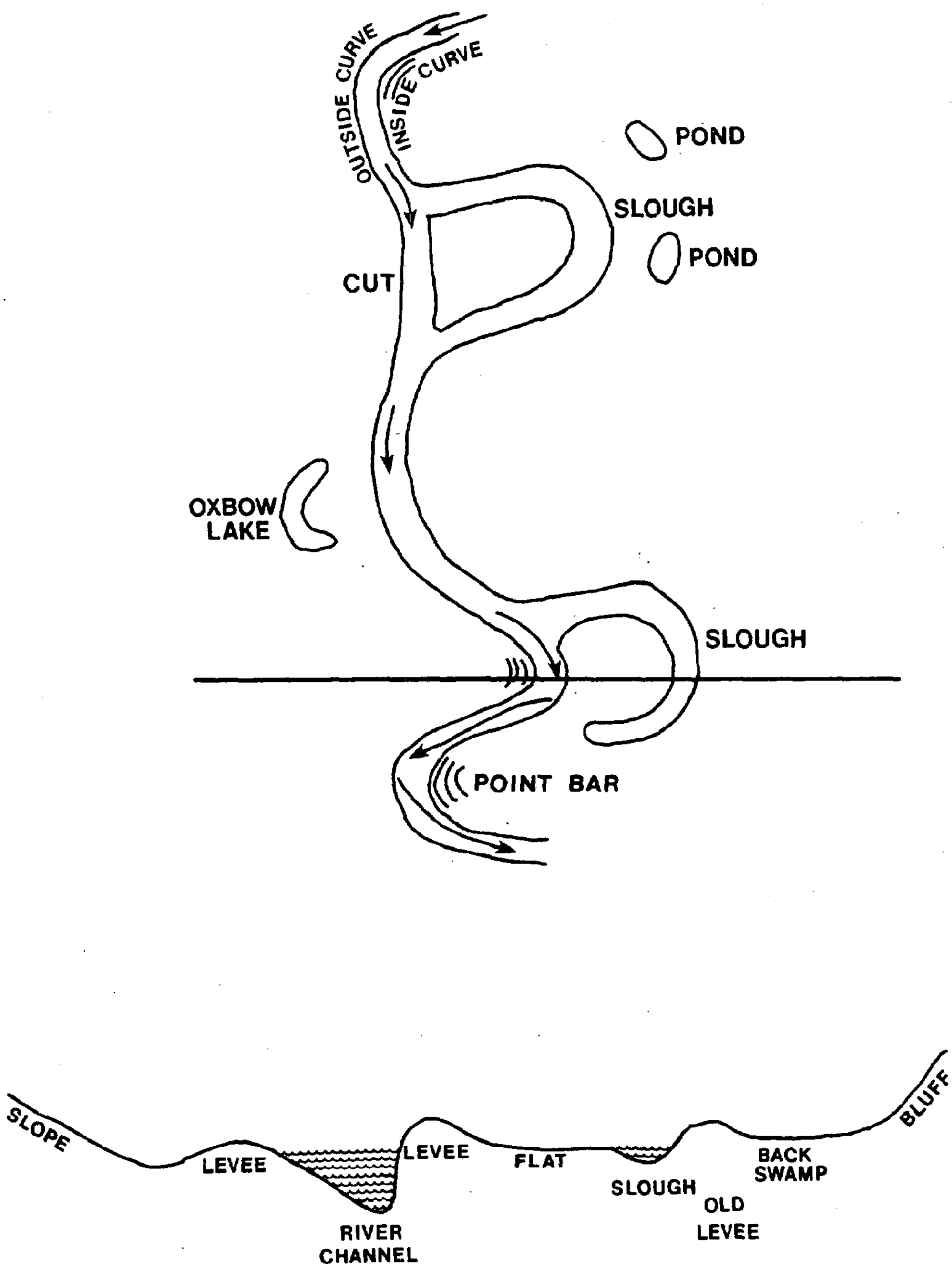


FIGURE 19. MAJOR FEATURES OF THE APALACHICOLA RIVER FLOODPLAIN [modified from Clewell,1986].

diversity. Due to disposal of dredge material on these sites, few natural point bars remain unaffected by spoil on the Apalachicola River (Ager et al, 1984).

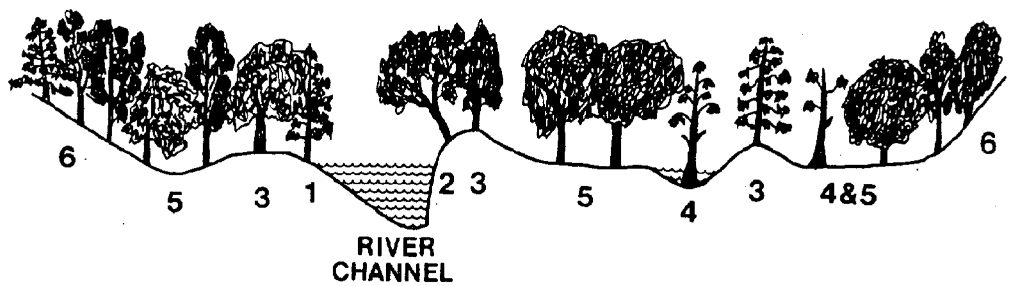
Other features such as scour channels, hummocks and minibasins, although not as prominent topographically, have a pronounced effect on plant distribution due to their slight elevational differences. Scour channels are small waterways which connect tributaries and depressions to the main channel and create shortcuts for water during high flows. Hummocks are areas of higher elevation left between scour channels or elevated areas left around the bases of trees. The small change in elevation of hummocks is enough that trees which cannot withstand 100 percent inundation can sometimes take root. Minibasins are small depressions which trap detritus and rainwater and are responsible for much of the nutrient recycling accomplished on floodplains (Wharton et al, 1982). All these features together create a diversity of soil conditions and inundation characteristics, which accounts for the wide range of plant associations occurring on the Apalachicola floodplain.

Forested Floodplain

Because floodplains occupy the transitional zone between aquatic and upland areas and are constantly changing, they are difficult to classify into distinctive habitats besides forested and nonforested. Of the 144,000 acres of floodplain on the Apalachicola River, approximately 85 percent is forested. The 121,000 acres of forested floodplain is the largest in the state with almost twice the area of the next largest floodplain. The term normally applied to forested floodplains in the Southeastern United States is bottomland hardwoods and generally includes wooded swamps, shrub swamps and seasonally flooded basins and flats (which are forested). Florida ranked second in the nation behind Louisiana in area of bottomland hardwoods with almost 16 percent of the state in bottomland hardwoods as of 1970 (Turner et al, 1981).

Attempts to classify bottomland hardwoods and floodplains themselves are numerous and usually include soil characteristics, degree and duration of flooding, floodplain features, and floristic characteristics (Cowardin et al, 1979; Larson et al, 1981). Several early studies of the Apalachicola floodplain identified general features as well as important vegetational relationships (Harper, 1911; Kurz, 1938; Hubbell et al, 1956). The most detailed studies of the floodplain to date, however, are those of Leitman (1978, 1983a, 1983b) and Clewell (1971, 1977, 1986). According to Clewell (1977) the major land use of the floodplain since the civil war has been forestry with most areas timbered between 1870 and 1925. Since that time, these same areas have been logged once or twice. Prior to the civil war, much of the upper river floodplain was used for growing cotton due to the fertile soils (Leitman, 1985). Therefore, the floodplain vegetation as it is today has been modified by man for over 100 years.

Clewell (1977, 1986) has identified at least six different vegetation types in the Apalachicola floodplain, which as he says "...are not always sharply differentiated from each other." He relates these forest types to floodplain features with the more water-tolerant species occurring in low areas and less tolerant species occupying higher elevations (Figure 20). The relationship between species distribution and elevation is not an accident. In floodplains, the most important determinant in the distribution of forest type is the presence of anaerobic conditions. Anaerobic conditions are related to the hydroperiod characteristics of the river and the elevation of floodplain features. The height, length of time and seasonality of flooding affects plant distribution on the floodplain by creating anaerobic conditions which some species can tolerate and others cannot. Depletion of available oxygen can occur in saturated soils in as little as three days. Areas which are inundated less often and for shorter periods support species which are intolerant of prolonged flooding (anaerobic conditions). Some species such as bald cypress and water tupelo have modified root structures which allow them to survive and prosper in low areas which are subject to lengthy flooding (Wharton et al, 1982).



#	Forest Types	Features Associated with
1	Black willow, cottonwood, sycamore	Aggrading sand bars
2	River birch, ogeechee-tupelo, alder	Steep river banks
3	Swamp chestnut oak, spruce pine, ironwood, water oak, sweetgum-(mixed hardwoods)	Natural levees
4	Bald cypress, water tupelo	Sloughs and oxbow lakes
5	Overcup oak, water hickory, diamond-leaf oak, ash	Low terraces
6	Loblolly pine, sweetgum	Slopes toward uplands

FIGURE 20. FOREST TYPE AND THEIR RELATIONSHIP WITH FLOODPLAIN FEATURES (modified from Clewell, 1977; 1986).

Leitman et al, (1983) has done the most detailed study on the Apalachicola floodplain forest types to date. Forty-seven species of trees were identified and density and basal areas were measured at various transects throughout the river. The three most predominant trees in terms of number are water tupelo, Carolina ash, and possumhaw. Based on basal area, the three most predominant trees are water tupelo, ogeechee tupelo and bald cypress. The floodplain is dominated by six wet-site species (water tupelo, ogeechee tupelo, bald cypress, Carolina ash, swamp tupelo and planer tree), which account for approximately 48 percent of the number and 65 percent of the basal area of trees found (Table 9). The upper river floodplain exhibits the highest diversity with 35 species, while 27 species have been found in the lower river floodplain.

Six forest types have been identified on the Apalachicola River floodplain using color infrared photographs and cruise transect data (Leitman, 1983; Leitman et al, 1983). The dominant and associated species found with them are the distinguishing characteristics used to separate these types from each other (Table 10). Acreage and distribution of forest types have also been included (Table 11).

The pine forest association is found on some of the highest elevations in the floodplain, near uplands or "islands" of higher elevation than the surrounding floodplain. This association consisting primarily of loblolly and other pines occurs mostly in the middle river stretches but is found in all three sections of the floodplain (Figures 21-24). Because this association needs drier soil conditions, it represents less than 1 percent of the floodplain area. Areas in which the pine forest type is found are inundated less than 10 percent of the year.

The pine and mixed hardwoods forest is found in areas with conditions similar to the pine association. Predominant species of this forest type are sweetgum, sugarberry, water oak, and loblolly pine. It is found throughout the river but has been found chiefly in the middle river sections and covers approximately 2 percent of the floodplain area (Figures 21-24).

Table 9. Tree Species of the Apalachicola River Floodplain (Leitman et al, 1983).

Species	Relative Basal Area In Percent	Relative Density In Percent
Water tupelo	29.9	12.8
Ogeechee tupelo	11.0	6.6
Bald cypress	10.6	5.5
Carolina ash	5.4	11.5
Swamp tupelo or blackgum	5.0	2.0
Sweetgum	4.8	3.2
Overcup oak	3.2	2.0
Planer tree	2.9	9.4
Green ash	2.9	2.7
Water hickory	2.9	0.8
Sugarberry or hackberry	2.8	2.1
Diamond-leaf oak	2.5	1.4
American elm	2.4	1.2
American hornbeam	2.0	4.7
Pumpkin ash	1.9	4.4
Water oak	1.8	0.5
Red maple	1.5	4.8
Sweetbay	1.0	0.5
River birch	0.8	0.7
Possumhaw	0.8	10.5
American sycamore	0.6	0.3
Swamp cottonwood	0.4	0.4
Black willow	0.4	0.4
Swamp chestnut oak	0.3	0.1
Box elder	0.3	0.8
Other 22 species	2.0	10.7

Table 10. Forest Types of the Apalachicola River Floodplain (modified from Leitman, 1983).

Name	Predominant Species	Associated Species	Percent Coverage
Pine	Loblolly pine and other pines	Sweetgum, sugarberry, water oak, possumhaw, American hornbeam	1%
Pine and mixed hardwoods	Sweetgum, sugarberry, water oak, loblolly pine	American hornbeam, possumhaw, diamond-leaf oak, green ash	2%
Mixed hardwoods	Water hickory, sweetgum, overcup oak, green ash, sugarberry	Diamond-leaf oak, water oak, American elm, possumhaw, red maple	43%
Tupelo-Cypress with mixed hardwoods	Water tupelo, ogeechee tupelo, bald cypress, swamp tupelo, Carolina ash, planer tree	Overcup oak, pumpkin ash, red maple, water hickory, American elm, green ash, diamond-leaf oak, sweetbay	24%
Tupelo-Cypress	Water tupelo, bald cypress, ogeechee tupelo, swamp tupelo	Carolina ash, planer tree, pumpkin ash, sweetbay	15%
Pioneer	Black Willow	American sycamore, swamp cottonwood, river birch, green ash	0.1%
		Forested	85%

Table 11. Area, in Acres, of Each Forest Type for Five Reaches of the River (Leitman, 1983).

Forest Type	Upper River	Middle River	Lower River from Wewahitchka to Sumatra	Lower River from Sumatra to Mile 10	Lower River from Mile 10 to Mouth	Total
Pine	136	672	0	204	0	1,010
Pine and Mixed Hardwoods	642	1,440	154	474	0	2,710
Mixed Hardwoods	12,500	32,200	15,800	1,770	48	62,300
Tupelo-Cypress with mixed hardwoods	1,170	1,860	8,310	15,800	6,920	34,100
Tupelo-Cypress	2,420	2,270	6,240	10,300	456	21,700
Pioneer	0	150	19	0	0	169
Marsh	0	0	0	0	9,030	9,030
Open water	2,730	3,110	1,540	2,010	1,260	10,700
Unidentified	1,020	748	81	76	19	1,950
Total	20,600	42,500	32,100	30,600	17,700	144,000

The mixed hardwood forest type is the largest association found in the Apalachicola floodplain, covering 43 percent of the area. In the upper and middle river sections, it is found across the entire floodplain covering 78 percent of the area, but is restricted to the natural levees in the lower, tidally influenced section of the river (Figures 21-24). Predominant species are water hickory, sweetgum, overcup oak, green ash and sugarberry. There appears to be a shift in species importance from the upper to lower floodplain with sweetgum and sugarberry becoming less numerous in the lower river. This forest type is the association usually found on levees, terraces, and areas that are inundated from 5 to 30 percent of the year.

The second largest forest type found on the Apalachicola floodplain is the tupelo-cypress with mixed hardwoods association. Covering 24 percent of the entire floodplain, it is most often found in the lower river where it covers 41 percent of the area (Figures 21-24). Dominant species of this forest type are water tupelo, ogeechee tupelo, bald cypress, swamp tupelo, Carolina ash, and planer tree. Occupying low flats, sloughs and hummocky areas which provide small variations in elevations, this is mostly a wet-site forest. Areas occupied by this forest type are inundated or saturated from 50 percent (hummocks) to 100 percent (sloughs and pools) of the year.

The tupelo-cypress association is found in areas where the soil is poorly drained, such as backswamps and low flats. This is also a wet-site forest and is found mostly in the lower river floodplain. It accounts for 15 percent of the entire floodplain area (Figures 21-24). Dominant species are water tupelo, bald cypress, ogeechee tupelo and swamp tupelo. All four species have modified root systems which are capable of surviving anaerobic conditions characteristic of long periods of inundation. Areas in which this forest type are found usually have heavy clay soils which are inundated more than 50 percent of the year and saturated continuously.

The pioneer forest type is the smallest association on the floodplain covering only about 169 acres. Black willow is the dominant species and in many cases is the only species present. Found in narrow zones

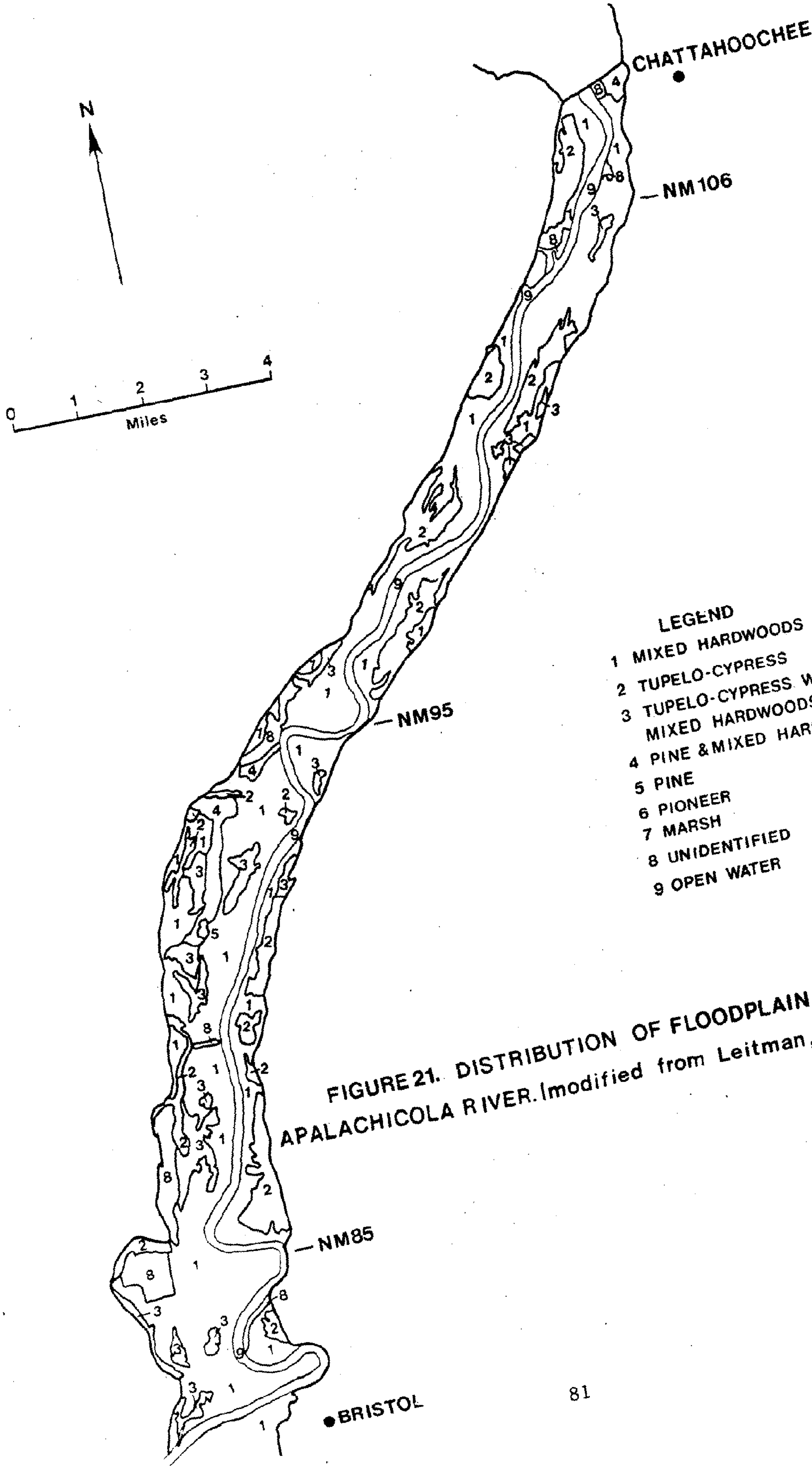


FIGURE 21. DISTRIBUTION OF FLOODPLAIN HABITATS ON THE APALACHICOLA RIVER. (modified from Leitman, 1983)

on "newly" formed point bars where sand is the predominant soil type, it occupies a somewhat dry area. Most of this type forest is located in the middle river where the majority of the meanders occur (Figures 21-24). As the age of the point bar increases, other species such as sycamore, swamp cottonwood and river birch appear. Areas in which this forest type are found are usually inundated at least 25 percent of the year (Leitman, 1983; Leitman et al, 1983).

There appears to be very little information concerning the floodplain of the Chipola River. One transect of the floodplain has been found which occurred north of the Dead Lake area above the Highway 71 bridge. At this point in the river the Chipola is anastomosing and has several channels. The majority of the floodplain here is characterized by wet flats between the channels with bald cypress, water tupelo, ogeechee tupelo, planer tree, and Carolina ash predominant. The higher elevation "island" areas are characterized by diamond-leaf oak, possumhaw and swamp dogwood. A bay swamp, which is a rare floodplain feature, is also located at this site characterized by sweetbay and royal fern (Wharton et al, 1982).

On the whole, the forested floodplain of the Apalachicola River appears to be split almost evenly between the wet-site species dominated by tupelo and cypress and the less water-tolerant bottomland hardwood species. Bottomland hardwood species dominate the upper and middle river floodplain while tupelo-cypress dominates the lower river forested floodplain. The absence of elevational differences in the lower river along with tidal influences is probably an important factor in this change. Elevational differences in the upper river floodplain vary up to 15 feet, while in the lower river floodplain relief is limited to 2 feet (Leitman et al, 1983; Leitman, 1983). As mentioned previously, the distribution of plants on floodplains is directly related to hydrologic characteristics which cause anaerobic soil conditions. This relationship is demonstrated quite clearly on the Apalachicola River floodplain by the forest types present and the locations they are found in.

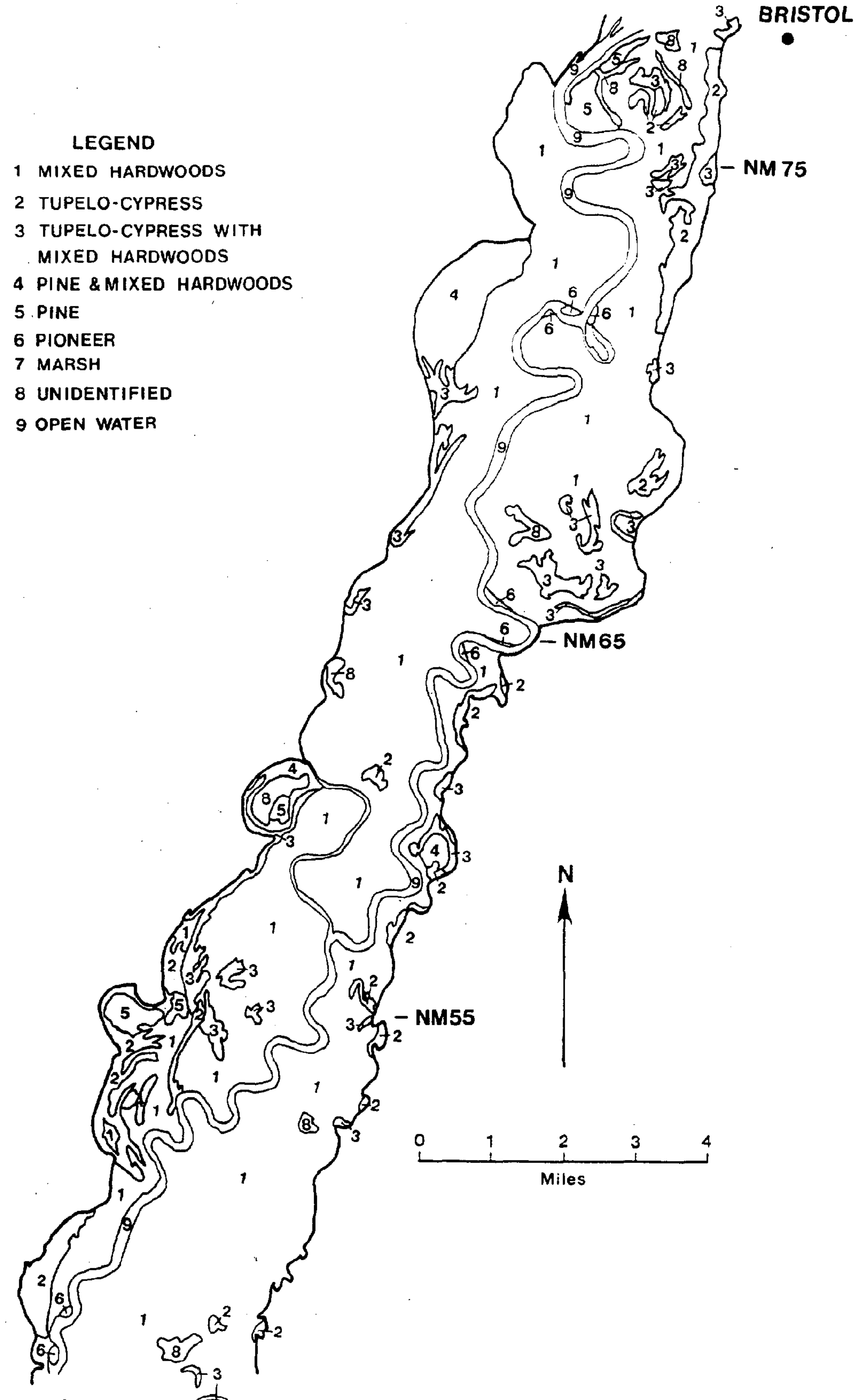


FIGURE 22. DISTRIBUTION OF FLOODPLAIN HABITATS ON THE APALACHICOLA RIVER. (modified from Leitman, 1983)

Nonforested Floodplain

The nonforested area accounts for approximately 15 percent of the total area of the Apalachicola floodplain. This component includes open water, marsh, and unidentified categories (Table 11). The open water category includes ponds, lakes, streams, rivers and excludes the bay area. Open water covers approximately 7 percent of the floodplain area mapped by Leitman (1983) and also includes the distributaries of the river which empty into East Bay. The river and bay habitats have already been discussed and will not be included here.

The unidentified areas cover less than 2 percent of the floodplain and include areas altered by man. These alterations can be clearing, timbering, agricultural endeavors, construction, or spoil disposal. Most of these areas occur on the edge of the floodplain where access is easy and flooding is minimal.

The last category of nonforested floodplain is marsh, which covers approximately 6 percent of the floodplain. All the marsh area is restricted to the lower 10 miles of the floodplain where it accounts for 51 percent of the floodplain area. Sawgrass is the predominant species although bullrushes, cattails, big cordgrass, softrush, and giant cutgrass are also present in the freshwater areas of the river and distributaries. In the lower reaches of the river and East Bay, brackish water species such as Spartina and Juncus appear and mix with freshwater species (Leitman, 1983; Livingston, 1984; Clewell, 1986). Approximately 1,500 acres of this marsh, located on the west side of the Apalachicola River and north of the Jackson River, was altered in the 1970s and was undergoing a vegetation shift due to ditching and draining activities. Shrubs and wet-site trees had begun to appear until this property was purchased by the State and restoration was undertaken by the Florida Game and Fresh Water Fish Commission. Dike breaching, ditch plugging and controlled burning have been used to partially restore part of the marsh to its former function (FGFWFC, 1982).

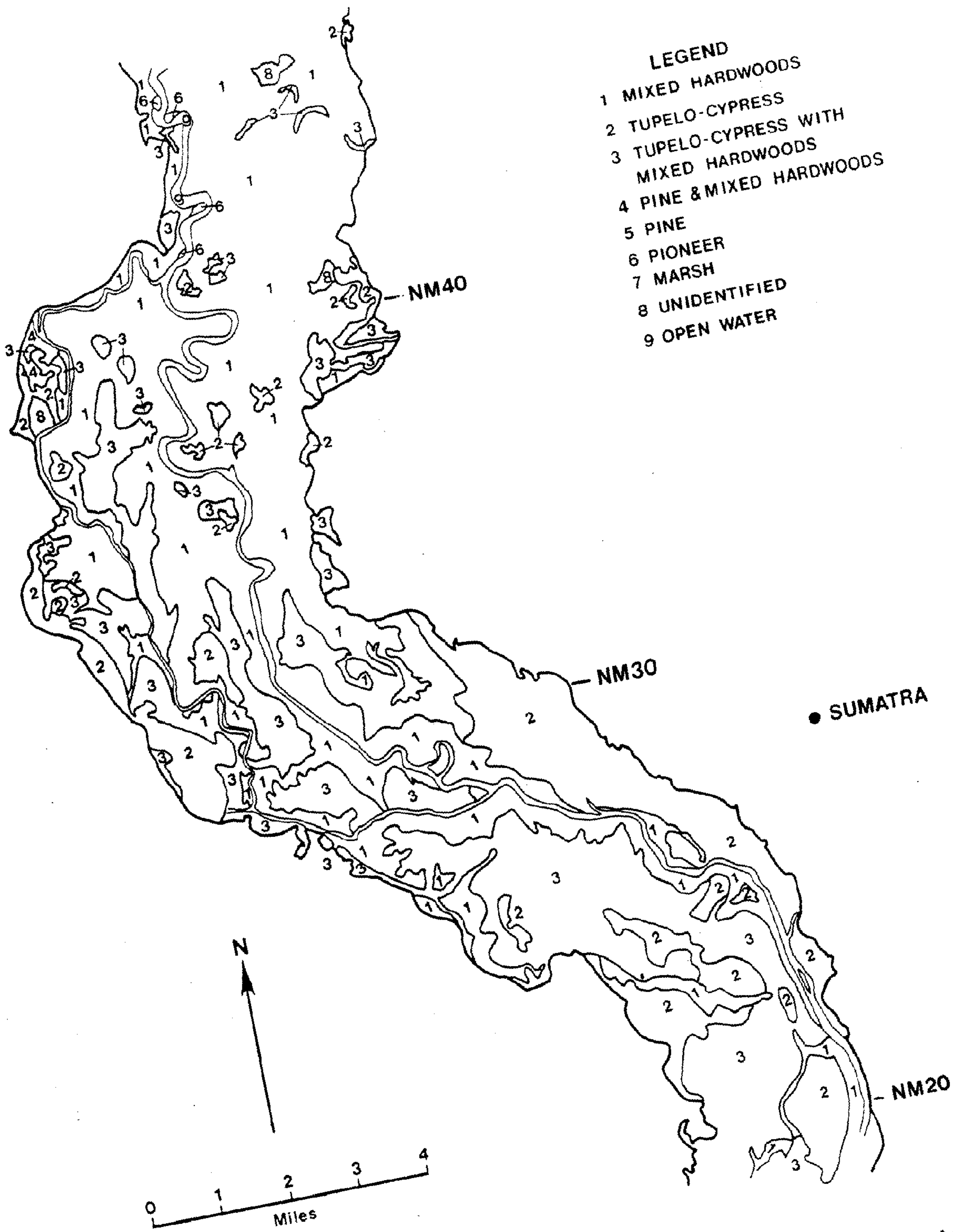


FIGURE 23. DISTRIBUTION OF FLOODPLAIN HABITATS ON THE APALACHICOLA RIVER. (modified from Leitman, 1983)

Fish and Wildlife Values

The Apalachicola River floodplain is rich in both plant and animal species. Gholson (1985) in his study of disposal sites within the floodplain, lists over 1,000 species of plants which includes canopy, understory, and ground cover types. In order to appreciate this diversity it should be realized that these species were found during a study which collectively looked at less than 200 acres of the entire floodplain in less than two weeks during the fall of 1984. A study currently underway through the Apalachicola National Estuarine Reserve (ANER) has documented over 1,000 species of plants from the lower Apalachicola River wetlands (ANERR, 1986). Clewell (1977) lists 16 species of plants only found in Florida on the Apalachicola floodplain. Preliminary data indicates that at least 22 species of threatened or endangered plants have been found in the floodplain (Table 12) and more could probably be added with further study.

The value of the plant diversity to wildlife is important. It has been estimated that approximately 361,000 metric tons of litter fall on the Apalachicola floodplain annually. Of this, 211,000 metric tons is strictly leaf fall with the remainder including berries, fruits, woody debris, etc. (Elder and Cairns, 1982). An important aspect of litter fall is not only the amount, which is high in the Apalachicola floodplain compared with other similar systems, but also the timing. Maximum litter fall peaks occur in the floodplain in late fall due mainly to leaf fall. However, non-leaf fall remains high and consistent throughout the year. The length of the growing season which ranges from 256 to 281 days throughout the length of the floodplain is also a factor. The high diversity of species and variations in their patterns and seasons of litter fall is responsible for this sustained input of detritus and nutrients, and is an important energy source in the floodplain food web.

Because the floodplain is a "fluctuating water level ecosystem," it is characterized by pulses of productivity (Odum, 1969). These pulses are based not only on photosynthesis, but also on the decomposition of organic material. A typical floodplain food web is shown in Figure 25, which

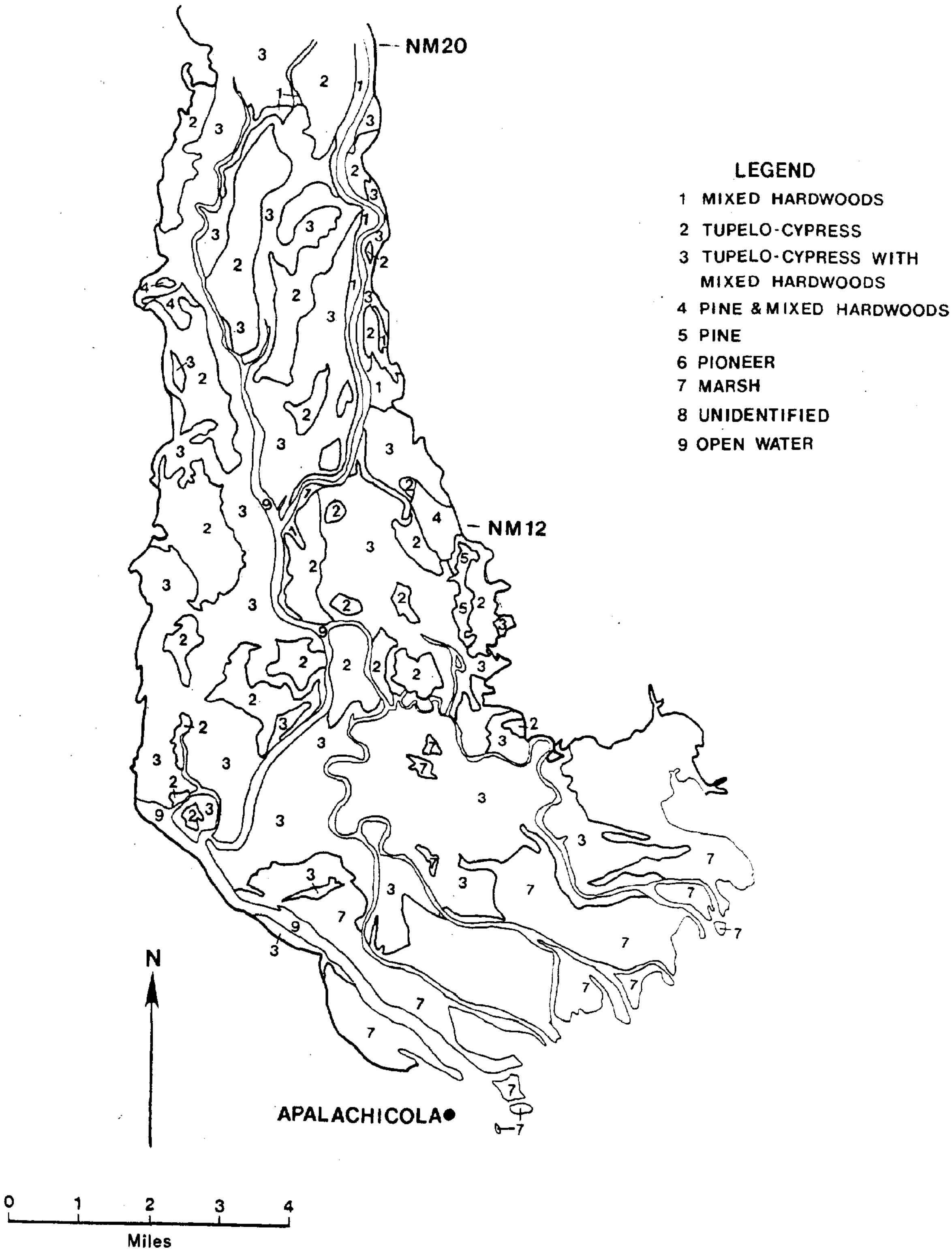


FIGURE 24. DISTRIBUTION OF FLOODPLAIN HABITATS ON THE APALACHICOLA RIVER. [modified from Leitman, 1983]

Table 12. Threatened (T) and Endangered (E) plants of the Apalachicola River Floodplain (Clewell, 1977, 1986; Gholson, 1985; ANERR, 1986; FGFWFC, 1987).

Scientific Name	Common Name	Status
Aristolochia tomentosa	Wooly dutchman's pipe	T
Asplenium platyneuron	Ebony spleenwort	T
Baptisia megacarpa	Apalachicola wild indigo	T
Botrychium biternatum	Southern grape fern	T
Bumelia lycioides	Buckthorn	T
Cryptotaenia canadensis	Honewort	T
Ilex decidua	Possum-haw	T
Isoetes flaccida	Florida quillwort	T
Lietneria floridana	Florida corkwood	T
Lobelia cardinalis var. cardinalis	Cardinal-flower	T
Malus angustifolia	Crabapple	T
Onoclea sensibilis	Sensitive fern	T
Rhododendron austrinum	Florida azalea	E
Sabal minor	Bluestem palmetto	T
Spiranthes cernua var. odorata	Fragrant ladies' tresses	T
Spiranthes ovalis	Oval ladies' tresses	T
Spiranthes vernalis	Spring ladies' tresses	T
Staphylea trifolia	Bladdernut	T
Thelypteris dentata	Downy shield fern	T
Thelypteris hexagonoptera	Southern beech fern	T
Thelypteris palustris	Marsh fern	T
Woodwardia aerolata	Netted chain fern	T

illustrates the importance of both the detrital food chain and the photosynthetic food chain to floodplain organisms. Some of the benefits man receives from this food web are also included.

The floodplain forest has been cited as being the most important wildlife habitat in northwest Florida (Gatewood and Hartman, 1977). Because of fluctuating water levels, the interface between the aquatic and terrestrial systems moves and organisms adapted to these systems must also move. Important macroinvertebrates found in alluvial floodplains include aquatic, terrestrial, and species adapted to varying stages in between. They include amphipods, isopods, a myriad of insects and insect larvae, clams, snails, worms, freshwater shrimp, and crawfish. Of the macroinvertebrates, the molluscs (clams and snails) and crawfish appear to be the only groups studied on the Apalachicola, which is fortunate, since they are important fish and wildlife food sources. Heard (1977) lists 60 species of snails and clams from the river and floodplain, seven of which are endemic. In his study, Ager et al (1984) found that the Asiatic clam was the most abundant benthic invertebrate found in the river. The Asiatic clam is an introduced species which has been out-competing and eliminating native clam species throughout southeastern rivers (Wharton, 1978). Clams are found not only in the river but also in sloughs and pools in the floodplain. They are fed on by some catfish species, shellcracker bream, birds, muskrat, raccoon, otters, salamanders, and turtles (Pennak, 1978). Another important mollusc found on the floodplain is the apple snail, which is an important food source of birds, especially the limpkin.

Crawfish are important food items of mammals, birds, and fish and their chimneys are visible evidence of high water tables. Seven species have been identified from the Apalachicola (Wharton et al, 1981). Holder (1971) estimates that crawfish account for over one-third of the floodplain biomass on the Suwannee River. Largemouth bass, bullheads, eels, bowfin, amphiuma, turtles, otter, raccoon, ibis and other birds, and water snakes utilize crawfish for food extensively. Alligators are also known to consume them as part of their diet. Crawfish burrows are also used by small fish and other aquatic animals as refuges during dry periods when the floodplain dries out (Neill, 1951).

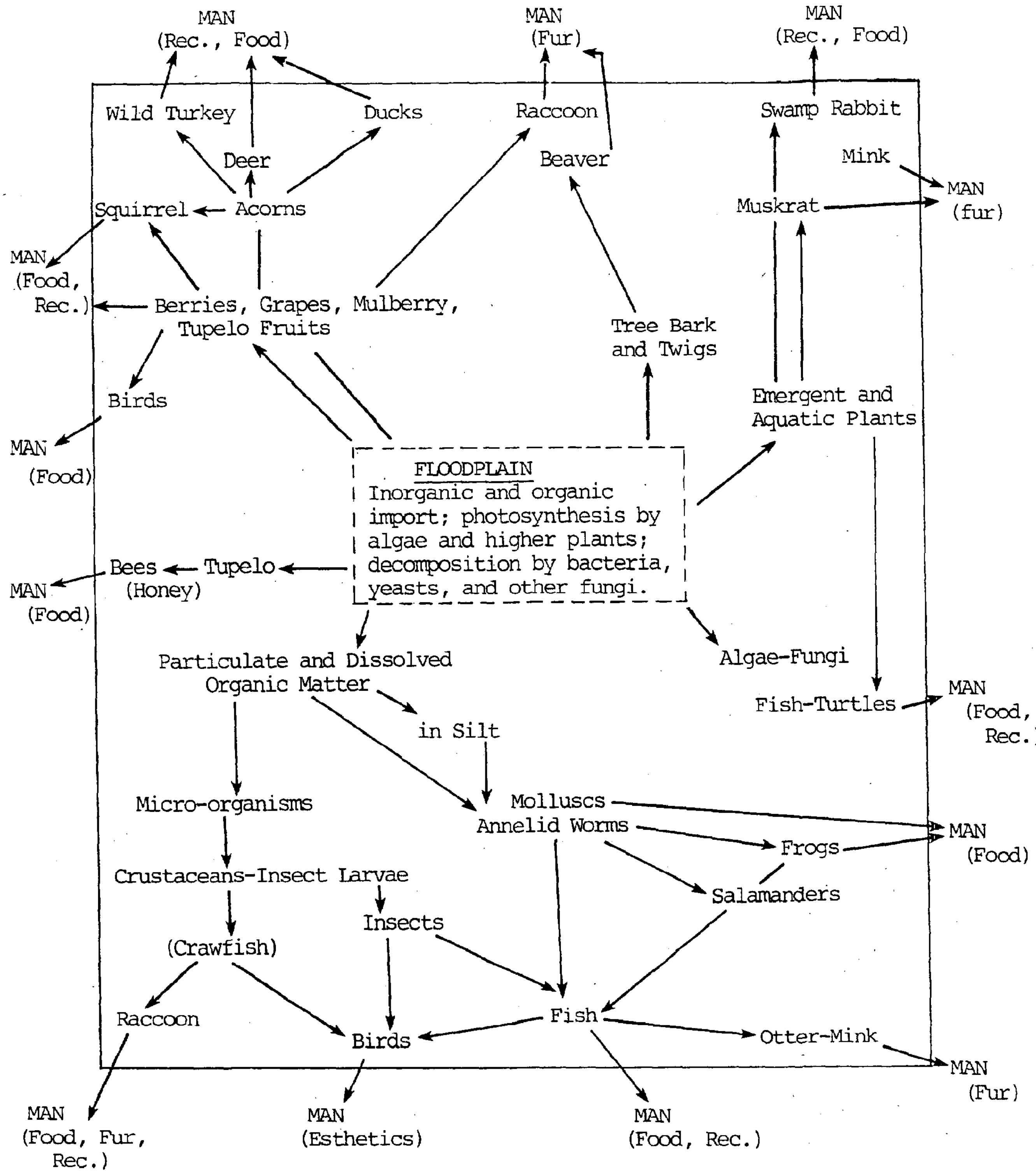


Figure 25. Generalized Food Web of the Apalachicola Floodplain (modified from Wharton, 1970).

Crawfish and other floodplain invertebrates are especially important food for fish, during high waters, when the floodplain is inundated. Studies have shown that many fish move out into the sloughs and onto the floodplain when it is inundated. The floodplain provides space, food, and more habitat for reproduction and growth (Holder et al, 1970). As the waters recede the fish concentrate in the sloughs before returning to the main channel. Small fish are known to survive low-water periods on the Apalachicola floodplain by remaining in minibasins formed by the root systems of trees (Wharton et al, 1977). Receding waters also wash large quantities of invertebrates into the river channel where they become an important food source. Studies on other rivers have related the standing stock of gamefish, the size of the year class of largemouth bass, and the type of fish found to the duration and extent of flooding (Lambou, 1962; Bryan and Sabins, 1979). Reduction in flooding levels, extent, and duration, whether by natural or man-made alterations, would have a profound effect on riverine fisheries.

The moist, shaded environment of the floodplain with the large accumulation of detrital material provides an ideal habitat for amphibians and reptiles. Means (1976, 1977) lists 44 species of amphibians and 64 species of reptiles found in the Apalachicola River basin. Although not all of these are found specifically within the floodplain, a significant number are transitory or permanent residents. Four species of special concern, the American alligator, Suwannee cooter, Barbour's map turtle, and the alligator snapping turtle are found in the river and on the floodplain (Table 13). The Barbour's map turtle is endemic to the Apalachicola. The alligator snapping turtle, once commercially important, is still taken for food, although possession of more than one is prohibited as is their sale. Because of the diversity of physical habitats, the mild climate, and the strategic location near four biogeographical areas, the Atlantic Coastal Plain, the Gulf Coastal Plain, peninsular Florida, and the northern area via the Piedmont and Appalachian regions, the Apalachicola basin supports the highest species density of amphibians and reptiles in North America, north of Mexico (Kiester, 1971; Means, 1977). Other important or unique species found in the Apalachicola floodplain includes the one-toed amphiuma, the Florida red-bellied turtle, the four-toed salamander, the southern coal skink, and the Georgia blind

Table 13. Threatened (T), Endangered (E), and Species of Special Concern (SSC) found on the Apalachicola River Floodplain (Means, 1977; Stevenson, 1977; FGFWFC, 1982; FGFWFC, 1987).

Scientific Name	Common Name	Status
Amphibians and Reptiles		
Alligator mississippiensis	American alligator	SSC
Graptemys barbouri	Barbour's map turtle	SSC
Maccroclemys temminckii	Alligator snapping turtle	SSC
Pseudomys concinna suwanniensis	Suwannee cooter	SSC
Mammals		
Felis concolor coryi	Florida panther	E
Myotis grisescens	Gray bat	E
Myotis sodalis	Indiana bat	E
Ursus americanus floridanus	Florida black bear	T
Birds		
Aramus quarauna	Limpkin	SSC
Campephilus principalis	Ivory-billed woodpecker	E
Cistothorus palustris marianae	Marian's marsh wren	SSC
Egretta caerulea	Little blue heron	SSC
Egretta thula	Snowy egret	SSC
Falco peregrinus	Peregrine falcon	E
Falco sparverius paulus	Southeastern kestrel	T
Grus canadensis pratensis	Florida sandhill crane	T
Halineetus leucocephalus	Bald eagle	T
Mycteria americana	Wood stork	E
Vermivora bachmanii	Bachman's warbler	E

salamander from the upper Chipola River floodplain (Means, 1977). The distribution of amphibians and reptiles within the floodplain is controlled by the hydrologic conditions of the varied environments. Aquatic or wet species are found in the tupelo-cypress and tupelo-cypress with mixed hardwood areas while species less tolerant to water range from the pine to mixed hardwood associations. There also is considerable overlap and movement through zones depending on environmental conditions, breeding requirements, and seasonal changes.

The Apalachicola River floodplain provides not only an abundance of food, but also a diversity of environments which supports a large and diverse population of birds year-round. Bottomland hardwoods, in particular, offer preferred habitat for migratory and overwintering species from the north (Figure 26) due to the abundance of acorns, seeds, and nuts during winter, when the surrounding uplands are somewhat dormant. The diverse environments of the floodplain are utilized by waterfowl, terrestrial, and arboreal species with their distribution dependent on the hydrological conditions. No comprehensive studies have been done on the avifauna of the entire Apalachicola River floodplain at this time. An ongoing study within the boundaries of the Apalachicola National Estuarine Research Reserve, which includes the lower river, bay and barrier islands, has identified 282 species. Of these, 164 species are migratory, 98 are breeding bird species, and 20 are nonbreeding, summer residents (ANERR, 1986). Eleven of these species are also listed as threatened, endangered or of special concern (Table 13), although two species, the ivory billed woodpecker and Bachman's warbler, have probably been extirpated from Florida.

Among the more prominent forested floodplain species observed by Stevenson (1977) are the swallow-tailed kite, Mississippi kite, red-shouldered hawk, barred owl, pileated woodpecker, hairy woodpecker, acadian flycatcher, red-eyed vireo, prothonotary warbler, Swainson's warbler, northern parula warbler, yellow-throated warbler, and hooded warbler. In his comparison of bird abundance below Jim Woodruff Dam in the forested floodplain and above the dam in the altered and flooded floodplain, he noted significant decreases or absence of these species in the altered habitat. Eichholz (1980) found what

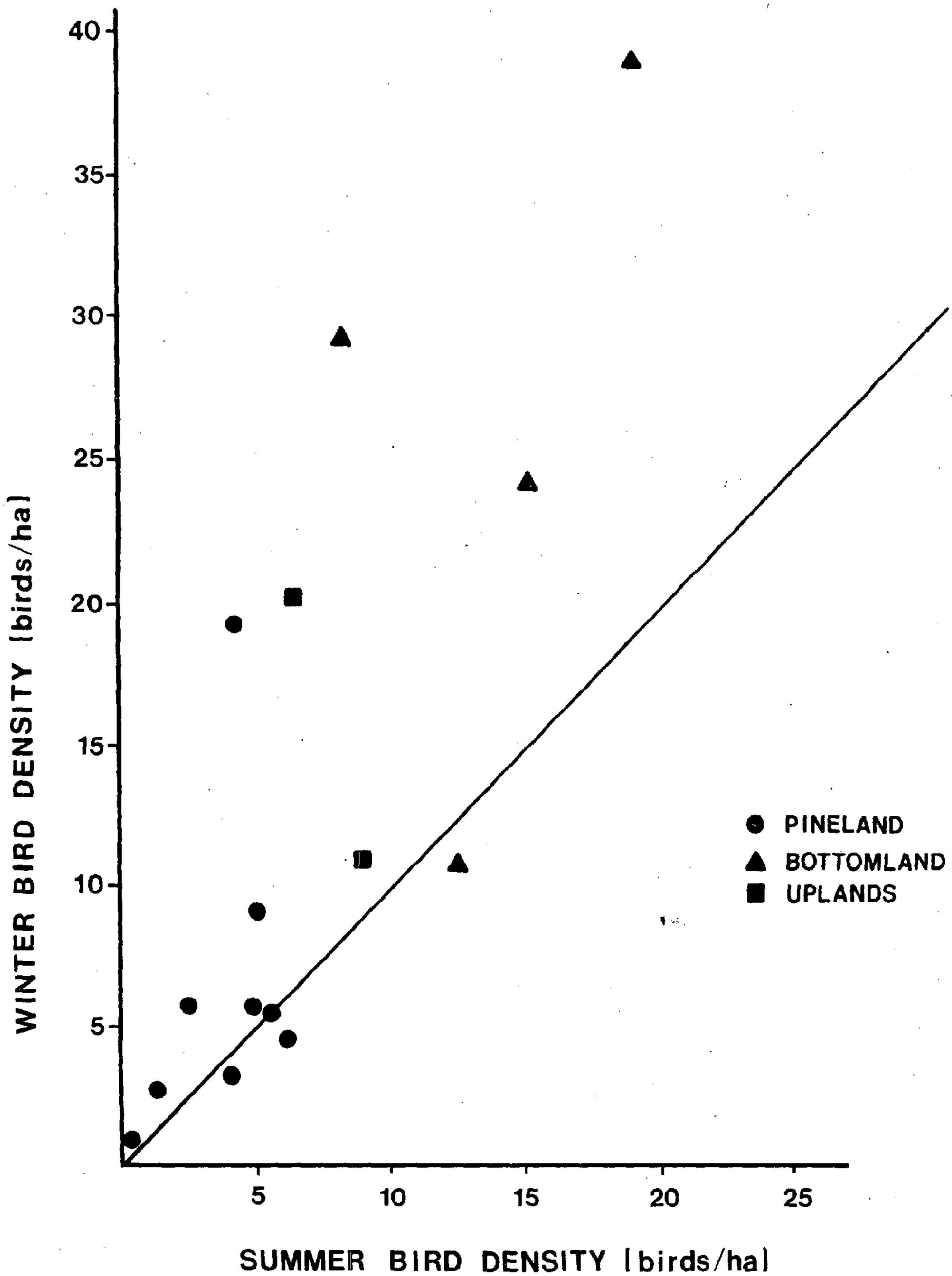


FIGURE 26. DISTRIBUTION OF BIRDS IN COASTAL PLAIN [modified from Harris & Gosselink, 1986]

is believed to be the largest concentration of nesting ospreys, 45 active nests, in northwest Florida in the lower Apalachicola River floodplain. The ospreys, along with bald eagles forage extensively in the floodplain marshes and in the nearby Apalachicola Bay system. Forested floodplains support wild turkey populations two to three times higher than uplands (FGFWFC, 1978) and are also important breeding areas to the wood duck (Gatewood and Hartman, 1977).

Mammals have probably been the least studied group, not only in the floodplain, but in the entire Apalachicola drainage basin. Means (1977) lists 52 species of mammals found in the drainage basin, which includes caves, uplands, floodplain, and barrier islands. This list is from a Hall and Kelson (1959) publication concerning the mammals of North America. While many of these species are found in the Apalachicola basin, not all are found on the floodplain. The American beaver and river otter probably utilize the river and tributaries of the floodplain more than any other mammal. The beaver is one of the few animals besides man which can change its environment. By damming small sloughs and backwaters, the beaver can pose a threat to some floodplain vegetation by changing the hydrologic conditions in selective areas. Other significant mammals expected in the wetter portions of the floodplain, such as the tupelo-cypress association and marshes include the raccoon, round-tailed muskrat, mink, and the rice rat (Wharton et al, 1982).

Mammals which prefer the drier areas of the floodplain, characterized by the mixed hardwood association and the tupelo-cypress with mixed hardwood association, include the cotton mouse, southeastern shrew, marsh rabbit, and bobcat. Many species nest in the less inundated areas and forage throughout the floodplain. Important game mammals found in the Apalachicola floodplain include the white-tailed deer, feral hog, grey squirrel, and Florida black bear (which can only be hunted within the Apalachicola Wildlife Management Area). Glasgow and Noble (1971) estimate that bottomland hardwoods have two to three times the carrying capacity of white-tailed deer than upland pine forests and almost two times that of upland hardwood forests. The grey squirrel also is known to reach its highest densities in the bottomland hardwoods (Gatewood and Hartman, 1977).

Perhaps the most important wildlife function floodplains serve today is that of providing large tracts of relatively undisturbed habitat. Not only are there species which are so specialized that they cannot survive elsewhere, but many species need large areas in which to roam and cannot survive in small blocked habitats. Kusler (1983) points out that while wetlands account for only 5 percent of the land area of the United States, 35 percent of the threatened, endangered, or rare animal species need wetlands to survive.

Apalachicola River System

The Apalachicola River is the largest in Florida and ranks 21st in the United States, in terms of flow. It is also one of the last remaining undammed large rivers in the country, although its tributaries contain numerous dams and locks. The importance of the Apalachicola River to the productivity of Apalachicola Bay cannot be overemphasized. Numerous studies relating the bay to the river's nutrients (Mattraw and Elder, 1980; 1983), floodplain litter and detritus (Livingston, 1981; Elder and Cairns, 1982; Elder and Mattraw, 1983), and flow (Maristany, 1981; Alabama et al, 1984) have been published and will not be discussed here. The following section will deal strictly with aquatic riverine habitats, what makes them different, and their associated biological components.

Physiography and Hydrology

The Apalachicola River is formed by the confluence of the Chattahoochee and Flint Rivers at Jim Woodruff Dam and flows 107 miles to Apalachicola Bay. Lake Seminole, its headwaters, a 37,500 acre man-made reservoir, borders the three states of Alabama, Georgia, and Florida. Of the 19,600 square miles in the entire ACF drainage basin, approximately 2,400 square miles (12 percent) are located within Florida. The main tributary of the Apalachicola River, the Chipola River, accounts for approximately half of this draining an area 1,237 square miles, of which 1,020 square miles are in Florida (COE, 1980). Table 14 lists all the important tributaries to the Apalachicola River which are at least ten miles long (Figure 27).

The Apalachicola River can be classified as a large, alluvial river. It is the only river in Florida which has its origins in the Piedmont and Southern Appalachians. Characteristics of alluvial rivers include a heavy sediment load, turbid water, large watersheds, sustained periods of high flow, and substantial annual flooding. The majority of its runoff is from distant precipitation and runoff from numerous tributaries (Clewell, 1986; Wharton et al, 1982).

The Chipola River is an entirely different type of river. The Chipola River is classified as a spring fed or calcareous spring run. Its waters come principally from underground aquifers. Originating in southeast Alabama it flows 125 miles and enters the Apalachicola River below Wewahitchka. Characteristics of spring fed rivers include a small sediment load, very little water level fluctuation, stable environmental conditions, and nominal flooding. The geology, water supply, habitat, and faunal assemblages between the two rivers differ greatly (Clewell, 1986; Bass, 1983).

The Apalachicola River can be divided into three sections based upon its physiography: lower, middle, and upper. The lower river (NM 0-35), from below Wewahitchka to Apalachicola, is tidally influenced up to approximately navigation mile (NM) 25. The Chipola River joins the Apalachicola at NM 28. The lower river flows through lowlands with a maximum land elevation less than 50 feet, and is characterized by a wide floodplain. The river itself is characterized by long straight reaches with few bends in this section. Near the lower end, numerous distributaries are formed which empty into East Bay.

The middle river section (NM 35-78) runs from below Wewahitchka to below Blountstown. Land elevations in this section range from 150 feet in the upper reaches to 50 feet in the lower reaches. The floodplain is not as wide as the lower river section but is still much wider than the floodplain in the upper section. The river meanders considerably in this section forming large loops

Table 14. Important Rivers and Streams in the Apalachicola Basin (COE, 1980).

Name of Stream [1]	Length (Miles)	Source Elev. (Ft. MSL)	Elev. (Ft. MSL)	Flows Into
Apalachicola River	106.7	45	5	Apalachicola Bay
Depot Creek	25.1	18	5	Lake Wimico
Cypress Creek	15.1	20	0	Indian Bayou
Brothers River	13.7	0	0	Apalachicola River
Chattahoochee River (in Florida)	25.7	200	80	Apalachicola River
Florida River	19.6	25	15	Apalachicola River
Mosquito Creek	19.4	290	45	Apalachicola River
Kennedy Creek	15.8	55	5	Apalachicola River
Big Gully Creek	11.5	120	25	Equaloxic Creek
Flat Creek	11.0	250	45	Apalachicola River
Chipola River (in Florida)	95.8	85	5	Apalachicola River
Juniper Creek	21.1	175	25	Chipola River
Ten Mile Creek	16.9	205	25	Chipola River
Four Mile Creek	16.3	200	30	Chipola River
Dry Creek	12.8	95	50	Chipola River

(1) Ten miles or longer

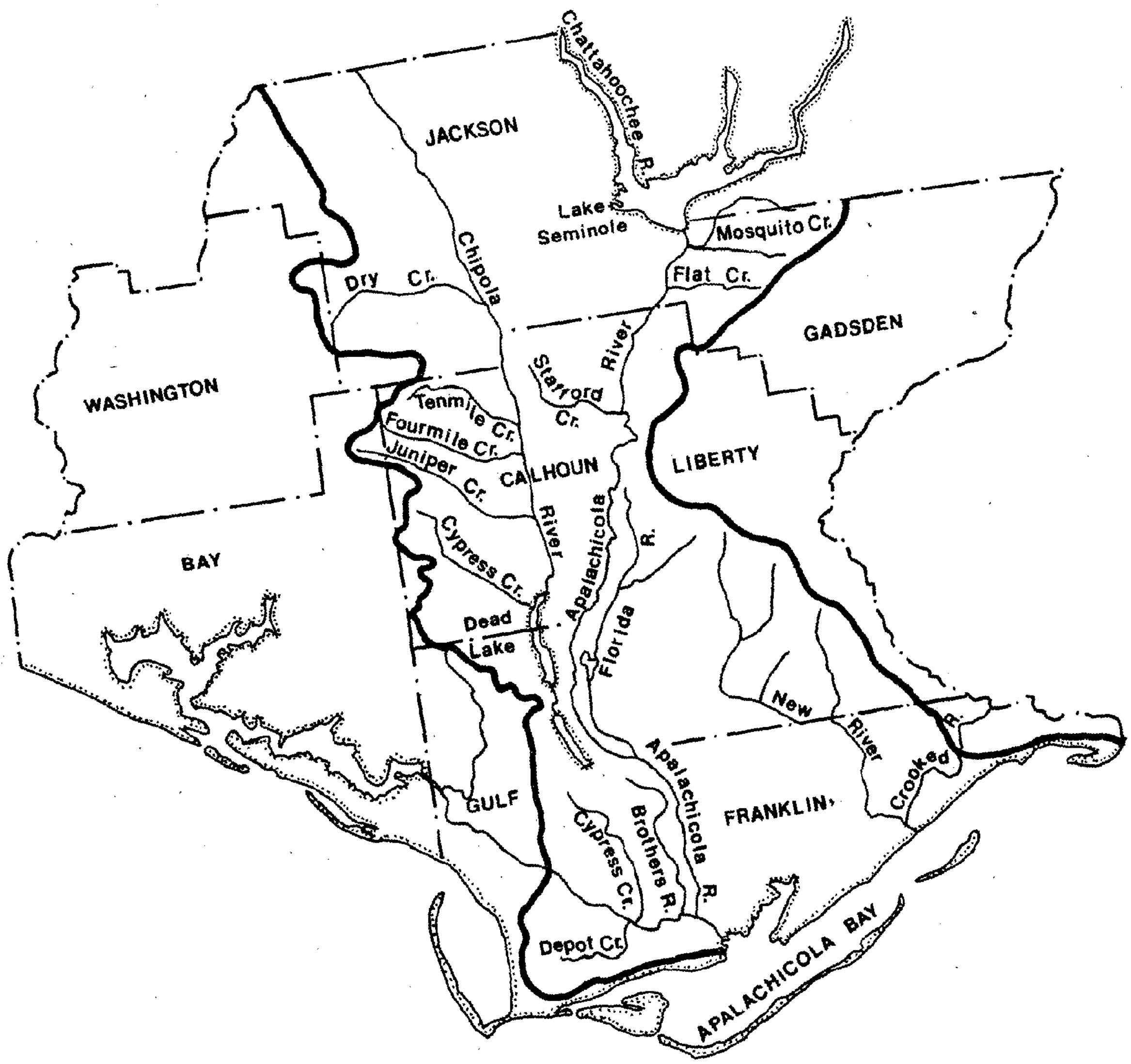


FIGURE 27. MAJOR TRIBUTARIES OF THE APALACHICOLA BASIN (modified from COE, 1980).

and numerous small acute bends. These acute bends are the cause of navigational problems in this area and some require frequent dredging by the COE. At NM 41 a natural cutoff, the Chipola Cutoff, which has been modified by man, diverts approximately 25 percent of the Apalachicola River flow to the Chipola River below. This natural cutoff also formed Dead Lake to the north which has since been modified by man with water control structures.

The upper river section (NM 78-107) runs from the Blountstown area to Jim Woodruff Dam. Land elevations in this section are among the highest in Florida and range up to 325 feet. A unique area of steep bluffs and ravines is located on the east side of the river below the dam, while the west side is characterized by gentle rolling hills. The river is characterized by long, straight reaches with a few wide gentle bends (Leitman et al, 1983). The entire river falls at a fairly uniform rate of 0.4 feet per mile with the greatest slope upriver.

Flow is an important factor not only to the bay but also to the river itself. The mean annual discharge of the river at Chattahoochee is 22,400 cfs (USGS, 1981) with summer and fall characterized by low flow and highest flows occurring in winter and spring (Figure 28). The mean annual discharge at Sumatra is 25,000 cfs, which also includes the discharge from the Chipola River. During low flow conditions, the Chipola River can substantially increase the flows in the lower Apalachicola River because it is spring fed, and from the influence of local rainfall. Minimum and maximum flows in the river including all presently constructed dams are approximately 9,300 and 200,000 cfs, respectively (COE, 1978). To get an idea of the amount and importance of the river flow, McNulty et al, (1972) estimates that the Apalachicola River discharge accounts for 35 percent of the total freshwater runoff for the west coast of Florida.

Riverine Habitats

Riverine habitats can be generally subdivided based upon the physical cover provided for organisms. This physical cover is dependent not only on

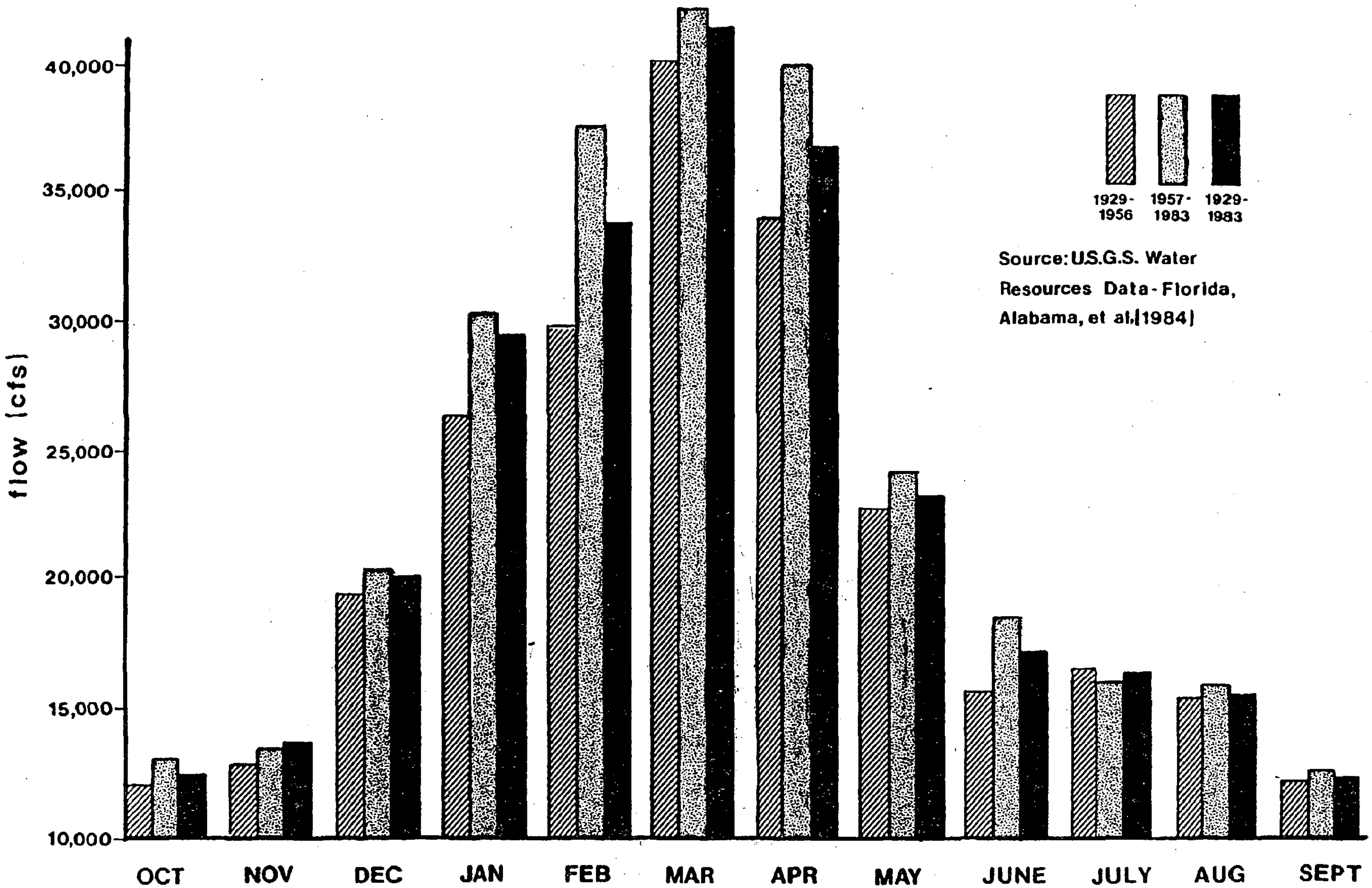


FIGURE 28. AVERAGE MONTHLY FLOWS OF THE APALACHICOLA RIVER AT CHATTAHOOCHEE, 1957 TO 1984

the substrate composition, but also on the shoreline features associated with the substrate (Bass, 1983). These two factors combine to help determine the amount and type of food available, the type of species which will use the habitat, and its adequacy as a spawning and nursery area. Six distinctive habitat types have been located within the Apalachicola River along its 215 miles of shoreline (Ager et al, 1983). These have been catalogued and divided into steep natural bank, gently sloping natural bank, dike field, sandbar, rock, and submersed vegetation. The amount and percent of each type of habitat is listed in Table 15. Surveys of fish populations of each habitat based upon electro-fishing samples, have been investigated and are discussed in detail.

The presence of snags on these riverine habitats is an important determinant of some habitats and significantly affects the productivity of these areas. Snags not only provide much needed cover for fish, but are also an important substrate for invertebrates which fish feed on. Catch rates of fish are almost twice as high for all habitats with snags as those without snags (Table 16). The only habitat where the presence of snags did not increase the catch was the submersed vegetation habitat which already provides a significant amount of cover and substrate. Removal or covering up of snags by dredge material eliminates productive habitat from the river.

During his investigations, Ager et al (1984) collected 79 species of fish, 21 of which were found at all six shoreline habitats throughout the river (Table 17). Yerger (1977) notes that 86 species of freshwater fish are found in the Apalachicola River proper if the Flint and Chattahoochee Rivers (an additional 30 species) and the areas of tidal influence are excluded. Comparing the freshwater ichthyofauna of Florida streams, Bass (1983) concluded that the Apalachicola River contained the richest assemblage of primarily freshwater fish in Florida. Over the years, very little fishery research has been accomplished on the Chipola River. The Chipola River, with its large amount of rock habitat in the upper reaches, apparently supports the largest population of shoal bass in the state (Bass, 1983). Table 18 shows the dominant fishes in the Chipola and upper Apalachicola rivers found by earlier investigators (Brown et al, 1964; Cox et al, 1975).

Table 15. Linear miles of shore habitat for the Apalachicola River by section and habitat type, 1982-83 (Ager et al, 1984).

	Steep Natural Bank >45°	Gently Sloped Bank <45°	Dike Field	Sand-bar	Rock	Submersed Vegetation	Total
Lower River (35.0-00.0)							
Shoreline Length (mi)	14.20	42.30	0.93	6.60	0	6.70	70.73
Percent of Shoreline	20.0	59.8	1.3	9.3	0	9.4	
Middle River (78.0-35.0)							
Shoreline Length (mi)	47.16	10.85	0.34	29.98	0	0	88.33
Percent of Shoreline	53.3	12.2	0.3	33.9			
Upper River (106.3-78.0)							
Shoreline Length (mi)	28.60	5.11	3.64	14.99	4.47	0	56.82
Percent of Shoreline	50.3	8.9	6.4	26.3	7.8		
Total Shoreline							
Length of Habitat for Entire River	89.96	58.26	4.92	51.57	4.47	6.70	215.88
Percent of Habitat type for Entire River	41.7	1027.0	2.3	23.9	2.1	3.1	

Table 16. Catch/effort values for number and weight of fish by habitats with and/without snags for Apalachicola River, 1982-83 Ager et al, 1984).

Habitat Type	Snags Present	Number Fish/Min.	Weight Kg/Min.	No. Samples N
Steep Natural Banks	Yes	16.5	1.50	25
Steep Natural Banks	No	6.3	0.37	6
Gently Sloping Natural Banks	Yes	11.7	0.60	33
Gently Sloping Natural Banks	No	6.8	0.62	3
Dike Fields	Yes	19.8	1.32	35
Dike Fields	No	12.4	1.36	6
Sandbars	Yes	11.3	0.51	35
Sandbars	No	5.6	0.55	27
Rocks	Yes	15.7	1.20	2
Rocks	No	10.8	0.95	11
Submersed Vegetation	Yes	4.6	0.78	9
Submersed Vegetation	No	6.9	0.53	13

Mean number for all habitats with snags: 14.1 fish/minute.
Mean number for all habitats without snags: 7.5 fish/minute.

Mean weight for all habitats with snags: 0.95 kilograms/minute.
Mean weight for all habitats without snags: 0.67 kilograms/minute.

There are eight diadromous species, four endemic species, seven introduced species, and two marine species that are commonly found throughout the river system. The diadromous fish can be further divided into anadromous and catadromous species. The five anadromous species are Atlantic needlefish, Gulf of Mexico sturgeon, Alabama shad, skipjack herring, and striped bass. The Gulf of Mexico sturgeon population in the Apalachicola-Chattahoochee-Flint River system once supported a commercial fishery in the early 1900s, but no sturgeon have been caught commercially since the 1970s. The striped bass and its hybrid--the sunshine bass--have been actively stocked in the system by all three states because of its desirability as a sport and food fish. Catadromous species in the river include, American eel, mountain mullet, and hogchoker. The establishment of dams on the system, especially the Jim Woodruff Dam, appears to have impacted most diadromous species negatively by limiting their range and closing off important spawning grounds.

The studies by Ager et al (1983) deal specifically with shoreline habitats. Mid-river habitat, which accounts for a significant portion of the riverine habitat, is less well known. Observations by USFWS personnel using SCUBA and observations of dredged spoil material indicate that the bottom substrate consists of smooth rock, rock rubble, gravel, clam shells, clay, detritus, or sand depending on river location (USFWS, 1986; Ager et al, 1987). Samples collected by detonating cord in depths ranging from 12 to 55 feet of water in mid-river habitats indicate that carp and carpsuckers generally dominate in weight of fish caught, but catfish (channel catfish, white catfish, spotted bullhead, and snail bullhead) account for 32 to 97 percent of the numbers caught (Ager et al, 1987).

Two species which are important inhabitants of the river, although they are not dominant species, are the Gulf sturgeon and striped bass. Both of these species have been studied extensively by state and federal agencies. The U.S. Fish and Wildlife Service currently estimates the Gulf sturgeon population in the Apalachicola River at approximately 60 individuals. This is a decrease of 222 fish from their 1983 population estimate (USFWS, 1986a). Important habitats for this species appears to be rock, deep holes in the

Table 17. Species of fish collected by electro-fishing from all habitats in the Apalachicola River, 1982-83 (Ager et al, 1984).

Roughfish

Spotted gar
Longnose gar
Bowfin
Atlantic needlefish
Spotted sucker
Gizzard shad
Common carp

Foodfish

American eel
Channel catfish
Striped mullet

Gamefish

Sunshine bass
Redbreast sunfish
Bluegill
Redear sunfish
Spotted sunfish
Largemouth bass
Black crappie

Forage fish

Threadfin shad
Coastal shiner
Blackbanded darter
Hogchoker

Table 18. Dominant fishes in the Apalachicola River, near Blountstown (Cox et al, 1975).

Species	Percentage Number
Spotted gar	5.0
Threadfin shad	4.0
Gizzard shad	11.6
Channel catfish	5.4
Spotted bullhead	7.3
Snail bullhead	6.1
Redhorse (*Moxostoma* sp.)	4.5
Blacktail shiner	5.9
Largemouth bass	7.6
Redbreast sunfish	13.2
Bluegill	10.4
Total	81.0

Dominant fishes of the Chipola River (Brown et al, 1964).

Species	Percentage Number	Percentage Weight
Notropis sp.	3.3	(tr.)
Spotted sucker	11.8	49.9
Channel catfish	25.1	34.6
Pirate perch	11.6	(0.2)
Warmouth	2.5	(0.1)
Spotted sunfish	9.6	(0.5)
Redear sunfish	4.6	(1.9)
Redbreast sunfish	3.7	(1.3)
Largemouth bass	3.2	(1.8)
Shoal bass	2.7	6.3
Total	78.1	90.8

mid-river habitat, in the tailrace of the Jim Woodruff Dam (due to upstream blockage) and in the deep, still-waters of oxbow lakes before most of these filled in or were altered (USFWS, 1986b).

Striped bass have been released in both Georgia and Florida in an effort to replenish this species in the river system. Important habitats for this species appears to be rock, the tailrace of the Jim Woodruff Dam (due to upstream blockage of migratory movement), submerged springs (present in the upper Apalachicola River), and the cool water plumes of spring runs which flow into the river via tributaries (USFWS, 1986; Wooley and Crateau, 1983). The construction of the Dead Lakes Dam on the Chipola River in 1962 also impacted this species by eliminating this important summer cool water refuge (USFWS, 1986b).

Rock

Rock habitat is uncommon in Florida rivers and is limited in the Apalachicola to small areas in the upper river section (Figures 29-32). The rock habitat varies from hard, solid limestone to soft sandstone. Limestone shoals and rubble are also important habitats in the Chipola River, especially the upper region (Brown et al, 1964). Rock habitats in these rivers are characterized by swift water velocities, few snags, and sparse overhanging vegetation (Ager et al, 1984). Approximately 4.5 miles of rock habitat remain in the Apalachicola River accounting for only about 2 percent of the available shoreline habitat (Table 15).

Compared to other riverine habitats, the rock habitat ranks third in catch per unit effort (CPUE) in both numbers and weight of fish (Figure 33). The rock habitat also produces the lowest number of species found with 35 species. However, this habitat ranks first in both number and weight of gamefish produced (Figure 34). Of the four most abundant species collected from rock habitats, redbreast sunfish, bluegill, largemouth bass, and bowfin, three are gamefish. Catch rates for largemouth bass are the highest of any habitat and nocturnal sampling produced catch rates four times higher than

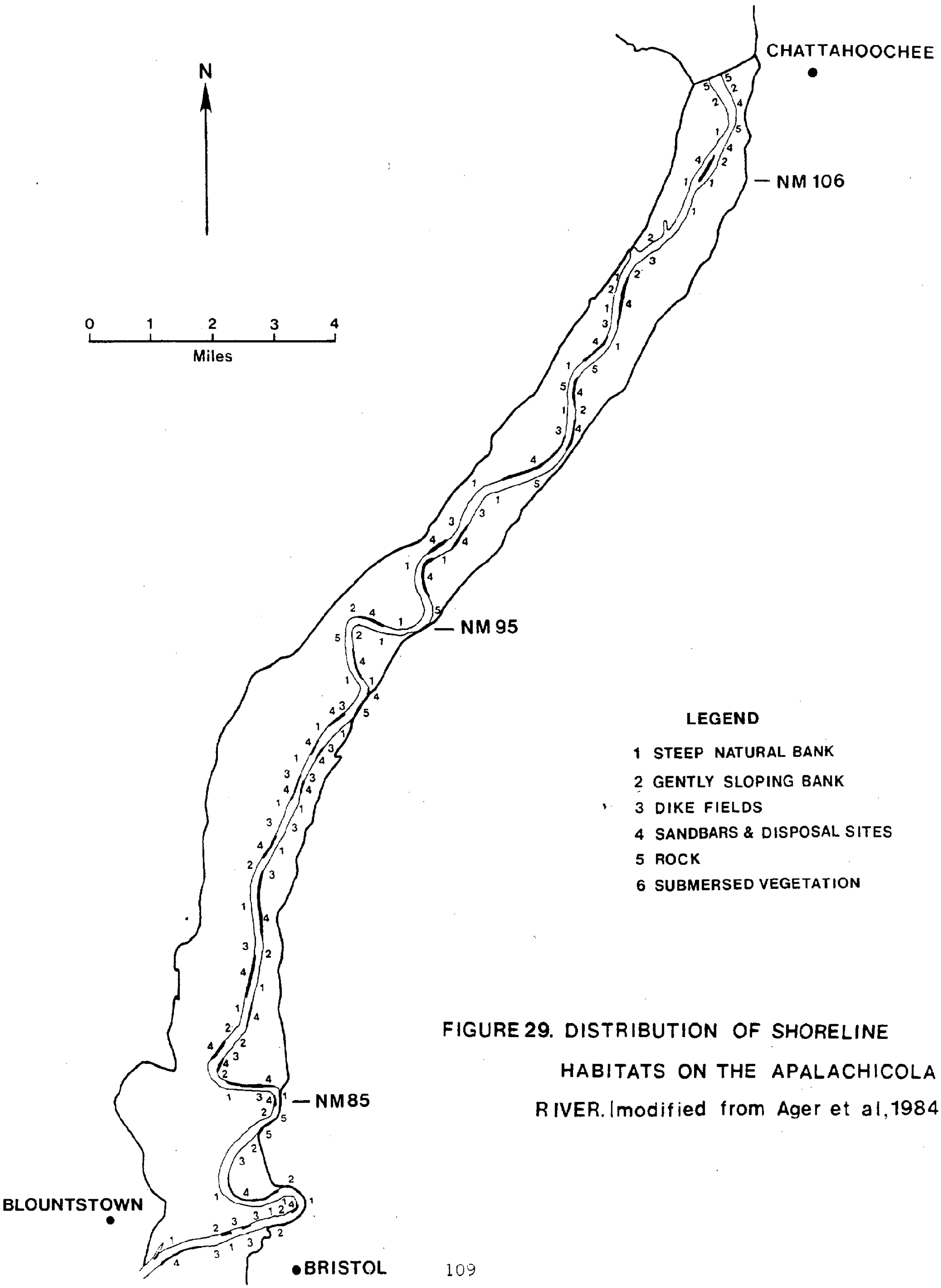


FIGURE 29. DISTRIBUTION OF SHORELINE HABITATS ON THE APALACHICOLA RIVER. (modified from Ager et al, 1984)

daytime sampling rates. Altogether gamefish account for 55 percent of the total catch with redbreast sunfish and bluegill comprising 34 percent of the total catch by themselves (Ager et al, 1984).

Species commonly found in rock habitats in the Apalachicola River include redear sunfish, gizzard shad, grayfin redhorse, American eel, spotted bullhead, striped mullet, threadfin shad, and blacktail shiner. The tadpole madtom has been found only in this habitat in the river so far. The bluestripe shiner, a threatened species in Florida, has also been found in this habitat (Ager et al, 1984).

Rock habitat not only provides an excellent cover for fish but is also an important substrate for the production of food organisms fish feed on. This stable substrate provides attachment sites for algae, moss, plants, and macro-invertebrates. Another important function this habitat is used for is spawning. As mentioned previously, a commercial fishery for Gulf of Mexico sturgeon used to exist on the river but is no longer viable. Since the inception of dredging in the river, rock removal has occurred in many areas of the upper river for navigational purposes. Sturgeon prefer hard bottom for spawning and it has been theorized that this modification of suitable shallow areas, along with overfishing and damming, have led to the demise of this fishery (COE, 1978). Investigations by the Florida Game and Fresh Water Fish Commission (Cox, 1969; Cox et al, 1975) have also concluded that the removal of rock shoals has been a major cause in the decline of biological productivity on the Apalachicola River.

Steep Natural Bank

The steep natural bank habitat comprises the largest percentage of any riverine habitat on the Apalachicola River, accounting for 90 miles of shoreline or approximately 42 percent of the total length. This habitat is characterized by a clay substrate with snags, roots, and submerged logs. The slope is greater than 45 degrees, which also accounts for a water depth usually greater than six feet. This habitat is typically found on the outside of river bends where stream bank cutting occurs; therefore, currents are

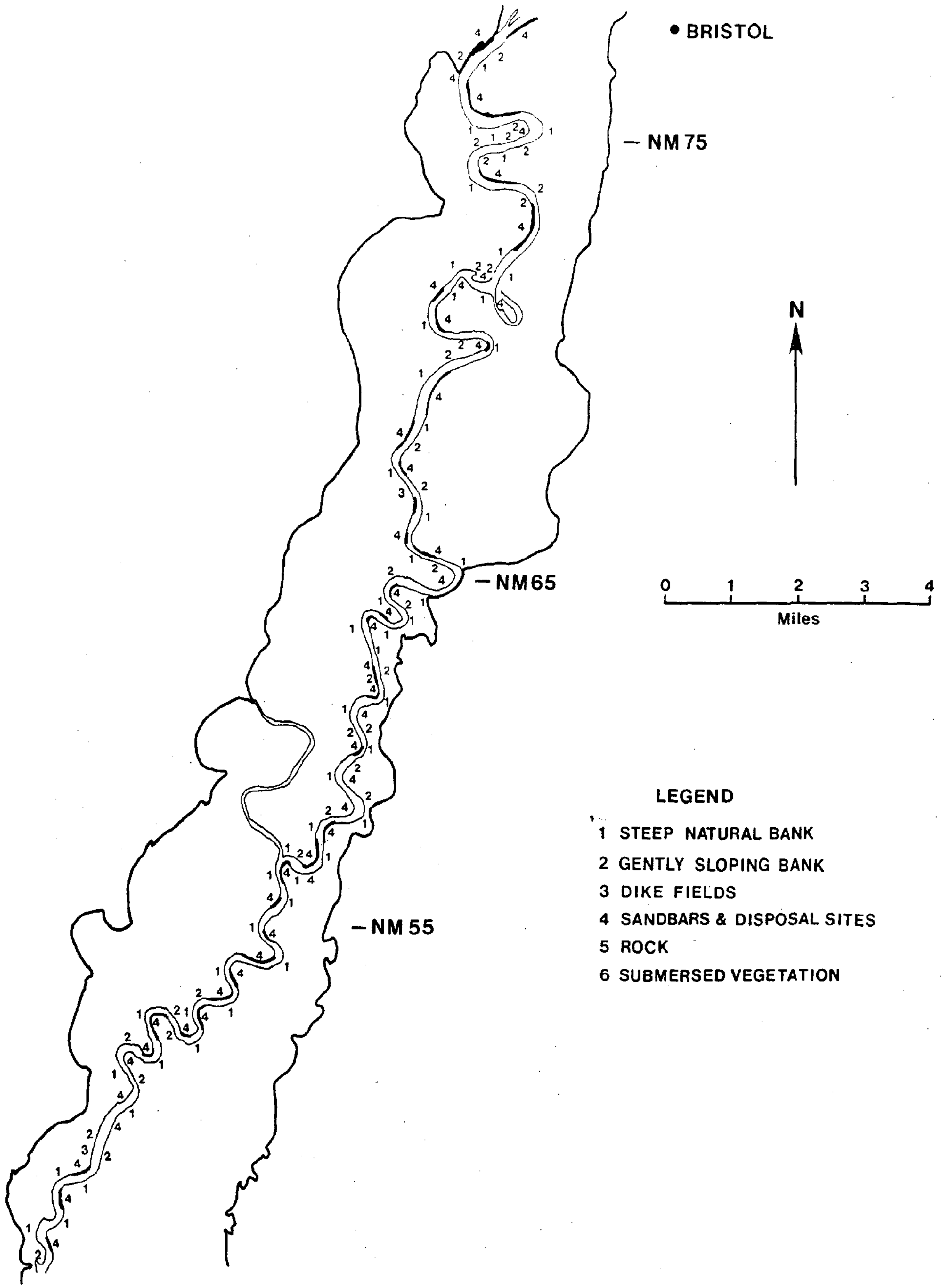


FIGURE 30. DISTRIBUTION OF SHORELINE HABITATS ON THE APALACHICOLA RIVER. (modified from Ager et al, 1984)

usually swift and erosional activities are apparent (Figure 29-32). The steep bank habitat is located throughout the river (Table 15), but predominates in the upper and middle sections, (Ager et al, 1983).

Steep natural bank habitat ranks second in both number and weight of fish caught (CPUE) when compared with other riverine habitats. There is also a noticeable difference in catch based on location in the river with the upper river producing twice the number and weight of fish than the same type habitat in the middle and lower river (Figure 33). Not only does catch rate (CPUE) rank above that for rock habitat, but more species are found in the steep bank habitat (43 species), although this number is less than the other four habitats. The most abundant species collected from this habitat are threadfin shad, blacktail shiners, bluegill, redbreast sunfish, largemouth bass, and bowfin. The forage species dominate upper river numbers while roughfish dominate upper river weight. Both these groups decrease in importance downriver. Gamefish species however increase in importance percent wise downriver, even though their catch rate declines. This is due to the larger decreases in numbers of forage and roughfish (Ager et al, 1984).

Species commonly found on steep natural bank habitats in the Apalachicola River include redear sunfish, black crappie, common carp, grayfin redhorse, channel catfish and weed shiner. Eleven species of gamefish are found in this habitat compared to nine from the rock habitat. Even so this habitat ranks second in gamefish number and weight caught (CPUE), behind rock habitat (Figure 34). Catch rates at night have also been shown to be approximately twice those during daylight hours, a tendency also exhibited by rock habitats. The bluestripe shiner, a threatened species in Florida, is also a rare inhabitant in the steep natural bank habitat (Ager et al, 1984).

As with other habitats which are located throughout the river, the steep bank habitat exhibited higher catch rates in the upper river than middle and lower river sections. Reasons for this include recruitment of individuals

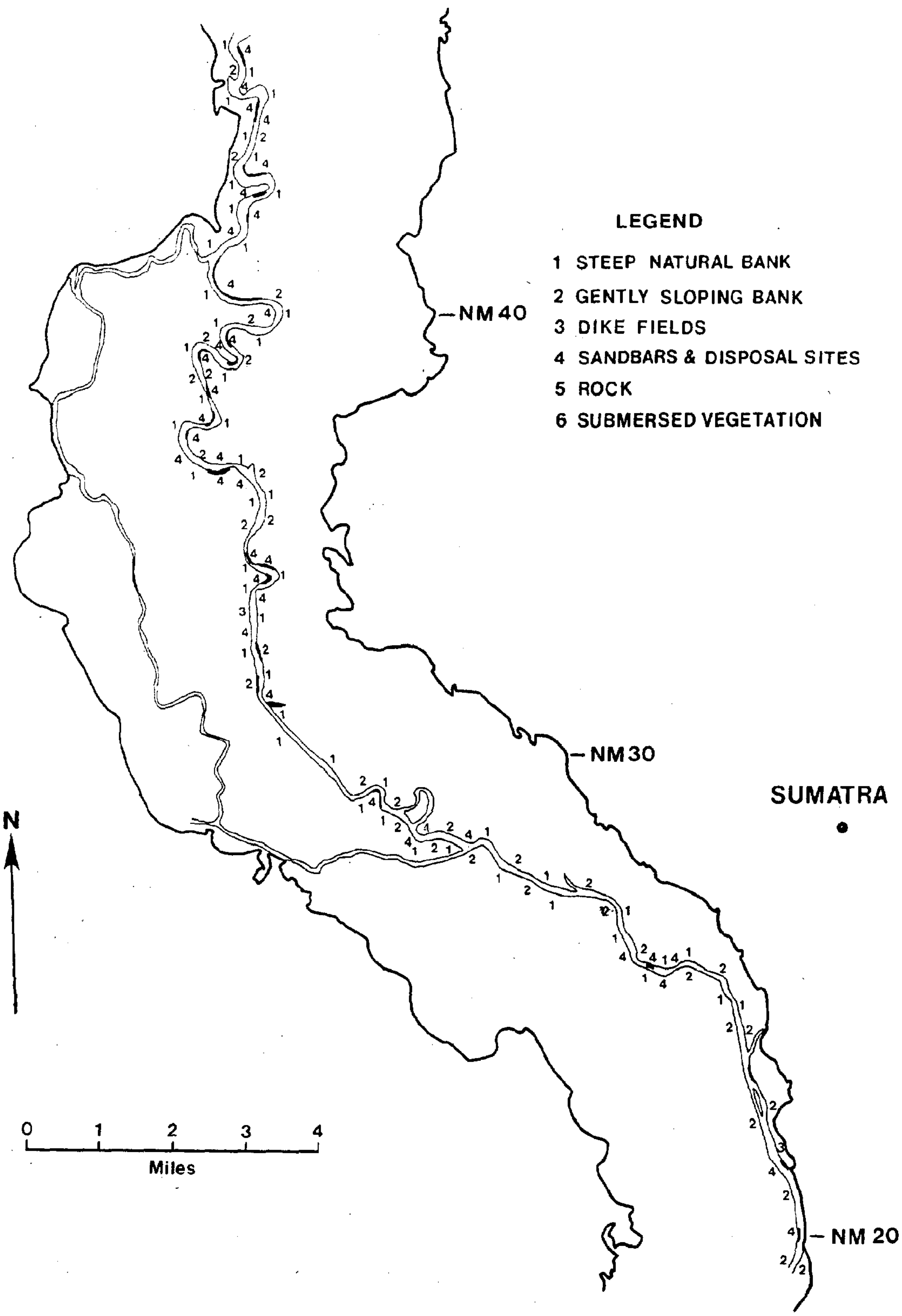


FIGURE 31 DISTRIBUTION OF SHORELINE HABITATS ON THE APALACHICOLA RIVER. [modified from Ager et al, 1984]

such as threadfin shad, bluegill, and others from Lake Seminole, abundance of good habitats, and blockage of upstream migration by the Jim Woodruff Dam (Ager et al, 1984).

Gentle Sloping Natural Bank

The gently sloping natural bank habitat currently comprises the second largest habitat type in the Apalachicola River (Table 15). The substrate in this habitat is a mixture of clay, mud, and fine sand, and typically contains overhanging trees with many snags and submerged logs. Water depth is generally less than 4 feet with a slope less than 45 degrees. This habitat typically is found in the coastal lowlands and on either side of point sandbars; therefore, currents are generally slow (Figures 29-32). The gently sloping bank habitat is found throughout the river accounting for 58 miles of shoreline, but predominates in the lower river comprising 60 percent of the shoreline in this section (Ager et al, 1984; 1985).

The gently sloping bank habitat ranks fourth by number and fifth by weight of fish caught when compared to the other habitats. Catch rates for the upper river were approximately twice those of the middle and lower sections, a phenomenon seen in the steep bank habitat also (Figure 33). Even though this habitat ranks below others in catch rate, it exhibits the highest number of species found in any habitat with 56 species, 13 of which are gamefish species. Of the four most abundant fish found in this habitat, bluegill, blacktail shiner, redbreast sunfish, and largemouth bass, three are gamefish species. By number, forage fish account for 52 percent of the total catch with blacktail shiners and threadfin shad predominating. Gamefish species account for 38 percent of the total catch with bluegill predominating (Figure 34). By weight, roughfish account for 61 percent of the catch with bowfin predominating in the upper and middle river and common carp predominating in the lower river. Two species which were found rarely in this habitat, gafftopsail catfish and spotted bass were found nowhere else in the river.

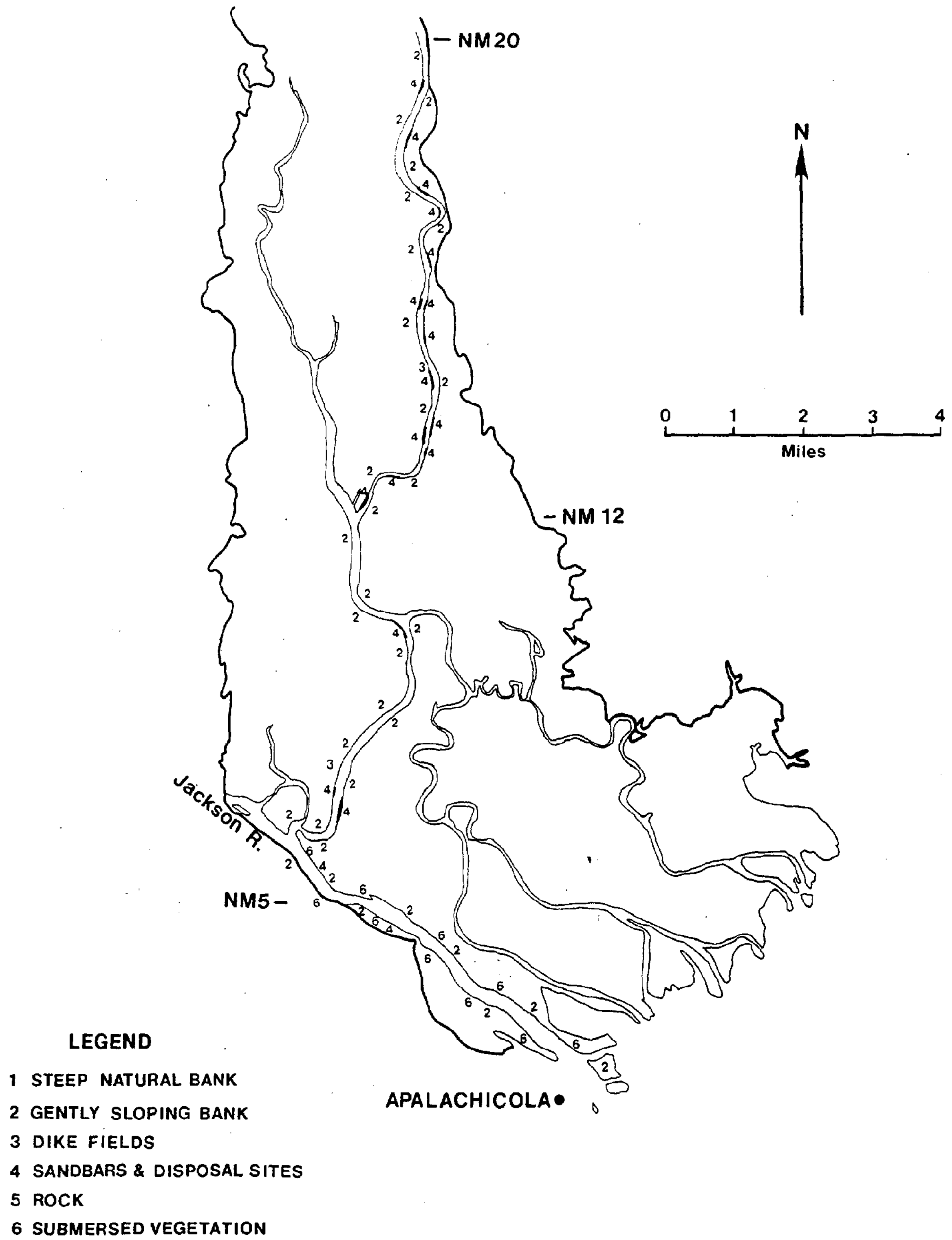


FIGURE 32. DISTRIBUTION OF SHORELINE HABITATS ON THE APALACHICOLA RIVER. [modified from Ager et al, 1984]

Species commonly found on gently sloping bank habitats include redear sunfish, spotted sunfish, spotted gar, bowfin, gizzard shad, common carp, grayfin redhorse, channel catfish, striped mullet, threadfin shad, coastal shiner and weed shiner. The bluestripe shiner, a threatened species, is a rare inhabitant of the gently sloping natural bank habitat.

In the upper Apalachicola River this habitat is one of the major types which has been used for spoil disposal by the COE maintenance dredging activity. Because of this, gently sloping natural bank habitat is scarce in the upper river, which accounts for overall low catch rates. Disposal of dredged material on this habitat type has been shown to reduce the total number of fish and gamefish in the upper river by 50 percent at these sites. Similar disposal in other areas of the river has reduced gamefish catches 75 percent at these sites the year following this disturbance. These reductions appear to persist 5-10 years after disposal on gently sloping natural bank habitats (Ager et al, 1984; Ager et al, 1985).

Dike Fields

The dike field habitat is an artificial habitat constructed by the COE for navigation purposes. Each field usually consists of three to five individual dikes. These dikes are constructed perpendicular to the shoreline and are made of wood pilings or rock. Dike field habitats are characterized by slow to swift water velocities, depending on river height and location on dike, and usually have large numbers of snags associated with them. The majority of the dike field habitat is located in the upper river where most of the navigation problems used to occur (Figures 29-32). River-wide, dike fields account for approximately five miles of shoreline (Table 15) and are therefore a larger habitat type than the natural rock habitat (Ager et al, 1984; Ager et al, 1985).

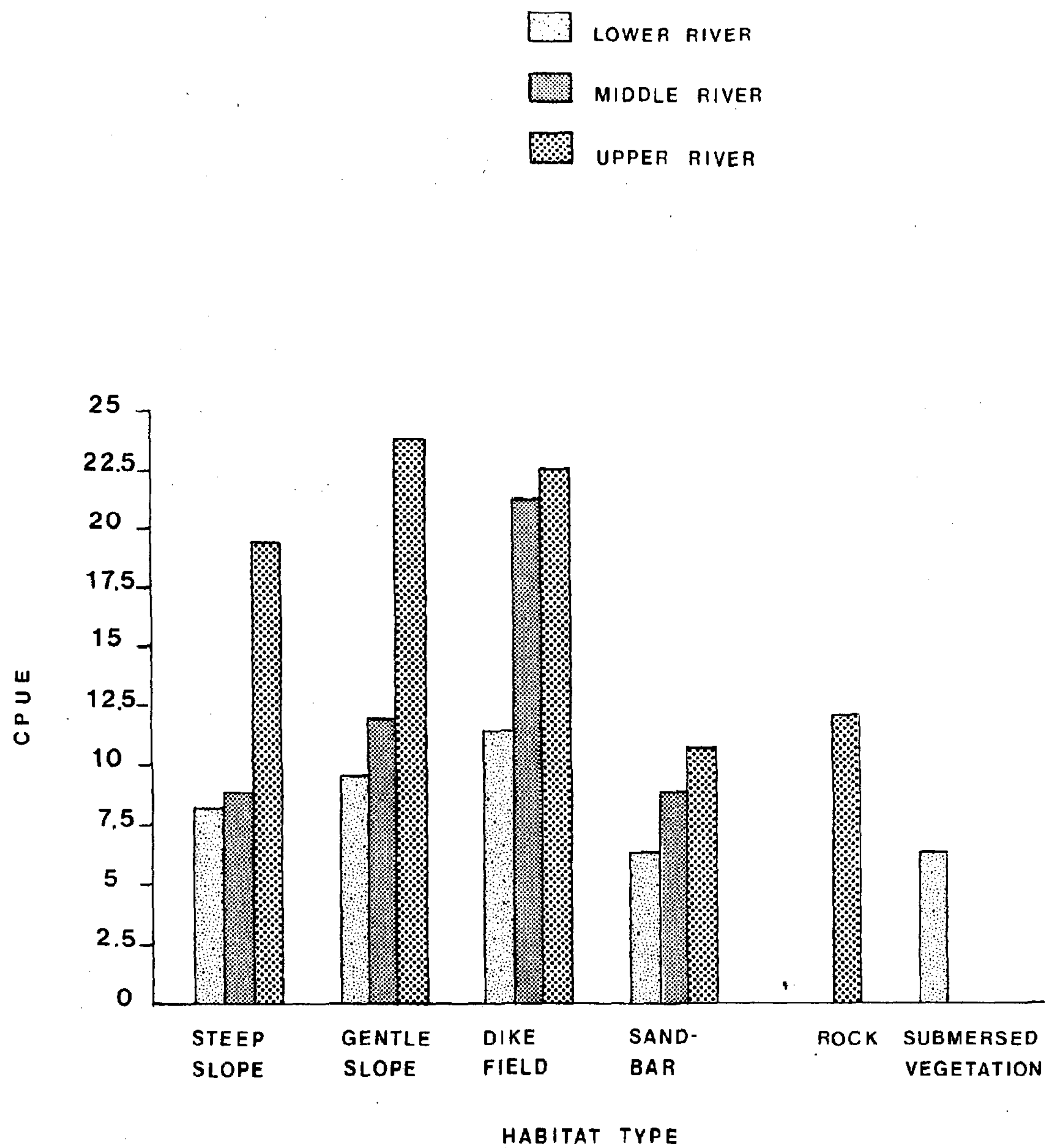


Figure 33. Number of fish (CPUE) collected by habitat and river section from the Apalachicola River samples, 1982-83.

Dike field habitat ranks first in catch rates for both numbers and weight of fish sampled in the Apalachicola River. This habitat also ranks high with regard to the number of species utilizing it, having produced 55 species of fish, second only to the gently sloping bank habitat. In terms of numbers, forage fish account for 60 percent of the catch while gamefish represent 30 percent. In terms of weight, roughfish account for 44 percent of the catch followed by foodfish, with 31 percent, and gamefish, 24 percent. The most abundant species collected on dike field habitats include redbreast sunfish, striped mullet, blacktail shiner, largemouth bass, and threadfin shad. As demonstrated in other river habitats, the catch declines downstream of the upper river section, with threadfin shad showing the largest decrease (Figure 33). Dike fields rank third in number of gamefish caught (Figure 34), but show the highest diversity of gamefish with 14 species represented (Ager et al, 1984).

Species commonly found on dike field habitats include bluegill, redear sunfish, spotted gar, bowfin, gizzard shad, common carp, spotted sucker, grayfin redhorse, American eel, coastal shiner, and weed shiner. Three species rarely found in the river, bannerfin shiner, mountain mullet, and yellow perch, have been found only on the dike field habitat by Ager et al (1984). However, the few numbers found are not significant to indicate habitat preference.

Dike field habitats, although man-made, provide cover and food for fish in much the same manner as the naturally occurring rock habitat. Because of this, and the diversity of the habitat itself, they are productive areas in the river. Unfortunately, they have also been used extensively for spoil disposal, especially in the upper river where they are most numerous. Disposal on these sites eliminates the cover and food which attracts fish to these habitats in the first place. A 50 percent reduction in catch rates of fish and gamefish has been observed by Ager et al (1985) on dike fields which have been disturbed by spoil disposal.

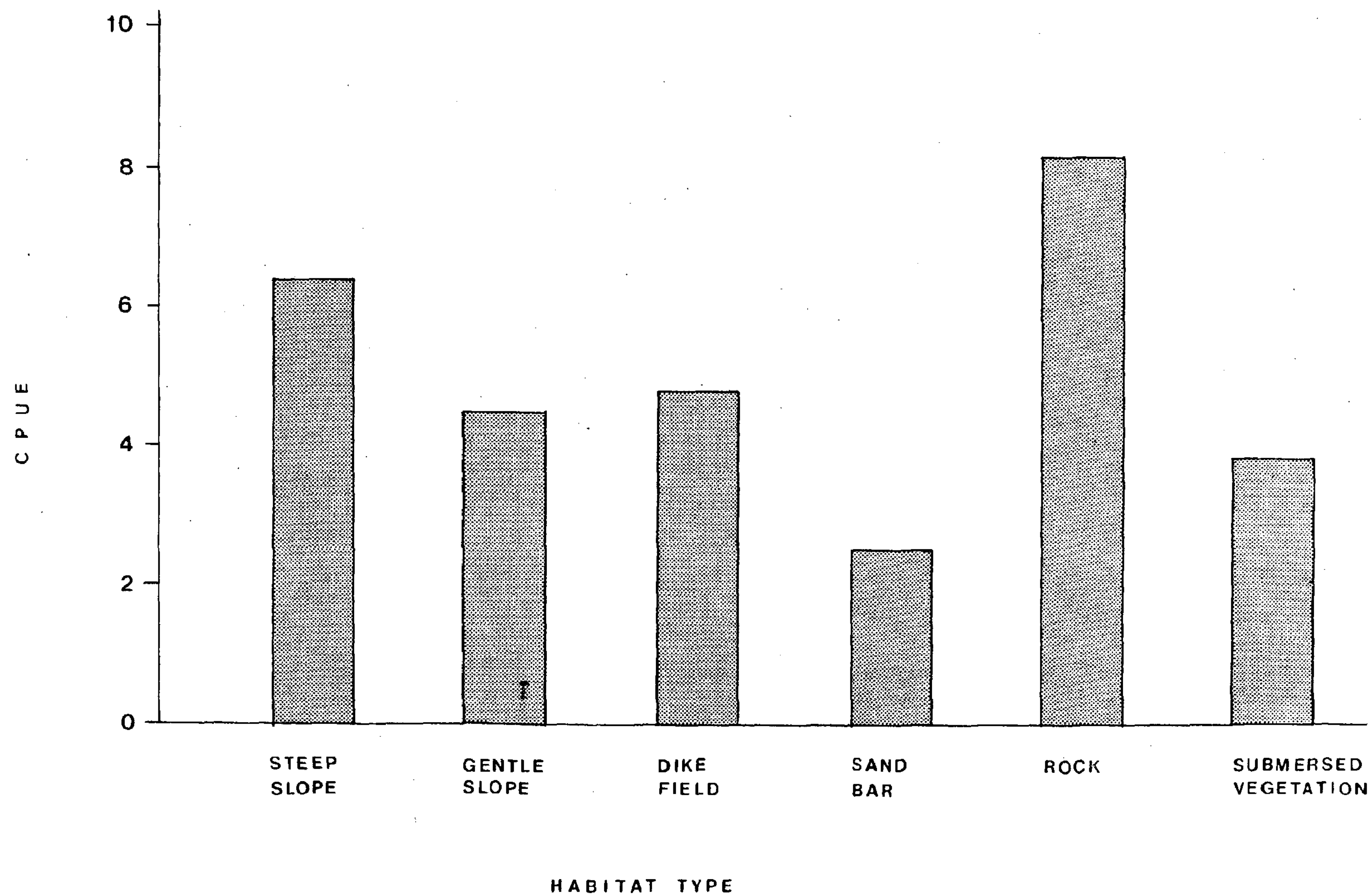


Figure 34. Number of gamefish per minute of electrofishing (CPUE) by habitat for all Apalachicola River samlples, 1982-83.

Submersed Vegetation

Submersed vegetation habitat is uncommon in the Apalachicola River and is only found in the lower river section near the bay (Figures 29-32). The vegetation characteristic of this habitat is Vallisneria americana, and is usually found in bands 10 to 100 feet wide parallel to the shoreline. Water depth is shallow and few snags or overhanging vegetation are present. Water velocity is also slow, again a characteristic of submersed vegetation habitats. This habitat is only found in the lower six miles of the river and accounts for approximately three percent of the total shoreline available (Table 15).

The submersed vegetation habitat ranks last in catch rate in numbers and fifth for weight of fish compared with other riverine habitats (Figure 33). Part of this is due to the fact that this habitat is limited to the lower river which is less productive than the upper and middle sections. This habitat is fairly diverse, being represented by 50 species of fish, ten of which are gamefish species. The high number of species is misleading however, due to the large number of estuarine and saltwater fish included. Gamefish account for 61 percent of the total number of fish caught, the highest percentage of any habitat sampled in the river. Compared to other habitats, however, catch rates for gamefish numbers rank fifth (Figure 34). Largemouth bass catch rates for submersed vegetation rank second behind rock habitat catch rates. Of the most abundant species collected from this habitat, largemouth bass, bluegill, American eel, redear sunfish, and striped mullet, three are gamefish species (Ager et al, 1984). Tidal influence is strong in the lower six miles of the river and undoubtedly affects fish distribution, as does saltwater influence from the bay.

Species commonly collected from the submersed vegetation habitat in the Apalachicola River include chain pickerel, spotted sunfish, spotted gar, bowfin, common carp, and golden shiner. Twelve species, many of them marine, have been found by Ager et al (1984) only from this habitat and include gulf menhaden, brown bullhead, sea catfish, golden topminnow, starhead topminnow, rainwater killifish, bluespotted sunfish, leather jacket, pinfish, silver perch, spot, and Atlantic croaker. The presence of so many marine species can be explained by salinity variations. Habitat preferences may be indicated by the fact that these species have not been collected from gently sloping natural bank habitats or sand bars and disposal site habitats in the same areas.

The submersed vegetation habitat appears to be important to the largemouth bass in the lower river as evidenced by the second highest catch rate in the river. This high catch rate is in spite of the lowest catch rate for total fish numbers of any habitat. Apparently, the tape grass beds are used by young-of-the-year or subadult bass as nursery areas. The submersed vegetation in the lower river has virtually been eliminated due to saltwater intrusion caused by the 1985 hurricanes. Although the vegetation is reappearing, the population of fish normally found in these regions has declined drastically (L. Ager, personal communication). It is too soon to tell if any long-term impacts will occur, or how long it will take for the vegetation to reestablish itself.

Sandbar

The sandbar habitat found in the Apalachicola River consists of two types, the natural sandbar of which few probably still exist, and the dredged material disposal sites which are already numerous and continue to increase in size and number. The sandbar habitat is found throughout the river with approximately 50 percent of the total in the middle section alone (Table 15). This habitat is characterized by shallow water less than 4 feet, slow to moderate water velocities, the absence of snags, and an unstable, shifting, sand substrate. Natural sandbars traditionally form on the inside of river bends (point bars); however, on the Apalachicola River, dredge material has been disposed of upriver, on, and downriver of many of these natural sandbars. Not only have the natural sandbars decreased, but considerable gently sloping natural bank habitat has also been converted to a sandbar type habitat (Figures 29-32).

The sandbar habitat ranks fifth in catch rates for total number of fish and last in total weight when compared with the other riverine habitats. This habitat ranks third with regard to number of species collected with 51, of which 13 are gamefish species. As with the other habitats represented throughout the river, total number of fish declines from upper to lower river, although the differences between the sections are not as large as the other habitats (Figure 33). Gamefish exhibit the lowest catch rate of any habitat, being lower than the next highest by almost 50 percent (Figure 34). The five most abundant species found on this habitat are blacktail shiner, striped mullet, redbreast sunfish, weed shiner, and threadfin shad. Of these, only one is a gamefish while three are forage fish. The dominant forage fish in the upper river is threadfin shad, but this changes downstream and weed shiner becomes dominant as shad numbers decline (Ager et al, 1984).

Species commonly collected on sandbar (disposal site) habitat include sunshine bass, bluegill, redear sunfish, largemouth bass, longnose gar, gizzard shad, common carp, quillback, spotted sucker, grayfin redhorse, channel catfish, bluestripe shiner, and hogchoker. Two fish, Morone spp. and channel catfish, utilize the sandbar habitat nocturnally in significant numbers compared to their daytime catch rates. The channel catfish young-of-the-year are evident nocturnally throughout the river while Morone spp. utilization is only evident in the upper river (Ager et al, 1984).

The sandbar habitat in the Apalachicola River which does not occur on point bars, is mostly man-made, created by the disposal of dredge material from the navigation channel maintained by the COE. Approximately 52 miles of shoreline, 25 percent of the total, are currently approved for within-bank disposal. At least 35 miles of this have been disposed on since 1977, with the majority of the rest utilized prior to 1977 (FDER, 1984). The river also currently has approximately 52 miles of sandbar (disposal site) habitat, much of which is disposal sites. A large portion of this has been changed from the more productive gently sloping natural bank habitat to the less productive sandbar habitat. This change will continue a shift from gamefish species, found on natural habitats, to forage and rough fish species, found on sandbar habitats (Ager et al, 1984). Studies by Ager et al, (1985) also show reductions of gamefish by 75 percent within the first year after disposal of material on natural habitats and an overall 50 percent loss of gamefish 5-10 years after disposal.

Upland System

The Florida portion of the Apalachicola drainage basin covers approximately 2,400 square miles and is evenly divided between the Chipola and Apalachicola rivers. Commercial forestry is the dominant land use throughout the drainage basin which includes parts of six counties: Gadsden, Liberty, Franklin, Gulf, Calhoun, and Jackson (COE, 1980; Alabama et al, 1984). The Chipola River drainage basin only includes parts of the latter three counties which are located west of the Apalachicola River. Although the major land use in each county is forestry operations, Jackson County, in the northern Chipola basin, also has a large percentage of agricultural lands which are drained by the Chipola River. A large amount of land is also in public holdings in all six counties including state parks, a federal wildlife refuge, a national forest, and other state and federal lands. Numerous other large holdings are managed for wildlife and forestry and will be discussed in a later section.

Physiography

The panhandle is comprised of three principal provinces, the Northern Highlands, Gulf Coastal Lowlands, and the Marianna Lowlands (Figure 2). In the ACF drainage basin the Northern Highlands consist of the Tallahassee Hills, New Hope Ridge, Grand Ridge, Apalachicola Bluff Region, and Cody Scarp. The Marianna Lowlands interrupts the Northern Highlands but the continuity of the Highlands is maintained by New Hope Ridge and Grand Ridge which are located just south of the Marianna Lowlands. New Hope Ridge and portions of Grand Ridge lie within the Chipola drainage basin.

The Tallahassee Hills are underlain by clastic sediments of old, Miocene deltas. These sediments contain clay and silt with phosphatic and calcareous deposits scattered randomly (Clewell, 1971). The western portions of the Tallahassee Hills lie within the Apalachicola drainage basin and end abruptly as tall (150-325 feet), steep bluffs along the Apalachicola River (Means, 1977; Leitman et al, 1983; Clewell, 1986). Creeks flow from deep ravines that cut into these bluffs of western Gadsden and Liberty counties. This area, located in the westernmost portion of the Tallahassee Hills, is known as the Apalachicola Bluff or Ravine Region (Figure 2). The Apalachicola Ravine area contains mostly small order stream bottoms having mesic to hydric plant communities, steep valley slopes grading from xeric vegetation near the top to mesic at bottom, and xeric vegetation inhabiting the tops of small divides between ravines (Means, 1977). Dry, sandy uplands consisting of the longleaf pine-turkey oak-wiregrass association exist east of the bluffs (Clewell, 1977).

The Marianna Lowlands is a large karst plain formed on limestones of Oligocene and Eocene age that have been elevated by structural lift (Puri and Vernon, 1964). More caves are located in the Marianna Lowlands than anywhere else in Florida or throughout the entire Coastal Plain (Means, 1977). The Marianna Lowlands and Grand Ridge regions, which occur mainly in the Chipola drainage basin, contain both longleaf pine woods and mesic hammocks similar to those on the bluffs (Clewell, 1977). Erosion has been so extensive in the Grand Ridge Region that well-developed flatwoods exist in its southern portion (Hubble et al, 1956). New Hope Ridge is higher in elevation and more relieved than Grand Ridge but is not as extensive or as deeply dissected as the Apalachicola Ravines.

The Gulf Coastal Lowlands are separated from the Tallahassee Hills by Cody Scarp. The Lowlands are typified by flatwoods of longleaf pine, saw palmetto, wiregrass, runner oak, and gallberry, interrupted frequently by poorly drained depressions and stringers of pond cypress, blackgum, sweetbay, and titi (Clewell, 1977). This area is also noted for numerous, small but botanically interesting savannahs (Clewell, 1977; Means, 1977).

The distribution of seven generalized plant communities has been mapped by Davis (1967) and is shown in Figure 35. This map does not give accurate

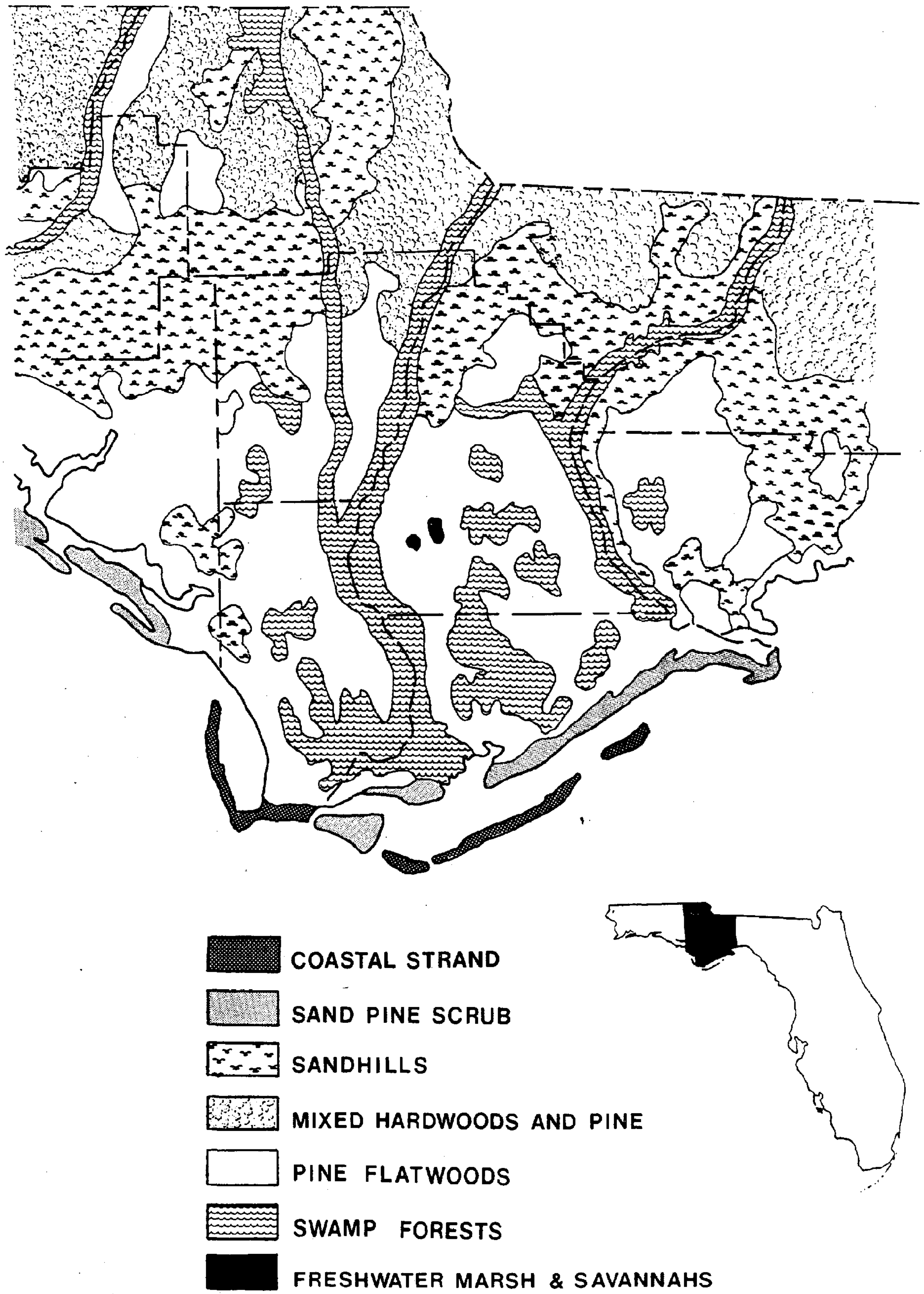


FIGURE 35. NATURAL VEGETATION OF THE APALACHICOLA BASIN [Davis,1967].

locations and distributions of these communities, but demonstrates their general occurrence and distribution in the ACF drainage basin. Various intergradations between these communities may exist in a given area or at a particular point in time.

Because of the diversity of the physical environment, the biota is high in species richness. The species richness is also due to contributions of the Gulf Coastal Plain, Atlantic Coastal Plain, Appalachian highway of dispersal, and Florida peninsula.

Upland Habitats

The Apalachicola River is the largest river in Florida and has quite an expansive floodplain considering the size of the drainage basin located within Florida. Only 12% of the Apalachicola River drainage basin is located in Florida with the remainder mostly in Georgia and some in Alabama. Fifteen percent of the Florida portion of the basin is floodplain and the rest consists of other palustrine, riverine, lacustrine, and terrestrial habitats. This section will cover the various terrestrial and palustrine habitats that are commonly found in the Apalachicola drainage basin. There is a limited amount of literature on the communities of the basin so many of the descriptions are taken from studies in the panhandle, in general, and the Apalachicola National Forest, in particular. Clewell's (1986) "Natural Setting and Vegetation of the Florida Panhandle" contains many research summaries of specific locations, several of which are included in the study area. Terrestrial vertebrates (including some aquatic species), their relationships with each other and the various plant communities will be included in this discussion.

Sandhills

Sandhills represent a xerophytic pine forest community occurring on hilltops and slopes of rolling hills. The sandhill community is common and widespread, particularly in the karst plains of the Gulf Coastal Lowlands and New Hope Ridge (Figure 2). However, most sandhills have been degraded or destroyed by timbering, overgrazing, fire exclusion, pine plantations, residential and commercial developments. Other names that have been applied to this community are high pinelands (Clewell, 1971), longleaf pine-turkey oak (FNAI, 1986), and longleaf pine-xeric oak woods (Clewell, 1986).

Sandhill vegetation consists of widely spaced longleaf pines which form an open canopy allowing sunlight to reach the ground enhancing the growth of the understory and ground cover. Deciduous oaks such as turkey oak, bluejack oak, southern red oak, and sand post oak are the most common understory species. The low dense ground cover is very high in species richness. Wiregrass, pineywoods dropseed, bracken fern and blueberry are just a few of the many herbaceous and woody plants that form this nearly continuous ground cover.

Clewell (1971), recognizes three phases of the sandhill community: turkey oak, bluejack oak, and coastal scrub oak. The turkey oak phase is the most common and occurs on the driest sites. The bluejack oak phase probably occupies relatively mesic sites and grows on more fertile sands than the turkey oak phase (Gatewood and Hartman, 1977). The coastal scrub oak phase is uncommon and scattered in the Apalachicola Coastal Lowlands, especially near river systems (Clewell, 1971). Myrtle oak and sand-live oak, two evergreen xerophytic oaks usually associated with sand pine scrub, are also understory oaks of the coastal scrub oak phase. Sand post oak, although not forming a phase representative of the sandhill community, is abundant along the edges of bluffs where moisture is plentiful (Clewell, 1986).

Sandhills occur on beds of non-calcareous sands over beds of sandy acid clay deposited during Pleistocene interglacials. The deep white to yellowish sandy soils that support this community are well-drained and infertile. However they tend to contain a bit more organic matter than soils of sand pine scrub. The heavily leached nutrients are brought back to the surface by the burrowing habits of animals.

The sandhill community is fire adapted and fire maintained. Historically fires occurred at frequent intervals, perhaps every 1-5 years. These natural fires occur in the summer and are caused by lightning. Wiregrass and pine straw provide the continuous fuel that supports frequent, light ground fires.

Because sandhills is a fire maintained community, many plant species have adaptations to the frequent ground fires and depend on them for their survival as do many species of wildlife. Wiregrass, as well as other associated species, requires summer fires in order to flower. The removal of litter by fires leaves bare mineral soil which longleaf pine seeds need in order to germinate. The young pines stay in what is known as the grass stage from 3-15 years. During this stage a long tap root develops for the uptake of water and nutrients. The bark on the stem becomes very thick and the bud remains at ground level and is surrounded by a protective tuft of needles. Growth out of the grass stage is rapid which minimizes its vulnerability to frequent ground fires. Large mature pines have thick bark which allows them to resist the damaging effects of fire. These characteristics allow longleaf pines to be the most fire adapted and fire tolerant of pine species.

Fire suppression, the alteration of burning seasons, and the changing of the natural fire frequency, has changed the species composition of sandhill communities. Hardwoods are very susceptible to fire and the above ground parts are killed, however, the root stocks which are not killed have the ability to resprout. Under a normal fire frequency the stands will be open and the oaks are maintained as shrubs. Less frequent fires allow the oaks to become small trees and in many areas now support a closed canopy of oaks. Other associates favored by the exclusion of fire include persimmon and winged sumac. With continued fire suppression sandhills will eventually succeed towards xeric mixed hardwood-pine (Laessle, 1942; Clewell, 1971).

Sandhills are often associated with and grade into scrub, pine flatwoods, xeric hammocks or scrubby flatwoods. Sandhills are often found adjacent to sand pine-rosemary scrub along the coast. It was previously thought that the vegetational differences between the communities were due to the lower available nutrients in the scrub soil (Harper, 1921; Laessle, 1958). However, soil differences between them (chemical and physical) are not consistently great enough to account for these differences. Fire appears to be the primary factor for maintaining the boundaries between scrub and sandhill vegetation (Kalisz and Stone, 1984; Myers, 1985). Fuel builds up quickly in sandhills and fires are frequent. Sand pine scrub has low fuel supplies and fires are infrequent. When fires do occur in sand pine scrub they are usually catastrophic fires and generally do not occur except under extreme fuel and weather conditions (Kalisz and Stone, 1984). Differences in fire frequencies and adaptations allow the two communities to coexist. With fire suppression sand pine scrub species readily invade longleaf pine communities (Laessle, 1968; Kalisz and Stone, 1984; Myers, 1985). Under certain conditions scrub will burn at frequent intervals and there will be an encroachment of sandhill species into scrub (Kalisz, 1982; Myers, 1985).

Sandhills provide year-round or seasonal habitat for approximately 30-40 invertebrates and vertebrates, many of which are endangered, threatened, or species of special concern (Landers and Speake, 1980). Typical animals of sandhill communities are the Eastern diamondback rattlesnake, Eastern indigo snake, pine snake, gopher frog, spadefoot toad, gopher tortoise, red-cockaded woodpecker, pocket gopher, fox squirrel, cotton mouse, cotton rat, Eastern cottontail, and Eastern mole (Landers and Speake, 1980; Snedaker and Lugo, 1972). Many of these vertebrates are found mainly in longleaf pine communities and have adapted to the hot summers and cool winters through the use of burrows.

These burrows are created by the gopher tortoise, a species of special concern (FGFWFC, 1987). Many of the vertebrates listed above use gopher burrows for nesting, feeding, and escape cover from predators and fire (Landers and Speake, 1980). The gopher frog, a species of special concern (FGFWFC, 1987), is rarely found outside the burrows and is therefore dependent on the gopher tortoise and its habitat requirements. The threatened Eastern indigo snakes distribution in the state is limited to areas with extensive sandhills interspersed with wetland habitats such as drainage ways, rivers, swamps, and cypress ponds (Landers and Speake, 1980). Other common residents of the burrows are the oldfield mouse, cotton mouse, cotton rat, and Eastern cottontail. Many kinds of invertebrates are residents and are found exclusively in tortoise burrows.

The red-cockaded woodpecker, an endangered species (FGFWFC, 1987), prefers old-growth longleaf pine forests. It is a highly specialized, non- migratory, cavity dwelling species and is the only woodpecker to roost in cavities of live pines (Labisky et al., 1983). It also needs extensive pine and pine hardwoods for its foraging requirements. Of all the inhabitants of longleaf pine forests, the red-cockaded woodpecker is probably in the greatest danger of extinction because of the drastic loss and decline of its habitat.

Clayhills

Clayhills are xerophytic longleaf pine communities occurring on an upland rolling topography. Clayhills exist in the region between the Georgia border and Cody Scarp. This region is called the Tallahassee Red Hills (Harper, 1914) or Northern Highlands (Puri and Vernon, 1964). Other names that have been given to this community are longleaf clayhill uplands (Means, personal communication), longleaf pine upland forest, high pineland (FNAI, 1986). Clayhills are often confused with sandhills. The primary differences between them reside in their soil characteristics, and a few species of their vegetative and wildlife composition.

Clayhills are characterized by widely spaced longleaf pines forming an open canopy. Deciduous oaks such as runner oak and dwarf live oak, chinkapin oak, post oak, southern red oak, blackjack oak, and bluejack oak are the dominant understory species. Other understory species include sassafras and persimmon. Turkey oak, blackjack oak, and bluejack oak are found on ridges and high slopes where clays have been leached from the topsoil (Means, personal communication). The ground cover is dense and continuous with wiregrass and many native grasses and forbs. Wiregrass is always present and usually the dominant species found. <u>Aristida</u> spp., <u>Sporobolus</u> spp. and <u>Andropogon</u> spp. are common. Other typical plants include huckleberry, blueberry, goldenrod, indian grass, partridge pea, goldenaster, and bracken fern (FNAI, 1986).

Clayhills occur on soils derived from clays and sands of the Miocene Hawthorne formation in the Tallahassee Red Hills physiographic region (Puri and Vernon, 1964; Means and Campbell, 1982). These soils are composed of sand with variable, sometimes substantial, amounts of clays (FNAI, 1986). The presence of clay creates a loamy soil which allows moisture to be retained, unlike the sandy well drained soils of sandhills.

The clayhill community, like the sandhill community, is also fire adapted and fire maintained. It depends on frequent ground fires to reduce hardwood competition and perpetuate the growth of pines and ground cover species (grasses, forbs, and herbs). Without relatively frequent fires, clayhills succeed to upland mixed hardwood-pine forests, and eventually to upland hardwood forests.

Clayhills are often associated with and grade into upland mixed hardwood-pine forests or upland hardwood forests (FNAI, 1986). Clayhill communities may be present up slope from these hardwood forests. Going down slope, the first hardwoods found are shrubby small-leaved evergreen species. Farther down slope, at the toe of the valley side wall, more substantial hardwoods are found. At the very bottom, species composition changes according to the hydrology of the stream course (Means and Grow, 1985). When fires are eliminated from the uplands these hardwoods begin moving up slope. Sweetgum and water oak are usually the first invaders. These belong to the beech-magnolia association which is capable of existing in the wettest sites, as well as extremely dry sites. The beech-magnolia is a climax community, replacing the hardwood communities that replaced the longleaf pine communities (Delcourt and Delcourt, 1977; Means and Grow, 1985).

Clayhills have been substantially degraded throughout their range. These pinelands today are very different from the native longleaf communities that existed in pre-settlement days. The old-growth pine stands are all second growth stands. Many longleaf pines have been logged. One of the more serious threats to clayhills, due to the richer loamy soils, has been the conversion to agricultural fields. Soil disturbances allow "oldfield successional communities" to replace the natural longleaf stands, the loblolly-shortleaf pine association being the major community to become established on oldfields (Quarterman and Keever, 1962; Means and Campbell, 1982). The loblolly pine may move up slope from the beech-magnolia association and establish itself on former longleaf sites. Loblolly and shortleaf pines are both fire intolerant species and therefore cannot survive frequent fires. However, with continued fire suppression the loblolly-shortleaf oldfield community will also succeed to the beech-magnolia association.

The faunal composition of clayhills is very similar to that of sandhills. Many species are endangered, threatened, or species of special concern. Typical animals of clayhill communities are the red-tailed hawk, great horned owl, red- cockaded woodpecker, Bachmann's sparrow, fox squirrel, white-tailed deer, armadillo, raccoon, opossum, Eastern diamondback rattlesnake, pine snake, Eastern indigo snake, gopher tortoise, and the gopher frog. Gopher tortoises are also found in clayhill communities but they do not do as well in clayey soils as they do in sandy soils. Many of the same associations exist in clayhills as in sandhills, and therefore will not be repeated in this community description.

Scrub

Scrub may be characterized by a dense shrub forest or a dense shrub-pine forest. It is probably the least fertile and one of the most xeric plant communities in Florida. Scrub is almost entirely confined to Florida, with a few examples occurring in Alabama (Laessle, 1958). In the panhandle scrub is common near the coast west of the Ochlockonee River. Within the Apalachicola Drainage Basin scrub occurs on dunes and beach ridges near the coast with small isolated stands existing inland on relic shoreline features (Clewell, 1986). Kurz (1942) correlated scrubs and other vegetation types with coastal landforms throughout Florida, including Cochran's Beach in Franklin County and Beacon Hill in Bay County.

Scrub contains fewer species than some of the more mesic and hydric communities. There are between 15-30 species in a given stand, not including invading species in disturbed areas or transition zones between adjacent communities (Clewell, 1986). Sand pine and slash pine are the overstory species of scrub, however, they will not occur together. Sand pine dominates the most xeric sites and slash pine may be found on these dry sites or may be found in the more mesic areas (Clewell, 1986). Sand pines grow in very dense stands forming a closed overstory. Slash pines, however, tend to grow in open stands with an open canopy.

Scrub consists of various evergreen scrub oaks and shrubs making up a thick, often clumped understory. These plants vary in size from low shrubs a few inches tall to small trees as tall as 10 feet. Major understory species of scrub are myrtle oak, Chapman's oak, staggerbush, sand live oak, rosemary, and Conradina canescens. Saw palmetto is also typical of scrub. Rosemary grows in open areas and has a distinctive zone of unvegetated white sand around each bush. Scrub contains little or no herbaceous ground cover. Those species that do exist grow as individuals or in patches rather than as a distinct stratum. Cladonia leporina and Cladonia evansii, which are capable of forming a very dense ground cover, are the most common species of lichens found in scrub communities.

Clewell (1986), recognizes three scrub communities: the coastal scrub community, the sand pine community, and the slash pine scrub community. An overstory is lacking in the coastal scrub community, although sand pines or slash pines may be widely scattered. The understory is usually 3-5 feet tall although some species may attain a greater height. The coastal scrub community contains fewer species than other scrub communities. Myrtle oak and sand live oak are the dominant species; rosemary also being conspicuous.

Sand pine scrub commonly occurs on beach ridges and other, relatively mature coastal upland land forms (Clewell, 1986). A dense stand of sand pine forms the overstory. The understory has the same species composition as the coastal scrub community.

The slash pine scrub communities often occupy interdunal swales between beach ridges. In many instances slash pine communities are referred to as slash pine flatwoods. Clewell (1986) indicates, however, that slash pine scrub exists and may have the same scrub stratum as sand pine scrub on dry sites and lacks a herbaceous ground cover on dry and moist sites. Scrub occurring along the coast is constantly subjected to salt spray and wind. Along the Gulf Coast sand live oak and other woody plants of scrub appear as if wind-sheared. Wells and Shunk (1937) assert that these plants are not wind-sheared but are growing in response to injury from salt spray. Other authors maintain, though, that wind and its enhancement of transpiration are more important factors than salt spray in causing the peculiar forms of coastal trees and shrubs (Clewell, 1986). Along portions of US Highway 98, the coast road, this is quite noticeable. The crowns are sloping with the tallest part of the crown away from the bay. The vegetation is also somewhat stunted in growth and the crowns of the oaks and pines are brown, appearing dead. This is especially apparent after hurricanes.

Scrub is susceptible to burial in active dune fields (Clewell, 1986). Kurz (1942) describes how slash pines, sand live oaks, and other woody species survive deep burial by the production of adventitious roots from trunks and branches. These species will persist after the dune has moved slowly but completely through a site, exposing the original soil surface.

Soils supporting scrub are formed from Pleistocene-age marine and aeolian deposits. These soils are composed of deep, sterile, well-drained sands and are very white at the surface. Scrub soils, unlike those of sandhill communities, exhibit eluviation characteristic of forest soils. Sandhill soils, like those of grasslands, undergo homogenization of the surface layer (Myers, 1985). Geologically, scrub soils occur on dunes and beach ridges near the coast and on relic shoreline features inland (Clewell, 1986).

The sandy soils of scrub contain little or no organic matter and silts and clays may be present in the upper horizons. Sands along the coast contain some shell fragments which provide nutrients upon weathering, however, the shell content in the sands along the coast in the panhandle is generally lower than elsewhere in Florida (Clewell, 1986). Nutrients may be provided to scrubs along the coast from meteorologic input. Aerosols, which are rich in nutrients, of salt spray are intercepted by coastal plants and the soil as winds move onshore from the Gulf.

Scrub is a fire dependent and a fire maintained community. However, scrub burns infrequently and has been labeled a "fire fighting association" because fires burning in adjacent vegetation rarely penetrate the scrub (Myers, 1985). Scrub may burn only once in the lifetime of sand pine which is usually no more than 50-60 years old (Clewell, 1986). When sand pine scrub does burn, it is usually during severe burning conditions and high fuel loads (Myers, 1985). Fuel builds up quickly in the crowns of sand pines so when a fire goes through, it is usually a very hot, fast burning crown fire. Sand pines are intolerant of fire and are generally killed by the intense heat, however, they have serotinous cones and depend on fire for reseeding the stand. It is interesting to note that the majority of sand pines found in the panhandle have open cones. Many of the woody plants found in scrub coppice following fire. Rosemary however, is killed.

Scrub without an overstory of pine on coastal dunes experiences fire infrequently. Topographic irregularities prevent the vegetation from being evenly distributed, making it almost impossible for a fire to spread for any distance (Clewell, 1986). The fires in slash pine scrub are usually surface fires, however, the fuel buildup between fires may be such that the crowns may singe.

Scrub is associated with and often grades into sandhill, scrubby flatwoods, coastal strand, and xeric hammock. The relationship of sand pine scrub and sandhill vegetation has been discussed in the sandhill community and will be mentioned only briefly. The early literature stressed the fact that scrub and sandhill communities were never mixed and that a well defined boundary separated the two (Nash, 1895). However, this boundary is not quite so evident today. Many sandhills near the coast contain a mixture of longleaf pine-xeric oak species (including turkey oak, bluejack oak, and wiregrass) and scrub species (including sand pine, myrtle oak, sand live oak, and rosemary). In the absence of fire sand pines and other typical scrub species will invade sandhill communities. Such transitional communities are common along the north side of U.S. 98 in Franklin County. It is evident, however, that the fire regimes not soil differences separate these two vegetation types and that these fire regimes may account for the distribution of the two types (Myers, 1985). With continued fire suppression scrub eventually succeeds to xeric hardwoods.

Because scrub occurs almost exclusively in Florida, it often contains several endemic plants and animals, many of which are rare and endangered. However, many of the Florida scrub endemics occur in peninsular Florida. The scrub fauna of the panhandle is fairly depauperate. There are very few residents of scrub communities, but several species are temporary residents or transient species. Wildlife species of scrub communities include the Eastern diamondback rattlesnake, coachwhip, black racer, anoles, six-lined racerunner, broadhead skink, Eastern glass lizard, slender glass lizard, Eastern mud turtle, Eastern box turtle, gopher tortoise, southern toad, oak toad, spotted skunk, loggerhead shrike, yellow-rumped warbler, and ground dove (FNAI, 1986; Means, personal communication).

Pine Flatwoods

Pine flatwoods are mesophytic communities characterized by one or more species of pine as the dominant tree species. Mesic flatwoods is the most widespread community in Florida comprising 30-50 percent of the uplands (FNAI, 1986), and occurs most frequently in areas with flat topography (marine terraces) (Monk, 1968).

Flatwoods are abundant and widespread throughout the panhandle and are particularly common in the Coastal Lowlands (Clewell, 1986). Patches of flatwoods also occur in the lowlands around Marianna and in the Tallahassee Red Hills (Hubbell et al, 1956). Wet flatwoods or boggy flatwoods are particularly characteristic of the Tates Hell region of Franklin County (Clewell, 1986). Pine flatwoods are also referred to as pine savannahs, low flatwoods, mesic flatwoods, wet flatwoods, pine barrens, slash pine flatwoods, longleaf pine flatwoods, or pond pine flatwoods.

The older literature speaks only of longleaf pine in pine-palmetto flatwoods (Clewell, 1971). Quintus A. Kyle emphasized that longleaf pine was the exclusive tree of the flatwoods in the Apalachicola National Forest until the suppression of fire began in the 1930's (Clewell, 1971). Slash pine plantations have replaced many of the old growth longleaf pine flatwood communities. Slash pine also occurred naturally in the original-growth pinelands but was largely restricted to sites just inland from tidal marshes and other coastal environments (Clewell, 1986).

The overstory of flatwoods consists of three pine types which separate flatwoods into three phases. These include: longleaf pine flatwoods, slash pine flatwoods, and pond pine flatwoods (Hubbell et al, 1956; Clewell, 1971, 1986). Each of these pine species tend to dominate a particular flatwood community. However, mixed stands of longleaf pine and slash pine can be found. Clewell (1986) identifies this as a fourth phase. Longleaf pines and/or slash pines may also be present in pond pine flatwoods. The pines in flatwood communities are usually widely spaced and form an open canopy.

An understory tends to be absent in pine flatwood communities. However, a very dense ground cover of 200 or more species of shrubs and herbs is present (Clewell, 1971). There is considerable overlap of these species among the three flatwood community types, with many species occurring in all three communities. Wiregrass and runner oaks generally dominate the ground cover of longleaf pine flatwoods; gallberry and saw palmetto are predominant in slash pine flatwoods; and rusty lyonia and several of the bay trees are characteristic of pond pine flatwoods (McDiarmid, 1978; FNAI, 1986). Shrubby species are more conspicuous than herbaceous species except during the first few months after a fire. Common shrub species include gallberry, runner oak, dwarf huckleberry, blueberry, wax myrtle, fetterbush, and St. John's-wort (Clewell, 1986). Common herbs include partridge-pea, butterfly-pea, milk pea, meadow beauty, blazing star, bog button, blackroot, gopher apple, false foxglove, white topped aster, yellow-eyed grass, and bracken fern (Clewell, 1986; FNAI, 1986).

Longleaf pine flatwoods dominate the drier sites and most commonly occur between the longleaf pine-turkey oak sandhill phase and the slash pine flatwoods phase (Monk, 1968; Snedaker and Lugo, 1972). Slash pine flatwoods dominate poorly drained sites and occur in low spots surrounded by longleaf pine flatwoods, around flatwoods ponds, in narrow belts around the edges of bayheads or swamps, and over rather extensive areas of wet soils marked by the presence of pitcher plants or crayfish burrows (Hubble et al, 1956). The more acid, poorly drained sites are dominated by pond pine flatwoods. They occur in extremely flat areas, always at a slightly lower level than bordering areas of longleaf pine flatwoods. Pond pine flatwoods are stressed by an excess of water and tend to have the lowest diversity of the three flatwoods communities (McDiarmid, 1978). Pond pines are usually scattered, with large areas of fetterbush. Herbaceous vegetation is scarce (Hubble et al, 1956).

The soils of flatwoods are moderately to poorly drained. They consist of acid sands, with a moderate amount of organic matter in the upper few centimeters, and generally overlying an organic hardpan at depths of 1-3 feet (Harper, 1914; Hubbell et al, 1956; Snedaker and Lugo, 1972). This hardpan reduces the percolation of water below and above its surface. During the rainy season water may stand in these areas and in the dry season plant roots may have trouble penetrating the hardpan layer. The frequency and intensity of fire is one of the major controlling agents in terms of flatwood succession toward some other community type. Nearly all plants and animals inhabiting these communities are adapted to frequent fires and are dependent on them for their continued existence. In the past, longleaf pine dominated flatwoods. Longleaf pines, however, are extremely fire tolerant and competition intolerant. Fire suppression has allowed slash pine, which is tolerant of competition and fire intolerant, to invade longleaf pine flatwoods. The elimination of fire in longleaf pine and slash pine flatwood communities allows succession to proceed towards mesophytic mixed hardwood communities. In the absence of fire, wetter slash pine flatwoods and pond pine flatwoods succeed towards bayhead communities (Monk, 1968; Snedaker and Lugo, 1972).

Pine flatwoods are associated with and grade into wet flatwoods, scrubby flatwoods, dry prairies, titi swamps, bayheads, and sandhills.

Flatwoods, depending on successional stage and management activities, generally have a high diversity of wildlife populations. Not only are flatwood communities important for wildlife, but the ecotones, or boundaries between flatwoods and associated communities are used extensively by various animals. Flatwoods and ecotones surrounding them provide an extensive source of wildlife food, nesting and escape cover. Animals characteristic of flatwood communities include black bear, white-tailed deer, raccoon, bobcat, fox, opossum, striped skunk, cotton rat, cotton mouse, black racer, pine warbler, red-shouldered hawk, southeastern kestrel, oak toad, and chorus frog.

Mixed Hardwoods

Mixed hardwood forests range from being nearly xerophytic to nearly hydrophytic communities containing a variety of mixed deciduous and evergreen upland hardwoods. These forests are well developed and generally have closed canopies. In the panhandle hardwood forests originally were restricted to riverine habitats and occasionally to protected habitats along the coast and around some lakes and sinks (Clewell, 1986). However, with fire protection and other human disturbances, hardwood forests have spread into other areas and habitats (pine communities).

Moisture, fire frequency, and the availability of nutrients account for the variations in species composition between communities. Because hardwood communities are so variable in species composition authors have given many different names to hardwood forest communities. Recent authors (Quarterman and Keever, 1962; Monk, 1967; Clewell, 1971) refer to hardwood forests of the southeastern coastal plain as the southern mixed hardwood forest. Other names applied to hardwood forest communities are sandy hammock (Hubbell et al, 1956), mixed hardwood forest/beech-magnolia forest (Delcourt and Delcourt, 1977), mixed hardwood pine, hardwood hammocks (Pritchard, 1978), pine-oak-hickory woods, mesic hardwood hammock, bottomland hardwood forest, coastal hammocks, coastal swamps (Clewell, 1986), upland hardwood forest, and upland mixed forest (FNAI, 1986).

Many authors (Kurz, 1944; Braun, 1950; Hubbell et al, 1956; Monk, 1967; Quarterman and Keever, 1962; Delcourt and Delcourt, 1977) consider the beech-magnolia forest as the climax community of the red hills section of north Florida. It is considered to be either climax or near-climax in the pine belt of the coastal plain of the southeastern U.S. because successional tendencies lead toward it; because it occurs over a wide range of mesic conditions and on a variety of soils; because it is not affected by minor climatic differences, hence is geographically widespread; and because of its persistent return after disturbance, to the same type of forest (Quarterman and Keever, 1962).

Species composition and habitat preference vary considerably in hardwood forest communities. Clewell (1986) presents a detailed conspectus of hardwood forest communities (Table 19). Hardwood forests usually have a dense overstory and a closed canopy. Saplings of overstory species are common. Smaller trees that rarely attain sufficient height to enter the canopy are also characteristic of many stands. Tall forests with closed canopies have sparse understories. Open forests tend to have dense understories. The ground cover consists of both herbs and shrubs and the density of these species varies from stand to stand (Clewell, 1986).

Broadleaved hardwoods are usually the dominant species of hardwood forest, however, conifers (pines, cedar) or cabbage palms may dominate some stands. Evergreen and tardily deciduous species are usually present and sometimes more abundant than deciduous hardwoods (Clewell, 1986). Xeric sites tend to be dominated by evergreens, and the mesic and hydric sites tend to be dominated by deciduous species. Southern mixed hardwood forests may contain a minimum of 71 tree species from 30 families. A few of these range throughout the community type, lending floristic continuity, whereas others are restricted to specific environmental situations (Monk, 1968).

Table 19. Hardwood Forest Communities (modified from Clewell, 1986).

COMMUNITIES	LOCATION	SOIL-MOISTURE/ FIRE/SALINITY	VEGETATION
Pine-Oak-Hickory	Northern Highlands of the Piedmont	Dry-mesic sandy loams, loamy sands/ Rather frequent/None	O-Shortleaf pine, red oak, post oak, mockernut
Mesic Hardwood Hammock		Mesic sands or loams/Rare/None	O-Laurel oak, white oak, beech, southern magnolia, sweetgum, spruce pine
- Laurel Oak woods	Bluffs and uplands which have been kept fire-free and undisturbed for several decades.	Well drained sands or loams/Rare	O-Laurel oak, mockernut hickory, blackgum, red oak, post oak, black oak, live oak U-Dogwood, dwarf-thorn, crab-apple, and sparkleberry
- Beach-magnolia hammock	Lower portions of bluffs and ravines; common in Tallahassee Hills where fire and land use have been minimal and soil moisture is adequate.	Mesic (rather moist) sands or loams/Rare	O-Dominated by American beech and southern magnolia
- Mixed hardwood hammock	Lower slopes on bluffs and levees on floodplains.	Mesic (well drained) sands or loams/Rare	All other combinations of mesic hardwood hammock vegetation; white-oak forms a narrow zone on bluffs between the laurel oak woods and the beech-magnolia hammocks

O-overstory
U-understory

Table 19 continued.

COMMUNITIES	LOCATION	SOIL-MOISTURE/ FIRE/SALINITY	VEGETATION
Coastal Hammocks	Mesic hardwood hammocks near coast occur next to scrub, border tidal marshes and coastal sloughs.	Mesic sands with limestone or shell within root zone/ Rare/Salt spray sometimes; tidal inundation in hurricanes	O-Live oak, southern magnolia, cabbage palm, southern red cedar, slash pine U-Yaupon, wax-myrtle, red bay, wild olive
Coastal Swamps - Tideland Swamps - Cabbage Palm Hammocks	Occur along floodplains of rivers within zone of tidal influence and along the inland margins of tidal marshes.	Wet-mesic to hydric; limited seasonal fluctuation of water table; loams or peaty sands/Rare or, in cabbage palm hammocks, frequent/Salt spray sparingly; tidal inundation in hurricanes	O-Cabbage palm, pumpkin ash, red maple, sweetbay, black-gum, southern red cedar, loblolly pine, slash pine U-Hazel alder, yaupon, sea myrtle

NOTES: Bottomland Hardwood Forest described in Floodplain section.

O-overstory
U-understory

Dominant overstory species of southern mixed hardwoods include beech, Southern magnolia, pignut hickory, mockernut hickory, laurel oak, hophornbeam, spruce pine, loblolly pine, shortleaf pine, white oak, diamond-leaved oak, water oak, swamp-chestnut oak, maple, and basswood. Understory species characteristic of hardwood forests include dogwood, Eastern redbud, sparkleberry, ironwood, wild olive, sweet leaf, and witch-hazel. Ground cover is usually sparse.

Southern mixed hardwood forests are found on a variety of soils. They occur on sands and loams covered with leaf litter. These soils are closely associated with limestone outcrops or sub-surface limestone or with exposed calcium-bearing Miocene clastics along river bluffs (Clewell, 1971). Some mesic hammocks occur along spring fed rivers, on the sides of sinks, and on bluffs near these limestone outcroppings. Species such as cabbage palm, southern red cedar, and redbud favor the calcareous habitats (Clewell, 1986).

Fire is usually rare in southern mixed hardwood forests. The thick leaf litter helps to conserve soil moisture. Air movement and light penetration are generally low due to the dense canopy. Fuel consists of leaf litter alone; therefore fires that do creep into hardwood forests generally kill the undergrowth and scar trees. However, crown fires may occur and will kill nearly all trees, along with understory and ground cover vegetation.

Hardwood forest are often associated with and grade into upland pine forests or xeric hammocks. Hardwood forests commonly invade communities where fire has been suppressed or other disturbances have occurred. These communities include sand pine scrub, sandhills, clayhills, longleaf pine flatwoods, and slash pine flatwoods. Hardwoods also invade swamps and other aquatic habitats that have been drained. Transitory communities that contain a mixture of the original vegetation and the invading hardwood vegetation occur on sites where this invasion is taking place (Clewell, 1986).

The wildlife present in mixed hardwood forests varies with the successional stage of the forest. Animals characteristic of early succession forests include broadly adapted generalists such as cottontail rabbit, quail and bobcat. More narrowly adapted species like the pileated woodpecker, turkey, and grey squirrel are typical of later successional stages (Gatewood and Hartman, 1977). Other animals characteristic of hardwood forests include the grey rat snake, coral snake, rough green snake, red-bellied snake, box turtle, eastern glass lizard, broadhead skink, ground skink, slimy salamander, green anole, grey tree frog, bronze frog, wood rat, cotton mouse, grey fox, shrews, moles, white-tailed deer, barred owl, red-bellied woodpecker, and woodcock (FNAI, 1986).

On upland xeric sites, hammocks are similar to the mixed hardwood forests of clay soils. Hammocks are best developed in areas where limestone or phosphatic deposits are near the surface. Hammocks differ from mixed hardwood forests in that they often lack shortleaf pine, beech and other more northern species. Characteristic species include southern magnolia, laurel oak, sweetgum, American holly, and cabbage palm (on mesic to hydric sites). A few scattered pines may also be present (Gatewood and Hartman, 1977). The understory includes muscadine grape, virginia creeper, American beautyberry, and dogwood. Drier sites have a similar understory with characteristic trees including live oak, southern red oak, laurel oak, and persimmon. Xeric hammocks may be found on sandhill sites, well-drained flatwoods, and fringing lakes and sinkholes (Gatewood and Hartman, 1977).

Titi Swamps, Bayheads, Shrub Bogs

Titi swamps, bayheads, and shrub bogs share similar community characteristics and are classified as acid swamp communities by Clewell (1986). These communities are widespread throughout the drainage basin occupying depressions within pine flatwoods and grass-sedge bogs. Moisture, fire frequency, and disturbances affect the abundance and distribution of these three communities.

Acid swamps are thickets or forests of evergreen and tardily deciduous trees. Common species of vegetation are woody. The total number of species in acid swamps of the panhandle is low and species composition changes only slightly between communities. In taller stands an overstory of scattered pines or bays may be present. Other stands may not be differentiated into a distinct overstory and understory. Species characteristic of acid swamps include sweetbay, loblolly bay, swamp bay, red bay, black titi, swamp cyrilla, little-leaf cyrilla, fetterbush, large gallberry, and myrtle-leaf holly. Slash pine and pond pine are often present and may be dominant. Ground cover is absent in closed canopy forests except for scattered patches of sphagnum moss. A herbaceous stratum (generally sedges) may be present in shrub bogs with open canopies (Clewell, 1986).

Soils of acid swamps contain highly organic, acidic sands often overlain by peat which may accumulate to several feet deep. The water table is generally close to the surface except during droughts. During the rainy season these communities may be temporarily inundated. Much of the soil moisture comes from runoff from surrounding communities.

Acid swamps experience irregular fires. The vegetation burns poorly compared to the vegetation of fireland communities and the leaf litter is usually too wet. Acid swamps adjacent to pine flatwoods burn more frequently but unless there are drought conditions only the edges of the swamps burn. Under extreme drought conditions crown fires may occur, killing all but the larger pines. Much or all of the peat may burn. Titi and other shrubby species resprout following fire.

Titi swamps, bayheads, and shrub bogs are usually but not always distinct from one another. They differ somewhat in their distribution, soil moisture, and species composition.

Titi Swamps. Titi swamps occur as strands or depressions in flatwoods or along the borders of some alluvial swamps in north Florida. Broadleaved shrubs and small trees comprise the principle element of the vegetation. The vegetation is usually very dense. At least one of the three species of titi (black titi, swamp cyrilla, little-leaf cyrilla) will be present and dominant. Their presence, dominance, and distribution varies between stands. Myrtle-leaf holly sometimes replaces titi as the principal dominant in small swamps at the heads of minor drainages. Black titi is usually more abundant than the two cyrillas and tends to occupy slightly higher sites than swamp cyrilla (Clewell, 1971). Pond pine and slash pine may be present as overstory species with the understory being dominated by titi.

Understory species characteristic of titi swamps include fetterbush and large gallberry which are often abundant. Other shrubs usually present include odorless wax-myrtle, staggerbush, sweet pepperbush, cane, Virginia willow, bayberry, red chokeberry, and swamp honeysuckle. Woody vines such as bamboo-vine, muscadine grape, and yellow jasmine may also be present (Clewell, 1986).

The water table of titi swamps is generally near the surface except during droughts. Therefore, the soils are generally saturated but are not inundated for long periods of time after rains. Fire frequency is variable but usually does not exceed 20 years. Fires generally do not occur except under extreme burning conditions (drought, high winds, and low humidity).

Bayheads. Bayheads or bay swamps occur in shallow depressions, particularly in pine flatwoods. They are dominated by broadleaved evergreen trees. Typical species include sweetbay, swamp bay, and loblolly bay. Sweetbay is usually present and is the dominant overstory species except when slash pine is present. Slash pine may be dominant and sometimes forms a semi-closed canopy. Loblolly bay occupies drier sites than sweetbay. Blackgum may be abundant in wetter bays, but is usually represented by a few individuals. Less common species include pond cypress, white-cedar, red maple, diamond-leaf oak, water oak, sweetgum, and popash. These tend to be present when bays are adjacent to cypress swamps, cedar swamps or hardwood forests (Clewell, 1986).

Understory species in bayheads are usually those found in titi swamps, including all species of titi. The understory is quite dense and where openings occur, the ground cover is usually sphagnum moss. Other ground cover species include Virginia and netted chain ferns. Sedges and grasses may be scattered and cane may be prominent in openings.

The water table of bayheads is within about four feet of the soil surface at all times (Clewell, 1971). The soil is moist and generally wetter than those soils supporting titi swamps. Bayheads have a fire frequency of about 15 to 50 years (Clewell, 1986).

Shrub Bogs. Shrub bogs usually do not have a well-defined understory or overstory. The trees and shrubs may be dense or they may form rather open canopies. The vegetation of shrub bogs may consist of various combinations of species found in titi swamps and bayheads. Open stands contain a distinct ground cover, often with sedges dominating. They probably burn more frequently than most acid swamps.

Common species include sweetbay, blackgum, slash pine, wax-myrtle, pond cypress, popash, and occasionally white-cedar. Shrubs and vines found in shrub bogs include fetterbush, sweet pepperbush, bamboo-vine, highbush blackberry, and titi.

The soils of shrub bogs are often saturated but are usually not saturated for long periods of time. However, they may be inundated for longer periods of time where they occur in shallow sloughs or stringers. The fire frequency of shrub bogs is about 5 to 20 years (Clewell, 1986).

Titi swamps, bayheads, and shrub bogs support various wildlife populations. Animals use these communities for refuge and cover but other than reptiles and amphibians few are permanent residents. Transient animals include raccoon, deer, hog, bear, wood ducks, and others.

Cypress Swamps

Cypress swamps are characterized as shallow, forested wetlands, that have water at or just below the surface of the ground, and are dominated by either pond cypress or bald cypress. These swamps may be located along stream or lake margins. They may also be interspersed throughout other habitats, such as flatwoods and savannahs, where they may be represented as circular depressions called domes or heads. Cypress swamps located along shallow drainage systems are referred to as strands or sloughs.

Pond cypress occurs in cypress heads or domes, and strands or stringers. In the lower Apalachicola River region, including Tates Hell, these strands or stringers are common. Cypress forests in these strands are usually open with a turf of sedges beneath. Cypress trees will extend into adjacent savannahs and boggy flatwoods (Clewell, 1986). Cypress domes or heads are generally characterized by taller, larger cypress trees growing in the deeper water in the interior and smaller trees growing in the shallower waters along the periphery.

Pond cypress and bald cypress are the dominant overstory species present in cypress swamp communities, however they generally do not occur together. When they do occur together in the same stand, rarely are both species of equal dominance. Tree diversity in cypress strands tends to be higher than that of cypress heads. Associated trees and shrubs include swamp tupelo, slash pine, blackgum, red maple, sweetbay, wax myrtle, and buttonbush. Other typical plants include dahoon holly, swamp bay, loblolly bay, pond apple, Virginia willow, fetterbush, chain fern, netted chain fern, poison ivy, spanish moss, cinnamon fern, orchids, swamp titi, St. John's-wort, sphagnum, and buttonbush. Various marsh plants are often found in the open water within these swamps (Gatewood and Hartman, 1977; Clewell, 1986; FNAI, 1986).

Soils of cypress swamps are composed of peat which is usually thicker towards the center of the dome. Clay pans or lens are present in some cypress swamps which help to retain water levels. They also prevent these swamps from serving as recharge areas for the aquifer. Water in cypress domes and ponds is usually from surface runoff. Water levels fluctuate above and below the soil surface. High water marks may reach 4 feet and during dry periods the soil may be so dry that it cracks (Clewell, 1977). Vegetational diversity in cypress domes tends to be inversely proportional to the degree of fluctuation of the water level (Ewel, 1976; Clewell, 1986). Open domes with low biomass tend to occur where the water level fluctuates considerably, which is also where the nutrients are in shortest supply. Period of inundation and degree of fluctuation in cypress swamps are important for the transport of nutrients, seed dispersal and germination. Seed dispersal is by water and their germination requires wet soil. It has been established that cypress is able to reproduce only in relatively open habitats where the soil is wet but not subjected to prolonged flooding (Clewell, 1986). However, cypress swamps are common where prolonged flooding is normal.

Fire is important in maintaining cypress swamps. Hardwood invasion and peat accumulation would result without periodic fires and cypress domes could succeed to bottomland forests or bogs. Fire frequency is dependent on hydroperiods and the frequency of fire of surrounding habitats. It is greatest at the periphery of the dome and least in the interior where longer hydroperiods and deep peat accumulations occur. The fire cycle may be as short as 3 to 5 years along the outer edge and as long as 100 to 150 years towards the center (FNAI, 1986). Cypress is tolerant of light surface fires but will be killed by peat fires.

The fauna of cypress swamps is not well studied, however they are important habitats for a variety of species. Species found will vary between those ponds with permanent standing water and those that are seasonally inundated. Bullfrogs and newts tend to utilize permanent bodies of water for breeding, while toads and most salamanders tend to utilize temporary bodies of water. Fish such as the mosquitofish, killifish, pygmy sunfish, and other small minnows, are commonly found in those ponds with permanent bodies of water (Wharton et al, 1977). Many insects also use cypress ponds for various stages of development. There are very few permanent residents of cypress swamps, however large aggregations of salamanders, frogs, insects, and birds may be observed during their breeding seasons. Many of these species are common residents of surrounding flatwood communities. Cypress swamps also provide valuable nesting and feeding habitats for ospreys, eagles, and wading birds. During drought periods, cypress strands may be the only source of water for many animals. Typical animals found in cypress swamps include the wood duck, swallow-tailed kite, Mississippi kite, great-crested flycatcher, woodstork, alligator, snapping turtle, mud turtle, stinkpot, Eastern mud snake, cottonmouth, barred owl, prothonotary warbler, and pileated woodpecker.

Seepage Bogs and Savannahs

Bogs and savannahs are low energy wetlands consisting mainly of grasses, sedges, orchids, insectivorous plants, and an abundance of wildflowers. Seepage bogs are common in the western half of the panhandle near the coast and towards the base of slopes. They are commonly found between bay swamps along creeks or rivers and in pine flatwoods. Seepage bogs also occur along the Cody Scarp and other escarpments where groundwater seeps to the surface. These habitats were once extensive in the western panhandle but many have been converted to pine plantations (Clewell, 1986).

Savannahs are found in areas with little relief. They have a limited distribution in the Apalachicola River basin in Liberty, Calhoun, and Franklin counties. Evidently the clay soils in Liberty County represent alluvial deposits at a time when the Apalachicola River valley was further eastward of its present location. It may be that the community is restricted largely or entirely to the lower Apalachicola River watershed (Clewell, 1986).

Soils of bogs and savannahs consist of sands, sandy loams, and loamy sands. The upper horizon is usually a deep peaty sand. The soils are typically acidic, ranging from pH 3.5 to pH 5.0. The water table is close to the surface except during droughts. The soils of these habitats tend to be wetter than surrounding pine flatwoods and some bays and are also poorly aerated. Fires are frequent and eliminate litter that accumulates. Nutrient cycling is dependent on the organisms present and on the frequent release of nutrients by fire (Folkerts, 1982). Soil acidity, low nutrient level, anaerobic soil conditions, and periodic fires inhibit invading species in bog and savannah communities. With fire suppression, succession is towards mixed-pine hardwood forest communities.

Seepage bogs have no distinct overstory or understory but a few trees and large shrubs may be widely scattered or in small thickets. Species included in the overstory and understory include slash pine, pond pine (uncommom), pond cypress, blackgum, white cedar, sweetbay, swamp bay, titi, large gallberry, and myrtle-leaf holly (Clewell, 1986).

The ground cover is the prominent vegetational stratum in seepage bogs. Wiregrass is the dominant grass, but is less abundant or even absent in wetter sites where species of Rhynchospora may replace it (Clewell, 1986). A variety of herbaceous heliophytes are found in seepage bogs. At various seasons they produce remarkable floral displays. These include crow poison, meadow-beauty, Sebatia sp., and several species of Polygala, Xyris, and Eriocaulon. Carnivorous plants such as the pitcher plants (Sarracenia) are the most noticeable. Other carnivorous flora include sundews, bladderworts, and butterworts (Folkerts, 1982; Clewell, 1986). Herbs are more conspicuous than shrubs. Rush-featherling and Barbara's buttons are indicators of this community and are rare or absent from the floristically similar savannahs (Clewell, 1986).

Savannahs have even a less defined overstory and understory than seepage bogs. An occasional isolated slash pine may occur on sandy knolls within the savannah. Other trees and shrubs, if present, will be widely scattered. Pond cypress, blackgum, sweetbay, and titi of bays and shrub bogs, may be found along the edges of savannahs. St. John's-wort is the only shrub of significance. The ground cover consist of wiregrass, sedges, and other herbs. Wild flowers such as colic-root, grass-pink, coreopsis, white-tops, leopard lily, snowy orchid, rose pogonia, milkworts, meadow-beauty, cone-flower, marsh pink, pitcher plants, yellow-eyed grass, and crow poison can also be found.

Except for the insect species associated with pitcher plants of the genus Sarracenia, the fauna of the bogs is poorly known. Pitcher plants have special adaptations that allow them to entrap, detain, and digest prey. The plants contain a decomposing mass of entrapped prey which is a potential food source for other organisms (Folkerts, 1982). Species that have evolved the ability to inhabit pitcher plants without being entrapped or digested include species of mosquitoes, the larvae of sarcophagid flies, larvae of some species of flies, species of moths, aphids, and several species of mites.

The pools of water within bog and savannah communities are important habitats for the larvae of the pine barrens tree frog (Means and Moler, 1978). Ants and earthworms are common in those communities with normal cycles of moisture and fire. Burrowing crayfish are common and are important in redistributing leached nutrients to the surface.

Bluffs and Ravines

The upper region of the Apalachicola River basin contains several unique habitats such as bluffs and ravines, including both steepheads and ravines of gully erosion origin. In the Apalachicola basin, these habitats are located along the eastern escarpment of the Apalachicola River in Liberty County. High bluffs (approximately 150-200 feet) occurring along the eastern side of the Apalachicola River, from the Georgia-Florida state line south to just below Bristol were estimated by Harper in 1914 to cover less than 50 square miles in Florida (Delcourt and Delcourt, 1977). The greatest topographic relief in Florida occurs along the bluffs of the Apalachicola River basin valleys. In areas such as Alum Bluff and Aspalaga the bluffs drop abruptly to the rivers edge.

Florida ravines are considered first order streams and may be categorized depending on their formation, which may be from gully erosion or steephead action. "All ravines north of Cody Scarp were created by the scouring action of surface runoff during baselevelling; steepheads formed south of the scarp in the porous sands of the Citronelle Formation" (Means and Karlin, in press). However, ravines created by gully erosion are not extensive in Florida and usually dry up during droughts. Steepheads in the Florida panhandle are distributed in an east to west alignment in areas where there are deep porous sands. Where rivers have cut beneath the water table, seepage flows laterally from the river valley walls. This seepage flow undercuts the sandy slope and a steephead is formed which continuously lengthens headward into the sloping plains between the major rivers of the panhandle (Means, 1981). Steepheads are characterized by steep sidewalls, up to 100 feet deep at the headwaters, amphitheater in shape, and may have one or more springs in them. Many of the best developed steepheads occur in the first order branches of two large streams (Sweetwater and Beaverdam Creeks) that cut through the escarpment just north of Bristol (Means, 1985).

The Nature Conservancy's purchase of a 1158 acre tract at Alum Bluff and an adjacent 3214 acres of Beaverdam Creek (which adds 50 of the best steepheads to its new Apalachicola Bluffs and Ravines Preserve) provides conservation and protection of important bluffs and steepheads, their associated flora and fauna, and Alum Bluff itself (Means, 1985).

The bluff and ravine region of the Apalachicola basin contains more plant and animal species than any other area of its size on the coastal plain from Virginia to Texas. It also contains more rare and endangered species and more endemics than any other area of its size in Florida. Many of the species that exist in the bluff and ravine region commonly occur in the Appalachian Mountains of north Georgia. Mountain laurel, wild ginger, wild hydrangea, trailing arbutus, baneberry and rattlesnake plantain are a few of the northern species (threatened and endangered) that are found in the sheltered depths of the ravines of the region. These ravines are similar to the mountain cove valleys of the southern Appalachians. The presence of these species is attributed to the fact that the headwaters of the Apalachicola River originates outside the coastal plain and drains the south face of the Blue Ridge in northern Georgia (Means, 1985).

The Apalachicola ravines biotic region contains mostly small-order stream bottoms with mesic to hydric plant communities, steep valley slopes which grade from xeric vegetation at the top to mesic and hydric vegetation at the bottom. Xeric communities inhabit the tops of small divides between ravines (Means, 1977).

The xeric communities on the upper reaches of the ravines are represented by sandhills (longleaf pine, wiregrass, turkey oak, and other oaks, etc.) or slash pine plantations. The sidewalls of the ravines are very steep, being 45 degrees or greater. Along the upper portion of the ravines, forests of oaks, hickories, and other shrubby hardwoods are found. The Alabama spiny-pod or Ashe's magnolia (both endangered species) may also be present. Farther down the slope is a beech-magnolia forest with spruce pine, American holly, dogwood, white oak, pignut hickory, maple, bay, cedar, beech, basswood, ash, sourwood and other deciduous trees. According to Delcourt and Delcourt, (1977), "the magnolia-beech forest of the Apalachicola River bluffs represents the second mesic upland magnolia beech forest quantitavely documented for the original vegetation of the Gulf Coastal Plain and is the first such record for Florida".

The bottom area consists of a dense understory of evergreen shrubs which forms an almost impenetrable wall of twisted and tangled stems. Appalachian mountain laurel, holly, vacciniums, star anise (principal evergreen shrub), Florida yew, and Florida torreya trees are present. The Florida yew and Florida torreya (endangered species) are both endemics to the bluff and ravine region. The valley floor is characterized by a thick leaf litter layer and the community is more mesic. Hardwoods and shrubs that prefer permanently saturated but not inundated soils are present in this zone. A clear, cool brook emerges from the sand at the base of the slope. Surrounding this brook are mosses, liverworts, and ferns. The air temperature is usually about 68 degrees (Means, 1985).

The bluff and ravine region of the Apalachicola basin supports a variety of species including the one-toed amphiuma and the copperhead. Birds are the most abundant. The leaf litter supports a variety of tiny amphipods, springtails, orthopterans, beetles, spiders, dipterons, earthworms, and millipedes. The ravines contain the greatest abundance of northern streamside salamanders, which are different from their cousins elsewhere. Distinct species of salamanders of the ravine region are Desmognathus apalachicolae (recently named), Eurbislineata, Pseudotriton ruber and Desmognathus fuscus (Means and Karlin, in press).

Caves

The eastern Gulf Coastal Plain generally consists of alternating carbonate terranes and clastic deposits. Limestone exposed in southwestern Georgia, extending into the eastern panhandle of Florida and a small portion of southeastern Alabama, forms a large karst plain called the Marianna Lowlands. Caves are found predominantly in these karst areas. Erosion has removed overlying clastics, exposing limestone to extensive solution, eventually allowing the invasion of underground cavities by life forms (Means, 1977).

Both terrestrial and aquatic caves may be found in a cave system. Aquatic caves may vary from shallow pool systems to totally submerged systems. Terrestrial caves can be considered essentially dry aquatic caves, because all caves intially develop under aquatic conditions. "Terrestrial caves may occur at the bottoms of dry sinkholes or be associated with ancient springs, shallow holes or aquatic caves that have been exposed by lower water tables" (FNAI, 1986). Sinkhole lakes and occasionally blackwater streams may lead into aquatic caves. During heavy rainfall terrestrial caves may exhibit aquatic conditions and during droughts aquatic caves may resemble terrestrial caves. Permanent pools of water may be found in natural depressions in cave floors where the aquifer inundates the lower cavities.

Water color and mineral content varies from cave to cave depending on the presence of tannins, rainwater, limestone, mud, and organic silts. Aquatic caves with flowing water usually have a low pH, low concentration of dissolved carbonates and a rich fauna, whereas pools that are fed by seepage or dripping water tend to have a higher pH, high concentration of dissolved carbonates, a low content of organic matter suitable for food, and a less rich fauna. Characteristics of aquatic cave waters may vary seasonally depending on inputs from the surrounding environment but for the most part they are very stable environments. Terrestrial caves maintain a fairly constant temperature and humidity. The air temperature tends to be warmer at the cave entrance and cooler farther into the cave (FNAI, 1986).

The area around cave entrances may be densely vegetated with plants from the surrounding community: however, light penetration and plant numbers decline in the mouth of the cave. Where light penetrates into caves, species of algae, mosses, liverworts, and occasionally ferns grow. Beyond the limits of light penetration, plants are generally absent or limited to a few inconspicuous species of fungi that grow on guano or other organic debris (FNAI, 1986).

There are very few cave-adapted organisms found in the Apalachicola River drainage basin "(containing the whole of the Marianna Lowlands and the southern portion of the Dougherty Plain physiographic regions)" and those that have been found are endemics. Larger fauna occur in cave ecosystems of the Appalachian region to the north, but not many species of troglobites (cave-adapted animals) inhabit the air passages of caves in the eastern Gulf Coastal Plain. However, the number of aquatic troglobites is large; the reason being that most of the solution cavities are presently filled with water (Means, 1977).

A few endemics have been recognized as occurring in the region. The Georgia blind salamander and the endemic crayfish (Cambarus cryptodytes), both troglobitic species, are known to be abundant in caves in Jackson County, Florida. The group of troglobites known for the region are the Chattahoochee fauna, named for the anticline which brought limestone terranes to the surface in the Marianna Lowlands-Dougherty Plain physiographic region. Eight of the caves (maybe more) in the Marianna Lowlands-Dougherty Plain region contain the Chattahoochee fauna (Means, 1977).

Species found in the caves of the Marianna Lowlands include the troglobitic isopod (Asellus hobbsi) and two epigean salamanders Eurycea bislineata and Eurycea longicauda (troglophiles). Trogloxenes spend a considerable amount of their time in caves, but they must periodically leave the caves to feed or breed. Many species of bats, some salamanders, and cave crickets are a few examples. Individuals that may regularly live in caves but whose conspecifics also inhabit surface communities with moist microhabitats, are troglophiles. These include organisms such as cave orb spiders, crickets, fish, and salamanders. Some animals are obligatory cave dwellers that possess special adaptations for living in darkness (troglobites) and include species such as the blind cave crayfish, blind cave salamanders, cave amphipods, and isopods (aquatic caves); cave mites, cave spiders, springtails and earwigs (terrestrial caves of north Florida).

Wildlife Values

This section has described community characteristics of the various upland habitats existing in the ACF drainage basin. The vegetative and wildlife composition mentioned, consists of those species that are dominant in or found exclusively in these habitats. Many other species of plants and animals are present. Because the Apalachicola River drainage basin contains such a diversity of habitats and has contributions from neighboring areas, it may have more species of plants and animals than anywhere else in temperate North America. The high species richness of the area includes many rare, endangered, threatened and endemic species. Table 20 lists many of the endangered and threatened plants of the basin, however, this list is not complete and the numbers have probably increased since these lists were made. Species of special concern or those species under review for listing are not included on this list.

A high species richness does not exist for plants alone. The highest species density of amphibians and reptiles in North America north of Mexico occurs in the upper Apalachicola River basin. The warm climate, high humidity, and rainfall allow for the high numbers of turtles, frogs, salamanders and snakes, and low numbers of lizards (Means, 1977). Many wildlife species require a variety of habitat types and successional stages to meet their requirements for shelter, diet, reproduction and escape cover. Some species are adapted to and depend on a single habitat type; others

Table 20. Threatened and Endangered Plants of the Apalachicola Basin. (Sources: see plant appendix)

SPECIES

Scientific Name	Common Name	Status	Habitats
Actaea pachypoda	Baneberry	T	bluffs
Adiantum capillus-veneris	Venus-hair fern	E	bluffs, sinks
Anemonella thalictroides	Rue anemone	T	bluffs
Aquilegia canadensis	Columbine	E	calcareous woods
Asclepias viridula	Southern milkweed or Green milkweed	T	flatwoods
Asplenium platyneuron	Ebony spleenwort	T	hammocks
Asplenium resiliens	Blackstem spleenwort	T	hammocks
Aster spinulosus	Pinewoods aster	T	flatwoods
Azolla caroliniana	Mosquito fern, Water fern	T	swamps
Baptisia megacarpa	Apalachicola wild indigo	T	bluffs
Botrychium biternatum	Southern grapefern	T	hammocks
Bumelia lycioides	Buckthorn	T	hammocks
Callirhoe papaver	Poppy mallow	T	pine-oak-hickory woods
Calopogon barbatus	Bearded grass pink	T	flatwoods, bogs
Calopogon pallidus	Pale grass pink	T	flatwoods, bogs
Calopogon tuberosus	Grass pink (unnamed)	T	flatwoods, bogs, marshes around cypress ponds
Cleistes divaricata	Rosebud orchid or spreading pogonia	T	flatwoods
Conradina glabra	Apalachicola rosemary or panhandle rosemary	T	sandhills
Cornus alternifolia	Pagoda dogwood	T	bluffs
Croomia pauciflora	Few-flowered croomia	E	bluffs
Epidendrum conopseum	Greenfly orchid	T	hammocks, sinks, gum, swamps
Epigaea repens	Trailing arbutus	E	dry hammocks
Erythronium umbilicatum	Dogtooth lily or dimpled dogtooth violet	T	bluffs, hammocks
Gentiana pennelliana	Wiregrass gentian	E	flatwoods
Habenaria repens	Water spider orchid or creeping orchid	T	marshes, cypress swamps
Harperocallis flava	Harper's beauty	E	bogs
Hedeomagraveolens	Mockpennyroyal	E	sandhills, flatwoods
Hepatica nobilis	Liverleaf	E	bluffs
Hexastylis arifolia	Heartleaf	T	bluffs, hammocks
Hydrangea arborescens	Wild hydrangea	T	bluffs
Hypericum lissophloeus	Smooth-barked St. John's-wort	E	sinks, pond margins
Ilex ambigua	Carolina holly, Sand holly	T	sandhills, scrub, dunes, dry hammocks
Ilex decidua	Possum haw	T	dry upland forests

Table 20 continued.

SPECIES			
Scientific Name	Common Name	Status	Habitats
Illicium floridanum	Purple anise	T	creek swamps, seepages on bluffs
Isoetes flaccida	Florida quillwort	T	swamps, ponds
Kalmia latifolia	Mountain laurel	T	bluffs, creek swamps
Leitneria floridana	Florida corkwood	T	coastal hammocks
Liatris provincialis	Godfrey's blazing star or Godfrey's gayfeather	E	dunes, sandhills
Lilium catesbaei	Catesby lily	T	flatwoods, bogs
Linum westii	West's flax	T	bogs, cypress, pond margins
Lobelia cardinalis	Cardinal flower	T	coastal hammocks
Lupinus westianus	Gulfcoast lupine	T	sandhills, scrub
ycopodium appressum	Southern clubmoss	T	bogs, moist flatwoods
Macbridea alba	White birds-in-a-nest	E	bogs, flatwoods
Magnolia ashei	Ashe's magnolia	E	bluffs, bayheads, hammocks
Magnolia pyramidata	Pyramid magnolia	E	bluffs
Malaxis unifolia	Green adder's mouth	T	bluffs, sinks
Malus angustifolia	Crab apple	T	bluffs, hammocks
Matelea alabamensis	Alabama spiny-pod	E	bluffs
Matelea floridana	Florida milkweed	E	bluffs, pine-oak-hickory woods
Medeola virginiana	Indian cucumber-root	T	bluffs
Nolina atopocarpa	Florida beargrass	E	flatwoods
Onoclea sensibilis	Sensitive fern	T	moist hammocks
Ophioglossum petiolatum	Stalked Adder's-tongue	T	moist roadsides
Opuntia stricta	Prickly pear	T	disturbed sands near coast
Oxypolis greenmanii	Giant water-dropwort giant water cowbane	E	acid swamps,
Parnassia grandifolia	Grass-of-parnassus	E	boggy cypress strands
Phlebodium aureum	Golden polypody	T	epiphytic in cabbage palms
Pinckneya bracteata	Hairy fevertree	T	creek swamps, titi swamps, bogs
Pityopsis flexuosa	Panhandle golden aster	E	sandhills
Platanthera blephariglottis	White fringed orchid	T	marshes
Platanthera cristata	Crested fringed orchid or	T	cypress swamps
Platanthera flava	Southern rein-orchid	T	spring-fed river swamps
Platanthera integra	Orange rein orchid	T	flatwoods
Platanthera nivea	Snowy orchid	T	bogs
Pogonia ophioglossoides	Rose pogonia	T	flatwoods, bogs

Table 20 continued.

SPECIES			
Scientific Name	Common Name	Status	Habitats
Polygonella macrophylla	Large-leaved jointweed	T	dunes, scrub
Rhexia lutea	Meadow beauty	T	flatwoods, bogs
Rhexia parviflora	Small-flowered meadowbeauty or Apalachicola meadowbeauty	E	margins of cypress swamp
Rhododendron austrinum	Florida flame azalea	E	bluffs, hammocks
Rhododendron serrulatum	Swamp honeysuckle	T	flatwoods, titi and bay swamps
Ruellia noctiflora	Night-flowering ruellia	T	bogs, coastal flatwoods
Sabal minor	Dwarf palmetto or bluestem	T	wet hammocks, bluffs
Sarracenia leucophylla	White-top pitcher-plant	E	bogs, creek swamps
Sarracenia psittacina	Parrot pitcher-plant	T	flatwoods, bogs
Selaginella apoda	Meadow spikemoss	T	stream banks
Selaginella arenicola	Sand spikemoss	T	sandhills, dunes, scrub
Spiranthes cernua var. odorata	Nodding ladies' tresses	T	river swamps, bogs
Spiranthes gracilis	Slender ladies's tresses	T	flatwoods, sandhills
Spiranthes ovalis	Lesser ladies' tresses	T	bogs, moist hammocks
Spiranthes praecox	Grass-leaved ladies' tresses	T	flatwoods, pinelands,
Spiranthes vernalis	Spring ladies' tresses	T	flatwoods, cypress swamps
Staphylea trifolia	Bladdernut	T	moist bluffs, creek bottoms
Stewartia malachodendron	Silky camellia	E	bluffs, steapheads, bayheads
Taxus floridana	Florida yew	E	hammocks, cedar swamps of Apalachicola River
Thelypteris hexagonoptera	Beech fern	T	bluffs, hammocks
Thelypteris interrupta		T	coastal hammock
Thelypteris kunthii	Southern shield fern	T	calcareous woods
Thelypteris palustris	Marsh fern	T	stream banks
Thelypteris quadrangularis var. versicolor	Aspidium fern (unnamed)	T	ravines
Tillandsia bartramii	Wild pine, air plant	T	moist woods
Torreya taxifolia	Florida torreya	E	hammocks near Apalachicola River
Trillium lancifolium	Lance-leaved wake-robin	E	bluffs
Veratrum woodii	False hellebores	E	bluffs
Verbesina chapmanii	Chapman's crownbeard	T	savannahs, bogs, flatwoods
Viola hastata	Halberd-leaved yellow violet	E	bluffs
Woodsia obtusa	Cliff fern	T	bluffs
Woodwardia areolata	Netted chain-fern	T	acid swamps, lime sinks
Xyris longisepala	Karst pond yellow-eyed grass	E	margins of sandhill
Xyris scabrifolia	Harper's yellow-eyed grass	T	bogs

however, need several habitats to fill these requirements. Animal species may find their life requirements in different habitat types during different seasons of the year. The interspersion of different habitat types within the normal home range size of the species in question is essential to the creation and conservation of ideal habitat (Harris and Skoog, 1980). Uplands and the interspersion of wetland communities among them provide valuable feeding, breeding, nesting and escape cover.

IV. LAND RESOURCES OF THE APALACHICOLA BASIN

The Apalachicola River and Bay drainage basin is sparsely settled with a 1980 population of approximately 113,000 people living in the six counties surrounding the basin (Alabama et al, 1984). Of the 4,055 square miles covered by this six county region, approximately 60 percent is within the drainage basin. This area includes a variety of land use categories, private and public ownership, and various management schemes employed for utilization of these resources.

Land Ownership

The majority of the land within the Apalachicola basin is privately owned, much of it by timber companies, although a considerable amount is owned by state and federal governments. Most of this publicly owned land is within Liberty, Franklin, and Gulf counties and includes almost the entire floodplain of the lower Apalachicola River. Publicly owned lands have been acquired for a variety of different reasons including recreation, wildlife management, conservation, and the protection of environmentally unique or irreplaceable resources. Land ownership patterns and characteristics are examined in this section.

Wildlife Management Areas

There are seven wildlife management areas (WMA) in the Apalachicola River drainage basin. The acreage of these lands open to public hunting is considerable and therefore is an important part of the resource base. These areas are used primarily for hunting, however they also provide opportunities for non-consumptive recreational activities such as hiking, nature study, fishing, and picnicking. These privately or publicly owned lands are administered by the Florida Game and Fresh Water Fish Commission (FGFWFC) and are separated into two categories, Type I and Type II wildlife management areas. Under Type I management, the hunting activities on the land, whether privately or publicly owned, are supervised by the FGFWFC. The Commission provides boundary markers, check stations are installed and manned where possible, minimum road maintenance is provided, in some cases food plots are planted, and controlled burning and other habitat improvements are accomplished. Under Type II management, the landowner is responsible for maintaining the management areas and issuing the permits (Gatewood and Hartman, 1977; F. Smith, personal communication). Wildlife management area permits are required to hunt in all wildlife management areas. State and federal regulations are enforced on all management areas. The seven wildlife management areas within the Apalachicola basin (Figure 36) are all Type I.

Apalachee Wildlife Management Area. The Apalachee WMA consists of 5,114 acres on the western shores of Lake Seminole in Jackson County. The management area is federally owned by the U. S. Army Corps of Engineers. A large portion of the management area is burned on an annual basis. Within the management area are fields of cereal crops that are grown by local farmers. Farmers are required to leave 20 percent of their crops for wildlife consumption (T. Breault, personal communication).

Apalachicola Wildlife Management Area. The Apalachicola WMA consists of 559,000 acres in the Apalachicola National Forest in Liberty, Wakulla, and Franklin counties. The land is federally owned and is actively managed by the U. S. Forest Service in cooperation with the Florida Game and Fresh Water Fish Commission. The majority of the forest is in multiple use management. Hunting is a part of this management, along with prescribed burning, timber management, dove fields, population surveys, deer track counts, and monitoring red-cockaded woodpecker colonies. The Apalachicola WMA is the only management area in the basin where the black bear can be hunted. The New and Sopchoppy rivers have their headwaters in the area. The Ochlockonee River transverses the center of the forest and the Apalachicola River flows along the western boundary. Because of its location and size, it is probably the most diverse management area in the region (Gatewood and Hartman, 1977).

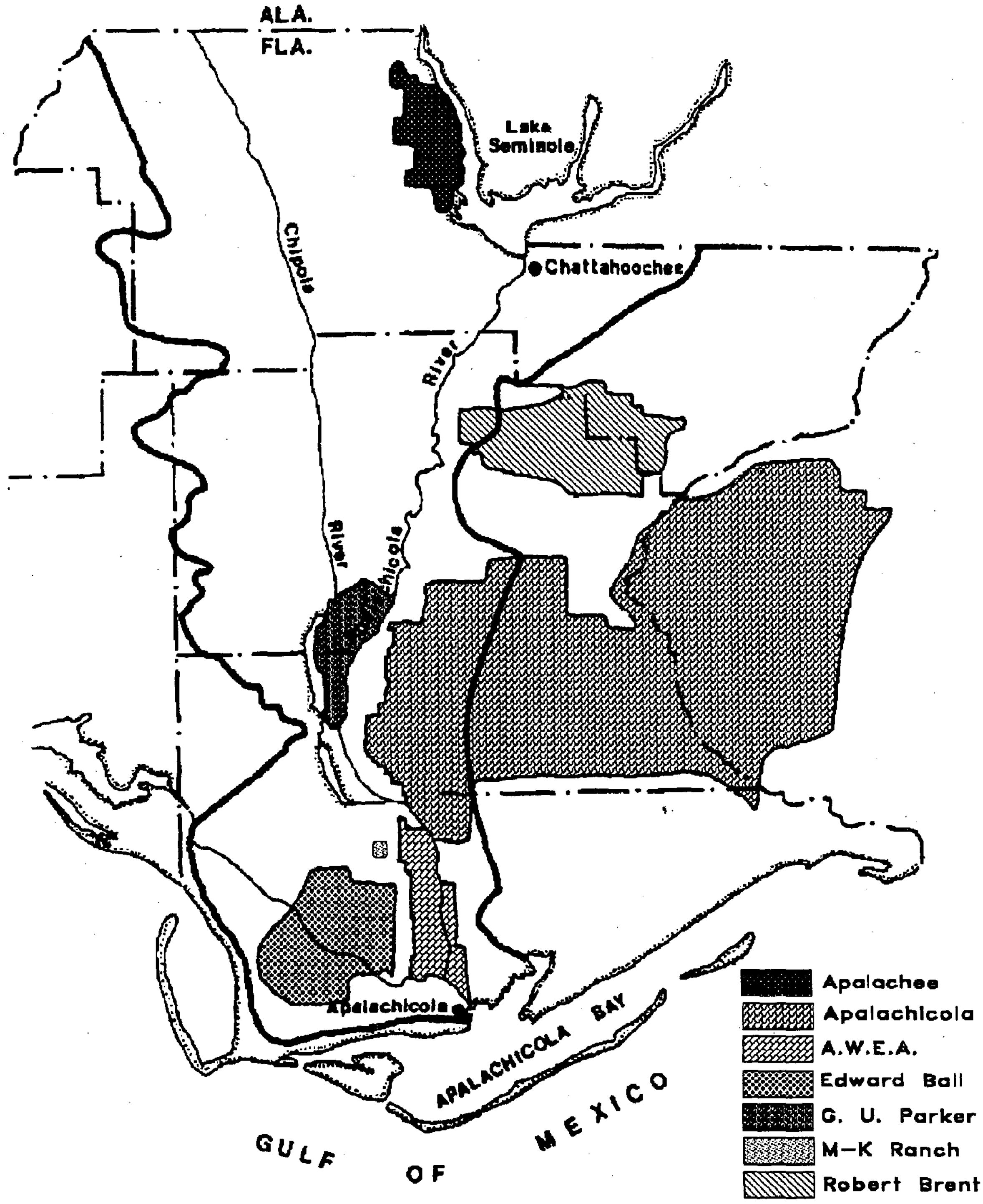


FIGURE 36. WATER MANAGEMENT AREAS OF THE APALACHICOLA BASIN.

Apalachicola Wildlife and Environmental Area. The Apalachicola Wildlife and Environmental Area (AWEA), located in Franklin and Gulf counties, consists of 28,762 acres purchased by the State of Florida under the Environmentally Endangered Lands Program. The AWEA is publicly owned by the trustees of the Internal Improvement Trust Fund, however, it is managed by three other agencies. The FGFWFC is the lead managing agency and the Division of Forestry of the Department of Agriculture and the Division of Historical Resources of the Department of State are cooperating agencies.

The AWEA lies within the Apalachicola River floodplain and extends from the mouth of the Apalachicola River to the northern tip of Forbes Island. The major habitat of the area is floodplain swamp dominated by tupelo and cypress. Freshwater marsh can be found on the west side of the floodplain and salt marsh is present near the mouth of the river (FGFWFC, 1986).

Current management of the AWEA consists of maintaining boundary lines and establishing and enforcing regulations for use of the area. Management programs on the AWEA that have been conducted in the past or proposed for the future include prescribed burning, water level management which is directed towards restoring natural water regimes, wildlife management consisting of regulating fishing and hunting, resolving nuisance bear problems, and recreation (FGFWFC, 1986).

Edward Ball Wildlife Management Area. The Edward Ball WMA consists of 65,025 acres in Gulf County and is privately owned by St. Joe Paper Company. Lake Wimico is within the boundaries of the management area. Major habitat types include low pinelands and hardwood swamps. The FGFWFC conducts prescribed burns on a 5-7 year rotation. Old road beds are planted to bahia grass, fertilized, mowed, and maintained primarily for turkey and quail (T. Breault, personal communication).

G. U. Parker Wildlife Management Area. The G. U. Parker WMA consists of 22,480 acres in Calhoun and Gulf Counties, and is privately owned by Neal Land and Timber Company. The management area is bordered by the Apalachicola River on the east and the Dead Lakes and Chipola River on the west. Cypress stands border both sides of the management area. These stands blend into river swamps which edge up a gentle slope to a mixture of second growth pine and hardwoods. High pine flatwoods occupy the center of the area (Gatewood and Hartman, 1977). The FGFWFC conducts prescribed burns on approximately 5,000 acres/year and on a 3-5 year rotation (T. Breault, personal communication).

Robert Brent Wildlife Management Area. The Robert Brent WMA consists of 80,750 acres in Gadsden and Liberty counties. The management area lies just west of Lake Talquin. Only the western portion of it lies in the Apalachicola River drainage basin. Robert Brent WMA is privately owned by St. Joe Paper Company and managed by the FGFWFC. There is no intensive management on the management area, except for monitoring various wildlife populations and conducting public hunts (T. Breault, personal communication).

M-K Ranch Public Waterfowl Area. The M-K Ranch Public Waterfowl Area consists of 3,320 acres in Gulf County. The land is privately owned by M-K Ranch and is managed by M-K Ranch and the FGFWFC. M-K Ranch uses the waterfowl area for rice production and the FGFWFC is responsible for controlling water levels and managing the land for waterfowl (T. Breault, personal communication) Waterfowl and coots can only be hunted during the established waterfowl hunts, which are made possible through funds derived from the Florida waterfowl stamp.

State Parks, Recreation Areas, and Special Feature Sites

State parks have been established primarily to preserve and maintain a natural setting of exceptional quality, while permitting a full program of compatible recreational activities. Each area displays some special quality of statewide or broad regional significance intended to attract visitors to it from long distances. State recreation areas are provided to meet the more active recreation demands of the general public. They are selected to ensure the availability of the most desirable types of recreational resources in its locality. Normally more extensive uses are allowed in a state recreation area than in a state park, although certain included areas of exceptional natural value may be set aside for special protective management. State special feature sites provide recreational enjoyment through visitation, observation, and study. These special feature sites are either historical or archaeological by type, but they may also have a special geological, botanical, or zoological trait. Special feature sites must be of unusual or exceptional character, or have a statewide or broad regional significance (FDNR, 1987a). The Florida Department of Natural Resources, Division of Recreation and Parks is the managing agency for state parks, recreation areas, and special feature sites (Figure 4).

St. George Island State Park. Dr. Julian G. Bruce St. George Island State Park occupies 1,883 acres at the eastern end of St. George Island in Franklin County. St. George Island State Park is also included within the boundaries of the Apalachicola National Estuarine Research Reserve. The park contains more than 9 miles of undeveloped beaches and dunes. Slash pine and scrub oak habitats dominate the interior portion of the island and low flatwoods, sandy coves, and salt marshes are found along the bayshore.

In the past, there has been minimal alteration of the natural systems in the park. The pines were turpentined during the early and middle 1900's. Scars from this activity may still be seen on many of the larger slash pines. During World War II the island was used for numerous training exercises by troops from bases located on the adjacent mainland. The principle alteration has been the grading and filling for roads on the backside of the primary dune system. The dunes have also been subject to some impact from vehicles. Jeep trails can be seen in the pine woods and in large open areas. Since the completion of the causeway in 1965 the major activity by visitors has been the use of the beaches for recreation. Public activities in the park include picnicking, hiking, primitive/backpack camping, swimming, and fishing (FDNR, 1985a).

Florida Caverns State Park. The most impressive feature of this 1,783-acre park is the intriguing network of caves. These caverns include a series of connecting rooms, which are closely hung with myriads of cave formations. The caves are the most fascinating feature; however, the park provides extensive hiking trails that meander along the Chipola River floodplain, through limestone outcroppings and hardwood hammocks.

American beech, Southern magnolia, white oak and dogwood are prominent in the park. A number of plants that occur in the southern Appalachian Mountains of north Georgia are also found in this unique botanical area. A variety of wildlife species are frequently encountered in the park. Rare and endangered cave-dwelling animals inhabit certain protected caves. Recreational activities include guided tours of the caverns, nature study, picnicking, camping, swimming, fishing, spelunking, and canoeing (FDNR, 1985b).

Torreya State Park. Bluffs rising more than 150 feet above the Apalachicola River make Torreya State Park one of the most scenic and distinctive state parks in Florida. Deep ravines, which have been eroded by streams through the centuries, shape and divide some of these steep bluffs. These bluffs and ravines are forested by many hardwoods and other plants that commonly occur in the Appalachian Mountains of north Georgia. Habitats of the park include the river floodplain swamp, hardwood hammocks, and high pinelands. The park is named for a species of rare Torreya that occurs only on the bluffs of the Apalachicola River. The rare Florida yew, the U.S. Champion bigleaf magnolia and many other rare plants are also present. Wildlife includes beaver, deer, grey fox, the rare Barbour's map turtle, and many species of birds. Recreational activities include hiking the nature trails along the river and bluffs, camping, and nature study (FDNR, 1985d).

Three Rivers State Recreation Area. Three Rivers State Recreation Area consists of 834 acres and has four miles of shoreline on Lake Seminole at the Florida-Georgia border. It is named for the Chattahoochee and Flint rivers, which merge to form the Apalachicola River below Lake Seminole. The park contains hardwood hammock and high pineland communities. Animals such as white-tailed deer, fox squirrels, grey fox, and quail inhabit these communities. Alligators and alligator snapping turtles can be found in the lake. Public use includes picnicking, camping, fishing, and boating (FDNR, 1985c).

Dead Lakes State Recreation Area. The Dead Lakes State Recreation Area overlooks Dead Lakes which was formed naturally when levees on the Apalachicola River blocked the Chipola River. The high water killed most of the trees in the floodplain of the Chipola river in this area. The 83-acre recreation area is forested with longleaf pines and carpet grass. A variety of native plants and animals may be observed along the trails. Many dead trees can still be seen in the lake. The park offers picnicking, fishing, boating, camping, and nature study (FDNR, 1984).

Fort Gadsden Special Feature Site. Fort Gadsden is a historical, special feature site consisting of 78 acres in the lower river. Fort Gadsden is also contiguous with the Apalachicola National Estuarine Research Reserve and may be considered for inclusion in the Reserve. The British built a fort in 1814 as a base for the recruitment of Indians and blacks during the war of 1812. In 1815 they abandoned the fort, along with its artillery and military supplies, to their allies. It later became known as the Negro Fort and was a threat to supply vessels on the river. A few years later Lt. James Gadsden of the Engineer Corps was directed by Andrew Jackson to build a fortification there as a supply base. In 1853, Lt. James Gadsden made the famed Gadsden Purchase. Jackson was pleased with Lt. Gadsden's zeal and named the fort, Fort Gadsden. The fort was occupied by confederate troops until July 1863, when malaria drove them out of the lowlands along the river. Fort Gadsden receded into oblivion after the war was over (FDNR, 1983a).

Other Public Lands

Apalachicola National Estuarine Research Reserve. The Apalachicola National Estuarine Research Reserve (ANERR) was designated in 1979 and is located in Gulf and Franklin counties. The Reserve, the largest of the existing 17 national estuarine reserves, encompasses approximately 193,758 acres, most (135,680 acres) of which are state-owned submerged lands. It includes the bay and many of its associated tidal creeks and marshes, that portion of the Apalachicola River floodplain that lies south of river mile 21, and some of the barrier islands offshore.

The ANERR, which is administered by the Florida Department of Natural Resources, consists of several independently managed subunits in which there is extensive multiple agency involvement. The major role of ANERR in land management is to coordinate and assist in management activities by other agencies and to provide technical input into management activities through the ANERR research and education programs. These subunits provide a variety of recreational and commercial activities. The upland regions within the Reserve that were acquired by state and federal governments include 28,762 acres of the Apalachicola River floodplain (AWEA), St. George Island State Park (1,883 acres), Cape St. George State Reserve (2,300 acres), St. Vincent National Wildlife Refuge (12,358 acres), East Bay CARL Lands (4,744 acres), Unit 4 (75 acres purchased as part of the EEL program) bordering East Hole, and a 17 acre tract (Trust for Public Lands) adjacent to St. George Island State Park. These units are discussed below and are shown in Figure 37 (ANERR, 1986).

Cape St. George State Reserve. Little St. George Island was acquired by the State of Florida in 1977 through the EEL Program of Florida's Conservation Act of 1972. This purchase was made in order to protect the island from development and to contribute to the protection of Apalachicola Bay. The Cape St. George lighthouse, which is maintained by the U.S. Coast Guard, and a surrounding 6-acre parcel are owned by the U.S. Government. A majority of the 6-acre parcel was assigned to the U.S. Army Aviation Center for use as a helicopter landing area during training exercises. In 1982 Little St. George Island was classified as a "state reserve" and was named Cape St. George State Reserve after the prominent cape landform on the gulfshore. The Cape consists of approximately 2,300 acres at mean high tide with an additional 400 acres of perimeter tidal marshlands and lower beach areas which are inundated by high tidal waters. The Reserve is managed by the Department of Natural Resources, Division of Recreation and Parks (FDNR, 1985). Cape St. George State Reserve is included within the boundaries of the Apalachicola National Estuarine Research Reserve and is cooperatively managed to meet the goals of the Estuarine Research Reserve (ANERR, 1986).

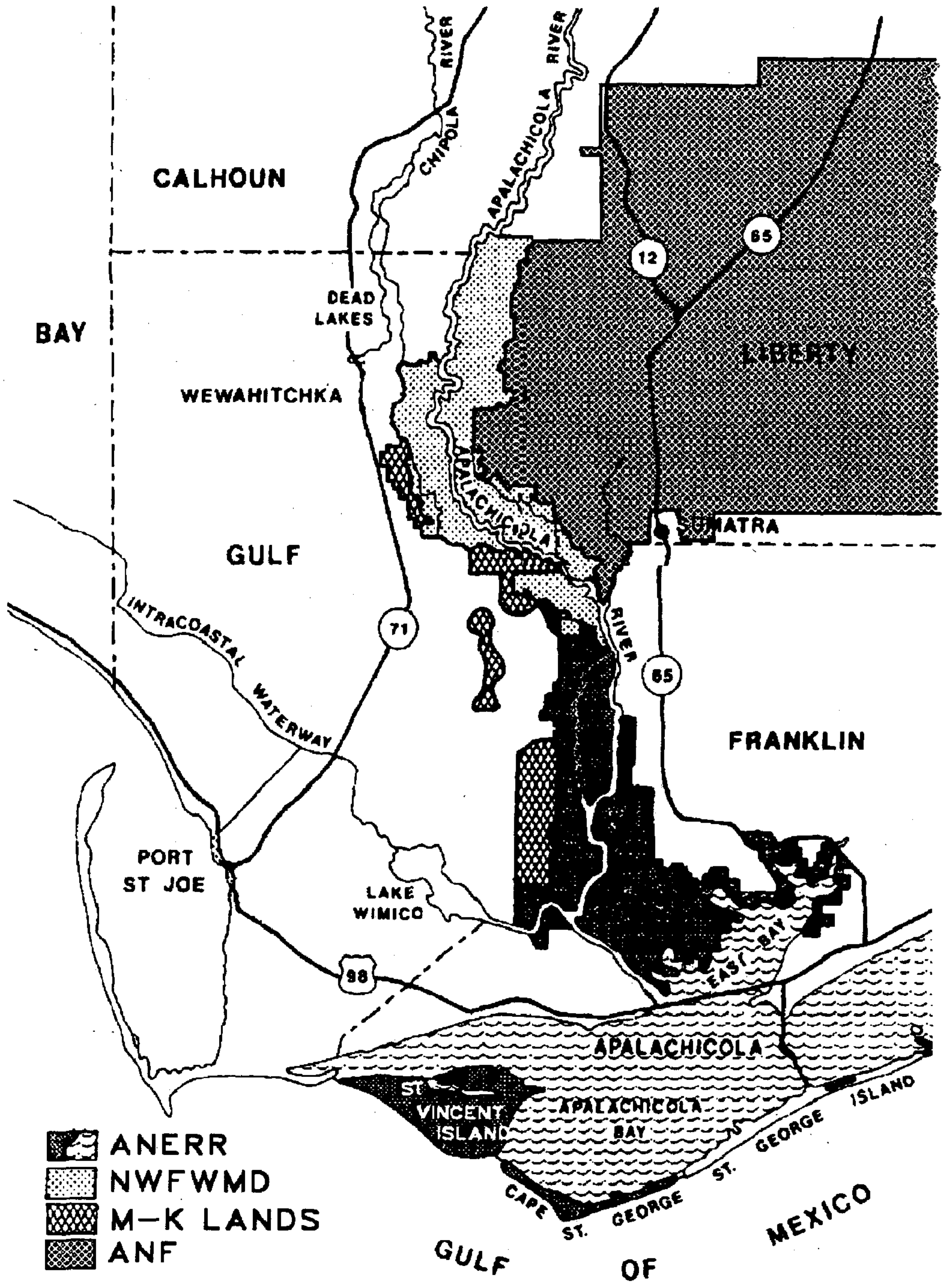


FIGURE 37. OTHER PUBLIC LANDS OF THE APALACHICOLA BASIN.

Disturbance to the island has been minimal. Various Indian cultures occupied the island for hundreds of years. Pottery shards dating from A.D. 750 to 1450 occasionally are found on portions of the island. Turpentining operations occurred from 1910-1916 and again from 1950-1956. Many of the pine trees on the island are catfaced from these operations. The greatest disturbance on Cape St. George Reserve didn't occur until the mid-1960s. At this time it was used for an amphibious military training operation. Heavy equipment was used to cut roads and flatten some of the dune ridges (FDNR, 1985).

Scrub is found on the old relict dune ridges and sea oats dominate the new primary dunes along the beach. Freshwater marshes and ponds are found in the low swales between the old dune ridges and pine flatwoods occupy the low flat areas. Extensive savannahs with scattered cabbage palms are found on overwash portions at the east and west ends of the island. Salt marshes occupy portions of the bayshore. One small coastal hammock is also present.

Wildlife on the island is fairly depauperate. Raccoons are the most common mammal found on the island. Feral hogs, gray squirrels, and cotton rats are also present in fewer numbers. There are few amphibians and reptiles on the Cape, however, cottonmouths are common in the ponds and marshes. The Cape is very important for spring and fall migrations of birds because it provides a rest over stop. More importantly the Cape provides important nesting areas for threatened species such as loggerhead turtles, snowy plovers, and least terns, and species of special concern such as oystercatchers.

Management on the Cape includes prescribed burning and the removal of exotic plants and animals. Recreation consists of hiking, primitive camping, nature study, swimming, and fishing. Primitive camping is permitted at designated sites at West Pass, Sikes Cut and the Government Dock (FDNR, 1985).

St. Vincent National Wildlife Refuge. Since the early 1900s and prior to 1968 St. Vincent Island was privately owned and used primarily as a private hunting and fishing preserve. In 1968 the island was acquired by the U.S. Fish and

Wildlife Service and is now St. Vincent National Wildlife Refuge. In addition to St. Vincent Island, which covers 12,358 acres, the refuge includes a 86-acre mainland tract as well as a 45-acre island within St. Joseph Bay (USFWS, 1983a).

There has been very little disturbance on St. Vincent Island. Apalachees, Creeks, and Seminoles entered the area around the 1600-1700s. Kitchen middens are located on various portions of the bayshore. Since this time, the island has had only a few owners. These owners used the island for growing beef cattle and harvesting timber. Many areas on the island were clearcut in the 1940s and have been allowed to regenerate naturally. St. Vincent was also managed as a private hunting reserve, at which time various exotic wildlife species were introduced. These included zebras, elands, black bucks, ring-neck pheasants, and Asian jungle fowl. Quail and turkey were also released on the island (USFWS, 1986c). The exotic species were removed as part of the acquisition agreement but the sambur deer, a large deer native to Asia, became acclimated and have been allowed to remain (USFWS, 1983). The only major construction on the island has been the building of lodges, outbuildings, water control structures, and a network of roads.

St. Vincent is a protected national wildlife refuge and is not presently under development. The main purpose for St. Vincent's establishment as a national wildlife refuge in 1968, was for migratory waterfowl management. It has become an important refuge for: (1) providing habitat for endangered and threatened species, (2) retaining unchanged biocommunities by protecting natural areas and (3) developing primitive area public use concepts which provide extremely high quality wildlife/wildlands experiences in a natural environment. The highest priority wildlife objective is to provide protection, habitat preservation and habitat management for endangered species such as the Artic peregrine falcon, threatened species such as the Southern bald eagle, loggerhead sea turtle, Eastern indigo snake, and species of special concern, such as the brown pelican, and American alligator (USFWS, 1983).

Plant communities of St. Vincent Island are more diverse and complex than those found on St. George and Little St. George islands. These vary from beach and berm, dune, tidal marsh, dense saw palmetto areas, fresh water marshes and ponds, cabbage palm and magnolia hammocks, oak hammocks, pine flatwoods, and scrub oak ridges.

St. Vincent National Wildlife Refuge also has a greater diversity of wildlife utilizing its resources. A few of the species supported by the island are white-tailed deer, sambur deer, feral hogs, turkeys, bald eagles, ospreys, raccoons, opossum, gopher tortoises, and alligators. The beaches of the refuge are important for nesting shorebirds and loggerhead sea turtles. Introduced indigo snakes inhabit gopher tortoise burrows in the inner dunes. The island also supports resident and migratory species of shorebirds, water birds, wading birds, gulls, terns, and ducks (USFWS, 1986c).

Management of St. Vincent National Wildlife Refuge is by the U.S. Fish and Wildlife Service. Access to the refuge is by water and visitors must provide their own boats. No transportation facilities are available. Public use on the island includes fishing (salt or freshwater; however, freshwater fishing is closed due to saltwater intrusion until further notice), hiking, wildlife observation, photography, and shelling. Some 14 miles of beaches along the south and east shores of the refuge and approximately 80 miles of inland trails are open to daytime public use. Primitive camping and open fires are allowed only at designated areas and during managed hunts. Managed hunts for deer, feral hogs, and turkey are held annually at specified times. A special permit from the refuge is required for these hunts (USFWS, 1986c).

Northwest Florida Water Management District. In late 1985, through the Save Our Rivers program, over 35,000 acres of bottomland hardwood swamp were purchased by the Northwest Florida Water Management District (NWFWMD) in conjunction with The Nature Conservancy. This purchase is in the lower floodplain of the Apalachicola River and borders the Apalachicola National Forest to the east and the ANERR to the south. A management plan for hunting, beekeeping, timbering, and recreational uses is currently being developed by the NWFWMD. These lands may be incorporated into the ANERR in the future (ANERR, 1986).

M-K Ranch. In 1980, M-K Ranch, a 33,000-acre cattle ranch, ditched and diked approximately 10,000 acres of the Apalachicola River floodplain without obtaining any permits. A total of 163 violations (13 creeks, 150 drainage canals) was found by the Environmental Protection Agency and U.S. Army Corps of Engineers. In an out-of-court settlement the ranch was required to restore hydrologic patterns to approximately 8,000 acres. This was accomplished by the efforts of M-K and several state agencies. In addition to the restoration project, M-K negotiated the sale of approximately 9,000 acres to the state and donated an additional 3,000 acres. These lands are managed by the FGFWFC and may become part of the Apalachicola National Estuarine Research Reserve (ANERR, 1986).

Apalachicola National Forest. The Apalachicola National Forest (ANF) is located in Franklin, Liberty, Wakulla, and Leon counties with the majority of it being in Liberty County. The ANF consists of approximately 557,400 acres which are administered by the U.S. Forest Service. Over 80 percent of the land within the national forest is federally owned. Most of the private lands within the forest are small homesites, farm lands or timber lands. The ANF is isolated from large populated areas and there is no significant degree of development in the area (USDA, 1975).

The ANF is located within six watersheds: Apalachicola River, New River, Ochlockonee River, Sopchoppy River, Lost Creek, and Wakulla River. There are a variety of habitats on the ANF including high pinelands, pine flatwoods, savannahs, bays, cypress swamps, and creek swamps. Dry, grassy longleaf pineland type dominates the northeastern corner of the forest and is scattered throughout the rest of the forest. Longleaf pine, natural slash pine, and planted slash pine forests are also scattered throughout the ANF. Titi swamps, bay swamps and savannahs are found within the pine flatwoods.

The ANF is a wildlife management area (Apalachicola Wildlife Management Area) managed by the Florida Game and Fresh Water Fish Commission and the U.S.

Forest Service. It provides habitats for a variety of important game species such as white-tailed deer, black bear (can only be hunted on this management area), squirrel, and turkey. Quail and waterfowl also exist but at less than desirable densities. Fishery resources can be found in the many lakes, rivers, and streams. Red-cockaded woodpecker colonies are located in some of the mature pine stands. The U.S. Forest Services is responsible for providing and protecting existing habitat for this endangered species (USDA, 1975).

The Apalachicola National Forest offers recreational opportunities that include swimming, boating, picnicking, and camping at developed facilities, and hunting and fishing in designated areas.

Private Lands

As mentioned previously, a majority of the land in the basin is privately owned and many of the owners are timber companies. Most of these lands are primarily used for timber management with some portions in wildlife management areas. Other private landowners, such as The Nature Conservancy and the Trust for Public Land, have purchased several areas for preservation and conservation.

In 1982 The Nature Conservancy acquired 1,182 acres on the Apalachicola River. This tract, known as the Alum Bluff tract or the Garden of Eden, includes Alum Bluff and most of Kelly Branch. Two years later The Nature Conservancy acquired an adjoining 3,187 acres from St. Joe Paper Company by swapping an identical amount of Liberty County timberland. The area is called the Apalachicola Bluffs and Ravines and is being managed as a preserve by The Nature Conservancy. This tract is in Liberty County and is approximately 3 miles south of Torreya State Park. The Apalachicola Bluffs and Ravines contain at least 50 prime steepheads. The bluffs and ravines also exhibit the state's longest exposed geological section. Alum Bluff is one of the Southeast's most significant fossil sites. This area is similar to Torreya State Park in that it contains a great assemblage of rare and endangered species (Means, 1985). The area has a strange mix of northern species, Florida endemics, and relicts of a bygone worldwide flora. Among these are the Florida yew, torreya and croomia.

The majority of Dog Island, 1,100 acres, is owned by the Cayahogua Trust, a private land trust; 145 acres are owned by The Nature Conservancy; 10 acres by the Dog Island Conservation District; and 595 by other private land holders. The land owned by The Nature Conservancy and all but 38 lots of the land owned by the private trust are set aside for preservation. On the remaining 38 acres, two housing sites may be sold for development each year for the next 20 years. If these sites are not sold each year, they will be given to The Nature Conservancy (ANERR, 1986).

Timber companies, such as Stone Container Corporation (formerly Southwest Forest Industries), Neal Land and Timber Company, St. Joe Paper Company, Buckeye Cellulose Corporation, Coastal Lumber, Florida Timberland, and Prosper Timber Company own large tracts of land and are the major private landowners within the basin. They also own a majority of the floodplain in Gadsden and Calhoun counties and approximately 50 percent of Liberty County. Other private landowners owning large parcels of land include Travelers Development Corporation, Sottera Inc., FICO Farms, and M-K Ranch.

Land Use

Land-use characteristics influence runoff patterns, types of pollutants, water quality and quantity, and virtually the health of river systems. It is therefore important to know these patterns in order to assess the resources of a river system. The Florida Department of Environmental Regulation, as part of the 208 Non-Point Source Project, has mapped all the drainage basins and sub-basins in the state with regard to land use (Figure 38). Although this data was compiled in 1981 and collected in the mid-1970s, very few changes have occurred in this region since then to invalidate the information. While land uses throughout the basin are similar, there are variations in the sub-basins which are important. Because of this the drainage basin has been divided into sub-basins for a more detailed discussion of land use (Table 21).

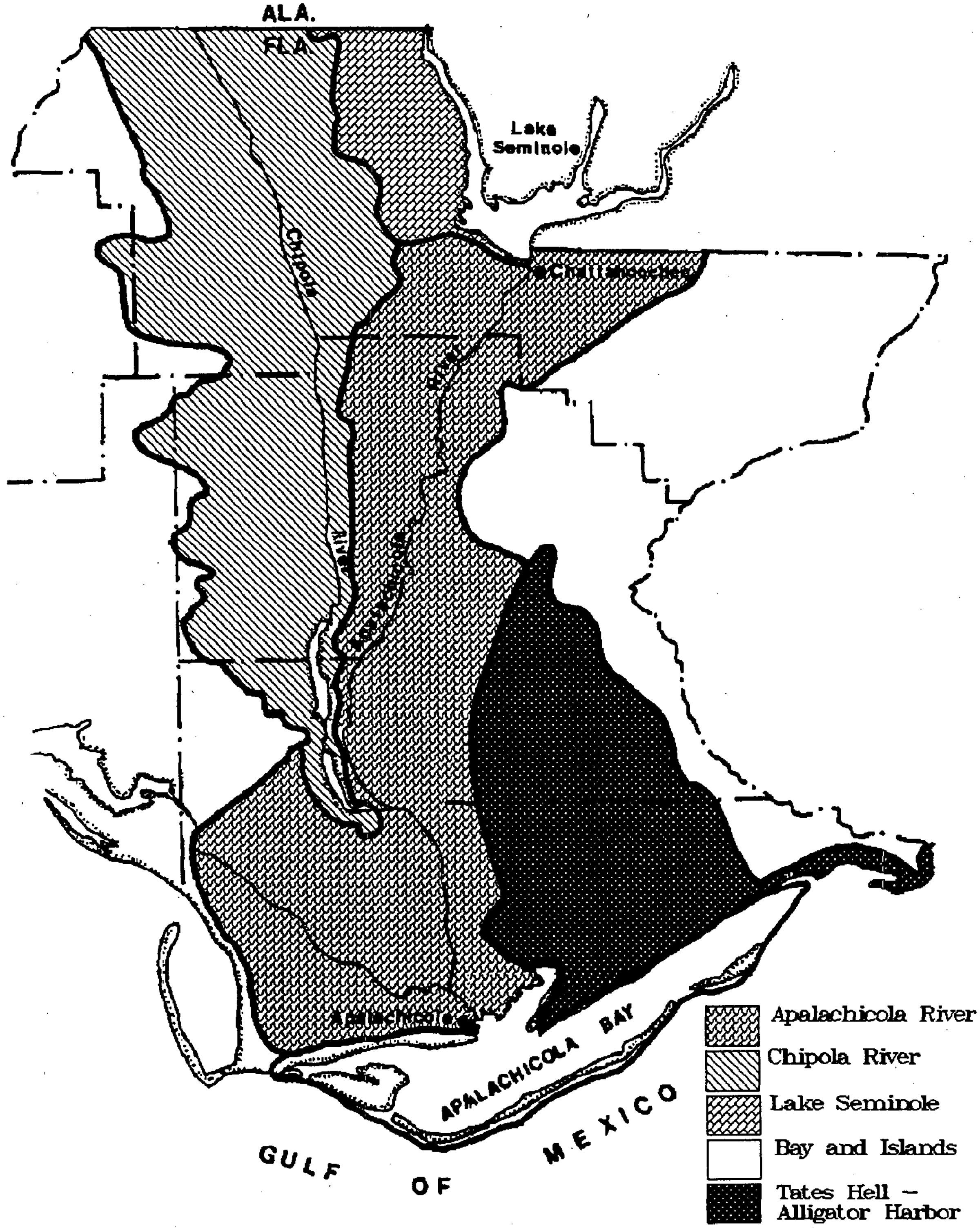


FIGURE 38. SUB-BASINS OF THE APALACHICOLA RIVER AND BAY DRAINAGE BASIN.

The largest sub-basin, covering 1,080 square miles, is the Apalachicola River drainage basin (Figure 38). Forestry is by far the number one land use in this basin accounting for over 57 percent of the total area. The majority of this, almost 77 percent, is in evergreen forests, primarily slash pine plantations. The remaining 23 percent of the forested land is comprised of a mixed forest type containing a combination of evergreen and hardwood trees. Wetlands comprise the second largest land use category accounting for almost 29 percent of the basin land area. The majority of this, 95 percent, is forested wetlands, much of which is Apalachicola River floodplain and river swamp. Nonforested wetlands are only found in the lowest reaches of the basin. Agricultural uses, primarily cropland and pastures, account for approximately 10 percent of the basin area and are concentrated mostly in the upper reaches of the drainage basin. The last two significant land use categories, water and urban, comprise 2 percent and 1 percent of the basin area, respectively.

The Chipola River basin, covering 1,023 square miles, is the second largest sub-basin and empties into the Apalachicola River at river mile 28 (Figure 38). Like the Apalachicola, the Chipola basin is dominated by forest land which accounts for 55 percent of the drainage area. A larger portion of this however, 92 percent, is evergreen forests with the remainder comprised of mixed forest land. Agricultural land use is high throughout the entire Chipola basin accounting for over 26 percent of the basin area. Almost all of this is comprised of cropland and pastures. Jackson County, which is in the upper reaches of the basin, is economically dependent on agricultural activities. Wetlands account for 15 percent of the basin with almost all of this classified as forested wetlands. The lower wetland acreage in the Chipola basin is due to the smaller floodplain of the Chipola River and also agricultural development in parts of the floodplain. Urban areas, 63 percent residential, account for almost 2 percent of the basin area.

The Lake Seminole sub-basin drains into Lake Seminole and the upper Apalachicola River and covers 185 square miles (Figure 38). Although most of this area drains into Lake Seminole, it is within Florida's boundaries and

Table 21. Land Use of the Major Sub-basins of the Apalachicola River and Bay Drainage Basin (in acres) (DER, 1981).

	Chipola River Basin	Apalachicola River Basin	Lake Seminole	Bay and Islands	Tates Hell	Total
Urban	10528	7806	1000	2002	4017	25353
Agricultural	174455	70238	53260	-0-	138	298091
Rangeland	-0-	62	-0-	-0-	-0-	62
Evergreen Forest	329341	305006	41488	18286	153003	847124
Mixed Forest	28929	93042	7976	405	104199	234551
Water	5548	14685	10337	140887	4653	176110
Forested Wetlands	100951	188134	3648	1401	73453	367587
Nonforested Wetlands	168	9957	546	6306	6854	23831
Barren	4609	2310	79	3246	461	10705
Miscellaneous	-0-	52	137	1173	358	1720
TOTAL	654529	691292	118471	173706	347136	1985134

should be considered within the drainage basin. Agriculture is the major land use accounting for 45 percent of the basin area. This is in contrast to the previously discussed sub-basins which are dominated by forested land. The second largest land-use category, forest land, accounts for 42 percent of the basin area and is predominantly evergreen forests. Water area ranks third in land-use area covering almost 9 percent of the basin. Wetlands, primarily forested wetlands, account for approximately 3 percent of the basin area and are primarily located in floodplain and river swamps. Urban areas cover another 1 percent of the basin.

The mainland and islands surrounding Apalachicola Bay, St. Vincent, and St. George sounds, which drain directly into these waterbodies, are also a part of the drainage basin (Figure 38). These areas are usually not included in drainage acreage calculations because they do not empty directly into the river. They are part of the basin, however, and will be included. If the water area is included, the sub-basin covers 271 square miles, 220 square miles of which are bays and estuaries. When the water area is not included, forest is the predominant land use accounting for 57 percent of the basin land area. Wetlands cover 23 percent of the basin land area, dominated by nonforested areas, primarily fresh and saltwater marshes. Beaches, which are classified under the barren land-use category, cover 10 percent of this basin. Urban areas, almost entirely residential, account for 6 percent of the basin land area and include both incorporated and unincorporated areas.

Another sub-basin usually excluded from consideration because it does not drain directly into the Apalachicola River, drains Tates Hell Swamp, New River, and Carrabelle (Figure 38). This sub-basin affects East Bay, St. George Sound, and Alligator Harbor and encompasses 542 square miles. Forest land predominates in the basin covering 74 percent of the land area, and is fairly evenly divided between evergreen forest and mixed forest. Wetlands rank second in land use accounting for 23 percent of the basin area. Ninety-one percent of these fall into the forested wetlands category. Water and urban areas each encompass approximately 1 percent of the area within this basin.

Overall, the drainage basin, which affects the Apalachicola River and Bay area and is located in Florida, encompasses 3,102 square miles. This basin encompasses two major river systems; the Apalachicola and Chipola, a major bay system - the Apalachicola, and a large swamp - Tates Hell Swamp. Forest land covers over half this area comprising almost 55 percent of the total basin area. The majority of this, 78 percent, is evergreen forests, much of which is slash pine plantations utilized by pulp and timber companies. Wetlands, 94 percent forested wetlands, cover approximately 20 percent of the basin area. Agricultural land use covers another 15 percent of the basin and is mainly found in the upper regions in Jackson and Calhoun counties. Open water encompasses 9 percent of the basin area dominated by the bay system. Urban areas cover approximately 1 percent of the basin, with residential land use being predominant. All of these land-use statistics point out that this basin is sparsely settled and populated with lumbering, farming, and fishing providing the economic backbone of the region.

V. PROTECTION OF THE NATURAL RESOURCES OF THE APALACHICOLA BASIN

Throughout this resource inventory the uniqueness of the biological communities within the Apalachicola River and Bay drainage basin has been repeatedly documented. The economic importance of the bay to Franklin County, as well as the State of Florida, has also been documented. Federal, state and county governments have all been involved in efforts to protect this natural resource. The primary methods which have been used to protect this system from degradation can generally be divided into three categories: land acquisition, restoration, and a wide range of governmental regulations. Brief descriptions of each category and their usefulness are the focus of this chapter.

The method used least often in this particular basin involves habitat restoration. The limited use of this category is primarily due to the relatively undeveloped nature of the basin; however, this method will almost certainly become more important in the future as development pressures increase. The major restoration accomplished in the Apalachicola basin involves M-K Ranch in Gulf County, which has been previously mentioned. State and federal agencies required them to reconnect approximately 9,000 acres of floodplain, which had been illegally diked, back to the Apalachicola River. This was accomplished primarily by breaching dikes and filling in ditches which had allowed the area to be isolated, drained, and farmed. This single project has been described by Environmental Protection Agency officials as the largest wetland restoration project accomplished to date under the Clean Water Act.

In January, 1987, the Florida Department of Environmental Regulation issued a two-year permit to the Corps of Engineers for maintenance dredging on the Apalachicola River navigation channel. One of the specific conditions included in this permit set up an interagency team, which includes DER, FGFWFC, DNR, NWFWMD, NMFS, FWS, and the COE, to investigate techniques and procedures for restoration and enhancement of altered riverine and floodplain habitats (DER, 1987). Studies by Ager et al. (1984,1985) have documented the impacts of within-bank spoiling, the most prevalent method on the river, on fish habitat and community structure. Eichholz et al. (1979) has documented the impacts of spoiling on vegetation and wildlife in the floodplain. The interagency team is currently analyzing options, techniques, locations, and funding sources for demonstration programs before recommending the types and extent of restoration needed to mitigate for past and future impacts. Restoration or enhancement of these dredge spoil sites will probably be the major thrust of any activity in this category in the future.

Land acquisition has been used extensively in the Apalachicola system as a means of protecting sensitive, unique, and economically important habitats. A description of state and federally owned lands is contained in Chapter IV. State and federal agencies own approximately 225,000 acres of land within the Apalachicola basin, which includes approximately 21 percent of the land area within the Apalachicola National Forest. This total does not include water area such as bay bottom in the lower basin. Public ownership therefore accounts for approximately 12 percent of the land area in the entire drainage basin.

The majority of land purchases within the basin in the last 10 years have been in the floodplain of the river and marsh areas surrounding the bay. These acquisitions have been for environmental rather than recreational reasons and have been designed to protect Apalachicola Bay and its natural resources from pollution problems associated with potential habitat alterations. These purchases include the Cape St. George State Reserve, Apalachicola Wildlife and Environmental Area, East Bay CARL lands, and the NWFWMD Apalachicola River floodplain tract.

The Northwest Florida Water Management District is currently negotiating with Neal Land and Timber Company for the purchase of approximately 45,000 acres of Apalachicola River floodplain using money from the Save Our Rivers Trust Fund. They are also negotiating to buy the 3,000-acre Atkins Tract, an environmentally unique area on the river. If these negotiations are successful approximately 90 percent of the floodplain will be in public ownership. These purchases, if completed, will probably mark the end of large land acquisitions in the drainage basin. However, several important small tracts remain which should be acquired.

The State of Florida is presently evaluating eight tracts of land within the Apalachicola drainage basin which are listed on the Conservation and Recreation Lands (CARL) acquisition list. These projects have been prioritized by the state as to their order of importance and are currently combined into three listings. During this evaluation period the boundaries for each project are drawn based on habitat importance, recreational importance, preservation importance, ease of acquisition (number of owners), and the overall size needed to accomplish the stated objectives. A list of these projects, a description and their ranking is included in Table 22.

The most important tract of land remaining in private ownership is probably the commercially-zoned parcel on St. George Island adjacent to Nick's Hole. This parcel includes the third most productive drainage area in the bay (ANERR,1986). In the past, plans for a marina with concurrent development have been proposed for this area, but these plans have not been pursued seriously due to environmental concerns. This parcel, which covers approximately 125 acres, includes bayfront, interior, and beachfront areas. Currently, only the part which affects the bay is being considered for acquisition; however, there is considerable pressure to buy the whole parcel.

Cat Point, which is within 100 yards of one of the most productive oyster bars in Franklin County, is another important tract of land currently under evaluation for acquisition. Thirty-one acres of approximately 115 acres in this project have recently been offered for sale to the state. The other six parcels listed are included for reasons of recreational value, uniqueness, to provide a buffer around the bay, or to complete the purchase of parcels within or between previously acquired state lands. While these parcels are important, Nick's Hole and Cat Point should be acquired before considering any of the other areas due to their importance.

As the more sensitive tracts of land are acquired by the state and land purchases cease, the means of protecting the natural resources of the bay

Table 22. Apalachicola River and Bay Lands on the Conservation and Recreation Lands (CARL) List (DNR, 1987).

Project	Ranking	Acreage	Reason for Proposed Purchase
Apalachicola River and Bay Phase I 1. Nick's Hole 2. Cat Point 3. East Hole 4. Shell Point Bayfront 5. Apalachicola Bayfront 6. Sike's Cut	3	552	Buffer around bay, preservation, and recreation.
Lower Apalachicola (East Bay CARL Lands)	4	7,800	Buffer around bay, preservation, and private holdings within the boundaries of the ANERR.
Gadsden County Glades communities.	19	1,800	Unique and endangered

shift to the third method mentioned previously. This last method involves government regulations such as planning, zoning, and land-use restrictions, and in the final analysis is the method which will determine the fate of the Apalachicola Bay system. The state realized this several years ago when it designated Franklin County an Area of Critical State Concern and required the local governments to deal with stormwater management, septic tanks, pollution sensitive segments, and to prepare reports dealing with fisheries and the environmental status of the bay. A copy of the "Apalachicola Bay Area Protection Act" (HB 1202), which accomplished this, has been included in the Appendices.

Franklin County and its municipalities have passed several new ordinances and updated others in order to comply with the provisions of the above mentioned act. To date, the most important ordinance enacted by the county is the Critical Shoreline District (No. 87-1) and the accompanying Pollution Sensitive Segment Maps. This ordinance provides for strict regulations for development on all lands 150 feet landward of wetlands of Franklin County. Lot clearing and impervious areas are to be minimized, especially within the first 50 feet landward of wetlands, in order to minimize stormwater runoff. Development within the first 50 feet is also prohibited except for pervious, non-habitable, pile supported, or water dependent structures, such as docks, piers, gazebos, etc. Standard septic tanks are prohibited within the 150-foot Critical Shoreline District, and only approved alternative wastewater treatment systems are allowed within 75 to 150 feet of wetlands if the area is not served by a central wastewater system. All development within this 150-foot zone must also submit a site plan and stormwater management plan with the application for a county development permit. This ordinance is intended to maintain and protect the water quality and wetlands surrounding the Apalachicola Bay system by preserving the natural buffering system which currently exists. This buffer system of natural vegetation and marshes filters stormwater runoff and helps minimize the adverse impacts which can be caused by development. A copy of the Critical Shoreline District Ordinance has been included in the Appendices.

Franklin County has also amended its Zoning Ordinance to conform to the requirements of the Apalachicola Bay Area Protection Act. The City of Apalachicola is in the process of amending its Land Development Code so that it also protects the bay and river system. Significant new additions to the city ordinance include the creation of a Riverfront District with specific regulations to deal with stormwater runoff, site plan review requirements, and density. These new sections are designed to provide for orderly and progressive development while at the same time protecting the natural resources of Apalachicola Bay. The county has also drafted a Stormwater Management Plan Ordinance which is currently being reviewed by the Apalachicola Bay Area Resource Planning and Management Committee and state agencies to determine whether or not it fulfills the requirements of HB 1202. Other ordinances currently being developed by state and local officials for Franklin County include a Subdivision Ordinance, a Planned Unit Development Ordinance (PUD), a Sign Ordinance, a Nuisance Ordinance, and more amendments to the Zoning Ordinance. So far, the City of Carrabelle, the only other municipality in the county, has yet to pass any ordinances to comply with the requirements of HB 1202.

The Area of Critical State Concern designation passed by the 1985 Florida Legislature is scheduled to expire in June, 1988, if it has been determined that all local regulations, comprehensive plans, and the administration of these regulations are adequate to protect the Apalachicola Bay area. If it is determined that the regulations are not adequate, then the designation would continue and would be renewed annually until such time as the county and its municipalities have complied with the requirements of HB 1202.

The specific nature of the language used in the act concerning the removal of the designation should be pointed out. It includes the phrase "...the administration of such regulations and plans..." Prior to designation, ordinances existed which were designed to help protect the natural resources. However, many were ambiguous and perhaps, more importantly, their application and enforcement were spotty at best. In fact, many argue that Franklin County was designated an Area of Critical State Concern for this very reason. The new ordinances adopted or proposed for adoption for this area, likewise, will fail if they are not applied fairly, across the board for all citizens. Therefore, it is imperative that the state guarantee that the proper administration of these regulations be carried out before it relinquishes its mandate in Franklin County.

VI. PROBLEMS AND SOLUTIONS FACING THE APALACHICOLA DRAINAGE BASIN

The Apalachicola drainage basin provides diverse and productive habitats for a wide range of plants and animals. Although these habitats have been dealt with separately, they are interrelated and affect each other considerably. The uplands influence the floodplain habitats by runoff, fire, and as a source of animal diversity. The river influences the floodplain character by volume of flow, frequency of flooding, sediment load, and timing of flooding. The river and floodplain are responsible for the character and productivity of the bay because of the volume of water, nutrients, and quality of water they deliver. The barrier islands help hold in the mixture of nutrients and freshwater long enough for utilization by estuarine organisms enabling Apalachicola Bay to be the productive bay it is. A threat to any component of the system has the potential to impact the entire system and these effects should be understood prior to any alteration of the system and should be avoided as necessary. Potential threats, along with possible solutions are discussed below.

Barrier Island System

The four barrier islands which help make up the Apalachicola estuarine system have been physically altered by the hurricanes of 1985. Barrier islands are shifting environments and eventually their habitats are able to readjust to natural situations. Cape St. George and St. Vincent islands are owned by the state and federal governments respectively, and are therefore protected from most man-made alterations. Dog Island is sparsely developed with 70 percent of the island currently restricted to minimal disturbance.

St. George Island, the only barrier island accessible by car, is mostly privately owned and most of the development along the coast is occurring in this area. There are approximately 700 dwelling units currently on the island, many of which support only weekend residents. The Department of Community Affairs estimates over 4,000 units are possible when the island is fully developed (FDCA, 1986). Most dwelling units on the island are now on septic tanks and the majority of planned units are also scheduled to be put on septic tanks. Currently the majority of the island's drinking water comes from a potable water system operated by the St. George Island Utility Company. However, many residents have private wells to supply heat pump and lawn care needs. Since St. George Island is the only barrier island which has the potential for large scale development, problems and possible solutions to the problems caused by increased development are discussed below.

Nutrient enrichment of freshwater ponds, coastal marshes, and adjacent estuarine waters can be caused by septic tank leachate moving horizontally through surficial waters. Improper installation of septic tanks and installation in unsuitable soils can allow nutrients and pathogens to leave drainfields. Improper maintenance of these systems can lead to similar results. Overenrichment by nutrients such as nitrates and phosphates can cause algae blooms, noxious aquatic plant problems, increased rates of sedimentation, and dissolved oxygen deficits in aquatic systems. Increased pathogens lead to human health concerns due to contaminated water as well as fish and shellfish resources. Several studies (Livingston, 1983; USEPA, 1981: Porter, 1985; FDNR, 1986) have either documented or commented on the possibilities of septic tank leachate problems on St. George Island.

Because of these concerns the State of Florida has mandated that a centralized wastewater treatment system be operational on St. George Island by the end of 1989. Furthermore, if the system is not operational within this period, only Class I aerobic treatment units will be permitted on the northern side of the island. A copy of the Executive Summary of the St. George Island Sewerage Study which details the reasoning, recommendations, and responsibilities of this study is included in the Appendix (FDCA, 1986). The establishment of a centralized sewer system and the elimination of existing septic tanks on the island should alleviate the possibility of septic tank leachate contamination.

Nutrient enrichment, contamination, and filling in by sediment of ponds, marshes, and sloughs can be caused by uncontrolled stormwater runoff from developed areas. When pervious natural areas are converted to impervious surfaces the amount of stormwater runoff increases dramatically with concurrent increases in types and amount of pollution. Types of contaminants found in runoff from developed areas include heavy metals, oils and greases, nutrients, toxic chemicals, bacteria, and sediments. These contaminants come from motor vehicles, lawn chemicals and fertilizers, animal wastes (pets), increased chemical usage, and increased erosion. Besides having many of the same impacts as septic tank leachate, stormwater runoff can cause water quality problems because of heavy metal, toxic chemicals, and oil and grease contaminants. In high enough concentrations these contaminants can cause fish and wildlife losses and become a human health hazard.

To alleviate the impacts caused by stormwater runoff, Franklin County passed the Critical Shoreline District Ordinance this year (see Appendix). This ordinance has been previously discussed in Chapter V. The county is also in the process of drafting a stormwater management ordinance for areas of the county outside the Critical Shoreline District. With the adoption of these two ordinances and proper enforcement, the impacts of stormwater runoff from future development should be minimized.

The inevitable loss of natural habitat on St. George Island, due to an influx of people and construction of vacation homes, is not likely to cease. Upland habitats such as scrub, pine flatwoods, and dunefields appear to be most susceptible to alteration. The Florida Department of Natural Resources under provisions of Chapter 161, F.S., is responsible for establishing a coastal construction control line designed to protect the coastal dunes fronting the Gulf of Mexico. A permit is required in order to build seaward of this line. This statute protects the primary or frontal dune in most cases but allows for development in the dunefields landward of this line. There are no constraints concerning clearing in the scrub or pine flatwoods habitats.

Loss of scrub and pine flatwood habitats will undoubtedly reduce the nesting and escape cover available to migratory and resident bird species which utilize these areas. Because the eastern end of the island is a state park and density restrictions of one unit per acre on most of the western end

(The Plantation) reduces clearing, large amounts of this habitat may not be lost. The other barrier islands still provide significant amounts of these habitat types. The loss of breeding bird habitat for black skimmers and least terns is also of concern. The causeway leading to St. George Island currently is one of the more important nesting areas in the panhandle for these species (Jeff Gore, personal communication). Increased traffic to the island as well as alteration of the causeway soils by highway construction and repair could make this area unacceptable to these nesting species. So far, cooperation between the state and the local government has managed to lower the speed limit during the summer nesting period on the causeway and postpone repair work until the nesting season is over. Continued cooperation will be necessary to maintain protection for these migratory species' nesting areas.

A final concern which is related to an increased human presence on St. George Island involves destabilization of the dune system, which helps prevent erosion and overwash during storm events. Foot traffic degrades dune systems by reducing important stabilizing vegetation. Fortunately, the dunes on the east and west ends of the island appear to be somewhat protected by boardwalks or walkovers. As foot traffic and construction in the central region of the island increases, the impact on these dunes could increase erosion and sand movement. Franklin County prohibits vehicular traffic on the beaches which helps protect the dunes. Currently this does not appear to be a major problem, although degradation of the dune systems in various heavily used areas is apparent.

Apalachicola Bay System

Of all the components of the Apalachicola drainage basin, the estuarine system is probably the most vulnerable because it is influenced significantly by the other four systems. Runoff from the uplands and barrier islands ends up in the bay either through the river or marsh system. The flow and quality of water available to the bay after upstream users have tapped the river, directly affects the productivity of the estuary. Many of the potential problems facing the estuarine environment such as nutrient enrichment and increased bacterial contamination have already been discussed and are related to upland development. These problems appear to have been addressed by regulations concerning types, densities, and methods of development.

Another concern related to the productivity of the Apalachicola Bay system deals with unpermitted dredge and fill operations. While many of the marshes in East Bay and along St. Vincent and Cape St. George islands are protected, there remains significant quantities in St. Vincent Sound, Apalachicola Bay, and St. George Sound which are not. This is not to suggest that all marshes in the system should be acquired by the State. The Florida Department of Environmental Regulation and the U.S. Army Corps of Engineers have jurisdiction over activities in these marshes. Considering the importance of these marshes as nursery areas, strict enforcement of regulations and requiring mitigative actions to offset losses is necessary. Education and coordination between local, state, and federal agencies is essential to inform developers and homeowners of the regulations governing wetlands and the reasons for these regulations.

Increased alteration of marshes also affects runoff, erosion, filtration of pollutants, and the turbidity of adjacent waters. Increased erosion causes the loss of marsh vegetation while increased sedimentation helps fill in existing marshes, changing their species composition or eliminating them entirely. Increased turbidity reduces light penetration, thereby decreasing productivity. This reduction of light can eliminate submerged vegetation which also affects the stability of bottom sediments.

There are currently two new marinas and the upgrading of an existing one proposed for St. George Island. Two existing marinas in Apalachicola are also being renovated. Marinas, even those designed properly, cause water quality degradation. The Florida Department of Natural Resources automatically closes any oyster beds within a specified radius of any marina. The distance is calculated based on the size of the marina, flushing rates, and the facilities provided by the marina. Types of pollution from marinas include toxic chemicals (contained in some marine paints), petroleum discharges, heavy metals, and bacterial contamination.

The two marinas being renovated in Apalachicola should not degrade water quality in the area further. These renovated marinas will have pump out facilities, restrooms, full time harbormasters, and strict regulations governing discharges which the existing marinas do not have. Therefore, even with increased boat traffic, little or no additional pollution should occur. The water quality in these basins may actually improve if everything functions as planned. A two-mile radius around Apalachicola is already closed to oystering because of pollution and it is unlikely any additional area will be closed due to these renovated marinas. The proposed marina on St. George Island at Sikes Cut could have some impact in certain areas of the bay; however, since details are currently unavailable, it is unknown what these impacts might be. A proposed marina at Nick's Hole will probably not proceed beyond the planning stage, due to the sensitive nature of the area and the State's interest in acquiring this property. In order to reduce the possibility of water quality degradation, any marina in Apalachicola Bay should provide an advanced design, safeguards against contamination, strict regulations, and methods to enforce these regulations prior to being permitted. They should also avoid sensitive habitats or shellfishing areas.

Perhaps the biggest potential problem facing Apalachicola Bay today is the equitable distribution of its fishery resources. As mentioned previously overharvesting of oysters has been a problem since commercial harvesting began in the late 1800's (Rogers, 1987). The oyster bars appear to have come back significantly since their devastation by hurricanes in 1985. The return of these productive bars was aided by closures and limited harvesting regulations. The Florida Marine Fisheries Commission has drafted a rule to allow the limited use of oyster dredges on private leased bars in Apalachicola Bay. This rule has been recommended to the Governor and Cabinet for approval. Local oystermen are concerned about enforcement and keeping the dredges off public bars.

Increased fishing pressure throughout the State has meant increased regulations concerning commercial and recreational harvests. Daily limits, size limits, quotas on total poundage taken, and outright bans have affected redfish, spanish mackerel, and king mackerel harvests this year. There are also increasing pressures concerning recreational versus commercial fishing impacts. Resolution of these issues will not be easy. Currently, all sides appear to be unwilling to compromise and seek an equitable solution.

Finally, the reduction of freshwater inputs from upstream continues to be a concern which cannot be addressed locally. As the usage of freshwater continues to increase in the more developed areas in Georgia and Alabama, less flow is available to Apalachicola Bay. This reduction in the volume of water could become critical in summer months or during prolonged droughts. The U.S. Army Corps of Engineers is currently carrying out a "308 study" which addresses water needs and develops a water budget for the entire Apalachicola-Chattahoochee-Flint River basin. This study appears to be stalled at the moment but should be completed in the next one to two years. A positive step which has occurred during this project is that Apalachicola Bay has been officially recognized as a water user in the system. During droughts the bay's freshwater needs must also be considered, rather than receiving water remaining after upstream users needs are satisfied.

Apalachicola River Floodplain System

Approximately half of the Apalachicola floodplain is currently owned by the state of Florida which is also negotiating to buy more. The upper Apalachicola floodplain is mostly owned by timber interests which have, in the past, harvested mostly by selective cutting techniques. The Chipola River floodplain is almost entirely in private ownership except for parts of the lower river below Dead Lakes and is more intensively developed, primarily by agriculture. The threat to floodplain areas not protected by the state is mainly from the destruction of natural communities by timbering and subsequent conversion to agricultural lands or pine plantations. Development in the Apalachicola River floodplain is unlikely in most areas; however, the floodplain system could be impacted by other activities occurring in the system.

Probably the biggest threat to areas within the floodplain near the river is navigation maintenance performed by the U.S. Army Corps of Engineers (COE). The navigation channel requires yearly dredging to maintain it and currently the COE is dredging over one million cubic yards a year (USCOE, 1986). The majority of this dredged material, sand, is deposited in within-bank spoil sites which the river removes during high water, if the material is not piled too high. In the past this has been a continuing problem along with the blocking of sloughs and creeks with spoil, which changes the hydrology in certain areas of the floodplain. The placement of dredged spoil material on floodplain sites, though limited, also impacts the floodplain hydrology along with permanently altering these tracts.

As mentioned previously the two-year dredging permit issued in January, 1987 to the Corps of Engineers created an interagency team to investigate within-bank and floodplain spoil sites, to recommend mitigation measures to be used on the river, and to put together a plan of study to deal with these issues. During this time, the Corps of Engineers has also received authority for the first time to open up sloughs and creeks which have previously been filled in by past spoiling activities. The interagency team is currently determining which sloughs should be opened first as experimental cases. Although disagreements still exist within the interagency team and violations of the permit are still continuing, this cooperation remains the best method to resolve some of the issues concerning the floodplain impacts caused by maintenance dredging activities. Other issues such as additional floodplain spoil sites, bend easings and cutoffs, and river training works still need to be addressed.

The conversion of upland habitats to agricultural uses will also impact the character of the adjacent floodplain because of increased runoff, sediments, pesticides, fertilizers, and a decrease in the movement of wildlife caused by reduced available habitat. Since floodplains act as corridors for wildlife, it is important that they not be broken up into parcels but remain continuous systems. Because the floodplain is also important to fish during high water any impacts could also affect fish communities in the river. Very little besides state acquisition of floodplains and encouraging agricultural and silvicultural interests to use Best Management Practices (BMP's), developed by interagency coordination, has been accomplished in this area.

One method which can be accomplished to increase the quality of the floodplain habitats and possibly mitigate for impacts elsewhere is better management of state-owned lands. In the last few years the state appears to be taking a lead role in managing public land better. The Northwest Florida Water Management District has recently developed a draft management plan for its Save Our Rivers lands. The Game and Fresh Water Fish Commission has also funded several new positions to manage some of its public lands, especially floodplain tracts like the Apalachicola Wildlife and Environmental Area. Better management of these lands could help decrease illegal harvesting of floodplain timber such as bald cypress, decrease illegal hunting, and improve the quality of important wildlife habitats.

Apalachicola River System

The riverine habitats appear to have been impacted considerably. Dredge and spoil activities associated with the authorized navigation channel have affected every type of habitat in the river. Approximately 25 miles of shoreline have been converted to less productive sand bars by within bank disposal of dredge material. Although riverine habitats by their nature are less stable than many other habitats, the conversion to sand bar habitats in the Apalachicola River has been quick, relative to natural occurrences. The riverine system is also the only component of the River and Bay drainage basin in which a reduction in productivity has been documented. This has been caused by a combination of physical destruction of the natural habitat from rock removal, dredging, and spoil disposal, and the creation of Lake Seminole (Seaman, 1985). These activities are related to the navigation channel maintained by the U.S. Army Corps of Engineers.

The activities mentioned above have both resulted in a loss of habitat for fish. Anadromous fish such as the Gulf sturgeon and striped bass have been impacted significantly. The construction of the Jim Woodruff Lock and Dam in

1957, the Dead Lakes Dam in 1962, and other dams on the Chattahoochee and Flint rivers has reduced the unrestricted river area to only 17 percent of its historic range (Wooley and Crateau, 1983). These restrictions have resulted in the loss of historic spawning grounds for sturgeon, especially rock habitat, and the elimination of many of the available thermal refuges which are important to striped bass in the summer.

Since the declines in the numbers of Gulf sturgeon and striped bass, several methods for mitigation have been investigated. Both species have been studied by state and federal agencies, with the identification of important habitat areas and restocking of striped bass the major effort undertaken so far. Stocking of a hybrid, the sunshine bass, has occurred extensively in the system. Methods to enhance fish passage through the dam have also been discussed. The U.S. Army Corps of Engineers has recently made funds available to be used exclusively for mitigation of impacts caused by previous dam construction. A proposal is being submitted by the Corps and state and federal fish and wildlife agencies to locate a fish hatchery at Jim Woodruff Dam specifically for these species. This would be a positive step toward restoring these two fisheries in the system, provided habitat restoration activities are undertaken concurrently.

Maintenance dredging along with spoil disposal and rock removal in the Apalachicola River has not only affected the remaining important habitat for Gulf sturgeon and striped bass, but has also affected other game fish as well. The destruction of productive riverine habitat and conversion to less productive sand bar habitat has resulted in a loss of fishery resources in the system.

In the last several years special conditions have been inserted in maintenance dredging permits to reduce some of the impacts associated with these activities. Historically large scale snag removal operations occurred even when there was no hazard to navigation. These snags, which provide important habitat and cover, were removed from the river. Current conditions require that these snags be removed only when they interfere with navigation and that they be put back in the river, preferably on less productive habitat such as spoil disposal areas. Another new agreement incorporated into the permit requires the COE to only dispose on agreed upon sites which are mainly limited to unproductive sand bar habitat, much of which has been previously spoiled upon. Currently an interagency team is investigating methods to rejuvenate old sites so new unaltered disposal sites will not be necessary, and develop plans to enhance or restore old disposal sites for mitigation purposes.

Upland System

The upland habitats within the drainage basin have been described without regard to predominance or alterations which have occurred. Because of fire suppression and pine plantations much of the original habitat has been altered over the last hundred years. Sandhills and clayhills in particular have been either altered by fire suppression and the creation of pine plantations or they have been destroyed by timbering, overgrazing, development, and the conversion to agricultural fields. Pine flatwoods, which is one of the dominant habitats in the basin, have also been altered significantly. The primary alteration has been caused by timbering operations in which longleaf pines are replaced by slash pines because of their faster growth. The methods used in planting and maintaining these pine plantations generally exclude longleaf pine regeneration. In Florida alone from 1959 to 1970 the area of slash pine increased by 22 percent (Sheffield et al, 1983). This increase has slowed since, primarily due to increased planting of sand and loblolly pine. However, very little new longleaf pine areas are being re-established.

The loss or alteration of these habitats impacts wildlife such as the red-cockaded woodpecker, pine snake, and gopher frog. Gopher tortoises and their associated communities, while not limited to longleaf pine forests, are also affected due to changes in the surrounding habitat and the increased density of trees found in pine plantations. There appears to be little that can be done to slow down this conversion on private lands because of the economic importance of the pulp industry and the increased need for more wood products. However, state and federal agencies responsible for managing public lands can and should be more involved in maintaining natural communities on their lands. This appears to be the only alternative to losing natural communities such as longleaf pine forests.

Scrub habitat, which is mainly found near the coast (in Panhandle Florida), is mainly threatened by increasing development. Since this habitat is the only "high and dry" community in many coastal areas, it is natural that development would occur within it. As development pressures increase, more scrub habitat will disappear in the panhandle. Eventually the largest stands remaining will probably occur on public lands.

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VIII. APPENDICES

Notes on Appendices

The following checklists of species from the Apalachicola Basin include species that have have been listed by various authors, however, these lists should not be considered complete because other species may exist but have not been listed for the study area.

Initials following common names indicate the status that the Florida Game and Fresh Water Fish Commission has listed the species as in the Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida, 1987.

E - Endangered

T - Threatened

SSC - Species of Special Concern

The initials following the scientific name of each species indicates the general location that has been noted for that individual species. However, this does not restrict the species to this particular location.

B - Bay -primarily brackish and saltwater species.

C - Cape St. George

D - Dog Island

G - St. George Island

M - Mainland -includes wetlands and uplands from Georgia border to the bay.

R - River -primarily freshwater species.

V - St. Vincent Island

Checklist of Amphibians and Reptiles of the Apalachicola Basin

Amphibians

Salamanders

Flatwoods salamander	*Ambystoma cingulatum*	M
Marbled salamander	*Ambystoma opacum*	M
Mole Salamander	*Ambystoma talpoideum*	M
Tiger Salamander	*Ambystoma tigrinum*	M
Two-toed amphiuma	*Amphiuma means*	M
One-toed amphiuma	*Amphiuma pholeter*	M
Southern dusky salamander	*Desmognathus auriculatus*	M
Dusky salamander	*Desmognathus fuscus*	M
Two-lined salamander	*Eurycea bislineata*	M
Longtail salamander	*Eurycea longicauda*	M
Dwarf salamander	*Eurycea quadridigitata*	M
Georgia blind salamander (SSC)	*Haideotriton wallacei*	M
Four-toed salamander	*Hemidactylium scutatum*	M
Gulf coast waterdog	*Necturus beveri*	M
Spotted newt	*Notophthalmus viridescens*	M
Slimy salamander	*Plethodon glutinosus*	M
Dwarf siren	*Pseudobranchus striatus*	M
Mud salamander	*Pseudotriton montanus*	M
Red salamander	*Pseudotriton ruber*	M
Lesser siren	*Siren intermedia*	M
Greater siren	*Siren lacertina*	M

Frogs

Northern cricket frog	*Acris crepitans*	M		G		
Southern cricket frog	*Acris gryllus*	M	D	G	C	V
Florida cricket frog	*Acris g. dorsalis*					V
Southern cricket frog	*Acris g. gryllus*	M				
Oak toad	*Bufo quercicus*	M				V
Southern toad	*Bufo terrestris*	M		G	C	V
Eastern narrowmouth toad	*Gastrophryne carolinensis*	M		G	C	V
Bird-voiced tree frog	*Hyla avivoca*	M				
Gray tree frog	*Hyla chrysoscelis*	M				
Green tree frog	*Hyla cinerea*	M		G	C	V
Spring peeper	*Hyla crucifer*	M				
Pine woods tree frog	*Hyla femoralis*	M				V
Barking tree frog	*Hyla gratiosa*	M				
Squirrel tree frog	*Hyla squirella*	M	D	G	C	V
Little grass frog	*Limnaoedus ocularis*	M				V
Southern chorus frog	*Pseudacris nigrita*	M				
Ornate chorus frog	*Pseudacris ornata*	M				

Upland chorus frog	<u>Pseudacris triseriata feriarum</u>	M				
Gopher frog (SSC)	<u>Rana areolata</u>	M				
Bullfrog	<u>Rana catesbeiana</u>	M				V
Bronze frog	<u>Rana clamitans clamitans</u>	M				
Pig frog	<u>Rana grylio</u>	M			C	V
River frog	<u>Rana heckscheri</u>	M				
Northern leopard frog	<u>Rana pipiens</u>	M	D	G		V
Southern leopard frog	<u>Rana sphenocephala</u>			G	C	V
Eastern spadefoot	<u>Scaphiopus holbrookii</u>	M				

Reptiles

Turtles

Atlantic loggerhead turtle (T)	<u>Caretta caretta caretta</u>				C	V
Snapping turtle	<u>Chelydra serpentina</u>	M				
Common snapping turtle	<u>Chelydra s. serpentina</u>					V
Chicken turtle	<u>Deirochelys reticularia</u>	M				
Gopher tortoise (SSC)	<u>Gopherus polyphemus</u>	M				V
Barbour's map turtle (SSC)	<u>Graptemys barbouri</u>	M				
Eastern mud turtle	<u>Kinosternon subrubrum</u>	M	D	G	C	V
Atlantic ridley (E)	<u>Lepidochelys kempi</u>					V
Alligator snapping turtle (SSC)	<u>Macroclemys temminckii</u>	M				
Diamondback terrapin	<u>Malaclemys terrapin</u>	M		G	C	
Suwannee cooter (SSC)	<u>Pseudemys concinna suwanniensis</u>	M				
Florida cooter	<u>Pseudemys floridana floridana</u>	M				V
Florida red-bellied turtle	<u>Pseudemys nelsoni</u>	M				
Yellow-bellied turtle	<u>Pseudemys scripta scripta</u>	M				
Loggerhead musk turtle	<u>Sternotherus minor</u>	M				
Stinkpot	<u>Sternotherus odoratus</u>	M				
Eastern box turtle	<u>Terrapene carolina</u>	M		G	C	
Gulf coast box turtle	<u>Terrapene c. major</u>		D	G	C	V
Florida softshell	<u>Trionyx ferox</u>	M			C	V
Gulf coast softshell	<u>Trionyx spiniferus</u>	M				

Crocodilians

American alligator (SSC)	<u>Alligator mississippiensis</u>	M	D	G	C	V

Checklist of Amphibians and Reptiles of the Apalachicola Basin (cont.)

Lizards

Green anole	Anolis carolinensis	M	D	G	C	V
Six-lined racerunner	Cnemidophorus sexlineatus sexlineatus	M	D	G	C	V
Coal skink	Eumeces anthracinus	M				
Southern coal skink	Eumeces a. pluvialis	M				
Mole skink	Eumeces egregius	M				
Five-lined skink	Eumeces fasciatus	M			C	
Southeastern five-lined skink	Eumeces inexpectatus	M				
Broadhead skink	Eumeces laticeps	M		G	C	V
Slender glass lizard	Ophisaurus attenuatus	M				
Island glass lizard	Ophisaurus compressus	M		G	C	
Eastern glass lizard	Ophisaurus ventralis	M		G	C	V
Eastern fence lizard	Sceloporus undulatus	M				
Ground skink	Scincella lateralis	M		G	C	

Snakes

Copperhead	Agkistrodon contortrix	M				
Cottonmouth	Agkistrodon piscivorus	M		G		
Florida cottonmouth	Agkistrodon p. conanti		D	G	C	V
Scarlet snake	Cemophora coccinea	M		G	C	
Northern scarlet snake	Cemophora c. copei					V
Black racer	Coluber constrictor	M		G		
Brownchin racer	Coluber c. helvigularis	M	D	G		V
Southern black racer	Coluber c. priapus					V
Eastern diamondback rattlesnake	Crotalus adamanteus	M	D	G	C	V
Ringneck snake	Diadophis punctatus	M				
Indigo snake (T)	Drymarchon corais	M				
Eastern indigo snake (T)	Drymarchon c. couperi					V
Corn snake	Elaphe guttata	M	D	G		
Corn snake	Elaphe g. guttata		D	G		V
Rat snake	Elaphe obsoleta	M				V
Gray rat snake	Elaphe o. spiloides					V
Mud snake	Farancia abacura	M				
Eastern mud snake	Farancia a. abacura					V
Rainbow snake	Farancia erytrogramma	M				
Eastern hognose snake	Heterodon platyrhinos	M				
Southern hognose snake	Heterodon simus	M				
Mole snake	Lampropeltis calligaster rhombomaculata	M				
Common kingsnake	Lampropeltis getulus	M				
Apalachicola kingsnake	Lampropeltis getul n. subspecies	M				

Checklist of Amphibians and Reptiles of the Apalachicola Basin (cont.)

Scarlet kingsnake	*Lampropeltis triangulum elapsoides*	M				
Coachwhip	*Masticophis flagellum*	M		G		
Eastern coachwhip	*Masticophis f. flagellum*		D	G		V
Eastern coral snake	*Micrurus fulvius*	M				
Green water snake	*Nerodia cyclopion*	M				
Florida green water snake	*Nerodia c. floridana*					V
Red-bellied water snake	*Nerodia erythrogaster erythrogaster*	M				
Southern water snake	*Nerodia fasciata*		D	G		V
Gulf salt marsh snake	*Nerodia f. clarkii*			G		
Banded water snake	*Nerodia f. fasciata*	M		G	C	
Brown water snake	*Nerodia taxispilota*	M				
Rough green snake	*Opheodrys aestivus*	M		G		V
Pine snake (SSC)	*Pituophis melanoleucus*	M				
Glossy water snake	*Regina rigida*	M				
Queen snake	*Regina septemvittata*	M				
Pine woods snake	*Rhadinaea flavilata*	M				
Black swamp snake	*Seminatrix pygaea*	M				
North Florida swamp snake	*Seminatrix p. pygaea*					V
Pygmy rattlesnake	*Sistrurus miliarius*	M				
Dusky pygmy rattlesnake	*Sistrurus m. barbouri*					V
Brown snake	*Storeria dekayi*	M				
Midland Brown snake	*Storeria d. wrightorum*					V
Red-bellied snake	*Storeria occipitomaculata*	M				
Southeastern crowned snake	*Tantilla coronata*	M				
Eastern ribbon snake	*Thamnophis sauritus*	M	D	G	C	V
Common garter snake	*Thamnophis sirtalis*	M		G		V
Eastern garter snake	*Thamnophis s. sirtalis*					V
Rough earth snake	*Virginia striatula*	M				V
Smooth earth snake	*Virginia valeriae*	M				

Sources: Blaney, 1971; Livingston et al, 1975; Means, 1977; U.S. Dept. of Commerce and DER, 1979; Dog Island Conservation District, 1981; Collins et al, 1982; Leonard and Baker, 1982; DNR, 1983; Christman, 1984; FGFWFC, 1987.

Checklist of Birds of the Apalachicola Basin

Red-throated loon	*Gavia stellata*			G	C	
Common loon	*Gavia immer*		D	G	C	
Pied-billed grebe	*Podilymbus podiceps*	M	D	G	C	V
Horned grebe	*Podiceps auritus*		D	G	C	V
Red-necked grebe	*Podiceps grisegena*	M		G		
Brown booby	*Sula leucogaster*					V
Northern gannet	*Sula bassanus*			G	C	V
American white pelican	*Pelecanus erythrorhynchos*		D		C	V
Brown pelican (SSC)	*Pelecanus occidentalis*	M	D	G	C	V
Double-crested cormorant	*Phalacrocorax auritus*	M	D	G	C	V
Anhinga	*Anhinga anhinga*	M			C	V
Magnificent frigatebird	*Fregata magnificens*			G	C	V
American bittern	*Botaurus lentiginosus*	M	D	G	C	V
Least bittern	*Ixobrychus exilis*	M	D	G	C	V
Great blue heron	*Ardea herodias*	M	D	G	C	V
Great egret	*Casmerodius albus*	M	D	G	C	V
Snowy egret (SSC)	*Egretta thula*	M	D	G	C	V
Little blue heron (SSC)	*Egretta caerulea*	M	D	G	C	V
Tricolored heron (SSC)	*Egretta tricolor*	M	D	G	C	V
Reddish egret (SSC)	*Egretta rufescens*		D			
Cattle egret	*Bubulcus ibis*	M	D	G	C	V
Green-backed heron	*Butorides striatus*	M	D	G	C	V
Black-crowned night-heron	*Nycticorax nycticorax*	M	D	G	C	V
Yellow-crowned night-heron	*Nycticorax violaceus*	M		G	C	V
White ibis	*Eudocimus albus*	M		G	C	V
Wood stork (E)	*Mycteria americana*	M			C	V
Fulvous whistling-duck	*Dendrocygna bicolor*			G		
Snow goose	*Chen caerulescens*	M			C	V
Canada goose	*Branta canadensis*	M		G	C	V
Wood duck	*Aix sponsa*	M	D	G	C	V
Green-winged teal	*Anas crecca*	M	D		C	V
American black duck	*Anas rubripes*	M	D	G	C	V
Mottled duck	*Anas fulvigula*			G	C	V
Mallard	*Anas platyrhynchos*	M	D	G	C	V
Northern pintail	*Anas acuta*		D	G	C	V
Blue-winged teal	*Anas discors*	M	D	G	C	V
Northern shoveler	*Anas clypeata*	M		G	C	V
Gadwall	*Anas strepera*	M		G	C	V
American wigeon	*Anas americana*	M	D	G	C	V
Canvasback	*Aythya valisineria*			G	C	V
Redhead	*Aythya americana*	M	D	G	C	V
Ring-necked duck	*Aythya collaris*	M		G	C	V
Greater scaup	*Aythya marila*	M	D	G	C	V
Lesser scaup	*Aythya affinis*	M	D	G	C	V
Oldsquaw	*Clangula hyemalis*			G		
Black scoter	*Melanitta nigra*			G		

Checklist of Birds of the Apalachicola Basin (cont.)

Surf scoter	*Melanitta perspicillata*			G		
White-winged scoter	*Melanitta fusca*			G		
Common goldeneye	*Bucephala clangula*			G	C	V
Bufflehead	*Bucephala albeola*	M	D	G	C	V
Hooded merganser	*Lophodytes cucullatus*	M	D	G	C	V
Red-breasted merganser	*Mergus serrator*		D	G	C	V
Ruddy duck	*Oxyura jamaicensis*	M		G	C	V
Black vulture	*Coragyps atratus*	M			C	V
Turkey vulture	*Cathartes aura*	M	D	G	C	V
Osprey	*Pandion haliaetus*	M	D	G	C	V
American swallow-tailed kite	*Elanoides forficatus*	M	D	G	C	V
Mississippi kite	*Ictinia mississippiensis*	M				
Bald eagle (T)	*Haliaeetus leucocephalus*	M	D	G	C	V
Northern harrier	*Circus cyaneus*	M	D	G	C	V
Sharp-shinned hawk	*Accipiter striatus*	M		G	C	V
Cooper's hawk	*Accipiter cooperii*	M	D	G	C	
Red-shouldered hawk	*Buteo lineatus*	M	D	G	C	V
Broad-winged hawk	*Buteo platypterus*	M			C	V
Short-tailed hawk	*Buteo brachyurus*	M				
Red-tailed hawk	*Buteo jamaicensis*	M	D	G	C	V
Rough-legged hawk	*Buteo lagopus*		D			
Golden eagle	*Aquila chrysaetos*					V
American kestrel	*Falco sparverius*	M	D	G	C	
Southeastern kestrel (T)	*Falco sparverius paulus*	M				
Merlin	*Falco columbarius*	M	D	G	C	V
Peregrine falcon (E)	*Falco peregrinus*		D	G	C	V
Wild turkey	*Meleagris gallopavo*	M				V
Northern bobwhite	*Colinus virginianus*	M		G		V
Black rail	*Laterallus jamaicensis*	M		G	C	V
Clapper rail	*Rallus longirostris*		D	G	C	V
Florida clapper rail	*Rallus l. scotti*	M				
King rail	*Rallus elegans*	M		G	C	
Virginia rail	*Rallus limicola*	M		G	C	
Sora	*Porzana carolina*	M	D	G	C	V
Purple gallinule	*Porphyrula martinica*	M			C	V
Common moorhen	*Gallinula chloropus*	M			C	V
American coot	*Fulica americana*	M	D	G	C	V
Limpkin (SSC)	*Aramus guarauna*	M				
Sandhill crane	*Grus canadensis*	M				
Florida sandhill crane (T)	*Grus c. pratensis*	M				
Black-bellied plover	*Pluvialis squatarola*		D	G	C	V
Lesser Golden-plover	*Pluvialis dominica*			G		
Snowy plover	*Charadrius alexandrinus*			G	C	V
Southeastern snowy plover (T)	*Charadrius a. tenuirostris*	M				
Wilson's plover	*Charadrius wilsonia*		D	G	C	V
Semipalmated plover	*Charadrius semiplamatus*	M	D	G	C	V

Checklist of Birds of the Apalachicola Basin (cont.)

Piping plover (T)	Charadrius melodus		D	G	C	V
Killdeer	Charadrius vociferus	M	D	G	C	V
Mountain plover	Charadrius montanus			G		
American oystercatcher (SSC)	Haematopus palliatus		D	G	C	V
Black-necked stilt	Himantopus mexicanus			G		
American avocet	Recurvirostra americana			G		
Greater yellowlegs	Tringa melanoleuca		D	G	C	V
Lesser yellowlegs	Tringa flavipes	M	D	G	C	V
Solitary sandpiper	Tringa solitaria	M		G	C	V
Willet	Catoptrophorus semipalmatus		D	G	C	V
Spotted sandpiper	Actitis macularia	M	D	G	C	V
Upland sandpiper	Bartramia longicauda	M				
Whimbrel	Numenius phaeopus		D	G		
Long-billed curlew	Numenius americanus			G	C	
Marbled godwit	Limosa fedoa		D	G		
Ruddy turnstone	Arenaria interpres		D	G	C	V
Red knot	Calidris canutus		D	G	C	V
Sanderling	Calidris alba		D	G	C	V
Semipalmated sandpiper	Calidris pusilla		D	G	C	V
Western sandpiper	Calidris mauri		D	G	C	V
Least sandpiper	Calidris minutilla	M	D	G	C	V
White-rumped sandpiper	Calidris fuscicollis			G		
Baird's sandpiper	Calidris bairdii			G		
Pectoral sandpiper	Calidris melanotos	M		G	C	
Dunlin	Calidris alpina		D	G	C	V
Buff-breasted sandpiper	Tryngites subruficollis			G		
Short-billed dowitcher	Limnodromus griseus		D	G	C	V
Common snipe	Gallinago gallinago	M	D	G	C	V
American woodcock	Scolopax minor	M		G	C	
Wilson's phalarope	Phalaropus tricolor			G		
Parasitic jaeger	Stercorarius parasiticus		D	G		
Laughing gull	Larus atricilla	M	D	G	C	V
Franklin's gull	Larus pipixcan				C	V
Bonaparte's gull	Larus philadelphia	M	D	G	C	V
Ring-billed gull	Larus delawarensis	M	D	G	C	V
Herring gull	Larus argentatus	M	D	G	C	V
Lesser black-backed gull	Larus fuscus			G		
Great black-backed gull	Larus marinus			G		
Gull-billed tern	Sterna nilotica			G	C	V
Caspian tern	Sterna caspia		D	G	C	V
Royal tern	Sterna maxima		D	G	C	V
Sandwich tern	Sterna sandvicensis		D	G	C	V
Common tern	Sterna hirundo		D	G	C	V
Arctic tern	Sterna paradisaea			G		
Forster's tern	Sterna forsteri	M	D	G	C	V
Least tern (T)	Sterna antillarum				C	V

Checklist of Birds of the Apalachicola Basin (cont.)

Sooty tern	Sterna fuscata			G		
Black tern	Chlidonias niger		D	G	C	V
Black skimmer	Rynchops niger		D	G	C	V
Razorbill	Alca torda			G		
Rock dove	Columbia livia	M		G		
White-winged dove	Zenaida asiatica		D	G	C	V
Mourning dove	Zenaida macroura	M	D	G	C	V
Common ground-dove	Columbina passerina	M	D	G	C	V
Black-billed cuckoo	Coccyzus erythropthalmus			G	C	
Yellow-billed cuckoo	Coccyzus americanus	M	D	G	C	V
Mangrove cuckoo	Coccyzus minor			G		
Groove-billed ani	Crotophaga sulcirostris			G		
Common barn-owl	Tyto alba	M	D	G	C	V
Eastern screech-owl	Otus asio	M				V
Great horned owl	Bubo virginianus	M			C	V
Barred owl	Strix varia	M				V
Short-eared owl	Asio flammeus			G		
Lesser nighthawk	Chordeiles acutipennis			G		
Common nighthawk	Chordeiles minor	M	D	G	C	V
Chuck-will's widow	Caprimulgus carolinensis	M	D	G	C	V
Whip-poor-will	Caprimulgus vociferus	M		G	C	
Chimney swift	Chaetura pelagica	M	D	G	C	V
Ruby-throated hummingbird	Archilochus colubris	M	D	G	C	V
Belted kingfisher	Ceryle alcyon	M	D	G	C	V
Red-headed woodpecker	Melanerpes erythrocephalus	M	D	G	C	V
Red-bellied woodpecker	Melanerpes carolinus	M	D	G	C	V
Yellow-bellied sapsucker	Sphyrapicus varius	M		G	C	V
Ladder-backed woodpecker	Picoides scalaris		D			
Downy woodpecker	Picoides pubescens	M		G	C	V
Hairy woodpecker	Picoides villosus	M				
Red-cockaded woodpecker (T)	Picoides borealis	M				
Northern flicker	Colaptes auratus	M	D	G	C	V
Pileated woodpecker	Dryocopus pileatus	M				V
Ivory-billed woodpecker (E)	Campephilus principalis	M				
Eastern wood-pewee	Contopus virens	M	D	G	C	
Yellow-bellied flycatcher	Empidonax flaviventris			G		
Acadian flycatcher	Empidonax virescens	M		G		
Willow flycatcher	Empidonax traillii			G		
Least flycatcher	Empidonax minimus			G		
Eastern phoebe	Sayornis phoebe	M	D	G	C	V
Vermilion flycatcher	Pyrocephalus rubinus			G		
Ash-throated flycatcher	Myiarchus cinerascens			G		
Great Crested flycatcher	Myiarchus crinitus	M	D	G	C	V
Western kingbird	Tyrannus verticalis			G		
Eastern kingbird	Tyrannus tyrannus	M	D	G	C	V
Gray kingbird	Tyrannus dominicensis		D	G	C	V

Scissor-tailed flycatcher	Tyrannus forficatus			G		
Purple martin	Progne subis	M	D	G	C	V
Tree swallow	Tachycineta bicolor	M	D	G	C	V
Northern rough-winged swallow	Stelgidopteryx serripennis	M		G	C	V
Bank swallow	Riparia riparia	M		G	C	
Cliff swallow	Hirundo pyrrhonota			G		
Barn swallow	Hirundo rustica	M	D	G	C	V
Blue jay	Cyanocitta cristata	M		G	C	V
American crow	Corvus brachyrhynchos	M	D			
Fish crow	Corvus ossifragus	M	D	G	C	V
Carolina chickadee	Parus carolinensis	M		G	C	V
Tufted titmouse	Parus bicolor	M				
Red-breasted nuthatch	Sitta canadensis	M		G		
White-breasted nuthatch	Sitta carolinensis	M				
Brown-headed nuthatch	Sitta pusilla	M	D	G	C	V
Brown creeper	Certhia americana	M		G	C	V
Rock wren	Salpinctes obsoletus			G		
Carolina wren	Thryothorus ludovicianus	M	D	G	C	V
House wren	Troglodytes aedon	M	D	G	C	V
Winter wren	Troglodytes troglodytes			G		
Sedge wren	Cistothorus platensis	M	D	G	C	V
Marsh wren	Cistothorus palustris	M	D	G	C	V
Marian's marsh wren (SSC)	Cistothorus p. marianae	M				
Golden-crowned kinglet	Regulus satrapa	M		G	C	V
Ruby-crowned kinglet	Regulus calendula	M	D	G	C	V
Blue-gray gnatcatcher	Polioptila caerulea	M	D	G	C	V
Eastern bluebird	Sialia sialis	M	D	G	C	V
Veery	Catharus fuscescens	M		G	C	
Gray-cheeked thrush	Catharus minimus	M	D	G	C	
Swainson's thrush	Catharus ustulatus	M	D	G	C	V
Hermit thrush	Catharus guttatus	M	D	G	C	V
Wood thrush	Hylocichla mustelina	M	D	G	C	
American robin	Turdus migratorius	M	D	G	C	V
Gray catbird	Dumetella carolinensis	M	D	G	C	V
Northern mockingbird	Mimus polyglottos	M	D	G	C	V
Brown thrasher	Toxostoma rufum	M	D	G	C	V
Water pipit	Anthus spinoletta	M		G	C	
Sprague's pipit	Anthus spragueii			G		
Cedar waxwing	Bombycilla cedrorum	M		G	C	V
Loggerhead shrike	Lanius ludovicianus	M	D	G	C	V
European starling	Sturnus vulgaris	M		G		
White-eyed vireo	Vireo griseus	M	D	G	C	V
Bell's vireo	Vireo bellii			G		
Solitary vireo	Vireo solitarius	M		G	C	V
Yellow-throated vireo	Vireo flavifrons	M	D	G	C	
Philadelphia vireo	Vireo philadelphicus		D	G		

Red-eyed vireo	Vireo olivaceus	M		G	C	V
Black-whiskered vireo	Vireo altiloquus			G		
Bachman's warbler (E)	Vermivora bachmanii	M				
Blue-winged warbler	Vermivora pinus	M		G	C	
Golden-winged warbler	Vermivora chrysoptera	M		G		
Tennessee warbler	Vermivora peregrina	M		G	C	
Orange-crowned warbler	Vermivora celata	M	D	G	C	
Nashville warbler	Vermivora ruficapilla			G		
Northern parula	Parula americana	M		G	C	V
Yellow warbler	Dendroica petechia	M	D	G	C	V
Chestnut-sided warbler	Dendroica pensylvanica	M		G	C	
Magnolia warbler	Dendroica magnolia	M	D	G	C	
Cape May warbler	Dendroica tigrina	M	D	G	C	V
Black-throated blue warbler	Dendroica caerulescens	M		G	C	V
Yellow-rumped warbler	Dendroica coronata	M		G	C	V
Black-throated gray warbler	Dendroica nigrescens			G		
Black-throated green warbler	Dendroica virens	M		G	C	V
Blackburnian warbler	Dendroica fusca	M		G	C	
Yellow-throated warbler	Dendroica dominica	M		G	C	V
Stoddard's yellow-throated warbler	Dendroica d. stoddardi	M				
Pine warbler	Dendroica pinus	M	D	G	C	V
Prairie warbler	Dendroica discolor	M		G	C	
Palm warbler	Dendroica palmarum	M	D	G	C	V
Bay-breasted warbler	Dendroica castanea	M	D	G	C	V
Blackpoll warbler	Dendroica striata	M		G	C	
Cerulean warbler	Dendroica cerulea	M		G		
Black-and-white warbler	Mniotilta varia	M	D	G	C	V
American redstart	Setophaga ruticilla		D	G	C	
Prothonotary warbler	Protonotaria citrea	M	D	G	C	V
Worm-eating warbler	Helmitheros vermivorus	M		G	C	
Swainson's warbler	Limnothlypis swainsonii	M				
Ovenbird	Seiurus aurocapillus	M		G	C	
Northern waterthrush	Seiurus noveboracensis	M		G	C	V
Louisiana waterthrush	Seiurus motacilla	M		G	C	
Kentucky warbler	Oporornis formosus	M		G	C	
Connecticut warbler	Oporornis agilis	M		G		
Common yellowthroat	Geothlypis trichas	M	D	G	C	V
Hooded warbler	Wilsonia citrina	M	D	G	C	
Wilson's warbler	Wilsonia pusilla	M				
Canada warbler	Wilsonia canadensis			G		
Yellow-breasted chat	Icteria virens	M		G	C	V
Summer tanager	Piranga rubra	M	D	G	C	V
Scarlet tanager	Piranga olivacea	M		G	C	
Western tanger	Piranga ludoviciana			G		
Northern cardinal	Cardinalis cardinalis	M	D	G	C	V
Rose-breasted grosbeak	Pheucticus ludovicianus	M	D	G	C	

Checklist of Birds of the Apalachicola Basin (cont.)

Blue grosbeak	*Guiraca caerulea*	M	D	G	C	
Indigo bunting	*Passerina cyanea*	M	D	G	C	V
Painted bunting	*Passerina ciris*	M		G	C	V
Dickcissel	*Spiza americana*			G		
Rufous-sided towhee	*Pipilo erythrophthalmus*	M	D	G	C	V
Bachman's sparrow	*Aimophila aestivalis*	M		G		
Chipping sparrow	*Spizella passerina*	M	D	G	C	V
Clay-colored sparrow	*Spizella pallida*			G		
Field sparrow	*Spizella pusilla*	M	D	G	C	
Vesper sparrow	*Pooecetes gramineus*	M		G		V
Lark sparrow	*Chondestes grammacus*			G		
Savannah sparrow	*Passerculus sandwichensis*	M	D	G	C	V
Grasshopper sparrow	*Ammodramus savannarum*	M		G	C	
Sharp-tailed sparrow	*Ammodramus caudacutus*	M	D	G	C	
Seaside sparrow	*Ammodramus maritimus*	M	D	G	C	V
Wakulla seaside sparrow (SSC)	*Ammodramus m. junciolus*	M				
Fox sparrow	*Passerella iliaca*			G		
Song sparrow	*Melospiza melodia*	M	D	G	C	V
Lincoln's sparrow	*Melospiza lincolnii*			G		
Swamp sparrow	*Melospiza georgiana*	M	D	G	C	V
White-throated sparrow	*Zonotrichia albicollis*	M	D	G	C	V
White-crowned sparrow	*Zonotrichia leucophrys*				C	V
Dark-eyed junco	*Junco hyemalis*	M		G	C	
Snow bunting	*Plectrophenax nivalis*			G		
Bobolink	*Dolichonyx oryzivorus*	M	D	G	C	V
Red-winged blackbird	*Agelaius phoeniceus*	M	D	G	C	V
Eastern meadowlark	*Sturnella magna*	M	D	G	C	V
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*			G		
Rusty blackbird	*Euphagus carolinus*	M		G	C	
Brewer's blackbird	*Euphagus cyanocephalus*		D			
Boat-tailed grackle	*Quiscalus major*	M	D	G	C	V
Common grackle	*Quiscalus quiscula*	M		G	C	V
Brown-headed cowbird	*Molothrus ater*	M	D	G	C	V
Orchard oriole	*Icterus spurius*	M	D	G	C	V
Northern oriole	*Icterus galbula*	M	D	G	C	
Purple finch	*Carpodacus purpureus*	M				
Pine siskin	*Carduelis pinus*	M		G		
American goldfinch	*Carduelis tristis*	M	D	G	C	V
House sparrow	*Passer domesticus*	M				

Sources: Livingston et al, 1975; Means, 1977; Stevenson, 1977; U.S. Dept. of Commerce and DER, 1979; St. Vincent National Wildlife Refuge, 1980; Dog Island Conservation District, 1981; Leonard and Baker, 1982; DNR, 1983; Christman, 1984; FGFWFC, 1985; Russell, 1985; Cole, 1986; FGFWFC, 1987.

Checklist of Fishes of the Apalachicola Basin

Gulf of Mexico Sturgeon (SSC)	Acipenser oxyrhynchus desotoi	R		
Diamond killifish	Adinia xenica	R	B	
Mountain mullet	Agonostomus monticola	R		
Alabama shad	Alosa alabamae	R		
Skipjack herring	Alosa chrysochloris	R		
Orange filefish	Aluterus schoepfi		B	
Shadow bass	Ambloplites ariommus	R		
Bowfin	Amia calva	R	B	V
Florida sand darter	Ammocrypta bifascia	R		
Striped anchovy	Anchoa hepsetus		B	
Bay anchovy	Anchoa mitchilli	R	B	
Ocellated flounder	Ancylopsetta quadrocellata		B	
American eel	Anguilla rostrata	R	B	
Pirate perch	Aphredoderus sayanus	R		
Sheepshead	Archosargus probatocephalus	R	B	
Sea catfish	Arius felis	R	B	
Southern stargazer	Astroscopus y-graecum		B	
Gafftopsail catfish	Bagre marinus	R	B	
Silver perch	Bairdiella chrysura	R	B	
Frillfin goby	Bathygobius soporator	R		
Gulf menhaden	Brevoortia patronus	R	B	
Yellow jack	Caranx bartholomaei		B	
Crevalle jack	Caranx hippos		B	
Bull shark	Carcharhinus leucas	R	B	
Blacktip shark	Carcharhinus limbatus		B	
Quillback	Carpiodes cyprinus	R		
Flier	Centrarchus macropterus	R		
Black sea bass	Centropristis melana		B	
Atlantic spadefish	Chaetodipterus faber		B	
Striped burrfish	Chilomycterus schoepfi		B	
Atlantic bumper	Chloroscombrus chrysurus		B	
Sand seatrout	Cynoscion arenarius	R	B	
Spotted seatrout	Cynoscion nebulosus	R	B	
Sheepshead minnow	Cyprinodon variegatus	R	B	
Carp	Cyprinus carpio	R	B	V
Atlantic stingray	Dasyatis sabina	R	B	
Sand perch	Diplectrum formosum		B	
Spottail pinfish	Diplodus holbrooki		B	
Fat sleeper	Dormitator maculatus			V
Gizzard shad	Dorosoma cepedianum	R		
Threadfin shad	Dorosoma petenense	R	B	
Everglades pygmy sunfish	Elassoma evergladei	R		V
Okefenokee pygmy sunfish	Elassoma okefenokee	R		
Banded pygmy sunfish	Elassoma zonatum	R		
Ladyfish	Elops saurus	R	B	
Bluespotted sunfish	Enneacanthus gloriosus	R		

Checklist of Fishes of the Apalachicola Basin (cont.)

Banded sunfish	Enneacanthus obesus	R				
Silverjaw minnow	Ericymba buccata	R				
Creek chubsucker	Erimyzon oblongus	R				
Lake chubsucker	Erimyzon sucetta	R				V
Redfin pickerel	Esox americanus	R				
Chain pickerel	Esox niger	R				
Brown darter	Etheostoma edwini	R				
Swamp darter	Etheostoma fusiforme	R				
Goldstripe darter	Etheostoma parvipinne	R				
Gulf darter	Etheostoma swaini	R				
Banded darter	Etheostoma zonale	R				
Fringed flounder	Etropus crossotus		B			
Spotfin mojarra	Eucinostomus argenteus	R	B			
Silver jenny	Eucinostomus gula	R	B			
Golden topminnow	Fundulus chrysotus	R				V
Banded topminnow	Fundulus cingulatus	R				
Marsh killifish	Fundulus confluentus	R	B			
Gulf killifish	Fundulus grandis	R	B			
Starhead topminnow	Fundulus notti	R				
Blackspotted topminnow	Fundulus olivaceous	R				
Longnose killifish	Fundulus similis	R	B			
Mosquitofish	Gambusia affinis	R		G	C	
Eastern mosquitofish	Gambusia affinis holbrooki					V
Darter goby	Gobionellus boleosoma	R	B			
Sharptail goby	Gobionellus hastatus		B			
Freshwater goby	Gobionellus shufeldti	R				
Naked goby	Gobiosoma bosci	R	B			
Code goby	Gobiosoma robustum	R	B			
Butterfly ray	Gymnura micrura		B			
Scaled sardine	Harengula pensacolae		B			
Least killifish	Heterandria formosa	R			C	V
Lined seahorse	Hippocampus erectus		B			
Clear chub	Hybopsis winchelli	R				
Carolina blenny	Hypsoblennius hentz		B			
Southern brook lamprey	Ichthyomyzon gagei	R				
Snail bullhead	Ictalurus brunneus	R				
White catfish	Ictalurus catus	R	B			
Yellow bullhead	Ictalurus natalis	R	B			
Brown bullhead	Ictalurus nebulosus	R				
Southern brown bullhead	Ictalurus nebulosus marmoratus					V
Channel catfish	Ictalurus punctatus	R				
Spotted bullhead	Ictalurus serracanthus	R				
Brook silverside	Labidesthes sicculus	R				
Scrawled cowfish	Lactophrys quadricornis		B			
Pinfish	Lagodon rhomboides	R	B			
Spot	Leiostomus xanthurus	R	B			

Checklist of Fishes of the Apalachicola Basin (cont.)

Spotted gar	Lepisosteus oculatus	R			V
Longnose gar	Lepisosteus osseus	R	B		
Florida spotted gar	Lepisosteus platyrhincus	R			
Redbreast sunfish	Lepomis auritus	R			
Green sunfish	Lepomis cyanellus	R			
Warmouth	Lepomis gulosus	R		C	V
Orangespotted sunfish	Lepomis humilis	R			
Bluegill	Lepomis macrochirus	R		C	V
Dollar sunfish	Lepomis marginatus	R			
Redear sunfish	Lepomis microlophus	R	B		V
Spotted sunfish	Lepomis punctatus	R	B		
Pygmy killifish	Leptolucania ommata	R			V
Bluefin killifish	Lucania goodei	R	B		
Rainwater killifish	Lucania parva	R	B		
Gray snapper	Lutjanus griseus	R	B		
Tarpon	Megalops atlantica	R	B		
Rough silverside	Membras martinica	R			
Tidewater silverside	Menidia beryllina	R	B		V
Southern kingfish	Menticirrhus americanus		B		
Northern kingfish	Menticirrhus saxatilis		B		
Clown goby	Microgobius gulosus	R	B		
Green goby	Microgobius thalassinus		B		
Atlantic croaker	Micropogonias undulatus	R	B		
Shoal bass (SSC)	Micropterus coosae	R			
Spotted bass	Micropterus punctulatus	R			
Largemouth bass	Micropterus salmoides	R	B	C	V
Spotted sucker	Minytrema melanops	R			
Fringed filefish	Monacanthus ciliatus	B			
Planehead filefish	Monacanthus hispidus		B		
White bass	Morone chrysops	R			
Sunshine bass	Morone hybrid	R			
Striped bass	Morone saxatilis	R			
Grayfin redhorse	Moxostoma sp.	R			
Striped mullet	Mugil cephalus	R	B		V
White mullet	Mugil curema	R	B		
Speckled worm eel	Myrophis punctatus	R	B		
Golden shiner	Notemigonus crysoleucas	R	B		
Bluestripe shiner (SSC)	Notropis callitaenia	R			
Ironcolor shiner	Notropis chalybaeus	R			
Dusky shiner	Notropis cummingsae	R			
Pugnose minnow	Notropis emiliae	R			
Redeye chub	Notropis harperi	R			
Sailfin shiner	Notropis hypselopterus	R			
Highscale shiner	Notropis hysilepis	R			
Bannerfin shiner	Notropis leedsi	R			
Longnose shiner	Notropis longirostris	R			

Checklist of Fishes of the Apalachicola Basin (cont.)

Taillight shiner	*Notropis maculatus*	R				
Coastal shiner	*Notropis petersoni*	R				
Flagfin shiner	*Notropis signipinnis*	R				
Weed shiner	*Notropis texanus*	R				
Blacktail shiner	*Notropis venustus*	R				
Bluenose shiner	*Notropis welaka*	R				
Bandfin shiner	*Notropis zonistius*	R				
Black madtom	*Noturus funebris*	R				
Tadpole madtom	*Noturus gyrinus*	R				
Speckled madtom	*Noturus leptacanthus*	R				
Brotula	*Ogilbia cayorum*		B			
Leatherjacket	*Oligoplites saurus*		B			
Shrimp eel	*Ophichthus gomesi*		B			
Bean's cusk eel	*Ophidion beani*		B			
Gulf toad fish	*Opsanus beta*		B			
Pig fish	*Orthopristis chrysoptera*	R	B			
Gulf flounder	*Paralichthys albigutta*		B			
Southern flounder	*Paralichthys lethostigma*	R	B			
Gulf butterfish	*Peprilus burti*		B			
Harvestfish	*Peprilus paru*		B			
Yellow perch	*Perca flavescens*	R				
Blackbanded darter	*Percina nigrofasciata*	R				
Sailfin molly	*Poecilia latipinna*	R	B	G	C	V
Black drum	*Pogonias cromis*	R				
Atlantic threadfin	*Polydactylus octonemus*		B			
Bluefish	*Pomatomus saltatrix*		B			
Black crappie	*Pomoxis nigromaculatus*	R	B			
Atlantic midshipman	*Porichthys porosissimus*		B			
Leopard searobin	*Prionotus scitulus*		B			
Bighead searobin	*Prionotus tribulus*		B			
Flathead catfish	*Pylodictis olivaris*	R				
Cownose ray	*Rhinoptera bonasus*		B			
Spanish sardine	*Sardinella anchovia*		B			
Red drum	*Sciaenops ocellata*	R	B			
Spanish mackerel	*Scomberomorus maculatus*		B			
Look-down	*Selene vomer*		B			
Creek chub	*Semotilus atromaculatus*	R				
Southern puffer	*Sphoeroides nephelus*		B			
Northern barracuda	*Sphyraena borealis*		B			
Bonnethead	*Sphyrna tiburo*		B			
Star drum	*Stellifer lanceolatus*		B			
Sauger	*Stizostedion canadense*	R				
Atlantic needlefish	*Strongylura marina*	R	B			
Blackcheek tonguefish	*Symphurus plagiusa*		B			
Dusky pipefish	*Syngnathus floridae*	R	B			
Chain pipefish	*Syngnathus louisianae*		B			

Gulf pipefish	*Syngnathus scovelli*	R	B
Inshore lizardfish	*Synodus foetens*		B
Hogchoker	*Trinectes maculatus*	R	B
Southern hake	*Urophycis floridanus*		B

Sources: Breder, 1948; Eddy, 1969; Livingston et al, 1975; Hoese and Moore, 1977; Livingston et al, 1977; Yerger, 1977; COE, 1978; McClane, 1978; U.S. Dept. of Commerce and DER, 1979; Bass, 1983; DNR, 1983; Ager et al, 1984; Christman, 1984; Livingston, 1984; Ager et al, 1985; FGFWFC, 1987.

Checklist of Important Macroinvertebrates of the Apalachicola Basin
(those mentioned in the text)

Crustaceans

Blue crab	Callinectes sapidus		B
Crawfish	Cambarus sp.	R	
Crawfish	Cambarus striatus	R	
Crawfish	Cambarus diogenes	R	
Amphipod	Corophium louisianum		B
Crawfish	Faxonella clypeata	R	
Amphipod	Gitanopsis spp.		B
Amphipod	Gammarus spp.		B
Stone crab	Menippe mercenaria		B
Amphipod	Melita spp.		B
Isopod	Munna reynoldsi		B
Mysid	Mysidopsis spp.		B
Mud crab	Neopanope texana		B
Ghost crab	Ocypode quadrata		B
Grass shrimp	Palaemonetes spp.		B
Brown shrimp	Penaeus aztecus		B
Pink shrimp	Penaeus duorarum		B
White shrimp	Penaeus setiferus		B
Flat crab	Petrolisthes armatus		B
Crawfish	Procambarus acutus	R	
Crawfish	Procambarus howellae	R	
Crawfish	Procambarus paeninsulanus	R	

Molluscs

Mussel	Brachidontes spp.		B
Asiatic clam	Corbicula manilensis	R	
American oyster	Crassotrea virginica		B
Boring clam	Martesia smithi		B
Crown conch	Melongena corona		B
Snail	Neritina reclivata		B
Snail	Odostomia impressa		B
Horse oyster	Ostrea equestris		B
Apple snail	Pomacea paludosa	R	
Southern oyster drill	Thais haemastoma		B

Miscellaneous

Boring sponge	Cliona spp.		B
Flatworm (oyster leech)	Stylochus frontalis		B
Mudworm	Polydora websteri		B

Checklist of Mammals of the Apalachicola Basin

Opossum	Didelphis virginiana	M		C	V
Southeastern shrew	Sorex longirostris	M			
Short-tailed shrew	Blarina brevicauda	M			
Least shrew	Cryptotis parva	M			
Eastern mole	Scalopus aquaticus	M	G		V
Southeastern brown bat	Myotis austroriparius	M			
Indiana bat (E)	Myotis sodalis	M			
Gray bat (E)	Myotis grisescens	M			
Keen's myotis	Myotis keeni	M			
Eastern pipistrelle	Pipistrellus subflavus	M			
Big brown bat	Eptesicus fuscus	M			
Red bat	Lasiurus borealis	M			
Seminole bat	Lasiurus seminolus	M			
Hoary bat	Lasiurus cinereus	M			
Northern yellow bat	Lasiurus intermedius	M			V
Evening bat	Nycticeius humeralis	M			
Rafinesque's big-eared bat	Plecotus rafinesquii	M			
Brazilian free-tailed bat	Tadarida brasiliensis	M			
Nine-banded armadillo	Dasypus novemcinctus	M			
Marsh rabbit	Sylvilagus palustris	M			
Eastern cottontail	Sylvilagus floridanus	M			
Gray squirrel	Sciurus carolinensis	M	G	C	V
Fox squirrel	Sciurus niger	M			
Southern flying squirrel	Glaucomys volans	M			
Southeastern pocket gopher	Geomys pinetus	M			
American beaver	Castor canadensis	M			
Marsh rice rat	Oryzomys palustris	M			V
Eastern harvest mouse	Reithrodontomys humulis	M			
Oldfield mouse	Peromyscus polionotus	M			
Cotton mouse	Peromyscus gossypinus	M	G		V
Golden mouse	Ochrotomys nuttalli	M			
Hispid cotton rat	Sigmodon hispidus	M	G	C	V
Eastern woodrat	Neotoma floridana	M			
Woodland vole	Microtus pinetorum	M			
Round-tailed muskrat	Neofiber alleni	M			
Black rat	Rattus rattus	M			
Norway rat	Rattus norvegicus	M			
House mouse	Mus musculus	M			
Red fox	Vulpes vulpes	M			
Gray fox	Urocyon cinereoargenteus	M			
Florida black bear (T)	Ursus americanus floridanus	M			
Raccoon	Procyon lotor	M	G	C	V
Long-tailed weasel	Mustela frenata	M			
Mink	Mustela vison	M			
Eastern spotted skunk	Spilogale putorius	M			
Striped skunk	Mephitis mephitis	M			

Checklist of Mammals of the Apalachicola Basin (cont.)

River otter	*Lutra canadensis*	M				V
Florida panther (E)	*Felis concolor coryi*	M				
Bobcat	*Lynx rufus*	M	D			
White-tailed deer	*Odocoileus virginianus*	M				V
Sambar deer	*Cervus unicolor*					V
Feral pig	*Sus scrofa*	M			C	V
West Indian manatee (E)	*Trichechus manatus latirostris*	R	B			
Atlantic bottle-nosed dolphin	*Tursiops truncatus*		B			

Sources: Livingston et al, 1975; Means, 1977; U.S. Dept. of Commerce and DER, 1979; DNR, 1983; Christman, 1984; ANERR, 1986; FGFWFC, 1987.

Checklist of Plants of the Apalachicola Basin

	Acacia farnesiana					V
Three-seeded mercury	Acalypha gracilens	M		G	C	V
Three-seeded mercury	Acalypha rhomboidea	M				V
	Acanthospermum hispidum		D			
Box-elder	Acer negundo	M				
Red maple	Acer rubrum	M		G	C	V
Silver maple	Acer saccharinum	M				
Sugar maple	Acer saccharum	M				
Florida maple	Acer saccharum ssp. floridanum	M				
	Acmella repens	M				
Water-hemp	Acnida cannabinus					V
Baneberry (T)	Actaea pachypoda	M				
Southern maidenhair fern (E)	Adiantum capillus-veneris	M				
	Aeschynomene americana	M				
	Aeschynomene indica			G		
	Aeschynomene viscidula	M	D			V
Red buckeye	Aesculus pavia	M				
Gerardia	Agalinis aphylla					V
Gerardia	Agalinis divaricata	M				V
Gerardia	Agalinis fasciculata	M	D	G	C	
Gerardia	Agalinis filifolia		D		C	V
Gerardia	Agalinis maritima		D		C	V
Gerardia	Agalinis pinetorum	M	D	G		V
Gerardia	Agalinis purpurea		D			
Gerardia	Agalinis setacea					V
Autumn bentgrass	Agrostis perennans	M				
Mimosa, Silktree	Albizia julibrissin	M	D		C	
Yellow colic-root	Aletris lutea	M				
White colic-root	Aletris obovata	M				
Wild onion	Allium canadense	M		G		
	Allium inodorum				C	
Hazel alder	Alnus serrulata	M	D		C	
Alligator-weed	Alternanthera philoxeroides	M			C	V
Chaff-flower	Alternanthera sessilis	M				
	Alysicarpus vaginalis			G		
Southern water hemp	Amaranthus australis	M	D	G	C	V
	Amaranthus tuberculatus					V
	Amaranthus viridis		D	G		
Common ragweed	Ambrosia artemisiifolia	M	D	G	C	V
Scarlet ammannia	Ammannia coccinea	M				V
Toothcups	Ammannia latifolia		D	G	C	V
False-indigo	Amorpha fruticosa	M		G		V
	Amorpha herbacea					V
Pepper-vine	Ampelopsis arborea	M		G	C	V
	Ampelopsis cordata	M				
	Amphicarpum muhlenbergianum		D	G	C	

Texas-star	*Amsonia tabernaemontana*	M				
Chaffweed	*Anagallis minima*		D	G		V
Bushy beardgrass	*Andropogon glomeratus*	M				V
Bushy beardgrass	*Andropogon glomeratus* var. *glaucopsis*					V
Bushy beardgrass	*Andropogon glomeratus* var. *pumilus*		D	G	C	V
Beardgrass	*Andropogon gyrans*					V
Beardgrass	*Andropogon gyrans* var. *stenophylla*	M				
Beardgrass	*Andropogon longiberbis*	M				
Broomsedge	*Andropogon virginicus*	M	D	G	C	V
Broomsedge	*Andropogon virginicus* var. *glaucus*	M	D	G	C	V
Rue anemone (T)	*Anemonella thalictroides*	M				
	Angelica dentata	M				
Purple silkyscale	*Anthaenantia rufa*	M				
Green silkyscale	*Anthaenantia villosa*	M				
Ground nut	*Apios americana*	M				
Wild celery	*Apium graveolens*			G		
Marsh parsley	*Apium leptophyllum*	M	D	G		
Dogbane, Indian hemp	*Apocynum cannabinum*	M				V
Columbine (E)	*Aquilegia canadensis*	M				
	Arabis canadensis	M				
Devils-walkingstick	*Aralia spinosa*	M				
Sandwort	*Arenaria lanuginosa*					V
Thyme-leaved sandwort	*Arenaria serpyllifolia*		D	G		
Carolina poppy	*Argemone albiflora*		D			
Green dragon	*Arisaema dracontium*	M				
Big threeawn	*Aristida condensata*					V
	Aristida gyrans					V
Mohr's threeawn	*Aristida mohrii*					V
Tall threeawn	*Aristida patula*					V
Arrowfeather	*Aristida purpurescens*		D	G	C	V
Bottlebrush threeawn	*Aristida spiciformis*		D	G	C	V
Wiregrass, Pineland threeawn	*Aristida stricta*	M				
Snake root	*Aristolochia serpentaria*	M				
Pipevine (T)	*Aristolochia tomentosa*	M				
Leopard's-bane	*Arnica acaulis*	M				
Indian plantain	*Arnoglossum atriplicifolium*	M				
Indian plantain	*Arnoglossum diversifolium*	M				
Indian plantain	*Arnoglossum ovatum*	M				
Red chokeberry	*Aronia arbutifolia*	M		G		V
Cane	*Arundinaria gigantea*	M				
	Arundinaria tecta	M				
Milkweed	*Asclepias cinerea*	M				

		M	D	G	C	V
Milkweed	Asclepias lanceolata	M				V
Milkweed	Asclepias pedicellata		D			
Milkweed	Asclepias perennis	M				
Milkweed	Asclepias viridiflora	M				
Southern milkweed (T)	Asclepias viridula	M				
	Asimina longifolia var. spathulata	M				
Small-fruited pawpaw	Asimina parviflora	M				
Ebony spleenwort (T)	Asplenium platyneuron	M				V
Blackstem spleenwort (T)	Asplenium resiliens	M				
	Aster adnatus	M				
Climbing aster	Aster carolinianus	M				
	Aster chapmanii	M				V
	Aster concolor	M				
	Aster dumosus	M				V
	Aster eryngiifolius	M				
Starved aster	Aster lateriflorus	M				
	Aster puniceus ssp. elliottii	M				
	Aster shortii	M				
Pinewoods aster (T)	Aster spinulosus	M				
	Aster subulatus	M		G	C	V
Perennial salt marsh aster	Aster tenuifolius	M	D	G	C	V
White-topped aster	Aster tortifolius	M				V
	Aster vimineus	M				
Seabeach orach	Atriplex pentandra		D	G	C	V
Yellow foxglove	Aureolaria flava	M				
	Aureolaria pedicularia	M				V
Black mangrove	Avicennia germinans		D			
Common carpetgrass	Axonopus affinis	M				V
Big carpetgrass	Axonopus furcatus	M				
Mosquito fern, Water fern (T)	Azolla caroliniana	M				
False willow	Baccharis angustifolia		D	G	C	V
Groundsel tree	Baccharis glomeruliflora	M	D	G		
Groundsel tree, Sea myrtle	Baccharis halimifolia	M	D	G	C	V
Blue hyssop	Bacopa caroliniana	M				
Water hyssop	Bacopa monnieri	M	D	G	C	V
	Balduina uniflora	M				
Bamboo	Bambusa multiplex	M				
White wild indigo	Baptisia lactea	M				
Wild indigo	Baptisia lecontei	M				
Apalachicola wild indigo (T)	Baptisia megacarpa	M				
	Bartonia verna		D			V
Saltwort	Batis maritima		D	G	C	V
Rattan vine	Berchemia scandens	M			C	
River birch	Betula nigra	M				
Beggar-ticks	Bidens alba var. radiata	M	D	G		

Spanish needles	Bidens bipinnata	M	D			
	Bidens cernua					V
Beggar-ticks	Bidens discoidea	M				
Beggar-ticks	Bidens frondosa	M				
Wild goldenglow	Bidens laevis					V
Beggar-ticks	Bidens mitis	M			C	
Rayless goldenrod	Bigelowia nudata	M				
Cross-vine	Bignonia capreolata	M				
False nettle, Bog hemp	Boehmeria cylindrica	M		G	C	V
Apalachicola daisy	Boltonia apalachicolensis	M				
	Boltonia asteroides	M				
Doll's daisy, False aster	Boltonia diffusa	M				
Borreria	Borreria laevis	M				
Sea oxeye, Sea daisies	Borrichia frutescens	M	D	G	C	V
Southern grapefern (T)	Botrychium biternatum	M				
	Brassica oleracea var. capitata		D			
Little quaking grass	Briza minor	M				
Rescuegrass, Bromegrass	Bromus unioloides	M	D			
Buckwheat vine	Brunnichia ovata	M				
Bluehart	Buchnera floridana	M	D		C	V
Watergrass	Bulbostylis barbata	M				
	Bulbostylis capillaris	M				V
	Bulbostylis ciliatifolia	M	D		C	V
	Bulbostylis ciliatifolia var. coarctata			G	C	
Black-haw, Gum bumelia	Bumelia lanuginosa	M		G	C	V
Buckthorn (T)	Bumelia lycioides	M				
	Burmannia capitata	M				
Sea rocket	Cakile constricta		D	G	C	V
Sea rocket	Cakile edentula			G	C	V
	Calamintha dentata	M				
American beautyberry	Callicarpa americana	M	D		C	V
Poppy mallow (T)	Callirhoe papaver	M				
Water starwort	Callitriche heterophylla					V
Bearded grass-pink (T)	Calopogon barbatus	M				
Pale grass-pink (T)	Calopogon pallidus	M				
Grass-pink (T)	Calopogon tuberosus	M				V
Sweet-shrub (T)	Calycanthus floridus	M				
Cup-seed	Calycocarpum lyonii	M				
Hedge bindweed	Calystegia sepium	M			C	
Trumpet-vine, Scarlet creeper	Campsis radicans	M				V
	Canavalia maritima					V
Yellow canna	Canna flaccida				C	V
Marijuana	Cannabis sativa	M				
Butter cress	Cardamine hirsuta	M				
Pepper root	Cardamine laciniata	M				

	Cardamine pensylvanica	M	D			
	Cardamine pensylvanica var. brittoniana	M				V
	Carex abscondita	M				
	Carex albolutescens	M	D		C	V
	Carex baltzellii	M				
	Carex caroliniana	M				
	Carex cephalophora	M				
	Carex cherokeensis	M				
	Carex crebriflora	M				
	Carex crus-corvi	M				
	Carex debilis	M				
	Carex fissa var. aristata	M				
	Carex folliculata	M				
	Carex frankii	M				
	Carex glaucescens	M				
	Carex gracilescens	M				
	Carex howei	M				
	Carex hyalinolepis	M				V
	Carex intumescens	M				
	Carex joorii	M				
	Carex louisianica	M				
	Carex lupulina	M				
	Carex lurida	M				V
	Carex physorhyncha	M				
	Carex reniformis			G		
	Carex stipata	M				
	Carex styloflexa	M				
	Carex tribuloides	M				
	Carex turgescens	M				
	Carex verrucosa					V
Deer's tongue, Vanilla plant	Carphephorus odoratissimus	M		G	C	V
	Carphephorus paniculatus	M				
	Carphephorus pseudoliatris	M				
Ironwood, American horn beam	Carpinus caroliniana	M				
Hottentot fig	Carpobrotus edulis		D			
Water hickory	Carya aquatica	M				V
Bitternut hickory	Carya cordiformis	M				
Pignut hickory	Carya glabra	M				V
Pecan	Carya illinoensis					V
Shagbark hickory	Carya ovata					V
Mockernut hickory	Carya tomentosa	M				
Partridge-pea	Cassia fasciculata	M		G	C	V
Wild senna	Cassia marilandica	M				V
Wild sensitive plant	Cassia nictitans	M				
Coffee weed	Cassia obtusifolia	M	D	G		

Catalpa	Catalpa bignonioides	M				
Sugarberry, Hackberry	Celtis laevigata	M				V
Southern sandspur	Cenchrus echinatus		D			
Coast sandspur	Cenchrus incertus		D	G	C	V
Dune sandspur	Cenchrus tribuloides		D	G	C	V
	Centella asiatica	M	D	G	C	V
Butterfly-pea	Centrosema virginianum	M	D			V
Buttonbush	Cephalanthus occidentalis	M	D	G	C	V
Mouse-ear chickweed	Cerastium glomeratum			G		
Rosemary	Ceratiola ericoides	M	D	G	C	V
Hornwort	Ceratophyllum demersum					V
	Ceratophyllum muricatum				C	V
Redbud	Cercis canadensis	M				
	Chaerophyllum procumbens					V
Wild chervil	Chaerophyllum tainturieri		D	G		V
Atlantic white-cedar	Chamaecyparis thyoides	M				
Sand-dune spurge	Chamaesyce ammannioides	M	D	G	C	V
Hairy spurge	Chamaesyce hirta	M				
	Chamaesyce humistrata	M			C	
Eyebane	Chamaesyce hyssopifolia		D	G	C	V
Milk purslane	Chamaesyce maculata	M	D	G		V
Eyebane	Chamaesyce nutans					V
Spikegrass	Chasmanthium latifolium	M				
Spikegrass	Chasmanthium laxum	M				
Spikegrass	Chasmanthium nitidum	M				
Spikegrass	Chasmanthium ornithorhynchum	M				
Spikegrass	Chasmanthium sessiliflorum	M				V
Lamb's quarters	Chenopodium album		D			
Mexican tea	Chenopodium ambrosioides	M	D	G		V
Pitseed goosefoot	Chenopodium berlandieri var. boscianum			G	C	
Fingergrass	Chloris glauca	M			C	V
Fingergrass	Chloris petraea	M	D	G	C	V
Bush goldenrod	Chrysoma pauciflosculosa		D	G	C	V
	Chrysopsis gossypina ssp. gossypina f. decumbens					V
	Chrysopsis gossypina ssp. hyssopifolia	M				
Water hemlock	Cicuta mexicana	M			C	
Camphor tree	Cinnamomum camphora	M	D			
Yellow thistle	Cirsium horridulum	M	D	G	C	V
	Cirsium nuttallii					V
Marine-ivy	Cissus incisa	M				V
Watermelon	Citrullus lanatus		D			
Sawgrass	Cladium jamaicense	M	D	G	C	V
	Cladonia evansii	M		G	C	V

	Cladonia leporina	M		G	C	V
Rosebud orchid (T)	*Cleistes divaricata*					V
Leather-flower	*Clematis crispa*	M				
	Clematis glaucophylla	M				
Leather-flower	*Clematis viorna*	M				
Sweet pepperbush	*Clethra alnifolia*	M				
Black titi	*Cliftonia monophylla*	M				V
Butterfly-pea	*Clitoria mariana*			G	C	V
Tread softly	*Cnidoscolus stimulosus*		D	G	C	V
Coralbeads	*Cocculus carolinus*	M				V
Wild taro	*Colocasia esculenta*	M				
Common dayflower	*Commelina diffusa*	M		G		
Dayflower	*Commelina erecta*	M		G	C	V
Dayflower	*Commelina erecta* var. *angustifolia*		D			
Dayflower	*Commelina virginica*	M				
Mist flower	*Conoclinium coelestinum*	M		G		
Scrub rosemary	*Conradina canescens*	M	D	G	C	V
Apalachicola rosemary (T)	*Conradina glabra*	M				
	Conyza bonariensis	M			C	
Horseweed	*Conyza canadensis*	M	D			
Horseweed	*Conyza canadensis* var. *pusilla*	M		G	C	V
	Coreopsis falcata					V
	Coreopsis gladiata					V
	Coreopsis lanceolata	M			C	V
	Coreopsis linifolia	M				V
Pagoda dogwood (T)	*Cornus alterniflora*	M				
Silky cornel	*Cornus amomum*	M				
Flowering dogwood	*Cornus florida*	M				
Stiff cornel	*Cornus foemina*	M				
Swamp dogwood	*Cornus stricta*	M				
	Corydalis flavula	M				
Harlequin slender fumeroot	*Corydalis micrantha* var. *australis*	M				
Parsley haw	*Crataegus marshallii*	M				
	Crataegus spathulata	M				
Green haw	*Crataegus viridis*	M				
Swamp lily	*Crinum americanum*	M			C	
	Crinum zeylanicum	M				
Few-flowered croomia (E)	*Croomia pauciflora*	M				
Rattle-box	*Crotalaria lanceolata*			G		
Rattle-box	*Crotalaria purshii*	M				
Rabbit-bells	*Crotalaria rotundifolia*	M			C	V
Rabbit-bells	*Crotalaria spectabilis*	M	D	G		
Wooly croton	*Croton capitatus*	M		G		
	Croton elliottii	M				

	Croton glandulosus var. *septentrionalis*	M	D		C	V
Silver-leaf croton, Beach tea	*Croton punctatus*		D		C	V
Honewort (T)	*Cryptotaenia canadensis*	M				
Toothache grass	*Ctenium aromaticum*	M				
Cucumber	*Cucumis sativus*		D			
	Cuphea aspera	M				
Waxweed	*Cuphea carthagenensis*	M	D		C	
Field dodder	*Cuscuta campestris*			G	C	
Compact dodder	*Cuscuta compacta*	M	D			V
Dodder, Love vine	*Cuscuta pentagona*		D		C	
	Cynanchum angustifolium		D	G	C	V
	Cynanchum scoparium					V
Bermudagrass	*Cynodon dactylon*	M	D			V
Wild comfrey	*Cynoglossum virginianum*	M				
	Cyperus aristatus	M				
	Cyperus brevifolius	M				
	Cyperus compressus		D	G		V
	Cyperus croceus	M	D			V
	Cyperus distinctus			G		V
Yellow nut grass, Chufas	*Cyperus esculentus*			G		V
Yellow nut grass, Chufas	*Cyperus esculentus* var. *macrostachyus*		D			
	Cyperus filiculmis				C	
	Cyperus haspan	M	D	G		V
	Cyperus iria	M				
	Cyperus lanceolatus					V
	Cyperus lecontei		D	G	C	
	Cyperus odoratus	M	D		C	V
	Cyperus polystachyos var. *texensis*		D	G	C	V
	Cyperus pseudovegetus	M				
	Cyperus retrorsus	M	D	G	C	V
	Cyperus robustus	M				
Nut grass	*Cyperus rotundus*			G		
	Cyperus sesquiflorus	M				
	Cyperus strigosus	M				
	Cyperus surinamensis	M	D	G		V
	Cyperus tetragonus					V
	Cyperus virens			G		V
Titi, Leatherwood	*Cyrilla racemiflora*	M				
	Cyrilla racemiflora var. *parvifolia*	M				V
Crowfoot grass	*Dactyloctenium aegyptium*		D	G		
Jimsonweed	*Datura stramonium*		D			
Wild carrot	*Daucus pusillus*		D		C	V

Climbing hydrangea, Wood vamp	*Decumaria barbara*	M				
Larkspur	*Delphinium carolinianum*	M				
Tansy mustard	*Descurainia pinnata*		D	G		V
Beggar's lice	*Desmodium ciliare*		D			
Beggar's lice	*Desmodium incanum*	M				
Beggar's lice	*Desmodium lineatum*	M				
Beggar's lice	*Desmodium paniculatum*	M		G	C	V
Beggar's lice	*Desmodium strictum*					V
Beggar's lice	*Desmodium viridiflorum*				C	V
	Dichanthelium aciculare		D	G	C	V
	Dichanthelium acuminatum	M				
	Dichanthelium commutatum	M			C	V
	Dichanthelium dichotomum	M	D		C	
	Dichanthelium erectifolium		D			V
	Dichanthelium oligosanthes					V
	Dichanthelium ovale				C	
	Dichanthelium sabulorum		D	G	C	
	Dichanthelium sphaerocarpon			G	C	
	Dichanthelium tenue	M				
Pony-foot	*Dichondra carolinensis*	M	D	G	C	V
Starrush	*Dichromena colorata*		D	G	C	V
White-tops	*Dichromena latifolia*	M		G		
	Dicliptera brachiata	M				
	Dicliptera halei	M				
Southern crabgrass	*Digitaria ciliaris*	M	D	G	C	V
Pangolagrass	*Digitaria decumbens*		D			
Slender crabgrass	*Digitaria filiformis*	M			C	V
Blanket crabgrass	*Digitaria serotina*	M				V
	Dioclea multiflora	M				
Poor joe, Buttonweed	*Diodia teres*	M	D	G	C	V
Buttonweed	*Diodia virginiana*	M	D	G	C	V
Wild yam	*Dioscorea villosa*	M				
Persimmon	*Diospyros virginiana*	M		G	C	V
Leatherwood	*Dirca palustris*	M				
Saltgrass	*Distichlis spicata*	M	D	G	C	V
Dwarf sundew	*Drosera brevifolia*			G		V
Pink sundew	*Drosera capillaris*	M	D	G	C	V
Dew-threads	*Drosera tracyi*	M				
Mock strawberry	*Duchesnea indica*	M				
Sheathed galingale	*Dulichium arundinaceum*	M				
Purple coneflower	*Echinacea purpurea*	M				
Jungle-rice	*Echinochloa colona*	M		G		
Barnyardgrass	*Echinochloa crusgalli*	M	D	G		V
	Echinochloa muricata	M				
Coastal cockspur	*Echinochloa walteri*		D	G	C	V
Burhead	*Echinodorus cordifolius*	M				

	Eclipta alba	M		G	C	V
Water-hyacinth	Eichhornia crassipes	M				
Silverthorn	Elaeagnus pungens		D			
	Eleocharis acicularis					V
	Eleocharis albida					V
Roadgrass	Eleocharis baldwinii	M		G		
	Eleocharis cellulosa	M	D	G	C	V
	Eleocharis elongata				C	
Knotted spikerush	Eleocharis equisetoides					V
Pale spikerush	Eleocharis flavescens		D		C	V
	Eleocharis geniculata	M	D	G	C	
	Eleocharis interstincta					V
Black spikerush	Eleocharis melanocarpa	M				
	Eleocharis minima					V
	Eleocharis montevidensis	M		G	C	V
	Eleocharis obtusa	M				
	Eleocharis olivacea		D		C	
	Eleocharis parvula		D			
	Eleocharis tortilis	M				
	Eleocharis tuberculosa	M				
	Eleocharis vivipara					V
Elephant's-foot	Elephantopus carolinianus	M				
Florida elephant's-foot	Elephantopus elatus					V
Purple elephant's-foot	Elephantopus nudatus	M				
Goosegrass	Eleusine indica	M	D	G		V
Virginia wild rye	Elymus virginicus	M				V
Pan-american balsamscale	Elyonurus tripsacoides		D	G		V
Green-fly orchid (T)	Epidendrum conopseum	M				
Trailing arbutus (E)	Epigaea repens	M				
Thalia lovegrass	Eragrostis atrovirens	M				V
Bahia lovegrass	Eragrostis bahiensis	M				
Elliott lovegrass	Eragrostis elliottii	M	D	G	C	
Pond lovegrass	Eragrostis glomerata	M				
Bigtop lovegrass	Eragrostis hirsuta		D			
Teal lovegrass	Eragrostis hypnoides	M				
Tufted lovegrass, Carolina lovegrass	Eragrostis pectinacea	M				
Indian lovegrass	Eragrostis pilosa	M				
Coastal lovegrass	Eragrostis refracta	M		G	C	V
Red lovegrass	Eragrostis secundiflora ssp. oxylepis		D	G		V
Purple lovegrass	Eragrostis spectabilis	M	D			V
	Eragrostis tephrosanthos	M				
Fireweed	Erechtites hieracifolia	M	D		C	V
Centipede grass	Eremochloa ophiuroides	M	D	G	C	
Plumegrass	Erianthus brevibarbis	M				V
Sugarcane plumegrass	Erianthus giganteus	M	D	G	C	V

Narrow plumegrass	Erianthus strictus	M				
Southern fleabane	Erigeron quercifolius	M				
White-tops	Erigeron strigosus	M				
	Erigeron vernus	M				V
Hat pins	Eriocaulon compressum		D			
Common pipewort	Eriocaulon decangulare	M				V
Longleaf cupgrass	Eriochloa michauxii					V
	Eryngium baldwinii	M				V
	Eryngium prostratum	M				
Coral bean, Cherokee bean	Erythrina herbacea	M		G	C	V
Dogtooth-violet (T)	Erythronium umbilicatum	M				
Strawberry bush	Euonymus americanus	M				
Burningbust	Euonymus atropurpureus	M				
Dog fennel	Eupatorium capillifolium	M	D	G	C	V
Dog fennel	Eupatorium compositifolium	M	D	G		V
	Eupatorium cuneifolium					V
Dog fennel	Eupatorium leptophyllum		D			
Semaphore eupatorium	Eupatorium mikanioides		D	G	C	V
	Eupatorium mohrii	M	D	G	C	V
Boneset	Eupatorium perfoliatum	M		G		
False hoarhound	Eupatorium rotundifolium	M				V
	Eupatorium rugosum	M				
	Eupatorium semiserratum	M				
	Eupatorium serotinum	M			C	V
	Euphorbia cyathophora					V
	Euphorbia discoidalis	M				
	Euphorbia exserta	M				
	Euphorbia maculata				C	
	Euphorbia telephioides	M				
	Euthamia graminifolia var. hirtipes	M				V
	Euthamia leptocephala			G		V
	Euthamia minor	M	D	G	C	V
	Euthamia tenuifolia			G		V
Buckwheat	Fagopyrum esculentum	M				
American beech	Fagus grandifolia	M				
	Festuca arundinacea		D		C	
	Fimbristylis autumnalis				C	V
	Fimbristylis caroliniana		D	G	C	
	Fimbristylis castanea		D	G	C	V
	Fimbristylis miliacea	M				
	Fimbristylis puberula	M				
	Fimbristylis schoenoides	M				
	Fimbristylis spadicea					V
	Fimbristylis tomentosa	M				
	Fimbristylis vahlii	M				

	Fleischmannia incarnata	M				
Swamp privet	Forestiera acuminata	M				
White ash	Fraxinus americana	M				
Carolina ash	Fraxinus caroliniana	M				
Green ash	Fraxinus pennsylvanica	M				
Pumpkin ash	Fraxinus profunda	M				
Cottonweed	Froelichia floridana		D	G	C	V
Umbrellagrass	Fuirena breviseta	M			C	V
Umbrellagrass	Fuirena longa	M				
Umbrellagrass	Fuirena scirpoidea	M	D	G	C	V
Umbrellagrass	Fuirena squarrosa					V
Ramping fumitory	Fumaria capreolata		D			
Milk-pea	Galactia floridana	M				
Milk-pea	Galactia macreei					V
	Galactia mollis					V
Milk pea	Galactia volubilis	M		G	C	V
Bedstraw, Goosegrass	Galium aparine	M	D	G		
Bedstraw	Galium hispidulum		D	G	C	V
Bedstraw	Galium pilosum var. laevicaule	M				V
Bedstraw	Galium tinctorium	M	D	G	C	V
Southern gaura	Gaura angustifolia		D		C	V
Dwarf huckleberry	Gaylussacia dumosa					V
Dangleberry	Gaylussacia frondosa					V
	Gaylussacia mosieri					V
Yellow jessamine	Gelsemium rankinii	M	D			
	Gelsemium sempervirens	M				
Wiregrass gentian (E)	Gentiana pennelliana	M				
Soapwort gentian	Gentiana saponaria	M				
Cranesbill	Geranium carolinianum	M	D	G		V
Water locust	Gleditsia aquatica	M				
Honey locust	Gleditsia tricanthos	M				
Cudweed	Gnaphalium falcatum	M	D	G		V
Sweet everlasting	Gnaphalium obtusifolium	M	D			V
Rabbit tobacco	Gnaphalium pensilvanicum	M	D		C	V
Purple cudweed	Gnaphalium purpureum		D	G		V
Rabbit tobacco	Gnaphalium spicatum				C	V
Downy rattlesnake plantain	Goodyera pubescens	M				
	Gratiola floridana	M				
	Gratiola hispida		D	G	C	V
	Gratiola pilosa	M				
	Gratiola virginiana	M				
Water spider orchid (T)	Habenaria repens	M				
Silverbells	Halesia carolina	M				
Silverbells	Halesia diptera	M				
Shoal grass	Halodule wrightii	M	D		C	
	Halophila engelmannii	M			C	

Witch hazel	*Hamamelis virginiana*	M				
Scratch daisy	*Haplopappus divaricatus*	M				
Harper's beauty (E)	*Harperocallis flava*	M				
Mock pennyroyal (E)	*Hedeoma graveolens*	M				
	Hedyotis boscii	M				
	Hedyotis corymbosa	M		G		
Innocence	*Hedyotis procumbens*	M		G	C	V
	Hedyotis uniflora		D	G	C	V
Bitterweed	*Helenium amarum*			G		V
Sneezeweed	*Helenium autumnale*	M				
Rockrose	*Helianthemum arenicola*		D			
Rockrose	*Helianthemum carolinianum*				C	V
Rockrose	*Helianthemum corymbosum*			G	C	V
Sunflower	*Helianthus angustifolius*	M				
Sunflower	*Helianthus debilis* ssp. *tardiflorus*					V
Sunflower	*Helianthus heterophyllus*	M				
Sunflower	*Helianthus strumosus*	M				
Oxeye	*Heliopsis helianthoides*	M				
Seaside heliotrope	*Heliotropium curassavicum*	M	D	G	C	V
Turnsole	*Heliotropium indicum*	M				V
	Hemicarpha micrantha					V
Liverleaf (E)	*Hepatica nobilis*	M				
Mud plantain	*Heteranthera dubia*	M				
	Heteranthera reniformis					V
	Heterotheca subaxillaris	M	D	G	C	V
Wild ginger, Heartleaf (T)	*Hexastylis arifolia*	M				
	Hibiscus aculeatus	M				
	Hibiscus coccineus	M				
Swamp hibiscus	*Hibiscus grandiflorus*		D		C	V
Halberd-leaved marshmallow	*Hibiscus militaris*	M				
Rose mallow	*Hibiscus moscheutos*	M		G	C	
Rose mallow	*Hibiscus moscheutos* ssp. *incanus*					V
Flower-of-an-hour	*Hibiscus trionum*			G		
Little barley	*Hordeum pusillum*		D	G		
Green violet	*Hybanthus concolor*	M				
Smooth hydrangea, Wild hydrangea (T)	*Hydrangea arborescens*	M				
Smooth hydrangea	*Hydrangea arborescens* ssp. *discolor*	M				
Watergrass	*Hydrochloa caroliniensis*	M				V
	Hydrocotyle bonariensis	M	D	G	C	V
	Hydrocotyle ranunculoides					V
Whorled pennywort, Marsh pennywort	*Hydrocotyle umbellata*	M	D	G	C	V
Swamp pennywort	*Hydrocotyle verticillata*	M	D			V

Swamp pennywort	*Hydrocotyle verticillata* var. *triradiata*				C	V
	Hydrolea quadrivalvis	M				
	Hygrophila lacustris	M				
Spider-lily	*Hymenocallis carolinensis*	M			C	
	Hymenocallis floridana	M				
	Hypericum brachyphyllum					V
St. John's-wort	*Hypericum cistifolium*		D	G		V
Sandweed	*Hypericum fasciculatum*	M	D			V
St. John's-wort	*Hypericum frondosum*	M				
St. John's-wort	*Hypericum galioides*	M				V
Pineweed	*Hypericum gentianoides*	M	D	G	C	
St. Andrew's cross	*Hypericum hypericoides*	M				V
Smooth-barked St. John's-wort (E)	*Hypericum lissophloeus*	M				
St. John's-wort	*Hypericum microsepalum*	M				V
Dwarf St. John's-wort	*Hypericum mutilum*	M				
St. John's-wort	*Hypericum nitidum*	M				V
St. John's-wort	*Hypericum reductum*	M	D	G	C	V
St. John's-wort	*Hypericum tetrapetalum*		D		C	V
Cat's-ears	*Hypochoeris brasiliensis*	M				
Common stargrass	*Hypoxis juncea*			G		V
Swamp stargrass	*Hypoxis leptocarpa*	M				
	Hypoxis rigida	M				
Musky mint, Cluster bushmint	*Hyptis alata*	M				V
	Hyptis mutabilis	M				V
Carolina holly, Sand holly (T)	*Ilex ambigua*					V
Dahoon, Dahoon holly	*Ilex cassine*	M	D		C	V
Large gallberry, Sweet gallberry	*Ilex coriacea*	M			C	V
Possum haw (T)	*Ilex decidua*	M				
Gallberry	*Ilex glabra*	M	D	G	C	V
Myrtle-leaf holly	*Ilex myrtifolia*					V
American holly	*Ilex opaca*	M				V
Yaupon	*Ilex vomitoria*	M	D	G	C	V
Purple anise, Florida anise-tree (T)	*Illicium floridanum*	M				
Jewel weed	*Impatiens capensis*	M				V
Red morning-glory	*Ipomoea hederifolia*	M				
Beach morning-glory	*Ipomoea imperati*	M	D	G	C	V
White morning-glory	*Ipomoea lacunosa*	M				
Manroot, Wild potato vine	*Ipomoea pandurata*	M				
Railroad vine	*Ipomoea pes-caprae*		D	G	C	V
Cypress vine	*Ipomoea quamoclit*				C	
	Ipomoea sagittata	M	D	G	C	V
	Ipomoea trichocarpa	M	D	G		
Prairie iris	*Iris hexagona*					V
	Iris tridentata	M				
Blue-flag	*Iris virginica*	M			C	V

Florida quillwort (T)	Isoetes flaccida	M				
False rue-anemone	Isopyrum biternatum	M				
Virginia willow	Itea virginica	M				
	Iva annua	M				
Marsh elder	Iva frutescens	M	D	G	C	V
	Iva microcephala	M				
	Jacquemontia tamnifolia	M		G		
Black walnut	Juglans nigra	M				
Rush	Juncus acuminatus	M				V
Toad rush	Juncus bufonius	M				V
Rush	Juncus coriaceus	M			C	
Rush	Juncus dichotomus	M	D	G	C	V
Rush	Juncus diffusissimus	M				
Soft rush	Juncus effusus	M				V
Bog rush	Juncus elliottii	M				V
Shore rush	Juncus marginatus	M	D		C	V
Rush	Juncus megacephalus	M	D	G	C	V
Rush	Juncus polycephalus	M				
	Juncus repens	M				
Needlerush, Black rush	Juncus roemerianus	M	D	G	C	V
Rush	Juncus scirpoides		D		C	
Path rush	Juncus tenuis	M			C	V
Rush	Juncus trigonocarpus	M				
Rush	Juncus scirpoides	M		G	C	V
Rush	Juncus validus	M				
Ground juniper	Juniperus communis var. depressa		D			
Southern red cedar	Juniperus silicicola	M		G	C	V
Red cedar	Juniperus virginiana	M				
Water-willow	Justicia americana	M				
	Justicia crassifolia	M				
	Justicia ovata	M				
	Justicia ovata var. lanceolata	M				
Wicky	Kalmia hirsuta	M				V
Mountain laurel (T)	Kalmia latifolia	M				
Seashore mallow	Kosteletzkya virginica	M	D	G	C	V
	Krigia cespitosa	M		G		
Dwarf dandelion	Krigia virginica	M	D	G	C	V
Common lespedeza	Kummerowia striata	M				V
Redroot	Lachnanthes caroliniana	M	D			V
Wood-letuce, Wild letuce	Lactuca canadensis	M				
Blue letuce	Lactuca graminifolia	M				V
Crepe myrtle	Lagerstroemia indica	M				
Henbit	Lamium amplexicaule		D			
Shrub verbena, Lantana	Lantana camara		D		C	
Wood-nettle	Laportea canadensis	M				
Pinweed	Lechea minor	M				V
Pinweed	Lechea mucronata	M		G	C	V
Pinweed	Lechea pulchella	M		G	C	V
Pinweed	Lechea sessiliflora	M	D			V

Checklist of Plants of the Apalachicola Basin (cont.)

Pinweed	*Lechea torreyi*		D	G	C	V
Southern cutgrass, Clubhead cutgrass	*Leersia hexandra*	M				
Catchflygrass	*Leersia lenticularis*	M				
Rice cutgrass	*Leersia oryzoides*	M				
Whitegrass	*Leersia virginica*	M				
Florida corkwood (T)	*Leitneria floridana*	M			C	V
Duckweed	*Lemna obscura*					V
Duckweed	*Lemna valdiviana*	M				
Lion's ear	*Leonotis nepetifolia*	M				V
Peppergrass	*Lepidium virginicum*	M	D			V
Bearded spangletop	*Leptochloa fascicularis*		D		C	V
	Lespedeza angustifolia	M				
Dusty clover	*Lespedeza capitata*	M				V
Bush clover	*Lespedeza hirta*					V
Bush clover	*Lespedeza hirta* ssp. *curtissii*					V
Fetterbush	*Leucothoe racemosa*	M				
Blazing star	*Liatris chapmanii*	M	D	G	C	V
Blazing star	*Liatris gracilis*	M				
Godfrey's blazing star (E)	*Liatris provincialis*	M			C	
Blazing star	*Liatris spicata*	M				
Blazing star	*Liatris tenuifolia*	M				V
Gopher apple	*Licania michauxii*	M				
Japanese privet	*Ligustrum japonicum*	M				
Wax-leaf privet	*Ligustrum lucidum*	M				
	Lilaeopsis carolinensis	M				
	Lilaeopsis chinensis	M		G		
Pine lily, Catesby lily (T)	*Lilium catesbaei*	M				
	Lilium michauxii	M				
Frog's-bit	*Limnobium spongia*					V
	Limnodea arkansana					V
	Limnophila sessiliflora			G		V
Sea lavender	*Limonium carolinianum*		D	G	C	V
Blue toad-flax	*Linaria canadensis*	M	D	G	C	V
	Linaria floridana		D	G	C	V
Spicebush	*Lindera benzoin*	M				
False pimpernel	*Lindernia anagallidea*	M		G		V
False pimpernel	*Lindernia dubia*	M				V
Yellow flax	*Linum medium*					V
Yellow flax	*Linum medium* var. *texanum*		D		C	V
Harper's grooved yellow flax	*Linum sulcatum* var. *harperi*	M				
Orange-flowered flax (T)	*Linum westii*	M				V
Sweetgum	*Liquidambar styraciflua*	M				V
Yellow poplar	*Liriodendron tulipifera*	M				
Lily-turf	*Liriope muscari*		D			
Pucoons	*Lithospermum tuberosum*	M				
Lobelia	*Lobelia amoena*	M				

Lobelia	Lobelia brevifolia					V
Cardinal flower (T)	Lobelia cardinalis	M				
Lobelia	Lobelia glandulosa	M				
Lobelia	Lobelia paludosa	M				
English ryegrass	Lolium perenne		D	G		
Japanese honeysuckle	Lonicera japonica	M				
Coral honeysuckle, Trumpet honeysuckle	Lonicera sempervirens	M				
Wedding ring lichen	Lopadium leucoxanthum				C	
Goldcrest	Lophiola americana	M				V
	Ludwigia alata	M	D	G	C	V
Seedbox	Ludwigia alternifolia	M				V
Primrose willow	Ludwigia decurrens	M				
	Ludwigia erecta	M				
Cylindric-fruited ludwigia	Ludwigia glandulosa	M				
	Ludwigia leptocarpa	M			C	V
	Ludwigia linearis	M				
	Ludwigia linifolia	M		G		V
	Ludwigia maritima	M	D	G	C	V
	Ludwigia microcarpa				C	
	Ludwigia octovalvis	M	D	G		
Marsh purslane	Ludwigia palustris	M			C	V
Primrose willow	Ludwigia peruviana	M				
	Ludwigia pilosa	M				
Water primrose	Ludwigia repens		D		C	V
	Ludwigia virgata	M				
Sky-blue lupine	Lupinus diffusus					V
Sanddune lupine, Gulfcoast lupine (T)	Lupinus westianus					V
Knot-leaved rush	Luzula acuminata	M				
Woodrush	Luzula echinata	M				
Christmas-berry	Lycium carolinianum			G		V
Tomato	Lycopersicon esculentum					V
Southern clubmoss (T)	Lycopodium appressum		D	G		
Bugleweed	Lycopus angustifolius	M				
Water hoarhound	Lycopus rubellus	M				
Water hoarhound	Lycopus virginicus	M				
Climbing fern	Lygodium japonicum	M	D			
Staggerbush, Rusty lyonia	Lyonia ferruginea				C	V
Staggerbush	Lyonia fruticosa		D			V
Maleberry	Lyonia ligustrina				C	
Fetterbush	Lyonia lucida	M	D	G	C	V
Staggerbush	Lyonia mariana				C	
Fringed loosestrife	Lysimachia ciliata	M				
Loosestrife	Lythrum curtissii	M				
Loosestrife	Lythrum lineare		D	G	C	
White birds-in-a-nest (E)	Macbridea alba	M				

Ashe's magnolia (E)	Magnolia ashei	M				
Southern magnolia	Magnolia grandiflora	M	D	G	C	V
Pyramid magnolia (E)	Magnolia pyramidata	M				
Sweetbay	Magnolia virginiana	M	D	G	C	V
Green adder's-mouth (T)	Malaxis unifolia	M				
Crab apple (T)	Malus angustifolia	M				
Wrinkled jointtail	Manisuris rugosa	M				
Lattice jointtail	Manisuris tesselata	M				
Florida jointtail	Manisuris tuberculosa	M				
Barbara's-button	Marshallia tenuifolia	M				
Alabama spiny-pod (E)	Matelea alabamensis	M				
	Matelea baldwiniana	M				
	Matelea flavidula	M				
Florida milkweed (E)	Matelea floridana	M				
Angle-pod	Matelea gonocarpa	M				V
	Mecardonia acuminata	M				
Indian cucumber-root (T)	Medeola virginiana	M				
Black medic	Medicago lupulina		D	G		V
Bur clover	Medicago polymorpha			G		
	Melanthera nivea	M				
Chinaberry	Melia azedarach	M				
Twoflower melic	Melica mutica	M				
White sweet-clover	Melilotus alba			G		
Sour clover	Melilotus indica	M		G		
Chocolate-weed	Melochia corchorifolia	M		G		
Creeping cucumber	Melothria pendula	M				V
	Micranthemum umbrosum	M				V
	Microstegium vimineum	M				
Climbing hempweed	Mikania scandens	M	D	G	C	V
Monkey flower	Mimulus alatus	M				
Twin berry, Partridge berry	Mitchella repens	M				V
	Mitreola angustifolia	M				
Miterwort	Mitreola petiolata	M	D			V
Miterwort	Mitreola sessilifolia	M				
	Modiola caroliniana	M		G		V
Carpetweed, Indian chickweed	Mollugo verticillata	M		G		V
Keygrass, Shoregrass	Monanthochloe littoralis					V
Horsemint, Spotted beebalm	Monarda punctata	M			C	V
White mulberry	Morus alba	M				
Red mulberry	Morus rubra	M			C	V
Hairgrass, Hairawn muhly	Muhlenbergia capillaris		D	G	C	V
Nimblewill	Muhlenbergia schreberi	M				
	Murdannia nudiflora	M				
Wax myrtle, Southern bayberry	Myrica cerifera	M	D	G	C	V
Bayberry	Myrica heterophylla	M				
Parrot-feather	Myriophyllum aquaticum	M				

	Myriophyllum laxum	M				
Water milfoil	*Myriophyllum spicatum*	M				
	Najas flexilis					V
Southern naiad	*Najas guadalupensis*					V
	Nandina domestica	M				
Duck acorn	*Nelumbo lutea*	M				V
	Nemophila aphylla	M				
	Neptunia pubescens	M				V
Oleander	*Nerium oleander*				C	
Florida beargrass (E)	*Nolina atopocarpa*	M		G		V
Spatterdock	*Nuphar luteum*	M				V
Fragrant water-lily	*Nymphaea odorata*	M	D	G	C	V
Yellow water-lily	*Nymphaea mexicana*					V
Floating hearts	*Nymphoides aquatica*	M				
Water tupelo	*Nyssa aquatica*	M				V
Blackgum, Swamp tupelo	*Nyssa biflora*	M				
Ogeechee-lime	*Nyssa ogeche*	M				V
Sour gum	*Nyssa sylvatica*	M				
Weedy evening-primrose	*Oenothera biennis*	M				V
Seaside evening-primrose	*Oenothera humifusa*		D	G	C	V
Cut-leaved evening-primrose	*Oenothera laciniata*		D			
Sensitive fern (T)	*Onoclea sensibilis*	M				
False gromwell	*Onosmodium virginianum*					V
Stalked adder's-tongue (T)	*Ophioglossum petiolatum*	M				
Wood grass	*Oplismenus setarius*	M		G	C	V
Prickly pear	*Opuntia humifusa*		D			
Prickly pear	*Opuntia humifusa* var. *ammophila*					V
Prickly pear	*Opuntia pusilla*	M	D		C	V
Prickly pear (T)	*Opuntia stricta*					V
Prickly pear	*Opuntia stricta* var. *dillenii*					V
Golden club	*Orontium aquaticum*	M				V
Rice	*Oryza sativa*					V
Wild olive	*Osmanthus americanus*	M		G	C	V
Cinnamon fern	*Osmunda cinnamomea*	M	D			V
Royal fern	*Osmunda regalis*	M		G	C	V
Royal fern	*Osmunda regalis* var. *spectabilis*	M	D			
Hop-hornbeam	*Ostrya virginiana*	M				
Lady's wood-sorrel	*Oxalis corniculata*	M	D	G		V
	Oxalis priceae ssp. *colorea*		D			
Common water-dropwort	*Oxypolis filiformis*	M				V
Giant water-dropwort (E)	*Oxypolis greenmanii*	M				
Beachgrass, Bitter panicum	*Panicum amarum*			G	C	V
Beachgrass, Bitter panicum	*Panicum amarum* var. *amarulum*	M	D	G	C	V
Beaked panicum	*Panicum anceps*	M			C	V

Checklist of Plants of the Apalachicola Basin (cont.)

Fall panicum	Panicum dichotomiflorum	M		G		
Savannah panicum	Panicum gymnocarpon	M			C	
Maidencane	Panicum hemitomon	M				
Gaping panicum	Panicum hians	M				V
	Panicum longifolium		D			V
Hog millet	Panicum miliaceum		D			
Torpedo grass	Panicum repens	M	D	G	C	V
Redtop panicum	Panicum rigidulum	M	D		C	V
Bluejoint panicum	Panicum tenerum	M				
Texas panicum	Panicum texanum			G		
Warty panicum	Panicum verrucosum	M		G		V
Switchgrass	Panicum virgatum		D	G	C	V
Pellitory	Parietaria praetermissa					V
Grass-of-Parnassus	Parnassia caroliniana	M				
Undine (E)	Parnassia grandifolia	M				
Whitlow-wort	Paronychia baldwinii	M	D		C	V
	Paronychia erecta		D	G	C	V
Whitlow-wort	Paronychia patula	M				
Sand-squares	Paronychia rugelii					V
Virginia creeper	Parthenocissus quinquefolia	M		G	C	V
Bull paspalum	Paspalum boscianum			G	C	V
Knotgrass	Paspalum distichum	M	D	G	C	V
Florida paspalum	Paspalum floridanum	M	D		C	V
Field paspalum	Paspalum laeve				C	
Bahiagrass	Paspalum notatum	M	D	G	C	
Brownseed paspalum	Paspalum plicatulum	M				
Early paspalum	Paspalum praecox					V
Thin paspalum	Paspalum setaceum	M	D	G	C	V
Vaseygrass	Paspalum urvillei	M	D	G	C	V
Yellow passionflower	Passiflora lutea	M				
Green arum	Peltandra virginica	M				V
Ditch stonecrop	Penthorum sedoides	M				
Beefsteak-plant	Perilla frutescens	M				
Redbay	Persea borbonia	M			C	V
Swamp bay	Persea palustris	M	D		C	V
	Petunia parviflora	M				
Mock-orange	Philadelphus inodorus	M				
Golden polypody (T)	Phlebodium aureum					V
Thick-leaf phlox	Phlox carolina	M				
	Phoebanthus tenuifolia	M				
Mistletoe	Phoradendron serotinum	M				
Common reed	Phragmites australis	M	D	G	C	V
Cape-weed	Phyla nodiflora		D	G	C	V
	Phyllanthus caroliniensis	M				
	Phyllanthus urinaria	M				
	Physalis angulata	M				V

Ground-cherry	Physalis angustifolia	M	D	G	C	V
Ground-cherry	Physalis pubescens	M			C	V
Ground-cherry	Physalis viscosa var. elliottii					V
Obedient plant	Physostegia godfreyi	M				
Obedient plant	Physostegia leptophylla	M				
Obedient plant	Physostegia purpurea	M				
Pokeweed, Pokeberry	Phytolacca americana	M	D	G	C	V
	Pieris phillyreifolia	M				V
Clearweed	Pilea pumila	M				
Fever tree (T)	Pinckneya bracteata	M				
	Pinguicula ionantha	M				
Yellow butterwort	Pinguicula lutea	M				
	Pinguicula planifolia	M				
Small butterwort	Pinguicula pumila	M				V
Sand pine	Pinus clausa	M	D	G		V
Shortleaf pine	Pinus echinata	M				
Slash pine	Pinus elliottii	M	D	G	C	V
Spruce pine	Pinus glabra	M				
Longleaf pine	Pinus palustris	M	D			
Loblolly pine	Pinus taeda	M				
Panhandle golden aster (E)	Pityopsis flexuosa	M				
	Pityopsis graminifolia var. latifolia	M				
Golden aster	Pityopsis graminifolia var. microcephala		D			
Golden aster	Pityopsis graminifolia var. tenuifolia					V
Golden aster	Pityopsis oligantha	M				
Planer tree, Water elm	Planera aquatica	M				
English plantain	Plantago lanceolata		D			
Plantain	Plantago major	M				
Hoary plantain	Plantago virginica	M	D	G	C	V
White fringed orchid (T)	Platanthera blephariglottis	M				
Crested fringed orchid (T)	Platanthera cristata	M				
Southern rein-orchid (T)	Platanthera flava	M				
Orange rein-orchid (T)	Platanthera integra	M				
Snowy orchid (T)	Platanthera nivea		D			
Sycamore	Platanus occidentalis	M				
Marsh fleabane	Pluchea camphorata	M				V
Marsh fleabane	Pluchea foetida	M				V
Salt marsh fleabane	Pluchea odorata	M	D		C	V
Marsh fleabane	Pluchea rosea	M	D	G	C	V
Annual bluegrass	Poa annua		D	G		
Rose pogonia (T)	Pogonia ophioglossoides					V
White bachelor's button	Polygala balduinii		D	G		V

Milkwort	Polygala brevifolia					V
Drumheads	Polygala cruciata	M				V
Milkwort	Polygala cymosa	M				
Milkwort	Polygala hookeri	M				
Procession flower	Polygala incarnata		D	G	C	V
Bog bachelor's button	Polygala lutea	M		G		V
Wild bachelor's button	Polygala nana		D	G	C	V
Milkwort	Polygala ramosa	M				
Milkwort	Polygala setacea	M				
Sandhill wireweed	Polygonella fimbriata var. robusta		D			
Wireweed	Polygonella gracilis					V
Large-leaved jointweed (T)	Polygonella macrophylla	M				
October-flower	Polygonella polygama	M	D	G	C	V
	Polygonella polygama var. brachystachya					V
Smartweed	Polygonum caespitosum var. longisetum	M				
Smartweed	Polygonum densiflorum	M				
Wild water-pepper	Polygonum hydropiperoides	M	D		C	
Pale smartweed	Polygonum lapathifolium	M				V
Pinkweed	Polygonum pensylvanicum	M				
Smartweed	Polygonum persicaria	M				
Dotted smartweed	Polygonum punctatum	M	D	G	C	V
Tearthumb	Polygonum sagittatum					V
False buckwheat	Polygonum scandens	M				
Smartweed	Polygonum setaceum				C	
Jumpseed	Polygonum virginianum	M				
Bear's foot, Yellow leafcup	Polymnia uvedalia	M				V
Resurrection fern	Polypodium polypodioides	M		G	C	V
	Polypremum procumbens	M	D	G	C	V
Christmas fern	Polystichum acrostichoides	M				
Pickerelweed	Pontederia cordata	M				
Pickerelweed	Pontederia cordata var. lancifolia				C	V
Pickerelweed	Pontederia lanceolata				C	
Cottonwood	Populus deltoides	M				
Swamp cottonwood	Populus heterophylla	M				
	Portulaca amilis			G		
	Portulaca oleracea	M				
	Portulaca oleracea ssp. nicaraguensis			G		
Pink purslane	Portulaca pilosa		D			V
Illinois pondweed	Potamogeton illinoensis	M				V
Sago pondweed	Potamogeton pectinatus		D			V
Pondweed	Potamogeton perfoliatus					V

Pondweed	Potamogeton pusillus					V
Mermaid-weed	Proserpinaca palustris	M	D	G	C	V
Wild	Proserpinaca pectinata	M		G	C	V
Wild plum	Prunus americana	M				
Laurel cherry	Prunus caroliniana	M				
Black cherry	Prunus serotina	M				
Hog plum	Prunus umbellata	M				
Baldrush	Psilocarya nitens		D	G	C	V
Wafer ash	Ptelea trifoliata	M				
Bracken fern	Pteridium aquilinum	M		G	C	V
	Pteridium aquilinum var. pseudocaudatum		D			
Blackroot	Pterocaulon pycnostachyum	M	D	G	C	V
Mock bishop's-weed	Ptilimnium capillaceum	M	D	G	C	V
Mountain-mint	Pycnanthemum flexuosum	M				
False dandelion	Pyrrhopappus carolinianus	M				
White oak	Quercus alba	M				
Chapman oak	Quercus chapmanii	M		G	C	V
Southern red oak	Quercus falcata	M				V
Cherry bark oak	Quercus falcata var. pagodifolia	M				
Sand-live oak	Quercus geminata	M	D	G	C	V
Laurel oak	Quercus hemisphaerica	M		G		V
Blue-jack oak	Quercus incana	M				
Turkey oak	Quercus laevis	M				
Diamond-leaf oak, Laurel oak	Quercus laurifolia	M				V
Overcup oak	Quercus lyrata	M				V
Sand-post oak	Quercus margaretta	M		G		V
Blackjack oak	Quercus marilandica	M				
Swamp chestnut oak	Quercus michauxii	M				
Dwarf-live oak	Quercus minima		D			V
Chinquapin oak	Quercus muhlenbergii	M				
Myrtle oak	Quercus myrtifolia	M	D	G	C	V
Water oak	Quercus nigra	M	D			V
Runner oak	Quercus pumila	M	D			
Shumard oak	Quercus shumardii	M				
Post oak	Quercus stellata	M		G		V
Black oak	Quercus velutina	M				
Live oak	Quercus virginiana	M		G	C	V
Wild radish	Raphanus raphanistrum			G		
	Ratibida pinnata	M				
Buckthorn	Rhamnus caroliniana					V
Needle palm	Rhapidophyllum hystrix	M				
Meadow beauty	Rhexia alifanus	M				
Meadow beauty	Rhexia cubensis		D	G	C	V
Meadow beauty (T)	Rhexia lutea	M				

Checklist of Plants of the Apalachicola Basin (cont.)

Pale meadow beauty	Rhexia mariana	M				
Meadow beauty	Rhexia nashii	M		G		V
Small-flowered meadow beauty (E)	Rhexia parviflora	M				
Meadow beauty	Rhexia petiolata	M				V
Panhandle meadow beauty	Rhexia salicifolia	M				
Meadow beauty	Rhexia virginica	M				
Florida flame azalea (E)	Rhododendron austrinum	M				
Sweet pinxter azalea, Wild azalea	Rhododendron canescens	M				
Swamp honeysuckle (T)	Rhododendron serrulatum	M				
Winged sumac, Shining sumac	Rhus copallina	M	D	G	C	V
Smooth sumac	Rhus glabra	M				
	Rhynchosia minima					V
Beakrush	Rhynchospora caduca	M				V
Beakrush	Rhynchospora cephalantha	M				V
Hornedrush	Rhynchospora corniculata	M				V
Beakrush	Rhynchospora curtissii	M				
Beakrush	Rhynchospora divergens		D	G		
Beakrush	Rhynchospora fascicularis		D	G		V
Beakrush	Rhynchospora fernaldii					V
Beakrush	Rhynchospora gracilenta	M				
Beakrush	Rhynchospora megalocarpa		D	G	C	V
Beakrush	Rhynchospora microcarpa		D	G	C	V
Beakrush	Rhynchospora miliacea	M				
Beakrush	Rhynchospora mixta	M				
Beakrush	Rhynchospora odorata			G		V
Beakrush	Rhynchospora plumosa	M				V
Beakrush	Rhynchospora tracyi		D	G		V
	Richardia scabra	M	D			
Yellow cress	Rorippa sessiliflora	M				
Swamp rose	Rosa palustris	M				
Toothcups	Rotala ramosior	M				
Highbush blackberry	Rubus argutus	M			C	V
Sand blackberry	Rubus cuneifolius	M	D		C	
Dewberry	Rubus trivialis	M	D	G	C	V
Coneflower	Rudbeckia graminifolia	M				
	Rudbeckia mohrii	M				
Wild petunia	Ruellia caroliniensis	M				
Night-flowering ruellia (T)	Ruellia noctiflora	M				
Dock	Rumex chrysocarpus				C	V
Curled dock	Rumex crispus	M		G	C	
Sourdock	Rumex hastatulus	M	D	G		V
Dock	Rumex paraguayensis			G	C	V
Swamp dock	Rumex verticillatus	M	D	G	C	V
Widgeon-grass	Ruppia maritima		D		C	V
Bluestem, Dwarf palmetto (T)	Sabal minor	M	D			
Cabbage palm	Sabal palmetto	M	D	G	C	V

Marsh pink	*Sabatia bartramii*	M				
Marsh pink	*Sabatia brevifolia*	M				
Marsh pink	*Sabatia calycina*	M				
Marsh pink	*Sabatia campanulata*				C	
Marsh pink	*Sabatia dodecandra*					V
Marsh pink	*Sabatia grandiflora*		D	G	C	
	Sabatia stellaris		D	G	C	V
India cupscale	*Sacciolepis indica*	M				
American cupscale	*Sacciolepis striata*	M	D	G	C	V
Buckthorn	*Sageretia minutiflora*			G	C	V
Pearlwort	*Sagina decumbens*	M	D			
Arrowhead	*Sagittaria graminea*	M				V
Arrowhead	*Sagittaria graminea* var. *chapmanii*	M				
Arrowhead	*Sagittaria lancifolia*	M	D	G	C	V
Duck potato	*Sagittaria latifolia*	M				V
Duck potato	*Sagittaria latifolia* var. *pubescens*	M				V
	Sagotia triflora	M				
Perennial glasswort	*Salicornia virginica*	M	D	G	C	V
Coastal plain willow	*Salix caroliniana*	M	D	G	C	V
Black willow	*Salix nigra*	M		G	C	
Russian thistle	*Salsola kali*		D	G	C	V
Lyre-leaved sage	*Salvia lyrata*	M				V
Elderberry	*Sambucus canadensis*	M	D			V
Water pimpernel	*Samolus ebracteatus*			G	C	
Pineland pimpernel	*Samolus parviflorus*	M	D	G		V
Black snakeroot	*Sanicula canadensis*	M				V
Soapberry	*Sapindus marginatus*	M				V
Trumpets	*Sarracenia flava*	M				
White-top pitcher-plant (E)	*Sarracenia leucophylla*	M				
Parrot pitcher-plant (T)	*Sarracenia psittacina*	M				
Sassafras	*Sassafras albidum*	M				
Lizard's tail	*Saururus cernuus*	M	D		C	V
Bay star vine	*Schisandra coccinea*	M				
	Schizachyrium maritimum		D	G	C	V
Little bluestem	*Schizachyrium scoparium*	M				
Bulrush	*Scirpus americanus*		D		C	V
Bulrush	*Scirpus californicus*	M				V
Wool-grass	*Scirpus cyperinus*	M				
Bulrush	*Scirpus divaricatus*	M				
Three-square	*Scirpus pungens*			G	C	V
Saltmarsh bulrush	*Scirpus robustus*		D	G	C	V
Great bulrush	*Scirpus validus*	M	D			V
Nutrush	*Scleria ciliata*		D		C	
Nutrush	*Scleria ciliata* var. *glabra*			G		V

Nutrush	*Scleria georgiana*	M	D			
Nutrush	*Scleria hirtella*	M				
Nutrush	*Scleria pauciflora*	M				V
Nutrush	*Scleria reticularis*			G		V
Nutrush	*Scleria reticularis* var. *pubescens*		D			
Nutrush	*Scleria triglomerata*	M			C	V
Nutrush	*Scleria verticillata*		D		C	V
Sweet broom	*Scoparia dulcis*	M	D		C	V
	Scoparia montevidensis		D			
Figwort	*Scrophularia marilandica*	M				
Skullcap	*Scutellaria floridana*	M				
Skullcap	*Scutellaria integrifolia*				C	V
Skullcap	*Scutellaria lateriflora*	M				
Sebastian bush	*Sebastiana fruticosa*	M				
Meadow spikemoss (T)	*Selaginella apoda*	M				
Sand spikemoss (T)	*Selaginella arenicola*	M				
Golden ragwort	*Senecio aureus*	M				
Butterweed, Golden ragwort	*Senecio glabellus*	M				
Saw-palmetto	*Serenoa repens*	M	D	G	C	V
	Sesbania macrocarpa	M		G	C	V
Purple sesban	*Sesbania punicea*	M				V
Bladderpod	*Sesbania vesicaria*	M			C	V
Sea purslane	*Sesuvium maritimum*		D			V
Sea purslane	*Sesuvium portulacastrum*	M	D	G	C	V
Knotroot foxtail	*Setaria geniculata*		D	G	C	V
Coral foxtail	*Setaria macrosperma*					V
Giant bristlegrass	*Setaria magna*		D			V
Green foxtail	*Setaria viridis*					V
Senna symeria, Black senna	*Seymeria cassioides*	M	D	G	C	
Bur cucumber	*Sicyos angulatus*	M				
Broomweed	*Sida acuta*	M				
Indian hemp	*Sida rhombifolia*	M	D	G	C	V
Prickly mallow	*Sida spinosa*	M				
Sleepy catchfly	*Silene antirrhina*	M	D	G		V
	Silene polypetala	M				
	Silphium compositum var. *ovatifolium*	M				
Blue-eyed grass	*Sisyrinchium atlanticum*		D	G	C	V
	Sisyrinchium nashii			G		
Annual blue-eyed grass	*Sisyrinchium rosulatum*	M				
Scrub blue-eyed-grass	*Sisyrinchium xerophyllum*		D			
False solomon's-seal	*Smilacina racemosa*	M				
Greenbrier	*Smilax auriculata*	M	D	G	C	V
Catbrier	*Smilax bona-nox*	M			C	V
Wild sarsaparilla	*Smilax glauca*	M				

Bamboo-vine	Smilax laurifolia	M	D	G	C	V
Wild sarsaparilla	Smilax pumila	M				
Greenbriar	Smilax rotundifolia	M	D			
Jackson-brier	Smilax smallii	M				V
Hogbrier	Smilax tamnoides	M				V
Coral greenbrier	Smilax walteri	M				
Nightshade	Solanum americanum			G	C	
Horse-nettle	Solanum carolinense	M	D			
Horse-nettle	Solanum carolinense var. floridanum	M				
Black nightshade	Solanum nigrescens	M			C	
Bluestem goldenrod	Solidago caesia	M				
Goldenrod	Solidago canadensis	M	D	G		
Goldenrod	Solidago chapmanii					V
	Solidago fistulosa	M	D	G		
Sweet goldenrod	Solidago odora	M			C	V
Seaside goldenrod	Solidago sempervirens		D			
Seaside goldenrod	Solidago sempervirens var. mexicana	M		G	C	V
	Solidago stricta	M	D	G	C	V
Spiny-leaved sow thistle	Sonchus asper		D		C	V
Common sow thistle	Sonchus oleraceus		D	G		V
Slender indiangrass	Sorghastrum elliottii					V
Wood grass	Sorghastrum nutans					V
Lopside indiangrass	Sorghastrum secundum	M				V
Smooth cordgrass	Spartina alterniflora	M	D	G	C	V
Saltmarsh cordgrass	Spartina alterniflora var. glabra			G	C	V
Sand cordgrass	Spartina bakeri		D			V
Big cordgrass	Spartina cynosuroides	M	D			V
Saltmeadow cordgrass, Marshhay	Spartina patens	M	D	G	C	V
Gulf cordgrass	Spartina spartinae		D	G	C	V
	Spermacoce prostrata	M				
Scale-seed	Spermolepis divaricata	M	D	G	C	V
Scale-seed	Spermolepis echinata		D	G		V
Gooseweed	Sphenoclea zeylanica	M				
Shiny wedgescale	Sphenopholis nitida	M				
Prairie wedgescale	Sphenopholis obtusata		D	G	C	V
	Spilanthes americana	M				
Nodding ladies'-tresses (T)	Spiranthes cernua var. odorata	M				
Slender ladies'-tresses (T)	Spiranthes gracilis	M				
Lesser ladies'-tresses (T)	Spiranthes ovalis	M				
Grass-leaved ladies'-tresses (T)	Spiranthes praecox	M			C	V
Spring ladies'-tresses (T)	Spiranthes vernalis	M	D		C	
Duckmeat	Spirodela polyrhiza					V

Duckmeat	Spirodela punctata		D			
Florida dropseed	Sporobolus floridanus					V
Smutgrass	Sporobolus indicus	M	D		C	V
Virginia dropseed	Sporobolus virginicus	M	D	G	C	V
Shade betony	Stachys crenata	M				
Bladdernut (T)	Staphylea trifolia	M				
Common chickweed	Stellaria media		D	G		
	Stellaria prostrata					V
	Stellaria pubera	M				
St. Augustine grass	Stenotaphrum secundatum	M	D		C	
Silky camellia (E)	Stewartia malachodendron	M				
Corkwood	Stillingia aquatica	M				V
Blackseed needlegrass	Stipa avenacea	M				
	Stipulicida setacea		D	G	C	V
Sand beans	Strophostyles helvola	M	D	G	C	V
Sand beans	Strophostyles leiosperma	M		G	C	V
	Stylisma humistrata	M				
	Stylisma patens	M				
Pencil flower	Stylosanthes biflora	M				
Storax	Styrax americana	M				
Storax	Styrax americana var. pulverulenta	M				
Big-leaf snowbell	Styrax grandifolia	M				
Southern sea blite	Suaeda linearis		D	G	C	V
Horse sugar, Sweetleaf	Symplocos tinctoria	M				
Shoe buttons	Syngonanthus flavidulus		D			
Manatee-grass	Syringodium filiforme	M	D		C	
Pondcypress	Taxodium ascendens	M	D			V
Baldcypress	Taxodium distichum	M			C	V
Florida yew (E)	Taxus floridana	M				
	Tephrosia hispidula	M				
Wood sage	Teucrium canadense var. nashii	M		G	C	V
Turtle-grass	Thalassia testudinum	M	D	G		
Fireflag	Thalia geniculata	M				V
Purple meadow parsnip	Thaspium trifoliatum	M				
Downy shield fern (T)	Thelypteris dentata	M				
Beech fern (T)	Thelypteris hexagonoptera	M				
(T)	Thelypteris interrupta		D			
Southern shield fern (T)	Thelypteris kunthii	M				
Marsh fern (T)	Thelypteris palustris	M	D	G		V
	Thelypteris quadrangularis var. versicolor	M				
Basswood	Tilia heterophylla	M				
Wild pine, Air plant (T)	Tillandsia bartramii	M				
Spanish moss	Tillandsia usneoides	M			C	V
Florida torreya, Stinking cedar (E)	Torreya taxifolia	M				

Poison ivy	*Toxicodendron radicans*	M	D	G	C	V
Eastern poison oak	*Toxicodendron toxicarium*			G	C	
Climbing dogbane	*Trachelospermum difforme*	M				
Wandering jew	*Tradescantia fluminensis*	M				
Spiderwort	*Tradescantia hirsutiflora*		D			
Common spiderwort	*Tradescantia ohiensis*	M	D	G		
	Tradescantia virginiana					V
	Tragia smallii	M				
	Trepocarpus aethusae	M				
	Triadenum tubulosum	M				
Marsh St. John's wort	*Triadenum virginicum*	M				
Marsh St. John's wort	*Triadenum walteri*	M				
Blue curls, Bastard pennyroyal	*Trichostema dichotomum*	M	D		C	V
Pine barren tridens	*Tridens ambiguus*	M				
Tall redtop	*Tridens flavus*	M				V
Low hop clover	*Trifolium campestre*			G		
Clover	*Trifolium carolinianum*		D			
Clover	*Trifolium dubium*		D			
White clover	*Trifolium repens*			G		
Arrowgrass	*Triglochin striata*					V
Wakerobins (E)	*Trillium lancifolium*	M				
Venus' looking-glass	*Triodanus biflora*	M		G		
Venus' looking-glass	*Triodanus perfoliata*	M	D	G		V
Perennial sandgrass	*Triplasis americana*		D	G	C	V
Purple sandgrass	*Triplasis purpurea*	M	D	G	C	V
Eastern gamagrass	*Tripsacum dactyloides*	M				
Montbretia	*Tritonia crocosmaeflora*		D			
Southern cattail	*Typha domingensis*	M	D	G	C	V
Common cattail	*Typha latifolia*		D		C	V
Winged elm	*Ulmus alata*	M				
American elm	*Ulmus americana*	M				V
Slippery elm	*Ulmus rubra*	M				
Sea oats	*Uniola paniculata*		D	G	C	V
Bladderwort	*Utricularia biflora*		D	G	C	V
Horned bladderwort	*Utricularia cornuta*			G		
Bladderwort	*Utricularia foliosa*	M				V
Bladderwort	*Utricularia juncea*		D			
Bladderwort	*Utricularia olivacea*	M				
Purple bladderwort	*Utricularia purpurea*	M				V
Bladderwort	*Utricularia radiata*		D			
Small purple-bladderwort	*Utricularia resupinata*					V
Bladderwort	*Utricularia subulata*					V
Bellwort	*Uvularia floridana*	M				
Bellwort	*Uvularia perfoliata*	M				
Bellwort	*Uvularia sessilifolia*	M				
Sparkleberry	*Vaccinium arboreum*	M		G	C	V

Highbush blueberry	*Vaccinium corymbosum*	M				V
	Vaccinium darrowii		D	G	C	V
Shiny blueberry	*Vaccinium myrsinites*			G	C	V
Deerberry	*Vaccinium stamineum*	M				V
Eelgrass	*Vallisneria americana*	M				V
False hellebores (E)	*Veratrum woodii*	M				
Wooly mullein	*Verbascum thapsus*	M				
Vervain	*Verbena bonariensis*		D			
Vervain	*Verbena brasiliensis*	M	D			
Vervain	*Verbena rigida*	M				
White vervain	*Verbena utricifolia*	M			C	V
	Verbesina alternifolia	M				
Chapman's crownbeard (T)	*Verbesina chapmanii*	M				
	Verbesina occidentalis	M				V
Frost weed	*Verbesina virginica*	M				V
Ironweed	*Vernonia angustifolia* var. *mohrii*	M				
Ironweed	*Vernonia gigantea*	M				
Corn speedwell	*Veronica arvensis*		D			
Neckweed	*Veronica peregrina*	M	D	G		V
	Veronica peregrina var *xalapensis*	M				
Southern arrow-wood	*Viburnum dentatum*	M				
Southern arrow-wood	*Viburnum dentatum* var. *scabrellum*	M				
Possum haw	*Viburnum nudum*	M				
Small viburnum	*Viburnum obovatum*	M				
Rusty-haw	*Viburnum rufidulum*	M				
Sand vetch	*Vicia acutifolia*	M	D	G	C	V
Common vetch	*Vicia sativa*		D	G		
Lentil-tare	*Vicia tetrasperma*			G		
	Vigna luteola	M		G	C	V
	Viola affinis	M				
Halberd-leaved yellow violet (E)	*Viola hastata*	M				
Bog-white violet	*Viola lanceolata*	M				V
Primrose-leaved violet	*Viola primulifolia*	M				
	Viola septemloba	M				
Chaste tree	*Vitex agnus-castus*	M	D			
Summer grape	*Vitis aestivalis*	M			C	V
Red grape	*Vitis palmata*	M				
Muscadine, Scuppernong	*Vitis rotundifolia*	M	D	G	C	V
Frost grape	*Vitis vulpina*	M				V
Common sixweeksgrass	*Vulpia octoflora*		D	G	C	V
	Wahlenbergia marginata	M	D			
	Warea sessilifolia	M				
American wisteria	*Wisteria frutescens*	M			C	

Chinese wisteria	*Wisteria sinensis*				C	V
Cliff fern (T)	*Woodsia obtusa*	M				
Netted chain-fern (T)	*Woodwardia areolata*	M	D			
Virginia chain-fern	*Woodwardia virginica*	M	D	G	C	V
Cocklebur	*Xanthium strumarium*	M		G	C	
Yellow-root	*Xanthorhiza simplicissima*	M				
Yellow-eyed grass	*Xyris ambigua*	M				
Yellow-eyed grass	*Xyris brevifolia*		D			V
Yellow-eyed grass	*Xyris caroliniana*	M	D	G		V
Yellow-eyed grass	*Xyris drummondii*	M				V
Yellow-eyed grass	*Xyris elliottii*		D			
Yellow-eyed grass	*Xyris flabelliformis*		D			
Yellow-eyed grass	*Xyris iridifolia*	M				V
Yellow-eyed grass	*Xyris isoetifolia*	M				
Common yellow-eyed grass	*Xyris jupicai*	M	D		C	V
Karst pond yellow-eyed grass (E)	*Xyris longisepala*	M				
Harper's yellow-eyed grass (T)	*Xyris scabrifolia*	M				
	Xyris stricta					V
Spanish bayonet	*Yucca aloifolia*	M	D	G	C	V
Weak-leaf yucca	*Yucca flaccida*		D		C	
	Yucca gloriosa					V
Horned pondweed	*Zannichellia palustris*					V
Toothache-tree	*Zanthoxylum americanum*	M				
Hercules'-club	*Zanthoxylum clava-herculis*	M			C	V
Zenobia	*Zenobia pulverulenta*					V
Rain-lily	*Zephyranthes treatiae*	M				
Crow-poison	*Zigadenus densus*	M				
	Zigadenus glaberrimus	M				
Indian rice	*Zizania aquatica*	M				V
Water millet, Southern wild rice	*Zizaniopsis miliacea*	M				
Golden alexander	*Zizia aurea*	M				
Salt water eel-grass	*Zostera marina*					V

Sources: McAtee, 1913; Kurz, 1938; Radford et al, 1968; Clewell, 1977; Leitman, 1978; Eichholz et al, 1979; U.S. Dept. of Commerce and DER, 1979; Kartesz and Kartesz, 1980; Leonard and Baker, 1982; FDNR, 1983; Judd et al, 1983; Leitman et al, 1983; Christman, 1984; Livingston, 1984; Anderson and Alexander, 1985; Clewell, 1985; Gholson, 1985; Anderson, 1986; FGFWFC, 1987.

APALACHICOLA BAY AREA PROTECTION ACT

ENROLLED

1985 Legislature CS/HB 1202, 3rd Engrossed

An act relating to environmental protection; creating the "Apalachicola Bay Area Protection Act"; providing legislative intent; designating Franklin County, excluding certain lands, as an area of critical state concern to be known as the Apalachicola Bay Area; providing for removal of such designation; providing for the application of certain land and water management laws; providing for the appointment of a resource planning and management committee; providing duties; providing principles for guiding development in the area; providing for comprehensive plan elements and land development regulations; providing for modifications; providing for local government requirements; providing a penalty; providing procedures for applications for certain grants; providing appropriations; providing an effective date.

WHEREAS, the Apalachicola River has the greatest volume of flow of any river in Florida, and its estuary, Apalachicola Bay, has been designated a National Estuarine Sanctuary, a Florida Aquatic Preserve, an Outstanding Florida Water, a Florida Class II Shellfish Harvesting Area, and an International Biosphere Reserve, and

WHEREAS, the Apalachicola River is at the southernmost portion of a multi-river system that spans three states, and is used for drinking, irrigation, hydropower, industrial and navigational uses, waste disposal, fishing and other recreational activities, and

WHEREAS, Apalachicola Bay provides a substantial harvest of shrimp and blue crabs, and produces 90 percent of the state's commercial oyster harvest, for a total dockside value of more than $12 million annually, and provides a large economic contribution to local governments along its banks, and

WHEREAS, the commercial and recreational fisheries activities in the Apalachicola River and Bay contribute an estimated $30 million per year to local economies, which sustains the largely traditional lifestyles of the residents in the area, and

WHEREAS, there is currently an inadequate sewage collection and treatment system in the Apalachicola Bay Area, resulting in frequent closings of the bay to shellfish harvesting, and

WHEREAS, existing and future sources of pollution must be controlled to protect the natural resources of the Apalachicola Bay Area, and

WHEREAS, the Legislature of the State of Florida declares that Apalachicola Bay is a vital state resource that needs to be protected for the benefit of all the citizens of the state, and

WHEREAS, the Legislature of the State of Florida acknowledges that the residents of Franklin County are unable to provide sufficient funding for adequate sewage treatment and proper implementation of comprehensive plans and land development regulations, and

WHEREAS, the Legislature of the State of Florida will, renovate and rehabilitate the sewer systems in Franklin County in order to protect Apalachicola Bay, and

WHEREAS, the Legislature of the State of Florida desires to protect the Apalachicola Bay Area by ensuring the proper implementation and enforcement of adequate comprehensive plans and land development regulations, and

WHEREAS, the Legislature of the State of Florida desires to assist Franklin County and its municipalities in modifying their comprehensive plans and developing additional land development regulations and implementing their plans and regulations in order to protect the Apalachicola Bay Area, NOW, THEREFORE,

Be It Enacted by the Legislature of the State of Florida:

Section 1. This act shall be known, and cited as the "Apalachicola Bay Area Protection Act."

Section 2. Legislative intent--It is hereby declared that the intent of the Legislature is:

(1) To protect the water quality of the Apalachicola Bay Area to ensure a healthy environment and a thriving economy for the residents of the area and the state.

(2) To financially assist Franklin County and its municipalities in upgrading and expanding their sewerage systems.

(3) To protect the Apalachicola Bay Area's natural and economic resources by implementing and enforcing comprehensive plans and land development regulations.

(4) To assist Franklin County and its municipalities with technical and advisory assistance in formulating

additional land development regulations and modifications to comprehensive plans.

(5) To monitor activities within the Apalachicola Bay Area to ensure the long-term protection of all the area's resources.

(6) To promote a broad base of economic growth which is compatible with the protection and conservation of the natural resources of the Apalachicola Bay Area.

(7) To educate the residents of the Apalachicola Bay Area in order to protect and preserve its natural resources.

Section 3. (1) DESIGNATION.--Franklin County, as described in s. 7.19, Florida Statutes, less all federally owned lands, and less all lands lying east of the line formed by the eastern boundary of State Road 319 running from the Ochlockonee River to the intersection of State Road 319 and State Road 98 and thence due south to the Gulf of Mexico, is hereby designated an area of critical state concern on the effective date of this act. State road, for the purpose of this section, shall be defined as in s. 334.03, Florida Statutes. For the purposes of this act, this area shall be known as the Apalachicola Bay Area.

(2) REMOVAL OF DESIGNATION.--The state land planning agency, 3 years following the effective date of this act, shall recommend to the Administration Commission the removal of the designation specified in subsection (1), if it determines that all local land development regulations, local comprehensive plans, and the administration of such regulations and plans are adequate to protect the Apalachicola Bay Area, continue to carry out the legislative intent set forth in section 2, and are in compliance with the principles

Administration Commission concurs with the recommendations of the state land planning agency to remove the designation, it shall, within 45 days of receipt of the recommendation, initiate rulemaking to remove the designation. The state land planning agency shall thereafter make the above determination annually, until such time as the designation is removed.

Section 4. (1) Section 380.05 (1)-(6), (8)-(12), (15), (17), and (21), Florida Statutes, shall not apply to the area designated by this act for so long as the designation remains in effect. Except as otherwise provided in this act, s. 380.045, Florida Statutes, shall not apply to the area designated by this act. All other provisions of chapter 380, Florida Statutes, shall apply, including ss. 380.07 and 380.11, Florida Statutes, except that the "local development regulations" in s. 380.05(13), Florida Statutes, shall include the regulations set forth in section 7 of this act for purposes of s. 380.05 (13), Florida Statutes, and the plan or plans submitted pursuant to s. 380.05(14), Florida Statutes, shall be submitted no later than February 1, 1986. All or part of the area designated by this act may be redesignated pursuant to s. 380.05, Florida Statutes, as if it had been initially designated pursuant to that section.

(2) If a developer has by his actions in reliance on prior regulations obtained vested or other legal rights including rights obtained by approval of a development of regional impact or a substantial deviation thereof pursuant to s. 380.06, Florida Statutes, that would have prevented a local government from changing those regulations in a way adverse to his interests, nothing in this act authorizes any governmental agency to abridge those rights.

Section 5. Resource planning and management committee.--The Governor, acting as the chief planning officer of the state, shall appoint a resource planning and management committee for the Apalachicola Bay Area, with the membership as specified in s. 380.045(2), Florida Statutes. Members of the committee shall be appointed for 2-year terms and may be reappointed. Meetings will be called as needed by the chairman or on the demand of three or more members of the committee. The committee shall continue in existence until 12 months after the Administration Commission removes the designation as an area of critical state concern. The committee shall:

(1) Develop, with officials of Franklin County and officials of the other units of government in the Apalachicola Bay Area, recommendations to the state land planning agency as to the sufficiency of the Apalachicola Bay Area's comprehensive plans and land development regulations.

(2) Recommend to the state land planning agency changes to state and regional plans and regulatory programs affecting the Apalachicola Bay Area.

(3) Recommend to the state land planning agency, not less than 33 months after the effective date of this act, whether the designation in section 3 should continue.

(4) Assist units of local government within the Apalachicola Bay Area in carrying out the planning functions and other responsibilities required by this act.

(5) Study the economic and environmental advisability of providing sewerage facilities to the residents of St. George Island and make a recommendation to the state land planning agency.

(6) Review, at a minimum, all reports and other materials provided to it by the state land planning agency or the Department of Environmental Regulation.

(7) Review the study done pursuant to (3)(a) of section 9 of this act, and make recommendations for implementation and funding.

Section 6. Principles for guiding development.--State, regional and local agencies and units of government in the Apalachicola Bay Area shall coordinate their plans and conduct their programs and regulatory activities consistent with the following principles for guiding the development of the area:

(1) Land development shall be guided so that the basic functions and productivity of the Apalachicola Bay Area's natural land and water systems will be conserved to reduce or avoid health, safety, and economic problems for present and future residents of the Apalachicola Bay Area.

(2) Land development shall be consistent with a safe environment, adequate community facilities, a superior quality of life and a desire to minimize environmental hazards.

(3) Growth and diversification of the local economy shall be fostered only if it is consistent with protecting the natural resources of the Apalachicola Bay Area through appropriate management of the land and water systems.

(4) Aquatic habitats and wildlife resources of the Apalachicola Bay Area shall be conserved and protected.

(5) Water quantity shall be managed to conserve and protect the natural resources and the scenic beauty of the Apalachicola Bay Area.

(6) The quality of water shall be protected, maintained and improved for public water supplies, the

propagation of aquatic life, and recreational and other uses which are consistent with these uses.

(7) No wastes shall be discharged into any waters of the Apalachicola Bay Area without first being given the degree of treatment necessary to protect the water uses as set forth in subsection (6).

(8) Stormwater discharges shall be managed in order to minimize their impacts on the bay system and protect the uses as set forth in subsection (6).

(9) Coastal dune systems, specifically the area extending landward from the extreme high tide line to the beginning of the pinelands of the Apalachicola Bay Area, shall be protected.

(10) Public lands shall be managed, enhanced, and protected so that the public may continue to enjoy the traditional use of such lands.

Section 7. Comprehensive plan elements and land development regulations.--The following comprehensive plan elements and land development regulations shall be administered by local governments within their jurisdiction in the Apalachicola Bay Area, as part of their local comprehensive plan and land development regulations. If a local government within the Apalachicola Bay Area has a provision in its local comprehensive plan or its land development regulations which conflicts with a provision of this section or has no comparable provision, the provision of this section shall control.

(1) COMPREHENSIVE PLAN.-- Chapter 1 of Volume I, and chapters 4, 5, 7, and 9 of Volume II of the Franklin County Comprehensive Land Use Plan adopted by Ordinance No. 81-4 on

Commissioners and filed with the Secretary of State on June 30, 1981, are incorporated by reference and adopted herein.

(2) ZONING ORDINANCES.--Ordinance No. 81-5 adopted June 22, 1981, by the Franklin County Board of County Commissioners and filed with the Secretary of State on June 30, 1981, and the following amendments are incorporated by reference and adopted herein:

(a) Ordinance 82-4, adopted June 18, 1982, and filed with the Secretary of State on July 28, 1982.

(b) Ordinance 83-4, adopted July 19, 1983, and filed with the Secretary of State on July 25, 1983.

(c) Ordinance 83-7, adopted October 4, 1983, and filed with the Secretary of State on October 6, 1983.

(d) Ordinance 84-2, adopted April 24, 1984, and filed with the Secretary of State on April 27, 1984.

(3) SUBDIVISION REGULATIONS.--Ordinance No. 74-1 adopted November 15, 1974, by the Franklin County Board of County Commissioners and filed with the Secretary of State on December 4, 1974, and December 5, 1974, and the following amendment is incorporated by reference and adopted herein:

(a) Ordinance 79-5, filed with the Secretary of State on May 30, 1979.

(4) FLOOD PLAIN MANAGEMENT ORDINANCE.--Ordinance No. 83-5 adopted on July 7, 1983, by the Franklin County Board of County Commissioners and filed with the Secretary of State on July 15, 1983, is incorporated by reference and adopted herein.

(5) SEPTIC TANK ORDINANCE.-- Ordinance 79-8 adopted on June 22, 1979, by the Franklin County Board of County

Commissioners and filed with the Secretary of State on June 27, 1979, is incorporated by reference and adopted herein.

(6) CONSTRUCTION; ELECTRICAL CONNECTION.--Ordinance No. 73-5A adopted July 3, 1973, by the Franklin County Board of County Commissioners and filed with the Secretary of State on March 6, 1981, is incorporated by reference and adopted herein.

(7) ALLIGATOR POINT WATER RESOURCE DISTRICT ACT.--Ordinance No. 76-7 adopted on November 16, 1976, by the Franklin County Board of County Commissioners and filed with the Secretary of State on March 6, 1981, is incorporated by reference and adopted herein.

(8) COASTAL AREA BUILDING CODES.--Ordinance No. 84-1 establishing building codes for coastal areas adopted by the Franklin County Board of County Commissioners on February 8, 1984, and filed with the Secretary of State on February 2, 1984, is incorporated by reference and adopted herein.

(9) STANDARD BUILDING CODE.--Ordinance adopting the 1976 Standard Building Code, Ordinance No. 83-1, adopted January 18, 1983, by the Franklin County Board of County Commissioners and filed with the Secretary of State January 20, 1983, is incorporated by reference and adopted herein.

(10) LOCAL PLANNING AGENCY.--Ordinance No. 77-6 adopted on June 21, 1977, by the Franklin County Board of County Commissioners and filed with the Secretary of State on June 22, 1977, is incorporated by reference and adopted herein.

(11) COASTAL HIGH HAZARD ZONES.--Ordinance No. 80-5 adopted on May 29, 1980, by the Franklin County Board of County Commissioners and filed with the Secretary of State on

May 30, 1980, is incorporated by reference and adopted herein.

(12) CONFLICTING REGULATIONS.--In the event of any inconsistency between subsection (1) and subsections (2)-(11), subsection (1) shall control. Further, in the event of any inconsistency between section 6 and subsections (1)-(11) of section 7 and a development order issued pursuant to s. 380.06, which has become final prior to the effective date of this act, or between section 6 and subsections (1)-(11) of section 7 and an amendment to a final development order, which amendment has been requested prior to April 2, 1985, the development order or amendment thereto shall control. However, any modification to subsections (1)-(11) enacted by a local government and approved by the Administration Commission pursuant to section 8, may provide whether it shall control over an inconsistent provision of a development order or amendment thereto. A development order or any amendment thereto referred to in this subsection shall not be subject to approval by the Administration Commission pursuant to section 8.

(13) EFFECT OF EXISTING PLANS AND REGULATIONS.--Legally adopted comprehensive plans and land development regulations other than those listed in this section shall remain in full force and effect unless inconsistent with the principles for guiding development set forth in section 6, the elements of the comprehensive plan listed in this section, or the land development regulations listed in this section.

(14) DEVELOPMENTS OF REGIONAL IMPACT.--A local government shall approve a development subject to the provisions of s. 380.06, Florida Statutes, only if it also complies with the provisions of this section.

Section 8. Modification to plans and regulations.--Any land development regulation or element of a local comprehensive plan in the Apalachicola Bay Area may be enacted, amended, or rescinded by a local government, but the enactment, amendment, or rescission becomes effective only upon the approval thereof by the Administration Commission. Further, the state land planning agency, after consulting with the appropriate local government, may, from time to time, recommend the enactment, amendment, or rescission of a land development regulation or element of a comprehensive plan. Within 45 days following the receipt of such recommendation by the state land planning agency, or enactment, amendment, or rescission by a local government, the commission shall reject or accept the recommendation, enactment, amendment, or rescission with or without modification and adopt, by rule, any changes. Any such local land development regulation or comprehensive plan or part of such regulation or plan may be adopted by the commission if it finds that it is in compliance with the principles for guiding development.

Section 9. Requirements; local governments.--

(1) As used in this section:

(a) "Alternative onsite system" means any approved onsite disposal system used in lieu of a standard subsurface system.

(b) "Critical shoreline zone" means all land within a distance of 150 feet landward of the mean high water line in tidal areas, the ordinary high water line in nontidal areas, or the inland wetland areas existing along the streams, lakes, rivers, bays, and sounds within the Apalachicola Bay Area.

(c) "Pollution-sensitive segment of the critical shoreline" means sensitive resources, including but not limited to, productive shellfish beds and nursery areas, requires special regulatory attention.

(d) "Low-income family" means a group of persons residing together whose combined income does not exceed 200 percent of the 1985 Poverty Income Guidelines for all states and the District of Columbia, promulgated by the United States Department of Health and Human Services, as published in Volume 50, No. 46 of the Federal Register, pages 9517-18. Income shall be as defined in said guidelines.

(2) Franklin County and the municipalities within it shall, within 60 days after a sewerage system is available for use, notify all owners and users of onsite sewage disposal systems of the availability of such a system and that connection is required within 180 days of the notice. Failure to connect to an available system within the time prescribed shall be a misdemeanor of the second degree, punishable as provided for in ss. 775.082 and 775.083, Florida Statutes. Further, Franklin County and the municipalities within it shall have the right to make the connection if it is not made within the prescribed time and to assess the owner of the real property on which the connection is made for the cost of such connection. Such assessments shall be levied according to law and shall become a lien against the real property, enforced according to law. Franklin County and the municipalities within it shall develop a program and implement ordinances to make available to low income families the sewer services available upon completion of the proposed sewer projects being funded by this act.

(3)(a) The Department of Health and Rehabilitative Services shall survey all septic tank soil-absorption systems in the Apalachicola Bay Area to determine their suitability as onsite sewage treatment systems. Within 6 months from the effective date of this act, Franklin County and the municipalities within it, after consultation with the Department of Health and Rehabilitative Services and the Department of Environmental Regulation, shall develop a program designed to correct any onsite sewage treatment systems that might endanger the water quality of the bay.

(b) Franklin County and the municipalities within it shall, within 9 months from the effective date of this act, enact by ordinance procedures implementing this program. These procedures shall include notification to owners of unacceptable septic tanks and procedures for correcting unacceptable septic tanks. These ordinances shall not be effective until approved by the Department of Health and Rehabilitative Services and the Department of Environmental Regulation.

(4) Franklin County and the municipalities within it shall, within 12 months from the effective date of this act, establish by ordinance a map of "pollution-sensitive segments of the critical shoreline" within the Apalachicola Bay Area, which ordinance shall not be effective until approved by the Department of Health and Rehabilitative Services and the Department of Environmental Regulation. Franklin County and the municipalities within it, after the effective date of these ordinances, shall no longer grant permits for onsite wastewater disposal systems in pollution-sensitive segments of the critical shoreline, except for those onsite wastewater systems that will not degrade water quality in the river or bay. These ordinances shall not become effective until approved by the resource planning and management committee.

Until such ordinances become effective, the Franklin County Health Department shall not give a favorable recommendation to the granting of a septic tank variance pursuant to section (1) of Ordinance 79-8, adopted on June 22, 1979, by the Franklin County Board of County Commissioners and filed with the Secretary of State on June 27, 1979, or issue a permit for a septic tank or alternative waste disposal system pursuant to Ordinance 81-5, adopted on June 22, 1981, by the Franklin County Board of County Commissioners and filed with the Secretary of State on June 30, 1981, as amended as set forth in section 7(2), unless the Franklin County Health Department certifies, in writing, that the use of such system will be consistent with section 6(6) and (7).

(5) Franklin County and the municipalities within it shall, within 9 months from the effective date of this act, enact land development regulations to protect the Apalachicola Bay Area from stormwater pollution, including provisions for development approval, before the issuance of building permits pursuant to Rule 17-25, F.A.C. Franklin County and the municipalities within it shall, within 90 days following the above deadline, survey existing stormwater management systems and discharges to determine their effect on the bay and develop a comprehensive stormwater management plan to minimize such effects. The plan will include recommendations and financing options for the retrofitting of existing systems. Franklin County and the municipalities within it shall, as part of an overall stormwater management program, inform its citizens about stormwater, its relationship to land use, and its effect upon the resources of the Apalachicola Bay Area.

(6) Franklin County and the municipalities within it shall, within 1 year from the effective date of this act,

prepare, with assistance from concerned state agencies and other interested parties, a report on options to improve the fisheries for the Apalachicola Bay Area. Assistance should also be requested from the appropriate federal agencies. Within 12 months from the effective date of this act, copies of the report shall be submitted to the Marine Fisheries Commission.

(7) Franklin County and the municipalities within it shall, beginning 12 months from the effective date of this act, prepare semiannual reports on the implementation of subsections (2)-(6) on the environmental status of the Apalachicola Bay Area. The state land planning agency may prescribe additional detailed information required to be reported. Each report shall be delivered to the resource planning and management committee and the state land planning agency for review and recommendations. The state land planning agency shall review each report and consider such reports when making recommendations to the Administration Commission pursuant to section 8.

Section 10. The applicants for grants from the Department of Environmental Regulation to finance sewerage improvements for Apalachicola, Carrabelle, and Eastpoint Water and Sewer District, herein referred to as applicants, shall not be required to submit planning or design documents prior to any grant award or prior to September 30, 1985, nor shall the applicants be required to establish a capital improvement account. The funds from any appropriation are to be held, together with any state or federal grant funds, to implement sewerage projects, subject to the requirements of Chapter 17, F.A.C. Such funds shall be deposited into a trust fund, to be known as the Apalachicola Bay Protection Trust Fund, which is hereby created, until the Department of Environmental Regulation determines that an applicant otherwise entitled to the funds has met all the Department of Environmental Regulation's requirements. Interest from moneys in the trust fund shall be deposited into the Water Pollution Control Trust Fund.

Section 11. (1) The sum of $101,744 and four additional positions is hereby appropriated from the General Revenue Fund to the Department of Community Affairs to carry out its responsibilities under this act.

(2) The sum of $39,188 and two additional positions is hereby appropriated from the General Revenue Fund to the Department of Health and Rehabilitative Services to carry out its responsibilities under this act.

(3) The sum of $29,800 and one additional position is hereby appropriated from the General Revenue Fund to the Department of Environmental Regulation to carry out its responsibilities under this act.

Section 12. This act shall take effect upon becoming a law.

AN ORDINANCE DEFINING AND REGULATING THE CRITICAL SHORELINE DISTRICT OF FRANKLIN COUNTY, AND ADOPTING MAPS OF THE POLLUTION SENSITIVE SEGMENT THEREOF

FRANKLIN COUNTY, FLORIDA

ORDINANCE No. 87-1

The Board of County Commissioners recognizes the need to maintain the seafood industry and aquatic recreational resources of Franklin County for the benefit of current and future residents by protecting coastal and inland waters from pollution generated by stormwater runoff, sedimentation and septic tanks. This ordinance shall repeal Ordinance 81-5 Special District S-3, Critical Shoreline Overlay, and shall prevail when in conflict with Ordinance 79-8, Septic Tanks.

I. Intent of the Critical Shoreline District

Good water quality is essential in maintaining viable seafood and aquatic recreational resources. The intent of this ordinance is to maintain good water quality by protecting wetlands and by guiding development and land use on adjacent uplands, thereby creating a buffer to reduce the adverse impacts of pollution on freshwater and marine resources.

II. Scope

This ordinance shall apply to all land and water in unincorporated Franklin County.

III. Definitions

1. Alternative Wastewater Treatment System - Any Department of Health and Rehabilitative Services (DHRS) approved onsite individual sewage disposal system which will consistently provide a level of sewage treatment equal to or exceeding that of a Class I aerobic treatment unit in compliance with National Sanitation Foundation (NSF) Standard 40, revised May 1983. The unit must also meet all requirements as called for in Chapter 10D-6, Florida Administrative Code, "Standards for Onsite Sewage Disposal Systems".

2. Clearing - The removal of live vegetation by any means including but not limited to cutting, grading, plowing, chemical treatment and mechanical or non-mechanical uprooting. Does not include mowing of existing lawns or planted grasses.

3. Critical (Habitat) Zone (CHZ) - All lands within 50 feet landward of Wetlands of Franklin County.

4. Critical Shoreline District - All land within 150 feet landward of Wetlands of Franklin County.

5. Development - As defined in Section 220.20 Franklin County Zoning Ordinance.

6. Development Permit - As defined in Sections 220.21 and 301 Franklin County Zoning Ordinance.

7. Habitable Structure - Any structure usable for living purposes, which includes working, sleeping, eating, cooking, recreation or any combination thereof.

8. Natural Vegetation - As defined in Section 220.46 Franklin County Zoning Ordinance.

9. Pollution Sensitive Segment - That part of the Critical Shoreline District requiring special regulatory attention due to its proximity to highly sensitive resources established on maps hereby adopted as part of this ordinance, pursuant to Chapter 380.0555(11)(d).

10. Septic Tank - As defined in Section 220.55 Franklin County Zoning Ordinance.

11. Water Dependent Structure - A structure, excluding habitable structures, used for water access placed within the Critical Habitat Zone including, but not limited to, docks, marinas, marine fueling stations other than bulk storage facilities, seafood processing houses and boat ramps.

12. Wetlands of Franklin County - The landward extent of wetlands dominated by vegetation listed in Rule 17-4.022, Florida Administrative Code (F.A.C.), which is contiguous to any manmade or natural waterbody containing an area, including wetlands vegetation, greater than ten (10) acres. Waterbodies include, but are not limited to,

sounds, bays, lagoons, lakes, streams, wet borrow pits and their tributaries. In the absence of wetlands, the landward extent shall be determined by approximate ordinary high water or approximate mean high water.

13. Wetlands - As defined in Section 220.67, Franklin County Zoning Ordinance.

IV. Critical Shoreline District

The intent of the Critical Shoreline District is to assure that all development within this District receives special regulatory attention so as to minimize adverse impacts on the county's freshwater and marine natural resources. The Critical Shoreline District includes the Pollution Sensitive Segment and the Critical Habitat Zone.

The purpose of the Critical Habitat Zone is to retain a natural, low maintenance, vegetated buffer between upland development and wetlands, freshwater and marine resources thereby minimizing shoreline erosion and stormwater runoff.

The purpose of the Pollution Sensitive Segment is to provide a protective buffer between lands suitable for standard septic tanks and sensitive, economically important, freshwater and marine resources.

There is hereby established the Critical Shoreline District which consists of all lands within a distance of 150 feet landward of Wetlands of Franklin County. The Pollution Sensitive Segment, also a distance of 150 feet landward of Wetlands of Franklin County is indicated on maps maintained by the Franklin County Planning and Building Department which are hereby declared to be a part of this ordinance. The maps are a guide to the location of the segment; its actual extent with respect to a particular parcel shall be made on a case-by-case basis by the Franklin County Planner, or his designated representative, in accordance with this ordinance.

V. Development in the Critical Shoreline District

1. Prior to any development in the Critical Shoreline District, the applicant must apply for and receive a development permit pursuant to Section 301.04 of the Franklin County Zoning Ordinance. Each applicant shall receive upon request a copy of the Critical Shoreline District (CSD) Development Manual to assist in understanding the development standards of the district.

2. Development within the Critical Habitat Zone will be prohibited except as provided by the following:

   (a) The construction of principal water dependent use structures as identified in the C-1 Commercial Fishing District as well as boat ramps, docking, fueling and boat storage facilities in the C-3 Commercial Recreation District;

   (b) The construction of pile supported pervious, non habitable water dependent structures;

   (c) Approval of a variance for shoreline stabilization structures, erosion control structures and habitable structures, including attached porches, will require a clear demonstration of hardship. An approved stormwater management system shall be required for the variance approval of a habitable structure. Construction of a structure wtihin or waterward of the Wetlands of Franklin County shall be expressly prohibited except for uses that are granted in this section.

3. All development proposals within the Pollution Sensitive Segment will be subject to the Planning Review Process as provided by Section 301.04, Franklin County Zoning Ordinance.

4. Forestry operations on land not within the Pollution Sensitive Segment shall be exempt from the provisions of this ordinance provided that all forestry operations 1) are conducted in compliance with the Silviculture Best Management Practice Manual (1979) published by the Division of Forestry; 2) maintain an agricultural exemption in the Franklin County tax appraiser's office

for lands that would be contained in the Critical Shoreline District. Forestry operations on land within the Critical Habitat Zone of the Pollution Sensitive Segment shall comply with the provisions of this ordinance.

VI. Guidelines and Minimum Standards for Development in the Critical Shoreline District

1. Impervious surfaces shall be minimized.
2. Existing natural vegetation shall be preserved to the maximum degree possible. Alteration or clearing of existing natural vegetation shall be allowed only when conducted in accordance with the requirements set forth in the Development Permits issued by the Franklin County Planning and Building Department.
3. Within 75 feet of the Wetlands of Franklin County neither septic tanks nor alternative wastewater treatment systems shall be allowed. Within 75 feet to 150 feet of the Wetlands of Franklin County and in areas not served by a central wastewater system, alternative wastewater treatment systems shall be required. Standard septic tanks and their associated absorption beds, including subsurface or mound systems, shall be prohibited. Approval of alternative wastewater treatment systems shall be determined by the following:

   (a) The County Health Officer shall determine from the information submitted by the applicant and all other pertinent available information that the proposed alternative wastewater treatment system will not cause or contribute to violations of State Water Quality Standards listed in Chapter 17-3, F.A.C.
   (b) Prior to construction, the applicant shall apply for and receive a wastewater system construction permit pursuant to Sections 10D-6.43 and 10D-6.44, F.A.C.
   (c) The alternative wastewater treatment system shall be designed and installed pursuant to Sections 10D-6.54(2) and 10D-6.063(2)(d), F.A.C., except that all setbacks shall be pursuant to Section 10D-6.46, F.A.C.

(d) A valid maintenance agreement pursuant to Sections 10D-6.54(2)(f) and 10D-6.063(2)(d), F.A.C. shall be required.

(e) No aerobic treatment unit shall be serviced or repaired by a person or entity engaged in aerobic treatment unit maintenance until the service entity has obtained an annual written permit pursuant to Section 10D-6.063(2)(e), F.A.C.

4. The contractor shall provide a solid waste dumpster and temporary wastewater disposal system on the project site during construction.

5. Stormwater Management:

(a) Each development in the Critical Shoreline District shall include a stormwater management system which assures that the post-development peak discharge rate, volume and pollution load of stormwater is no greater than that which existed before development.

(b) Minimum lot clearing, swale/berm systems, small depressional retention areas and the integration of a stormwater system into a site's landscaping are recommended as practical and inexpensive means of managing stormwater.

(c) Single family residential structures shall minimize stormwater impacts by using site suitable best management practices which maximize the infiltration of stormwater and minimize the off-site discharge of stormwater.

(d) For all land uses other than single family residences, the applicant shall provide, as part of the development permit application, a site plan pursuant to 301.04, Franklin County Zoning Ordinance, that includes a detailed stormwater management plan for treating the first 1.5 inches of runoff. Whenever soil percolation on a site will allow the infiltration of the required stormwater treatment volume within 72 hours, the stormwater system shall consist of off-line retention practices. To the greatest extent possible, it is recommended that retention areas be integrated into a site's open space and landscaping areas so as to reduce operation and maintenance needs. Prior to receiving a development permit, the applicant shall apply for and receive a stormwater permit from the Department of Environmental Regulation pursuant to Chapter 17-25, F.A.C., except that the first 1.5 inches of runoff shall be the required treatment volume and that all development projects shall obtain a stormwater permit.

VII. Inspections

1. A permit for development within the Pollution Sensitive Segment shall not be issued without prior inspection of the development site by a permitting official of the planning and building department. The purpose of the initial inspection is to verify the Critical Habitat Zone, and the Pollution Sensitive Segment, the existence of wetlands vegetation, and the existing soil, water table and vegetation conditions.
2. Alternative wastewater treatment systems shall be inspected by the County Health Officer pursuant to Section 10D-6.43(2), F.A.C.
3. The applicant shall schedule the following inspections with the County Planning and Building Department:
   (a) Erosion and Sediment Control Inspection: as necessary to ensure effective control of erosion and sedimentation. Control practices shall be installed and stabilized between any waters and any areas cleared prior to land clearing.
   (b) Bury Inspection: inspection of any stormwater management systems which include underground components prior to covering of such components.
   (c) Final Inspection: upon completion of all work associated with installation of the stormwater management facility. A certificate of occupancy for residential structures or final approval of any other development will not be issued until such time

the stormwater management system complies with standards as approved on the development application.

4. The permitting officer who inspects the work shall either approve the stormwater management system or notify the applicant and/or the contractor in writing in what respects there has been a failure to comply with the requirements of the approved permit. Any portion of the work which does not comply shall be corrected prior to occupancy or use of the development.

VIII. Maintenance

The stormwater system(s) required by this ordinance shall be maintained by the owner and shall be subject to an annual inspection by Franklin County. The system(s) shall have adequate easements to permit such county inspection, and if necessary, to take corrective action should the owner fail to properly maintain the system(s). Should the owner fail to properly maintain the system(s), the county shall give the owner written notice of the nature of the corrective action necessary. Should the owner fail, within thirty (30) days from the date of the notice to take corrective action to the satisfaction of the County, the County may enter upon lands, take corrective action and place a lien on the property of the owner for the costs thereof. All liens shall be recorded with the Clerk of the Circuit Court and may be enforced pursuant to Chapter 85, F.S.

IX. Enforcement

Enforcement of the regulations and standards of the Critical Shoreline District will be pursuant to Sections 310 and 330 of the Franklin County Zoning Ordinance.

X. Appeals

Any applicant aggrieved by the action of any official charged with the enforcement of this ordinance of the Critical Shoreline District requirements shall have the right of appeal pursuant to Section 315.04 of the Franklin County Zoning Ordinance.

XI. <u>Fees</u>

All development within the Critical Shoreline District shall require the payment of a Critical Shoreline District permit fee as established by Resolution of the Franklin County Board of County Commissioners.

THIS Ordinance adopted in open special session this 29th day of January, 1987, having been considered and notice given as a rezoning of more than 5% of the County, by publication in the Apalachicola Times, a newspaper of general circulation within the County. This Ordinance shall take effect upon its approval by the Administration Commission, the Department of Health and Rehabilitative Services, and the Department of Environmental Regulation of the State of Florida.

THE BOARD OF COUNTY COMMISSIONERS
OF FRANKLIN COUNTY, FLORIDA

BY:______________________________
Its Chairman

ATTEST:

____
Clerk

EXECUTIVE SUMMARY OF THE ST. GEORGE ISLAND SEWERAGE STUDY

On June 17, 1986, the Governor and Cabinet requested the Department of Community Affairs to review current and planned sewage treatment facilities on St. George Island to determine whether they are adequate to preserve the ecological integrity of Apalachicola Bay. If the facilities were found to be inadequate, the Department was asked to recommend the type of treatment that would provide sufficient protection.

This report was prepared by the Department of Community Affairs in response to the Cabinet's request. In addition, it provides the Apalachicola Bay Area Resource Planning and Management Committee with information they need to fulfill their responsibilities under Chapter 380.0555. Section 380.0555(7)(e) requires the Committee to "study the economic and environmental advisibility of providing sewerage facilities to the residents of St. George Island and make a recommendation to the state land planning agency."

The report is based upon an analysis of population and land use, recently completed soil and septic tank surveys, a preliminary feasibility study of central sewage treatment for the island, and a review of the literature linking septic tank effluent to estuarine pollution. When completely developed, it is projected that from 14,000 to 17,000 people could be residing on the island. If the day visitors to the park and public beach, and temporary hotel guests are included, the number of people on the island at any one time could swell to 20,000 to 25,000 persons. That population will be housed in 4,048 dwelling units. An analysis of the suitability of the island's soils for septic tanks indicates that 88.4% have either severe limitations for septic tank use or are part of the coastal beach and dune system upon which the state limits development. Even so, without a central sewage system, the Department of Community Affairs estimates that 2,602, or 64.3%, of all future housing units will use septic tanks, and of those, 2,298, or 88.3%, will be located in soils unsuited for septic tank use. If all septic tank users are included (businesses and the state park), there will be 2,765 future septic tanks, of which it is estimated that 2,418, or 87.5%, will be located in unsuitable soils.

The major findings of this report are as follows:

1. A central sewage system for the island is the only safe option for ensuring that the resources of Apalachicola Bay will be protected as development occurs.

2. Although evidence to date does not clearly indicate that septic tanks on on St. George Island are currently contaminating the Bay with disease-causing organisms, evidence does indicate that nutrient pollution of the island's canals and boat basin is occurring, that this is most likely being caused by septic tank leachates and stormwater runoff, and that this could threaten the Bay's ecological integrity.

3. Based upon population projections and septic tank densities, as well as the similarity of the island's poor soils and high water table to other coastal areas that have experienced septic tank pollution, the probability that septic tank effluent will significantly contribute to the Bay's eventual degradation creates unacceptable risks to the commercial and recreational industries dependent upon the Bay.

Although the problems are not severe now, the likelihood that they will become severe in the future calls for a series of actions that provide in the short term maximum protection against further environmental degradation, but at the same time, ensure in the long term that bay waters will remain clean. Therefore, the Department submits the following recommendations:

1. A planning study should begin at once to determine the economic and environmental feasibility of providing a central sewage system to St. George Island. Within six months, a planning feasibility study should be completed and involve a determination as to the type and location of central sewage treatment system that is most appropriate for the island. Within six months from the completion of the planning feasibility study, funding sources should be identified and implementation actions established to have the island fully sewered within two years. If a central wastewater treatment system is not operational within this three-year planning and implementation time frame, additional septic tank permits north of Gulf Beach Drive and Leisure Lane should only be issued for Class I Aerobic Treatment Units. The planning process should be accomplished within the context of Chapter 380.0555, F.S., and should consider the feasibility of alternative wastewater treatment systems and their financial, environmental, and aesthetic impacts on the island, its residents, and Apalachicola Bay. To allow progress to be monitored, the plan should specify interim steps that must be accomplished and establish milestone dates for their accomplishment. Funding for preparation of the plan will come from the Area of Critical State Concern Trust Fund.

2. Because densities on the island are the key, not only for septic tank pollution, but also for stormwater runoff, recreational demand, and potable water, they should not be permitted to rise beyond current levels specified in the Franklin County Comprehensive Plan and the Critical Area legislation, Section 380.0555 (9)(a)1, either before or after a central sewage system is in place. The Department of Community Affairs should investigate additional safeguards to ensure the densities are kept constant.

3. Franklin County should immediately begin to require all new users on the island to connect to the central potable water system. In addition, when the new sewage system is available, Franklin County should require all users on the island to be connected to the central potable water system. The requirement of any additional connections to the central potable water system should be contingent on the availability of capacity of that system for such connections.

4. In the interim, between now and when a central sewage system is operational, the following safeguards regarding cumulative monitoring, location, type, and density of additonal septic tanks should be followed:

a. The issuance of all individual on-site sewage disposal permits should be temporary, and when centralized wastewater treatment becomes available to individual property owners, Franklin County should require all users of existing sanitary treatment systems to connect to it within 90 days.

b. The ordinance designating the Pollution Sensitive Segment and Critical Habitat Zone now under consideration by Franklin County should be adopted by the County in January, 1987, and approved by the Administration Commission and implemented by the County in March, 1987. If this is not done, the further issuance of septic tank permits should be closely monitored by the Department of Community Affairs pursuant to Chapter 380.05, F.S., and where necessary to protect the Bay, the Department should seek administrative or judicial remedies as provided by Chapter 380.11, F.S. The effectiveness of the ordinance in protecting the Bay from septic tank pollution will be monitored by the Department of Community Affairs through the DNR/DER water quality monitoring program recommended below. If it is determined that the ordinance is not providing adequate protection, additional measures will be proposed.

c. All wastewater disposal systems within the Critical Habitat Zone and Pollution Sensitive Segment of St. George Island, should be visually inspected by the Department of Health and Rehabilitative Services on an annual basis for proper operation. The Department of Environmental Regulation should conduct quarterly inspections of the septic tanks and package plants it has permitted for proper operation.

d. No individual on-site sewage disposal system should be approved within 75 feet of the mean high water line, or where wetlands exist, within 75' of the inland wetland boundary, as defined by the Department of Environmental Regulation at F.A.C. 17-4.022.

5. DER and DNR should establish a water quality monitoring program in the Apalachicola Bay. If signs of degradation appear, the Resource Planning and Management Committee should be notified and it should undertake a review of the causes of the pollution. The Committee should submit its findings to the State Land Planning Agency, which will make recommendations to the Administrative Commission regarding actions needed to abate the problem.

6. Franklin County and responsible agencies should take the appropriate actions to implement these recommendations pursuant to statutory authority as soon as possible. The Department of Community Affairs and other responsible agencies should provide technical assistance to property owners on the island to assist them in complying with the recommendations of this report.