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SOUTHWEST FLORIDA ECOLOGICAL CHARACTERIZATION ATLAS

Map Narratives

U.S. DEPARTMENT OF THE INTERIOR
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SOUTHWESTERN FLORIDA ECOLOGICAL CHARACTERIZATION: AN ECOLOGICAL ATLAS

MAP NARRATIVES

Edited
by

Martel Laboratories, Inc.
7100 30th Avenue North
St. Petersburg, Florida 33710

and

Mangrove Systems, Inc.
4010 West Cayuga Avenue
Tampa, Florida 33684

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Project Officers

Martha Young
and
Jimmy Johnston
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA/Slidell Computer Complex
1010 Gause Boulevard
Slidell, Louisiana 70460

Lawrence Handley
Minerals Management Service
P.O. Box 7944
Metairie, Louisiana 70010

Performed for

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PREFACE

The purpose of the Southwestern Florida Ecological Characterization study is to compile existing information about the biological, social, and physical sciences for the Gulf coastal counties of Florida from Pasco County to Monroe County, including the Florida Keys and Dry Tortugas (see map of the study area that follows). The Southwest Florida Ecological Atlas consists of composited overlay topic information with sixteen base maps to produce a total of 80 maps, and a volume of map narratives. Federal and State decisionmakers, among others, may use these maps and narratives for coastal planning and management, and in planning for Outer Continental Shelf oil and gas development. This study is one of a series of characterizations of coastal ecosystems being produced by the U.S. Fish and Wildlife Service. Additional studies include the Chenier Plain of Louisiana and Texas, the sea islands of Georgia and South Carolina, the rocky coast of Maine, the coast of northern and central California, the Pacific Northwest (Oregon and Washington), the Texas barrier islands, and Mobile Bay (Alabama).

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Any questions regarding this publication should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA - Slidell Computer Complex
1010 Gause Boulevard
Slidell, Louisiana 70460

SUMMARY

The study area is the southwest Florida coastal region from the northern boundary of Pasco County and southeast to the Dade-Monroe County line, including all of the Florida Keys therein. The offshore area includes the region from the State-Federal demarcation to the shoreline, and the inland area includes the following counties:

Pasco	De Soto
Pinellas	Charlotte
Hillsborough	Lee
Manatee	Collier
Sarasota	Monroe

These counties are included in the following 16 U.S. Geological Survey 1:100,000-scale topographic maps:

Tarpon Springs	Naples
St. Petersburg	Ft. Lauderdale
Sarasota	Everglades City
Arcadia	Miami
Charlotte Harbor	Cape Sable
Ft. Myers	Homestead
Sanibel	Dry Tortugas
Key West	Islamorada

The data used in the production of this atlas meets all cartographic and narrative presentation standards and specifications outlined by the Minerals Management Service and U.S. Fish and Wildlife Service, thus presenting data in a useful format for coastal decisionmakers. Previously or newly acquired map data and collateral information have been compiled to produce this atlas.

The topics included within this map narrative are: biological resources, socioeconomic features, soils and landforms, oil, gas and mineral resources, and hydrology and climatology.

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CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.470	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	0.000811	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (mt)	2205.0	pounds
metric tons (mt)	1.102	short tons
kilocalories (kcal)	3.968	BTU
Celsius degrees	1.8(C°) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.4	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
short tons (ton)	0.9072	metric tons
BTU	0.2520	kilocalories
Fahrenheit degrees	0.5556 (F° -32)	Celsius degrees

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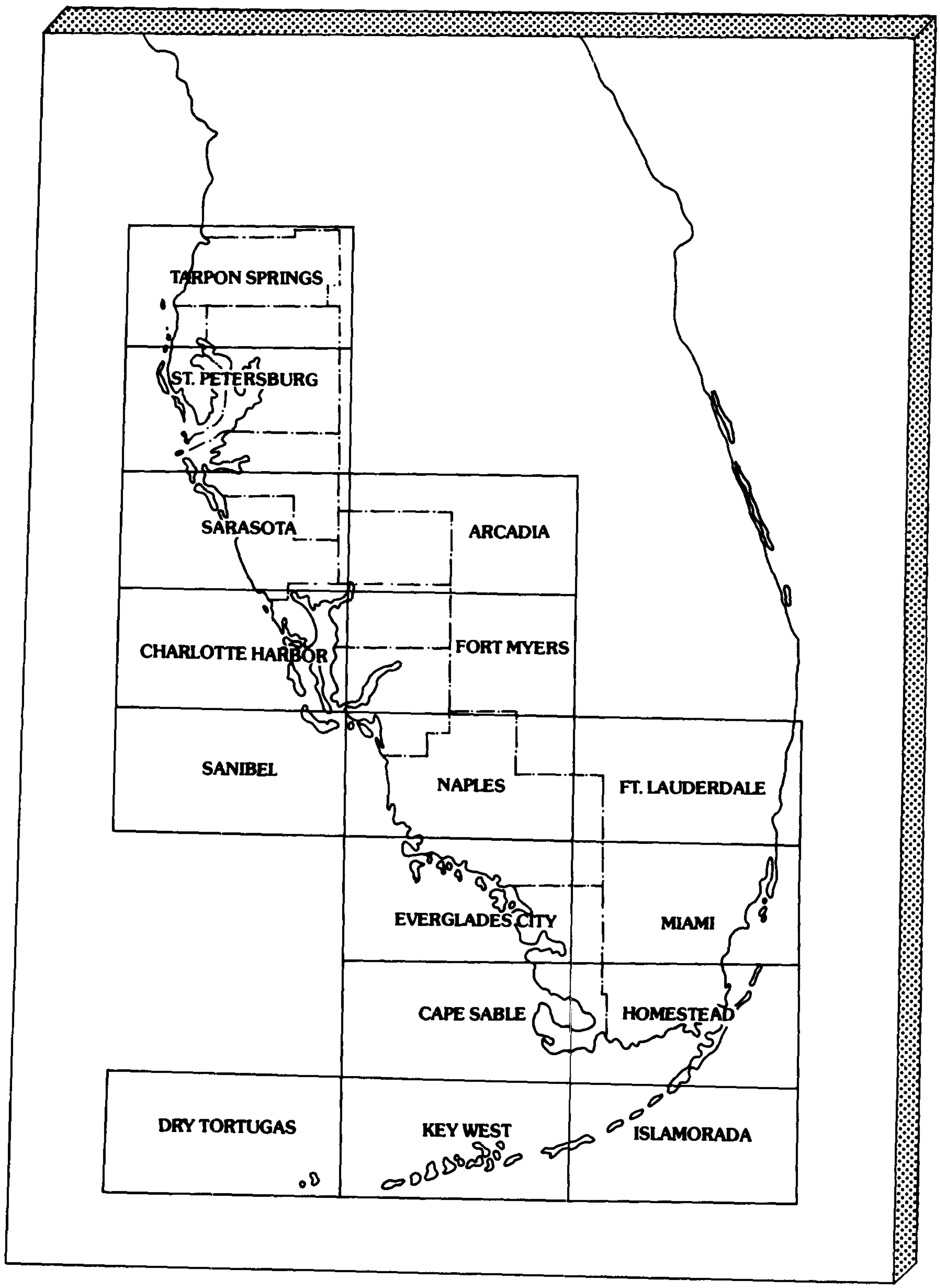

SOUTHWEST FLORIDA ECOLOGICAL ATLAS PROJECT AREA

BIOLOGICAL RESOURCES

by

Roy R. Lewis III
and
Robert L. Whitman Jr.
Mangrove Systems, Inc.

Southwest Florida is divided into two ecoregions according to R.G. Bailey (1980). They are the Everglades Ecological Province and the Outer Coastal Plain Forest Ecological Province.

The Everglades Ecological Province is a flat expanse which contains large areas of hardwood swamps and emergent marshes with broad, poorly defined streams. These habitats support a highly diverse animal population.

The Outer Coastal Plain Ecological Province is an area of gentle slopes with numerous sluggish rivers and creeks. Swamps, marshes, and lakes are abundant and support a wide variety of animal life.

1. MAJOR HABITATS

There are five groups of marine plants responsible for primary production (photosynthesis) in the southwest Florida region. These are: microalgae (benthic and phytoplankton), macroalgae (seaweeds), seagrasses, tidal marshes, and mangroves. A brief description of phytoplankton and macroalgae (seaweeds) follows.

Phytoplankton: Steidinger (1972) indicates that the phytoplankton, both pelagic and benthic, populations along the southwest Florida coast can be divided into four assemblages: 1) estuarine, 2) estuarine and coastal, 3) coastal, and 4) open Gulf. Although there are seasonal changes in species dominance and abundance, the resident assemblages would include the diatoms *Skeletonema costatum*, *Chaetoceros* spp., *Rhizosolenia* spp., and *Thalassiosira* spp.; the dinoflagellates *Ceratium hircus*, *Gymnodinium splendens*, and *Ptychodiscus brevis*; and the blue-green algal species *Oscillatoria* (= *Trichodesmium*) *erythraea*.

In addition to their importance as food sources, some phytoplankton species can cause mass mortalities of fish. These are commonly called red tides, due to the discoloration of the water. There are four toxic dinoflagellate species in the Gulf of Mexico: *Gonyaulax monilata*, *G. polyedra*, *tamarensis* var. *excavata*, and *Ptychodiscus brevis* (formerly *Gymnodinium breve*) (Steidinger 1972). Only two of these are commonly associated with red tides along southwest Florida, *Gonyaulax monilata* and *Ptychodiscus brevis*. The latter is the species associated with most of the widespread fish mortalities and toxic shellfish due to periodic population increases or blooms.

These blooms have not been shown to be associated with any manmade pollutants or coastal modifications to date. They are believed to be of natural origin and, although detrimental to beach tourism, may have some beneficial effects in reducing populations of "trash" fish species, such as catfish, on a regular basis. The blooms do cause the temporary closure of shellfish harvesting areas due to the possibility of toxic concentrations of the neurotoxin in the dinoflagellates being concentrated in the edible tissues of harvested shellfish. The toxins do not appear to be toxic to the shellfish.

Phytoplankton are important food sources for filter feeding organisms such as zooplankton and larger commercially and recreationally important species of mollusks such as the American oyster (*Crassostrea virginica*), the southern hardshell clam (*Mercenaria campechiensis*), the sunray venus clam (*Macrocallista nimbosa*), calico clam (*Macrocallista maculata*), bay scallop (*Argopecten irradians*) and calico scallop (*Argopecten gibbus*).

Macroalgae: Earle (1972) listed 610 species of macroalgae for the entire Gulf of Mexico, 575 of which occur in the eastern Gulf of Mexico, and approximately 525 of which occur along southwest Florida both within the estuaries and on the continental shelf (Humm 1973).

Excluding the blue-green algae (phylum Cyanophyta) for which taxonomy is confused (see Humm and Wicks 1980), the approximate distribution of these species among the other three phyla is 51% red algae (Rhodophyta), 18% brown algae (Phaeophyta), and 31% green algae (Chlorophyta) (Humm 1973).

The ecology and physiology of the macroalgae of Florida's west coast are discussed by Dawes (1974). A wide variety of macroalgal communities exists in the study area depending upon variations in substrate, salinity, downwelling, light, temperature, and nutrient concentrations. Examples of these communities are estuarine drift algal communities composed of species of *Ulva*, *Gracilaria*, *Hypnea* and *Enteromorpha*; gulf stenohaline benthic communities consisting of species of *Caulerpa*, *Udotea*, *Penicillus*, *Spyridia*, *Digenia*, and *Laurencia*; and an epiphytic algal community found attached to mangrove prop roots and pneumatophores consisting of species of *Bostrichia*, *Caloglossa*, *Catanella*, and *Murrayella*.

Unfortunately, the faunal assemblages associated with algal communities in the study area and their ecological roles as habitat and food sources are almost entirely unknown.

The major habitats mapped on the biological resources maps are estuarine tidal marshes, estuarine scrub/shrubs, palustrine marshes, palustrine forests, and seagrass beds. The major habitats were compiled from 1:250,000 scale National Wetland Inventory maps of the study area and are portrayed graphically by screens on the biological resources maps.

1.1 ESTUARINE (SALTWATER) TIDAL MARSH

Within the study area there are 19,986 hectares (49,361 acres) of tidal marshes which only represents 13% of the total (383,317 hectares or 946,793 acres) for the State. The reason for this is that within the subtropical climate of the study area, mangroves are rarely killed back by periodic freezes, and thus can outcompete the shorter marsh grass species over most of the area. The exceptions to this appear to be in brackish to freshwater streams connected to marine waters where marshes dominated by needlerush, (*Juncus roemerianus* Scheele) can form large monotypic stands. Narrow fringes of these marshes often have a mixture of mangroves and smooth cordgrass (*Spartina alterniflora* Loisel)(see Table 1).

These tidal marshes are more common northward in the study area because freeze damage to mangroves is more common in the north Charlotte Harbor and Tampa Bay areas.

The role of these marshes is similar to that of mangroves; they provide detrital food sources and nursery habitat for the same variety of marine species. Because of their typically lower salinity regimes, however, tidal marshes may be more important for those species which seek the saltwater/freshwater interface as postlarvae in order to escape predation. An example of such a species is the snook. Also, because of their lower stature, marshes are less important as nesting sites for those species typically associated with mangroves. Instead, species such as the clapper rail are more often found using these areas as nesting sites.

Table 1. Total number of acres or hectares of mangroves and tidal marshes by county in southwest Florida (Lewis et al. in press).

	Mangroves		Tidal marshes	
County	acres	hectares	acres	hectares
Charlotte	22,431	9,081	3,831	1,551
Collier	85,513	34,621	14,177	5,740
De Soto	204	83	204	83
Hillsborough	10,095	4,087	1,675	678
Lee	40,164	16,261	2,832	1,147
Manatee	5,754	2,330	1,029	417
Monroe	361,063	146,179	11,834	4,791
Pasco	10,588	4,287	12,228	4,951
Pinellas	7,216	2,921	423	171
Sarasota	1,115	451	1,128	457
Total	544,143	220,301	49,361	19,986

1.2 ESTUARINE SCRUB/SHRUB (MANGROVE)

Mangrove forests in the study area are composed of three dominant tree species. These are the red mangrove (*Rhizophora mangle* L.), the black mangrove (*Avicennia germinans* L.), and the white mangrove (*Laguncularia racemosa* Gaertn. f.).

Within the study area there are 220,301 hectares (544,143 acres) of mangrove forests, which represents 81% of the 272,973 hectares (674,241 acres) of mangrove forests in the entire state (Lewis et al. in press). The largest single area of mangroves is represented by the Ten Thousand Islands and Lower Everglades areas in Collier and Monroe Counties. These two counties alone account for 66% of the total area of mangroves in the State (see Table 1).

The mangrove community has received a lot of attention regarding its role in marine ecosystems (Odum et al. 1982). Work done in the Lower Everglades by Odum and Heald (1972) documented the importance of mangrove leaf detritus in the food web of that area. Like the seagrass meadows, mangroves provide both food and habitat, and direct herbivory of the plants appears to be very limited. Within any mangrove ecosystem there are at least six other possible sources of organic carbon in addition to leaf detritus, and measurements of the relative importance of each in any given ecosystem are generally lacking (Odum et al. 1982).

For this reason, we do not know to what extent mangroves contribute to the direct food supply of most marine organisms. The exception to this is the North River Estuary in the Lower Everglades where Odum and Heald (1972) did their extensive work and found that red mangrove leaf detritus was of great importance in the food web.

As habitat, mangroves also serve as nursery areas for pink shrimp, spiny lobster, snook, mullet, red drum, and numerous forage fish species such as the killifishes. In addition, many marine bird species depend on mangroves for nesting and feeding areas. These include the brown pelican, great blue heron, wood stork, reddish egret, common egret, double-crested cormorant, and roseate spoonbill.

1.3 PALUSTRINE (FRESHWATER) MARSH

Within the study area, non-forested emergent freshwater wetlands are generally subdivided into deep and shallow marshes (Environmental Effects Laboratory 1978) or 1) sawgrass marsh, 2) spike rush-beak rush flats, 3) maidencane flats, 4) flag-pickerelweed ponds, and 5) cattail marshes (Schomer and Drew 1982).

Deep marshes are dominated by cattails (*Typha* spp.), and may include arrowhead (*Sagittaria* spp.) and water lilies (*Nymphea elegans*, *N. odorata*, and *Nuphar luteum*).

Shallow marshes may be dominated by one or more of the following: sawgrass (*Cladium jamaicense*), maidencane (*Panicum hemitomon*), spike rush (*Pontedaria lanceolata*), fireflag (*Thalia geniculata*), and arrowhead (*Sagittaria lancifolia*).

The Everglades, located in the southern portion of the study area, covers approximately one million hectares (2.5 million acres) and is 75% dominated by sawgrass (Environmental Effects Laboratory 1978). This may be due to the frequency of fires and the low nutrient conditions of the soil.

The habitat value of the emergent marshes in the study area is enormous. Schomer and Drew (1982) described the invertebrates, fishes, amphibians, reptiles, birds, and mammals characteristic of the emergent marshes of the study area. Thirty-four species of fishes, 18 species of amphibians, 47 species of reptiles, and 28 species of mammals including the Florida panther, Florida black bear, and Everglades mink are listed. But by far, the most important group of animals that uses these systems are the birds. Schomer and Drew list 221 species of water and land birds found in the aquatic and terrestrial environments of the Everglades.

1.4 PALUSTRINE FOREST

The palustrine system as described by Cowardin et al. (1979) is "nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens." Within the study area, the dominant palustrine forests are cypress domes, cypress strands, river swamps, bay swamps, and south Florida hammocks (hydric hammock)(Wharton et al. 1976).

Cypress ponds are circular to irregularly shaped wetlands varying from less than 1 hectare to more than 10 hectares. The smaller ones are called cypress domes because of their shape, with taller trees in the middle and shorter trees around the edges (Wharton et al. 1976). The dominant trees are cypress (*Taxodium distichum*) although some swamp blackgum (*Nyssa biflora*) can occur. Water is usually retained in the ponds due to a semi-impermeable clay or hardpan layer. Cypress ponds are important habitat for many amphibians and reptiles, and are used as feeding areas for birds such as bitterns, egrets and herons. Permanently flooded ponds are also used as rookery areas for such species as the wood stork.

A cypress strand is a "diffused freshwater stream flowing through a shallow forested depression on a gently sloping plain" (Wharton et al. 1976). Cypress grows very well in these areas probably due to greater fire protection and nutrient and energy subsidy due to flowing water. Two of the largest strand systems, the Fakahatchee Strand and the Corkscrew Swamp, are located in the study area in Collier County. Other trees commonly occurring in the strands are willow (*Salix* sp.), red maple (*Acer rubrum*), and pond apple (*Annona glabra*). Strands are important wildlife habitat, particularly for such rare and endangered species as the Florida panther, wood stork, and short-tailed hawk (Wharton et al. 1976).

River swamps are wetland forests that border streams and are quite diverse. Of the 23 major river swamps identified by Wharton et al. (1976), only one, the Peace River swamp, occurs in the study area. This swamp covers an area of 2,935 hectares (7,254 acres). Several other smaller swamps are present along the Alafia, Little Manatee, Manatee, and Myakka Rivers. River swamps are forested by complex mixtures of cypress, water tupelo (*Nyssa aquatica*), red maple, sweet bay (*Magnolia virginiana*), and pond apple. Ecological functions and values are similar to those for cypress strands. In addition, they may filter runoff that eventually enters coastal waters, removing sediment and nutrients detrimental to estuarine plant communities.

Bayheads are similar to cypress ponds or strands except that typically no cypress is present. Instead, the dominant trees are sweet bay and red bay (*Persea borbonia*). In south Florida, bayheads also contain cocoplum (*Chrysobalanus icaco*), pigeonplum (*Coccolobus diversifolia*), dahoon holly (*Ilex cassine*), and poisonwood (*Metopium toxifera*) (Craighead 1971).

Wharton et al. (1976) distinguished two types of hydric hammocks, a north and south Florida type. They described the north Florida type as "a wetland forest with an evergreen-oak appearance on poorly drained soils, soils subject to constant seepage, or soils with high water tables. Red cedar and cabbage palm are abundant." They described a south Florida hammock only as "[occupying] elevated mound, surrounded by depressed wetland." It is assumed that they are referring to a tropical hardwood hammock as described by Craighead (1971) and also referred to as "tree islands." Dominant tree species include live oak (*Quercus virginiana*), pond apple, pigeon plum, poisonwood, mahogany (*Swietenia mahogani*), and white stopper (*Eugenia axillaris*).

1.5 SEAGRASS BED

Unlike macroalgal communities, seagrass beds have received much attention and are acknowledged as very important habitat and food sources in the study area (Phillips 1960, 1978; Taylor and Saloman 1968; Zieman 1982; Lewis et al. in press).

Eiseman (1980) reported the occurrence of seven species of seagrasses in Florida:

1. *Thalassia testudinum* Banks *ex* Konig (turtle grass)
2. *Syringodium filiforme* Kutzing (manatee grass)
3. *Halodule wrightii* Ascherson (shoal grass)
4. *Ruppia maritima* L. (widgeon grass)
5. *Halophila engelmannii* Ascherson
6. *Halophila decipiens* Ostenfeld
7. *Halophila johnsonii* Eiseman

The first six are found throughout southwest Florida while the last species (H. johnsonii) occurs from Biscayne Bay north to Cape Canaveral.

Seagrass beds are acknowledged to provide sediment stabilization, habitat diversity, nursery habitat for commercial and recreationally important species of fish and shellfish, and direct and indirect (detrital) food sources for many marine species.

McNulty et al. (1972) stated that there are 210,618 hectares (520,226 acres) of seagrass beds along the west coast of Florida, of which 143,192 hectares (353,684 acres) are within the study area. Bittaker and Iverson (1981), however, report that a 550,089 hectare (1,358,720 acre) area in the Florida Keys and Florida Bay "is at least 80% covered with seagrasses" which means at least 440,071 hectares (1,086,976 acres) of seagrass beds may be present here alone. Combined with the 20,235 hectares (49,980 acres) of beds in Charlotte Harbor (McNulty et al. 1972), 3,925 hectares (9,695 acres) in Sarasota and Lemon Bays, 5,750 hectares (14,202 acres) in Tampa Bay (Lewis et al. 1982), and 3,520 hectares (8,694 acres) in St. Joseph Sound and Anclote Anchorage, this brings the current estimated total to 473,501 hectares (1,169,547 acres) of seagrass beds in the study area.

In general, extensive seagrass beds do exist behind or adjacent to the barrier islands north of Tampa Bay (Mullet Key to Anclote Key). Patchy areas of shoal grass occur out to a depth of 20-30 feet offshore of Anclote Key, and very patchy Halophila decipiens has been observed out to a depth of 80 feet offshore of Mullet Key (Lewis unpublished observation). South of Tampa Bay, seagrasses are uncommon outside the barrier island chain, but are common inside the islands due to the protection and shallow depths in the lee of the islands.

South of Cape Romano, the shallow depths and semi-protected nature of Florida Bay provide ideal conditions for seagrass beds (Bittaker and Iverson 1981). These protected conditions and increasingly stenohaline and less turbid waters extend into the Keys where seagrass beds are common behind the reef tract on the Atlantic side and extend into the Gulf of Mexico as far as the 8 meter (about 24 feet) contour (Bittaker and Iverson 1981). Seagrass beds are patchy in much of the Keys area due to large expanses of exposed rock or very shallow sediments over rock in much of the shallow areas in the Keys.

Seagrass beds are important to marine life primarily for two reasons - food and habitat. As a food source, direct herbivory of the leaves or rhizomes is limited to only a few species including sea urchins, queen conch, some fish, the green turtle, and the Caribbean manatee (Zieman 1982). The consumption of seagrass detritus and leaf epiphytes (microalgae and macroalgae) appears to be the major energy transfer pathway to gastropods, amphipods, isopods, caridean and penaeid shrimp, and crabs. These in turn support a food web through smaller fish, such as pinfish and grunts, up to the top carnivores including larger game fish (snook, tarpon, spotted seatrout), wading birds, and man (Zieman 1982).

As habitat, seagrass beds are particularly important as nursery grounds for juveniles of pink shrimp, spiny lobster, queen conch, several species of grunts and snappers, snook, spotted seatrout, red drum, and sheepshead. The adult of some of these species may be more commonly associated with other habitats (such as the association of snook with mangroves), but the critical seagrass nursery habitat is probably more important in controlling the numbers of adults available to commercial and recreational fisheries.

2. CORAL REEFS

The Florida Reef Tract (FRT) represents the most recent period in a long history of coral reef development. This Holocene phase of coral reef development in Florida began approximately 15,000 years ago when the sea level began to rise from about 125 meters (410 feet) below the present level. As the sea rose, coral reefs began to grow, especially on rocky ridges of the fossilized remains of coral reefs of earlier interglacial periods. These fossil reefs presented a stable, elevated colonization point for corals, sponges, algae, and other organisms.

The Florida Reef Tract is a unique limestone shelf bordered by the Straits of Florida on the seaward side and the Florida Keys on the shoreward side. This arc-shaped formation stretches 150 miles in length and has an average width of 4 miles. The tract consists of two reef types, the outer reefs, found along the seaward edge of the shelf, and patch reefs, which form behind the outer reefs.

The Florida Reef Tract supports an estimated 50 coral species, which are commonly found in the Bahamian and West Indian coral regions. There are three different environments of the FRT which affect the growth and type of corals. First, the outer reef at the seaward edge of the shelf yields the greatest productivity and exhibits greatest species diversity. Second, the more protected back reef has diminished currents and is subject to more sedimentation. Third, the inshore shoals exhibit small corals existing at a water depth which is usually less than 10 feet (Hoffmeister 1974).

The only true coral reefs found along any of the United States coastlines are located in the FRT. The coral reef is a framework of living and dead coral and coral-like algae, which exist in areas of warm water and adequate sunlight penetration. Coral reef communities support more plant and animal species than any other marine ecosystem. Most reef-building corals share a symbiotic relationship with microscopic unicellular algae, which live in the tissues of the coral polyps. This animal/plant symbiosis forms the basis of the biological productivity of the ecosystem and for the secretion of calcium carbonate, which forms the hard skeleton of the corals. Light controls the amount of photosynthesis of the algal symbionts, which in turn control the rate of calcium carbonate deposition by the coral. This fact makes light the most important element in the growth and distribution of these corals.

The Florida Reef Tract, as well as providing habitat for economically important fishes, directly supports the economically valuable passive recreational industry of skin and SCUBA diving.

Florida statutes prohibit the possession and sales of all hard corals (order Scleractinia) and fire coral (*Millepora*). Also protected are the sea fans *Gorgonia flabellum* and *Gorgonia ventalina*.

3. ARTIFICIAL REEFS

The artificial reefs program of the State of Florida is administered by the Bureau of Marine Science and Technology under Section 370.013 of the Florida Statutes. Approximately $110,000 in grants was awarded in 1979 and 1980, the first 2 years of the newly adopted program (Florida Department of Natural Resources (FDNR) 1981b). The principle types of fish that inhabit the artificial reefs located in the southwest Florida study area coastal waters are grouper, snapper, Spanish mackerel, king mackerel and amberjacks. A complete matrix of artificial reefs keyed by number on the atlas overlays is shown in Table 2.

Florida's coastal waters contain more artificial reefs than any other state (Seaman 1982). Scientific development and deployment of artificial reefs has been a slow process with little research and scanty funding. Without considerable volunteer effort to secure materials and free labor, many of the present artificial reefs off southwest Florida would not exist. The largest group of organizations which have put together an artificial reef program is found in Pinellas County. The cities of Clearwater, Madeira Beach, St. Petersburg, St. Petersburg Beach, and Treasure Island, and the Pinellas County Board of Commissioners have built 20 reefs, of which 10 are presently being maintained by Pinellas County Mosquito Control. Its annual budget supports a small crew, barge rental, operating expenses, and equipment (Seaman 1982).

Virtually all artificial reefs in Florida are composed of either ships, automobiles, tires, or concrete. New prefabricated artificial reefs are being introduced in Florida by the Japanese (off Ft. Lauderdale, Panama City, and Jacksonville) under contract with the National Marine Fisheries Service.

Table 2. Southwest Florida artificial reef matrix (Palik 1982a).

No.	Composition	Latitude	Longitude	Depth (ft)	Distance offshore (mi)
(Tarpon Springs)					
1.	Barges	28°15'19"	82°57'27"	25	9.0
2.	Unknown	28°15'00"	82°58'00"	21	7.5
3.	Unknown	28°08'25"	82°55'05"	20	5.2
4.	Concrete Culverts	28°08'15"	82°55'51"	27	3.7
5.	Tires, Concrete Culverts	28°08'03"	82°55'51"	26–28	5.3
6.	Conc. Culverts, Tires, Conc. Pilings	28°03'12"	82°54'33"	25–30	4.5
7.	Conc. Pilings, S. Barges, Tires, Culverts	28°00'57"	82°54'42"	29	3.8
(St. Petersburg)					
1.	Concrete Rubble, 32' Steel Hull Ships	27°47'11"	82°35'57"	34–36	1.0
2.	Tires, Metal Junk, Conc. Rubble	27°47'06"	82°50'02"	20–22	0.8
3.	Tires, Metal Junk, Conc. Rubble	27°47'00"	82°49'08"	20–22	1.3
4.	Tires	27°46'18"	82°54'54"	30–32	6.3
5.	Tires, Conc. Rubble, Clay Pipes	27°46'32"	82°35'48"	16	1.3
6.	Tires, Concrete Culvert	27°44'30"	82°52'51"	29–33	6.1
7.	Junk, Tires	27°43'07"	82°46'02"	20	1.6
8.	Junk, Tires	27°43'01"	82°45'09"	20	0.8
9.	Junk, Tires	27°42'03"	82°45'06"	20	1.0
10.	Junk, Tires	27°41'05"	82°45'08"	20	1.0
11.	Tires, Conc. Rubble, Clay Pipes	27°40'56"	82°38'01"	11	1.3
12.	Tires, Conc. Culverts, Pilings and Slab	27°40'36"	82°51'45"	34–36	7.6
13.	Autos	27°39'17"	82°35'28"	25	2.1
14.	Concrete Pipe	27°36'00"	82°46'00"	90	0.4
15.	Tires, Concrete Pipe	27°32'15"	82°42'42"	40	7.8
16.	Concrete, Tires	27°31'42"	82°38'42"	15	0.01
17.	Concrete, Tires	27°30'24"	82°35'00"	12	0.1
(Sarasota)					
1.	Tires, Concrete Pipe	27°29'57"	82°48'00"	30	3.5
2.	Barge, Metal Junk, C. Pipe, Tires	27°29'30"	82°44'05"	21	1.0
3.	Autos	27°29'20"	82°43'47"	32	1.2
4.	Tires, Concrete Pipe	27°26'33"	82°49'12"	40	7.9
5.	Tires, Concrete Pipe	27°26'33"	82°44'48"	30	3.1
6.	Tires, Broken Concrete, Sewer Tile	27°23'51"	82°35'49"	12	1.0
7.	Unknown	SR 780	Bridge		
8.	Tires, Fiberglass, Conc. Rubble	27°18'06"	82°36'36"	20–30	2.1
9.	Tires, Fiberglass, Conc. Rubble	27°18'06"	82°35'36"	20–30	1.3
10.	Unknown	27°18'01"	82°35'06"	7	0.7
11.	Tires, Fiberglass, Conc. Rubble	27°17'06"	82°36'36"	20–30	2.2
12.	Tires, Rock, Tile, Conc. Rubble, Pipe	27°06'00"	82°29'00"	25	1.3
13.	Unknown	27°04'20"	82°28'40"	22	1.6

(continued)

Table 2 (concluded)

No.	Composition	Latitude	Longitude	Depth (ft)	Distance offshore
(Charlotte Harbor)					
1.	Tires	26°54'49"	82°07'36"	7-9	1.5
2.	Metal Junk	26°54'42"	82°21'48"	28	0.3
3.	Unknown	26°38'09"	82°18'09"	34	3.6
4.	Tires, Concrete Rubble	26°33'15"	82°13'14"	23	1.5
(Sanibel)					
1.	Tires, Concrete Rubble	26°24'21"	82°02'38"	20	1.2
2.	Unknown	26°24'21"	82°02'15"	20	2.2
3.	Unknown	26°20'07"	82°05'05"	30	5.7
4.	Weighted Tires	26°19'05"	82°07'05"	31-34	9.8
(Naples)					
1.	Concrete Bridge Rubble, Ships, 175' Patrol Craft	26°22'32"	81°55'04"	20	2.0
2.	Unknown	26°08'00"	81°50'40"	17	2.5
3.	Tires, Concrete Rubble	26°07'45"	81°50'45"	21	2.0
(Everglades City)					
1.	Tires	25°55'24"	81°46'15"	20-23	1.5
2.	Barge, Crane, Tires, C. Rubble Pipe, Trucks	25°52'42"	81°47'38"	30-35	4.4
(Key West)					
1.	Autos	24°39'30"	81°51'05"	20	5.3
2.	Tires, Autos, Metal Junk	24°39'36"	81°04'41"	25	2.0
3.	Unknown	24°36'00"	81°48'40"	14	0.8
(Islamorada)					
1.	Unknown	24°41'00"	80°57'30"	10	8.5

4. SHELLFISH HARVEST AREAS

Shellfish harvest areas depicted in the atlas are defined by strict water quality standards and do not show actual extent of shellfish aggregations. Continual monitoring of fecal coliform bacteria levels is done by the Florida Department of Natural Resources, Bureau of Marine Regulation and Development through the Department's Shellfish Environmental Assessment Section.

Shellfish harvest areas are classified as either approved, conditionally approved, prohibited, or unclassified. Approved areas consistently fulfill water quality criteria.

Conditionally approved areas also meet water quality standards, but are subject to more frequent localized changes, which may affect water quality by flooding and urban runoff.

Prohibited areas, which consistently do not fulfill such requirements, are officially prohibited for the harvesting of shellfish.

Unclassified areas are not subjected to continual water quality monitoring and are officially unapproved for shellfish harvesting.

The classification of all coastal and estuarine waters is subject to change due to water quality standards. Current shellfish harvest status of any particular area can be obtained from county health departments and the local office of the FDNR, Shellfish Environmental Assessment Section located in Punta Gorda, Florida, (813) 639-3443.

Shellfish is a broad term applied to many invertebrates. The water quality constraints imposed by shellfish harvest areas are directed at those species of shellfish which filter water to feed, specifically clams and oysters. These filter feeders, in which the entire animal is eaten, have potential to concentrate pathogens and toxins. Only the adductor muscle of scallops, which also filter feeds, is commonly eaten and possesses less potential for concentrating pathogens and toxins. Healthy populations of bay scallops are generally associated with good water quality.

4.1 OYSTER BEDS

The American oyster, <u>Crassostrea virginica</u>, spawns during warm months, generally from April through October. Larvae are pelagic for 2-3 weeks, then settle and become permanently attached when suitable hard substrate is encountered. They then grow rapidly, providing water flow, temperature, and salinity are suitable. Good water flow not only aids in dispersal of the larvae, but also assures transport of nutrients and removal of wastes. Oysters can tolerate a wide salinity range (10-30 ppt) and temperatures of 25°-26°C promote optimal growth. Oysters in Florida attain marketable size in 2 to 3 years. Oysters are non-selective filter feeders, sorting food by size during ingestion. Phytoplankton, bacteria, and detritus are important nutrient sources.

The southernmost oyster reef in the United States is located in Oyster Bay, between Whitewater Bay and the Shark River (Monroe County). North of this area the oyster (<u>Crassostrea virginica</u>) is nearly ubiquitous. In southwest Florida, this species is characterized by growing on nearly any suitable substrate such as seawalls, red mounds, and ridge-shaped reefs, particularly in the northern portions of the study area. Larger, naturally occurring, aggregations of oysters are depicted in the atlas as public oyster beds (Oys-1).

In certain areas, portions of submerged lands within estuaries have been leased by private interests in a maricultural effort to grow oysters. These areas appear in the atlas as private oyster beds (Oys-2). Interestingly, some areas acquired for oyster growing were subsequently closed to shellfish harvesting by the FDNR due to water quality degradation below approved criteria.

Because they are filter feeders, oysters can concentrate microorganisms as much as several thousandfold; this poses a potential health hazard since oysters are often found in shallow estuaries which may be contaminated with effluent containing pathogenic bacteria and viruses. For this reason, oyster harvesting is regulated according to strict water quality standards. Because estuarine water quality is subject to rapid change, oyster areas must be monitored frequently and may be only conditionally approved. With one exception, State law prohibits the taking of oysters between June 1 and August 31. The exception is East Bay, outside the study area. The minimum allowable size is 3 inches, also determined by State law (FDNR). In 1982, 4,816,936 lbs of oysters worth $4,834,994 were caught commercially on the Florida Gulf coast (Snell 1984).

4.2 SCALLOP BEDS

Two species of scallops occur in the study area, bay scallops (*Argopecten irradians*) and calico scallops (*Argopecten gibbus*). Bay scallops spawn offshore in spring and early summer, with some spawning occurring year round. Larvae of both species are planktonic for 1 to 2 weeks, then become sessile. Bay scallop larvae attach to seagrasses for several weeks prior to metamorphosis to the adult form. Calico scallop larvae require a hard substrate in water 60-240 feet deep offshore for attachment prior to becoming mobile juveniles. Both species reach sexual maturity within their first year.

Bay scallops occupy the same general areas each year whereas calico scallop beds are variable, depending on where postlarvae are distributed by water currents. The maximum life span of scallops is about 2 years; most die at the age of 12-14 months, after one spawning season. Scallops are filter feeders, consuming phytoplankton. Bay scallops occur in most Florida estuaries, and large populations occur where seagrass meadows are extensive, including Anclote Anchorage (Pasco County). Red tides and habitat alterations have reduced the populations in Pine Island Sound (Lee County), but evidence suggests that it may be recovering. Where abundant, bay scallops support recreational fisheries. There is no closed season on bay scallops except in Pinellas County, where they may be taken only from August 15 through December 31. Since bay scallops reach their maximum size in late July or early August, regulation by a January-July closed season would regulate minimum size as well (FDNR). In 1982, 13,842 lbs of scallops worth $37,487 were commercially caught on the Florida Gulf coast (Snell 1984).

4.3 CLAMS

Three species of clams occur in significant abundance in southwest Florida: the northern quahog (*Mercenaria mercenaria*), southern quahog (*Mercenaria campechiensis*), and the sunray venus clam (*Macrocallista nimbosa*). All are found in estuaries and coastal waters from the mean high tide level to depths of 50 ft, and are most common on shallow flats.

Sandy bottoms are the preferred substrate. Clear water is also important as too much silt in the water can smother the animals. In bays, clams are found in close association with seagrasses and algae. The northern quahog did not historically occur on the west coast of Florida, but introductions appear to have established successful populations in Tampa Bay. Quahogs spawn between April and August, sunray venus clams from July through December. Planktonic larvae remain in the water column for about 2 weeks before settling and burrowing into the sediments. Southern quahogs grow to commercial size most rapidly, reaching minimum size in 1 - 1.5 years. Northern quahogs require 2 - 3 years, and sunray venus clams 5 - 6 years. Quahogs may live more than 15 years.

Clams are suspension feeders, filtering detritus and microorganisms from the water column. Thus they may accumulate toxins and pathogens in the presence of red tides or polluted water. One of the largest clam beds to exist in the study area (possible in the country) was that of southern quahogs which extended from Cape Romano through the Ten Thousand Islands. Massive die-offs caused collapse of the fishery in the late 1940's and no recovery has since been noted. Areas of Tampa Bay and Charlotte Harbor have also supported clam fisheries on a sporadic basis. State law regulates clam harvesting according to water quality standards; also, certain kinds of harvesting equipment are prohibited because they cause excessive damage to sensitive areas such as seagrass meadows (Godcharles 1971). In 1982, only 860 lbs of clams worth $1,581 were commercially caught on the Florida Gulf coast (Snell 1984).

4.4 SHRIMP

In the study area, three shrimp species are predominant: pink shrimp (Penaeus duorarum), rock shrimp (Sicyonia brevirostris), and royal red shrimp (Hymenopenaeus robustus).

Pink shrimp are the most economically significant in the State. The two major pink shrimp fishing grounds in the United States are both located in the study area -- the Tortugas in the Florida Keys, and the Sanibel grounds off Lee County. Spawning occurs in the open Gulf, year round in the Tortugas, but only in the summer months further north in Tampa Bay. After several molts, postlarvae enter estuaries where they become bottom feeders. The estuarine phase of growth is the most critical in the life cycle of the pink shrimp. These areas provide postlarval, juvenile, and subadult shrimp with food and protection from predation. Research indicates that the shrimp yield depends on the survival of the estuarine marshes, mangroves, and seagrass meadows in their natural state (Fishery Management Council 1981b). Areas such as the marsh- or mangrove-water interface and seagrass meadows offer a rich food source for juvenile pink shrimp, which feed on detritus, algae and microfauna.

As they become older, pink shrimp emigrate to the Gulf and become predatory and omnivorous in their feeding habits. Sexual maturity is reached in about 1 year. The majority of commercial pink shrimp are caught at depths of 20-27 meters (66-90 ft), and the catch is greatest in southwestern Florida. Shallow grass beds provide a source of smaller animals for the live-bait shrimp fishery. There are State and local size standards, but no catch limit for pink shrimp in Florida. The season permissible for catch varies according to area. The Florida catch accounts for approximately 97% of the total annual value of pink shrimp caught in the Gulf; the Dry Tortugas area accounts for about 70% alone (Fishery Management Council 1981b).

Rock shrimp (<u>Sicyonia brevirostris</u>) are not dependent on estuaries during any part of their life cycle, which is apparently passed entirely in offshore waters and primarily in depths of 18-82 meters (60-270 ft). Spawning occurs year round; no information has been reported regarding larval development, feeding habits, or migration patterns. Sexual maturity is reached in approximately 1 year. Adult rock shrimp are apparently nocturnal, generalized carnivores. In Florida, rock shrimp are harvested mainly from sandy bottoms at depths of 18-40 meters (60-132 ft). Rock shrimp are most frequently taken as incidental bycatch, especially with pink shrimp. A small-scale directed fishery does exist and both catch and effort have been increasing steadily (Fishery Management Council 1981b).

The royal red shrimp (<u>Hymenopenaeus robustus</u>) is a deep water species compared with the others discussed above, occurring mostly at depths of 256-549 meters (840-1,800 ft). One area of concentration of royal red shrimp is south-southeast of Dry Tortugas in the Florida Straits. Unlike the species previously discussed, these shrimp appear to have a major spawning peak during winter and spring, although some spawning occurs year round. Sexual maturity is not reached until after the first year, and populations include several generations (as many as five year classes). There have been no reports on migration patterns, larval development or food habits of royal red shrimp. Because of the greater depths at which they occur, these shrimp are not taken as incidental bycatch with other species, and commercial fishing efforts are limited. Royal red shrimp are sought when shrimping along the coast is poor; heavier equipment and different types of nets are required because of the deep-water habitat. Although the average annual commercial catch is less than that for other shrimp species, the Dry Tortugas area provides approximately 45% of the total (Fishery Management Council 1981b).

In 1982, the exvessel value of all shrimp landings for the Florida west coast exceeded $47 million. The exvessel value is the total paid to fisherman by dealers (it does not include sales directly to restaurants or other private concerns). As such, it indicates the direct economic contribution of the fishery (Snell 1984).

4.5 SPINY LOBSTER

The spiny lobster (Panulirus argus) is second only to pink shrimp in commercial value. Typically, 50% or more of the State's annual lobster catch is landed in Monroe County. The life cycle and development are relatively well known; spawning occurs from April through July, and the eggs are carried by the female for 4 weeks before being released into the plankton as larvae. The pelagic larvae remain in the plankton in deep water for about 6 months, then metamorphose into a postlarval puerulus. The pueruli move into shallow water and settle to the benthos. Although postlarvae can settle and survive on oceanic banks, the optimum habitat for growth and survival is shallow, mangrove-fringed areas. These areas appear to be essential for a productive fishery. Florida Bay is the principle juvenile nursery area for south Florida's spiny lobster population. As they increase in size, the lobsters migrate to deeper water, occupying seaward reefs as adults. Reproductive maturity occurs at about 3 years, at which time the carapace length is about 3 inches. Larval lobsters feed on zooplankton; as adults they are opportunistic omnivores, preying particularly on mollusks and crustaceans at night. The commercial lobster fishing season is open from July 25 through March 31. There is a special sport fishermen's season on July 20 and 21. Commercial lobster fishing is prohibited in the Everglades National Park, which includes part of Florida Bay. Recreational fishing only is permitted there, and in the Marquesas National Wildlife Refuge and Fort Jefferson National Monument, Dry Tortugas. Further regulations of commercial lobster fishing involves licensing, gear restrictions, size and condition of lobsters taken, and time of day when traps may be pulled. The annual exvessel value of the Florida west coast lobster catch exceeded $13 million in 1980 (Snell 1984).

4.6 STONE CRAB

The stone crab (Menippe mercenaria) has recently become an important commercial and recreational fishery resource in Florida where the principle fishing areas are northern Florida Bay and waters off Collier County. Most fishing occurs in coastal waters near shore, but extends to depths of 50-60 feet in Collier County. Spawning occurs year round in Florida Bay, but only from April through September in more northern areas. The planktonic larvae live near the water surface for approximately 2 to 4 weeks. The postlarvae become more benthic and attain the adult form at about 6 weeks. The larvae feed on zooplankton while juveniles and adults are opportunistic carnivores. Juvenile stone crabs do not burrow, living instead in areas that offer both food and protection such as seagrass beds, sponges, soft corals, and Sargassum mats.

Reproductive maturity occurs at about 1 year, at which time males are of harvestable size, but females are not. Thus, female crabs may spawn more than once prior to entering the fishable population. Adult stone crabs live in burrows most often contructed in or near seagrass meadows. The commercial stone crab season extends from October 15 to May 15; only the claws may be kept, and must be of a minimum size (2.75 inches propodus length, or 4.25 inches overall length). Other regulations govern permits and traps, and several regulations differ in the Everglades National Park because of Federal jurisdiction. The northern half of eastern Florida Bay and all areas within 400 meters (1,312 feet) of the coast are closed to stone crabbing.

In terms of economic value, Collier and Monroe Counties have accounted for over 75% of the total statewide stone crab landings since 1966. Collier County obtains from 35% to 40% of its total fishery earnings from the stone crab industry (Salt Water Fisheries Study Advisory Council 1982). In 1982, 5,694.454 lbs of stone crab worth $7,886,432 were commercially caught on the Florida Gulf coast (Snell 1984).

4.7 BLUE CRAB

Blue crabs (Callinectes sapidus) are most abundant in bays and river mouths in Florida. They prefer muddy bottoms in waters to about 35 meters (100 feet) depth. Females migrate offshore to waters of higher salinity for spawning, which occurs year round except in northern portions of the State. The planktonic larvae remain in higher salinity water for 30-50 days. The postlarvae and first few juvenile stages settle to the bottom and migrate (using tidal currents) back towards the estuaries. Juveniles occupy shallow areas in the estuary such as seagrass meadows while adults prefer deeper regions. Adults reach commercial size (5 inch carapace width) at 1 - 1.5 years, and may live as long as 3 to 4 years. Larvae eat both phyto- and zooplankton. Adult blue crabs are scavengers, but prefer live prey such as small fish, oysters, and clams. There is no closed season on blue crab in Florida. Crabs taken must measure 5 inches across the carapace, and egg-bearing females may not be sold. Since the late 1950's, the volume of blue crab landings of Florida's west coast have exceeded those of the east coast. The value per pound of blue crab is considerably less than that of stone crab, 16.8 vs. 90 cents (Florida Sea Grant Publications 1978-1980). In 1982, 8,870,850 lbs of blue crabs worth $2,209,055 were caught commercially on the Florida Gulf coast (Snell 1984).

5. FINFISH SPAWNING, NURSERY, AND HARVEST AREAS

The extensive shoreline and sheltered embayments of southwest Florida provide vital habitat for adult and nursery stocks necessary to the maintenance of the commercial and recreational fisheries of the region. Habitats such as coral reefs, mangrove forests, seagrass beds, and marshes provide refuge and forage areas for economically important species. Information on the following species was provided by the Florida Department of Natural Resources, the Gulf of Mexico and South Atlantic Fisheries Management Councils (Fisheries Management Plans), and the Saltwater Fisheries Study and Advisory Council (Final Report 1982).

Finfish spawning, nursery, and harvest areas are keyed on the biological resources maps by a species data matrix on the map legend. Commercial fishery data for landings (in pounds) and ex-vessel value of selected species is listed by county in Appendix A.

5.1 ESTUARINE-DEPENDENT SPECIES

5.1.1 Red Drum (Sciaenops ocellata)

Red drum inhabit estuarine and nearshore Gulf of Mexico waters. Spawning occurs in coastal, nearshore areas beginning in September and continuing through February. Larvae are transported to estuarine nursery areas by currents, where they remain during the summer, developing into juveniles which leave the estuary with the onset of cold weather. As the fish mature they apparently prefer to spend more time in the shallow nearshore gulf. Redfish are primarily bottom feeders with a preference for crabs and shrimp. They exhibit secondary midwater and surface feeding. There is a 12 inch minimum size limit on redfish.

5.1.2 Spotted Seatrout (Cynoscion nebulosus)

The spotted seatrout is very closely tied to the estuary. Spawning occurs within the estuary and possibly in those waters immediately adjacent to the mouth of the estuary. Generally a spring and summer spawner, with peak spawning occurring from April through July, south Florida stocks apparently spawn year round with a major peak in the spring and a minor peak in the fall. Essentially non-migratory, seatrout exhibit a random residential range within the estuary. Tagging studies have shown that most fish move less than 30 miles.

Each estuary appears to have a unique breeding stock, each stock having slightly different morphological racial traits. Habitat preference appears to be seagrass beds. Spotted seatrout feed on fish, shrimp, and other crustaceans and become more piscivorous as they mature. A 12 inch minimum size limit is imposed throughout the study area.

5.1.3 Snook (*Centropomus undecemalis*)

Snook are essentially tropical fishes and sensitive to cold-induced mortality. The northern limit of their range is located just north of the Crystal River. Spawning, possibly lunar induced, occurs at and near tidal passes from late May through July. Eggs and larvae are transported to estuarine and brackish nursery areas by currents. Juveniles live in the upper reaches of the estuary primarily in brackish streams, ditches, and tidal freshwater creeks. Snook are essentially non-migratory, but do exhibit a residential range within the estuary and a net movement to the passes during the spawning season. Snook feed on fish and crustaceans. A closed season on snook exists between June 1 and July 31. A possession limit of 2 fish, as well as a minimum size limit of 18 inches, has also been imposed. This judicious action has been imposed in an effort to promote recovery of a declining population. A 1981 population estimate indicated a reduction to one-third the number of mature fish from the 1977 estimate.

5.1.4 Atlantic Croaker (*Micropogonias undulatus*)

The Atlantic croaker, primarily a northern gulf species, is not a major component of the ichthyofauna of southwest Florida. Spawning occurs offshore and peaks about October. Larvae are transported into the estuary where they develop rapidly. In spring, the juveniles move into the coastal nearshore environment before moving further offshore in the fall, possibly in response to declining water temperature. Croakers are harvested by the industrial fleet and processed into pet food, crab bait, and fish meal. Croakers are bottom feeders, preying on polychaetes, crustaceans, and fish and become more piscivorous as they mature.

5.1.5 Southern Flounder (*Paralichthys lethostigma*)

Spawning occurs offshore in fall and winter when adults migrate offshore from estuarine and coastal nearshore waters. The buoyant eggs usually hatch within 2 days, and larvae move to inshore and estuarine nursery areas. During this time, the symmetric larvae undergo a metamorphosis in which the skull contorts and the right eye moves around to the left of the body. Juveniles typically inhabit shallow estuarine grass beds where they feed largely on marine worms, crustaceans, and fish. Adults are capable of protective coloration changes to blend with the surrounding bottom, feeding almost exclusively on fish and crustaceans. The State has imposed an 11 inch minimum size limit on flounders.

5.1.6 Florida Pompano (Trachinotus carolinus)

Although the exact spawning location is unknown, pompano are considered to spawn offshore, evidenced by the appearance of very early larval forms in offshore Gulf waters. The peak of an extended spawning season occurs from April through June. Rapidly growing juveniles prefer open beach areas where they forage for crustaceans and mollusks. Florida supplies nearly 90% of the U.S. population of pompano, which commands the highest price per pound of any fish in the southern United States. Florida law prohibits the harvest of pompano less than 9.5 inches long.

5.1.7 Striped Mullet (Mugil cephalus)

Spawning occurs between October and January in offshore waters. Floating eggs typically hatch within 2 days, and the developing planktonic larvae move into estuarine nursery areas as juveniles where they remain until sexual maturity, approximately 2-3 years. Larvae and small juveniles feed on zooplankton, while juveniles and adults are herbivorous, feeding on diatoms, algae, and benthic detritus. With the exception of the seaward spawning migration in the fall, mullets remain in and are directly dependant on the estuary.

5.1.8 Gulf Menhaden (Brevoortia patronus)

The gulf menhaden is abundant in the northern Gulf of Mexico, and commercial harvesting efforts are concentrated in that region. Spawning probably occurs in coastal inshore areas. Planktonic larvae are selective carnivores, and migrate inshore and enter the estuarine nursery areas as juveniles. Juveniles develop a specialized gill raker - alimentary tract complex with which it feeds by non-selective omnivorous filtering. Movement into, and established residence in the estuary is an integral part of the menhaden life cycle.

5.1.9 Tarpon (Megalops atlantica)

Tarpon support an important recreational fishery in Florida. Spawning occurs from May through August in waters adjacent to offshore currents, along the outer continental shelf. Larvae are transported or migrate inshore developing into juveniles upon reaching estuarine nursery areas. Planktivorous juveniles inhabit isolated, often stagnant, pools which fringe the estuary. Adults feed on fish, crustaceans, and polychaete worms. Sexual maturity is reached at about 7 years of age; weighing approximately 60 lb., these fish have become an important part of the sport fishery. Gulf coast stocks exhibit a faster growth rate than do east coast fish.

5.1.10 Bonefish (*Albula vulpes*)

Solely a sports species, the bonefish supports an important recreational fishery centered in the Florida Keys. Spawning occurs offshore year round. Oceanic currents transport larvae into bays and nearshore waters where they develop into juveniles. Adults forage in and around grass flats in search of shrimp, crabs, mollusks, and small fishes.

5.2 REEF FISHES

Groupers and snappers are important to both the recreational and commercial fisheries of the region. Generally, spawning occurs offshore over the continental shelf. Pelagic larvae are transported great distances by oceanic currents. Upon arrival at inshore, coastal, and estuarine nursery areas, juveniles seek cover and forage for fishes and crustaceans. Typically, as these fishes develop, they exhibit an offshore movement. Although inhabitants of other areas, these fish generally seek out structures with some vertical relief, such as wrecks, artifical and coral reefs, rocky areas, holes, and ledges. Most groupers are protogynous hermaphrodites, beginning life as females and transforming into males at around age five to seven years. The State of Florida imposes a 12 inch minimum size on grouper.

5.2.1 Red Grouper (*Epinephelus morio*)

Commonly occurring offshore on the gulf coast, the red grouper is found in more nearshore habitats in the Keys. Spawning occurs in the spring over the continental shelf. Juveniles develop in coastal areas and tend to move offshore with age. This is an economically important species in southwest Florida.

5.2.2 Jewfish (*Epinephelus itajara*)

The jewfish is the largest of the groupers and can attain lengths in excess of 8 feet and weigh over 700 lb. Spawning occurs in offshore waters during July and August. Juveniles and young adults inhabit coastal and estuarine seagrass beds and mangroves. Although occasionally occurring inshore, marine jewfish tend to frequent offshore habitats.

5.2.3 Gag Grouper (*Mycteroperca microlepis*)

The gag and the red are the major groupers contributing to the commercial and recreational fishery. The gag is the most frequently caught inshore grouper on the peninsular gulf coast. Spawning, between January and March, occurs in offshore waters of the continental shelf. Juveniles inhabit nearshore and estuarine nursery areas. Also found offshore, adult gag groupers do take residence in nearshore habitats.

5.2.4 Scamp (*Mycteroperca phenax*)

More common offshore, the adult scamp is not relatively abundant in coastal waters. Spawning occurs offshore during March and April. Adults are more common over hard, broken bottoms such as rock and coral.

5.2.5 Red Snapper (*Lutjanus campechanus*)

Although the specific spawning location is not known, red snapper probably spawn in offshore waters of the continental shelf from late June until October. Larvae are transported or move to coastal and estuarine waters. Juveniles exhibit a preference for inshore areas of mud or sand bottoms, and exercise an offshore movement as a function of size. Primarily found offshore, adult red snapper are not harvested in coastal and nearshore waters, but are an economically important species in the region.

5.2.6 Mangrove Snapper (*Lutjanus griseus*)

Although occurring in offshore habitats, the mangrove snapper is the most common inshore snapper in southwest Florida. Adults are commonly found around structures, grassbeds, and mangroves in the estuary. However, spawning takes place offshore from April through October. Larvae are transported inshore, and juveniles are common in estuarine seagrass beds and mangrove-fringed shorelines. This species is also referred to as the gray snapper.

5.3 COASTAL PELAGIC FISHES

The mackerels are fast-swimming, oceanic fishes that make extensive seasonal migrations.

5.3.1 King Mackerel (*Scomberomorus cavalla*)

The king mackerel is one of the most economically important finfish, both commercially and recreationally, in Florida. Spawning occurs in waters over the outer continental shelf and in adjacent offshore currents between May and September. Little is known of juvenile forms; most inshore collections have been incidental in shrimp trawls. Adults undertake mass migrations. Evidently, there are several populations of kingfish in Florida, and some intermixing does occur. The gulf stock is apparently composed of most fishes which winter between Cape Canaveral and Key West. These fishes move into the Gulf in the spring exhibiting a northward movement and spend the summer in the northern gulf as far west as Texas. A return migration to southeast Florida is demonstrated during the fall and winter. Another population of king mackerel, which is presently off the southeast coast in the spring, apparently moves down the Atlantic coast into the area to spawn. Adults feed on small schooling jacks, menhaden, and other schooling herring-like fishes, shrimp, and squid.

5.3.2 Spanish Mackerel (*Scomberomorus maculatus*)

The spanish mackerel also support a large recreational and commercial fishery in Florida. Whereas king mackerel are not commonly associated with nearshore areas, the Spanish mackerel frequently enters saline embayments during their migration runs. Spawning occurs over the inner continental shelf from May through September. Juveniles are poorly known, although they are captured inshore in shrimp trawls. Separate stocks are presumed for each coast of Florida. Fishes wintering in Florida Bay migrate into the northeastern Gulf in the spring and return by the following winter. Spanish mackerel feed heavily on menhaden and commonly eat anchovies, small jacks, squid, and shrimp. There is a 12 inch minimum size limit imposed by the State of Florida on spanish mackerel.

5.4 COMMERCIAL FISHERIES

Commercial landing and exvessel value for the coastal counties in the study area are depicted in Appendix A for the economically important finfish. These data were supplied by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (1981).

5.5 RECREATIONAL FISHERIES

Bell et al. (1982) assessed the annual value of the saltwater recreational fishery in Florida at approximately 5 billion dollars, in terms of directly and indirectly generated income.

The finfish habitat matrix displayed in the atlas legend was derived from currently available data supplied largely by the Florida Department of Natural Resources. Finfish species were assigned applicable movement migration status as described by Moe (1972).

6. SENSITIVE PLANT SPECIES

The floral assemblage of Florida is comprised of approximately 3,500 vascular plant species. Within this assemblage of largely native flora occur many species which have received special attention and status from numerous agencies. Florida ranks fourth behind Hawaii, California, and Texas in number of listed plant taxa, which exceeds 400 species with special designations. Of these, at least one-half and possibly two-thirds occur in the southwest Florida study area.

The United States Fish and Wildlife Service (USFWS), in the 1980 Federal Register, lists only two species found in Florida as threatened or endangered. These are Chapman's rhododendron (*Rhododendron chapmanii*) and Harper's beauty (*Harperocallis flava*), neither of which occur in the study area. However, the Federal Register does list 41 species which do occur in the study area and are currently under review status (category UR-1). These are considered as primary candidates for listing as threatened or endangered (refer to Appendix C for special status definitions). Of these candidates, mappable information depicting locations of extant populations was obtained for 22 species.

These locations are plotted in the atlas for the following plant species:

Blodgett's wild mercury	*Argythamnia blodgettii*
Florida three-awned grass	*Aristida floridana*
Florida Keys senna	*Cassia keyensis*
Original prickly-apple cereus	*Cereus gracilis aboriginum*
Simpson's prickly-apple cereus	*Cereus gracilis simpsonii*
Robin's tree cactus cereus	*Cereus robinii robinii*
Florida golden aster	*Chrysopsis floridana*
Sanibel love grass	*Eragrostis tracyi*
Wild thyme spurge	*Euphorbia deltoidea serphyllum*
Garber's spurge	*Euphorbia garberi*
Porter's hairy-podded spurge	*Euphorbia porterana keyensis*
Porter's broom spurge	*Euphorbia porterana scoparia*
Wiregrass gentian	*Gentiana pennelliana*
Sand flax	*Linum arenicola*
Small-leaved melanthera	*Melanthera parvifolia*
Boykin's few-leaved milkwort	*Polygala boykinii sparsifolia*
Brown-haired snoutbean	*Rhynchosia cinerea*
Florida royal palm	*Roystonea elata*
Red-flowered ladies'-tresses	*Spiranthes lanceolata paludicola*
Florida Key noseburn	*Tragia saxicola*
Florida gramagrass	*Tripsacum floridanum*
Tampa verbain	*Verbena tampensis*

The official list prepared by the Florida Department of Agriculture and Consumer Service (FDACS) contains approximately 200 plant species which occur in southwest Florida. Of these, 18 are considered endangered and the remainder threatened (refer to Appendix C for special status definitions). Cacti, bromeliads, orchids, and ferns comprise nearly three-quarters of the endangered species listed by the State and occurring in the study area.

Other organizations and agencies which apply special designations to components of Florida flora are the Florida Committee on Rare and Endangered Plants and Animals; the Convention on International Trade in Endangered Species of Wild Flora and Fauna; the Smithsonian Institution; and the United States Forest Service.

Despite the vast numbers of sensitive plants in southwest Florida, very little information on their natural history is available, and further study is warranted if this resource is to be preserved. Natural rarity of a species may be due to narrow habitat specificity, intense competitive pressure, or limited populations (as in pollution). Without proper information, such assessments are difficult to make.

Indiscriminant collection of rare plants for landscaping and horticulture has decimated populations and in some instances led to expiration and extinction. Orchids, ferns, and bromeliads are most severely affected by this type of activity. Florida Statutes (1979), designed for the "Preservation of the Native Flora of Florida," offers judicious protection to sensitive plant species which are under collection pressure. There is an active, largely informal, trade in sensitive Florida flora, with some collection occurring within Federal and State parks, preserves, and refuges, and even the Everglades National Park is not isolated from such illegal activities. Evidently, the inaccessibility of the remaining areas of abundance of these species may have afforded more pragmatic protection from collection than legislative action.

Urbanization and development for agricultural and mining activities contribute to alteration and direct loss of habitat necessary to support sensitive plant species. Urban development is most noticeable in the coastal areas of southwest Florida and the Florida Keys. In addition, modification to hydrologic regimes can alter the hydroperiod on which habitats are critically dependent.

When characterizing the sensitive flora of southwest Florida, specific regions exhibit rich densities. The Florida Keys host the largest aggregation of tropical flora in the continental United States, however, a large portion of this tropical assemblage is not endemic. Many of these species are recent chance arrivals from the New World Tropics after the last inter-glacial rise in sea level.

In southwest Florida, the largest numbers of sensitive plant species are found in tropical hammocks. These mesic hardwood assemblages are unique to southern Florida. The Florida Keys are particularly rich in this habitat, which may be comprised of over 100 species of trees and shrubs.

The royal palm-bald cypress forest occurring in the Fakahatchee Strand (Collier County) harbors the largest and most diverse concentration of native orchids in North America. At least a dozen endemic plants occur there and discoveries of new species in this cypress slough-swamp forest are still occurring. With regard to diversity of both sensitive plant and animal taxa, the importance of this region and the adjacent Big Cypress Swamp cannot be over-emphasized (Ward 1979).

The Everglades region is a mosaic of wet prairies, marshes, sloughs, and scattered tree islands which support approximately 70 species of the sensitive flora of southwest Florida. The Everglades covers approximately 3,900 square miles with grasses and sedges most abundant. Variations in plant communities are often small differences in only one or two factors, such as soil type or water depth. Many Everglades plant species appear to be well adapted to a wide range of environmental conditions while a few plant species have very specific requirements.

A compilation devoted exclusively to the rare, threatened and endangered flora of southwest Florida may be found in McCoy (1981).

7. COLONIAL BIRD NESTING SITES

Habitat diversity, mild winter climate, and geographic location allow southwest Florida to support one of the richest assemblages of avifauna in the continental United States. The vast expanses of coastal mudflats, saline marsh, and the mangrove sheltered embayments as well as the marshes, wooded swamps, and cypress stands of the interior provide the forage areas and nesting substrate essential to the survival of vast populations of seabirds, shorebirds, wading birds, and waterfowl which predominate in the region. Nesting colonies are depicted on the atlas by numbered symbols. Species composition of each colony is listed by map base in Appendix B. The status categories of "endangered," "threatened," and "species of special concern," as listed by the Florida Game and Fresh Water Fish Commission (FGFWFC), apply to several bird species. Refer to Appendix C for special status definitions. Information pertaining to the following species was provided by the National Audubon Society, Florida Audubon Society, and Rare and Endangered Biota of Florida, Volume 2, Birds (Pritchard 1978).

7.1 SEABIRDS

Colonial nesting seabirds, considered regular inhabitants within the study area, include: the eastern brown pelican (_Pelicanus occidentalis carolinensis_), double-crested cormorant (_Phalacrocorax auritus_), and magnificent frigatebird (_Frigata magnificens_).

7.1.1 Eastern Brown Pelican (_Pelecanus occidentalis carolinensis_)

The eastern brown pelican is listed by the USFWS as an endangered species, and is listed by FGFWFC as a threatened species. Aerial surveys estimate the Florida breeding population to be around 8,000 pairs, of which approximately 50% occur in the study area. Nesting occurs in mangroves (_Rhizophora mangle_, _Avicennia germinans_), usually on small coastal islands from early spring through summer. Two to three eggs are usually laid and food availability determines fledgling success. The diet consists exclusively of fish, which are secured by plunge diving. Menhaden, mullet, sardines, and pinfish are the major prey items. The high incidence of first year mortality (approximately 70%) due to starvation may be due to the inefficiency of the young to secure prey. Because of its special status, the brown pelican is mapped in the endangered species portion of the atlas.

7.1.2 Double-crested Cormorant (*Phalacrocorax auritus*)

The double-crested cormorant usually lays three or four eggs with most nesting occurring in April through June, however, nesting has been reported throughout the year. Cormorants dive after and pursue prey underwater, returning to the surface to swallow the food item, usually fish. Nesting often occurs with colonial wading birds, and for this reason Cormorant nesting sites are mapped under the heading of wading bird colonies in this atlas.

7.1.3 Magnificent Frigatebird (*Frigata magnificens*)

The only nesting colony in the United States is located on the Marquesas Keys in the Key West National Wildlife Refuge. Some stage of breeding has been reported year round at this colony of between 50 and 150 pairs. Nesting occurs in mangroves on small islands. The female lays one egg. Frigatebirds secure prey, primarily fish, by aerial dipping, picking up food items from the surface of the water while in flight.

7.2 SHOREBIRDS

Shorebirds include gulls, terns, sandpipers, plovers, stilts, skimmers, and oystercatchers. Resident nesting species utilize coastal mudflats, saline and brackish marshes, sheltered embayments, and estuarine and coastal open water as forage areas. Nesting usually occurs on undisturbed beaches, islands, and sand spits where vegetation is sparse or absent. Southwest Florida is host to a wide variety of migrant and wintering shorebirds including plovers, sandpipers, turnstones, yellowlegs, godwits, and avocets. Gulls and terns capture small fish by hovering and diving.

7.2.1 Laughing Gull (*Larus atricilla*)

The laughing gull is the most common breeding gull in the study area. Nesting occurs on both natural and dredged material islands where low vegetation covers sandy soil. Typically one to three eggs are laid in late April and early May, and young birds fledge by late August. The largest laughing gull nesting colony in Florida, composed of about 20,000 individuals, occurred on a dredged material island in Boca Ciega Bay (Tampa Bay) until it was bulldozed recently to permit condominium development.

7.2.2 Least Tern (*Sterna albifrons*)

This opportunistic breeder requires sandy, unvegetated nesting substrate such as sand spits, islands, dunes, and gravel-covered rooftops. Two eggs are usually laid in shallow scraps in the sand. Nesting begins in late April. The least tern is listed as a threatened species by the FGFWFC.

7.2.3 Royal Tern (Sterna maxima)

This uncommon tern nests periodically in small numbers in the study area and occasionally within colonies of laughing gulls.

7.2.4 Roseate Tern (Sterna dougallii dougallii)

A relatively rare species which begins nesting in late May on Long Key in the Dry Tortugas and in a few isolated locations in the lower and middle Florida Keys. Clutches of up to three or four eggs are laid on the ground on sparsely or non-vegetated beaches during late May and early June. Young hatch in three weeks and fledging occurs approximately one month later. The adults continue to feed the young for several weeks to months after fledging. The diet is comprised exclusively of small fish, which are secured by plunge diving. The roseate tern is listed as a threatened species by the FGFWFC.

7.2.5 Gull-billed Tern (Gelochelidon nilotica)

This relatively rare tern nests in low numbers with colonies of laughing gulls and black skimmers in the Tampa Bay area.

7.2.6 Noddy Tern (Anous stolidus)

Approximately 2,000-4,000 pairs of noddy terns breed on Bush Key in the Dry Tortugas, where nesting occurs from April until August. Noddy terns remain near the Dry Tortugas when foraging for food for the young.

7.2.7 Sooty Tern (Sterna fuscta)

Approximately 70,000-100,000 sooty terns nest on Bush Key in the Dry Tortugas. Nesting occurs from March until July or August. This aggregation constitutes the largest colony of sooty terns in North America. Adults sometimes travel hundreds of miles offshore on feeding expeditions.

7.2.8 Snowy Plover (Charadrius alexandrius tenuirostris)

The cuban snowy plover is listed as an endangered species by the FGFWFC. Conservation estimates place the gulf coast population at 100 pairs. Nesting habitat requirements are isolated expansive dry sandy beaches where breeding occurs from April to June. Eggs, usually three, are laid in a shallow depression which is sometimes lined with shell fragments. Snowy plovers forage in search of insects, worms, mollusks, and crustaceans on dry and tidally influenced sand flats. No other bird species in Florida relies solely on sandy beaches for nesting and foraging habitat.

In general, site specific nesting colony data is sparse for many species due to either the small numbers of individuals which comprise a colony or the transitory nature of the colony location.

7.2.9 Wilson's Plover (Charadrius wilsonia)

The Wilson's plover breeds sporadically from the Tampa Bay area southward through the Keys. Nesting habitat diversity ranges from interior marshes to dredged spoil islands.

7.2.10 Black Skimmer (Rynchops niger)

Nesting occurs from May through August on bare or sparsely vegetated beaches, dunes, spits or dredged spoil islands.

7.2.11 American Oystercatcher (Hematopus palliatus)

Resident populations are estimated at between 100 and 200 pairs. This local population is augmented by winter migrants from mid-Atlantic states each year. Non-colonial nesting occurs on islands in tidal bays on unvegetated sand or shell well above the high water mark. Two or three eggs are usually laid. Oyster beds and mudflats are the primary forage areas where oystercatchers secure their diet of mollusks and crustaceans. Tampa Bay and Charlotte Harbor appear to be areas of concentration for this species. The American oystercatcher is listed as a species of special concern by the FGFWFC.

7.3 WADING BIRDS

Vast expanses of coastal and interior wetland habitat support a great number of colonial nesting wading birds including herons, egrets, ibises and spoonbills.

7.3.1 Great Blue Heron (Ardea herodius occidentalis)

The great blue heron begins nesting in early January in small numbers with other colonial waders, or in small specific colonies. Major forage areas consist of interior marshes, shallow areas of sheltered saline embayments, and inland bodies of water. Major prey items are fish and crustaceans although the diet may be augmented by small reptiles and mammals. The great blue heron is a common breeding resident in the entire study area. A white color morph (phase) of this species is commonly referred to as the great white heron. Although regular non-breeding occurrences prevail throughout the coastal regions of the study area, the breeding range of the great white heron appears to be confined to Florida Bay and small islands in the lower Keys where pairs breed alone or in small colonies. Hybrid nesting has been reported.

7.3.2 Little Blue Heron (*Florida caerulea*)

The little blue heron inhabits fresh or brackish marshes. The nesting season begins in February and lasts through August or September. The average clutch size consists of three eggs. Little blue herons prefer freshwater and brackish habitats in which to forage for fish, crustaceans, insects, and small reptiles and amphibians. This species is listed as a species of special concern by the FGFWFC.

7.3.3 Louisiana Heron (*Hydranassa tricolor*)

The Louisiana heron, although found in wetlands throughout the study area, is more common in estuarine habitats, where it forages for small fish and crustaceans. Typically the breeding season extends from March to July during which time three or four eggs are laid in mixed or single species colonies. The Louisiana heron is listed as a species of special concern by the FGFWFC.

7.3.4 Green Heron (*Butorides striatus*)

This common species is typically a solitary nester but will sometimes nest in small numbers on the edge of other wading bird colonies.

7.3.5 Black-crowned Night Heron (*Nycticorax nycticorax*)

Feeding occurs in all shallow water habitats, but breeding concentrations appear to be associated with estuarine habitats where nesting occurs usually in mangroves or Brazilian pepper trees (*Schinus terebenthifolius*). Breeding occurs from March to July and clutch size ranges from two to five eggs. A diet composed largely of fish may be supplemented by mollusks, crustaceans, small reptiles, amphibians, and mammals. This is the most nocturnal foraging heron, often preying on nestlings of ibis and other herons.

7.3.6 Yellow-crowned Night Heron (*Nyctanassa violacea*)

More diurnal in nature than the black-crowned night heron, the yellow-crowned night heron forages on coastal mudflats for fiddler crabs and other crustaceans which constitute a major portion of the diet. Typically forming small colonies with other yellow-crowned night herons, only occasionally does this bird nest with other waders.

7.3.7 Cattle Egret (*Bubulcus ibis*)

Since its first appearance in 1952, the cattle egret, an Old World species, has become the most abundant bird in mixed species heronries in Florida. Although it occupies coastal colonies, it rarely forages in marine and estuarine areas.

7.3.8 Great Egret (Casmerodius albus)

The great egret utilizes a variety of forage habitats, from open pasture and interior impoundments to coastlines and saline marshes. The diet consists of fish, reptiles, amphibians, birds, small mammals, and various invertebrates. The great egret exhibits a preference for more isolated heronries, where two to six eggs are laid per clutch from March through July.

7.3.9 Snowy Egret (Egretta thula)

Snowy egrets typically nest in mixed species colonies. Although widely distributed in coastal as well as interior wetlands, larger breeding colonies appear to establish near estuarine habitats. Eggs may be laid as early as December, although most nesting occurs between March and August. The snowy egret is an active predator often running through shallow water or along the shoreline in pursuit of small fish. The diet is also supported by insects and crustaceans. The snowy egret is listed as a species of special concern by the FGFWFC.

7.3.10 Reddish Egret (Dichromanassa rufescens)

Primarily a coastal species, the reddish egret nests on mangrove islands and feeds by actively pursuing fish in the surrounding shallows. Nesting is initiated in December in Florida Bay and the Keys, March in Pine Island Sound, and April in Tampa Bay. Individual pairs may nest alone, or in small groups associated with mixed species colonies. Clutch size ranges between two to five eggs. The reddish egret is listed as a species of special concern by the FGFWFC.

7.3.11 Roseate Spoonbill (Ajaia ajaja)

Primarily a coastal species which nests in mangroves on coastal islands, the roseate spoonbill nests from October through February in Florida Bay, the major nesting area for this species. Feeding on killifish and small crustaceans, spoonbills feed in shallow pools and creeks in small groups, securing prey with a specialized spatulate bill. This species is listed as a species of special concern by the FGFWFC.

7.3.12 White Ibis (Eudocinus albus)

This is an abundant species which flies and feeds in tight flocks. The diet consists largely of crawfish and other crustaceans, but white ibis also eat insects, mollusks and small fish which are secured from shallow water areas. The white ibis inhabits both freshwater and estuarine wetlands where it nests on islands, marshes, or in mangroves.

7.3.13 Glossy Ibis (*Plegadis falcinellus*)

This species inhabits fresh, brackish, and saltwater wetlands, nesting colonially with other wading bird species. Major foraging areas are grasslands, prairies, and high marsh areas which are exposed to seasonal inundation by rainfall. Preferred food items include crawfish and other crustaceans, and insects. Typically three or four eggs are laid in the spring, with breeding continuing through the summer.

7.3.14 Wood stork (*Mycteria americana*)

The wood stork inhabits freshwater and brackish marshes, where it forms large rookeries, nesting primarily in cypress swamps and protected mangrove embayments. Breeding occurs from November through January with clutch sizes ranging from two to four eggs. Primary feeding areas are pools and depressions in marshes where small fish concentrate. Feeding is accomplished by tacto-location probing. This species is listed as endangered by both the FGFWFC and the USFWS.

7.3.15 Anhinga (*Anhinga anhinga*)

Although the anhinga does nest in some coastal wading bird colonies, it is chiefly a resident of interior and brackish wetlands. Fish comprise the bulk of the diet, and are pursued and captured underwater.

7.3.16 Migratory Waterfowl

The large coastal expanses of sheltered saline embayments, brackish sounds, tidal creeks, and salt marshes support large numbers of wintering waterfowl. Peak populations occur from November through January with some members remaining through March. The most common species attracted to these coastal open water and saline environs include:

Lesser scaup (*Arythya affinis*)
Pintail (*Anas acuta*)
Blue-winged teal (*Anas discors*)
Red-breasted merganser (*Mergus serrator*)
American widgeon (*Anas americana*)
Shoveler (*Anas clypeta*)
Common loon (*Gavia immer*)

The interior freshwater wetlands appear attractive to another assemblage of migratory waterfowl. Species commonly associated with inland habitats include:

Blue-winged teal (*Anas discors*)
Green-winged teal (*Anas crecca*)
American widgeon (*Anas americana*)
Wood duck (*Aix sponsa*)
Pintail (*Anas acuta*)
Shoveler (*Anas clypeata*)
American coot (*Fulica americana*)

The wood duck and American coot are breeding residents within the study area, with local populations being augmented by winter migrants.

Coastal waterfowl concentration areas include Tampa Bay, Hillsborough Bay, McKay Bay, Charlotte Harbor, Gasparilla and Pine Island Sounds. Major waterfowl concentration areas, which are managed to some degree, include Everglades National Park, Key Deer and Great White Heron National Wildlife Refuges, Corkscrew Swamp Sanctuary, and J.N. "Ding" Darling National Wildlife Refuge.

8. THREATENED AND ENDANGERED ANIMALS

Factors directing the diversity of biota in southwest Florida are complex. The Florida peninsula is an extension into the subtropics of the temperate southeastern coastal plain of the United States. This peninsular configuration has also served to isolate existing populations and impede species enrichment. Fluctuations in climate have favored species invasion from both temperate and tropical regimes. Historic changes in sea level have also affected the biotic constituents in southwest Florida.

The biotic assemblage of southwest Florida includes many species which warrant special status from Federal and State agencies. The United States Fish and Wildlife Service (USFWS) lists species as "threatened," "endangered by extinction" or "under review" (for listing as threatened or endangered). The Florida Game and Fresh Water Fish Commission (FGFWFC) lists taxa as "endangered," "threatened" or as "species of special concern" (refer to Appendix C for special status definitions).

The mapping of threatened and endangered species in this atlas was confined to legally defined areas established for the judicious protection of listed taxa. These include federally designated critical habitat for the American crocodile and West Indian manatee, and the Key Deer National Wildlife Refuge, established for the protection of this species. State manatee sanctuaries are also mapped.

Nesting localities for the southern bald eagle and eastern brown pelican nesting colonies were plotted using information supplied by the USFWS and the FGFWFC. Nesting beaches of the loggerhead seaturtle were mapped from data supplied largely by the Florida Department of Natural Resources. Information on the following species with special status was obtained from Rare and Endangered Biota of Florida, Volumes 1-6, Pritchard (Series editor), 1978-1982.

8.1 AMERICAN CROCODILE (Crocodylus acutus)

The American crocodile occurs in extreme southern Florida where it inhabits coastal mangrove forests as well as saline and brackish embayments and creeks. Breeding range is apparently confined to eastern Florida Bay and extreme southern Biscayne Bay, although they do move into other areas. Another population has been reported in the lower Florida Keys (Big Pine Key, Little Pine Key, and Howe Key) in the vicinity of the Key Deer National Wildlife Refuge. Breeding in this area has not been documented.

Nests are dug in April; 20-80 eggs are laid in late April or May, and the young hatch in late July or early August. The hatchlings are dug from the nest by the female. Cold-induced mortality and predation by raccoons are responsible for approximately 50% of the nests in Florida Bay which fail each year. Accurate population surveys have not been completed, but estimates between 200 and 400 individuals have been generated. Of these, probably no more than 25 are breeding females. The diet consists largely of fish. Habitat loss and human disturbance are major threats. The American crocodile is listed as an endangered species by the USFWS. Federal designated critical habitat is depicted in the atlas.

8.2 KEY DEER (Odocoileus virginianus clavium)

The smallest race of North American deer, the Key deer, is confined to a few islands in the lower Florida Keys from Little Pine and Johnson Keys to occasional sightings on Sugarloaf Key. Habitat requirements include extensive pinewoods and hardwood hammocks and permanent freshwater supply. The major portion of the Key deer population is centered on Big Pine Key in the Key Deer National Wildlife Refuge (depicted on atlas overlay), which was established to protect the species. Breeding occurs primarily in September and October with fawns being produced in late April and May. The total population is estimated at between 300 and 400 individuals. The USFWS considers the Key deer an endangered species, while the FGFWFC lists this deer as threatened.

8.3 WEST INDIAN MANATEE (Trichechus manatus latirostris)

This large, passive mammal inhabits slow moving rivers, estuaries, and saline embayments where it feeds on aquatic and submerged vegetation. The total population of manatees in the United States is estimated at between 750 and 850 individuals, with approximately 350-400 inhabiting gulf coastal areas.

Manatees are weakly social animals which tend to congregate during cold weather around springs and warm water outfalls from power plants. The breeding season is not known. Calves are born after a 385-400 day gestation period and remain with the mother for an extended period of time. Major threats to this species include collision with powerboat propellers, vandalism, poaching, and habitat destruction. The USFWS has established designated critical habitats for the protection of this species which are delineated in the atlas.

The State of Florida has also established manatee sanctuaries, which are shown in the atlas. The West Indian manatee is listed as an endangered species by both the USFWS and FGFWFC.

8.4 EASTERN BROWN PELICAN (Pelecanus occidentalis carolinensis)

The eastern brown pelican is listed by the USFWS as an endangered species, and is listed by the FGFWFC as a threatened species. Aerial surveys estimate the Florida breeding population to be around 8,000 pairs, of which approximately 50% occur in the study area. Nesting occurs in mangroves (Rhizophora mangle, Avicenia germinans) usually on small coastal islands from early spring through summer.

8.5 ATLANTIC LOGGERHEAD TURTLE (Caretta caretta caretta)

Loggerhead turtles inhabit temperate and subtropical seas worldwide. The central east coast of Florida harbors the major rookeries in the United States. Nesting on the peninsular gulf coast is confined to sandy beaches within the study area. Females emerge from the water at night, fan out depressions in the sand, deposit an average of 120 eggs, and backfill the nest. After an incubation time from 1 to 3 months, the hatchlings emerge from the nest en masse. The nesting season begins in May and lasts through September. In Florida, range and population size appear to be decreasing. Major threats appear to be human interference and development near nesting habitat, entrapment in shrimp trawls, and nest predation largely by raccoons.

8.6 OTHER THREATENED AND ENDANGERED ANIMALS

8.6.1 Key Silverside (Menidia conchorum)

The Key silverside may have the narrowest geographic range of any marine fish in North America. This species is found in small populations in the lower Florida Keys (Big Pine, Cudjoe Key, Key West) where it inhabits shallow open bays. Primarily a marine fish, it exhibits a wide range of salinity tolerance, and sometimes is found in freshwater. It is listed as an endangered species by the FGFWFC.

8.6.2 Key Blenny (Starksia starcki)

The Key blenny is known only from six specimens collected at Looe Key, an offshore reef, south of Big Pine Key in the Florida Keys. Due to its limited range, it is designated as a species of special concern by the FGFWFC.

8.6.3 Rivulus (*Rivulus marmortus*)

This fish is the sole member of the genus *Rivulus* that occurs in North America. Widely scattered collections of the relatively rare fish have been made near Key West and St. Petersburg, as well as Miami, Biscayne Bay, and Ft. Pierce. The rivulus inhabits shallow water ditches and embayments and is usually associated with mangrove and marsh-fringed shorelines. This species is a synchronous self-fertilizing hermaphrodite which feeds on small crabs, mollusks, and mosquito larvae. The rivulus is designated as a species of special concern by the FGFWFC.

8.6.4 Florida Gopher Frog (*Rana areolata aesopus*)

The Florida gopher frog inhabits sandhill communities and sand pine scrub communities where it commonly shares the burrow of the Florida gopher tortoise (*Gopherus polyphemus*). Generally nocturnal, it forages at night for insects, which constitute the major portion of the diet. Gopher frogs congregate in shallow grassy pools to breed from early spring to late fall. The major threat is habitat destruction. The Florida gopher frog is listed as a species of special concern by the FGFWFC.

8.6.5 American Alligator (*Alligator mississippiensis*)

The American alligator occurs throughout Florida in interior wetland habitats, occasionally entering brackish and saline wetlands. Breeding season begins in mid-March. The female constructs a mound-shaped nest of vegetation in which 20-50 eggs are deposited. The female digs the hatchlings from the nest in approximately 9 weeks. Adults construct dens in the banks of rivers and lakes. Until the late 1960's, the hunting of alligators for hides dramatically reduced population size. Once listed as an endangered species by the USFWS, this Federal status has been reduced to threatened, largely due to alligator population increases. The American alligator is listed as a species of special concern by FGFWFC. Strictly controlled harvesting of alligators has recently been allowed in some locations within the State.

8.6.6 Marine Turtles

Five marine turtles could be encountered in the waters of South Florida. These are: the leatherback turtle (*Dermochelys coriacea*), the Atlantic green turtle (*Chelonia mydas mydas*), the Atlantic hawksbill turtle (*Eretmochelys imbricata imbricata*), the Atlantic ridley turtle (*Lepidochelys kempi*), and the Atlantic loggerhead turtle (*Caretta caretta caretta*). The first four are listed as endangered species by both the USFWS and the FGFWFC, and the Atlantic loggerhead is designated as threatened by both agencies.

Only the Atlantic loggerhead turtle commonly nests in the study area. The first documented nesting on the Florida west coast of an Atlantic hawksbill occurred on Longboat Key (Manatee County) in May 1980.

8.6.7 Florida Keys Mud Turtle (*Kinosternon bauri bauri*)

This turtle inhabits brackish and freshwater habitats where it prefers mud bottoms. Up to four eggs are laid in sand or piles of vegetation, April through June. The range is limited to the lower Florida Keys (Big Pine Key to Key West). Loss of habitat due to development in the lower Florida Keys is the major threat to this species. The Florida Keys mud turtle is designated as a threatened species by the FGFWFC.

8.6.8 Gopher Tortoise (*Gopherus polyphemus*)

The gopher tortoise inhabits drier areas such as beach scrub, live oak hammocks, and sandhill communities. In the study area, scattered populations occur from Cape Sable to the Charlotte Harbor area, usually in coastal situations. North of this general vicinity, populations are more widely distributed through suitable habitat. By excavating a long burrow, these turtles are host to many species. Other species with special status which use these burrows are the indigo snake (*Drymarchon corais couperi*), the gopher frog (*Rana areolator aesopus*), and the Florida mouse (*Peromyscus floridanus*).

The gopher tortoise lays up to 15 eggs in sand near the burrow. Incubation time is about 65 days, and the young construct their burrows in the same general vicinity as the nest shortly after hatching. The gopher tortoise is listed as a species of special concern by the FGFWFC.

8.6.9 Florida Keys Mole Skink (*Eumeces egregius egregius*)

This lizard inhabits the lower Florida Keys and the Dry Tortugas. Specimens collected from the upper Florida Keys exhibit characteristics intermediate between this form and the mainland race. Mating in March, the female deposits three to seven eggs under debris where she remains until hatching 1 - 1.5 months later. The Florida Keys mole skink inhabits sandy areas, usually near shorelines, where it forages for insects and spiders. This lizard is listed as a species of special concern by the FGFWFC.

8.6.10 Short-tailed Snake (Stilosoma extenuatum)

The short-tailed snake is endemic to central peninsular Florida, with collections in the study area coming from Pasco, Pinellas, and Hillsborough Counties. Habitat preference appears to be Longleaf Pine/Turkey Oak Communities. The life history of this snake is poorly known. This species is a burrower, not usually seen above ground. The short-tailed snake is listed as a threatened species by the FGFWFC, and its status is currently under review by the USFWS.

8.6.11 Big Pine Ringneck Snake (Diadophis punctatus acricus)

This species has only been documented from Big Pine Key. Little information is available on this snake's history. Impact from development of habitat is a potential threat to this uncommon species. The Big Pine ringneck snake is listed as a threatened species by the FGFWFC.

8.6.12 Red Rat Snake (Elaphe guttata guttata)

The red rat snake that inhabits the lower Florida Keys warrants listing as a species of special concern by the FGFWFC.

8.6.13 Florida Brown Snake (Storeria dekayi victa)

Lower Florida Keys populations of this species are designated as threatened by the FGFWFC. Usually found under rocks in pine forests, specimens of this race have only been collected on Big Pine, Sugarloaf, and No Name Keys.

8.6.14 Miami Black-headed Snake (Tantilla oolitica)

This species is endemic to a small area of Dade and Monroe Counties. Little is known about the life history of this secretive burrower. Specimens have been collected in sandy soil in tropical hammocks, pine flatwoods, and pastures. The FGFWFC lists this snake as a threatened species, and the USFWS lists the current status as under review.

8.6.15 Eastern Indigo Snake (Drymarchon corais couperi)

This snake inhabits dry, sandy areas, pine flatwoods, and moist tropical hammocks throughout peninsular Florida and the Florida Keys. In drier areas, it will utilize the burrows of the gopher tortoise (Gopherus polyphemus) as shelter. Five to twelve eggs are usually laid in May, hatching during August and Septemer. The snake is attractive to collectors because of its large size and gentle nature. Over-collection and habitat loss have contributed to its listing as a threatened species by both the USFWS and the FGFWFC.

8.6.16 Florida Ribbon Snake (Thamnophis sauritus sackeni)

Populations of this species which inhabit the lower Florida Keys warrant listing by the FGFWFC as a threatened species. Populations are known only from Big Pine, Cudjoe, and No Name Keys where they inhabit mangrove and marsh areas as well as freshwater areas.

8.6.17 Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus)

Historically, the southern bald eagle was nearly omnipresent in Florida. Breeding populations near Tampa Bay were once among the densest of large raptors known on earth. The current Florida breeding population is estimated at approximately 300 pairs.

Typically a coastal species, the southern bald eagle is also associated with larger lakes and rivers. Coastal nests in the study area are usually built in mangroves, while those near interior watersheds are constructed in tall pine and cypress trees. Nests are constructed of sticks to which a veneer of finer material is applied. The bald eagle mates for life. Eggs, usually two, are laid between October and February; incubation takes about 35 days, and young remain in the nest for up to 3 months. The diet consists chiefly of fish, birds, turtles, and carrion. The status of the southern bald eagle is defined as endangered by the USFWS and threatened by the FGFWFC.

8.6.18 Florida Everglade Kite (Rostrhamus sociabilis plumbeus)

This species feeds exclusively on the freshwater apple snail (Pomacea paludosa) and is presently found only in the upper St. Johns River watershed, western Lake Okeechobee, and northern areas of the Everglades National Park. Habitat requirements include expansive areas of freshwater marsh and shallow open water. Two to three eggs are laid February to July in small shrubs, trees, or cattails. Population size is estimated at slightly over 100 individuals. The Florida Everglade kite is listed as an endangered species by both the USFWS and FGFWFC.

8.6.19 Southeastern American Kestrel (Falco sparverius paulus)

This small falcon typically occurs in open habitats throughout the study area except in southern Monroe County. This bird hunts by hovering and plunging or dropping onto prey from high perches. Three to five eggs are laid usually in old woodpecker holes between March and June. Incubation requires 30 days. The young remain in the nest for approximately 1 month before fledging. The Southeastern American kestrel is considered a threatened species by the FGFWFC.

8.6.20 Peregrine Falcon (*Falco peregrinus*)

Although no breeding records exist for this species in Florida, the study area provides optimum wintering habitat offering a dependable supply of waterfowl and shorebirds, which are major prey items. Wintering peregrine falcons arrive in Florida by September or October and usually depart by May. The peregrine falcon is listed as an endangered species by both the USFWS and the FGFWFC.

8.6.21 Audubon's Caracara (*Caracara cheriway auduboni*)

The caracara, in Florida, inhabits the central part of the peninsula, occurring in drier prairies with scattered areas of cabbage palms (*Sabal palmetto*). One to four eggs are usually laid from January to March in a bulky nest constructed in a cabbage palm. Incubation requires approximately 30 days, and young fledge about 8 weeks after hatching. The diet consists of fish, reptiles, birds, mammals, and carrion. The caracara is listed as a threatened species by the FGFwFC.

8.6.22 Burrowing Owl (*Athena cunicularia floridana*)

The burrowing owl inhabits high sandy ground, typically prairies, sandhills, and pastures in central rows in which four to eight eggs are laid and incubated for about 3 weeks. Diet includes insects, reptiles, amphibians, and small mammals. The Florida burrowing owl is listed as a species of special concern by the FGFWFC.

8.6.23 Florida Sandhill Crane (*Grus canadensis pratensis*)

Inhabiting wet prairies, cattle pastures, and marshy lake shorelines, the Florida sandhill crane occurs in peninsular Florida. Within the study area, this crane is scarce in Monroe County and coastal strands.

Typically, two eggs are laid on a mound constructed of vegetation in shallow water during January. Both parents aid in guarding the nest, and hatching occurs in the early spring. Habitat destruction and human disturbance are the major threats to this species. The Florida sandhill crane is considered a threatened species by the FGFWFC. Total population is estimated at 4,000 individuals.

8.6.24 Limpkin (Aramus guarauna)

The limpkin is found in shoreline situations associated with slow-moving freshwater where it forages for aquatic snails, which constitute a major portion of the diet. Eggs are laid in the central depression of the nest, which is constructed of aquatic vegetation. Nesting may occur year round. The limpkin is listed as a species of special concern by the FGFWFC.

8.6.25 White-crowned Pigeon (Columba leucocephala)

The breeding range of the white-crowned pigeon is confined to the Keys and extreme southern portions of the State, generally adjacent to Florida Bay. This pigeon inhabits tropical hammocks, mangrove islands and fringing forests, where it usually nests. These migrants usually arrive in the spring from the Caribbean and depart in the fall after nesting is accomplished. The diet consists chiefly of fruits and berries. The white-crowned pigeon is listed as a threatened species by the FGFWFC.

8.6.26 Ivory-billed Woodpecker (Campephilus principalis)

The Florida population is probably extinct. This species requires vast expanses of virgin lowland hardwood forests isolated from timber harvesting operations. A small number of possible recent sightings have occurred near De Soto County; these sightings may be attributed to wandering non-breeding individuals from other populations. The last definite sighting in Florida occurred in Polk County in 1967 (Agey and Heinzmann 1971). The ivory-billed woodpecker is listed as an endangered species by both the USFWS and the FGFWFC.

8.6.27 Red-cockaded Woodpecker (Picoides borealis)

The red-cockaded woodpecker inhabits mature stands of southern pine, typically with an open understory. Although rarer in the southern reaches of the State, several small colonies exist within the study area. Cavities used for nesting are excavated in live trees. Three to five eggs are laid between April and June. Red-cockaded woodpecker is listed as an endangered species by the USFWS and as a threatened species by the FGFWFC.

8.6.28 Florida Scrub Jay (Aphelocoma coerulescens coerulesceus)

The Florida scrub jay inhabits both coastal and interior scrub oak areas of peninsular Florida. The relatively short breeding season extends from March to mid-June with two to five eggs being laid in the spring. Insects and acorns comprise the bulk of the diet, which is sometimes supplemented with small lizards and frogs. The Florida scrub jay is listed as a threatened species by the FGFWFC.

8.6.29 Marian's Marsh Wren (Cistothorus palustris marianae)

This species is an inhabitant of salt and brackish marshes along the Florida gulf coast north of Tarpon Springs. Habitat requirements include expansive areas of black rush (Juncus roemerianus) and cordgrass (Spartina alterniflora). Three to five eggs are laid in a nest constructed in these grasses or in the canopy of small black mangroves (Avicennia germinans). The breeding season extends from April through July. This species feeds on insects, crustaceans, and mollusks. Marian's marsh wren is listed as a species of special concern by the FGFWFC.

8.6.30 Bachman's Warbler (Vermivora bachmanii)

Possibly extirpated, this species is considered a migrant in Florida inhabiting wooded lowlands. Wintering occurs in Cuba and the Isle de Pines, and breeding occurs in limited localities in several areas of south and central eastern United States. Bachman's warbler is listed as an endangered species by both the USFWS and the FGFWFC. It is doubtful that this bird has been sighted since 1965.

8.6.31 Kirtland's Warbler (Dendrovica kirtlandii)

Kirtland's warbler breeds in Michigan and migrates during fall to wintering grounds in the Bahamas. Most Florida occurances are reported from the Atlantic coast. The population is estimated at 240 breeding pairs. Both the USFWS and the FGFWFC consider Kirtland's warbler an endangered species.

8.6.32 Cape Sable Seaside Sparrow (Ammospiza maritima mirabilis)

This secretive sparrow inhabits interior freshwater and brackish marshes in the extreme southern portions of the Florida peninsula. In the study area, this species is known only from Collier and mainland Monroe Counties. Federally designated critical habitat has been established in the Taylor Slough region of the Everglades National Park (Dade County) to protect a large population of Cape Sable seaside sparrows.

Nesting can occur from February through August when three to four eggs are laid in a well-concealed nest constructed in marsh grasses. Young are capable of short flights within 3 weeks after hatching. Both the USFWS and the FGFWFC list the Cape Sable seaside sparrow as an endangered species.

8.6.33 Mangrove Fox Squirrel (*Sciurus niger avicennia*)

The range of the mangrove fox squirrel appears to be limited to Big Cypress Swamp (Collier and northern Monroe Counties), where it inhabits open pinelands, dry cypress areas, and coastal tropical hammocks. Although this species may wander into mangrove areas, it does not establish permanent residence in this habitat. The mangrove fox squirrel utilizes tree cavities and leaf nests. Litters consisting of two to four young are produced once or twice per year. This species generally is not very tolerant of man or habitat loss due to logging and human development, which are major threats. The mangrove fox squirrel is listed as a threatened species by the FGFWFC.

8.6.34 Sherman's Fox Squirrel (*Sciurus niger shermani*)

This large tree squirrel inhabits longleaf pine - turkey oak vegetated sandhill communities. This species' range includes the northern two-thirds of peninsular Florida, reported in the study area from Hillsborough and Pinellas Counties. Sherman's fox squirrel constructs nests of spanish moss (*Tillandsia usneoides*), leaves, and twigs. The litter ranges in size from one to four young which remain in the brood nest for up to 2.5 months. Preferred food consists of acorns and pine seeds. Sherman's fox squirrel is considered a species of special concern by the FGFWFC.

8.6.35 Silver Rice Rat (*Oryzomys argentatus*)

This species, also called the Cudjoe Key rice rat, is known only from a small freshwater marsh on Cudjoe Key in the lower Florida Keys. Little is known of this relatively recently discovered species, and its range may extend to nearby keys. The silver rice rat is listed as endangered by the FGFWFC, and its status is currently under review by the USFWS.

8.6.36 Florida Mouse (*Peromyscus floridanus*)

Within the study area this species occurs throughout the coastal half of Sarasota and Manatee Counties to Pasco County, inhabiting the early successional stages of sand pine scrub and also occurring in longleaf pine - turkey oak communities. Typically a ground dweller, this species commonly inhabits the burrow of the gopher tortoise (*Gopherus polyphemus*). Breeding takes place in the fall and winter. The average litter contains three or four young. The Florida mouse is considered a threatened species by the FGFWFC.

8.6.37 Key Largo Cotton Mouse (*Peromyscus gossypinus allapaticola*)

This species occurs only in the mature tropical hardwood hammocks located in the northern half of Key Largo in the Florida Keys. These nocturnal mice build small nests in hollow logs, trees, and limestone rock crevices. The average litters consist of four young. Formerly found throughout Key Largo, the habitat of the Key Largo cotton mouse has been severely impacted by human development. The FGFWFC lists this species as threatened, and it is currently under review by the USFWS. A small population of Key Largo cotton mice has been introduced on Lignumvitae Key.

8.6.38 Key Largo Woodrat (*Neotoma floridana smalli*)

Once occurring on the entire island of Key Largo, the range of the Key Largo woodrat is now restricted to the few remaining tropical hardwood hammocks located on the northern one-third of the island. Occurring only in mature hammocks, younger strands of hardwoods do not appear suitable as habitat. There are presently less than 400 acres of this habitat on Key Largo. Woodrats construct large stick houses which are similar in size and appearance to beaver lodges. Typically, litters consisting of two young are produced twice a year. The habitat of the Key Largo woodrat has been severely reduced due to human encroachment through development. A small population of Key Largo woodrats was introduced onto Lignumvitae Key in 1970 and appears to have become established. The Key Largo woodrat is listed as an endangered species by the FGFWFC, and the status of this species is currently under review by the USFWS.

8.6.39 Florida Black Bear (*Ursus americanus floridanus*)

Occurring in widely scattered low density populations in Florida, the Florida black bear inhabits swamps and thickets characterized by very dense, almost impenetrable cover. This species is generally nocturnal and may travel great distances.

Litters of two young are usually produced by temporarily formed breeding pairs. Essentially omnivorous, these bears eat acorns, berries, honey, and will occasionally prey on hogs and cattle although it is not considered a serious pest. The Florida black bear is considered a threatened species by the FGFWFC, except in a few areas of the State where hunting is allowed.

8.6.40 Key Vaca Raccoon (Procyon lotor auspicatus)

The smallest race of North American raccoon, this species inhabits mangrove forests and wooded areas in the middle Florida Keys. Populations are centered on Key Vaca and Grassy Key, possibly ranging to Long and Fiesta Keys. The Key Vaca raccoon excavates sandy areas above high tide to obtain freshwater, and the natural diet consists of crustaceans and mollusks, although they will forage in human refuse. The Key Vaca raccoon is considered a threatened species by the FGFWFC.

8.6.41 Everglades Mink (Mustela vison evergladensis)

The Everglades mink is a wary, secretive species, which inhabits freshwater marshes, streams, lakes, and swamps from Lake Okeechobee through the Big Cypress Swamp and Everglades drainage area. This species is nocturnal, and prey includes fish, crustaceans, mollusks, reptiles, amphibians, birds, and mammals. Foraging is accomplished in both terrestrial and aquatic environments. This species is poorly known due to the secretive nature of this animal. The Everglades mink is considered a threatened species by the FGFWFC.

8.6.42 Florida Panther (Felis concolor coryi)

Possibly the only population of panthers in the eastern United States exists in Florida. One of two possible breeding populations in Florida occurs in an area encompassing the Fakahatchee Strand, Big Cypress Swamp, and portions of the Everglades National Park. Population size estimates range from 20 in south Florida to 30 in the entire State. Estimates are difficult because this animal is capable of traveling great distances; therefore, one panther could be responsible for many separate sightings. Florida panthers probably do not breed until 3 years of age, and most panther families observed contain two or three young. Dens are probably constructed in areas of dense thickets and fallen timber. Panthers require large expanses of undisturbed territory in which to hunt. Deer and other mammals support the diet. Federally designated critical habitat acquisition in the area of the Fakahatchee Strand and Big Cypress Swamp is being investigated by the United States Fish and Wildlife Service. Both the USFWS and the FGFWFC designate the Florida panther as an endangered species.

8.6.43 Stock Island Tree Snail (Orthalicus reses reses)

This arboreal gastropod presently occurs in a small tropical hammock on Stock Island in the lower Florida Keys. The diet consists of epiphytic growth including lichens, fungi, and algae, which are found on leaves and bark of trees within the hammock. Feeding occurs at night during periods of damp or rainy weather with most active foraging occurring during August and September. During dry weather, these snails are essentially dormant and adhere to cover by means of a mucous seal. The estimated population of 200-800 individuals is confined to approximately five acres of suitable habitat. Both the USFWS and the FGFWFC list the Stock Island tree snail as a threatened species.

8.6.44 Schaus' Swallowtail Butterfly (Heraclides aristodermus ponceanus)

This species occurs only in tropical hammocks containing the host plant torchwood (Amyris elemifera) on northern Key Largo and Elliot Key. The reproductive period extends from April to June and lasts approximately 3 weeks. Pupal stages exhibit the ability to maintain dormancy for at least two seasons. Principal threats to this species include habitat loss due to developmental stress, and aerial spraying of insecticides for the control of mosquitoes. Both the USFWS and the FGFWFC list Schaus' swallowtail butterfly as a threatened species.

8.7 WATERBIRDS WITH SPECIAL STATUS

Several seabirds, shorebirds, and wading birds with special status are discussed in a previous section (Birds).

Principal factors contributing to the listing of these species as endangered, threatened, and/or of special concern include hunting for sport or plumage; habitat loss and degradation; and reduced nesting success due to harmful pesticides. These species include: the eastern brown pelican (Pelecanus occidentalis carolinensis), wood stork (Mycteria americana), Cuban snowy plover (Charadrius alexandrinus teniurostris), American oystercatcher (Haematopus palliatus), little blue heron (Florida caerulea), snowy egret (Egretta thula), reddish egret (Dichromanassa trufescens), Louisiana heron (Hydranassa tricolor), roseate spoonbill (Ajaia ajaja), roseate tern (Sterna dougallii), and least tern (Sterna albifrons).

9. SENSITIVE HABITATS

The general region in which an active southern bald eagle nesting site is located is denoted on the Biological Resources Maps as a sensitive habitat polygon. The map may not represent reality at the time of its publication since animals move from one location to another with time. The data on the maps are from a variety of survey efforts at different times, i.e., animal locations may have been missed; animals may have moved; new ones may have established themselves, etc. Annual surveying is necessary for the State and Federal Government to keep their records up-to-date. This species is discussed in more detail in a previous section, 8.6.17 (other threatened and endangered animals, southern bald eagle).

10. STATE MANATEE SANCTUARIES

The locations of State manatee sanctuaries are shown on the Biological Resources Maps and are administered by the Florida Marine Patrol which is a branch of the Florida Department of Natural Resources. Detailed information on these sanctuaries can be found in the Boater's Guide to Manatees, the Gentle Giants (Florida Marine Patrol 1980).

11. APPENDICES

11.1 APPENDIX A - COMMERCIAL FISHERY DATA

The relative participation (by county) in the commercial fishery industry of selected species in southwest Florida in 1981 is shown below. The reported landings of each fish species are given in pounds and the exvessel value in dollars. Data is from Eric Snell of the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Miami, Florida.

A summary of the landings (lb) and exvessel values ($) for the entire study area is listed below:

Species	Landings (lb)	Study area rank	Value ($)	Study area rank	Mean price per lb.
Red Drum	722,944	7	410,141	9	0.57
Spotted Seatrout	1,501,781	5	1,211,174	4	0.81
Atlantic Croaker	1,260	14	246	14	0.20
Flounder	138,675	12	78,918	11	0.57
Pompano	452,136	10	1,186,187	5	2.62
Striped Mullet	21,064,024	1	4,824,098	2	0.23
Menhaden	40,521	13	10,895	13	0.27
Sardines	1,748,235	5	163,840	10	0.09
Grouper & Scamp	6,706,202	2	7,124,962	1	1.06
Jewfish	181,359	11	70,807	12	0.39
Red Snapper	559,850	9	1,172,477	6	2.09
Mangrove Snapper	673,214	8	577,143	8	0.86
King Mackerel	3,019,483	3	2,477,716	3	0.82
Spanish Mackerel	2,327,552	4	759,587	7	0.33
Total	39,137,235	--	20,068,191	--	--

APPENDIX A

Species	Pasco County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	4,546	2,077	722,944	410,141	<1	<1
Spotted Seatrout	21,070	14,008	1,501,781	1,211,174	1	1
Atlantic Croaker	*	*	1,260	246	*	*
Flounder	6,329	5,932	138,675	78,918	5	8
Pompano	69	134	452,136	1,186,187	<1	<1
Striped Mullet	376,278	122,039	21,064,023	4,824,098	2	3
Menhaden	*	*	40,521	10,895	*	*
Sardines	*	*	1,748,235	163,840	*	*
Grouper & Scamp	287,067	306,541	6,706,202	7,124,962	4	4
Jewfish	170	68	181,359	70,807	<1	<1
Red Snapper	10,740	24,145	559,850	1,172,477	2	2
Mangrove Snapper	996	1,318	673,214	577,143	<1	<1
King Mackerel	2	*	3,019,483	2,477,716	<1	<1
Spanish Mackerel	1,948	960	2,327,552	759,587	<1	<1
TOTAL	709,215	477,223	39,137,235	20,068,191	2	2

* Denotes no landings reported

Appendix A (continued)

Species	Pinellas County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	(Weight (lb)	Value ($)	Weight ($)	Value ($)
Red Drum	21,117	10,137	722,944	410,141	3	3
Spotted Seatrout	78,779	52,047	1,501,781	1,211,174	5	4
Atlantic Croaker	965	163	1,260	246	77	66
Flounder	14,123	7,920	138,675	78,918	10	10
Pompano	7,190	18,387	452,136	1,186,187	2	2
Striped Mullet	2,171,717	516,014	21,064,023	4,824,098	10	11
Menhaden	40,521	10,895	40,521	10,895	100	100
Sardines	268,013	30,420	1,748,235	163,840	15	19
Grouper & Scamp	2,986,019	3,254,688	6,706,202	7,124,962	45	46
Jewfish	12,659	5,795	181,359	70,807	7	8
Red Snapper	160,715	358,230	559,850	1,172,477	29	31
Mangrove Snapper	41,271	47,497	673,214	577,143	6	8
King Mackerel	19,991	12,823	30,194,483	2,477,716	<1	<1
Spanish Mackerel	57,105	22,956	2,327,552	759,587	2	3
TOTAL	5,880,185	4,347,972	39,137,235	20,068,191	15	22

Appendix A (continued)

Species	Hillsborough County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	104,775	56,944	722,944	410,141	15	14
Spotted Seatrout	60,367	42,666	1,501,781	1,211,174	4	4
Atlantic Croaker	*	*	1,260	246	*	*
Flounder	2,908	1,525	138,675	78,918	2	2
Pompano	1,008	2,888	452,136	1,186,187	<1	<1
Striped Mullet	1,362,368	283,011	21,064,023	4,824,098	7	6
Menhaden	*	*	40,521	10,895	*	*
Sardines	18,775	9,460	1,748,235	163,840	7	6
Grouper & Scamp	423,159	460,935	6,706,202	7,124,962	6	7
Jewfish	--	*	181,359	70,807	--	*
Red Snapper	44,713	93,920	559,850	1,172,477	8	8
Mangrove Snapper	2,749	2,980	673,214	577,143	<1	<1
King Mackerel	6	5	3,019,483	2,477,716	<1	<1
Spanish Mackerel	4,181	1,750	2,327,552	759,587	<1	<1
TOTAL	2,024,469	956,084	39,137,235	20,068,191	5	5

* Denotes no landings reported

Appendix A (continued)

Species	Manatee County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	65,386	37,660	722,944	410,141	9	9
Spotted Seatrout	75,453	51,543	1,501,781	1,211,174	5	4
Atlantic Croaker	55	17	1,260	246	4	7
Flounder	3,051	1,567	138,675	78,918	2	2
Pompano	16,457	45,374	452,136	1,186,187	4	4
Striped Mullet	4,848,931	1,132,375	21,064,023	4,824,098	23	24
Menhaden	*	*	40,521	10,895	*	*
Sardines	1,360,147	123,779	1,748,235	163,840	78	76
Grouper & Scamp	911,898	980,997	6,706,202	7,124,962	14	14
Jewfish	1,677	839	181,359	70,807	1	1
Red Snapper	91,418	189,727	559,850	1,172,477	16	16
Mangrove Snapper	6,961	12,182	673,214	577,143	1	2
King Mackerel	16,098	14,918	3,019,483	2,477,716	<1	<1
Spanish Mackerel	39,300	11,139	2,327,552	759,587	2	2
TOTAL	7,436,832	2,602,117	39,137,235	20,068,191	19	19

* Denotes no landings reported

Appendix A (continued)

Species	Sarasota County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	3,315	1,987	722,944	410,141	<1	<1
Spotted Seatrout	9,005	6,347	1,501,781	1,211,174	<1	<1
Atlantic Croaker	200	50	1,260	246	16	16
Flounder	278	181	138,675	78,918	<1	<1
Pompano	1,837	5,487	452,136	1,186,187	<1	<1
Striped Mullet	156,891	36,300	21,064,023	4,824,098	<1	<1
Menhaden	*	*	40,521	10,895	*	*
Sardines	*	*	1,748,235	163,840	*	*
Grouper & Scamp	200	250	6,706,202	7,124,962	<1	<1
Jewfish	*	*	70,807		*	*
Red Snapper	*	*	559,850	1,172,477	*	*
Mangrove Snapper	160	117	673,214	577,143	<1	<1
King Mackerel	*	*	3,019,483	2,477,716	*	*
Spanish Mackerel	500	225	2,327,552	759,587	<1	<1
TOTALS	172,386	50,944	39,137,235	20,068,191	<1	<1

* Denotes no landings reported

Appendix A (continued)

Species	Charlotte County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	73,611	44,700	722,944	410,141	10	11
Spotted Seatrout	128,748	105,959	1,501,781	1,211,174	9	9
Atlantic Croaker	20	4	1,260	246	2	2
Flounder	4,239	2,268	138,675	78,918	3	3
Pompano	15,196	38,067	452,136	1,186,187	3	3
Striped Mullet	3,383,592	722,130	21,064,023	4,824,098	16	15
Menhaden	*	*	40,521	10,895	*	*
Sardines	1,300	181	1,748,235	163,840	<1	<1
Grouper & Scamp	104,480	107,790	6,706,202	7,124,962	2	2
Jewfish	1,220	734	181,359	70,807	<1	<1
Red Snapper	1,308	2,556	559,850	1,172,477	<1	<1
Mangrove Snapper	687	554	673,214	577,143	<1	<1
King Mackerel	12	9	3,019,483	2,477,716	<1	<1
Spanish Mackerel	8,379	2,161	2,327,552	759,587	<1	<1
TOTALS	3,722,792	1,027,113	39,137,235	20,068,191	10	5

* Denotes no landings reported

Appendix A (continued)

Species	Lee County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	380,015	246,166	722,944	410,141	53	60
Spotted Seatrout	1,079,274	903,553	1,501,781	1,211,174	72	75
Atlantic Croaker	20	12	1,260	246	2	5
Flounder	107,239	59,351	138,675	78,918	77	75
Pompano	250,758	695,854	452,136	1,186,187	56	59
Striped Mullet	6,455,411	1,454,940	21,064,023	4,824,098	30	30
Menhaden	*	*	40,521	10,895	*	*
Sardines	*	*	1,748,235	163,840	*	*
Grouper & Scamp	757,052	813,821	6,706,202	7,124,962	11	11
Jewfish	138,984	50,150	181,359	70,807	77	71
Red Snapper	229,572	460,606	559,850	1,172,477	41	39
Mangrove Snapper	338,972	176,936	673,214	577,143	50	31
King Mackerel	5,355	4,899	3,019,483	2,477,716	<1	<1
Spanish Mackerel	49,460	16,533	2,327,552	759,587	2	2
TOTALS	9,792,112	3,882,821	39,137,235	20,068,191	25	24

Appendix A (continued)

Species	Collier County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	19,146	10,450	722,944	410,141	3	3
Spotted Seatrout	34,754	25,475	1,501,781	1,211,174	2	2
Atlantic Croaker	*	*	1,260	246	*	*
Flounder	4	2	138,675	78,918	<1	<1
Pompano	66,122	162,805	452,136	1,186,187	15	14
Striped Mullet	2,254,860	541,902	21,064,023	4,824,098	11	11
Menhaden	*	*	40,521	10,895	*	*
Sardines	*	*	1,748,235	163,840	*	*
Grouper & Scamp	385,490	330,012	6,706,202	7,124,962	6	5
Jewfish	4,137	2,054	181,359	70,807	2	2
Red Snapper	1,512	3,578	559,850	1,172,477	<1	<1
Mangrove Snapper	8,479	6,396	673,214	577,143	1	1
King Mackerel	36,921	29,840	3,019,483	2,477,716	1	1
Spanish Mackerel	42,782	16,590	2,327,552	759,587	2	2
TOTALS	2,854,207	1,129,104	39,137,235	20,068,191	7	6

Appendix A (concluded)

Species	Monroe County		Total study area		Percent of study area	
	Weight (lb)	Value ($)	Weight (lb)	Value ($)	Weight (lb)	Value ($)
Red Drum	33	20	722,944	410,141	<1	<1
Spotted Seatrout	14,331	9,576	1,501,781	1,211,174	<1	<1
Atlantic Croaker	*	*	1,260	246	*	*
Flounder	504	172	138,675	78,918	<1	<1
Pompano	93,499	217,191	452,136	1,186,187	21	18
Striped Mullet	53,975	15,387	21,064,023	4,824,098	<1	<1
Menhaden	*	*	40,521	10,895	*	*
Sardines	*	*	1,748,235	163,840	*	*
Grouper & Scamp	850,837	869,928	6,706,202	7,124,962	13	12
Jewfish	22,512	11,167	181,359	70,807	12	16
Red Snapper	19,872	39,715	559,850	1,172,477	3	3
Mangrove Snapper	272,921	329,163	673,214	577,143	41	57
King Mackerel	2,941,098	2,415,221	3,019,483	2,477,716	97	98
Spanish Mackerel	2,123,897	687,273	2,327,552	759,587	91	91
TOTALS	6,393,479	4,594,813	39,137,235	20,068,191	16	23

* Denotes no landings reported

11.1 APPENDIX B - COLONIAL BIRD NESTING SITE MATRIX

Key to Appendix A, Colonial Bird Nesting Site Matrix.

Colony Number - This is the colony number which appears next to the symbology in the atlas.

Colony Type - The colonies in the atlas are type-classed:

SB = Shorebird
WB = Wading Bird
CB = Seabird
BP = Brown Pelican

FWS Number - The corresponding colony numbers used by the United States Fish and Wildlife Service and the National Audubon Society for larger or less ephemeral colonies are shown in this column. Information concerning colonies without a corresponding FWS number was gathered largely through personal communication with the National Audubon Society and Florida Audubon Society members as well as other published data.

Species Composition

CB = Seabirds
- MFB - Magnificent Frigatebird

SB = Shorebirds
- AO - American Oystercatcher
- BS - Black Skimmer
- CT - Caspian Tern
- GBT - Gull-Billed Tern
- LG - Laughing Gull
- LT - Least Tern
- NOT - Noddy Tern
- RST - Roseate Tern
- ROT - Royal Tern
- ST - Sandwich Tern
- SP - Snowy Plover
- SOT - Sooty Tern
- W - Willet
- WP - Wilson's Plover

WB = Wading Birds

- A - Anhinga
- BCNH - Black-Crowned Night Heron
- CE - Cattle Egret
- DCC - Double-Crested Cormorant
- GI - Glossy Ibis
- GBH - Great Blue Heron
- GE - Great Egret
- LB - Least Bittern
- LBH - Little Blue Heron
- LH - Louisiana Heron
- RE - Reddish Egret
- RS - Roseate Spoonbill
- SE - Snowy Egret
- YCNH - Yellow-Crowned Night Heron
- WI - White Ibis
- WS - Wood Stork

BP = Brown Pelican

APPENDIX B

Dry Tortugas Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	SB	RST	
2	SB	RST, SOT, NOT	
3	CB	MFB	
4	WB, CB	MFB, DCC	
5	WB	DCC	

Key West Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	DCC, GBH	621001
2	WB	DCC, GWH, GBH	621003
3	WB, BP	BP, DCC, GBH, GWH, GE	621004
4	WB	DCC, GWH	621006
5	WB, BP	BP, DCC, GE	621008
6	WB, BP	BP, GBH	621009
7	WB	WI, DCC, LH, LBH, SE	621010
8	WB, BP	BP, DCC, GE, GWH	621011
9	WB, BP	BP, GWH, GBH	621024
10	WB, SB	GWH, GBH, LG	621013
11	WB, BP	BP, WI, DCC, LH, LBH, RE, GBH	621014
12	WB	WI, DCC, GBH, LBH, LH, RE	621015
13	WB	DCC, GWH, WI	621025
14	WB	GWH	621019
15	WB	DCC, GWH	621020
16	WB	DCC, GWH, WI	621023
17	WB	DCC	621016
18	SB	LG	621030
19	WB	DCC	621031
20	WB	DCC	
21	WB	DCC, GWH	
22	WB	DCC	
23	WB	DCC, GWH	
24	WB	DCC	
25	WB	DCC, GWH, GBH	
26	WB	DCC, GWH, GBH	
27	WB	GWH, GBH	
28	WB	DCC	
29	WB	DCC	

(continued)

Key West Map Base (continued).

Colony Number	Colony Type	Species Composition	FWS #
30	WB	DCC	
31	WB	DCC	
32	WB	GWH	
33	WB	DCC	
34	WB	DCC, WI, GWH	
35	WB	DCC, GBH	
36	WB	GWH	
37	WB	GWH	
38	WB	GWH, GBH	
39	WB	GWH	
40	WB	DCC, GBH	
41	WB	DCC	
42	WB	DCC, GWH	
43	WB	GWH	
44	WB	DCC	
45	SB	LT	
46	WB	GWH, GBH	
47	SB	RST	
48	SB	RST	
49	WB	DCC	

Islamorada Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB, SB	GWH, DCC, LG	621002
2	WB, SB	GWH, LG	620043
3	BP, WB, SB	BP, DCC, GE, LG, RS, SE	621005
4	WB	DCC, GE, GBH	621005
5	WB	DCC, GE, GWH, SE	621007
6	WB	DCC, GE, GWH	621017
7	WB	DCC, GE	621012
8	WB, BP	BP, GWH, GBH, DCC	621018
9	WB, BP	BP, GWH, GBH, DCC	621021
10	SB	LG	621026
11	SB	LG	621028

(continued)

Homestead Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	GBH, GWH	620002
2	WB	GWH, GBH, GE	620003
3	WB	GBH, GWH	620044
4	WB	RS, GE	620045
5	WB, SB	GE, GBH, LG	620046
6	WB	RS, GWH	620048
7	WB	GE, WS	620008
8	BP, WB	BP, WI, DCC, SE, GE	620009
9	WB	GE, SE, LH, WI, WS	620011
10	WB	GWH	620049
11	WB, BP	BP, DCC, RS	620012
12	WB	DCC, GE	620014
13	WB	RS	620017
14	WB	WI, RS	620019
15	WB, BP	BP, DCC, GWH, GE, RS	620005
16	WB	SE, RS	620015
17	SB	LG	620053
18	SB	LG	620054
19	SB	LG	620055
20	SB	LG	620056
21	SB	LG	620057
22	WB	DCC, GE, LH	620013

Miami Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	LBH	620052
2	WB	GE, SE, GBH	620023
3	WB	CE, LBH, LH	620037

Ft. Lauderdale Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, GE, LBH	619029
2	WB	CE, GE, LBH	619022

(continued)

Cape Sable Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	DCC, LH, GE, E, RS, GWH	620016

Everglades City Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	GE	620047
2	WB	SE, LH, GE	620051
3	WB, BP	BP, DCC, GE, SE, LH	620021
4	WB, BP	BP, CE, GE, LBH, LH, SE, DCC, GR, A	620022
5	WB	CE, GE, LBH	620053
6	WB	DCC	
7	SB	LT, BS	
8	SB	LT, BS	

Naples Map Base

Colony Number	Colony Type	Species Composition	FWS #
			B2
1	WB, BP	BP, GE, SE, DCC, LH	619038-B1
2	WB, BP	BP, SE, GE, GBH, DCC, LH	619038-A
3	WB, BP	BP, GE, DCC	619038-C
4	WB, BP	BP, GE, SE, DCC, LH, LBH	619038-
5	WB	CE, LBH	619016
6	WB	CE, LBH, GE, SE, LH	619017 1
7	WB	CE, LBH, LH	619018-2
8	WB	WS, GE	619018-3
9	WB	GE, LBH, WS, CE	619018-
10	WB	LBH	619019
11	WB	GE	619020
12	WB	CE, GE, LH, WI, GI, SE	619024
13	WB	LBH, CE, GE	619025
14	WB	GE	619026
15	WB	CE, LBH	619027
16	WB	WS	619028
17	WB	CE, SE, GE, LBH	619030
18	SB	LT, BS	
19	SB	LT, BS	
20	SB	LT, BS	

(continued)

Fort Myers Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, LH, GBH, LBH	619040
2	WB	CE, GE, SE, GBH, LBH, LH	619041
3	WB	GE, WS, GBH	619013
4	WB	CE, GE, WI, LBH	619014
5	WB	CE, GE, LBH	619015
6	WB	CE, GE, GBH, SE, LH	619012
7	WB	WS	

Sanibel Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	GE, GBH	615017
2	WB	A, GE, LH, SE, LBH, YCNH, WI, GR	615019
3	WB	A, SE, LBH, LH, GR	615021
4	WB, BP	BP, GE, GBH	
5	SB	LT, BS	
6	SB	LT, BS	

Charlotte Harbor Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, GE, GBH	615002
2	WB	GE, SE, GBH	615003
3	WB	GE, GBH	615004
4	WB	WI, SE, GE, GBH, CE, LH, DC, LBH	615012
5	WB, BP	BP, GBH	615013
6	WB, BP	BP, GE, CE, DCC, SE, LH	615015
7	WB, BP	BP, GE, GBH, DCC, LH, SE, LBH, RE	615016
8	WB, BP	BP, GBH, DCC	615018
9	WB	LBH, A, GE, GR, SE, LH	615020
10	WB, BP	BP, GBH, GE, DCC, LBH, SE, LH, A, WI	615022
11	SB	LG, ROT, CT	
12	WB	SE, GE, GBH	
13	WB	GBH, GE	
14	SB	LT, BS	
15	SB	LT, BS	

(continued)

Sarasota Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	GBH	615035
2	WB	DCC, GBH	615036
3	WB, BP	BP, GE, SE, CE, GBH	615041
4	WB	SE, GE, GBH, CE, LH, WI	615023
5	WB	CE, LBH	615042
6	WB	GE, CE	615038
7	WB	CE, LBH, LH	615045
8	WB	GE, CE, GBH, A	615037
9	WB, BP	BP, GE, SE, GBH, CE	615044
10	WB	CE, GE, GBH, A	615005
11	WB	CE	615039
12	WB	CE, GE, SE, LH, YCNH, WS	615040
13	WB, BP	BP, GE, DCC, SE, CE	615043
14	WB	CE, GE, LH	615024
15	WB	GE, GBH, LBH	615025
16	WB	GBH	615026

Arcadia Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	GE, GBH, A	616013
2	WB	CE, LBH, LH	616011
3	WB	GE, CE, GBH	616012

St. Petersburg Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB, BP	BP, CE, WI, GE, GBH, LBH, RE, SE, LH, BCNH, GE, RS	615007
2	WB	YCNH	615010
3	WB	CE	615011
4	WB	CE, WS, LBH, GE, SE, WI	615009
5	WB	CE, GBH, GE, SE	615030
6	WB	GE, GBH, SE	615029
7	WB	GE, GBH, YCNH, WI	615031
8	WB, BP	BP, CE, WI, GBH, GE, SE, LH	615027
9	WB	GBH	615028
10	SB	BS, AO	

(continued)

Appendix B (concluded)

St. Petersburg Map Base (continued).

Colony Number	Colony Type	Species Composition	FWS #
11	SB	LT, AO	
12	SB	LT, AO	
13	SB	LG, AO, W	
14	SB, WB	AO, W, GR	
15	SB	W	
16	WB, SB	WI, DCC, YCNH, BCNH, JLH, SE, GE, LBH, GBH, CE, GI, RS, LG, CT, ST	
17	SB	W	
18	WB	CE, SE, WI, GE	
19	SB	WP	
20	SB	LG, BS	
21	SB	LT	
22	SB	LT, BS, LG, GBT	
23	SB	LT, BS, LG, GBT	
24	SB	AO	
25	SB	LT, BS	
26	SB	BS	
27	SB	BS, LG, ROT, ST, LT, AO	
28	SB	LT	
29	SB	LT	
30	SB	LT, BS	
31	SB	AO	

Tarpon Springs Map Base

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, LH	611022
2	WB	GE, GBH, CE, WI	611025
3	WB	CE, GE, LBH, SE, LH, WI, GBH	611026
4	SB	AO	
5	SB	LT	
6	WB	WI, DCC, GBH	611027
7	WB	GE, SE, BCNH, DCC, GBH, LH, LBH	611027
8	WB	CE, LBH, WS	611021
9	WB	CE	611023
10	WB	CE, WS, GE, WI	611024
11	WB	WI	611017
12	WB	GBH	611018
13	WB	CE, LBH, GE, SE, LH	611020
14	WB	LBH, GR, LB, SE	611019
15	SB	AO, LT, WP, SP	
16	SB	LT, WP, SP	

11.3 APPENDIX C - SPECIAL STATUS DEFINITIONS FOR PLANT AND ANIMAL SPECIES

U.S. Fish and Wildlife Service:

Endangered: Species in danger of extinction throughout all or a significant portion of their range.

Threatened: Species likely to become endangered within the foreseeable future.

Under Review: (1) species for which the service presently has sufficient information on hand to support listing, (2) species for which further research is necessary to support listing, (3) species no longer being considered for listing.

Florida Game and Fresh Water Fish Commission:

Endangered: Species, subspecies, or isolated population which is resident in Florida during a substantial portion of its life cycle and so few or depleted in number or so restricted in range or habitat due to any man-made or natural factors that it is in immediate danger of extinction or extirpation from the State, or which may attain such a status within the immediate future unless it or its habitat are fully protected and managed in such a way as to enhance its survival potential; or migratory or occasional in Florida and included as endangered on the United States Endangered and Threatened Species List.

Threatened: Species, subspecies, or isolated population which is resident in Florida during a substantial portion of its life cycle and which is acutely vulnerable to environmental alteration, declining in area at a rapid rate due to any man-made or natural factors and as a consequence is destined or very likely to become an endangered species within the foreseeable and predictable future unless appropriate protective measures or management techniques are initiated or maintained; or migratory or occasional in Florida and included as threatened on the United States Endangered and Threatened Species List.

Species of Special Concern: Species, subspecies, or isolated population which warrant special protection, recognition, or consideration because it occurs disjunctly or continuously in Florida and has a unique and significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable and predictable future, may result in its becoming a threatened species unless appropriate protective or management techniques are initiated or maintained; may already meet certain criteria for consideration as a threatened species, but for which conclusive data are limited or lacking; may occupy such an unusually vital and essential ecological niche that should it decline significantly in numbers or distribution other species would be adversely affected to a significant degree; or has not sufficiently recovered from past population depletion.

Florida Department of Agriculture and Consumer Services:

The official Florida list of threatened and endangered plants was prepared by the Division of Plant Industry (Dept. of Agriculture and Consumer Services) for the Florida State Legislature. No criteria are stated for these designations.

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14. GLOSSARY

amphipod - Small crustaceans of the order Amphipoda.

benthic - Organisms living on the sea or lake bottom.

crustacean - An aquatic arthropod of the class Crustacea characteristically having a segmented body, a chitinous exoskeleton, and paired, jointed limbs. Examples include lobsters, crabs, shrimp, and barnacles.

detritus - Any disintegrated matter.

dinoflagellate - Minute, chiefly marine protozoans of the class Dinoflagellata, characteristically having two flagella and a cellulose outer envelope.

endangered species - A species in danger of extinction.

gastropod - A mollusk of the class Gastropoda characteristically having a single, usually coiled shell and ventral muscular mass serving as an organ of locomotion. Examples include snails.

hammock - A mound of forested upland elevated above the level of a surrounding marsh.

hermaphrodites - An organism such as an earthworm, having both male and female reproductive organs in the same individual.

Holocene - The current geological epoch extending from the end of the last ice age (10,000 years before the present) to the present.

invertebrate - An animal species having no backbone or spinal column.

isopod - A crustacean of the order Isopoda. Examples include sow bugs and gribbles.

metamorphosis - Change in the structure of an animal during normal growth, usually in the postembryonic stage. Examples include caterpillars changing into butterflies and tadpoles changing into frogs.

palustrine - Nontidal wetlands dominated by trees, shrubs, persistent emergents, and freshwater flats with salinities of less than 0.5%.

pathogen - Any agent that causes disease. Examples include viruses, bacteria, and fungi.

pelagic - Organisms living in the open water.

phytoplankton - Minute, floating aquatic plants.

planktivorous - Feeding on plankton.

protogynous - A hermaphroditic organism in which the female reproductive organs are first to mature.

substrate - A surface on which a plant or animal grows or is attached.

threatened species - A species whose population is steadily declining.

toxin - A poisonous substance, having a protein structure, secreted by certain organisms and capable of causing toxicosis when introduced into the body tissues, but also capable of inducing a counteragent or an antitoxin.

SOCIOECONOMIC FEATURES

by

Thomas F. Palik
Martel Laboratories, Inc.

The southwest Florida region encompasses an area of 8,057 square miles (Fernald 1981). Since 1950, the region's population has grown at a phenomenal rate due to in-migration. A demographic profile of the ten counties in the southwest Florida region is shown in Table 3.

The population of the region according to the 1980 census was 2,352,494, which is a 52.5 percent increase in the area's population of 1,542,538 in 1970 (Fernald 1981). The region has a low minority population and is perhaps best known as a retirement mecca. The crime rate in the region varies from low to moderate. Over 20 percent of the housing in the region is mobile homes. The price level index and the per capita income in the region is close to the national average. The principal sources of income in the region are from bank interest and dividend income, and from transfer payments (Fernald 1981).

Table 3. Selected demographic statistics of southwest Florida counties (Fernald 1981).

Parameter	Pasco	Pinellas	Hillsborough	Manatee	Sarasota	Charlotte
Land Area (Square Miles)	742.00	265.00	1,038.00	739.00	587.00	703.00
1980 Population	194,123.00	728,409.00	646,960.00	148,442.00	202,251.00	59,115.00
1970 Population	75,955.00	522,329.00	490,265.00	97,115.00	120,413.00	27,559.00
% Population Change 1970-80	155.60	39.50	32.00	52.90	68.00	114.50
% In-Migration 1970-80	100.00	100.00	77.90	100.00	100.00	100.00
% Black Population	2.10	7.60	13.30	8.90	5.20	19.00
% Spanish Origin	2.40	1.40	9.90	2.10	1.50	1.20
% $\geq$ 65 Years Old (1979)	34.10	31.60	11.30	31.10	8.40	39.20
Birth Rate/1,000 (1980)	9.30	9.60	15.10	12.20	9.10	8.00
Death Rate/1,000 (1980)	14.60	15.80	8.90	14.50	14.60	30.40
Population/M.D. (1980)	1,869.00	651.00	546.00	781.00	553.00	508.00
% W/Some College (1979-80)	39.00	68.00	38.00	50.00	53.00	52.00
Crime rate/100,000 (1980)	4,254.00	7,011.00	10,363.00	6,857.00	6,574.00	3,352.00
% Mobile Homes	23.10	19.00	9.50	38.10	25.20	34.30
Farm Sales-1978, $(000)	72,445.00	7,991.00	172,416.00	70,930.00	11,050.00	12,843.00
Bldg Permits-1980, $(000)	168,479.00	629,827.00	537,196.00	198,551.00	219,972.00	134,514.00
1977 Manufacturing, $(000,000)	115.90	1,349.20	2,851.60	261.80	347.50	6.80
1977 Wholesale Trade, $(000,000)	152.20	972.40	4,851.50	203.50	263.00	12.40
1977 Retail Trade, $(000,000)	342.00	2,438.00	2,070.00	477.00	776.00	151.00
Hotel & Motel Units (1980)	1,207.00	21,503.00	9,951.00	2,198.00	5,021.00	930.00
1980 Price Level Index	95.63	99.75	97.95	99.29	100.17	96.97
1979 Per Capita Income	6,191.00	9,007.00	7,775.00	8,279.00	10,425.00	7,805.00
% U.S. Avg. Per Capita Income	71.00	103.00	89.00	95.00	119.00	89.00
% Change-Per Capita Income, 1970-79	138.00	137.00	128.70	149.00	132.00	148.00
% Farm Income*	3.30	0.10	1.00	4.30	0.30	1.00
% Construction Income*	4.70	8.40	6.00	5.50	6.30	6.20
% Manufacturing Income*	3.90	3.40	12.30	9.30	4.60	1.00
% Government Income*	5.50	6.80	14.00	7.10	5.70	3.90
% Dividend-Interest Income*	23.80	26.50	10.70	24.70	36.90	30.90
% Transfer Payments Income*	29.90	23.30	14.50	22.00	20.20	28.50

*Excluding % Tourist Income

(continued)

Table 3 (concluded)

Parameter	De Soto	Lee	Collier	Monroe	S.W. Florida
Land Area (Square Miles)	648.00	785.00	2,006.00	1,034.00	8,547.00
1980 Population	19,039.00	205,266.00	85,791.00	63,098.00	2,352,494.00
1970 Population	13,060.00	105,216.00	38,040.00	52,586.00	1,542,538.00
% Population Change 1970-80	45.80	95.10	125.50	20.00	52.50
% In-Migration 1970-80	87.00	98.50	94.30	66.40	92.60
% Black Population	18.70	8.00	5.30	6.00	8.90
% Spanish Origin	3.20	2.80	10.80	11.30	4.60
% > 65 Years Old (1979)	15.30	22.70	17.60	12.70	22.50
Birth Rate/1,000 (1980)	16.50	12.00	15.00	12.40	11.90
Death Rate/1,000 (1980)	11.60	11.80	9.80	8.90	14.10
Population/M.D. (1980)	680.00	700.00	568.00	621.00	720.00
% With Some College (1979-80)	38.00	58.00	53.00	42.00	52.00
Crime rate/100,000 (1980)	3,912.00	5,301.00	7,884.00	10,817.00	7,525.00
% Mobile Homes	26.90	33.80	16.10	22.60	20.20
Farm Sales-1978, $(000)	38,539.00	39,216.00	45,682.00	203.00	471,315.00
Building Permits-1980, $(000)	7,680.00	398,944.00	216,492.00	75,249.00	2,586,904.00
1977 Manufacturing, $(000,000)	13.30	173.10	34.20	30.80	5,184.20
1977 Wholesale Trade, $(000,000)	22.70	350.30	132.70	73.80	7,034.50
1977 Retail Trade, $(000,000)	40.00	721.00	343.00	212.00	7,570.00
Hotel and Motel Units (1980)	173.00	6,228.00	2,965.00	5,496.00	55,672.00
1980 Price Level Index	96.00	98.62	100.64	106.24	99.13
1979 Per Capita Income	6,670.00	7,949.00	9,791.00	8,362.00	8,225.00
% U.S. Avg. Per Capita Income	76.00	91.00	112.00	95.00	94.00
% Change-Per Capita Income, 1970-79	139.00	124.00	108.00	152.00	136.00
% Farm Income*	19.40	1.40	4.90	0.20	1.60
% Construction Income*	0.00	8.20	7.40	4.30	6.80
% Manufacturing Income*	19.20	3.20	1.70	2.20	6.30
% Government Income*	19.20	7.60	5.80	22.50	9.10
% Dividend-Interest Income*	12.00	24.50	36.40	22.20	22.80
% Transfer Payments Income*	18.10	20.50	13.30	17.30	20.40

*Excluding % Tourist Income

1. NATIONAL LANDS

1.1 NATIONAL PARKS

Everglades National Park was set aside as a national park in 1947 by Congress and is the only national park located within the study area. Everglades National Park encompasses an area of 1,560 square miles of marshy land and open water (about the size of the State of Delaware). The park was set aside to protect the fragile environment of the Everglades and to protect its endangered wildlife. The Everglades is dependent on water for its survival. Summer rains, which soak the Kissimmee River Valley to the north, provide runoff to the Everglades during its winter and spring dry season.

During the twentieth century, man's attempt to provide flood relief by building canals has increased the flow rate of runoff discharge in the region and decreased the water table storage. As a result, water table levels in the Everglades have dropped substantially during the dry season. These very low water levels have caused an extreme hardship for wildlife in the Everglades and spawned large brush fires. The combination of water shortage and fire has pushed many animal species to the brink of extinction and greatly reduced the numbers of animal species inhabiting the park region.

Approximately 50 pairs of endangered southern bald eagles nest in the park. Other rare and endangered species found include the Florida panther, West Indian manatee, Everglades mink, Atlantic green turtle, loggerhead turtle, brown pelican, Florida sandhill crane, Everglades kite, short-tailed hawk, Peregrine falcon, Cape Sable sparrow, roseate spoonbill, and crocodile. The alligator, reddish egret, Florida mangrove cuckoo, osprey, and round-tailed muskrat are other species whose small numbers are protected within the park.

Life hangs on by a thread in the Everglades. The once thick veneer of peat which underlies the Everglades is gradually being reduced by oxidation due to the low water levels. The fragile rooting plants, which depend on this moist peat mat to survive, will be destroyed if and when this moist peat layer is completely burned away. The Everglades would cease to exist and an arid, subtropical savannah would take its place. Much of the wildlife, including most of the endangered species present today, would cease to exist. This gloomy scenario will prabably come true within the next half century, unless a concerted effort is made to restore the natural drainage to this unique natural resource region (National Park Service 1982b). Florida Governor Bob Graham has recently announced a "Save our Everglades" program which is designed to restore the region to its natural condition as much as possible.

Since 1979, the monthly visitor counts at the National Park have been steadily declining as shown in Table 4. At the same time, attendance at Florida state parks has been slowly increasing. The decline in visitor counts at the National Park can be blamed on a general decline in tourism in southeast Florida. Increasing crime and bad publicity, along with an increase in tourist attractions in Central Florida, are primarily responsible for this decline (National Park Service 1982b).

Table 4. Everglades National Park monthly visitor counts; Jan. 1975 - Oct. 1981 (National Park Service 1982a).

Month	1975	1976	1977	1978	1979	1980	1981
Jan	170,181	127,309	153,450	220,690	115,576	94,137	78,178
Feb	127,713	130,121	130,045	122,450	185,612	97,927	81,453
Mar	284,374	131,832	128,805	109,377	88,921	107,957	101,594
Apr	90,874	95,577	104,000	97,522	81,519	85,781	63,246
May	44,922	66,568	57,554	62,344	48,724	58,478	41,811
Jun	56,312	56,007	48,713	71,290	30,068	41,872	27,735
Jul	60,230	65,575	61,987	125,665	46,637	50,702	28,916
Aug	64,748	62,796	63,674	51,068	64,786	52,055	32,994
Sep	21,862	46,357	53,805	42,129	26,342	39,163	25,700
Oct	53,169	59,248	61,834	45,732	36,347	51,755	33,538
Nov	68,736	76,533	71,228	90,238	42,723	41,558	------
Dec	98,857	114,744	132,672	97,642	72,097	73,561	------
Total	1,141,978	1,032,667	1,067,767	1,136,147	839,352	794,946	------

1.2 NATIONAL PRESERVES

The National Park Service is responsible for the administration of the Big Cypress National Preserve which is the only national preserve located in the study area. Congress established the preserve in October of 1974 to assure the preservation of the natural values of the Big Cypress watershed. The preserve is located on a 430,000-acre tract located in Collier, Dade, and Monroe Counties. The State of Florida contributed the initial $40 million for land acquisition for this project (Florida Department of Natural Resources 1981).

1.3 NATIONAL MONUMENTS

The National Park Service administers the Fort Jefferson National Monument, which is the only national monument located in the study area. The Fort Jefferson National Monument is located in the Dry Tortugas west of Key West, Florida, and can only be reached by boat or helicopter.

1.4 NATIONAL WILDERNESS AREAS

Seven national wilderness areas comprising some 1,305,327 acres are located in southwest Florida. The wilderness areas are managed by the U.S. Fish and Wildlife Service with the exception of the Everglades, which is managed by the National Park Service. Portions of park areas, wildlife refuges, etc. are included in the seven designated national wilderness areas.

National wilderness areas have been created by Congress to set aside in permanent preserves, wilderness areas, which will be forever off-limits to incompatible human activities. A matrix describing the location, acreage, and year designated as a wilderness area for national wilderness areas located in southwest Florida is shown in Table 5 (Florida Department of Natural Resources 1981).

Table 5. National wilderness area matrix (Florida Department of Transportation 1981; Florida Department of Natural Resources 1981).

National Wilderness Area	Location	Acreage	Year designated
Everglades	Monroe Co. Collier Co.	1,296,500	1978
Great White Heron	Monroe Co.	1,855	1974
Island Bay	Charlotte Co.	20	1970
J.N. "Ding" Darling	Lee Co.	2,619	1976
Key Deer	Monroe Co.	2,278	1974
Key West	Monroe Co.	2,019	1974
Passage Key	Manatee Co.	36	1970

1.5 NATIONAL WILDLIFE REFUGES

The U.S. Fish and Wildlife Service manages 11 wildlife refuges in southwest Florida consisting of a total of 17,115 acres (Florida Department of Transportation 1981). Most of the wildlife refuges are limited purpose outdoor recreation areas designed for nature study, natural scenery appreciation, photography, hiking and picnicking. A matrix decribing the location, acreage, endangered wildlife, and nesting bird colonies for the 11 wildlife refuges in southwest Florida is shown in Table 6.

Crocodile Lake is a proposed National Wildlife Refuge in the middle Florida Keys and is not mapped.

1.6 NATIONAL MARINE AND ESTUARINE SANCTUARIES

The two national marine sanctuaries located in southwest Florida are Key Largo and Looe Key (Florida Power & Light Co. 1981).

Key Largo National Marine Sanctuary is located in the offshore waters southeast of Key Largo (Marszalek 1981). The sanctuary is located on the only true coral reefs found along the continental U.S. coast. The Florida reef tract, as it exists today, represents the most recent episode of a long and complex history of coral reef development, death and regrowth (Multer 1971). The two principal flourishing outer coral reefs located in the sanctuary are the Key Largo Dry Rocks and the Molasses Reef (Multer 1971). Looe Key National Marine Sanctuary is a flourishing outer coral reef located approximately 30 miles east-southeast of Key West, Florida (Florida Power & Light Co. 1981). The three distinctive features of the flourishing Florida outer reefs are the presence of Acropora palmata (moosehorn coral), vertical coral zonation off the terraced reef front, and spur and groove structures (Multer 1971). The extremely complex coral reef ecosystem supports more plant and animal species than does any other marine ecosystem. Among the varied assemblage of plants and animals of the coral reef ecosystem, corals play the dominant role providing for reef growth and nutrient cycling. All reef-building corals share a symbiotic relationship with microscopic unicellular algae located within the tissues of the coral polyps.

The enormous biological productivity of the coral reef ecosystem is a direct result of this animal/plant symbiosis and allows corals to secrete skeletal calcium carbonate at a rate sufficient to maintain reef building (Marszalek 1981). The two national marine sanctuaries located in the southwest Florida study area are administered by the U.S. Department of Commerce.

The Rookery Bay National Estuarine Sanctuary is the only national estuarine sanctuary located in southwest Florida. The sanctuary is located south of Naples in Collier County on one of the last pristine estuarine areas remaining on Florida's southwest coast.

Table 6. National wildlife refuge matrix (Florida Department of Transportation 1981; Kale 1978; Layne 1978; and McDiarmid 1978).

Name	County	Acreage	Endangered wildlife	Nesting bird colonies
Pinellas	Pinellas	394	W. Indian Manatee Bald Eagle Brown Pelican American Alligator Sea Turtles Wood Stork	Great Egret Great Blue Heron Yellow Crowned Night Heron White Ibis
Egmont Key	Hillsborough	350	W. Indian Manatee Bald Eagle Brown Pelican Red Cockaded Woodpecker Sea Turtles	(none)
Passage Key	Manatee	36	W. Indian Manatee Bald Eagle Brown Pelican American Alligator Sea Turtles	Black Skimmer Laughing Gull Royal Tern Sandwich Tern Least Tern American Oyster-catcher
Island Bay	Charlotte	20	W. Indian Manatee Bald Eagle Brown Pelican Red Cockaded Woodpecker American Alligator Sea Turtles	Bald Eagle Laughing Gull Royal Tern Caspian Tern Snowy Egret Great Egret Great Blue Heron
Pine Island	Lee	646	W. Indian Manatee Brown Pelican Red Cockaded Woodpecker American Alligator Sea Turtles	Brown Pelican Great Blue Heron Great Egret Little Blue Heron Snowy Egret Louisiana Heron White Ibis
Matlacha Pass	Lee	125	W. Indian Manatee Brown Pelican Red Cockaded Woodpecker American Alligator	Great Egret Cattle Egret Brown Pelican Double Crested Cormorant Snowy Egret Louisiana Heron Little Blue Heron Anhinga

(continued)

Table 6 (concluded)

Name	County	Acreage	Endangered wildlife	Nesting bird colonies
Caloosahatchee	Lee	40	W. Indian Manatee Brown Pelican Red Cockaded Woodpecker American Alligator Sea Turtles	Cattle Egret Louisiana Heron Great Blue Heron Little Blue Heron Great Egret Snowy Egret
Jay N. "Ding" Darling	Lee	4,788	W. Indian Mantee Brown Pelican Red Cockaded Woodpecker American Alligator Sea Turtles Artic Peregrine Falcon	Bald Eagle
National Key Deer	Monroe	5,444	W. Indian Manatee Key Deer Florida Manatee Arctic Peregrine Falcon Bald Eagle Brown Pelican American Alligator American Crocodile Sea Turtles	Brown Pelican Great Blue Heron Double-crested Cormorant Great White Heron
Great White Heron	Monroe	6,202	Key Deer W. Indian Manatee Arctic Peregrine Falcon Bald Eagle Brown Pelican American Alligator American Crocodile Sea Turtles	Double-crested Cormorant Great White Heron Great Blue Heron Laughing Gull White Ibis Brown Pelican Louisiana Heron Little Blue Heron Reddish Egret
Key West	Monroe	2,019	W. Indian Manatee Arctic Peregrine Falcon Bald Eagle Brown Pelican Sea Turtles	Magnificent-Frigatebird Double-crested Cormorant Great Blue Heron Brown Pelican

2. NATIONAL AUDUBON SOCIETY SANCTUARIES

There are five National Audubon Society Sanctuaries located in southwest Florida. They are Big Pine Key, Corkscrew Swamp, Cowpens Key, Rookery Bay and Tampa Bay.

Big Pine Key is a 747-acre sanctuary which was purchased by the National Audubon Society and is leased, without charge, to the U.S. Fish and Wildlife Service as an additional sanctuary to protect the endangered Key deer.

Corkscrew Swamp is an 11,000-acre sanctuary located approximately 16 miles southwest of Immokalee in Collier County. Included within the sanctuary is Florida's last large stand of virgin bald cypress. A wide variety of wildlife is found within the sanctuary. One of the remaining 22 rookeries in the 1983 breeding season of the American wood stork is found within the sanctuary. A 1.75 mile boardwalk has been built within the sanctuary to provide visitors' a close look at the wildlife and fauna found within this unique sanctuary. An admission fee is charged to maintain the sanctuary.

Cowpens Key is a 10-acre sanctuary located west of Tavernier in the Florida Keys. The sanctuary is located on a mangrove-covered island leased to the Audubon Society by the State of Florida and provides a haven and nesting site to several important bird species. One of Florida's largest roseate spoonbill colonies nests in this sanctuary. Great white herons and frigatebirds nest in this sanctuary in the Fall.

Rookery Bay is a 3,050-acre sanctuary located south of Naples in Collier County. The sanctuary is located on one of the last remaining pristine estuarine areas on Florida's southwest coast. A wide variety of bird and aquatic life is located within the sanctuary. The Collier County Nature Conservancy operates a marine biology research laboratory within the sanctuary.

Tampa Bay sanctuary is an assemblage of small islands located in Hillsborough, Tampa, and Sarasota Bays purchased by the National Audubon Society to provide a refuge and nesting location for nesting and wading birds found in the Tampa Bay region. Large colonies of herons, egrets, ibis, terns, and the endangered brown pelican nest on these spoil and mangrove islands.

A matrix of the five National Audubon Society sanctuaries is found in Table 7 (National Audubon Society 1981).

Table 7. National Audubon Society sanctuary matrix (National Audubon Society 1981).

Sanctuary	County	Acreage	Endangered wildlife	Nesting bird colonies	Mailing address
Tampa Bay	Hills-borough	N.A.[a]	Brown Pelican	Herons, Egrets, Ibises, Terns	Tampa Bay Sanctuary 1020 82nd St. S Tampa, FL 33619
Corkscrew Swamp	Collier	11,000	Fla. Panther, American Wood Stork	Wood Stork, White Ibis	Corkscrew Swamp Sanctuary Box 1875-A, Rt. 6 Sanctuary Road Naples, FL 33999
Rookery Bay	Collier	5,000			Collier County Conservancy 842 Magnolia Crt. Marco Island, FL 33937
Big Pine Key	Monroe	747	Key deer		Key Deer National Wildlife Refuge Box 510 Big Pine Key, FL 33043
Cowpens Key	Monroe	10		Roseate Spoonbills, White Herons, Frigatebirds	Cowpens Key Sanctuary 115 Indian Trail Tavernier, FL 33070

a - Not available

3. STATE PARKS, RECREATION AREAS, WILDERNESS AREAS, AND WILDLIFE MANAGEMENT AREAS

3.1 STATE PARKS

Florida's State Park system was created by the Florida Legislature to preserve and maintain, for the visitor, a natural environment with a full program of compatible recreational activities. There are seven state parks located within the southwest Florida region. A matrix describing the parks, complete with visitor counts and recreational facilities provided, is found in Table 8 (Florida Department of Natural Resources 1981). Caladesi Island is a new state park located in Pinellas County and is not shown in Table 8. Lovers' Key is a new state park located in Lee County.

Table 8. State park matrix (Florida Department of Natural Resources 1982; American Automobile Association 1982).

Parameter	Caladesi Island State Park	Hillsborough River State Park	Myakka River State Park	Collier-Seminole State Park	John Pennecamp State Park
County	Pinellas	Hillsborough	Manatee/ Sarasota	Collier	Monroe
Size (Acres)	1,711.62	2,964.00	28,875.00	6,423.40	55,011.83
1979 Visitors	113,115	255,962	184,166	75,473	—
1980 Visitors	128,405	259,844	178,856	45,988	—
Camping	No	Yes	Yes	Yes	Yes
Picnicking	Yes	Yes	Yes	Yes	Yes
Trails	Yes	Yes	Yes	Yes	Yes
Boating	Yes	Yes	Yes	Yes	Yes
Boat Ramps	No	No	Yes	Yes	Yes
Boat Rental	No	Yes	Yes	No	Yes
Fishing	Yes	Yes	Yes	Yes	Yes
Swimming	Yes	Yes	No	No	Yes
Horseback Riding	No	No	No	No	No
Bicycle Trails	No	No	Yes	No	No
Scuba Diving	Yes	No	No	No	Yes
Visitor Center	No	No	Yes	Yes	No
Cabins	No	No	Yes	No	No
Food Service	No	Yes	No	No	Yes

3.2 STATE RECREATION AREAS

There are six major state recreation areas located in southwest Florida. State recreation areas provide more active recreation facilities than do state parks. They need not be of any special size or in any special location. They need only to be located conveniently to population centers. Honeymoon Island is a new state recreation area located in Pinellas County. A matrix describing the facilities located at the five older state recreation areas present in southwest Florida is shown in Table 9 (Florida Department of Natural Resources 1981).

Table 9. State recreation area matrix (American Automobile Association 1982; Florida Department of Natural Resources 1981; Florida Department of Transportation 1981).

Parameter	Lake Manatee	Oscar Scherer	Wiggins Pass	Long Key	Bahia Honda
County	Manatee	Sarasota	Collier	Monroe	Monroe
Size (Acres)	555.98	461.96	166.00	966.28	276.12
1979 Visitor Count	20,622	109,585	428,595	124,981	325,830
1980 Visitor Count	25,102	110,981	465,276	110,335	283,977
Camping	No	Yes	NA*	Yes	Yes
Picnicking	Yes	Yes	NA*	Yes	Yes
Transportation	Yes	Yes	NA*	Yes	Yes
Boating	Yes	Yes	NA*	Yes	Yes
Boat Ramps	No	Yes	NA*	No	Yes
Boat Rental	No	Yes	NA*	No	No
Fishing	Yes	Yes	NA*	Yes	Yes
Swimming	Yes	Yes	NA*	Yes	Yes
Horseback Riding	No	No	NA*	No	No
Bicycle Trails	No	Yes	NA*	No	No
Scuba Diving	No	No	NA*	Yes	Yes
Visitor Center	No	No	NA*	No	No
Cabins	No	No	NA*	No	No
Food Service	No	No	NA*	No	Yes

*Not available

3.3 STATE WILDERNESS AREAS

The Florida Wilderness System Act (Section 258.17, Florida Statutes, see Addendum 3) established two state wilderness areas in southwest Florida. The Robert Crown State Wilderness Area is a 47-acre tract located in southern Pasco County (Florida Department of Natural Resources 1981). The Town Islands State Wilderness Area is a 55-acre tract located in the offshore islands of Manatee County.

3.4 STATE WILDLIFE MANAGEMENT AREAS

The Florida Game and Fresh Water Fish Commission manages four state wildlife management areas in southwest Florida. They are the Big Cypress (Monroe and Collier Counties), Cecil Webb (Charlotte County), Lower Hillsborough (Hillsborough County) and Richloam (Pasco County). An active habitat improvement program, including controlled burning, water fowl impoundments, and hardwood tree planting is maintained by the Florida Game and Fresh Water Fish Commission. A matrix describing the location, acreage, endangered wildlife and nesting bird colonies present is shown in Table 10 (Fernald 1981).

Table 10. State wildlife management areas (Florida Department of Transportation 1981; Kale 1978; Layne 1978; McDiarmid 1978).

Wildlife management areas	County	Acreage	Endangered wildlife	Nesting bird colonies
Big Cypress	Monroe/ Collier	540,000	American Alligator Mangrove Fox Squirrel Florida Panther Wood Stork Red Cockaded Woodpecker Bald Eagle	Bald Eagle Cattle Egret Great Egret Little Blue Heron
Cecil Webb	Charlotte	62,500	American Alligator Wood Stork Red Cockaded Woodpecker Bald Eagle	Cattle Egret Great Egret Little Blue Heron
Lower Hillsborough	Hillsborough	5,000	American Alligator Wood Stork Bald Eagle	Bald Eagle Great Blue Heron
Richloam	Pasco	7,028	American Alligator Wood Stork Bald Eagle	None

4. STATE AQUATIC PRESERVES

A total of 31 aquatic preserves were established by the Florida Aquatic Preserve Act of 1975 (Section 258.35 Florida Statutes) in the coastal waters of Florida (Florida Department of Natural Resources 1981). Four other aquatic preserves were established under separate acts (Sections 258.16, 258.165, 258.391, and 258.392, Florida Statutes). Twelve aquatic preserves are located within the Southwest Florida study region (Allender 1982). The aquatic preserves located in southwest Florida are: Pinellas County, Boca Ciega, Cockroach Bay, Cape Haze, Gasparilla Sound - Charlotte Harbor, Matlacha Pass, Pine Island Sound, Estero Bay, Rookery Bay, Cape Romano - Ten Thousand Islands, Coupon Bight, and Lignumvitae Bay.

Florida's Aquatic Preserve System is regulated by the Florida Department of Natural Resources. Private submerged lands located within an aquatic preserve area will be managed as part of the preserve, provided the private landowner contracts with the State of Florida for the donation or lease of his property to the State. Aquatic preserves have been established to preserve State-owned submerged lands in areas which have exceptional biological, aesthetic, and scientific value (Florida Department of Natural Resources 1981).

5. CONSERVATION LANDS

In 1979, the Florida Legislature established the Conservation and Recreation Lands (CARL) Trust Fund (Section 253.023, Florida Statutes) to provide a means of acquiring and managing environmentally endangered lands and other lands for recreation, water management, and preservation of significant archaeological and historical sites. The fund combines $27 million remaining from the $240 million authorized by the Land Conservation Act of 1972 with a portion of the annual revenues obtained from severence taxes on solid minerals and liquid fuels. Beginning in 1982, $20 million will be allocated each year for land acquisition. The areas were selected by a committee. The Governor and Cabinet, acting as the Board of Trustees of The Internal Improvement Trust Fund, then selects specific parcels for actual purchase from this selection list. The program is administered by the Florida Department of Natural Resources. A list of lands purchased under the Land Conservation Act of 1972 and under the new CARL Program established in 1979 is listed in Table 11 (Florida Department of Natural Resources 1981).

In addition to these programs, several other conservation land acquisition programs are currently ongoing in Florida. These lands are not mapped on the atlas. One is the "Save Our Coasts" program administered by the five water management districts. The "Save Our Everglades" program has just been announced and is currently being administered by the Governor's office.

The designation of "State Reserve" was adopted by the State of Florida in 1982 as lands to be set aside and managed by the Florida Department of Natural Resources. Charlotte Harbor is the only state reserve area in the study region.

Table 11. Conservation lands (Florida Department of Natural Resources 1981).

Lands purchased under Land Conservation Act of 1972	Proposed lands to be purchased under 1979 CARL Program	County
Weedon Island		Pinellas
Charlotte Harbor		Charlotte, Lee
Cayo Costa - North Captiva Islands		Lee
Barefoot Beach		Lee, Collier
Fakahatchee Strand		Collier
Big Cypress National Preserve		Collier, Lee
	Little Gator Creek Woodstork Rookery	Pasco
	Double Branch Bay/Bower Tract	Hillsborough
	Cockroach Key	Hillsborough
	Horton Property/Snead Island	Manatee
	Oaks/Palmer Estate	Sarasota
	Charlotte Harbor	Charlotte
	Sixmile Cypress Swamp	Lee
	Josslyn Island	Lee
	Fakahatchee Strand	Collier
	Rookery Bay	Collier
	New Mahogany/Hammock	Monroe

6. RECREATION LANDS

All State, county and municipal recreation areas greater than or equal to 25 acres are plotted on the individual atlas overlays. A matrix describing each recreation area is shown in Table 12. Recreation areas are provided by the State of Florida, as well as the various local county and municipal governments, to meet the various recreational needs of their citizens. The State Division of Recreation and Parks has established criteria for evaluating the recreational needs of its citizens. Their recommendations are shown in Table 13.

Table 12. Recreation matrix; recreation areas greater than or equal to 25 acres (Florida Department of Transportation 1981).

Name	County	Acreage
Zephyr Park	Pasco	30.0
Starkey Wilderness Park	Pasco	2,000.0
Anclote River Park	Pasco	30.0
Anclote Key State Recreation Area	Pasco	160.1
Gulfish School Congress and East Louisiana	Pasco	30.0
Sand Key Park	Pinellas	65.0
Walsingham Park	Pinellas	240.0
Brooker Creek Park	Pinellas	180.0
Anclote Key State Recreation Area	Pinellas	35.0
Honeymoon Isl. State Rec. Area	Pinellas	1,453.0
A. L. Anderson Park	Pinellas	128.0
Sawgrass Lake	Pinellas	36.0
Fred Howard Park	Pinellas	106.0
Tarpon Springs Senior High School	Pinellas	35.0
Dunedin Junior High School	Pinellas	40.0
Dunedin Comprehensive Sr. High Sch.	Pinellas	40.0
Highlander Park	Pinellas	134.0
Crest Lake Park	Pinellas	40.0
Carpenter Field	Pinellas	30.0
Coachman Park	Pinellas	46.0
Norton & Ed Wright Park	Pinellas	38.0
J. F. Kennedy Junior High School	Pinellas	35.0
Clearwater Senior High School	Pinellas	35.0
Largo Senior High School	Pinellas	33.0
J. S. Taylor Park	Pinellas	118.0
Largo Recreation Complex	Pinellas	32.0
Seminole Junior High School	Pinellas	30.0
Seminole Senior High School	Pinellas	45.0
Dixie Hollins Senior High School	Pinellas	40.0
Azalea Park	Pinellas	35.0
Fuller Park	Pinellas	101.0
War Veterans Memorial Park	Pinellas	122.0
Lake Seminole Park	Pinellas	255.0
Northwest Park	Pinellas	36.0
Gulfport Blvd. Parkway	Pinellas	28.0
Boca Ciega High School	Pinellas	40.0
Tangerine Parkway & Tomlinson Park	Pinellas	28.0
Maximo Park	Pinellas	42.0
Lake Maggiore Park	Pinellas	755.0
Lakewood Senior High School	Pinellas	40.0
Lake Vista Park	Pinellas	39.0
Bartlett Park	Pinellas	40.0
Woodlawn Park	Pinellas	34.0
Uray Holland Land	Pinellas	97.0
Fossil Park	Pinellas	38.0
Northeast Park	Pinellas	375.0

(continued)

Table 12 (continued)

Name	County	Acreage
Crescent Lake Park	Pinellas	49.0
North Shore Park	Pinellas	33.0
Freedom Lake Park	Pinellas	29.0
Phillippe Park	Pinellas	122.0
Fort De Soto Park	Pinellas	884.0
Little Manatee River Park	Hillsbrgh	27.0
Picnic Island Park	Hillsbrgh	83.0
Little Manatee State Rec. Area	Hillsbrgh	1,675.0
Bullfrog Creek Park	Hillsbrgh	80.0
E. G. Simmons Park	Hillsbrgh	334.0
Little Manatee Park	Hillsbrgh	27.0
Upper Tampa Bay Park	Hillsbrgh	410.0
Morgan Wood Park	Hillsbrgh	32.0
Well Field Park	Hillsbrgh	330.0
Northwest Land Fill Park	Hillsbrgh	120.0
Keystone Park	Hillsbrgh	30.0
Lake Park	Hillsbrgh	600.0
Eureka Springs Park	Hillsbrgh	27.0
Pleasant Grove Reservoir	Hillsbrgh	1,200.0
Alderman Ford Park	Hillsbrgh	630.0
Lithia Springs Park	Hillsbrgh	160.0
Rhodin Bell	Hillsbrgh	107.0
South Brandon Park	Hillsbrgh	46.0
Lower Hillsbrgh R. Detention Area	Hillsbrgh	1,670.0
Mike Sansome Park	Hillsbrgh	80.0
Skyway Park	Hillsbrgh	35.0
MacFarlane Park	Hillsbrgh	40.0
Bayshore Park	Hillsbrgh	25.0
Horizon Park	Hillsbrgh	290.0
Rowlett Park	Hillsbrgh	220.0
Rogers Park	Hillsbrgh	80.0
Lake Manatee State Rec. Area	Manatee	556.0
D.O.T. Wayside Park	Manatee	26.0
East Bradenton Park	Manatee	32.0
Pirate Center	Manatee	37.0
Bayshore Middle School	Manatee	30.0
Oneca Land Fill Park	Manatee	30.0
Fruitville Park	Sarasota	25.0
17th Street Park	Sarasota	130.0
Venice School Complex	Sarasota	76.0
McIntosh Student Center	Sarasota	118.0
Bobby Jones Golf Course	Sarasota	120.0
Babe Ruth Baseball Stadium	Sarasota	160.0
Booker School Complex	Sarasota	35.0

(continued)

Table 12 (concluded)

Name	County	Acreage
City Island Park	Sarasota	60.0
Ringling Redskins and Little League	Sarasota	40.0
Arthur Allyn Fields	Sarasota	35.0
Fairgrounds Park	Sarasota	30.0
Sarasota Junior & Senior High School	Sarasota	38.0
Riverview High	Sarasota	30.0
Lake Venice Golf Course	Sarasota	341.0
Caspersen's County Park	Sarasota	327.0
De Soto Peace River Pond	De Soto	40.0
Arcadia Mun. Golf Course	De Soto	98.0
County Park & Soft Ball Complex	Charlotte	30.0
Port Charlotte Beach State Rec. Area	Charlotte	245.0
Caloosahatchee River St. Rec. Area	Lee	718.0
Turner Beach Park	Lee	28.0
Cayo Costa Island Park	Lee	640.0
Punta Blanco Island Park	Lee	95.0
Carl Johnson Park	Lee	278.0
Bonita Springs Community Park	Lee	60.0
Nalle Grade Park	Lee	70.0
Franklin Locks Recreation Area	Lee	30.0
The Hundred Acres	Lee	100.0
Terry Park	Lee	40.0
Shady Oaks Park	Lee	31.0
Tiger Tail Park	Collier	32.0
Immokalee High School	Collier	50.0
County Park (Fakahatchee Scenic Dr.)	Collier	1,920.0
Scenic Drive Parkway	Collier	146.0
South Lely	Collier	273.0
Little Duck Key County Park	Monroe	26.0
East Martello Fortress and Park	Monroe	25.0
Stock Island Golf Course	Monroe	200.0

Table 13. State of Florida - Division of Recreation and Parks user guidelines for resource-based outdoor recreation activities (Florida Department of Natural Resources 1981).

Activity	Resource/Facility	Guidelines	Population served per resource/facility unit
Swimming (non-pool) Freshwater or Saltwater	Freshwater or Saltwater Beach	2.5 linear feet of beach per user per day	1 linear mile/25,000
Saltwater Beach Activities (sunbathing, shelling, etc.)	Saltwater Beach Area	100 sq. ft of beach per user per day	1 sq. mile/50,000
Camping (RV/Trailer and Tent)	Designated Camp Site	4 users per site per day	1 acre/25,000
Picnicking	Picnic Tables	8 users per table per day	1 acre/25,000
Fishing, Power Boating, Water Skiing, Sailing Freshwater or Saltwater	Boat Ramps	160 users per single lane ramp per day	1 ramp/5,000
Fishing (non-boat) freshwater or saltwater	Piers, Catwalks, and Shoreline	6 linear feet of facility per user per day	1 pier or catwalk/ 5,000
Visiting Archaeological/ Historical Sites	Archaeological/ Historical Sites	384 users per site per day	Not available
Hiking	Hiking Trails	1 mile of trail per 125 users per day	1 mile/10,000
Nature Study	Nature Trails	1 mile of trail per 250 users per day	1 mile/10,000
Bicycling	Bicycle Trails	1 mile of trail 261 users per day	1 mile/5,000
Horseback Riding	Horseback Riding Trails	1 mile of trail per 80 users per day	1 mile/20,000
Hunting	Hunting Land	21 acres per user per day	5,500 acres/ 10,000

7. INTENSIVELY UTILIZED RECREATIONAL BEACH ACCESS POINTS

Florida's southwest coast contains 819,005 feet (154.9 miles) of intensively used recreational beaches. The recreational beaches are composed of white quartz sand and are located from Anclote Key (off Tarpon Springs) south to Marco Island (Naples). Access points to these recreational beaches are plotted on the atlas overlays. A matrix compiling the total linear feet of recreational beach coastline by county is found in Table 14 (Henningsen and Salmon 1981). Only intensively utilized recreational beach access points designated by the Florida Department of Natural Resources, are mapped on the atlas.

Table 14. Recreational beach coastline by county (Henningsen and Salmon 1981).

County	Total linear feet of recreational beach coastline
Pasco	0
Pinellas	170,630
Hillsborough	3,500
Manatee	54,550
Sarasota	157,050
De Soto	0
Charlotte	56,850
Lee	220,775
Collier	153,650
Monroe	2,000
Total	819,005

8. MARINAS

Southwest Florida is renowned for its fishing, and boating opportunities and has a high concentration of marinas. A summary of marinas by county is shown in Table 15. Individual marinas are numbered by county on the atlas maps and their names listed in Table 16.

Table 15. Number of marinas by county (Kunneke and Swenson 1982b).

County	No. of marinas
Pasco	11
Pinellas	94
Hillsborough	12
Manatee	29
Sarasota	45
Charlotte	5
De Soto	3
Lee	68
Collier	56
Monroe	113
Total	436

Table 16. Marina matrix (Kunneke and Swenson 1982b).

County	No. on map	Name	No. on map	Name
Pasco	1	Pleasure Island Marina	7	Unknown
	2	Unknown	8	Unknown
	3	Unknown	9	Gooney Bird Marina
	4	Staley's Hudson Marina, Inc.	10	Korman's Landing
	5	Gulfview Marina	11	Gulf Harbors
	6	Unknown		
Hillsborough	1	Unknown	8	Ballast Pt. Park Fishing Pier
	2	Unknown		
	3	Marjorie Park Marina	9	Interbay Marineways, Inc.
	4	Davis Island Yacht Club	10	Unknown
	5	Tampa Yacht & Country Club	11	Unknown
	6	Unknown	12	Bahia Beach Marina
	7	Imperial Yacht Club		
Pinellas	1	Duke's Fish Camp	29	Dunedin City Marina
	2	Unknown	30	Unknown
	3	Unknown	31	Unknown
	4	Russelo's Sun Marina	32	Island Yacht Club
	5	Unknown	33	Unknown
	6	Port Tarpon Marina	34	High & Dry Marina
	7	Unknown	35	Yacht Yard South
	8	Tarpon Springs City Marina	36	Ross Yacht Service, Inc.
	9	Gulf Marineways	37	Unknown
	10	F & Y, Inc.	38	Clearwater Marina
	11	Tarpon Marineways, Inc.	39	Clearwater Bay Marineways
	12	Blue Fin Marina	40	Unknown
	13	Unknown	41	Unknown
	14	Unknown	42	Unknown
	15	Unknown	43	Unknown
	16	Unknown	44	Unknown
	17	Unknown	45	Unknown
	18	Unknown	46	Unknown
	19	Home Port Marina	47	Largo Intercoast Marine
	20	Minnow Creek Marineways	48	Indian Springs Marina
	21	Home Port Marina	49	Unknown
	22	Prior Boat Builders, Inc.	50	Bay West Boatworks
	23	Unknown	51	Unknown
	24	Commodores Int'l Yacht Club	52	Unknown
	25	Pirates Cove Marina	53	Unknown
	26	Greentree Marina	54	Unknown
	27	Unverified loc. (not mapped)	55	Unknown
	28	Dunedin Municipal Marina	56	Unknown

(continued)

Table 16 (continued)

County	No. on map	Name	No. on map	Name
Pinellas	57	Unknown	76	Unknown
	58	Unknown	77	Harborside Marina
	59	Indian Shores Marina	78	Pasadena Bayside Marina
	60	Hi-Dry Marina	79	Unknown
	61	Bay Pines Marina	80	Unknown
	62	Holiday Isles Marina	81	Unknown
	63	Madeira Beach Municipal Marina	82	Billy's Moorings
			83	Gulfport City Marina
	64	Snell Isle Marina	84	Maximo's Moorings Marina
	65	Snug Harbor Marina	85	Hansen Marine, Inc.
	66	Hubbards Passport Marina	86	Huber Yacht Harbor
	67	John's Pass Marina	87	Unknown
	68	Jolly Roger Boatel	88	Sheraton Marina
	69	St. Pete. Municipal Marina	89	Unknown
	70	Marina Point Ships Store	90	Unknown
	71	St. Pete. Yacht Club	91	Pass-a-Grille High & Dry
	72	Unknown	92	Unknown
	73	Bayboro Marine, Inc.	93	Stroller's Pass-a-Grille
	74	Johnnie's Boatyard	94	Tierra Verde Island Resort
	75	Unknown		
Manatee	1	Palm View Marina	15	Pete Reynard's Restaurant
	2	Unknown	16	Island Bay Marine
	3	Harringtons Hidden Harbor Marine	17	Privateer's Marina
			18	City Yacht Basin Marina
	4	Snead Island Boatworks	19	North Bay Harbor
	5	Snead Island Boatworks	20	Marker "50" Marina
	6	Unknown	21	Cortez Marina
	7	Unknown	22	CNC Marina Sales
	8	Anna Maria Yacht Club	23	Snead Island Boatworks
	9	Sea Hut Marine Restaurant	24	Snead Island Boatworks
	10	Snead Island Boat Works	25	The Fields' Buccaneer Inn
	11	Boca Del Rio Marina	26	Cannon's Marina
	12	Snead Island Boatworks	27	The Fields' Buccaneer Inn
	13	Snead Island Boatworks	28	Skip's Trailer Marina
	14	Ellenton Marina	29	Holiday Inn Marina
Sarasota	1	The Dock On The Bay	10	Unknown
	2	Unknown	11	Unknown
	3	Marlowe Marine	12	Unknown
	4	Hansen Marina, Inc.	13	Unknown
	5	Helmsman Marina	14	Landing Marina
	6	Unknown	15	Abbey Marine, Inc.
	7	Gulfwind Marine	16	Phillipe Shores Marina
	8	Marina Jack	17	Unknown
	9	Unknown	18	Siesta Key Marine, Inc.

(continued)

Table 16 (continued)

County	No. on map	Name	No. on map	Name
	19	Unknown	33	Unknown
	20	Snug Harbor Marine	34	Unknown
	21	Yacht & Harbor Marine, Inc.	35	Unknown
	22	Unknown	36	Unknown
	23	Midnight Pass Marina	37	The Crow's Nest
	24	Midnight Pass Fish Camp	38	Venice Yacht Club
	25	Unknown	39	Unknown
	26	Unknown	40	Unknown
	27	Casey Key Marina	41	Unknown
	28	John Holmes, Inc.	42	Unknown
	29	Unknown	43	Unknown
	30	Unknown	44	Venice Marine Center
	31	Unknown	45	Unknown
	32	Nokomis Marineways		
De Soto	1	De Soto Marina	3	Purdie's Fish Camp
	2	Stout Canoe Outpost		
Charlotte	1	Fisherman's Village	4	Gasparilla
	2	Riviera Marina	5	Eldred's Marina
	3	Marker 7 Marina		
Lee	1	Burnt Store Marina	24	Al & Jean's Fishcamp
	2	Knight's Boatyard	25	Unknown
	3	Unknown	26	Coastal Marine Mart
	4	Miller's Marina	27	Unknown
	5	Waterfront Boatel	28	Unknown
	6	Unknown	29	Unknown
	7	Four Winds Marina	30	Marinatown
	8	Useppa Island Club	31	Unknown
	9	Unknown	32	Unknown
	10	Cabbage Key Hide-A-Way	33	Ft. Myers Yacht Basin
	11	Unknown	34	Unknown
	12	South Seas Plantation Marina	35	Unknown
	13	Twin Palms, Inc.	36	Waterways Yacht Club
	14	Unknown	37	Harbor Village Marina
	15	Unknown	38	Cape Coral Marina, Inc.
	16	'Tween Waters Marina	39	Dolphin Marina
	17	Gulf Haven Fish Op. & Marina	40	Unknown
	18	Unknown	41	Deep Lagoon Marina
	19	Unknown	42	Cape Coral Yacht Club
	20	Unknown	43	Unknown
	21	Owl Creek Boatworks Storage	44	Unknown
	22	Unknown	45	Unknown
	23	Unknown	46	Cove Marina

(continued)

Table 16 (continued)

County	No. on map	Name	No. on map	Name
Lee	47	Unknown	58	Olsen's Marine Service
	48	Pier "50" (Punta Rassa)	59	Gulf Star Marina
	49	Tarpon Bay Marina	60	San Carlos Marina
	50	Sanibel Marina	61	Moss Marina
	51	Port Comfort Marina	62	Unknown
	52	Unknown	63	Unknown
	53	Hurricane Bay Marine	64	Snug Harbor Marina
	54	Unknown	65	Unknown
	55	Unknown	66	Unknown
	56	Ft. Myers Beach Boatyard and Marina	67	Unknown
			68	Unknown
	57	Compass Rose Marina		
Collier	1	Lake Trafford Marina	29	Unknown
	2	Backbay Marina	30	Noeta Sailing Center
	3	Wiggen's Pass Marina	31	Unknown
	4	Unknown	32	Unknown
	5	Unknown	33	Unknown
	6	Unknown	34	Remuda Ranch Marina
	7	Port-O-Call Marina	35	Port Of The Island Marina
	8	Capt. Bill's Marco Lodge Marine Harbor Place	36	Unknown
			37	Unknown
	9	Hansen Marine, Inc.	38	Unknown
	10	Unknown	39	Marco Lodge & Marina
	11	Unknown	40	Unknown
	12	Bay Marina	41	Goodland Marina
	13	Boat Haven, Naples	42	Unknown
	14	Naples Marine & Yacht Center	43	Coon Key Pass Marina
	15	Brookside Marine, Inc.	44	Unknown
	16	Unknown	45	Unknown
	17	Cove Inn	46	Unknown
	18	Naples City Docks	47	Unknown
	19	Gulfwind & Nichols Marine	48	Unknown
	20	Naples Yacht Club	49	Rod & Gun Lodge
	21	Unknown	50	Unknown
	22	Unknown	51	Unknown
	23	Keewaydin Dock	52	Unknown
	24	Unknown	53	Unknown
	25	Isle of Capri Marina	54	Unknown
	26	Unknown	55	Unknown
	27	Unknown	56	Unknown
	28	Marco River Marina		

(continued)

Table 16 (continued)

County	No. on map	Name	No. on map	Name
Monroe	1	Ocean Reef Club	45	Holiday Isle Resort
	2	Tahiti Village Marina	46	Unknown
	3	World's Beyond	47	Unknown
	4	Manatee Bay Marina	48	Islamorada Yacht Basin
	5	Point Laura Marina	49	Coral Bay Marina
	6	Unknown	50	Unknown
	7	Gilbert's Motel & Marina	51	Unknown
	8	Unwinder Motel & Marina	52	Unknown
	9	Unknown	53	Max's Marine
	10	Unknown	54	Bud N' Mary's Marina
	11	Garden Cover Marine	55	Bird Marina South
	12	Pilot House Rest. & Marina	56	Bird Marina South
	13	Deep Six Marina	57	Caloosa Cover Marina
	14	Flamingo Marina	58	Bird Marina South
	15	Ocean Safari	59	Bird Marina South
	16	Pilot House Rest. & Marina	60	Unknown
	17	Tahiti Village Marina	61	Unknown
	18	Tahiti Village Marina	62	Outdoor Resorts
	19	Tahiti Village Marina	63	Unknown
	20	Pilot House Rest. & Marina	64	Unknown
	21	Unknown	65	Unknown
	22	Airport Marina	66	Unknown
	23	Port Largo Marina & Boatyard	67	Unknown
	24	Key Largo Oceanside Marina & Airport	68	Duck Key Marina
			69	Unknown
	25	Pilot House Rest. & Marina	70	Holiday Inn
	26	Unknown	71	The Boat House
	27	Mandalay Marina	72	Unknown
	28	Unknown	73	Key Colony Beach Boatels
	29	Bryn Mawr Ocean Resort	74	Key Colony Marina
	30	Curtis Marina	75	Bonefish Towers
	31	Snug Harbor Marina	76	Salty Dog Marina
	32	Campbell's Marine	77	Bonefish Harbor Marina
	33	Tavernier Harbor Marina	78	Holiday Island
	34	Tavernier Creek Marina	79	Tarpon Lodge
	35	Unknown	80	Mercier Boatworks, Inc.
	36	Unknown	81	Latitude 24 Club Resort
	37	Unknown	82	Harbor Cey Club
	38	Unknown	83	Faro Blanco Marine Resort
	39	Futura Yacht Club	84	Marathon Boatyard, Inc.
	40	Plantation Yacht Harbor	85	Unknown
	41	Unknown	86	Unknown
	42	Unknown	87	Tahiti villge Marina
	43	Unknown	88	Unknown
	44	Unknown	89	Unknown

(continued)

Table 16 (concluded)

County	No. on map	Name	No. on map	Name
Monroe	90	Unkown	102	Muray Marine Inc.
	91	Unknown	103	Geiger Key Marina
	92	Unknown	104	Cow Key Marina
	93	Joe & Bobbi's Boot Key Marina	105	Safe Harbor Marina
	94	Unknown	106	Peninsula Marina Enterprises
	95	Mariner Resort Marina	107	Key West Marina
	96	Sunshine Key Marina	108	Key West Oceanside Marina
	97	Sea Center, Inc.	109	Key West Yacht Club
	98	Dolphin Marina	110	Garrison Bight Marina
	199	Bow Channel Camp & Marina	111	Ship-A-Hoy Motel Marina
	100	Bahia Honda State Recreation Area	112	City Marina/Amberjack Pier
	101	Summerland Key Marina	113	Key West Redevelopment Agency Marina

9. CHARTER AND HEAD BOAT LOCATIONS

Charter boats are boats that can be rented (chartered) for a specified period of time. Head boats are large party boats that go fishing offshore in the Gulf of Mexico or Florida Straits for a specified period of time (usually half-day, one day, or two days) and charge a dollar fee per person (head). Base locations of charter and head boats are mapped on the individual atlas overlays. A list of the principal ports of call for charter and head boats is shown in Table 17.

Table 17. Charter and head boat principal ports of call (Kunneke and Swenson 1982a).

Port of call	Number of charter boats	Number of head boats
Clearwater/Dunedin/Tarpon Springs	19	8
St. Petersburg/Madeira Beach	3	3
Bradenton/Cortez	2	3
Sarasota/Venice/Englewood	14	0
Boca Grande/Captiva/Bokeelia/ Matlacha	25	1
Ft. Myers/Cape Coral/Bonita Springs	25	3
Naples	17	3
Marco Island/Marco/Goodland	30	0
Everglades City/Chokoloskee	19	0
Flamingo	1	0
Florida Keys	120	24
Total	275	45

10. PUBLIC BOAT RAMPS

The distribution of boat ramps in southwest Florida is shown in Table 18. Most of the boat ramps are centered in the high density urban coastal counties of Pinellas, Sarasota, and Lee.

Table 18. Total number of boat ramps by county in southwest Florida (Kunneke and Swenson 1982b).

County	Number of boat ramps
Pasco	3
Pinellas	22
Hillsborough	3
Manatee	1
Sarasota	17
Charlotte	7
De Soto	6
Lee	18
Collier	10
Monroe	10
Total	97

11. FLORIDA CANOE TRAIL SYSTEM

The National Wild and Scenic Rivers Act of 1968 (16 U.S. Code 1271) establishes a national system for the identification and preservation of wild and scenic rivers. In accordance with this act, the Bureau of Outdoor Recreation (precursor of the Heritage Conservation and Recreation Service) forwarded a detailed study to the President recommending the Suwannee River (in northern Florida) to be formally declared a National Wild and Scenic River. No formal action has been taken on this measure. In 1975, the Florida Bureau of Outdoor Recreation recommended that portions of the Peace, Hillsborough, and Withlachoochee Rivers in southwest Florida, be placed on the list of possible rivers to be declared National Wild and Scenic Rivers. In 1982, the Florida Bureau of Outdoor Recreation recommended the Little Manatee River be included on this list. As of January 1983, none of the rivers in southwest Florida have been declared National Wild and Scenic Rivers.

The Florida Scenic and Wild Rivers Program was established by the Executive Board of The Department of Natural Resources in January of 1972 and revised in June of 1978. It is designed to preserve the aesthetic and wilderness qualities of exceptional rivers in Florida. Wild rivers are those which merit protection and preservation of their wilderness qualities (to prevent human development on their shorelines). Scenic rivers are rivers whose scenic or aesthetic characteristics merit their preservation and inclusion within the program. The Hillsborough River is the only river under study to be designated a wild and scenic river in southwest Florida under this State program.

The Florida Recreational Trails Act of 1979 (Chapter 260, Florida Statutes) establishes a system of canoe trails for recreational boating in Florida. Table 19 lists the canoe trails present in southwest Florida. The trails are mapped on the individual atlas overlays.

Table 19. Canoe trail matrix (Florida Department of Natural Resources 1981).

Canoe Trail	County
Pithlachascotee River	Pasco
Alafia River	Hillsborough
Little Manatee River	Hillsborough
Upper Manatee River	Manatee
Peace River	De Soto
Hickey's Creek	Lee
Estero River	Lee
Blackwater/Royal Palm Creek	Collier

12. MAJOR PUBLIC FISHING PIERS

There are 25 major public fishing piers located in southwest Florida. A matrix describing these piers is shown in Table 20.

Table 20. Major public pier matrix (Aska 1983).

No. on map	Pier name	County	Latitude	Longitude
1	Oldsmar Fishing Pier	Pinellas	28°01'45"	82°40'15"
2	Safety Harbor City Pier	Pinellas	27°59'20"	82°41'10"
3	Big Pier 60	Pinellas	27°58'25"	82°49'50"
4	Big Indian Rcks F'ing Pier	Pinellas	27°53'40"	82°51'10"
5	Ballast Point Pier	Hillsbrgh	27°53'25"	82°28'45"
6	Williams Park Pier	Hillsbrgh	27°51'35"	82°23'10"
7	Redington Long Pier	Pinellas	27°49'20"	82°49'50"
8	St. Pete. Mun. Pier	Pinellas	27°46'30"	82°37'30"
9	Pass Fishing Pier	Pinellas	27°36'50"	82°43'35"
10	Andrew Potter Pier	Pinellas	27°36'30"	82°44'20"
11	Rod & Reel Fishing Pier	Manatee	27°32'20"	82°44'15"
12	Anna Maria City Pier	Manatee	27°32'00"	82°44'15"
13	Bradenton Beach Pier	Manatee	27°29'45"	82°42'45"
14	Sarasota Mun. Pier	Manatee	27°20'00"	82°32'50"
15	Venice Mun. F'ing Pier	Sarasota	27°05'50"	82°27'38"
16	Port Charlotte Beach Pier	Charlotte	26°57'40"	82°07'00"
17	Charlotte Harbor F'ing Pier	Charlotte	26°57'15"	82°05'40"
18	Punta Gorda Mun. Pier	Charlotte	26°56'45"	82°02'50"
19	Angler's Piers/Lemon Bay	Charlotte	26°56'05"	82°21'15"
20	Bokeelia Pier	Lee	26°42'30"	82°09'50"
21	Tarpon Street Pier	Lee	26°39'40"	81°50'50"
22	Cape Coral Mun. Pier	Lee	26°32'35"	81°57'03"
23	Fort Myers Beach Pier	Lee	26°27'10"	81°57'25"
24	Lighthouse Fishing Pier	Lee	26°26'50"	82°00'50"
25	Naples Mun. Pier	Collier	26°07'50"	81°48'30"

(continued)

Table 20 (concluded)

Map No.	Daily charge	Operating hours	Length (ft)	Max. water depth (ft)	Constr. materials	Year built	Capacity
1	--	7 AM-11 PM	500	3	Wood	1973	--
2	--	24 hours	650	4	Wood	1952	50
3	$3.00	8 AM-12 PM	1,109	12	St, Conc.	1962	250
4	$3.50	24 hours	1,041	26	Wood	1960	1,000
5	--	6 AM-1 AM	1,400	8-10	Wood	1933	200-300
6	--	24 hours	100	6	Wood	1979	40
7	$3.50	24 hours	1,000	16	Wood	1962	--
8	--	24 hours	1,800	16	Concrete	1973	200
9	--	--	450	--	--	--	--
10	--	24 hours	1,000	10-12	Concrete	1964	300-400
11	--	24 hours	300	21	Wd/conc.	1949	100
12	--	7 AM-11 PM	735	14	Wood	1910	250
13	--	6 AM-10 PM	700	10	Wood	1976	125
14	--	6 AM-10 PM	570	--	Concrete	1980	150
15	$ .50	7 AM-8 PM	425	15	Concrete	1966	200
16	--	8 AM-9 AM	250	5	Wood	1981	100
17	--	24 hours	600	4	Wood	1976	50
18	--	24 hours	400	4	Concrete	1977	100
19	--	24 hours	300/ea.	10	Wood	--	200
20	$2.00	24 hours	300	8	Wood	--	--
21	--	24 hours	300-400	6	Wood	1940's	50
22	--	24 hours	400	8-10	Wood	1967	70
23	--	--	600	10	Concrete	1974	--
24	--	24 hours	150	12	Wood	1974	---
25	--	7:30 AM 6:30 PM	1,000	15-18	Wood	1961	500

13. ARTIFICIAL REEFS

The artificial reefs program of the State of Florida is administered by the Bureau of Marine Science and Technology under Section 370.013 of the Florida Statutes. Approximately $110,000 in grants was awarded in 1979 and 1980, which were the first two years of the newly adopted program. The principle types of fish that inhabit the artificial reefs located in the southwest Florida study area coastal waters are grouper, snapper, Spanish mackerel, king mackerel, and amberjacks. A complete matrix of artificial reefs keyed by number on the atlas overlays is shown in Table 21 (Florida Department of Natural Resources 1981).

Florida's coastal waters contain more artificial reefs than any other state (Seaman 1982). Scientific development and deployment of artificial reefs has been a slow process with little research and scanty funding. Without considerable volunteer effort to secure materials and free labor, many of the present artificial reefs off southwest Florida would not exist. The largest group of organizations which have put together an artificial reef program is found in Pinellas County. The cities of Clearwater, Madeira Beach, St. Petersburg, St. Petersburg Beach, and Treasure Island, and the Pinellas County Board of Commissioners have built 20 reefs, of which 10 are presently being maintained by Pinellas County Mosquito Control. Its annual budget supports a small crew, barge rental, operating expenses, and equipment (Seaman 1982).

Virtually all artificial reefs in Florida are composed of either ships, automobiles, tires, or concrete. New, prefabricated artificial reefs are being introduced in Florida by the Japanese (off Ft. Lauderdale, Panama City, and Jacksonville) under contract with the National Marine Fisheries Service.

Table 21. Artificial reef matrix (Palik 1982).

No. on map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
(Tarpon Springs)					
1	Barges	28°15'19"	82°57'27"	25	9.0
2	Unknown	28°15'00"	82°58'00"	21	7.5
3	Unknown	28°08'25"	82°55'05"	20	5.2
4	Concrete Culverts	28°08'15"	82°55'51"	27	3.7
5	Tires, Concrete Culverts	28°08'03"	82°55'51"	26-28	5.3
6	Conc. Culverts, Tires, Conc. Pilings	28°03'12"	82°54'33"	25-30	4.5
7	Conc. Pilings, S. Barges, Tires, Culverts	28°00'57"	82°54'42"	29	3.8
(St. Petersburg)					
1	Concrete Rubble, 32' Steel Hull Ships	27°47'11"	82°35'57"	34-36	1.0
2	Tires, Metal Junk, Conc. Rubble	27°47'06"	82°50'02"	20-22	0.8
3	Tires, Metal Junk, Conc. Rubble	27°47'00"	82°49'08"	20-22	1.3
4	Tires	27°46'18"	82°54'54"	30-32	6.3
5	Tires, Conc. Rubble, Clay Pipes	27°46'32"	82°35'48"	16	1.3
6	Tires, Concrete Culvert	27°44'30"	82°52'51"	29-33	6.1
7	Junk, Tires	27°43'07"	82°46'02"	20	1.6
8	Junk, Tires	27°43'01"	82°45'09"	20	0.8
9	Junk, Tires	27°42'03"	82°45'06"	20	1.0
10	Junk, Tires	27°41'05"	82°45'08"	20	1.0
11	Tires, Conc. Rubble, Clay Pipes	27°40'56"	82°38'01"	11	1.3
12	Tires, Conc. Culverts, Pilings and Slab	27°40'36"	82°51'45"	34-36	7.6
13	Autos	27°39'17"	82°35'28"	25	2.1
14	Concrete Pipe	27°36'00"	82°46'00"	90	0.4
15	Tires, Concrete Pipe	27°32'15"	82°42'42"	40	7.8
16	Concrete, Tires	27°31'42"	82°38'42"	15	0.01
17	Concrete, Tires	27°30'24"	82°35'00"	12	0.1
(Sarasota)					
1	Tires, Concrete Pipe	27°29'57"	82°48'00"	30	3.5
2	Barge, Metal Junk, C. Pipe, Tires	27°29'30"	82°44'05"	21	1.0
3	Autos	27°29'20"	82°43'47"	32	1.2
4	Tires, Concrete Pipe	27°26'33"	82°49'12"	40	7.9
5	Tires, Concrete Pipe	27°26'33"	82°44'48"	30	3.1
6	Tires, Broken Concrete, Sewer Tile	27°23'51"	82°35'49"	12	1.0
7	Unknown	SR 780	Bridge		
8	Tires, Fiberglass, Conc. Rubble	27°18'06"	82°36'36"	20-30	2.1
9	Tires, Fiberglass, Conc. Rubble	27°18'06"	82°35'36"	20-30	1.3
10	Unknown	27°18'01"	82°35'06"	7	0.7
11	Tires, Fiberglass, Conc. Rubble	27°17'06"	82°36'36"	20-30	2.2
12	Tires, Rock, Tile, Conc. Rubble, Pipe	27°06'00"	82°29'00"	25	1.3
13	Unknown	27°04'20"	82°28'40"	22	1.6

(continued)

Table 21 (concluded)

No. on map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
(Charlotte Harbor)					
1	Tires	26°54'49"	82°07'36"	7-9	1.5
2	Metal Junk	26°54'42"	82°21'48"	28	0.3
3	Unknown	26°38'09"	82°18'09"	34	3.6
4	Tires, Concrete Rubble	26°33'15"	82°13'14"	23	1.5
(Sanibel)					
1	Tires, Concrete Rubble	26°24'21"	82°02'38"	20	1.2
2	Unknown	26°24'21"	82°02'15"	20	2.2
3	Unknown	26°20'07"	82°05'05"	30	5.7
4	Weighted Tires	26°19'05"	82°07'05"	31-34	9.8
(Naples)					
1	Concrete Bridge Rubble, Ships, 175' Patrol Craft	26°22'32"	81°55'04"	20	2.0
2	Unknown	26°08'00"	81°50'40"	17	2.5
3	Tires, Concrete Rubble	26°07'45"	81°50'45"	21	2.0
(Everglades City)					
1	Tires	25°55'24"	81°46'15"	20-23	1.5
2	Barge, Crane, Tires, C. Rubble Pipe, Trucks	25°52'42"	81°47'38"	30-35	4.4
(Key West)					
1	Autos	24°39'30"	81°51'05"	20	5.3
2	Tires, Autos, Metal Junk	24°39'36"	81°04'41"	25	2.0
3	Unknown	24°36'00"	81°48'40"	14	0.8
(Islamorada)					
1	Unknown	24°41'00"	80°57'30"	10	8.5

14. SHIPWRECKS

The National Ocean Survey maintains an updated computer data base on all shipwrecks located in the United States and its coastal waters. Individual shipwreck locations are plotted on their various nautical charts. The data base gives an indepth description of each shipwreck site. The two types of shipwrecks mapped in the atlas are sunken and exposed. Shipwrecks act as artificial fishing reefs for many fish species. All shipwrecks are plotted on the individual atlas maps and described in detail in Table 22.

Table 22. Shipwreck matrix (National Oceanic and Atmospheric Administration 1981a; National Oceanic and Atmospheric Administration 1981b).

Ship name	Size	Latitude	Longitude	Depth (ft)
Belmont	1521 GT [a]	27°37'30"	82°52'00"	33
Caterpillar	---	24°46'06"	82°04'30"	66
Eagle	188 GT [a]	25°52'00"	82°20'00"	78
Eagle Boat	800 GT [a]	24°38'25"	82°06'30"	10
Ed. Luckenback	7934 GT [a]	24°57'06"	81°54'00"	60
Gasparilla	---	26°43'00"	82°15'42"	30
Maria Louisa	---	24°35'36"	82°43'36"	30
Unknown	---	24°34'40"	81°24'42"	18
Unknown	---	24°32'04"	81°50'42"	10
Unknown	---	26°20'50"	82°07'00"	36
Unknown	---	27°46'30"	82°32'42"	23
Unknown	---	27°05'12"	82°41'00"	35
Unknown	---	26°45'49"	82°50'47"	66
U.S.S. Sturtevant	---	24°45'00"	82°01'00"	60
Y.M.S. 319	---	24°38'00"	84°10'00"	8
Zalophus	300 GT [a]	27°21'00"	82°38'00"	30
Cindy	Tugboat	27°34'36"	82°46'06"	3
Empress Ann	---	28°08'00"	82°51'00"	12
Restless	---	27°40'00"	82°44'10"	4
Sea Gal	28 ft.	27°47'12"	82°49'30"	15
Unknown	28 ft.	28°00'00"	82°50'00"	20
Unknown	41 ft.	27°58'05"	82°50'05"	5
Unknown	35 ft.	27°58'36"	82°56'54"	34
Unknown	---	25°26'00"	81°12'00"	7
Unknown	---	25°45'10"	81°35'45"	13
Unknown	---	25°54'25"	81°46'00"	22
Unknown	---	26°01'45"	81°50'05"	28
Unknown	---	26°05'00"	81°50'00"	23
Unknown	---	26°05'40"	81°48'15"	6
Unknown	---	26°23'10"	81°53'55"	13
Unknown	---	25°45'00"	81°23'30"	6
Unknown	---	26°35'55"	81°55'10"	1
Unknown	---	26°32'25"	81°56'15"	1
Unknown	---	26°39'30"	81°51'30"	1
Unknown	---	26°39'00"	81°51'25"	1
Unknown	---	26°41'30"	81°51'05"	3
Unknown	---	26°41'25"	81°49'15"	1
Unknown	---	26°27'15"	81°00'25"	9
Unknown	---	26°33'10"	81°55'40"	2
Unknown	---	26°32'05"	81°55'35"	1
Unknown	---	26°32'10"	81°55'40"	1
Unknown	---	26°32'20"	81°56'20"	1
Unknown	---	26°31'45"	81°58'15"	6
Unknown	---	26°31'40"	81°59'40"	11

(continued)

a - GT = gross tons

Table 22 (continued)

Ship name	Size	Latitude	Longitude	Depth (ft)
Unknown	---	26°30'10"	81°01'35"	1
Unknown	---	26°29'10"	82°01'10"	1
Unknown	---	28°29'35"	81°59'55"	1
Unknown	---	26°29'35"	82°14'20"	1
Unknown	---	26°29'00"	82°12'10"	12
Unknown	---	26°36'00"	82°23'55"	54
Unknown	---	26°46'50"	82°21'35"	38
Unknown	---	26°54'00"	82°42'10"	79
Unknown	---	26°48'15"	82°15'35"	1
Unknown	---	26°49'20"	82°15'40"	3
Unknown	---	26°50'50"	82°17'45"	3
Unknown	---	26°58'10"	82°22'30"	3
Unknown	---	26°58'10"	82°22'40"	3
Unknown	---	27°00'10"	82°24'25"	2
Unknown	---	27°03'20"	82°26'40"	6
Unknown	---	27°15'10"	82°31'40"	1
Unknown	---	27°16'20"	82°34'20"	6
Unknown	---	27°16'40"	82°34'40"	2
Unknown	---	27°19'20"	82°32'40"	6
Unknown	---	24°43'00"	82°12'00"	66
Unknown	---	24°50'00"	82°03'00"	60
Unknown	---	24°47'30"	82°03'00"	57
Unknown	---	24°45'45"	82°01'30"	46
Unknown	---	24°46'00"	82°00'15"	60
Unknown	---	24°44'45"	82°00'15"	63
Unknown	---	24°41'30"	82°46'20"	12
Unknown	---	24°38'55"	82°47'50"	3
Unknown	---	24°39'20"	82°47'20"	14
Unknown	---	24°36'20"	82°52'45"	10
Unknown	---	24°36'30"	82°52'40"	2
Unknown	---	24°36'30"	82°52'20"	30
Unknown	---	24°37'24"	82°52'12"	3
Unknown	---	24°37'31"	82°52'45"	44
Unknown	---	24°38'20"	82°55'20"	3
Unknown	---	24°37'30"	82°56'10"	6
Unknown	---	24°37'10"	82°56'30"	6
Unknown	---	24°37'20"	82°56'40"	6
Unknown	---	24°37'10"	82°56'50"	6
Unknown	---	24°37'10"	82°57'10"	6
Unknown	---	24°34'00"	82°12'15"	6
Unknown	---	24°33'00"	82°11'00"	6
Unknown	---	24°35'30"	82°11'00"	6
Unknown	---	24°35'00"	82°10'30"	6
Unknown	---	24°31'00"	82°12'00"	33
Unknown	---	24°35'00"	82°09'30"	6
Unknown	---	24°35'00"	82°05'00"	12

(continued)

Table 22 (continued)

Ship name	Size	Latitude	Longitude	Depth (ft)
Unknown	---	24°37'00"	81°59'00"	24
Unknown	---	24°37'00"	82°00'45"	12
Unknown	---	24°32'40"	81°59'55"	7
Unknown	---	24°32'45"	81°59'45"	6
Unknown	---	24°33'25"	81°58'40"	6
Unknown	---	24°31'05"	82°00'00"	18
Unknown	---	24°31'20"	81°57'50"	1
Unknown	---	24°30'50"	81°55'25"	10
Unknown	---	24°38'40"	81°54'00"	22
Unknown	---	24°39'25"	81°53'45"	33
Unknown	---	24°36'15"	81°53'15"	3
Unknown	---	24°40'00"	81°48'00"	20
Unknown	---	24°34'50"	81°48'00"	4
Unknown	---	24°34'50"	81°48'05"	6
Unknown	---	24°34'30"	81°48'25"	1
Unknown	---	24°34'10"	81°48'05"	11
Unknown	---	24°34'05"	81°48'48"	2
Unknown	---	24°34'04"	81°48'46°	1
Unknown	---	24°33'56"	81°48'45"	1
Unknown	---	24°33'54"	81°48'40"	1
Unknown	---	24°33'53"	81°48'35"	9
Unknown	---	24°34'55"	81°48'25"	18
Unknown	---	28°11'30"	82°51'15"	5
Unknown	---	28°11'32"	82°51'15"	5
Unknown	---	27°37'20"	82°46'30"	10
Unknown	---	27°34'30"	82°46'10"	6
Unknown	---	27°40'42"	82°44'54"	27
Unknown	---	27°40'00"	82°44'10"	4
Unknown	---	24°35'10"	81°48'35"	5
Unknown	---	24°35'10"	81°48'40"	5
Unknown	---	24°35'20"	81°48'10"	2
Unknown	---	24°33'00"	81°43'50"	6
Unknown	---	24°37'00"	81°31'00"	1
Unknown	---	24°36'40"	81°29'40"	4
Unknown	---	24°36'00"	81°22'50"	27
Unknown	---	24°39'15"	81°18'30"	1
Unknown	---	24°39'15"	81°18'15"	1
Unknown	---	24°44'15"	81°14'00"	4
Unknown	---	24°41'45"	81°12'20"	1
Unknown	---	24°41'00"	81°11'50"	6
Unknown	---	24°44'10"	81°06'15"	7
Unknown	---	24°42'30"	81°07'35"	6
Unknown	---	24°44'05"	81°06'00"	7
Unknown	---	24°41'00"	81°05'15"	4
Unknown	---	24°41'20"	81°05'00"	3
Unknown	---	24°40'50"	81°04'45"	12

(continued)

Table 22 (concluded)

Ship name	Size	Latitude	Longitude	Depth (ft)
Unknown	---	24°43'20"	81°00'10"	8
Unknown	---	24°40'10"	80°58'00"	18
Unknown	---	24°46'30"	80°54'30"	4
Unknown	---	24°45'20"	80°48'45"	22
Unknown	---	24°48'15"	80°49'45"	2
Unknown	---	24°51'00"	80°37'30"	12
Unknown	---	24°54'00"	80°37'30"	8
Unknown	---	24°56'45"	80°33'40"	7
Unknown	---	24°55'55"	80°33'00"	9
Unknown	---	25°00'00"	80°30'20"	6
Unknown	---	25°00'40"	80°29'30"	8
Unknown	---	25°04'20"	80°27'20"	5
Unknown	---	25°02'50"	80°27'00"	5
Unknown	---	25°09'00"	80°21'30"	6
Unknown	---	25°03'10"	80°27'00"	4
Unknown	---	24°59'10"	80°33'50"	1
Unknown	---	25°04'50"	80°28'50"	1
Unknown	---	24°44'10"	81°06'10"	8
Unknown	---	25°08'00"	80°22'30"	1
Unknown	---	25°09'00"	80°22'00"	1
Unknown	---	25°09'00"	80°21'30"	5
Unknown	---	25°10'20"	80°21'20"	3
Unknown	---	25°10'40"	80°21'20"	3
Unknown	---	25°10'45"	80°20'50"	3

15. MAJOR OFFSHORE STRUCTURES

Major offshore structures, as mapped on the atlas maps, represent fish havens for various pelagic and neritic fish. The major offshore structures that are mapped on the atlas overlays are fixed steel towers greater than or equal to 30 feet above mean sea level in height, or fishing platforms. There are no other large offshore structures (oil drilling platforms, etc.) within the study area.

16. LAND USE

The first settlements in southwest Florida occurred in the mid-1800's along coastal areas and streams which were navigable by boat. The earliest inland communities developed as offshoots of these coastal settlements. They were connected by trails and shallow streams. The railway system's expansion into southwest Florida provided the first stimulus to development by increasing the overall accessibility of the region. Communities connected by the railroad and provided with railroad terminals quickly became centers of trade and economic activity. Another major boost to the region's development came with the introduction of the automobile and the subsequent development of a highway system. Since 1950 the region has experienced rapid growth which has increased steadily during the period (Texas Instruments, Inc. 1975).

The U.S. Geological Survey (USGS) has developed a land use and land cover classification system, which is described in USGS Circular 671. A Level I Land Use Classification using 1973 data has been mapped on the individual atlas overlays for all urban lands, agricultural lands, and rangeland (the data has been updated in urban areas with recent land use maps). The classification system is described in Table 23.

A percentage breakdown by USGS Luda Level I Classification by county is shown in Table 24. Pinellas is the most densely populated and urbanized county in southwest Florida. Collier and De Soto Counties are the least urbanized. De Soto County has the highest percentage of agricultural lands, with over 50% of the land being used for agriculture.

Table 23. U.S. Geological Survey Level I and II land use classification systems (Kuyper et al. 1981).

Level I (mapped)	Level II (not mapped)
Urban or built-up land (mapped as urban land)	Residential
	Commercial and services
	Industrial
	Transportation, communications and utilities
	Industrial and commercial employees
	Mixed urban or built-up land
	Other urban or built-up land
Agricultural land (mapped as agricultural land)	Cropland and pasture
	Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
	Confined feeding operations
	Other agricultural land
Rangeland (mapped as rangeland)	Herbaceous rangeland
	Shrub-brushland rangeland
	Mixed rangeland
Forest land (not mapped)	Deciduous forest land
	Evergreen forest land
	Mixed forest land
Water (not mapped)	Streams and canals
	Lakes
	Reservoirs
	Bays and estuaries
Wetland (mapped on Overlay #1, Biological Resources)	Forested wetland
	Nonforested wetland
	Dry salt flats
Barren land (not mapped)	Beaches
	Sandy areas other than beaches
	Bare exposed rock
	Strip mines, quarries and gravel pits
	Transitional areas
	Mixed barren land

Table 24. U.S. Geological Survey Level I land use percentages by county (French and Parsons 1983).

County	Urban	Agricultural	Rangeland	Forestland	Water	Wetland	Barren
Pasco	10.1%	41.7%	15.6%	7.3%	3.2%	18.6%	3.7%
Pinellas	38.8%	7.3%	5.5%	3.4%	36.9%	5.7%	2.4%
Hillsborough	17.5%	36.7%	12.1%	5.8%	16.3%	9.4%	2.3%
Manatee	5.2%	35.7%	35.0%	3.9%	11.1%	8.6%	0.5%
Sarasota	12.0%	20.6%	41.4%	8.3%	4.9%	7.5%	5.3%
Charlotte	3.9%	11.9%	41.5%	4.1%	14.2%	16.2%	8.1%
De Soto	1.7%	53.1%	31.3%	1.1%	0.5%	11.9%	0.3%
Lee	6.7%	13.6%	22.1%	6.3%	21.5%	18.1%	11.7%
Collier	1.6%	7.8%	15.7%	12.2%	3.5%	50.28%	9.0%
Monroe	4.8%	0.0%	0.0%	5.8%	25.7%	63.2%	0.4%

17. LANDFILLS

The Florida Department of Environmental Regulation maintains an updated computer data base on all landfills and dumpsites in southwest Florida. Solid waste facilities are categorized by the computer data base as follows (Florida Dept. of Environmental Regulation):

Code:

100 Class I landfill (landfills handling greater than or equal to 200 tons per month or greater than or equal to 50 cubic yards per month refuse)

200 Class II landfill (landfills handling less than 200 tons per month or less than 50 cubic yards per month refuse)

300 Class III landfill (dumpsites)
- 310 Trash/yard trash
- 320 Trash composting

400 Sludge disposal facility

500 Other (transfer stations)

Class I and II landfills are numbered and plotted on the individual atlas overlays and described, in detail, in Tables 25 and 26. Class III landfills (dumpsites) as well as transfer stations are not mapped but are described in Tables 27 and 28.

Table 25. Class I landfill matrix (Florida Department of Environmental Regulation 1981).

No. on map	Name	County	Owner	Population served	Cubic yd/day	Cost/ ton	Life expect.
1	Redding Sanitary Landfill	Pasco	C. Redding	22,000	250	3.25	1989
2	Environmental Waste Control, Inc.	Pasco	Env. Waste Control	40,000	80	1.88	1985
3	Ridge Road Landfill	Pasco	Pasco Co.	65,000	600	5.00yd	1983
4	East Pasco Landfill	Pasco	Pasco Co.	30,000	345	0.80yd	1989
5	Toytown S. Landfill*	Pinellas	Pinellas Co.	550,000	5,230	6.50	1988
6	Bridgeway Acres	Pinellas	Pinellas Co.	350,000	700 tons	4.00	----
7	City of Largo S. Landfill	Pinellas	City of Largo	58,000	900	3.00	1986
8	City of Tarpon Springs Landfill	Pinellas	Tarpon Springs	15,000	400	----	----
9	Hillsborough Heights Landfill	Hillsbrgh	SW Con Dept	196,000	270 tons	3.00	----
10	Northwest Landfill	Hillsbrgh	Public Utilities	125,000	1,760	----	1986
11	Palmetto Erie Road Landfill	Manatee	City of Palmetto	24,000	90 tons	2.85	1986
12	Lena Road Landfill	Manatee	Co. Mosq. Control	104,000	470 tons	2.96	1987
13	Venice Landfill	Sarasota	Bd.of Co. Comm.	60,000	200 tons	2.50	1985
14	Bee Ridge Landfill	Sarasota	Bd.of Co. Comm.	162,000	600 tons	----	1986
15	City of Arcadia Landfill	De Soto	City Arcadia	7,500	55	1.50yd	1993
16	Section 16 Landfill	De Soto	Bd.of Co. Comm.	18,000	19 tons	4.00	2003
17	Charlotte County San. Landfill	Charlotte	Co. Mosq. Control	55,000	400	1.11yd	1991
18	Gulf Coast Landfill	Lee	Waste Mgt	720,000	572 tons	4.00	1991
19	Immokalee Sanitary Landfill	Collier	Bd.of Co. Comm.	11,000	127	----	1984
20	Naples Sanitary Landfill	Collier	Bd.of Co. Comm.	69,000	1,586	3.00	1996
21	Stock Island Landfill	Monroe	Key West	25,382	100 tons	----	2007
22	Cudjoe Key Sanitary Landfill	Monroe	County	10,000	50 tons	----	1983
23	Long Key Sanitary Landfill	Monroe	County	30,000	90 tons	6.00	1995
24	Cudjoe Key Volume Reduction Facility	Monroe	Co. Comm.	13,500	90 tons	----	----
25	Pinellas County Incinerator	Pinellas	Co. Comm.	550,000	(Incinerator)		----

* Closed 1983

Table 26. Class II landfill matrix (Florida Department of Environmental Regulation 1981).

No. on map	Name	County	Owner	Population served	Cubic yd/day	Cost/ ton	Life expect.
1	Kingsway Road Landfill	Hillsbrgh	D.J. Joseph Co.	------	100 tons	1.00	1991
2	City of North Port San. Landfill	Sarasota	North Port	6,000	25 tons	7.56	1986

Table 27. Class III landfill matrix (Florida Department of Environmental Regulation 1981).

Name	County	Owner	Population served	Cubic yd/day	Cost/ ton	Life expect.
Zephyrhills Yard Trash Landfill	Pasco	City of Zephyrhills	7,000	72	----	1986
Sunshine Excavating	Pinellas	Sunshine Excavating	100,000	---	----	1984
Beasley and Sons Landfill	Hillsbrgh	Beasley & Sons, Inc.	----	---	----	----
TECO Composting Facility	Hillsbrgh	Tampa Electric Co.	----	43	----	1984
Lee Mar Yard Trash Compost Site	Lee	Lee Mar Const. Co.	----	175	5.00yd	----
Carnestone Yard Trash Compost Site	Collier	Bd. of Comm.	2,400	Stone/dy	----	1991
Naples Yard Trash	Collier	City of Naples	55,000	104	----	1991
Key Largo Disposal Site	Monroe	County	16,000	5 tons	3.00yd	----

Table 28. Transfer station matrix (Florida Department of Environmental Regulation 1981).

Name	County	Owner	Population served	Cubic yd/day	Cost/ ton	Life expect.
City of Clearwater Transfer Stat.	Pinellas	City of Clearwater	90,000	350 tons	----	----
South County Transfer Station	Hillsbrgh	Hillsbrgh County	50,000	410 tons	3.00	----
N.W. Hillsbrgh Co. Solid Waste TS	Hillsbrgh	Public Utilities	80,000	650 tons	----	----
Waste Mgmt. Inc. Hazardous Waste TS	Hillsbrgh	Waste Mgmt.	----	----	----	----
Charlotte Sanitation Transfer Stat.	Charlotte	Lou Decker Waste Mgt	40,000	200	----	----
Englewood Disposal Transfer Station	Charlotte	Stephen Barton	1,200	75	----	----
Beach Disposal, Inc. Transfer Stat.	Lee	Joseph Hamstra	10,000	175	----	----
Southern Disposal Transfer Stat.	Lee	Charles Helmschoot	3,000	175	----	----
Turner Disposal Transfer Station	Lee	Morris Garner	35,000	125	----	----
Carnestown Transfer Station	Collier	County Solid Waste	2,400	9 tons	3.00yd	----
Naples Transfer Station	Collier	County Solid Waste	45,000	150	----	----
Marco Island Transfer Station	Collier	County Comm.	5,500	10 tons	----	----
Cudjoe Key Transfer Station	Monroe	Waste Management, Inc.	3,000	80	----	----
Key Largo Transfer Station	Monroe	Co. Mun. Service	10,000	20 tons	----	----

18. DREDGE SPOIL DISPOSAL SITES

The U.S. Army Corps of Engineers and the Florida Department of Environmental Regulation are responsible for all dredge and fill activities in the State. A permit must be obtained from the Corps before any dredge and fill activity will be allowed. The Florida Department of Environmental Regulation is responsible for permitting all dredge spoil sites in the State. They maintain location maps and site data on all dredge spoil disposal sites in southwest Florida. Individual dredge spoil sites have been plotted on the atlas overlays and represent all dredge spoil and disposal sites permitted by the Florida Department of Environmental Regulation in southwest Florida.

19. INDUSTRIAL AND MUNICIPAL POINT SOURCE DISCHARGES

The Florida Department of Environmental Regulation, in Tallahassee, keeps an updated computer data base on all industrial and municipal (sewage) point source discharges in southwest Florida. The individual industrial (sewage) point discharges are numbered and plotted on the individual atlas maps. A detailed matrix describing each industrial point source is found in Table 29. The individual municipal (sewage) point discharges are numbered and plotted on the individual atlas maps. A detailed matrix describing each municipal point source is found in Table 30 (Florida Dept. of Environmental Regulation 1981).

Table 29. Industrial point source discharge matrix (Florida Department of Environmental Regulation 1982).

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
1	Alligator Utilities, Inc.	Reverse osmosis, brine discharge	13.3 TGD
2	Burnt Store Utilities	Reverse osmosis, brine reject water	51.0 TGD
3	Florida Mining and Materials	--------	----
4	Gulf Shore Seafood, Inc.	Seafood processing wastes	----
5	Rotunda West Utilities, Corp.	Reverse osmosis, brine discharge	0.5 MGD
6	Immokalee Landfill	--------	----
7	Shell Mound Coin Laundry	--------	12.0 TGD
8	Al Hitzing & Co., Inc.	Extended aeration to river	2.5 TGD
9	Florida Power and Light	Thermal effluent to river	563.0 MGD
10	Island Water Assoc. Inc.	Reverse osmosis, brine discharge	----
11	Lee County Utilities	--------	5.0 MGD
12	San Carlos Park Laundromat	Trickling filter to lake	10.0 TGD
13	Sunset Captiva LTD.	Reverse osmosis, rej. water disposal	30.0 TGD
14	Useppa Inn and Dock Co.	Reverse osmosis, brine water dischg.	27.0 TGD
15	City Fish Market, Inc.	Screening	6.5 TGD
16	Coral Shrimp Co.	--------	0.7 TGD
17	Crawl Key Resort	Reverse osmosis	100.0 TGD
18	Cudjoe Key Sanitary Landfill	--------	----
19	Florida Keys Aqueduct Authority	Brine discharge to harbor channel	7.0 MGD
20	Harry S. Truman Animal Import Center	Brine dischg. from desalin. plant	400.0 TGD
21	Harry S. Truman Animal Import Center	Waste treatment and disposal	30.0 TGD
22	Ocean Farming Systems, Inc.	--------	8.0 MGD
23	Stock Island Landfill Area	Wetland and high-rise methods	----
24	Turtle Kraals, LTD	Brine reject water to a lagoon	100.0 TGD
25	Utility Board of Key West	Utility cooling water to surface wtr	69.8 MGD
26	Utility Board of Key West	--------	47.5 MGD
27	Amax Boggy Branch	--------	----
28	Amax Gully Branch	--------	----
29	Amax Lake Branch	--------	----
30	Amax Settling Area BF-2	--------	----
31	Amoco Oil Lagoon	Evap.-Percolation lagoon	----
32	Brewster Outfall 1-CL	--------	----
33	Brewster Phosphates (Lonesome Mine)	--------	----
34	Brewster Spillway 1-AL	Emergency spillway	----
35	Brewster Spillway 1-DL	Stormwater replacement structure	----
36	Brewster Spillway 1-BL	Emergency outfall	
37	Brewster Stormwater Area E	--------	----
38	Central Phosphates, Inc.	--------	----
39	Crystals International, Inc.	--------	----
40	Del Monte Corp.	Surface drainage	----
41	Eastside Water Co.	Trickling filter (2 outfalls)	250.0 TGD
42	Fleet Transport Co.	Tank truck wsh discharge to bay	80.0 TGD
43	Florida Agglaite Corp.	--------	----
44	Florida Sip., Inc.	Steam evap. & cooling to lake	3.7 MGD
45	Gardiner, Inc.	--------	----

(continued)

Table 29 (continued)

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
46	Gibsonton Speedwash	Trickling filter, chlorination	----
47	Hopewell Land Corp.	--------	----
48	Hopewell Land Corp.	--------	----
49	IMC Port Sutton	--------	864.0 TGD
50	Kaiser Aggre-Chemical	Urea store and load	300.0 TGD
51	Lutz Laundry	Screening, settling&trickling filter	4.2 TGD
52	MRI Corp.	--------	----
53	Nottingham Co.	Oil water separation	----
54	Ruskin Laundromat	Trickling filter	10.0 TGD
55	Shell Oil Co.	Oil water separation	----
56	Southland Frozen Food	--------	----
57	Tropicana	Aeration & sprayfield (2 outfalls)	26.0 MGD
58	TECO, Big Bend	Coal pile runoff to pond	33.0 MGD
59	W. R. Grace Ammonia Terminal	--------	----
60	W. R. Grace Four Corners	--------	----
61	Amax: Piney Point	Dischg of untreated water (3 outfalls)	---
62	Nord Southern Dolomite	--------	----
63	Evans Packing	Aeration (2 outfalls)	1.7 MGD
64	Florida Power, Anclote	Cooling water discharge to gulf	1435.0 MGD
65	Lykes Pasco Packing Co.	Cooling water treatment	----
66	Zepher Rock & Lime, Inc.	--------	----
67	Florida Power, Bartow	Cooling water collection & storage	----
68	Florida Power, Bartow	Evap-percolation pond	----
69	Florida Power, Higgins	Cooling water discharge	----
70	Golden Triangle Asphalt Paving	--------	----
71	H. P. Hood, Inc.	Citrus waste, sludge discharge	600.0 TGD
72	Industrial Concrete, Inc.	--------	----
73	Midway Service	Trickling filter	150.0 TGD
74	Modern Plating Corp.	Rinse water discharge	----
75	PBC Industries Palm Harbor Laundry	--------	----
76	Pierce Landfill	--------	----
77	Pinellas County Sanitary Landfill	Trench and area methods	----
78	Benefield Debris Recovery	Loop settling areas	----
79	Toytown Sanitary Landfill	Area method	----
80	Windisch Landfill	--------	----
81	Atlantic Utilities	Contact stabilization, chorination	----
82	Culligan Water Conditioning Co.	--------	----
83	Florida Cities Water Co/South Gate	Advanced waste treatment	136.0 TGD
84	Dolomite Utilities	Contact stabilization	300.0 TGD
85	Florida Cities Water Co./Gulf Gate	Advanced waste treatment	1.8 MGD
86	Macasphalt, Inc.	Silica, sand and shell marl washing	----
87	Myakka Utilities	Contact stabilization	400.0 TGD
88	Sorrento Utilities	Reverse osmosis discharge	280.0 TGD
89	Southbay Utility Co.	Reverse osmosis discharge	----

(continued)

Table 29 (concluded)

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
90	Dyne-Flo Service Food	Extended aeration	1.0 MGD
91	Kensington Park Utilities	Trickling filterfield (2 outfalls)	560.0 TGD
92	Kings Gate Club	Retention Lake	18.0 MGD
93	Southeast Shopping Plaza	Activated sludge	9.2 TGD
94	Forest Hills Utilities	Extended aeration	300.0 TGD
95	Stuckey's	Extended aeration	5.0 TGD
96	Tampa Downs	Extended aeration	100.0 TGD
97	Aerosonics Corp.	Extended aeration	7.5 TGD
98	Air International, Inc.	Extended aeration	3.0 TGD
99	Siesta Keys Utilities Authority	Contact stabilization	2.7 MGD
100	Charlotte Harbor Water Assoc.	Reverse osmosis discharge to canal	80.0 TGD
101	Charlotte Harbor Water Assoc.	Treatment & dispersal of r/o dischg.	120.0 TGD
102	Carnestown Yard Trash Comp.	--------	----
103	Naples Industrial Park Ltd.	Extended aeration to surface dischg.	100.0 TGD
104	Naples Sanitary Landfill	--------	----
105	Naples Yard Trash Compost	--------	----
106	Greater Pine Island Water Assoc.	Reverse osmosis discharge to canal	550.0 TGD
107	Florida Keys Aqueduct Authority	--------	1.0 MGD
108	Florida Keys Aqueduct Authority	--------	6.0 MGD
109	Keyhaven Utilities	Extended aeration	100.0 TGD
110	Long Key Landfill	--------	----

Table 30. Municipal point source discharge matrix (Florida Department of Environmental Regulation 1982).

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
1	Eagle Point Mobile Home Park (MHP)	Reverse osmosis discharge	14.4 TGD
2	Charlotte County Public Safety	Extended aeration to perc. pond	10.0 TGD
3	Punta Gorda Isles #15	Extended aeration to retention pond	10.0 TGD
4	Punta Gorda, Inc.	-----------	36.0 TGD
5	City of Punta Gorda	Contact stabilization, water dischg.	1.0 MGD
6	City of Punta Gorda	Contact stabilization, water dischg.	100.0 TGD
7	Shell Creek Park	Extended aeration to retention pond	20.0 TGD
8	Windmill Village of Punta Gorda	Extended aeration and seepage	50.0 TGD
9	Everglades City	Contact stabilization	100.0 TGD
10	City of Golden Gate	Contact stabilization	300.0 TGD
11	City of Naples	Activated sludge to pond	5.4 MGD
12	Enchanting Acres	Contact stabilization	25.0 TGD
13	Lake Trafford Marina	Extended aeration to perc. pond	5.0 TGD
14	Moorhead Manor MHP	Extended aeration to perc. pond	20.0 TGD
15	River Bend MYP	Extended aeration to canal	6.6 TGD
16	Ville DeMarco	Extended aeration to river	10.0 TGD
17	Bayshore Elementary School	Extended aeration to ditch	9.0 TGD
18	City of Cape Coral	Contact stabilization	4.0 MGD
19	City of Cape Coral	Reverse osmosis discharge (2 outfalls)	1.6 MGD
20	Fiesta Village	Contact stabilization	1.5 MGD
21	City of Fort Myers	Aeration and trickling filter	9.0 MGD
22	City of Fort Myers	Contact stabilization	6.0 MGD
23	Gulf Coast SLF	Landfill, area method	550.0 TGD
24	Imperial Harbor MHP	----------	18.0 TGD
25	J. Colin English Elem. School	Septic tank to filter to ditch	9.6 TGD
26	Lee Mar Yard Trash Comp. Site	Composting; area method	---
27	Oak Park M.H. Village	Extended aeration	13.0 TGD
28	Orange River Elem School	Sand filter; effluent to ditch	9.6 TGD
29	Russell Park	Non-run effluent to river	20.0 TGD
30	Waterway Estates	Contact stabilization	1.0 MGD
31	Buccaneer Lodge	Extended aeration to recharge well	15.0 TGD
32	Caribbean Apartments	Extended aeration to borehole	3.3 TGD
33	Coconut Grove Trailer Park	Trickling filter	6.0 TGD
34	Coral Club Condo	Extended aeration to borehole	5.0 TGD
35	Coral Harbour Club	-----------	72.0 TGD
36	Coral Shores School	Extended aeration to ocean	15.0 TGD
37	Fiesta Key K.O.A.	Extended aeration to gulf	46.0 TGD
38	Fishermen's Hospital	Extended aeration to ocean	21.0 TGD
39	Florida Keys Community College	Extended aeration to ocean	15.0 TGD
40	Geiger Key Marina	Ext. aeration, surface water dischg.	5.0 TGD

(continued)

Table 30 (continued)

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
41	Gerald Adams Elementary School	Extended aeration to borehole	10.0 TGD
42	Gilberts Motel and Marine	Extended aeration to gulf	10.0 TGD
43	Harbor Club South Condo	Extended aeration to boreholes	10.0 TGD
44	Howard Johnson Islamorada	Extended aeration to boreholes	20.0 TGD
45	Indies Inn and Yacht Club	Ext. aeration to ocean (2 outfalls)	50.0 TGD
46	Jerry's Sunset Inn	Contact stabilization	3.0 TGD
47	Jolly Roger's T.P.	Extended aeration to gulf	30.0 TGD
48	City of Key Colony Beach	Contact stabilization	200.0 TGD
49	Key Trailer Courts	Extended aeration to ocean	15.0 TGD
50	City of Key West	Raw collection to ocean	4.3 MGD
51	Lady Alexander Condo	Extended aeration to boreholes	5.0 TGD
52	Man O'War Boatels	Extended aeration to ocean	7.5 TGD
53	Marathon High School	Sec. extended aeration to ocean	15.0 TGD
54	Monroe City Public Service Bldg.	Extended aeration to bay	12.0 TGD
55	Nu Age Utility	Extended aeration to harbor channel	200.0 TGD
56	Paradise Point MHP	Extended aeration to drainage well	3.2 TGD
57	Royal Palm Condo	Extended aeration to borehole	10.0 TGD
58	Seabreeze MHP	Extended aeration to ocean	7.5 TGD
59	Sigsbee Park Navy Housing	Contact stabilization	600.0 TGD
60	Stirrup Key	Extended aeration to borehole	25.0 TGD
61	Sunshine Key Travel Park	Extended aeration to gulf	60.0 TGD
62	Trader Jim's Restaurant	Extended aeration to creek	2.6 TGD
63	USCG Station	Extended aeration to gulf	2.5 TGD
64	U.S. Naval Air Station	Contact stabilization	400.0 TGD
65	U.S.C.G. Station	Extended aeration to gulf	5.0 TGD
66	Venture Out At Cudjoe Cay	Contact stabilization	70.0 TGD
67	Water's Edge Colony T.P.	Extended aeration to channel	7.5 TGD
68	City of Clearwater, Marshall St.	Activated sludge	10.0 MGD
69	City of Clearwater, Northeast	Contact stabilization	8.0 MGD
70	City of Clearwater, East	Activated sludgen to ocean	5.0 MGD
71	Coquina Cover T.P.	Extended aeration	8.3 TGD
72	City of Dunedin, Mainland	Contact stabilization	4.0 MGD
73	Fort De Soto Park #1 North	Extended aeration	30.0 TGD
74	Fort De Soto Park #2 Fort Area	Extended aeration	12.0 TGD
75	Fort De Soto Park #3 East	Extended aeration	12.0 TGD
76	Fort De Soto Park #5 Madelaine	Extended aeration	80.0 TGD
77	H. P. Hood, Inc.	Mixing and activated sludge	600.0 TDG
78	Holiday Harbor T.P.	Extended aeration	10.0 TGD
79	Town of Indian Shores	Activated sludge and ext. aeration	15.0 TGD
80	Kakusha MHP	Extended aeration	16.5 TGD
81	City of Largo	Activated sludge	13.5 MGD
82	McKay Creek	Activated sludge	1.8 MGD
83	City of Oldsmar	Extended aeration	1.0 MGD
84	Serving Ecology w/Everyone's Refuse	Extended aeration	3.0 TGD
85	South Cross Bayou	Contact stabilization-complete mix	28.5 MGD

(continued)

Table 30 (continued)

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
86	South Gate Park	Trickling filter	50.0 TGD
87	City of St. Petersburg Beach	Contact stabilization	1.3 MGD
88	City of St. Petrsbrg, Albert Whitted	Contact stabilization	20.0 MGD
89	City of St. Petersburg, Northwest#3	Activated sludge	9.0 MGD
90	City of St. Petersburg, Southwest#4	Activated sludge	20.0 MGD
91	City of Treasure Island	Contact stabilization	2.3 MGD
92	Yankee Travel TP	Extended aeration	15.0 TGD
93	Lake Village MHP	----------	---
94	City of Sarasota	Contact stabilization	9.1 MGD
95	Venice Campground TTP	Extended aeration	10.0 TGD
96	City of Venice	Contact stabilization	3.0 MGD
97	City of Venice	Reverse osmosis	392.0 TGD
98	Deleted from list	----------	---
99	City of Arcadia	Activated sludge	1.0 MDG
100	Peace River Development, Inc.	Two sedimentation ponds to road ditch to pond to praire creek	---
101	Adamo Acres	Trickling filter	271.2 TGD
102	Alafia MHP	Contact stabilization	20.0 TGD
103	Apollo Beach S/D	Extended aeration	1.0 MGD
104	Bahia Beach	Extended aeration	35.0 TGD
105	Bayshore Palms Apartments	Extended aeration	10.0 TGD
106	Carrollwood S/D	Activated sludge	453.0 TGD
107	Hookers Point	High rate activated sludge and AWT	60.0 MGD
108	City of Plant City	Activated sludge and tertiary	8.0 MGD
109	City of Plant City	Activated sludge and tertiary	8.0 MGD
110	River Oaks	Advanced waste treatment	4.6 MGD
111	River Oaks	Advanced waste treatment	4.6 MGD
112	Tampa City of Waterworks	----	----
113	Treasure Isle	Treatment plant with pond	800.0 TGD
114	City of Bradenton	Contact stabilization	6.0 MGD
115	City of Palmetto	Expanded bardenpho process AWT	1.4 MGD
116	Southwest Regional	Contact stabilization	9.0 MGD
117	Tidevue Estates	Trickling filter	100.0 TGD
118	Tillman Elementary School	Extended aeration	10.0 TGD
119	Beacon Square S/D	Extended aeration	625.0 TGD
120	Beacon Square S/D	Extended aeration	625.0 TGD
121	Beacon Square S/D	Extended aeration	625.0 TGD
122	City of Dade City	Contact stabilization	1.0 MGD
123	Foxwood S/D	AWT	70.0 TGD
124	Gardens of Beacon Square #2	Extended aeration	200.0 TGD
125	Lake Padgett MV	Extended aeration	10.0 TGD
126	Lake Padgett MV	Extended aeration	10.0 TGD
127	New Port Richey City of Lindrick	Contact stabilization	500.0 TGD
128	New Port Richey City of Lindrick	Contact stabilization	500.0 TGD
129	New Port Richey City of Main	High rate trickling filter and activated sludge	1.5 MGD

(continued)

Table 30 (concluded)

No. on map	Name	Process and/or treatment	Total capacity thousand or million gal/day
130	New Port Richey City of Main	High rate trickling filter and activated sludge	1.5 MGD
131	Quail Hollow Golf & Country Club	Extended aeration	5.0 TGD
132	Town of Belleair	Activated sludge & tertiary process	900.0 TGD
133	Town of Belleair	Activated sludge & tertiary process	900.0 TGD
134	Boulevard TP	Extended aeration	16.5 TGD
135	City of Clearwater transfer process	Transfer station	----
136	City of Largo sanitary landfill	High-rise method	----
137	City of Tarpon Springs landfill	High-rise method	----
138	City of St. Petersburg NE	Activated sludge	20.0 MGD

20. NATIONAL NATURAL LANDMARKS

The Heritage Conservation and Recreation Service administers the National Natural Landmarks Program, which was established by 16 U.S. Code 461. The objective of the program is to assist in the preservation of a variety of significant natural areas which, when considered together, will illustrate the diversity of the country's natural heritage.

A designated natural landmark is an ecological or geological feature that is identified and recognized by a panel of scientists as being qualified for this distinction. A registered natural landmark is a designated natural landmark where the owner has agreed to preserve the site in its natural state and is given a plaque to commemorate the occasion. There are three registered natural landmarks in southwest Florida. A matrix describing these natural landmarks is shown in Table 31 (Schuler 1981).

Table 31. National natural landmarks matrix (Schuler 1981).

	Landmark		
Parameter	Corkscrew Swamp National Audubon Society Sanctuary	Big Cypress	Lignumvitae Key
County	Collier	Collier	Monroe
Class	Registered NL (April 1964)	Registered NL (October 1966)	Registered NL (May 1974)
Owner	National Audubon Society	Lester Norris (Pres. Norbak Corp.)	Dr. Lunsford Dr. N. Parson
Size	11,000 acres	650 acres	240 acres
Description	Florida's last large stand of virgin bald cypress; wide wildlife variety contains one of two remaining colonies of Wood Stork, only American member of stork family. Maintains a staff of naturalists. Admission fee charged	215 acres of virgin cypress; one of largest remaining cypress stands in Florida	Unusual high outcropping of coral

21. HISTORIC PLACES DESIGNATED ON THE NATIONAL REGISTER

The Historic Sites Act of 1935 states that the preservation of historic and prehistoric sites is national policy and the National Park Service should be the investigative agent for obtaining accurate facts concerning these sites. The Historic Preservation Act of 1966 provides for an expanded National Register of districts, sites, and objects significant in American history and archeology, and funds to help acquire and preserve sites. The program is administered in Florida by the Florida Department of State, Division of Archives, History and Records Management, Bureau of Historic Preservation.

A listing of all historic sites and places designated on the National Register as of February 1982 is shown in Table 32.

Table 32. Historic sites appearing on the National Register Florida Department of State 1982b).

County	Location (lat./long.)	Site
Pasco (None)		
Pinellas	27°51'25", 82°36'31"	Weedon Island Site
	28°00'31", 82°40'41"	Safety Harbor Site
	27°36'55", 82°44'11"	Fort De Soto Batteries
	28°09'18", 82°45'40"	Tarpon Springs Sponge Exchange
	28°01'52", 82°47'09"	Andrews Memorial Chapel
	27°42'32", 82°44'15"	Don Ce Sar Hotel
	27°57'30", 82°48'02"	South Ward School
	27°57'25", 82°48'20"	Donald Roebling Estate (Spotswood)
	27°56'36", 82°48'37"	Belleview-Biltmore Hotel
	28°08'53", 82°45'36"	Stafford House
	27°45'54", 82°38'23"	John C. Williams House (Manhattan Hotel)
	27°46'40", 82°37'50"	Vinoy Park Hotel
	27°46'17", 82°38'21"	United States Post Office
	28°00'35", 82°47'36"	J.O. Douglas House
	27°57'08", 82°47'25"	Louis Ducros House
	27°57'56", 82°47'51"	Cleveland Street Post Office
	27°47'34", 82°38'46"	St. Petersburg Lawn Bowling Club
	27°46'38", 82°42'47"	Cassa Coe da Sol
Hillsborough	27°41'04", 82°31'19"	Cockroach Key
	28°08'55", 82°12'06"	Fort Foster
	27°57'39", 82°26'42"	Circulo Cubano de Tampa (Cuban Club)
	27°35'23", 82°45'48"	Egmont Key
	27°57'40", 82°26'42"	El Pasaje (Cherokee Club)
	27°56'48", 82°27'53"	Tampa Bay Hotel
	27°57'38", 82°26'43"	Ybor Factory Building
	27°57'42', 82°27'03"	Centro Asturiano Hospital

(continued)

Table 32 (continued)

County	Location (lat./long.)	Site
Hillsborough	27°56'26", 82°27'46"	Hutchinson House
	27°57'08", 82°27'03"	Union Railroad Station
	27°53'46", 82°29'22"	Stavall House
	27°42'50", 82°26'05"	George MCA Miller House (Ruskin Women's Club)
	27°56'09", 82°28'19"	Leiman House
	27°51'59", 82°31'33"	Johnson-Wolff House
	27°57'41", 82°29'00"	El Centro Espanol of West Tampa
	27°56'59", 82°27'27"	Federal Building, U.S. Courthouse, Downtown Postal Station
	27°56'49", 82°27'55"	Old School House
	27°56'27", 82°27'52"	T.C. Taliaferro House (Paul T. Ward House)
	27°57'00", 82°27'33"	Tampa Theatre and Office Bldg.
	27°56'50", 82°27'27"	Tampa City Hall
	27°57'38", 82°26'26"	Ybor City Historic District
	28°00'54", 82°07'19"	Plant City Union Depot
	28°01'09", 82°07'28"	Plant City High School
Manatee	27°33'50", 82°35'33"	Madira Bickel Mounds
	27°31'23", 82°31'28"	Robert Gamble House (Judith P. Benjamin Memorial)
	27°31'29", 82°38'29"	De Soto National Memorial
	27°39'39", 82°32'52"	Original Manatee County Courthouse
Sarasota	27°12'12", 82°29'54"	Osprey Site
	27°04'29", 82°14'00"	Little Salt Springs
	27°03'35", 82°15'38"	Warm Mineral Springs
De Soto (None)		
Charlotte (None)		
Lee	26°25'21", 81°51'51"	Mound Key
	26°35'33", 82°08'01"	Demere Key
	26°37'25", 82°09'13"	Josslyn Island Site
	26°39'36", 82°08'57"	Pineland Site
	26°26'03", 82°48'54"	Koreshan Unity Settlement Historic District
	26°27'10", 82°00'52"	Sanibel Lighthouse and Keepers Quarters
	26°45'00", 82°15'43"	Charlotte Harbor and Railway Depot
	26°43'02", 82°15'38"	Boca Grande Lighthouse

(continued)

Table 32 (concluded)

County	Location (lat./long.)	Site
Collier	25°53'31", 81°16'09"	Turner River Site
	25°48'34", 81°21'45"	Ted Smallwood Store
	26°08'23", 81°47'35"	Seaboard Coast Line Railroad Depot
	25°49'27", 81°01'25"	C.J. Ostl Site
	25°50'39", 81°13'19"	Sugar Pot Site
	25°52'48", 81°20'34"	Halfway Creek Site
	26°10'24", 81°15'35"	Hinson Mounds
	26°12'53", 81°18'59"	Platt Island
Monroe	24°52'39", 80°40'38"	Indian Key
	25°06'33", 80°25'45"	Rock Mound
	24°55'45", 80°32'45"	San Jose Shipwreck
	24°33'30", 81°48'27"	Old Post Office and Customs-house
	24°32'51', 81°48'37"	Fort Zachery Taylor
	25°11'30", 80°18'30"	John Pennekamp Coral Reef State Park and Reserve
	24°33'07", 81°45'18"	Martello Gallery - Key West Art and Historical Museum (East Martello Tower)
	24°33'19", 81°47'25"	Eduardo H. Gato Home (Mercedes Hospital)
	24°33'46", 81°48'17"	Dr. Joseph Y. Porter House
	24°33'38", 81°47'39"	The Armory
	24°37'38", 82°52'23"	Fort Jefferson National Monument
	24°32'58", 81°48'06"	Ernest Hemingway House
	24°33'31", 81°48'27"	U.S. Coast Guard Headquarters, Key West Station
	24°33'07", 81°45'18"	West Martello Tower
	24°33'21", 81°48'28"	Little White House (Quarters A)
	24°33'35", 81°48'06"	Key West Historic District
	24°47'39", 80°52'30"	Long Key Bridge
	24°41'38", 81°11'23"	Knight Key Bridge
	24°39'17", 81°17'25"	Old Bahia Honda Bridge

22. ARCHAEOLOGICAL AND HISTORICAL SITES

Prehistoric man has inhabited southwest Florida for the past 10,000 years (radiocarbon dating of skeletal remains at Warm Springs in Sarasota County). A total of 3,020 archeological sites are listed on the Florida Master Site File of the Florida Division of Archives, History, and Records Management. The Florida Master Site File classes 16th and 17th century and later European colonial sites as being "historic" and all sites predating that period as "prehistoric". The total number of historic and prehistoric sites for both terrestrial and underwater locations for Southwest Florida are mapped by township on the individual atlas overlays.

Archaeological resources in the study area are afforded varying degrees of protection by the following Federal, State, and local laws:

* The Antiquity Act of 1906 (PL 59-209, 34 Stat. 225; 16 USC 431-433) provides Federal control of all archaeological resources on lands owned or controlled by the United States government.

* The Historic Sites Act of 1935 (PL 74-292, 49 Stat. 666; 16 USC 461-467) states that the preservation of historic and prehistoric sites is national policy and that the National Park Service should be the investigative agent for obtaining accurate facts concerning these sites.

* The Reservoir Salvage Act of 1960 (PL 86-523, 74 Stat. 220; 16 USC 469-469c) provides for a survey of the archaeological resources of any area to be affected by federally funded construction of a dam.

* The Historic Preservation Act of 1966 (PL 89-665, 80 Stat. 915; USC 470) provides for an expanded National Register of Historic Places including districts, sites, and objects significant in American history and archaeology and funds to help acquire and preserve sites. National Register sites must be given careful consideration when any project utilizing Federal funds might adversely affect them. The head of the responsible Federal agency must allow the Advisory Council on Historic Preservation established under Title II of this act a reasonable opportunity to comment on the undertaking. Two archaeological sites in the study area - Picnic Mound in Hillsborough County and Osprey, a series of burial mounds and middens, in Sarasota County - are on the National Register.

* The Archaeological and Historic Preservation Act of 1974 provides for preservation and recovery of archaeological remains and/or historical sites which are endangered by any federally funded project. Provisions of this act may be applied only after an agency has shown initial compliance with other appropriate Federal planning requirements.

* Executive Order 11593 (May 1971) states that heads of Federal agencies shall locate, inventory, and nominate to the National Regiser all sites, buildings, districts, and objects which are under their jurisdiction and are eligible for listing.

* The Florida Archives and History Act of 1969 (Chapter 267, Florida Statutes) created the Division of Archives and History and gave it responsibility for all Florida-owned historical sites and properties. In addition, this act establishes the Division's authority to issue permits for excavation or surfaced reconnaissance of historic and archaeological sites on State owned and controlled lands.

On the local level, County Commissioners have the power to establish zoning ordinances that would affect archaeological sites under their jurisdiction (Texas Instruments 1975).

The total number of archaeological and historical sites by county for southwest Florida is shown in Table 33.

Table 33. Archaeological and historical sites per county (Florida Department of State 1982a).

County	Total no. of sites
Pasco	72
Pinellas	155
Hillsborough	473
Manatee	168
Sarasota	99
De Soto	60
Charlotte	70
Lee	637
Collier	210
Monroe	1,076
Total Sites	3,020

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25. GLOSSARY

algae - A group of plants, one-celled, colonial, or many-celled, containing clorophyll and having no true root, stem, or leaf. Algae are found in water or damp places.

coral reef - A ridge or mound of limestone, the upper surface of which lies, or lay at the time of its formation, near the level of the sea, and is predominantly composed of calcium carbonate secreted by organisms, of which the most important are corals.

demography - The study and description of population.

dredge spoil disposal site - A submerged spot where solid materials which have been dredged from the bottoms of waterways are dumped or disposed.

ecosystem - An interacting organic community of plants and animals, viewed within its physical environment or habitat.

estuary - A drainage channel adjacent to the sea in which the tide ebbs and flows.

mangrove - A tropical tree with branches that spread and send down roots, thus forming more trunks. Mangroves are considered important "land builders" because they trap debris and sediments washed in by tides or carried down to the sea by fresh water and consolidate this into dry land.

neritic fish - Fish which swim in shallow ocean waters of less than 200 meters depth, usually associated with the continental shelf.

oxidation - One of the processes of chemical weathering, involving the combination with oxygen.

peat - A dark-brown or black residue produced by the partial decomposition and decay of mosses, sedges, trees, and other plants that grow in marshes and other wet places.

pelagic fish - Fish which live free from direct dependence on the ocean bottom or shore.

polyps - A small, flowerlike water animal having a mouth fringed with tentacles at the top of a tube-like body.

price level index - An index used for measuring the rate of inflation by comparing the present prices of various consumer items with the 1967 price of similar items.

quartz - A brilliant, crystalline mineral composed of silicone dioxide (SiO_2).

Radiocarbon dating - The determination of the age of a material by measuring the proportion of the isotope C^{14} (radioactive carbon) in the carbon it contains. The method is suitable for the determination of ages up to a maximum of about 3,000 years.

sanctuary - A reservation or refuge where animals or birds may not be hunted or molested.

savannah - A tract of level open land having a wet soil except during periods of dry weather and supporting grass and other low vegetation, with but a scattered growth of pine or other trees and bushes.

symbiosis - The living together in close association of two dissimilar organisms. Ordinarily it is used in cases where the association is advantageous to one or both, and not harmful to either.

water table - The upper surface of the zone of saturation in permeable rocks; this level varies seasonally with the amount of percolation.

SOILS AND LANDFORMS

by

Wayne C. Coleman
and
Terri L. Woods
Martel Laboratories, Inc.

1. SOILS

1.1 BACKGROUND

The soils mapped within the southwest Florida study area reflect a pattern of soil associations. Each soil association consists of one or more major soils for which it is named, and at least one minor soil. The soils in one association may occur in another association, however, in a different pattern. The data used to produce the soil maps in this atlas were the most up-to-date information available from the U.S. Soil Conservation Service at the time material for these maps was collected. The attached 1:100,000 scale maps are most valuable as a source of information on the general nature of soils and the various soil types to be found in an area rather than as a precise location map for the soil types. A map at a smaller scale (1:1,000,000 scale) displaying the most recent soil survey data for Florida is available from the U.S. Soil Conservation Service (U.S. Department of Agriculture 1982).

1.2 GENESIS

The soils in southwest Florida have been derived from recent beach deposits (wind- or wave- derived), river alluvium, marine terrace deposits or directly from a particular geologic formation. Most of southwest Florida is underlain by marine terrace deposits of the Holocene and Pleistocene Epochs.

1.3 SOIL CLASSIFICATION

The classification of soils follows the standard soil taxonomy key of the U.S. Soil Conservation Service. (U.S.S.C.S., Soil Survey Staff 1975. Soil Taxonomy: a basic system of soil classification for making and interpreting soils surveys. U.S.S.C.S., Agricultural Handbook No. 436, 754 pp.).

1.3.1 Soil Association Per Legend Unit

1. Tavares-Myakka Association. Nearly level, moderately well-drained soils, sandy throughout, and poorly drained, sandy soils with weakly cemented sandy subsoil.

2. Pomello-St. Lucie Association. Nearly level, moderately well-drained, sandy soils with weakly cemented sandy subsoil, and excessively drained soils, sandy throughout.

3. Broward-Bradenton-Manatee Association. Nearly level, poorly drained, sandy soils underlain by limestone; poorly drained soils with sandy layers over loamy subsoil, underlain by marly material; and very poorly drained, sandy soils with loamy subsoil.

4. Myakka-Pomello-Basinger Association. Nearly level, poorly drained and moderately well-drained, sandy soils with weakly cemented, sandy subsoil and poorly drained soils, sandy throughout.

5. Myakka-Immokalee-Basinger Association. Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil, and poorly drained soils, sandy throughout.

6. Wabasso-Bradenton-Myakka Association. Nearly level, poorly drained, sandy soils with a weakly cemented, sandy, subsoil layer over loamy subsoil; poorly drained soils with thin, sandy layers over loamy subsoil; and poorly drained, sandy soil with weakly cemented, sandy subsoil.

7. Placid-Basinger Association. Nearly level, very poorly and poorly drained soils, sandy throughout.

8. Delray-Manatee-Pompano Association. Nearly level, very poorly drained soils with thick, sandy layers over loamy subsoil; very poorly drained, sandy soils with loamy subsoil, and poorly drained soils, sandy throughout.

9. Fresh Water Swamp And Marsh Association. Nearly level, very poorly drained soils subject to prolonged flooding.

10. Pomello-Paola-St. Lucie Association. Nearly level to sloping, moderately well-drained, sandy soils with weakly cemented sandy subsoils, and excessively drained soils, sandy throughout.

11. Immokalee-Myakka-Pompano Association. Nearly level, poorly drained, sandy soils with weakly cemented, sandy subsoil, and poorly drained soils, sandy throughout.

12. Adamsville-Pompano Association. Nearly level, somewhat poorly and poorly drained soils, sandy throughout.

13. Scranton, var.-Ona-Placid Association. Nearly level, somewhat poorly drained, dark surface soils, sandy throughout; poorly drained soils with thin, sandy layers over weakly cemented, sandy subsoil, and very poorly drained soils, sandy throughout.

14. Pompano-Delray Association. Nearly level, poorly drained soils, sandy throughout, and very poorly drained soils with thick, sandy layers over loamy subsoil.

15. Terra Ceia Association. Nearly level, very poorly drained, well-decomposed, organic soils, 16 to 36 inches thick, over loamy material.

16. Bradenton-Wabasso-Felda Association. Nearly level, poorly drained soils with thin, sandy layers over loamy subsoil; poorly drained, sandy soils with a weakly cemented, sandy subsoil layer underlain by loamy subsoil, and poorly drained sandy soils with loamy subsoil.

17. Keri-Ft. Drum-Hallandale Association. Nearly level, somewhat poorly drained soils with thin, sandy layers over loamy marl, underlain by sand, and poorly drained soils with thin, sandy layers over porous limestone.

18. Pompano-Charlotte Association. Nearly level, poorly drained soils, sandy throughout.

19. Felda-Manatee Association. Nearly level, poorly drained soils with loamy subsoil, and very poorly drained soils with loamy subsoil.

20. Tidal Marsh And Swamp Dunes Association. Nearly level, very poorly drained soils subject to frequent flooding by tidal waters, and deep, droughty sands.

21. Tavares-Adamsville Association. Nearly level to gently sloping moderately well and somewhat poorly drained soils, sandy throughout.

22. Wabasso-Felda Association. Nearly level, poorly drained, sandy soils with a weakly cemented, sandy subsoil layer underlain by loamy subsoil, and poorly drained, sandy soils with loamy subsoil.

23. Pompano, high-Felda Association. Nearly level, poorly drained soils, sandy throughout, and poorly drained, sandy soil with loamy subsoil.

24. Pompano, high-Pompano Association. Nearly level, poorly drained soils, sandy throughout.

25. Pompano-Charlotte-Delray Association. Nearly level, poorly drained soils, sandy throughout, and very poorly drained soils with thick, sandy layers over loamy subsoil.

26. Basinger-Placid Association. Nearly level, poorly and very poorly drained, sandy soils, sandy throughout.

27. Salt Water Marsh And Swamp Association. Nearly level, very poorly drained soils subject to frequent tidal flooding.

28. St. Lucie-Paola Association. Nearly level to sloping, excessively drained soils, sandy throughout.

29. Candler-Paola-Tavares Association. Nearly level to sloping, excessively drained soils, with very thick sandy layers over thin loamy or sandy loam lamella, and excessively and moderately well-drained soils, sandy throughout.

30. Astatula-St. Lucie Association. Nearly level to sloping, excessively drained soils, sandy throughout.

31. Arredondo-Kendrick Association. Nearly level to sloping, well-drained soils, with very thick, sandy layers over loamy subsoil.

32. Tavares-Basinger-Candler Association. Nearly level to sloping, poorly drained soils, sandy throughout, and excessively drained soils with very thick, sandy layers over thin, loamy sand or sandy loam lamellae.

33. Bradenton-Salt Water Swamp Association. Nearly level, poorly drained soils with thin, sandy layers over loamy subsoil, and very poorly drained soils subject to frequent tidal flooding.

34. Blichton-Lochloosa-Kendrick Association. Nearly level to sloping, poorly drained, sandy soils with loamy subsoil; somewhat poorly drained, soils with thick, sandy layers over loamy subsoil; and well-drained soils with very thick, sandy layers over loamy subsoil.

35. Paisley-Bushnell Association. Nearly level to gently sloping, poorly and somewhat poorly drained, soils with thin, sandy layers over clayey subsoil.

36. Myakka-Astatula-Tavares Association. Nearly level, poorly and moderately well-drained, sandy soils with weakly cemented, sandy subsoil, and excessively and moderately well-drained soils, sandy throughout.

37. Astatula-Arredondo Association. Nearly level to sloping, excessively drained soils, sandy throughout, and well-drained soils with very thick, sandy layers over loamy subsoil.

38. Arredondo-Ft. Meade-Astatula Association. Nearly level to sloping, well-drained soils with very thick, sandy layers over loamy subsoil, and excessively drained soils, sandy throughout.

39. Sunniland-Bradenton Association. Nearly level, somewhat poorly and poorly drained soils, with thin, sandy layers over loamy subsoil underlain by marly material.

40. Ona-Myakka Association. Nearly level, poorly drained, sandy soils with weakly cemented, sandy subsoil.

41. Wabasso-Elred-Oldsmar Association. Nearly level, poorly drained, sandy soils with a weakly cemented, sandy subsoil layer over loamy subsoil, and poorly drained, sandy soils with loamy subsoil.

42. Basinger-Pompano-Swamp Association. Nearly level, poorly drained soils, sandy throughout, and very poorly drained soils subject to prolonged flooding.

43. Placid-Swamp Association. Nearly level, very poorly drained soils, sandy throughout, and very poorly drained soils subject to prolonged flooding.

44. Brighton-Terra Ceia Association. Nearly level, very poorly decomposed, organic soils, 52 or more inches thick, and well-decomposed organic soils, 52 or more inches thick.

45. Made Land-Palm Beach Association. Nearly level land, extensively altered by man, and excessively drained soils, sandy throughout.

46. Astor Association. Nearly level, very poorly drained, sandy soils subject to prolonged flooding.

47. Pomello Association. Nearly level to gently sloping, moderately well-drained, sandy soils with weakly cemented, sandy subsoil.

48. Sunniland-Keri-Felda Association. Nearly level, somewhat poorly and poorly drained, sandy soils with loamy subsoil, and poorly drained soils with thin sandy layers over loamy marl underlain by sand.

49. Broward-Pompano Association. Nearly level, somewhat poorly drained, sandy soils over limestone, and poorly drained soils, sandy throughout.

50. Felda, high-Wabasso, Pineda Association. Nearly level, poorly drained, sandy soils with loamy subsoil, and poorly drained, sandy soils with a weakly cemented, sandy subsoil layer underlain by loamy subsoil.

51. Felda-Broward Association. Nearly level, poorly drained, sandy soils with loamy subsoil, and somewhat poorly drained, sandy soils over limestone.

52. Ochopee-Broward Association. Nearly level, very poorly drained soils with thin to very thin, sandy or loamy layers over limestone, and somewhat poorly drained, sandy soils over limestone.

53. Rockdale-Hallandale Association. Nearly level, moderately well and poorly drained soils with thin or very thin, loamy or sandy layers over porous limestone. Porous limestone is exposed in numerous places.

54. Perrine-Ochopee Association. Nearly level, very poorly drained soils with very thin to thin layers of loamy marl over limestone, in some areas layers of organic material 6 to 30 inches thick occur between the loamy marl layer and the limestone, and very poorly drained soils with thin or very thin, sandy marl layers over limestone.

55. Pahokee Association. Nearly level, very poorly drained, organic soils 36 to 51 inches thick, over limestone.

56. Myakka-Immokalee-Pomello Association. Nearly level, very poorly drained soils subject to frequent flooding by tidal waters, and deep, droughty sands.

57. Medisaprist-Anclote Association. Nearly level, very poorly drained, organic soils 16 to 51 inches or more thick, and very poorly drained soils, sandy throughout.

58. Urban Land Association. Soil areas altered by heavy machinery. Buildings, streets, parking lots, etc., cover 75 percent or more of the association.

59. Rock Land Association. Exposed limerock with little or no soil cover.

60. Mine Pits and Dumps.

1.4 PHYSICAL SOIL PROPERTIES

Table 34 gives estimates of the physical properties of the soil of each association. The table is divided into the following components:

- Soil number on map (see map legend)
- Soil associations and components (see 1.3.1)
- Percent of component soils
- Flood probability (years)
- USDA Classification for soil texture

- Permeability (in/hr)
  Permeability refers to the vertical rate at which water passes through uncompacted and undisturbed soil above the water table.

- Percent water capacity
  Water capacity is the percent of empty space available in soil for water retention.

- pH
  The acidity or alkalinity of the soils is referred to as pH. A pH of less than 7.0 indicates an acid soil; a pH of more than 7.0 indicates an alkaline soil.

Table 34. Composite soil association physical properties matrix (U.S. Department of Agriculture 1958-1982; Florida Department of Administration 1975).

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
1	Tavares-Myakka						
	Tavares	55	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Myakka	25	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-6.5
	Others	20					
2	Pomello-St. Lucie						
	Pomello	45	None	Fine sand	2.0 - 20.0	<0.05-0.15	4.5-5.5
	St. Lucie	25	None	Fine sand	> 20.0	<0.05	5.1-6.0
	Others	30					
3	Broward-Bradenton-Manatee						
	Broward	35	1:1.0	Fine sand and loam (all)	> 10.0	0.04	5.5-7.0
	Bradenton	30	1:1.0		0.8 - 10.0+	0.06-0.11	6.0-8.5
	Manatee	15	1:1.0		0.63 - 20.0	<0.05-20.0+	6.1-7.8
	Others	20					
4	Immokalee-Pomello						
	Immokalee	40	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-5.5
	Pomello	30	None	Fine sand	2.0 - 20.0	<0.05-0.15	4.5-5.5
	Others	30					
5	Myakka-Pomello-Basinger						
	Myakka	50	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-6.5
	Pomello	20	None	Fine sand	2.0 - 20.0	<0.05-0.15	4.5-5.5
	Basinger	15	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
	Others	15					
6	Myakka-Immokalee-Basinger						
	Myakka	55	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-6.5
	Immokalee	20	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-5.5
	Basinger	15	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
	Others	10					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
7	Wabasso-Bradenton-Myakka						
	Wabasso	45	1:12.5	Fine sand	0.63 - 20.0	<0.05-20.0	4.5-7.8
	Bradenton	30	1:1.0	Fine sand & loam	0.8 - >10.0	0.06-0.11	6.0-8.5
	Myakka	15	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-6.5
	Others	10					
8	Placid-Basinger						
	Placid	40	1:10.0	Fine sand	6.3 - 20.0	<0.05-20.0	4.5-5.5
	Basinger	30	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
	Others	30					
9	Delray-Manatee-Pompano						
	Delray	40	1:1.0	Fine sand	6.3	0.07-0.20	5.0-7.0
	Manatee	35	1:1.0	Fine sand & loam	0.63 - 20.0	<0.05-0.15	6.1-7.8
	Pompano	15	1:12.5	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
	Others	10					
10	Freshwater swamp & marsh						
	Freshwater swamp & marsh	75					
	Others	25					
11	Pomello-Paola-St. Lucie						
	Pomello	25	None	Fine sand	2.0 - 20.0	<0.05-0.15	4.5-5.5
	Paola	20	None	Fine sand	> 20.0	<0.05	4.5-5.0
	St. Lucie	20	None	Fine sand	> 20.0	<0.05	5.1-6.0
	Others	35					
12	Immokalee-Myakka-Pompano						
	Immokalee	45	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-5.5
	Myakka	30	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-6.5
	Pompano	15	1:12.5	Fine sand	6.3 - 20.0	<0.05	5.6-7.8

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
13	Adamsville-Pompano						
	Adamsville	40	1:35	Fine sand	> 20.0	<0.05	4.5-5.5
	Pompano	25	1:12.5	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
	Others	35					
14	Scranton, var.-Ona-Placid						
	Scranton	35	1:3.0	Fine sand	6.3	0.10-0.15	5.0-5.5
	Ona	15	1:3.0	Fine sand	6.3	0.10-0.15	4.5-5.5
	Placid	15	1:1.0	Fine sand	6.3 - 20.0	<0.05-20.0	4.5-5.5
	Others	35					
15	Pompano-Delray						
	Pompano	50	1:12.5	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
	Delray	20	1:1.0	Fine sand	6.3	0.07-20.0	5.0-7.0
	Others	30					
16	Terra Ceia		Most of				
	Terra Ceia	80	year	Muck, peat	6.3 - 20.0	<0.20	6.6-7.8
	Others	20					
17	Bradenton-Wabasso-Felda						
	Bradenton	40	1:1.0	Fine sand & loam	0.8 - 10.0+	0.06-0.11	6.0-8.5
	Wabasso	35	1:12.5	Fine sand	0.63 - 20.0	<0.05-0.15	4.5-7.8
	Felda	15	1:12.5	Fine sand, slightly loamy, some shells	0.63 - 20.0	<0.05-0.15	5.1-7.8
	Others	10					
18	Keri-Ft. Drum-Hallendale						
	Keri	35	1:12.5	Fine sand	0.20-6.3	0.05-0.15	5.5-8.5
	Ft. Drum	30	1:3.5	Fine sand & loam	0.63-6.3+	<0.05-0.15	5.1-8.0
	Hallandale	15	1:1.0	Fine sand	6.0-20.0	0.02-0.10	5.1-7.8
	Others	20					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
19	Pompano-Charlotte						
	Pompano	55	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	Charlotte	25	1:1.0	Fine sand	> 20.0	<0.05	5.6-8.4
	Others	20					
20	Felda-Manatee						
	Felda	50	1:12.5	Fine sand, slightly loamy, with some shells	0.63-20.0	<0.05-0.15	5.1-7.8
	Manatee	30	1:1.0	fine sand & loam	0.63-20.0	<0.05-0.15	6.1-7.8
	Others	20					
21	Tidal marsh and Swamp-dunes						
	Tidal marsh & Swamp	60	Tidal	Variable	5.0-10.0	Variable	8.5-9.0
	Dunes	15	1:5.0	Fine sand & shell	> 20.0	<0.05	
	Others	25					
22	Tavares-Adamsville						
	Tavares	50	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Adamsville	30	1:35	Fine sand	> 20.0	<0.05	4.5-5.5
	Others	20					
23	Wabasso-Felda						
	Wabasso	40	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-7.8
	Felda	30	1:12.5	Fine sand, slightly loamy, with some shells	0.63-20.0	<0.05-0.15	5.1-7.8
	Others	30					
24	Pompano, high-Felda						
	Pompano	55	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	high-Felda	20	1:12.5	Fine sand	6.3-20.0	<0.05	5.1-7.8
	Others	25					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
25	Pompano, high-Pompano						
	Pompano	50	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	high-Pompano	20	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	Others	30					
26	Pompano-Charlotte-Delray						
	Pompano	40	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	Charlotte	20	1:1.0	Fine sand	> 20.0	<0.05	5.6-8.4
	Delray	15	1:1.0	Fine sand	6.3	0.07-20.0	5.0-7.0
	Others	25					
27	Basinger-Placid						
	Basinger	60	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
	Placid	20	1:1.0	Fine sand	6.3-20.0	<0.05.20.0	4.5-5.5
	Others	20					
28	Saltwater marsh and swamp						
	Saltwater marsh & swamp	80	Tidal	Variable	5.0-10.0	Variable	8.5-9.0
	Others	20					
29	St. Lucie-Paola						
	St. Lucie	40	None	Fine sand	> 20.0	<0.05	5.1-6.0
	Paola	40	None	Fine sand	> 20.0	<0.05	4.5-5.0
	Others	20					
30	Candler-Paola-Tavares						
	Candler	85	None	Fine sand	6.0-20+	0.02-0.05	4.5-5.5
	Paola	4	None	Fine sand	> 20.0	<0.05	4.5-5.0
	Tavares	4	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Others	7					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
31	Astatula-St. Lucie						
	Astatula	65	None	Fine sand	> 20.0	<0.05	5.6-7.8
	St. Lucie	20	None	Fine sand	> 20.0	<0.05	5.1-6.0
	Others	15					
32	Arredondo-Kendrick						
	Arredondo	55	None	Fine sand	6.3	0.05-0.10	
	Kendrick	25	None	Loamy fine sand	0.6-20.0	0.05-0.17	4.5-5.5
	Others	20					
33	Tavares-Basinger-Candler						
	Tavares	60	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Basinger	15	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
	Candler	15	None	Fine sand	6.0-20.0+	0.02-0.05	4.5-5.5
	Others	10					
34	Bradenton-Salt Water Swamp						
	Bradenton	40	1:1.0	Fine sand & loam	0.80-10.0	0.06-0.11	6.0-8.5
	Salt Water Swamp	35	Tidal	Variable	5.0-10.0	Variable	8.5-9.0
	Others	25					
35	Blichton-Lochloosa-Kendrick						
	Blichton	40	1:12.5	Fine sand	0.06-6.3	0.05-0.20	
	Lochloosa	20					
	Kendrick	15	None	Loamy fine sand	0.6-20.0	0.05-0.17	4.5-5.5
	Others	25					
36	Paisley-Bushnell						
	Paisley	40	Rare	Fine sand (>13" fine sandy clay)	0.06-20.0	0.05-0.18	4.5-8.4
	Bushnell	35	Rare	Fine sand	0.06-2.0		
	Others	25					

(continued)

Table 34 (continued)

Soil # on map	Soil asociation & component soil	%	Flood prob (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
37	Myakka-Astatula-Tavares						
	Myakka	40	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-6.5
	Astatula	30	None	Fine sand	> 20.0	<0.05	5.6-7.8
	Tavares	15	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Others	15					
38	Astatula-Arredondo						
	Astatula	60	None	Fine sand	> 20.0	<0.05	5.6-7.8
	Arredondo	15	None	Fine sand	6.3	0.05-0.10	
	Others	25					
39	Arredondo-Ft. Meade-Astatula						
	Arredondo	45	None	Fine sand	> 20.0	<0.05	
	Ft. Meade	30	None	Loamy fine sand	6.3	0.05-0.10	
	Astatula	15	None	Fine sand	> 20.0	<0.05	5.6-7.8
	Others	10					
40	Sunniland-Bradenton						
	Sunniland	40	1:12.5	Fine sand (over marl)	2.0 - 6.3	0.05-0.15	4.5-8.5
	Bradenton	30	1:1.0	Fine sand & loam	0.80-10.0	0.06-0.11	6.0-8.5
	Others	30					
41	Ona-Myakka						
	Ona	55	1:3.0	Fine sand	6.3	0.10-0.15	4.5-5.5
	Myakka	20	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-6.5
	Others	25					
42	Wabasso-Elred-Oldsmar						
	Wabasso	25	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-7.8
	Elred	20	1:12.5	Fine sand, slightly loamy, with some shell	0.63-20.0	0.05-0.15	5.6-7.8
	Oldsmar	15	1:12.5	Fine sand, slightly loamy	0.63-20.0	<0.05-0.15	4.5-8.4
	Others	40					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
43	Basinger-Pompano-Swamp						
	Basinger	35	None	Fine sand	> 20.00	0.03-0.07	3.6-5.5
	Pompano	30	1:12.5	Fine sand	6.3-20.0	<0.05	5.6-7.8
	Swamp	25					
	Others	10					
44	Placid-Swamp						
	Placid	40	1:1.0	Fine sand	6.3-20.0	<0.05-0.20	4.5-5.5
	Swamp	35					
	Others	25					
45	Brighton-Terra Ceia						
	Brighton	40	Most of	Peat	6.3	0.05-0.20	
	Terra Ceia	30	Year	Muck, peat	6.3-20.0	<0.20	6.6-7.8
	Others	30					
46	Made Land-Palm Beach						
	Made land	70					
	Palm Beach	18	None	Sand, shell	> 20.0	<0.05	7.4-8.4
	Others	12					
47	Astor						
	Astor	48	Most of	Fine sand	> 20.0	<0.05	5.6-8.4
	Others	52	Year				
48	Pomello						
	Pomello	65	None	Fine sand	2.0-20.0	<0.05-0.15	4.5-5.5
	Others	35					
49	Sunniland-Keri-Felda						
	Sunniland	40	1:12.5	Fine sand (over marl)	2.0- 6.3	0.05-0.15	4.5-8.5
	Keri	20	1:12.5	Fine sand	0.2- 6.3	0.05-0.15	5.5-8.5
	Felda	15	1:12.5	Fine sand, slightly loamy, with some shells	0.63-20.0	<0.05-0.15	5.1-7.8
	Others	25					

(continued)

Table 34 (continued)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
50	Broward-Pompano						
	Broward	50	1:10.0	Fine sand & loam	> 10.0	0.04	5.5-7.0
	Pompano	20	1:12.5	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
	Others	30					
51	Felda, high-Wabasso-Pineda						
	Felda	30	1:12.5	Fine sand,	0.63-20.0	<0.05-0.15	5.1-7.8
	high-Wabasso	25	1:12.5	slightly loamy, with some shells	0.63-20.0	<0.05-0.15	
	Pineda	25	Rare	Fine sand (sandy loam subsoil)	2.0 - 20.0	0.02-0.15	5.6-8.4
	Others	20					
52	Felda-Broward						
	Felda	55	1:12.5	Fine sand, slightly loamy, with some shells	0.63-20.0	<0.05-0.15	5.1-7.8
	Broward	30	1:1.0	Fine sand and loam	>10.0	0.04	5.5-7.0
	Others	15					
53	Ochopee-Broward						
	Ochopee	60	None	Fine sand	0.6-2.0		
	Broward	20	1:1.0	Fine sand & loam	>10.0	0.04	5.5-7.0
	Others	20					
54	Rockdale-Hallandale						
	Rockdale	70	None	Fine sand	0.2-2.0		
	Hallandale	20	1:1.0	Fine sand	0.6-20.0	0.02-0.10	5.1-7.8
	Others	10					
55	Perrine-Ochopee						
	Perrine	40	None	Fine sand	0.2-2.0		
	Ochopee	30	None	Fine sand	0.6-2.0		
	Others	30					

(continued)

Table 34 (concluded)

Soil # on map	Soil association & component soil	%	Flood prob. (yr.)	USDA classification	Permeability (inches/hour)	% Water capacity	pH
56	Pahokee						
	Pahokee	70	Most of year	Organic fine sand	6.0-20.0	0.2-0.25	5.5-7.3
	Others	30					
57	Myakka-Immokalee-Pomello						
	Myakka	57	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-6.5
	Immokalee	11	1:12.5	Fine sand	0.63-20.0	<0.05-0.15	4.5-5.5
	Pomello	5	None	Fine sand	2.0 -20.0	<0.05-0.15	4.5-5.5
	Others	27					
58	Medisaprist-Anclote						
	Medisaprist	60					
	Anclote	20	None	Fine sand	6.0 -20.0	0.03-0.15	5.6-8.4
	Others	20					
59	Urban Land						
	Urban Land	100					
	Others	0					
60	Rock Land						
	Rock Land	85		Limestone and other bedrock			
	Others	15					
61	Mine pits and dumps						
	Mine pits and dumps	90					
	Others	10					

2. LANDFORMS

2.1 MAJOR PHYSIOGRAPHIC REGIONS

Florida is divided into three major physiographic regions separated by lines that cut across the long axis of the Florida peninsula. The inset map on Figure 1 illustrates these three divisions. The Southern or Distal Region extends from the southern end of the peninsula north to a line that runs from Stuart on the east coast, to Ft. Myers on the west coast, including Lake Okeechobee. The Central or Mid-peninsular Region extends north from the Southern Region to a line that passes through St. Augustine, Palatka, Hawthorne, and Gainesville, and continues northwestward along the gulf coast of the panhandle. The Northern or Proximal Region extends northward from the Central Region to the State boundary line. Some of the features to be discussed cross the boundaries of these three major physiographic regions. The study area of the ecological atlas for Southwest Florida only includes portions of the Central and Southern Regions.

2.2 MAJOR SURFACE LANDFORMS WITHIN THE CENTRAL REGION

2.2.1 Central Region Legend Units

1. Coastal Swamps: This physiographic province extends from the west side of Apalachee Bay southward to Tarpon Springs, and south of Naples along the contiguous coast of the Gulf of Mexico. The landward edge of the Coastal Swamps has been delineated as a line enclosing all continuous areas of swamp adjacent to the coast. A paucity of sand for beach-building is largely responsible for the development of these swamps. No sand is carried in from outside the province, and there is no local source of sand since the underlying rocks are carbonates. Therefore, a marshy coastline with no definite shoreline results.

2. Gulf Coastal Lowlands: The Gulf Coastal Lowlands are found between the Central Highlands (for example, the Brooksville Ridge, the Polk Upland, and the De Soto Plain), and either the shoreline of the Gulf of Mexico, or the Coastal Swamps. The Lowlands encompass northwestern Lee County, all but northeasternmost Charlotte and Sarasota Counties, the southwestern corner of De Soto County, western Manatee, Hillsborough and Pasco Counties, and all of Pinellas County.

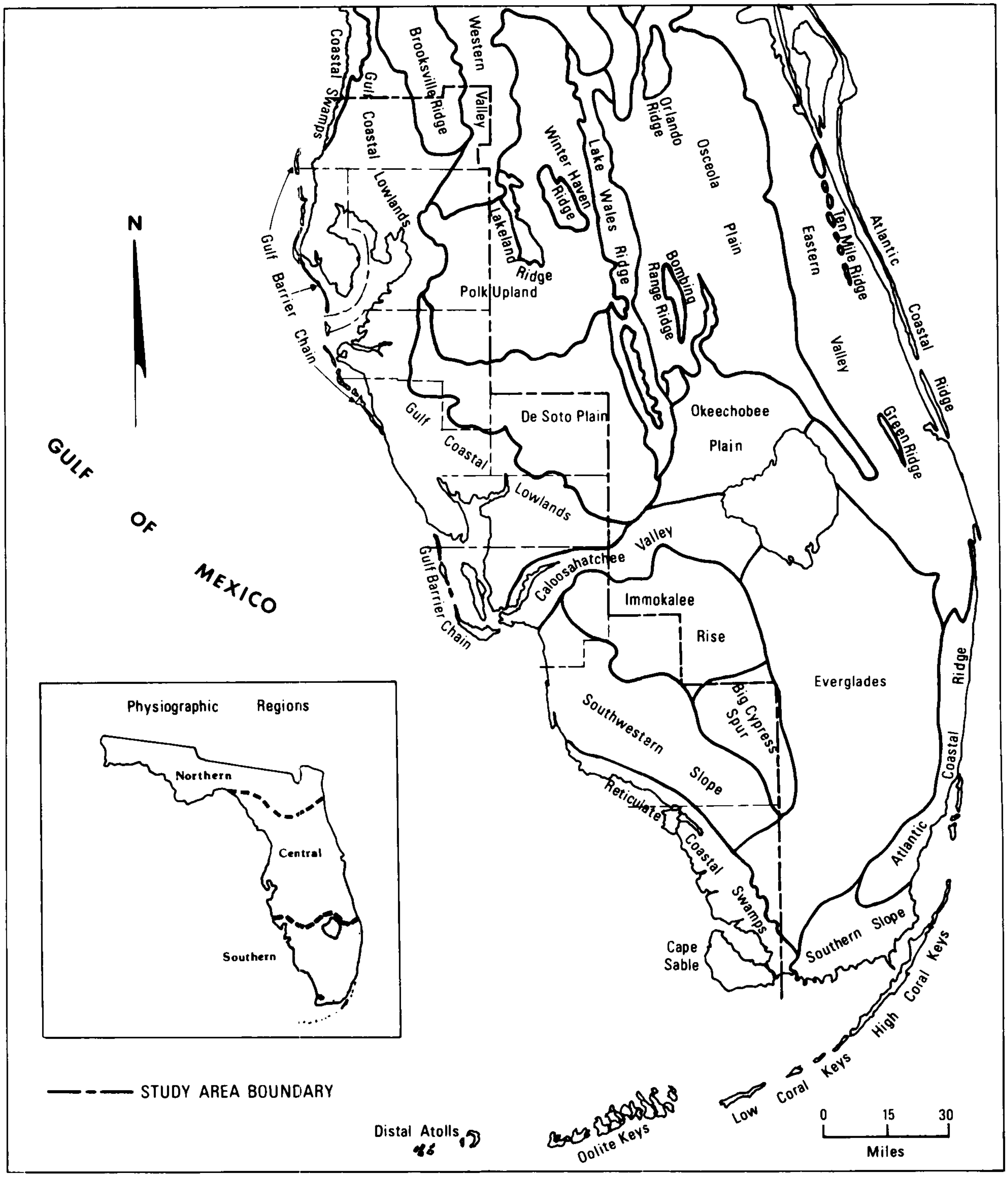

Figure 1. Physiographic provinces of peninsular Florida within the southwest study area (after Scott et al. 1980).

In many places these Lowlands are separated from the Central Highlands by a series of marine terraces that have developed on the south sides of the Hillsborough, Waccasassa, and Peace River Valleys. The lowermost toes of these terraces often occur at elevations of 5 to 15 ft. Where the terraces do not occur, the transition from upland to shoreline is in the form of broad, gently southwestward-sloping plains representing marine depositional surfaces.

The Coastal Lowlands are poorly drained and generally parallel the coastline indicating the relationship between their orientation and their formation by marine forces. Ancient barrier islands, lagoons, estuaries, coastal ridges, sand dune ridges, relict spits and bars, and coastal valleys are found in this physiographic region.

3. Polk Upland: The Polk Upland occupies much of Polk County's eastern half, as well as eastern Hillsborough County, the northern half of Hardee County, and northeastern Manatee County. It is inland of the Gulf Coastal Lowlands, north of the De Soto Plain, south of the Hillsborough and Withlacoochee River Valleys, and west of the Lake Wales Ridge. The Winter Haven and Lakeland Ridges rise above it in the northeast, but elsewhere on its surface the elevation is usually between 100 and 130 ft. The boundaries of this feature are poorly defined and in places have been set arbitrarily (White 1970).

The Upland, as well as the De Soto Plain, is underlain by the siliclastic Bone Valley Formation. Therefore, unlike limestone terrains, the effects of solution are not as intense, and the effects of surface streams manifest themselves more clearly. In limestone terrains streams are short and scarce with ill-defined valleys, and often end in sinkholes. Streams persist on the surface in siliclastic-dominated terrains, and the stream system is reflected in hills with linear divides and well-defined valleys. Also, because most of the surface water disappears into solution features formed in limestone terrains, the landscape is dry and barren, whereas vegetation is more abundant in siliclastic terrain. Topographic dissection in the Polk Upland generally amounts to 50 ft. Similar ramifications are seen in the De Soto Plain, although to a lesser extent.

4. Brooksville Ridge: The Brooksville Ridge extends from eastern Gilchrist County in a south-southeasterly direction into Pasco County. It is the most massive of several ridges that rise above the general level of the Central Highlands. The Ridge is a linear feature 110 miles long which is divided into two parts by the Withlacoochee River at Dunnellon. Its southern section is 60 miles long and 10 to 15 miles wide, and its northern section is 50 miles long and 4 to 6 miles wide.

The Ridge stands 100 ft above the lowland floors which surround it and reaches its maximum elevation at approximately 200 ft. The maximum elevation of the southern section is 75 ft higher than that of the northern section. The upper surface of the ridge is rough and dissected forming the most irregular land surface in any area of comparable size in peninsular Florida (White 1970).

The Ridge is capped by insoluble Miocene beds overlain by thin sand layers. These Miocene sediments are the red clastics of the Bone Valley and Alachua Formations. Thicker deposits of white sand occur near the western edge of the ridge and may be old stabilized dunes. The western edge of the ridge is probably a marine terrace scarp. The elevation of the toe of this scarp varies, possibly because segments of the scarp were shorelines at more than one sea level.

All the major ridges of the Central Highlands owe their general orientation to relict coastal features. They are long, straight, narrow, and parallel to one another. They are elongated in the common orientation of relict beach ridges.

5. Western Valley: Differential erosion of a former highland created two large, irregular lowlands in unprotected areas of soluble substrate; notably the easily eroded Eocene formations. The longer, more westerly of these two lowlands is the Western Valley. It runs from the south corner of Gilchrist County in a south-southeasterly direction for 140 miles to the northeast corner of Hillsborough County. The elevation of this valley ranges from 50 to 100 feet.

The Western Valley includes the upper portions of the Withlacoochee and Hillsborough River Valleys, and the Tsala Apopka Plain area. The latter is approximately 50 miles long from north to south with a maximum width of about 14 miles in the center. It is flatter and lower than most of the other parts of these valleys, ranging from 50 to 75 feet in elevation with sections of higher, irregular topography.

The boundaries of the Western Valley are only vaguely defined, but correspond generally to the eastern edge of the Brooksville Ridge and the western edges of the Sumter and Lake Uplands.

6. De Soto Plain: The De Soto Plain is a broad, flat plain 45 to 50 miles long which is 25 miles wide in the south and 50 miles wide in the north. It includes all of De Soto County, southern Hardee and Manatee Counties, western Highlands County, and the northernmost portion of Charlotte and Glades Counties.

The plain is bounded to the north and south by scarps. Its northern edge is at the foot of the south-facing scarp which terminates the Polk Upland and reaches elevations of 75 to 85 feet. Its southern edge marks the steeper transition zone between two of the largest and flattest plains in Florida and occurs at an elevation of 60 feet. This scarp declines 30 feet in 5 to 6 miles, whereas the remainder of the plain declines 15 to 25 feet in 40 miles.

White (1970) postulates that the De Soto Plain is an emergent, relict, submarine shoal formed during the Wicomico sea level stand. The submarine origin of the plain is suggested by the absence of linear features such as relict shorelines or beach ridges.

7. <u>Gulf Barrier Chain</u>: Barrier islands occur along the coast of the United States from Massachusetts to Texas. These dynamic features take the form of long, narrow, unconsolidated masses of sand which are constantly eroding, accreting, and migrating in response to oceanic and atmospheric processes. They are periodically flooded, breached, and overwashed during hurricanes and winter storms. Barrier islands are a vulnerable and fragile resource which protect the mainland, bays, and estuaries from direct ocean waves and storm events. There are 300 barrier islands and spits in the United States which total 1,658,700 acres. Of these, 80 are in Florida with a total area of 467,700 acres (Sharma 1979).

The barrier islands of Florida's southern gulf coast include the barrier islands from offshore Tarpon Springs (Anclote Key), southward to Cape Romano (Figure 1). Such islands are often associated with estuaries such as Charlotte Harbor or Tampa Bay, and owe their existence to changes in sea level which have occurred since the last Ice Age [Wisconsin Stage; 120,000 to 11,000 years before present (B.P.)]. For the most part, barriers began as dune ridges and spits formed from sand supplied by coastal headlands, rivers, and formerly emergent areas of the continental shelf. As the rise in sea level slowed 4,000 to 5,000 years ago, this sand was worked by winds, currents, and waves to form features parallel to the ancient shoreline. Periodic storm surges flooded the areas behind these ridges and spits, isolating them from the mainland to form chains of barrier islands. A slightly different origin of eroded deltaic deposits is postulated for Sanibel Island (Sharma 1979). Biogenic materials, especially mollusk shells, played an integral role in the formation of this island.

In assessing human impact upon these features one must take the larger system into account including other barrier islands, inlets, salt marshes, sand bars, and barrier flats or uplands between the berm or dune and the salt marsh. These interrelationships are important because the alteration of one component of the system can be reflected throughout the entire system and may have a profound effect on one or many of the other components. For example, dredging of an inlet to maintain a navigable channel often affects the sand distribution on bordering barrier islands and the disposition of sand bars in and around the inlet.

8. Caloosahatchee Valley: The Caloosahatchee River flows westward between higher ground to the north and south, the Caloosahatchee Incline and the Immokalee Rise, respectively. The land below 25 feet elevation, and between these two features is the Caloosahatchee Valley. The Caloosahatchee Valley extends through Glades County south of the De Soto Plain, into Charlotte County and the northern and western parts of Lee County. This landform is generally underlain at shallow depths by clayey, shelly, or limey units (Scott et al. 1980).

Most of the northern wall of the valley is formed by the Caloosahatchee Incline. This broad, gentle incline is a southward-sloping surface which runs concentrically around the southern edge of the De Soto Plain and the eastern edge of the Lake Wales Ridge. This incline has a toe at 30 to 35 feet and a crest at 60 feet and apparently formed as the steeper slope at the distal end of the submarine shoal which emerged to become the De Soto Plain. The De Soto Plain and the Caloosahatchee Incline are probably the emergent counterpart of submarine shoals evolving south of capes such as Cape Canaveral.

2.3 MAJOR SURFACE LANDFORMS WITHIN THE SOUTHERN REGION

The Southern Region is characterized by a broad, flat, gently-sloping, and poorly-drained plain. The Southern Region is almost entirely below the piezometric surface with lakes only in its most northerly part. In the south, limestone lies bare or is covered by peat, lime mud, or occasionally by scant accumulations of sand (White 1970).

The terrain of the Southern Region is built of lime sediments derived from seawater. These sediments consist of accumulations of marine shell, oolite, limey muds, and coral. Lime sediments are precipitated in a variety of ways and make a variety of depositional sedimentary masses, which have emerged largely unchanged as sea level has fallen, to make the present features. The terrain achieves its maximum elevation on the Immokalee Rise which crests around 30 feet with isolated higher elevations up to 42 feet (Scott et al. 1980).

The major surface landforms within the Southern Region are: the Immokalee Rise, Southwestern Slope, Big Cypress Spur, Reticulate Coastal Swamps, the Everglades, High Coral Keys, Low Coral Keys, Oolite Keys, Distal Atolls, and Cape Sable.

2.3.1 Southern Region Legend Units

1. Immokalee Rise: The Immokalee Rise, occupying most of Hendry County plus northernmost Collier County and easternmost Lee County, is a broad, flat, roughly pear-shaped area of somewhat dome-shaped form. Its lower boundary is placed in the general area of the 25 foot contour line, and the Rise reaches its maximum elevations of 35-42 feet about 10 miles north of the town of Immokalee. The upper surface of the Rise maintains an average elevation of 30 feet. The Rise lies north of the Big Cypress Spur, west of the Everglades, and south of the Caloosahatchee Valley. This sandy rise is ringed with small solution lakes to the extent that the edge of the rise can be delineated by drawing a line on the map connecting the lakes.

The Rise was apparently built in the time of the Pamlico shoreline (100,000 years B.P.) as a submarine shoal that extended southward from a mainland cape at the south end of the De Soto Plain (White 1970). The Rise is covered by thick sand deposits overlying shell or limestone units (Scott et al. 1980).

2. Southwestern Slope: The Southwestern Slope comprises the southwestern half of Collier County landward of the Reticulate Coastal Swamps and the northeastern corner of Monroe County. The Slope is bounded on the north by the Caloosahatchee Valley, on the east by the Immokalee Rise and Big Cypress Spur, on the southeast by the Everglades, and on the southwest by the Reticulate Coastal Swamps. The region probably originated as a marine terrace during the Pamlico and Silver Bluff sea level stands. The area slopes gently to the southwest from the Immokalee Rise to the Reticulate Coastal Swamps, varying from approximately 25 feet in elevation to sea level. A thin layer of sand mixed with shells, marls, and organic material overlies the limestone basement material in the region.

3. Big Cypress Spur: The Big Cypress Spur occupies the northeastern corner of Collier County and includes the Big Cypress Swamp. Big Cypress Spur is bordered by the Immokalee Rise to the north, the Everglades to the east and southeast, and the Southwestern Slope to the west. The Big Cypress Swamp area is distinguished from its peat and marl-buried surroundings by a more irregular surface, a much greater abundance of quartz sand, and largely bare, karst surfaces.

In Big Cypress Swamp, which has a more diffluent drainage pattern than that of the Everglades, the flow of swamp water is less restricted and surface water at times flows away completely. This discourages the growth of swamp vegetation and permits the oxidation of peat which has developed from that vegetation in the past. The karst surface of the Big Cypress Spur is studded with dwarf cypress trees and solution pits filled with water which frequently harbor aquatic animals such as alligators.

4. Reticulate Coastal Swamps: From the Atlantic Coastal Ridge on Florida's east coast, the land slopes gently westward into the Everglades, which have an elevation of approximately 10 feet in Broward County. The elevation drops to 5 feet in both Dade and Monroe Counties. As the southwestern coast is approached, the elevation drops to sea level in the southwestern half of Monroe County and the southwestern- most portion of Collier County. A jagged, reticulate, swampy shoreline with a profusion of mangrove islands and small creeks results. This is the area of the Reticulate Coastal Swamps and the Ten Thousand Islands.

These swamps extend approximately 50 miles from Florida's southern tip to Cape Romano and several miles inland from the Ten Thousand Islands. It is one of the largest coastal swamps in North America, encompassing approximately 200 miles of coastline (Hoffmeister 1974).

Two factors have contributed to the paucity of quartz sand, which has significantly affected the development of this coastal area. First, this low energy, reentrant section of coast is floored by limestone. Secondly, little sand is transported into the area by the longshore currents from the north. As a result, the beaches of the Ten Thousand Islands are unable to coalesce into a solid barrier. Instead, the sand carried from the north is deposited as small, offshore mounds around cores of vermetid reef rock produced by the shells of the mollusk (*Vermetus* (*thylaeodus*) *nigricans*) (Shier 1969). Shier believes that extensive oyster (*Crassostrea virginica*) beds form on these sand banks in the lee of these vermetid reef-founded islands and eventually build up to intertidal levels. At this point mangroves establish themselves on the mounds and form islands. Thick peat deposits are created between the limits of high and low tide by disintegration of generations of mangroves.

The resultant pattern is one of outer, beach-rimmed islands, with a core of vermetid reef rock, which grade into mangrove-covered oyster mounds. Marl extends landward as far as the scrub mangrove. Farther inland a swamp of brackish water grades eastward into primarily freshwater swamp. The freshwater swamp predominates in the area of the Everglades Sloughs. This abundant discharge of fresh water has helped wear away the profile of the shoreline by solution of shelly limestone, contributing to the reentrant nature of the coastline.

5. The Everglades: The Everglades encompass most of Broward County, all of Dade and Monroe, and the southwestern half of Palm Beach County. The average elevation of the Everglades is 5 feet in Monroe County, and 10 feet in the other three counties. Except for the agricultural area south of Lake Okeechobee, the Everglades are covered with shallow water that moves very slowly southward as sheet-flow. The slope of the water surface may be only 1-2 in/mi which is so flat that rainstorms can reverse the gradient of the local water surface (Scott et al. 1980).

The Everglades cover much of the low, soluble limestone surfaces of southern Florida. Thick accumulations of Recent peat overlie the karst surface in the Everglades. The basal part of the peat has been dated by carbon-14 at about 4,000 yrs B.P. (Schroeder et al. 1958; Spackman et al. 1964). At that time the limestone surface underlying the Everglades was lowered relative to sea level to bring a water table to the surface, resulting in swampy conditions.

The lack of a significant elevation gradient has restricted the flow of swamp water, and the deposition of sediment, which has occurred along the edges of the Everglades, led to the development of thick accumulations of peat. The Everglades are bounded on either side by much higher, sandy areas: the Immokalee Rise to the west and the Atlantic Coastal Ridge to the east. Both of these barriers were formed when quartz sand carried over these then submerged features moved southeastward from both coasts of Florida during the time of the Pamlico shoreline (100,000 years B.P.).

The aerial extent and depth of the Everglades peat has been greatly reduced by the loss of water into drainage canals constructed during the last 25 years. The subsequent lowering of the water table due to these canals has caused marked decrease in the rate of peat accumulation due to spontaneous combustion and slow oxidation. Areas around the rim of the Everglades that once were covered by several feet of peat are now bare sand, marl, or limestone.

6. High Coral Keys: Originating as living coral reefs, the High Coral Keys form the northeastern section of the Florida Keys extending southwestward to Upper Matecumbe Key. Coral rock from Windley Key has been dated and yields an age of 95 ± 9,000 years B.P. and coral from Key Largo has yielded three dates: 130 ± 20,000; 130 ± 15,000; and 140 ± 15,000 years B.P.

In the highest parts of the High Coral Keys, the surface of the original reef has been eroded away. The resulting surface has considerable local relief and occasionally shows the ragged, irregular features of microkarst. Accumulations of residual soil occur and there is no evidence of the re-submergence of this portion of the reef since its initial emergence (Broecker and Thurber 1965). The maximum elevation attained in this portion of the Florida Keys is 18 feet found on Key Largo east of the place where U.S. Highway 1 enters the keys and on Windley Key near the quarry.

The lower portion of the High Coral Keys has a smoother surface produced by solution of limestone due to wave splash which denudes progressively more land surface as sea level rises. A morphological counterpart of this surface is apparently forming now below the high water mark of the High Coral Keys.

7. Low Coral Keys: This portion of the Florida Keys extends from Lower Matecumbe Key southwestward to Big Pine Key. It is part of the same relict, emergent coral reef, as the High Coral Keys. The Low Coral Keys have the same low, smooth, denuded surface as the lower portions of the High Coral Keys. In cross-section the Low Coral Keys are smooth and flat in the center and slope gently down to the shore. White (1970) suggests that the surface of these keys has been beveled by a sea level some 4 or 5 feet higher than the present sea level. It is not clear whether sea level rose from a lower stand or dropped to this level directly from the higher stand which beveled the lower parts of the High Coral Keys.

8. Oolite Keys: The Oolite Keys include the keys from Big Pine Key to Key West. They are 40 miles long and average 10 to 15 miles in width. These keys are elongated perpendicular to the trend of the archipelago and are separated by channels running north to south. The Oolite Keys seem to continue the line of the southwestward- curving arc of the Coral Keys, but upon closer observation, are seen to be offset northward from this arc making a break in the trend of the coastline. These keys are relict oolite shoals which formed landward of the coral reef that became the Coral Keys. They become more sparse in distribution to the northeast and disappear entirely beyond East Bahia Honda Key. Oolite from Key West has been dated and yielded an age of 90,000 ± 9,000 years (Broecker and Thurber 1965), approximately contemporaneous with the coral of the High Coral Keys.

9. Distal Atolls: The Distal Atolls are made up of the Marquesas Keys and the Dry Tortugas. The Marquesas form a roughly elliptical group of islands 4.75 miles long by 3.5 miles wide enclosing a shallow lagoon with a maximum depth of 10 feet. The Marquesas have a long crescent-shaped key on the windward side (i.e., to the east), with small keys enclosing the central lagoon on the west. The Dry Tortugas to the west of the Marquesas are atolls in the developing stage. Both groups of islands are composed entirely of inorganic detritus, chiefly broken shells and other calcareous material, which overlies the Miami Oolite.

10. Cape Sable: This province in southern Monroe County represents a broad coastal prominence built on the Miami Oolite. The Oolite is topographically high under the cape and falls away to the north and south. Cape Sable consists of coquinoid beach ridges formed more recently than 4000 years B.P., separated from the mainland oolite exposures by broad areas of peat and marl, and lagoon-like Whitewater Bay (White 1970). Cape Sable has developed between two reentrant sections of coast: Florida Bay and the area of debouchure of the Everglades Sloughs.

White (1970) speculates that a wave-cut notch in the Oolite bedrock localized wavebreaking long enough to allow a bar to build up and form the Cape Sable barrier front.

3. BEACH EROSION

3.1 GENERAL

Beaches, like barrier islands, are constantly changing in response to fluctuations in sea level, wave conditions, longshore currents, atmospheric conditions, and human activities. In Florida, over 200 miles of ocean and gulf front property are in a critical state of erosion which poses a threat to both coastal and inland structures and property (U.S. Army Corps of Engineers 1971).

The causes of beach erosion are natural and manmade. One major natural cause of beach erosion is sea level rise which is currently occurring at the rate of 0.005 ft/yr on the Gulf coast (Hicks 1983). For Florida, this rate of sea level rise amounts to a rate of shoreline retreat of about 1 to 3 ft/yr (Bruun 1962). Walton (1978) suggested that "This trend of shoreline erosion in response to rising sea level is not gradual, but rather takes place during more severe wave activity, such as occurs during hurricanes or extra-tropical storms." Another natural cause of shoreline erosion is barrier overwash which occurs during periods of high tides when wave action transports sand into bays landward of the beach.

Dredging of the navigational channels in inlets that cut through the littoral zone is another major cause of beach erosion. Many of the 57 inlets in Florida have Federal maintenance programs with authorized channel depths of 10 to 20 ft. Minimum depths on the outer bars of unimproved inlets are naturally about 6 to 8 ft. As Walton (1978) explains it, "When a channel is either cut through a barrier island or dredged below the natural existing depths, the flow of water through the channel to the bay (or lagoon) on flood tide and to the ocean (or gulf) on ebb tide is increased leading to an increased capability of the channel to flush sand to its inner bay system or outer shoal system." The channel also acts as a barrier to sand carried along the coast by longshore drift. Therefore, drifting sands are carried through the inlet and deposited in bays behind the beaches. Once the sand has migrated into the bays the wave energy there is insufficient to agitate it into suspension and allow it to be carried out again so large amounts of former beach sand end up in bays behind dredged inlets or in the inlets themselves.

Manmade structures, such as jetties at inlets, can cut off the natural movement of sand in the longshore current. Beaches "downstream" from these jetties are starved for sand to the extent that large stretches of Florida shoreline adjacent to the south side of inlets are undergoing beach recession at rates greater than 10 ft/yr (Walton 1978). At present, there are no methods of dealing with beach erosion that have been consistently successful. Nourishing beaches with sediment dredged from offshore is estimated to cost about $1 million/mile of restored beach, initially, and requires approximately $25,000/yr/mi to maintain (Sharma 1979). Other structures such as offshore breakwaters, groin fields, rock revetments, and seawalls have been found to have adverse effects on shorelines if not properly implemented.

The University of West Forida has compiled a matrix of available studies of beach erosion in all Florida counties with significant stretches of sandy beach bordering the Gulf of Mexico or the Atlantic Ocean (Henningsen and Salmon 1981). Table 36 contains data for the coastal counties in the Southwest Florida region. The matrix classifies areas according to the severity of the erosion problem. Table 35 lists acronyms used for Table 36.

Table 35. Acronyms

COE	U.S. Army Corps of Engineers Jacksonville District
NSS	National Shoreline Study
DNR	Florida Department of Natural Resources, Bureau of Beaches and Shores
U of FL	University of Florida
Sea Grant	Sea Grant Program
NPS	U.S. Department of the Interior National Park Service
S	South or Southern
N	North or Northern

Below is a description of components of Table 36.

Historical Data Column

The first column of the matrix provides historical data on State funds spent for beach erosion control projects from 1975 to 1981. The word "None" indicates that either no project studies have been undertaken or that information was not available at the time of this study. Monetary figures listed in the matrix have been converted to the 1975 dollar value.

Local Survey Column

The second column of the matrix gives information concerning an evaluation of the beach erosion problem as perceived by local officials and residents. Data was obtained from interviews and correspondence with local officials, news clippings, and government comprehensive plans. Erosion is not viewed as a problem in areas where human activities are not threatened.

Erosion Rates Column

This column itemizes erosion and/or accretion rates in the study area. Data represent one-dimensional, erosion-rate measurements indicating changes in beach width over a given time period.

These figures indicate the regression of the mean-high-water line expressed in ft/yr. These rates are calculated by periodically reviewing shorelines using aerial photography or U.S. Army Corps of Engineers high-water-shoreline-change charts, for example. Except for Collier County where the most recent aerial photographs used were taken in 1979, the aerial photographs used were taken in 1974. These linear measurements are of limited use because they can show considerable regression while no net sand loss occurred. More accurate erosion rate information was not available at the time of the study. A "+" in front of a number in this column indicates accretion rather than erosion.

Professional Studies Column

This column lists the published professional studies in which beach erosion rates are recorded. In most cases, only the most recent studies are listed, but where studies conflict or data conflicts among columns, more than one study is noted.

Remarks Column

This last column of the matrix contains notes and the significance of erosion problems and restoration projects. It also provides clarification where erosion data conflicts.

Table 36. Beach erosion in the coastal counties of southwestern Florida (Modified after Henningsen and Salmon 1981).

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
PINELLAS COUNTY		Interview 9/2/80			
Honeymoon Island	None	Moderate problem	2 ft/yr (1942-1974) (Chiu) 4 ft/yr (1974-1979)	Moderate erosion (COE-NSS, 1973)	Problem serious N. part of island.
Caladesi Island N. part	None	Moderate	10 ft/yr (1942-1974) (Chiu) 9 ft/yr (1974-1977)	Critical erosion (COE-NSS, 1973)	State owned
Caladesi Island N. part	None	No problem	+3 ft/yr (1950-1965) (Chiu) +7 ft/yr (1974-1977)	Non-critical erosion (COE-NSS, 1973)	State owned
Clearwater Beach Island	None	No problem	+5 ft/yr (1950-1966) (Chiu) +6 ft/yr (1950-1979) (COE, 1979a)	More or less stable (COE-NSS, 1973a) Accretion (COE, 1979a)	Recently accreting due to erosion control structures. Locally funded. Ero sion on S. end

(continued)

Table 36 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
PINELLAS COUNTY					
Sand Key (N. of Belleair Shores)	None	Severe problem	3 ft/yr (1950-1965) (COE, 1979) 5 ft/yr (1950-1965) (Chiu)	Severe erosion (COE, 1979a) Critical erosion (COE-NSS, 1973)	Numerous seawalls, etc. Nourishment project ongoing in N. end.
Sand Key (Belleair Shore-Madiera Beach)	None	No problem	+3 ft/yr (1950-1965) (Chiu) +1 ft/yr (1950-1979) (COE, 1979)	Accretion (COE, 1979a)	Numerous seawalls, etc. Groinfield at Madeira Beach caused some of the accretion. Recent nourishment, N. Redington Beach.
Treasure Island N. one-third	None	No problem	+5 ft/yr (1950-1979) (Chiu)	Accretion (COE, 1979a)	
Treasure Island Southern portion.	$341,378	Severe problem	5 ft/yr (1950-1965) (Chiu)	Moderate erosion (COE-NSS, 1973)	Area previously restored in 1969,1972, and 1976. (Sea Grant Dec. 1976). Project proposed 1981-1982.
Long Key N. Part	None	No problem	+5 ft/yr (1960-1965) (Chiu) +3 ft/yr (1950-1978) (COE, 1979)	Accretion (COE, 1979a)	
Long Key to Pass-a-Grill area	$350,769	Severe problem	3 ft/yr (1942-1974) (Chiu)	Moderate erosion (COE-NSS, 1973)	Last nourishment project in 1978.
Mullet Key	None	No problem	5 ft/yr (1942-1974) (Chiu)	Moderate erosion (COE-NSS, 1973)	Erosion worse at S. end. N. tip accreting. Island is State Park.

(continued)

Table 36 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
MANATEE COUNTY		Interview 9/4/80			
N. part of Anna Maria Key	None	Severe problem	+5 ft/yr (1946-1968) (COE, 1972a) Accretion/stable (1951-1974) (Chiu)	Accretion (COE-NSS, 1973)	N. tip very unstable. Accretion before Hurricane Agnes in 1968. Severe erosion since.
Holmes Beach - Bradenton Beach	None	Critical problem	No data	Critical (COE-NSS, 1973)	Many seawalls and groins erected in this area
S. end of Anna Maria Key	None	Critical in some areas	No data	Severe erosion (COE, 1978)	Area is partially in County Park.
Beer Can Island	$50,132	No problem	Accreting	Accreting (COE, 1972a)	Spit is unstable
Longboat Key to Sarasota Co. Line	None	Moderate problem	10 ft/yr (1946-1968) (COE, 1972a) 1 ft/yr (1968-1979) (COE, 1979b)	Severe erosion (COE, 1972a)	Problem worse just N. of county line. Very narrow beach.
SARASOTA COUNTY		Interview 10/24/80			
Longboat Key S. of Manatee County line	None	Severe problem	5 ft/yr (1948-1974) (Chiu)	Critical erosion (DNR, 1975)	Extensive groinfield and some seawalls. Problem worse in N. part. Nourishment project at inlet starting in 1981.

(continued)

Table 36 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional	Remarks
SARASOTA COUNTY		Interview 10/24/82			
Lido Key	None	No problem	1 ft/yr (1952-1966) (COE, 1968) +8 ft/yr (1966-1979) (COE, 1980a)	Moderate erosion (COE, 1968) Critical (DNR, 1975) Accretion (COE, 1980a)	Dredging of pass and nourishment project in 1979. Status unknown. N. end extremely unstable.
Siesta Key - Sarasota Point area	None	Critical problem	No data		
Siesta Key - Central & S. Part	None	Moderate problem	No data	Severe erosion (COE, 1980a) Critical erosion (COE-NSS, 1973)	No beach at Point O'Rocks, natural stabilization by rock outcrop. Natural spit forming about 2 miles north of rocks.
Casey Key	None	Severe problem	No data		
Venice Area	None	Severe problem	No data	Critical erosion (DNR, 1975)	Proposed project by city to put rocks on the beach.
Manasota Key	None	Moderate problem	No data	Severe erosion (1973-1975) Accretion (1976-1979) Possible erosion (1980's) (DNR: BBS, 1981)	

(continued)

Table 36 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
<u>CHARLOTTE COUNTY</u>		Interview 10/23/80			
Sarasota Co. line to Stump Pass	None	Moderate problem	6 ft/yr (1952-1975) (Chiu)	Critical erosion (Chiu, 1975) Severe erosion (COE, 1980b)	Nourishment proposed, not supported by county. N. of Stump Pass recently restored.
Knight Island and Bocilla Island	None	Moderate problem	9 ft/yr (1895-1970) (Chiu)	Critical erosion (Chiu, 1975) Severe erosion (NPS, 1980)	N. end is very unstable. Recent dredging of Stump Pass.
Don Pedro Island and N. part Little Gasparilla Island	None	No problem	+12.5 ft/yr (1895-1970) (Chiu)	Accretion (Chiu, 1975)	
S. Part Little Gasparilla Island	None		4 ft/yr (1895-1970) (Chiu, 1975)		
N. Part Gasparilla Island	None	No problem	+1-5 ft/yr (1952-1974) (Chiu)	Accretion (Sea Grant 1977)	
Gasparilla Island to Lee County line	None	No data	No data	No data	Data varies according to source.
<u>LEE COUNTY</u>		Interview 10/20/80			
Gasparilla Island S. of Charlotte Co. line	None	Critical	5 ft/yr (1958-1974) (Chiu, 1977)	Critical erosion (Chiu, 1977)	Nourishment project proposed.

(continued)

Table 36 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
LEE COUNTY		Interview 10/20/80			
Cayo Costa (La Costa Island)	None	No problem	No data	Stable (Chiu, 1977)	Erosion at both ends.
N. Captiva Island	None	No problem	No data	Severe erosion (Chiu, 1977)	
Captiva Island	$38,405	Critical problem	+3 ft/yr (1943-1967) (Sea Grant, 1977)	Critical erosion (Hall & Assoc., 1975) Severe (N. & S. tips) (Sea Grant, 1977)	Private/public project proposed at N. end for 1982 (South Seas Plantation).
Sanibel Island	None	Moderate problem	4 ft/yr (1958-1974) (Chiu, 1977)	Moderate erosion (Chiu, 1977) Stable (Sea Grant, 1977)	
Estero Island	None	Moderate problems	+1 ft/yr (1885-1967) (Sea Grant, 1977) 3 ft/yr (1958-1974) (Chiu, 1977)	Severe erosion (Chiu, 1977) Moderate erosion (Sea Grant, 1977)	Highly developed Numerous groins and seawalls. Emerging sandbar increasingly protects island.
Lovers Key	None	No problem	No data	Accretion (Chiu, 1977)	Island undeveloped.
Hickory Islands	None	Moderate problem	3 ft/yr (1958-1974) (Chiu, 1977)	Moderate erosion (Chiu, 1977)	

(continued)

Table 36 (concluded)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
COLLIER COUNTY		Interview 10/21/80			
Lee County line to Doctor's Pass	None	No problem Severe problem N. of Clam Pass.	+2 ft/yr (1927-1970) (COE, 1972b)	Accretion (COE, 1972b)	Moderate problem in Vanderbilt Beach area.
Naples area - (Doctor's Pass to Gordon Pass)	$25,754	Moderate problem	+1.5 ft/yr (1968-1980) (Suboceanic Consultants, Inc., 1980)	Severe erosion (COE, 1972b) Accretion (1980) (Suboceanic Consultants Inc., 1980)	Some erosion S. of Doctor's Pass
Gordon Pass - Little Marco Pass	None	Moderate problem	1 ft/yr (1927-1970) (COE, 1972b)	Severe erosion (COE-NSS, 1973) Stable (NPS, 1980)	Accretion on North side of Little Marco Pass.
Little Marco Pass-Big Marco Pass	None	No data	7 ft/yr (1927-1970) (COE, 1972b)	Moderate (COE, 1972b)	
Marco Island	None	Severe problem	+4 ft/yr (1927-1970) (COE, 1972b)	Accretion (COE, 1972b)	No recent erosion rates available. Severe erosion S. end. Nourishment project proposed.

The Coastal Hydrographic Section of the Florida Bureau of Beaches and Shores is developing a computer program to interpolate erosion rates between measured beach profiles. When completed, this program will be the most reliable method of calculating erosion rates. Initial data from these programs is now available for the area from Manatee County south through Collier County. A total of $806,438 (1975 dollars) was spent in the southwest Florida coastal region on erosional control projects from 1975-1981 (Henningsen and Salmon 1981).

3.2 ACTIVE DUNES

Sand dunes are composed of coarse sediment which has been transported by the wind. One of the prerequisites of dune formation is an adequate supply of sand for transport to sand-flats. Also, these sandflats must exist at a sufficiently high level to allow the surface layer of sand to dry out between tides. The source of sediment can be relatively old marine deposits, more recent coastal headlands, or fluvial deposits.

The second prerequisite is sufficient wind velocity to pick up and transport sand.

The beach can be divided into two zones of wind transport. In the foreshore zone sand is transported by water currents, waves, and occasionally the wind. Oceanic overwash of dunes is usually restricted to this area of the beach. In the backshore zone sand is transported primarily by wind, and breaking waves play only a minor role. The boundary between these zones is transitional. As Boorman (1977) points out, it is important to remember that the beach is the area of transport between submarine sand deposits and growing dunes, and that human activity on, and development of, the beach area affect the formation and growth of dunes.

The pattern of dune ridges which forms is a function of the sand supply. On a prograding coast with an abundant supply of sand, a series of ridges forms with the youngest to seaward. Eventually these dunes become stabilized approximately where they formed. On the other hand, if the coast is an eroding one with a limited supply of sand, the seaward dune ridge grows to a maximum height and then migrates inland. The ridge moves landward, by a process of local erosion and deposition, as either a parabolic dune or as a complete dune ridge.

Vegetation plays two roles in dune development. It stabilizes existing sand surfaces, and it enhances further accretion by creating a barrier which reduces surface wind speed. Boorman (1977) discussed the differences between natural and manmade methods of dune stabilization. He pointed out that fixed barriers are effective for a time, but that dune accretion soon overwhelms them. Stabilization by vegetation is not subject to this limitation as dune grasses continue to grow with the developing dune. However, more than one species of vegetation is required as dune development proceeds and conditions change.

Active dune areas are no longer an extensive natural resource on the southwest coast of Florida. Development that has occurred along this coast has vastly reduced the active dune regions. Therefore, these areas have lost the stabilizing effects of dunes which in the past served to protect the coast from the effects of wind, water, and hurricane-induced erosion. Small areas where active dunes can still be found are shown on the Atlas maps. They occur on northernmost Clearwater Beach Island in the St. Petersburg and Tarpon Springs 1:100,000 quads and in the Sarasota 1:100,000 quad on Longboat and Siesta Keys and on the gulf beaches of the City of Venice.

3.3 HIGH ENERGY BEACHES

W. A. Price (1955) and Tanner (1960) devised a system of shoreline classification based on the energy level necessary to maintain a beach in equilibrium. The concept of the equilibrium beach involves a balance between coastal energy and littoral drift. According to Tanner (1960), "The equilibrium beach has curvature and sand prism characteristics adjusted to each other so delicately that potential littoral motion provides precisely the energy needed to transport the detritus supplied at the upcurrent end; the time element in this balance is longterm rather than instantaneous." These authors used different methods for estimating the energy level of a beach. Price's method relates the offshore slope of the beach to its energy level, with higher slopes occurring on the higher energy level beaches.

Tanner associated average breaker height with varying energy conditions. He used breaker heights of 10 and 50 cm to distinguish among low, moderate, and high energy levels. Florida has coastlines in all three of the energy categories, as well as a "zero energy" shoreline. High energy beaches, as classified by Tanner (1960), occur in the study area only in southwesternmost Florida on the end of Bahia Honda and Long Keys.

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6. GLOSSARY

alluvium - A general term for unconsolidated sediments deposited from a river, including sediments laid down in river beds, floodplains, lakes, fans at the foot of mountain slopes, and estuaries.

accretion - The gradual addition of new land to old by the deposition of sediment carried by the water of a stream.

archipelago - Any sea or broad sheet of water interspersed with many islands or with a group of islands; also such a group of islands.

atoll - A ring-like coral island or islands encircling or nearly encircling a lagoon.

B.P. - "Before present" used as the reference point for ages determined on rocks, minerals and fossilized flora and fauna.

clastics (also "clastic sediments") - Sediments produced by rock destruction.

coquina - Sedimentary rock formed by deposition and later consolidation (whole or partial) of masses of mollusk shells mixed with sand.

"dead-zone" karst - An area of karst topography no longer undergoing solution or deposition.

debouchure - The point of issuance of flowing water from a channel.

denude - To wear away or remove overlying matter from underlying rocks, exposing them to view.

detritus - Any fine particulate debris, usually of organic origin.

droughty - Refers to a soil with a low holding capacity for water.

ebb tide - A nontechnical term referring to that period of tide between high water and the succeeding low water, falling tide.

Eocene - The epoch of geologic time occuring between 60 and 40 million years B.P.

epoch - A unit of geological time (i.e., Holocene [or Recent], Pleistocene, Miocene, Eocene, etc.).

Everglades sloughs - The somewhat restricted area of outlet of the Everglades drainage at the southwestern extreme of the Everglades.

facies - General appearance or nature of one part of a rock body as contrasted with other parts.

geologic formation - A bed, or assemblage of beds, with well-marked upper and lower boundaries that can be traced and mapped over a considerable tract of country.

Holocene (also "Recent") - The epoch of geologic time between 11,000 yr B.P. and the present.

jetty - A structure extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow.

karst topography - Irregular topography developed by the solution of limestone by surface water and ground water.

limestone - A bedded sedimentary deposit consisting chiefly of calcium carbonate ($CaCO_3$).

littoral zone - The zone on a coast bounded by high and low tide levels.

loamy - Composed of a mixture of clay, silt, sand, and organic matter.

longshore drift (also "littoral drift") - The movement of sediment parallel to the shore by an inshore current usually generated by waves breaking at an angle to the shore.

marl - Unconsolidated sediment composed of muds and calcium carbonate-rich materials.

Miami Oolite - One facies of the geologic formation called the Miami Limestone deposited around 100,000 yr B.P. and found on the southern tip of the Florida peninsula in Dade, Monroe, and Broward Counties. It is composed dominantly of oolitic limestone.

microkarst - Small-scale karst features.

Miocene - The epoch of geologic time between 25 and 12 million years B.P.

oolite (also oolitic limestone) - A carbonate rock composed of grains made up of concentric layers of calcium carbonate, often having a piece of shell or a tiny calcium carbonate grain as a nucleus. The individual grains, or ooliths, are formed in warm, marine waters agitated by waves or currents.

Pamlico shoreline - A former shoreline representing a sea level stand 25-35 ft above present sea level, which occurred during an interglacial period preceeding the Wisconsin Ice Age.

parabolic dune - A U-shaped dune, concave toward the wind, formed when the wind blows out the center of a dune leaving behind the sides which are anchored by vegetation.

piezometric surface - An imaginary surface applied in areas where the local aquifer (a water-saturated geologic unit) is confined between impermeable layers so that water occurs at pressures greater than atmospheric pressure and the upper limit of the aquifer is trapped below the water table. The surface represents the level to which the water from a given aquifer will rise under its full head.

Pleistocene - The epoch of geologic time between 2-3 million years B.P. and 11,000 years B.P.

Recent (also "Holocene") - The epoch of geologic time between 11,000 years B.P. and the present.

reentrant - A feature directed inward as a reentrant angle in a coastline or any indentation in a landform.

reticulate - Netted. Having veins, fibers or lines crossing like the threads or fibers of a network.

scarp - Any cliff or steep slope of considerable linear extent.

shoal - A part of the area covered by water, of the sea or lake or river, when the depth is little; a bank always covered, though not deeply.

OIL, GAS, AND MINERAL RESOURCES

by

Thomas F. Palik
and
Terri L. Woods
Martel Laboratories, Inc.

Although Florida is generally thought of as a vacation and retirement state, it is also the sixth largest, non-fuel mineral-producing state in the nation (Fernald 1981). Mineral production in Florida (see Table 37) ranks 14th as a source of income to the State (Sweeney and Hendry 1979). In terms of dollars, phosphate is the leading mineral resource, followed by petroleum, cement and stone. The leading mineral resources of southwest Florida are oil and gas, sand and gravel, clay, phosphate, uranium, limestone, dolomite, and peat (see Figure 2 and Glossary for definition of terms).

Table 37. 1979 mineral resource production in Florida (Modified after Boyle and Hendry 1981 and Sweeney and Hendry 1979).

Mineral resource	Value (Million $)
Cement	139.7
Clays	31.3
Gem stones	0.004
Lime	11.4
Peat	2.2
Sand and gravel	39.5
Crushed stone	200.0*
Phosphate, uranium, kaolin, magnesium compounds, rare earth concentrate, staurolite, titanium, and zircon concentrate	1,045.5
Petroleum (crude)	659.0*
Natural gas	63.0*
Total	2,201.6

*Estimated by extrapolating 1977 and 1978 data and assuming a constant rate of increase.

Table 38 lists the principal mineral resources produced in each of the ten counties in the southwest Florida study area (Sweeney and Hendry 1979). The continued growth and diversification of the mineral industry in southwest Florida will be dependent upon the utilization of its non-metallic mineral resources (Calver 1957). Sources for the information included in this report are the most up-to-date available as of February 1982.

Table 38. Principal minerals produced, by county, in southwest Florida in 1978 (Sweeney and Hendry 1979; Boyle and Hendry 1981).

County	Principal mineral resources*
Pasco	Limestone
Pinellas	None
Hillsborough	Phosphate Cement Limestone Peat
Manatee	Cement
Sarasota	Sand and gravel Limestone
Charlotte	Limestone Sand and gravel
De Soto	None
Lee	Oil and gas Limestone
Collier	Oil and gas Limestone
Monroe	Limestone

*Listed in order of decreasing monetary value.

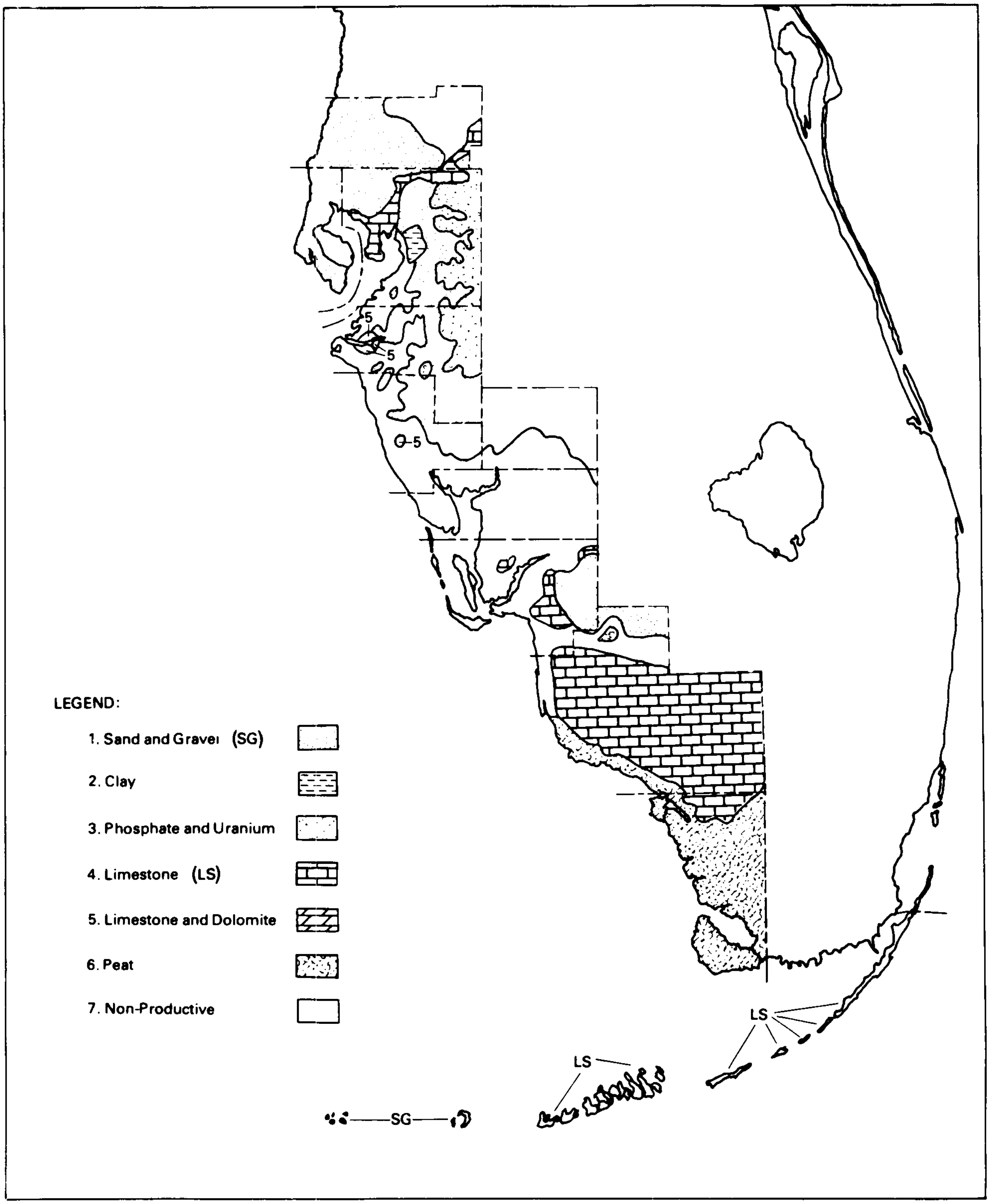

Figure 2. Surface mineral resources of southwest Florida (after Knapp 1980; Lane 1980; Deuerling 1981; and MacGill 1981).

1. PIPELINES

1.1 BACKGROUND

Only a limited number of oil and gas pipelines are located in the southwest Florida study area. The pipelines are owned and maintained by the Florida Gas Transmission Company (FGT), the Tampa Pipeline Corporation (TPC), the Central Florida Pipeline Corporation (CFP), and the Sunniland Pipeline Company (SPC). The general location of these pipelines is shown in Figure 3. Table 39 itemizes the pipeline mileage within the ten county study region of southwest Florida.

Table 39. Southwest Florida pipeline mileage (Central Florida Pipeline Company 1982).

Pipeline type	Pipeline company	Mileage	Capacity
Petroleum crude oil product lines	Sunniland Pipeline Company	105.0	44.4
Refined oil pipeline	Tampa Pipeline Corporation	10.6	4.5
	Central Florida Pipeline Corporation	30.0	12.7
Natural gas lines	Florida Gas Transmission Company	165.4	70.0
Total pipeline		311.0	131.6

1.2 LEGEND EXPLANATION

The diameter (inches) and owner of each pipeline are shown on the maps. The pipeline owners in southwest Florida are Sunniland Pipeline Company (SPC), Tampa Pipeline Company (TPC), Central Florida Pipeline Corp. (CFP), and Florida Gas Transmission Company (FGT). In addition, all crude oil meters, crude oil pump stations and gas compressor stations are shown on the atlas maps.

2. DRILLING SITES

2.1 BACKGROUND

Oil was first discovered in southwest Florida on September 26, 1943, when an exploration well tapped the Sunniland Formation and produced 20,550 barrels of oil before conversion into a salt water disposal well on May 10, 1946 (Calver 1957). The discovery well was drilled by the Humble Oil and Refining Company, and an additional eleven wells were drilled at that site.

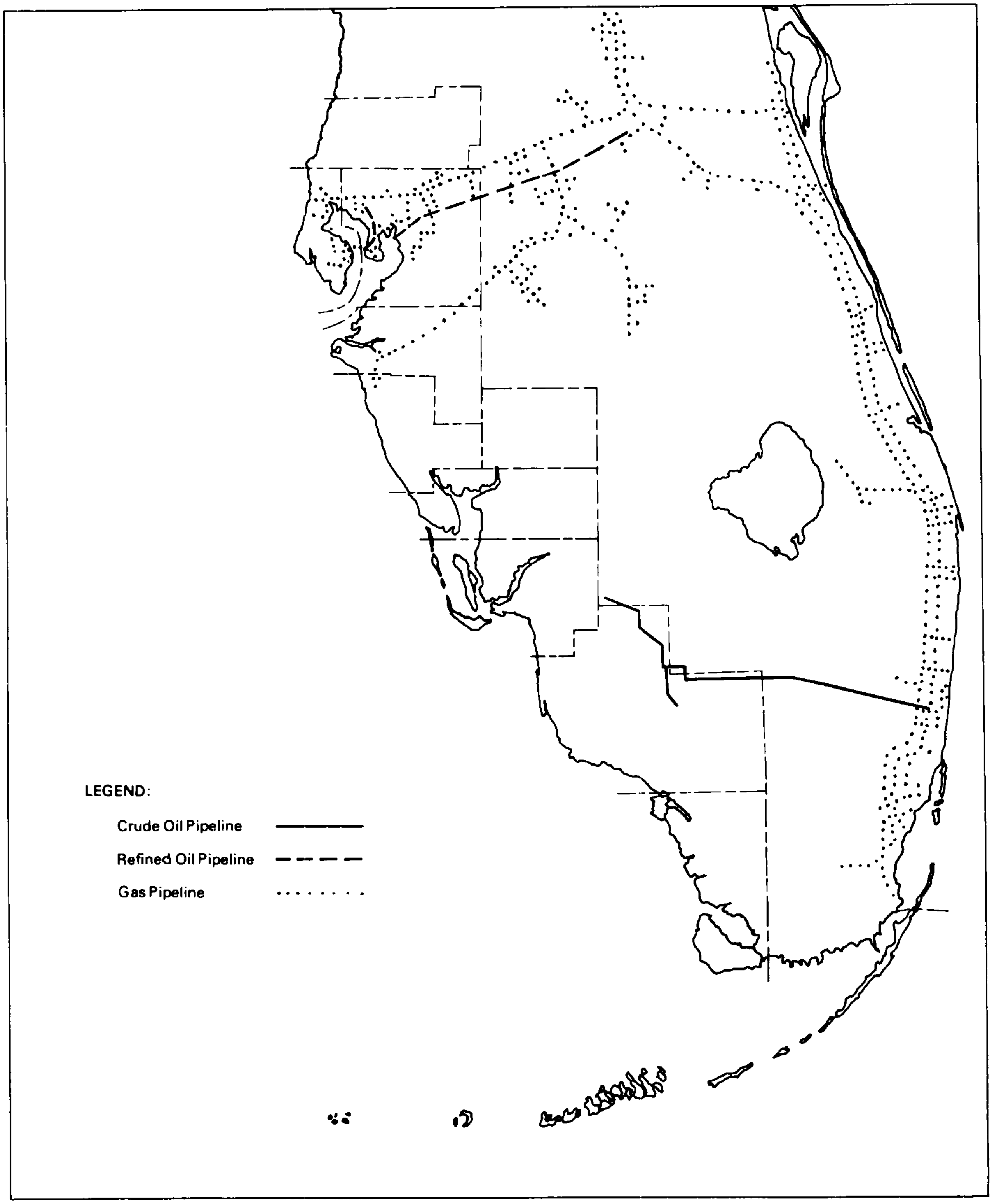

Figure 3. Pipelines in south Florida (after Tootle 1979).

A total of 375 oil exploration wells have been drilled in the ten county study region of southwest Florida. Of these, a total of 73 wells have produced oil and/or gas. An inventory, by county, of exploration wells drilled, dry holes, and completed producers is shown in Table 40. Figure 4 shows the location of 73 oil and gas wells that have been completed as producers in southwest Florida.

2.2 LEGEND EXPLANATION

A brief description of the oil well drilling site symbology used on the Atlas overlays follows. "Location" indicates a drilling site where oil was not discovered. "Temporarily abandoned location" indicates a drilling site which is temporily abandoned without oil having been discovered. "Abandoned location" indicates a drilling site which has been abandoned because it is believed that oil will not be found. "Oil well" indicates a producing oil well. "Abandoned oil well" indicates a one-time producing oil well that has been abandoned. "Plugged and abandoned oil well" indicates a one-time producing oil well that has been plugged and abandoned.

Table 40. Oil well inventory of southwest Florida study area (Florida Department of Natural Resources 1981).

County	Number of dry holes	Number of producing wells	Total number of oil wells drilled
Pasco	6	0	6
Pinellas	10	0	10
Hillsborough	2	0	2
Manatee	4	0	4
Sarasota	0	0	0
Charlotte	10	0	10
De Soto	2	0	2
Lee	85	19	104
Collier	165	54	219
Monroe	18	0	18
Totals	302	73	375

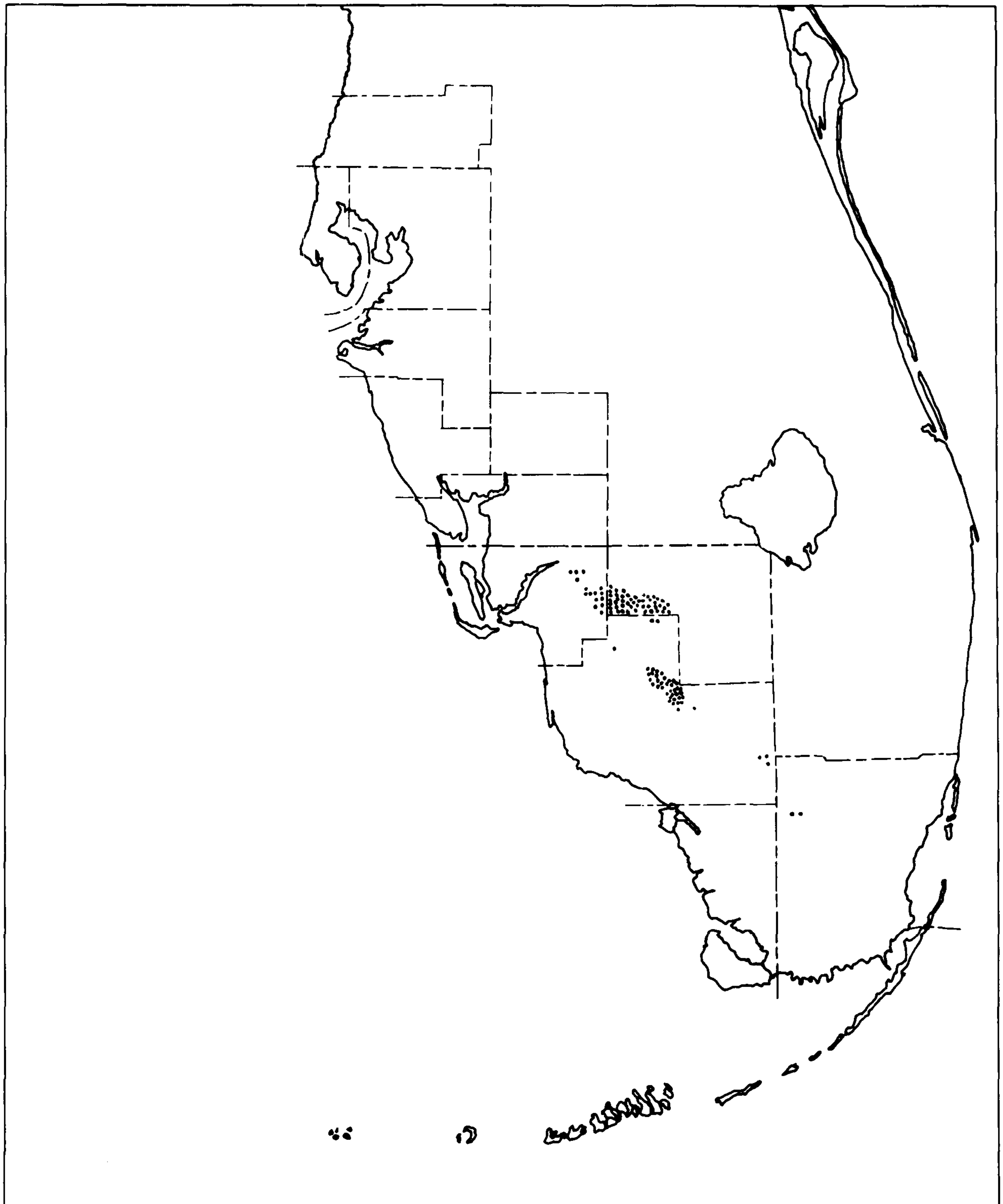

Figure 4. Oil and gas wells completed as producers in southwest Florida (Florida Department of Natural Resources 1981).

3. SURFACE MINERAL DEPOSITS

3.1 GEOLOGIC SETTING

The Florida Peninsula is underlain by more than 4,000 feet of sedimentary rocks that overlie much older sedimentary, metamorphic, and igneous basement rocks. This upper sequence of carbonate and clastic rocks forms the broad flat Floridan Plateau that encompasses all of Peninsular Florida and its continental shelves. In Late Oligocene to Early Miocene time (Table 41), the paleoclimate of Florida turned much colder, and sea level fell more than 200 ft (Scott et al. 1980). As a result, the thick sequence of limestone and dolomite accumulating on the Floridan Plateau was flooded by clastic, deltaic, and riverine sediments originating from the Appalachian Mountains to the north.

Table 41. Geologic time scale for the Cenozoic Era.

Era	Period	Epoch	Approximate dates (yrs before present)
Cenozoic	Quaternary	Recent	12,000
		Pleistocene	2,000,000
	Tertiary	Pliocene	12,000,000
		Miocene	25,000,000
		Oligocene	38,000,000
		Eocene	55,000,000
		Paleocene	65,000,000

Since that time, sea level has fluctuated several times, and with each fluctuation, a marine terrace and ancient shoreline has developed with its associated depositional material.

The following surface mineral deposits in southwest Florida are discussed in this narrative: sand and gravel, clay, phosphate and uranium, limestone, limestone and dolomite, and peat.

3.2 SAND AND GRAVEL DEPOSITS

During the pleistocene and recent geologic epochs, sea level has fluctuated several times, and with each fluctuation, a marine terrace and ancient shoreline has developed. The sand deposits covering these terraces vary considerably in thickness and lithology and are predominately composed of quartz sand containing varying proportions of silt, clay, and organic material (Scott et al. 1980). In general, the coarsest sand and gravel deposits are found in the higher terraces, and the lower terrace deposits contain more clay and carbonate.

In southern Florida, the terrace deposits are much thinner than those to the north and contain much more clay, silt and organic material. The identification of terraces and shorelines is based primarily on elevation. The various terraces recognized by Cooke (1939, 1945), MacNeil (1949) and Healy (1975) with their approximate elevations are compared in Table 42.

Table 42. Correlation of terraces and shorelines in Florida (after Scott et al. 1980).

Cooke (1939, 1945)	MacNeil (1949)	Healy (1975)
Hazlehurst, formerly Brandywine (215-270 ft)*	High Pleistocene Terrace (150-280 ft)*	Hazelhurst Terrace, Coastwise Delta Plain, High Pliocene Terrace (215-320 ft)*
Coharie (170-215 ft)*		Coharie (170-215 ft)*
Sunderland (100-170 ft)*	Okefenokee (150 ft)*	Sunderland and Okefenokee (100-170 ft)
Wicomico (70-100 ft)*	Wicomico (100 ft)*	Wicomico (70-100 ft)*
Penholoway (42-70 ft)*		Penholoway (42-70 ft)*
Talbot (25-42 ft)*		Talbot (25-42 ft)*
Pamlico (5-25 ft)*	Pamlico (25-35 ft)*	Pamlico (8-25 ft)*
Silver Bluff (0-10 ft)*	Silver Bluff (8-10 ft)*	Silver Bluff (1-10 ft)*

* The numbers in parentheses after the terrace names are the elevations.

The mining of sand and gravel is the largest non-fuel mineral industry in the United States and the sixth leading mineral resource produced in Florida (Table 37). Approximately 95% of the sand and gravel produced in the United States is used for building and highway construction, and the remaining 5% is used in industry as abrasives, foundry sands, filtering media, etc. (Scott et al. 1980).

Sand and gravel deposits, as mapped on the atlas overlays, refer to sand aggregate mixed with some gravel aggregate. Sand represents mostly quartz material between 0.0625 and 2 millimeters in size. Gravel aggregates range from 2 to 6 millimeters in size and vary in composition (Scott et al. 1980). Sand and gravel deposits in southwest Florida are composed primarily of quartz sand with a small percentage of gravel of varied composition.

There are more producers of sand and gravel than of any other mineral commodity in southwest Florida (Scott et al. 1980). The names and locations of these producers are listed in Table 43. Most of Florida's gravel production is from the Panhandle with some potential for development in central Florida. The most productive sand quarries in southwest Florida are in Polk and Sarasota Counties, and these two counties combined with Lake County accounted for about 60% of the state's total sand and gravel output in 1977-79 (Boyle and Hendry 1981).

Table 43. Active producers of sand and gravel in the southwest Florida study area (Scott et al. 1980).

County	Company	Mine	Location		
			Township	Range	Section
Hillsborough	Jernigan Trucking Co. Route 1, Box 141 J Sefner, Fla. 33584	579 Pit	28S	20E	22
Manatee	Purington and Rhoades Route 3, Box 98A Sarasota, Fla. 33580	P & R Shell Pit	35S	17E	9
	Wendell Kent and Co. P.O. Box 2719 Sarasota, Fla. 33580	State Road 70 Pit	35S	19E	16
Sarasota	Ashland-Warren, Inc. P. O. Box 7368 Naples, Fla. 33941	Newburn Road Pit	36S	18E	12
	B & J Dragline Hanchey Dr. & Nokomis Venice, Fla. 33959	No Name	39S	19E	
	General Development Corp. 1111 South Bayshore Drive Miami, Fla. 33131	Sarasota County Pit	39S	22E	19, 36
	Venice Fill & Shell Co. P. O. Box 691 Venice, Fla. 33595	Laurel Pit	38S	19E	7
	Wendell Kent & Co. P. O. Box 2719 Sarasota, Fla. 33580	Brown Road Pit	36S	19E	7
Charlotte	General Development Corp. 1111 South Bayshore Drive Miami, Fla. 3313	Charlotte County Pit	41S	21E	23, 26
Lee	Labelle Limerock Co. General Delivery Labelle, Fla. 33935	Triple C Fill and Paving	44S	26E	28

Sand and gravel that is mined in Florida is extracted from stream alluvium deposits, highland sands, terraces, and beach and dune deposits. The majority of deposits in southwest Florida are terrace deposits. The economic sand deposits in Florida's central region are found predominantly in the Central Highlands between the Atlantic and Gulf Coastal Lowlands (Scott et al. 1980; see Figure 1, Soils and Landforms section). The Gulf Coastal Lowlands are not an important source of sand, and most of the sand used in the study area comes from the Central Highlands. The surface sand in the lowlands is dominated by Pleistocene terrace deposits, such as the Pamlico sand, which covers a large part of the area to a thickness of less than 5 feet.

The Central Highlands are composed of numerous local areas of higher elevation (generally above 100 feet), such as the Brooksville Ridge, which contain significant economic deposits. Most of the surface sand deposits in the Central Highlands are associated with terraces (Scott et al. 1980). Two terraces in particular are abundant sources of sand. The Coharie Terrace (170-215 foot elevation), which is found in Hillsborough, Manatee, Pasco, and Polk Counties, consists of coarse sand with a thickness of approximately 6 ft near Lakeland (Cooke 1945). The Sunderland Terrace (100-170 foot elevation), in Pasco, Hillsborough, Manatee, Polk, and De Soto Counties, is composed of sand and clay of varying grain size. The maximum thickness of these terrace deposits probably does not exceed 40 feet (Scott et al. 1980).

Terrace sands, associated with the Pamlico and Silver Bluff terraces, cover much of Florida's southern region (Cooke 1945). Although small, localized accumulations do occur; these sands do not form economic deposits in southwest Florida. A typically coarse sand unit of the Upper Miocene-Pliocene Tamiami Formation is currently being mined near Ortona in Glades County (Scott et al. 1980).

Surface mining is the only method used for mining sand and gravel in southwest Florida. There are three major types of surface mining employed: bank mining, pit mining, and subaqueous mining (Scott et al. 1980). The type of surface mining employed is dictated by the nature of the deposit. Bank and pit mining are the most common types. In bank mining, the elevation of the excavation floor is at or above the general land surface, whereas pit mining involves excavation below the land surface. Subaqueous mining involves excavation of sand and gravel below the surface of a natural body of water. Subaqueous mining is restricted to the coastal areas where erosion has created the need for beach replenishment programs.

The mining of sand and gravel from a pit or bank can be quite difficult since extensive sorting is required. A hydraulic gun is employed to undermine the pit walls allowing the sand to slump into the pit where it is then piped in a slurry to the screening area. In the larger operations, a suction dredge carries sand and gravel from the pit bottoms. In the screening area, the gravel portion of the sand is removed by screen shakers, and the sand fraction is sorted by vats of water.

The coarse sand is then taken by conveyor belt to a stockpile or truck and the fine sand portion is piped to a settling pond. Approximately 90% of Florida's sand and gravel is transported by truck, 8% by rail, and the remaining portion by water (U.S. Bureau of Mines 1965-1979).

3.3 CLAY DEPOSITS

Clays are hydrous aluminum silicates mixed with varying proportions of intrinsic impurities. Clays occur in several different mineral forms. The principal industrial clays are kaolin (china clay), ball clay, fire clay, fuller's earth, and common earth clays. Clay is no longer mined within the ten-county study area of southwest Florida, although at one time fuller's earth and common earth clays were mined in eastern Manatee County. These types of clay consist of a mixture of montmorillonite and attapulgite. A small area southeast of Tampa has the potential for future mining operations (Calver 1957).

Clays are mined by first removing the overburden by dragline, bulldozer, or pan scrapers depending on the depth of the overburden and the distance it must be moved. The clay bed is then carefully cleaned, and the clays are then loaded onto trucks from the dragline.

3.4 PHOSPHATE AND URANIUM DEPOSITS

3.4.1 Geologic Setting

Sixty-five million years ago, peninsular Florida and its continental shelves existed as a broad continuous plateau separated from the rest of the United States by the Suwannee Straits, which trended northeastward from what is now Apalachicola Bay to Brunswick, Georgia (Sweeney and Windham 1979). The geologic environment that existed over the Floridan Plateau was analagous to that of the modern day Bahama Banks with calcium and magnesium carbonates being precipitated out in the warm tropical sea.

Wherever water circulation and oxygenation were adequate, marine organisms thrived, and pure carbonates were deposited. Where circulation was inadequate, hyper-saline waters existed, marine faunal assemblages were scarce, and evaporites were primarily deposited. In Oligocene and Lower Miocene time (Table 41), longshore currents transported progressively increasing amounts of fine quartz sands along the western Floridan Peninsula and intermixed these clastics with the carbonates (Sweeney and Windham 1979).

In Early to Late Miocene time, the Suwannee Straits ceased to exist due to falling sea level and a tremendous influx of riverine and deltaic sediments from the north, and Florida was once again connected with the mainland. The longshore current, which had flowed through the straits, was diverted southward to flow along and over Florida's southwest peninsula. This resulted in the mixing of clastics from the north with the carbonates present on the Floridan Plateau. The new geologic formation that developed from this interaction has been named the Hawthorn Formation. Seventy-five percent of peninsular Florida is underlain by the Hawthorn Formation which has an average thickness of 200 feet. Phosphate, accompanied by uranium, occurs throughout the Hawthorn.

3.4.2 Origin, Nature and Development of the Deposits

The origin of phosphate in the Hawthorn Formation is not well understood. Sweeney and Windham (1979) reported from the work of others that low temperature, phosphorus-rich waters from cold, deep Atlantic Ocean and Gulf currents upwelled over the Floridan Plateau causing the precipitation of phosphate from the warm shallow waters. As sea level slowly dropped, Florida entered an emergent phase after the Middle Miocene epoch, and primary phosphate deposition ceased (Sweeney and Windham 1979).

In the Upper Miocene and Pliocene, phosphate in the marine sedimentary deposits around the Floridan plateau area were redistributed and concentrated. The depositional environment was that of a broad, shallow submarine shoal. The phosphate deposits in this basin, at the top of the Hawthorn Formation, were reworked by the warm, shallow, hyper-saline waters, and the Bone Valley Formation was deposited. These secondary phosphate deposits were enriched by phosphate from deposits to the north on both the Ocala Uplift and from exposed portions of the Hawthorn Formation which were being flushed southward at the same time.

In the Pleistocene, during glacial periods when sea level was much lower, surface leaching further increased the phosphate content in the Bone Valley Formation by dissolving and removing the other more soluble constituents. The average thickness of the phosphate deposits in the Bone Valley Formation is 6 to 7 feet (Sweeney and Windham 1979).

Phosphate, in the Hawthorn Formation, occurs as small, tannish/black, rounded, sand-size grains known as phosphorite. Phosphorite percentages in the Hawthorn Formation vary greatly; however, 2-10% is common, 10-30% uncommon, and greater than 30% rare. The average uranium oxide content of the Hawthorn Formation is 0.006%. The uranium associated with the phosphorite occurs in minerals of the apatite group (Sweeney and Windham 1979).

The average phosphorite content of the Bone Valley Formation ranges from 20 to 30 percent, and the average uranium oxide content ranges from 0.012 to 0.024 percent. Phosphate pebbles eroded out of hard rock phosphate deposits to the north, as well as phosphorite concentrated and reworked from the Hawthorn Formation, are found in the Bone Valley Formation. The high concentrations of phosphate in this formation are not due to continued deposition of phosphate past the Middle Miocene, but to the reworking and concentration of pre-existing phosphate (Sweeney and Windham 1979).

The phosphate reserve in South and Central Florida is estimated to be 1.4 billion metric tons (Zellars-Williams, Inc. 1978). Hillsborough County's reserves are estimated at 176,470,000 metric tons, and the combined reserves of De Soto, Manatee and Sarasota Counties are estimated at 908,260,000 metric tons (Sweeney and Hendry 1979). An estimated 204,000 metric tons of economic uranium oxide ore are found in South and Central Florida, as well as another 171,000 metric tons of subeconomic uranium oxide. The principal phosphate and uranium producing companies are listed in Table 44 (Sweeney and Windham 1979).

The phosphate and uranium deposits delineated on the Ecological Atlas map sheets represent surface exposures of the Bone Valley Formation that underlie most of Manatee, Sarasota, De Soto, and a portion of Charlotte Counties. In many places, all or part of the lenses of the Bone Valley Formation are overlain by 10 to 25 feet of sand and gravel deposits.

3.4.3 Mining of the Deposits

In 1881, Captain J. Francis Le Baron of the U.S. Army Corps of Engineers discovered the presence of rich phosphate deposits in the Peace River vicinity. Mining of river-pebble phosphate, by means of a floating dredge, began in 1887. These river operations centered on the Peace River and its tributaries and involved 12 companies. In 1891, extensive land pebble deposits were discovered to the north, and with the development of an economical means of strip mining, surface phosphate mining blossomed and the underwater operations were shut down. Modern phosphate mining utilizes huge draglines and complicated washers, crushers, screens, hydraulic separators, and flotation plants. The pebble-, gravel-, and sand-size phosphate and phosphorite is removed using this technology (Calver 1957).

Uranium oxide is recovered from Florida phosphates as a byproduct of phosphoric acid production. As a general rule of thumb, a pound of uranium oxide can be recovered per ton of phosphorite (Sweeney and Hendry 1979).

Table 44. Principal phosphate and uranium-producing companies located in the southwest Florida study area (Sweeney and Windham 1979).

County	Company name/address
Hillsborough	Borden, Inc. Box 790 Plant City, Fla. 33566
	International Minerals & Chemical Corp.* Box 867 Bartow, Fla. 38830
	Gardinier, Inc.* Box 3269 Tampa, Fla. 33601
Manatee	AMAX Inc.**
	Beker Industries Corp.**
	Estech General Chemical Corp.** Box 208 Bartow, Fla. 33830
	W. R. Grace & Company Box 471 Bartow, Fla. 33830
De Soto	AMAX Inc. **

* Produces both uranium and phosphate; all other firms produce phosphate only.
** Construction planned.

3.5 LIMESTONE DEPOSITS

Limestone of the Suwannee, St. Marks, Tamiami, Miami Oolite, Ft. Thompson, and Key Largo Formations are mined by open pit methods in southwest Florida. Hard-rock and soft-rock limestone are the two principal types of limestone mined. Soft rock lime stone is used primarily in the chemical industry, metal extraction processes, soil conditioning, and as a road base. Hard-rock lime stone, which is no longer mined in Florida, is used as a building stone. The principal uses for limestone in Florida are as con crete aggregate and road base (approximately 87%), agricultural limestone (i.e., fertilizers, soil conditioning and acidity control)(3.5%), and chemical-lime markets (approximately 10%). The companies operating limestone mines in southwest Florida are indicated in Table 45 (Schmidt et al. 1979).

Limestone is mined by the open pit method. The overburden is first stripped off by a bulldozer or dragline and stacked near the excavation. Soft-rock limestone is mined by bulldozers or front-end loaders. Submerged soft-rock limestone is mined by draglines. Hard-rock limestone is first blasted by drilling slot-holes into the limestone for the detonating explosives. The hard-rock is then mined by bulldozer or front-end loader, or by dragline (submerged hard-rock limestone). In dry pits, the limestone is loaded onto trucks or conveyor belts and taken directly to the processing plant or it is crushed (hard-rock) and then hauled to the processing plant.

3.6 LIMESTONE AND DOLOMITE DEPOSITS

Dolomite is much less common than limestone. It can be defined as a sedimentary rock containing more than 50% dolomite and calcite with dolomite being the most abundant. The only dolomite deposits in the ten county study area of southwest Florida are located along the Manatee River, near Bradenton, Florida (Figure 5). These deposits occur with limestone outcrops and are part of the Hawthorn Formation. There are four inactive dolomite mines in this area and there are presently no active dolomite mines in southwest Florida (Schmidt et al. 1979). The uses of dolomite are generally the same as limestone although it is also a source of high-grade refractory materials. Limestone and dolomite deposits are mined by open-pit methods described in Section 3.5.

Table 45. Active limestone-producing companies in the southwest Florida study area (Schmidt et al. 1979).

County	Company	Mine	Location		
			Township	Range	Section
Pasco	Belcher Mine Inc. P. O. Box 86 Aripeka, Fla. 33502	Belcher Mine	24S	16E	1, 2, 11 & 12
	Int'l Minerals & Chemical Co. Box 867 Bartow, Fla. 33830	Morrel Limerock Mine	25S	22E	24, 25
Lee	Ballard Shell & Fill, Inc. Rt. 2, Box 1104 North Ft. Myers, Fla. 33903	Ballard Pit	44S	23E	10
Lee	Coral Rock Industries P. O. Box 1021 Ft. Myers, Fla. 33901	Cape Coral Pit	43S	24E	17-20
	Florida Rock Industries, Inc. P.O. Box 158 Ft. Myers, Fla. 33901	Alico Road Pit	46S	25E	1, 12
	Fugate Construction Co. 137 Texas Avenue Ft. Myers, Fla. 33901	Alva Mine	43S	27E	10
	Harper Bros., Inc. Rt. 13, Box 821 Ft. Myers, Fla. 33901	Estero Quarry	46S	25E	7
	J. L. Kelly Rock Co., Inc. P. O. Box 353 LaBelle, Fla. 33935	Alva Pit	43S	27E	11, 14
Collier	Ashland-Warren, Inc. P. O. Box 7368 Naples, Fla. 33941	Golden Gate Quarry	49S	27E	16
	A. J. Capeletti, Inc. P. O. Box 9444 Hialeah, Fla. 33021	Collier #1 Quarry	53S	33E	14
	Century Industries P. O. Box 4667 Jacksonville, Fla.	Sunniland Quarry	48S	30E	28

(continued)

Table 45 (concluded)

County	Company	Mine	Location		
			Township	Range	Section
Collier	Florida Rock Corp. Box 2037 Naples, Fla. 33940	Golden Gate Quarry	49S	26E	21
	Highway Pavers, Inc. P. O. Box 7098 Naples, Fla. 33941	Virgil Marcum Pit	50S	26E	7
	Meekins, Inc. 3500 Pembroke Road Hollywood, Fla. 33021	Mule Pen Rock Quarry	48S	26E	13, 14, 23 & 24
Monroe	Parks Banks Trucking P. O. Box 327 Rockledge, Fla. 32955	Big Pine Key Quarry	66S	29E	25
	A. J. Capeletti, Inc. P. O. Box 9444 Hialeah, Fla. 33021	Monroe Pit #1	60S	40E	29
	Alonzo Cothron, Inc. P. O. Box 450 Big Pine Key, Fla. 33043	Tavernier Pit	62S	39E	6
	Charley Toppino & Sons, Inc. Box 787 Key West, Fla. 33041	Rockland Key Quarry	67S	26E	21

3.7 PEAT DEPOSITS

Peat is extremely varied in its composition and its chemical and physical properties. In commercial usage, three types of peat are recognized: moss peat consisting of poorly decomposed remains of sphagnum and other mosses; reed, or sedge peat, consisting of poorly decomposed plants of the sedge family (reeds, cattails, etc.); and humus consisting of peats decomposed to the extent that their biological identity is lost. Most of the peat found in Florida is classified as humus (Calver 1957).

Peat is used primarily as a soil conditioner. It is also used as a fertilizer filler, plant packing material, poultry litter, and infrequently as a low grade fuel. Nearly all the peat marketed in Florida is used for soil improvement (Calver 1957).

Florida ranked second in the United States in peat prodution in 1978 and 1979 (Boyle and Hendry 1981). Peat is found in vast quantities over the Everglades and the Coastal Reticulate Swamps of southwest Florida (Figure 2). It is also found in bogs located in collapsed sinkholes located in Pinellas, Pasco, and Hillsborough Counties. The known original reserves of peat in Florida are estimated to be 1.9 billion metric tons (Calver 1957). The only large peat mine in southwest Florida is located at the F. E. Stearns Peat Bog at Route 1, Box 5420, Dover, Florida 33527. This mine is located just west of Plant City in Hillsborough County, Florida (Boyle and Hendry 1981).

Peat is mined in open pits by bulldozers, front-end loaders or draglines. The mined peat is transported to the processing plant by truck.

4. OIL AND GAS RESOURCES

The producing zone that contains oil in southwest Florida is known as the Sunniland Formation, which is a fossiliferous, porous, Lower Cretaceous limestone found at a depth of approximately 11,500 ft. The thickness and areal extent of the Sunniland Limestone Formation are depicted in Figure 5.

In 1943, the first commercially producing oil well was drilled near Sunniland in Collier County. The next discovery of oil was in 1964 near the town of Felda in Hendry County, located just north of Immokalee, followed by a discovery in 1966 near the Lee-Hendry County line about 8 miles west of Felda. Oil was found again in 1969 approximately two miles southwest of Lake Trafford in Collier County. In 1970, new discoveries extended the Felda Field, and in 1972 a new producing field was developed approximately three miles southeast of Sunniland in Collier County, and another in 1973, about 15 miles east of Sunniland. The last oil discovery in southwest Florida was made in 1974 approximately 4 miles northwest of the Lehigh Acres Development in Lee County (Lane 1980).

Oil and gas have been extracted from the following well fields in southwest Florida: Lehigh Park, West Sunoco Felda, Sunoco Felda, Lake Trafford, Sunniland, Bear Island, Baxter Island, Raccoon Point, and Forty Mile Bend. These fields are located in eastern Lee, southwestern Hendry, northeastern Collier and northwestern Dade counties. The taxes and royalties paid on the oil produced from these fields continues to contribute significantly to the State's economy.

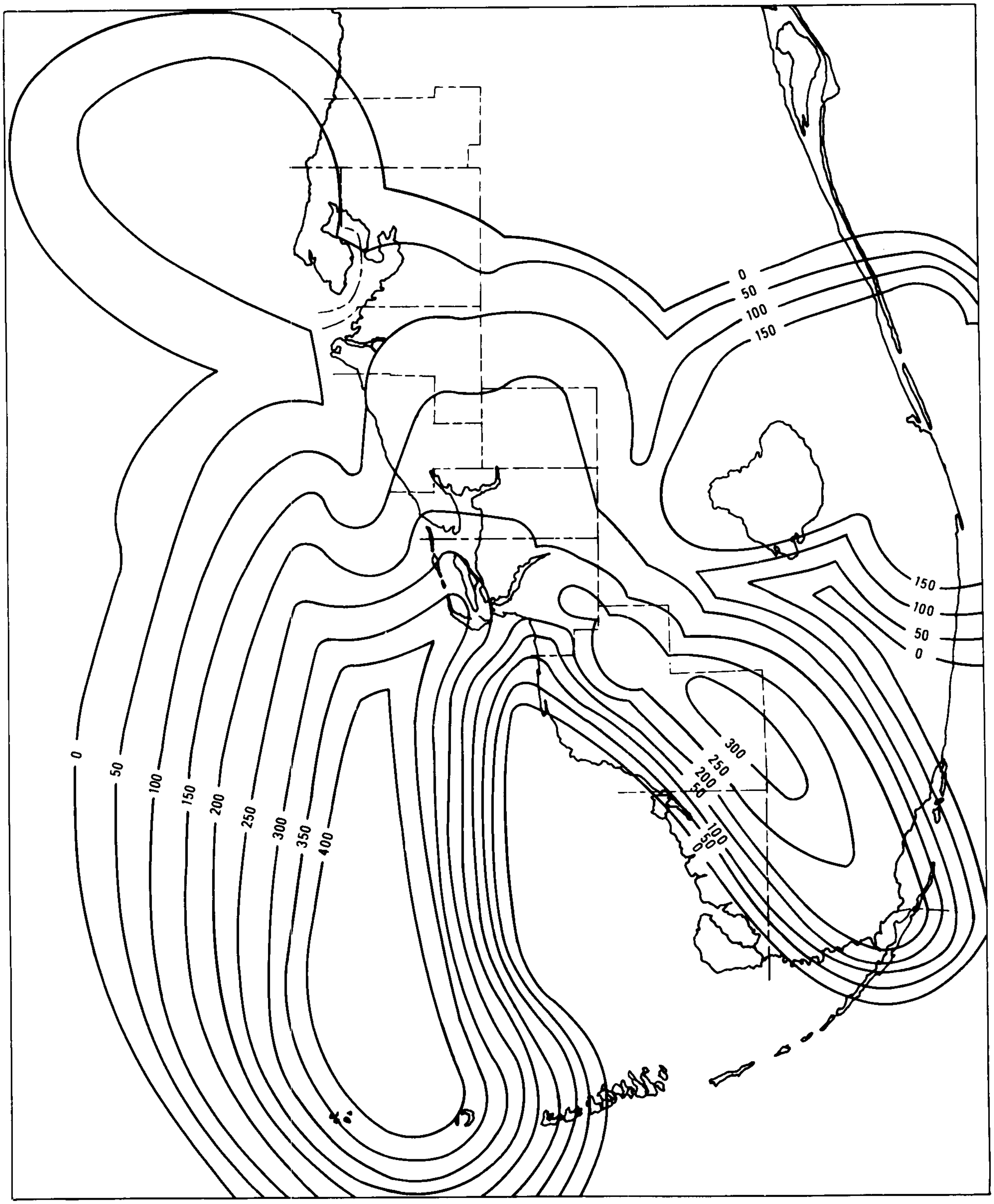

Figure 5. Isopach map of Sunniland limestone formation (after Oglesby 1965).

5. ENVIRONMENTAL CONSTRAINTS ON MINERALS MINING IN SOUTHWEST FLORIDA

In March of 1976, President Carter requested the Council on Environmental Quality to investigate the environmental consequences of the proposed expansion of the phosphate industry in Central Florida. Under contract with the Environmental Protection Agency, Texas Instruments, Inc., prepared an environmental impact statement that was released to the public in November of 1978. The recommendations listed by the Environmental Impact Statement established guidelines for the issuance of Federal permits to new phosphate mines and are as follows (Texas Instruments 1978):

1. "Rock drying should be eliminated except in cases where energy conservation strategies or fertilizer production processes require drying."
2. "Conventional above ground slime disposal ponds should be eliminated."
3. "Storage should be provided for the capture and recirculation of 100 percent of the water recovered from phosphate clay slimes."
4. "New mines should address proposed radiation standards, to be published by the EPA, through a soil-testing program to be conducted prior to mining and a land reclamation plan to be implemented after mining to reduce the amount of radiation left near the surface as much as possible."
5. "Local and State Government reclamation requirements should be met."
6. "Wetlands, under the jurisdiction of Federal laws administered by the U.S. Army Corps of Engineers, should be protected or restored according to a differential value scale offering absolute protection to certain wetland types."
7. "Toxic acid waste ponds should be lined with impervious materials, unless studies can demonstrate such lining is unnecessary to protect ground water systems from chemical and radiological contamination."
8. "Mines should either provide for recovery of fluorine compounds or install treatment and containment facilities such that the entire processing plant complex, including the gypsum waste pond, meets total point-source fluorine emission standards."
9. "Uranium recovery should be encouraged."

The principal Federal environmental constraints on pit or quarry mining (e.g. sand and gravel, limestone, dolomite, peat) are that wetland habitats be protected and that suitable land reclamation be accomplished when mining activities cease. The principal environmental constraints on land-based crude oil extraction and exploration activities are as follows (Texas Instruments 1978):

1. "Wetland habitats should be protected from fill activities that may be associated with drill site preparation."
2. "Runoff of drill slurry 'mud' should be prevented."
3. "Wells must be properly cased to prevent ground water contamination from drilling activities."
4. "Producing wells must be adequately capped and monitored to prevent oil spills into nearby wildlife habitats."

There is no single State agency that regulates mining operations in Florida. The environmental and public safety aspects of these activities are overseen by the following institutions: the Department of Community Affairs, the Department of Natural Resources, the Department of Environmental Regulation, and the Southwest Florida Water Management District offices.

The Department of Community Affairs, through the Bureau of Land and Water Management, reviews any proposed mining operation to determine the extent of its environmental and community impact. A prospective mine is required to file a Development of Regional Impact (DRI) application for approval if the project will disturb minerals or overburden over an area greater than 100 acres annually or if its proposed consumption of water will exceed 3,000,000 gallons/day.

The DRI program is covered under Chapter 27F-2, Part II of the Rules of the Administrative Commission of the Executive Office of the Governor, and Chapter 380 of the Florida Statutes. Under these rules and statutes, the State Regional Planning Councils provide information to local governments to assist them in making decisions concerning mining operations. The local governments use this information to determine:

1. If the development will have an unfavorable impact on the environment and natural resources of the region, the economy of the region and the ability of people to find adequate housing.
2. If the development will unduly burden public facilities and transportation.

After the Regional Planning Council examines the DRI application, they notify the local government. A public hearing is scheduled to get community views on the project, and the report of the Planning Council is evaluated. If the mining project is proposed for an area of critical State concern, the local government can approve it only if there is compliance with the land development regulations of Chapter 380.05 of the Florida Statutes. If the development is not in an area of critical State concern, the local government can approve it, deny it, or approve it subject to conditions and restrictions. After approval, the local government is responsible for monitoring the mining operation and enforcing the provisions of the development order.

At present, only two mines in central and southern Florida are large enough (in terms of acreage or water use) to have required DRI review. These are a rock mining operation in Broward County and Noranda's Hopewell Mine, a phosphate producer, in Hillsborough County (Tom Beck, Tampa Bay Regional Planning Council 1983, personal communication).

The Department of Natural Resources regulates mining activities by requiring mine owners to submit conceptual reclamation plans, actual reclamation plans, annual applications for reclamation of yearly land disturbance, and records of surface radiation and phosphate levels. Chapter 16C-16 of the Rules of the Department of Natural Resources regulates mine reclamation. These reclamation plans must address the following issues:

1. Backfilling and grading of excavations and above-ground waste dumps use material unsuitable for general reclamation use, because of potential hazards to public health and safety, must be replaced in the mine cut beneath all other backfill material.

2. Quality of topsoil used for reclamation.

3. Restoration of wetlands.

4. Design of artificially created wetlands and water bodies.

5. Quality of local water on the property and leaving the property before and after the mining operation.

6. Potential flood hazards induced by altering local drainage patterns.

7. Potential radiation hazards.

8. Waste storage.

9. Revegetation of disturbed land surfaces.

10. Protection of endangered species and wildlife habitats.

The Department of Environmental Regulation issues permits for mining activities that affect air and water quality. The Southwest Florida Water Management District regulates aspects of mining that involve water use and the management and storage of surface waters. Table 46 summarizes the Federal, State, and local government permits and approvals necessary for mining and processing of extracted material.

Table 46. Mining and processing permits and approvals (Sweeney and Hendry 1979).

Permits	Agency
Federal:	
Ambient Air Quality	Environmental Protection Agency
Emission Standards	Environmental Protection Agency
Preconstruction Review and Approval	Environmental Protection Agency
Water Quality	Environmental Protection Agency
Dredge and Fill Permit	U.S. Army Corps of Engineers
Environmental Impact Statement	Council on Environmental Quality
State:	
Development of Regional Impact	Division of State Planning (through Regional Planning Council)
Air Quality: Permits to construct; Permits to operate; Permits to maintain; Permits to expand; Permits to modify	Department of Environmental Regulation
Water Quality: Industrial waste water; Dredge and fill; Drainage well permit	Department of Environmental Regulation
Potable water supplies	Department of Environmental Regulation
Dam construction	Department of Environmental Regulation

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8. GLOSSARY

calcareous - Containing calcium carbonate.

carbonate - A salt of carbonic acid; a compound containing the radical CO_3.

clastic - Consisting of fragments of rocks or of organic structures that have been moved individually from their places of origin.

Cretaceous - The third and latest period included in the Mesozoic Era characterized by the development of flowering plants and the disappearance of dinosaurs.

dolomite - A common white sedimentary mineral composed of calcium-magnesium carbonate ($Ca, Mg [CO_3]_2$).

domal trap - A symmetrical, elliptically shaped upfold in rocks where oil or gas can accumulate.

evaporite - One of the sediments that are deposited from aqueous solution as a result of extensive or total evaporation of the liquid.

formation - A bed, or assemblage of beds with well-marked upper and lower boundaries that can be traced and mapped over a considerble tract of country.

gravel - Rounded rock or mineral fragments between 2 and 4.76 mm in diameter (1/8 - 1/4 inches).

gypsum - A mineral with the chemical formula $CaSO_4 \cdot 2H_2O$.

hydrous - Containing water.

hyper-saline - Very salty.

igneous - Rocks formed by solidification of hot mobile material termed magma.

isopach - A geologic map depicting the thickness of a geologic formation.

limestone - A sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$).

lithology - The physical character of a rock.

longshore current - A surface water current that flows parallel with the coastline in the direction of the prevailing wind.

marine terrace - A narrow, elevated, seaward-sloping, wave-cut platform formed by an ancient sea level stand.

metamorphic - Sedimentary or igneous rocks that have been altered by pressure, heat, or the introduction of new chemical substances.

paleoclimate - Ancient climate.

peat - A dark brown or black residuum produced by the partial decomposition and disintegration of mosses, sedges, trees, and other wetland foliage.

plateau - A relatively flat elevated area of land.

precipitate - A solid substance which settles out of an aqueous solution.

quarry - An open or surface mining pit.

sand - Rock fragments ranging in size from 1/16 to 2mm (1/256 - 1/8 inches).

sedimentary - Rocks formed by the accumulation of sediment in water (aqueous deposits), or from wind deposition (aeolian deposits).

shoal - A shallow, submarine bank of uniform elevation rising above the surrounding submarine topography.

silicate - A compound composed of the SiO_4 tetrahedron.

sinkhole - A funnel-shaped depression in the ground surface formed by solution of limestone.

HYDROLOGY AND CLIMATOLOGY

by

Thomas F. Palik
Martel Laboratories, Inc.

0. INTRODUCTION

0.1 HYDROLOGY OF SOUTHWEST FLORIDA

The hydrologic cycle is the circulation of water from where it falls as rain, flows overland and in streams as runoff to the ocean, and circulates back to the atmosphere through evapotranspiration. A small portion of the rainfall seeps into underground storage as recharge to ground water reservoirs (aquifers).

Surface waters in southwest Florida drain into the Gulf of Mexico. Stream discharges normally reach their peak during the latter part of the summer rainy season.

Ground water is one of southwest Florida's most valuable and abundant resources. The artesian Floridan aquifer and the nonartesian surficial shallow aquifer are the two principal aquifers present in the southwest Florida study area.

0.2 CLIMATOLOGY OF SOUTHWEST FLORIDA

Southwest Florida is renowned for its warm subtropical climate. Each year thousands of tourists flock to the region to bask in the warm Florida sun and swim in the warm waters of the Gulf of Mexico.

Southwest Florida receives more than 50 percent of its rainfall during the warm summer months. The summer rainy season, as it is known, normally runs from approximately May 20 through September 20.

Over 80 percent of summer rainfall is associated with convective thunderstorms (Palik 1978). Such thunderstorms form from intense daytime heating of warm subtropical air masses that prevail over the region during the summer months. Atmospheric moisture content and direct solar radiation are key ingredients in the formation of these thunderstorms. The sun reaches its highest point in the sky on June 21 (summer solstice). The optimum solar radiation period in southwest Florida ranges from April through August. The optimum atmospheric moisture content period ranges from approximately May 20 through September 20 which coincides with the summer rainy season. Since the optimum solar radiation period occurs during the first 3 months of the rainy season, thunderstorms are most intense at this time.

During May and June, atmospheric steering currents are weak, and thunderstorms tend to form along sea breeze convergence fronts in the interior of peninsula Florida. Sea breeze convergence fronts form where land breezes and sea breezes come together and winds are forced upwards. During July, August, and September, a southeasterly steering current usually prevails across the area.

The Atlantic Ridge, a semi-permanent high pressure system which prevails across the Atlantic from May through October, is located north of the region, at this time, allowing moist southeasterly trade winds to prevail across the region.

Showers and a few thunderstorms first form in the morning hours along the Florida east coast and Gulf Stream and then re-develop westward during the day steered by prevailing tradewinds (the average life expectancy of a thunderstorm cell is one hour; for this reason, precipitation totals tend to be quite erratic as thunderstorm cells continually form, develop and die). By late afternoon, these cells are approaching the gulf coast of Florida. The thunderstorms mushroom rapidly as this moisture surge of shower activity reaches the sea breeze convergence zone just inland of the gulf coast. Because the atmosphere holds more moisture at high temperatures, the heaviest precipitation totals occur along the gulf coast during the late afternoon hours at the time of maximum solar heating.

From time to time, frontal systems intrude into the southeastern states bringing westerly steering currents to the region, and the precipitation cycle reverses. During these periods, showers develop during the morning on the gulf coast and re-develop eastward during the day reaching the east coast during the late afternoon where they are most intense. During these periods of westerly steering current intrusions, the heaviest precipitation totals occur along the east coast.

The west coast of Florida is the thunderstorm capital of the United States.

During the fall, from late September through November, the fall dry season is characterized by atmospheric moisture drops and solar radiation decreases.

During the winter, from December until mid-March, precipitation occurs almost exclusively along cold fronts reaching a peak during February and March. During late March, frontal systems stall mostly north of the region, and the spring dry season ensues.

1. FLORIDAN AQUIFER

1.1 BACKGROUND

Ground water is one of Florida's most valuable and abundant resources. Two principal aquifers are present in southwest Florida (Figure 6). The artesian Floridan aquifer contains water under sufficient pressure to rise above the top of the containing geological formations. It is also the principal source of ground water in most of Florida. The surficial shallow nonartesian aquifer, which lies at depths of less than 100 feet, underlies most of the southern portion of the southwest Florida study area.

In addition, a small portion of the southeast portion of peninsular Monroe County is underlain by the Biscayne aquifer. This aquifer is the principal water source for the densely populated Gold Coast of southeast Florida. In southwest Florida, it is located beneath a virtually uninhabited portion of the lower Everglades and is only a minor source of water for the southwest Florida study area.

The Floridan aquifer is included within the Lake City, Avon Park, and Ocala Limestones, all of Eocene Age; the Suwannee Limestone of Oligocene Age; and the Tampa Limestone and permeable portions of the Hawthorn Formation of Miocene Age. The Floridan aquifer is one of the world's largest. In some areas, the aquifer is exposed at the land surface, but over most of the State, it is beneath several hundred feet of sediments and confining formations. The thick non-porous rocks restrict the vertical flow of water upward and downward from the Floridan aquifer. In several places, there are large breaks in the confining formation, where large springs discharge. The depth to the base of water containing less than 10,000 mg/l of dissolved solids (freshwater-saltwater interface) in the Floridan aquifer across southwest Florida in 1980 is shown in Figure 7.

1.2 POTENTIOMETRIC CONTOUR MAP OF THE FLORIDAN AQUIFER

The altitude to which water will rise in artesian wells generally ranges from a few feet to more than 130 feet and is known as the potentiometric surface. The potentiometric surface for the Floridan aquifer as determined in May 1981, is shown in Figure 8 and is shown on the individual atlas maps. This was the latest data available at the time the maps were compiled and represents dry season potentiometric levels. A potentiometric map provides valuable data on the relative size and storage of subsurface waters and directions of groundwater flow. Saltwater intrusion is a major problem in areas where the potentiometric surface approaches or falls below sea level (portions of Manatee County). Generally speaking, the depth to the base of potable water can be estimated by multiplying the altitude of the potentiometric surface by 40.

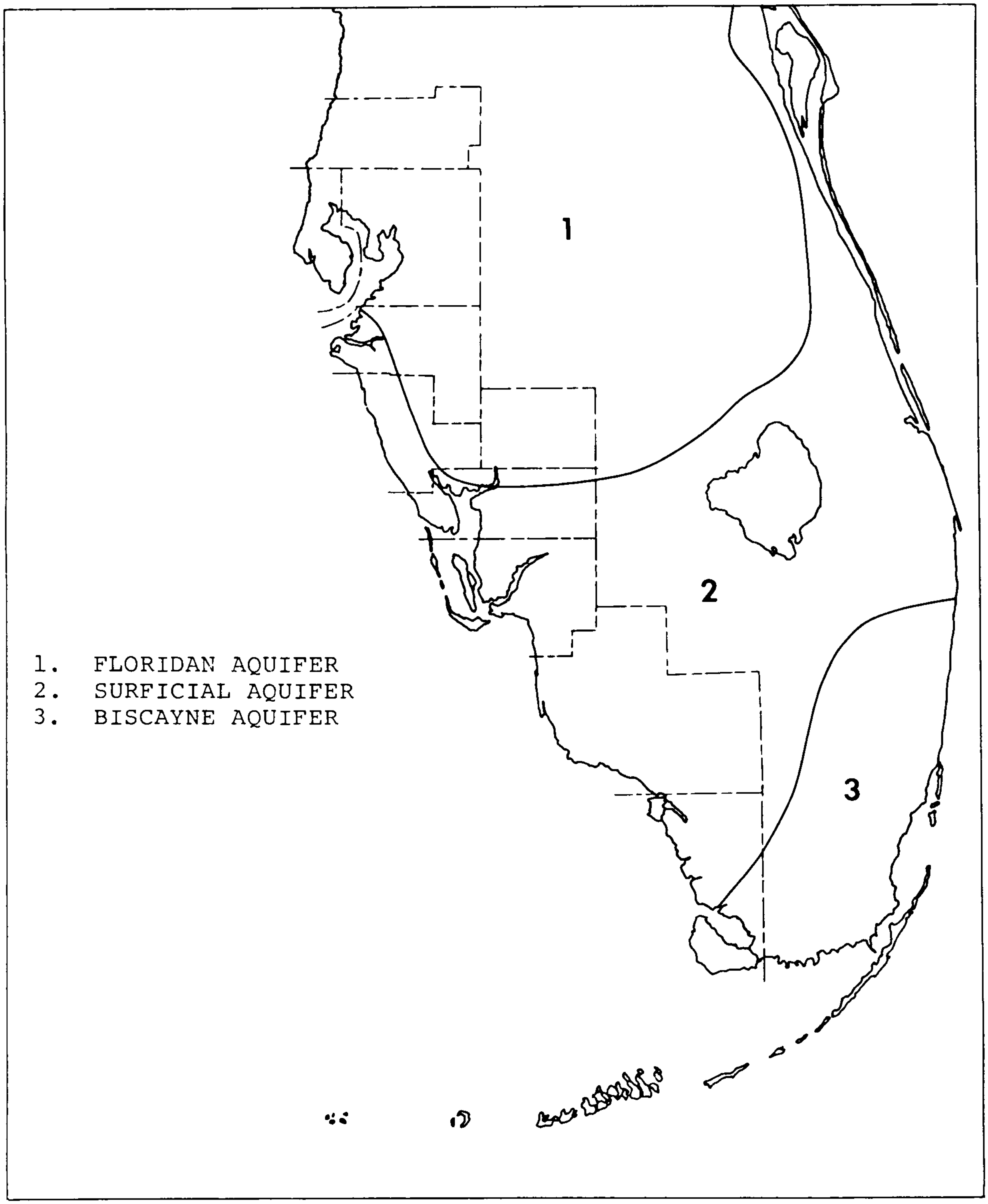


Figure 6. Aguifers of south Florida (after Franks 1982).

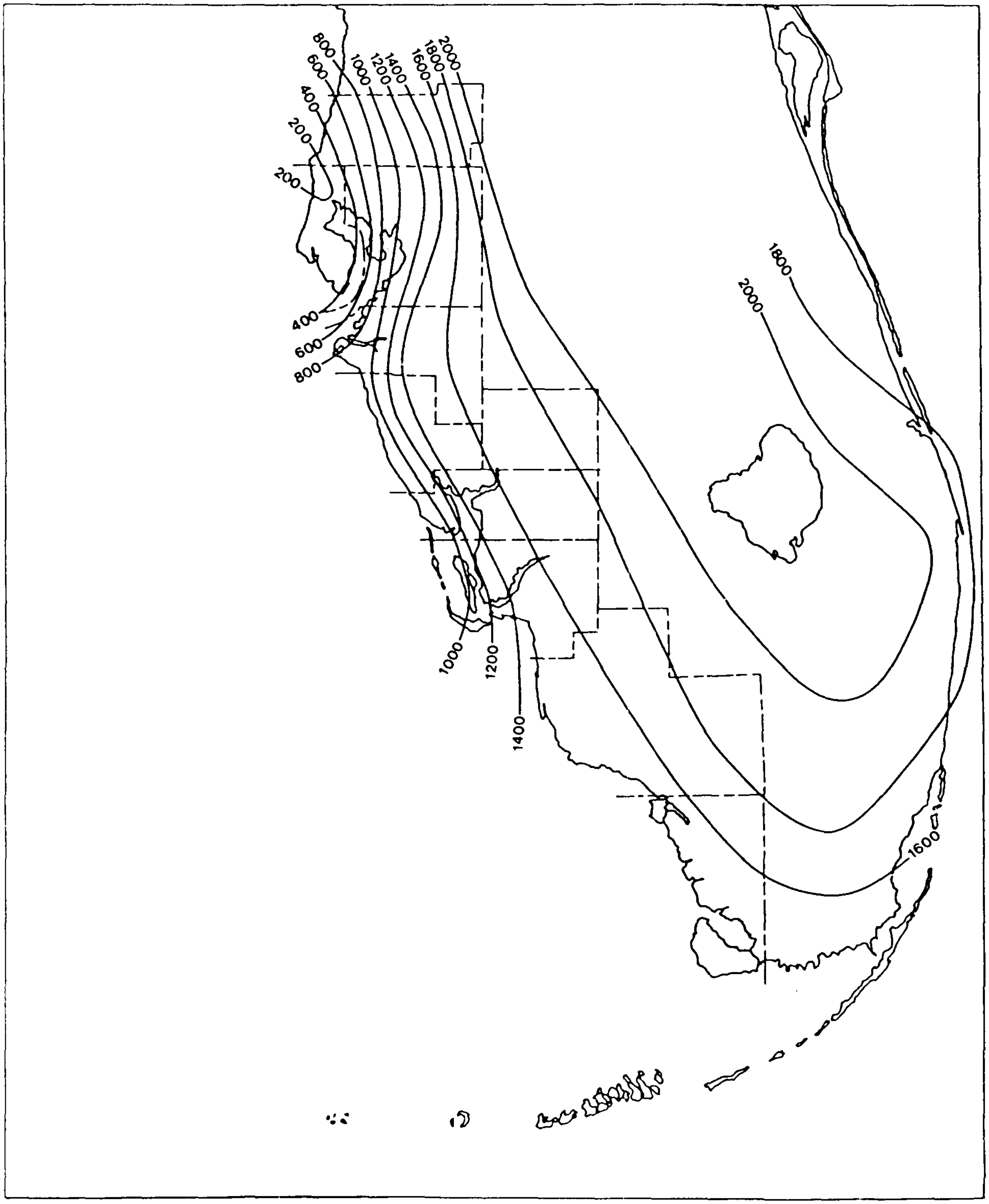


Figure 7. Depth to base of water containing less than 10,000 mg/l of dissolved solids in the Floridan aquifer across southern Florida in 1980; contours are in feet below mean sea level (adapted from Franks 1982).

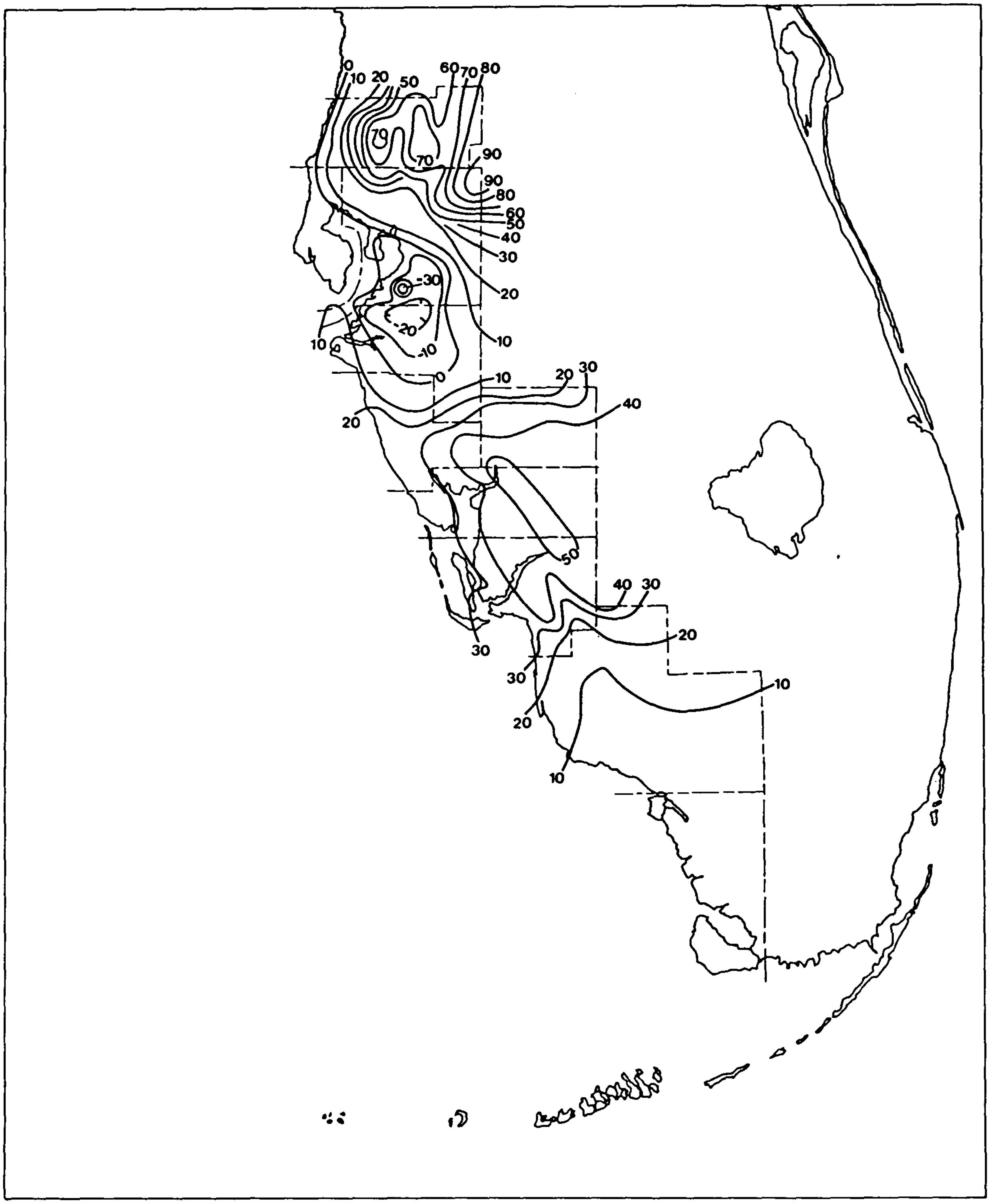


Figure 8. Generalized potentiometric surface of Floridan aquifer across southern Florida, May 1981; contours are in feet above mean sea level (U.S. Geological Survey 1981a).

1.3 POTENTIOMETRIC CONTOUR MAP LEGEND EXPLANATION

The potentiometric contour map of the Floridan aquifer portrayed on the atlas maps represents dry season water levels present in tightly cased wells penetrating the Floridan aquifer in May 1981. The contour interval is 10 feet with a supplemental contour interval of 5 feet and is expressed in feet above mean sea level. Contour lines on the atlas maps have been generalized to allow for non-simultaneous water level measurement and variable well depth.

2. MONTHLY PRECIPITATION

2.1 BACKGROUND

The southwest Florida study area has a bi-modal annual monthly precipitation pattern which consists of the summer rainy season, a secondary late winter rainy season, and the fall and spring dry seasons. This bi-modal annual rainfall pattern is shown graphically in Figure 9.

2.2 MEAN MONTHLY PRECIPITATION

The summer rainy season normally starts during the latter portion of May. Atmospheric moisture increases, and with high solar radiation levels present, convective thunderstorms build up during the afternoon hours over the Florida peninsula. During May and June, these thunderstorms form along land and sea breeze convergence zones in the interior of the Florida peninsula. Since atmospheric steering currents are weak at this time of year, the thunderstorms show little movement, and the aerial distribution of these thunderstorms is limited (Figures 10 and 11). During July, August, and September, easterly tradewinds usually prevail across the area, and the aerial coverage of the thunderstorms increases. The thunderstorms are heaviest along the Florida gulf coast during the late afternoon and early evening hours (Figures 12, 13, and 14).

During the fall, from late September through November, the fall dry season is characterized by atmospheric moisture drops and solar radiation decreases (Figures 15 and 16).

During the winter, from December until mid-March, a secondary winter rainy season occurs. Precipitation occurs almost exclusively along cold fronts reaching a peak during February and March (Figures 17, 18, 19, and 20).

During late spring, fronts stall mostly north of the region and the spring dry season ensues (Figure 21). With a scarcity of rainfall and solar radiation at its annual maximum, water tables reach their annual lowest level.

(Note: Figures 10-21 were compiled by the author from 1951-1980 monthly precipitation means for National Weather Service climatological stations in Florida)

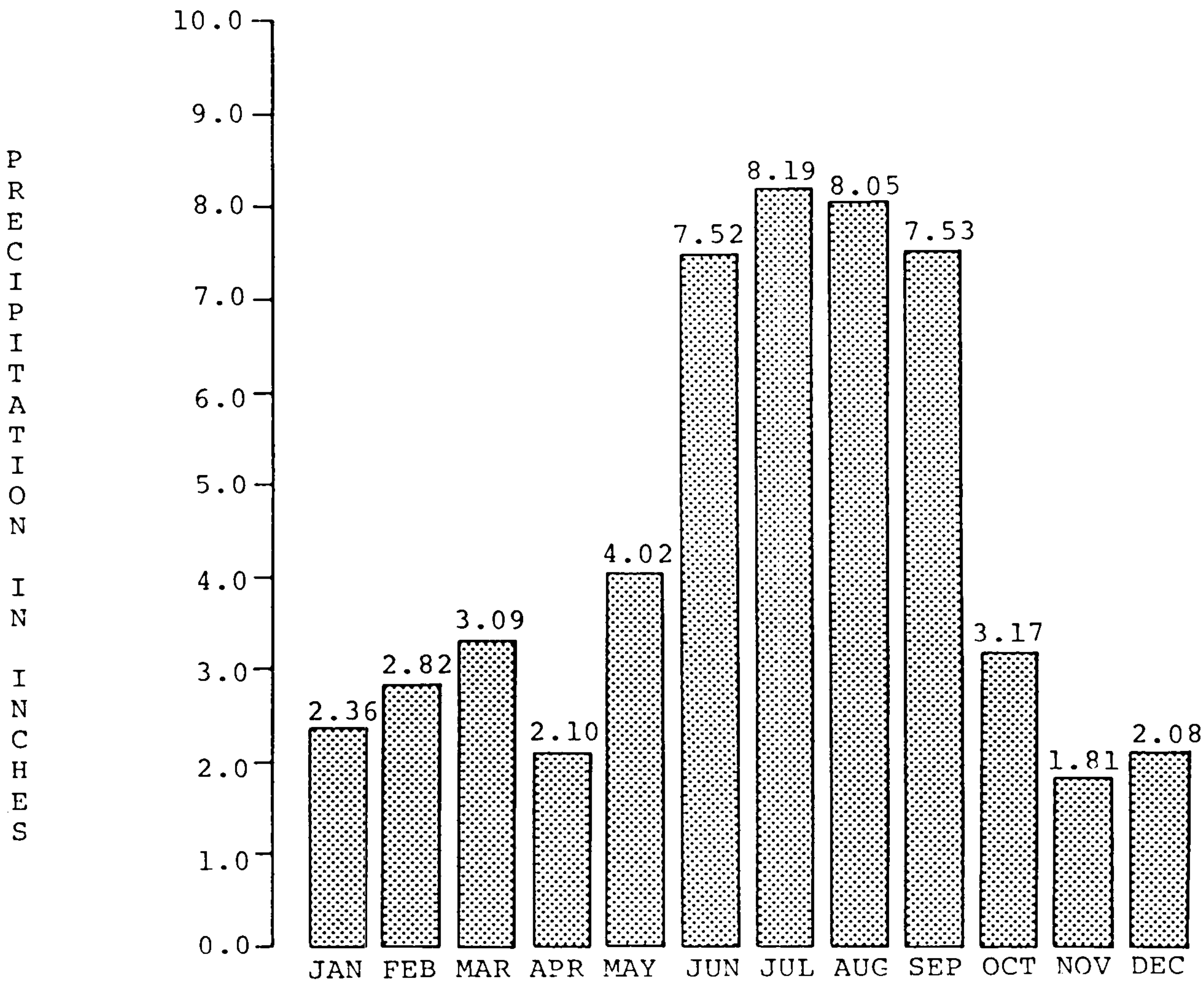


Figure 9. Normal mean monthly precipitation for southwest Florida, 1951-1980; represents areal mean of monthly precipitation for study area (Palik 1982c).

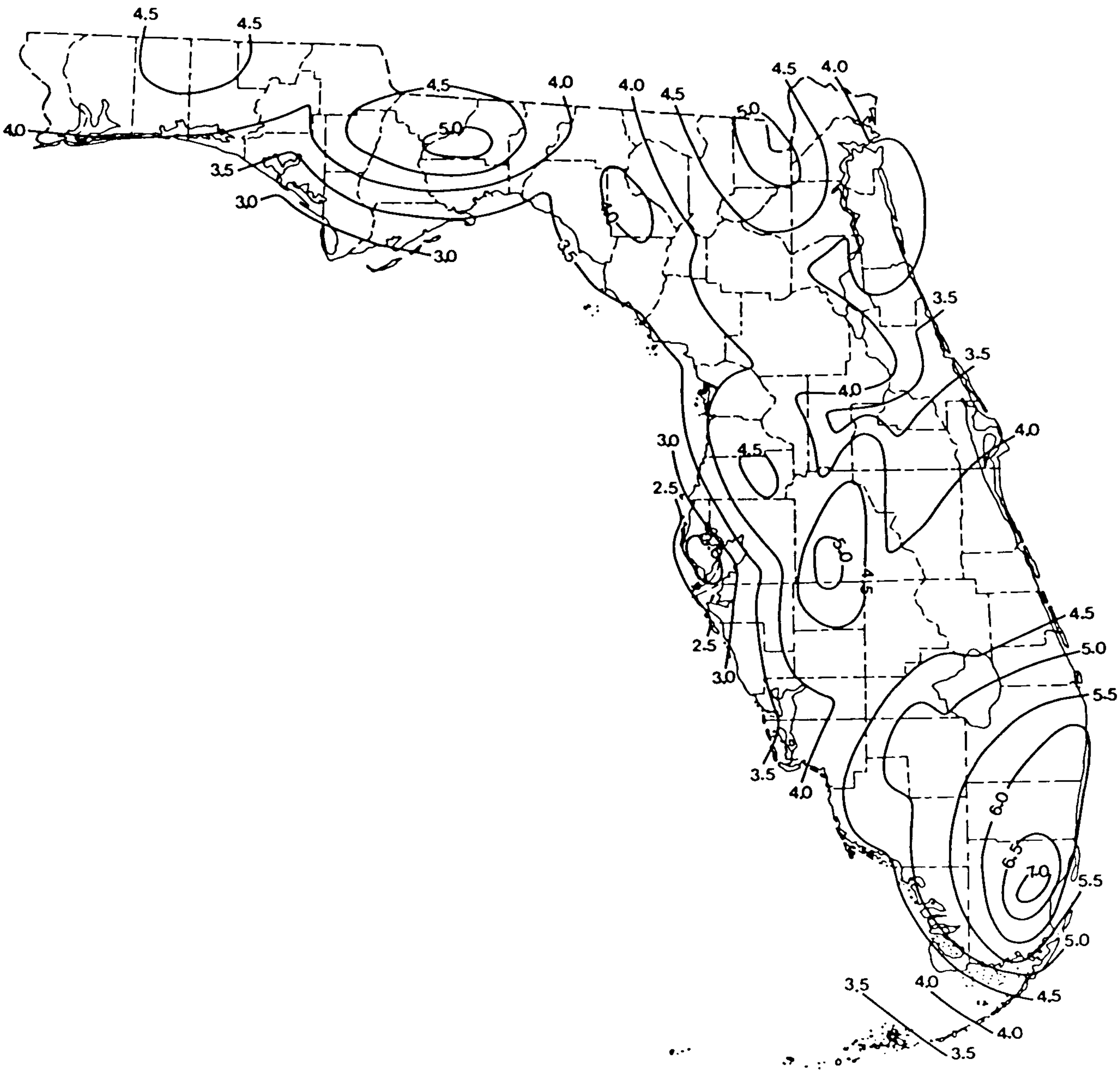


Figure 10. 1951-1980 normal mean May isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

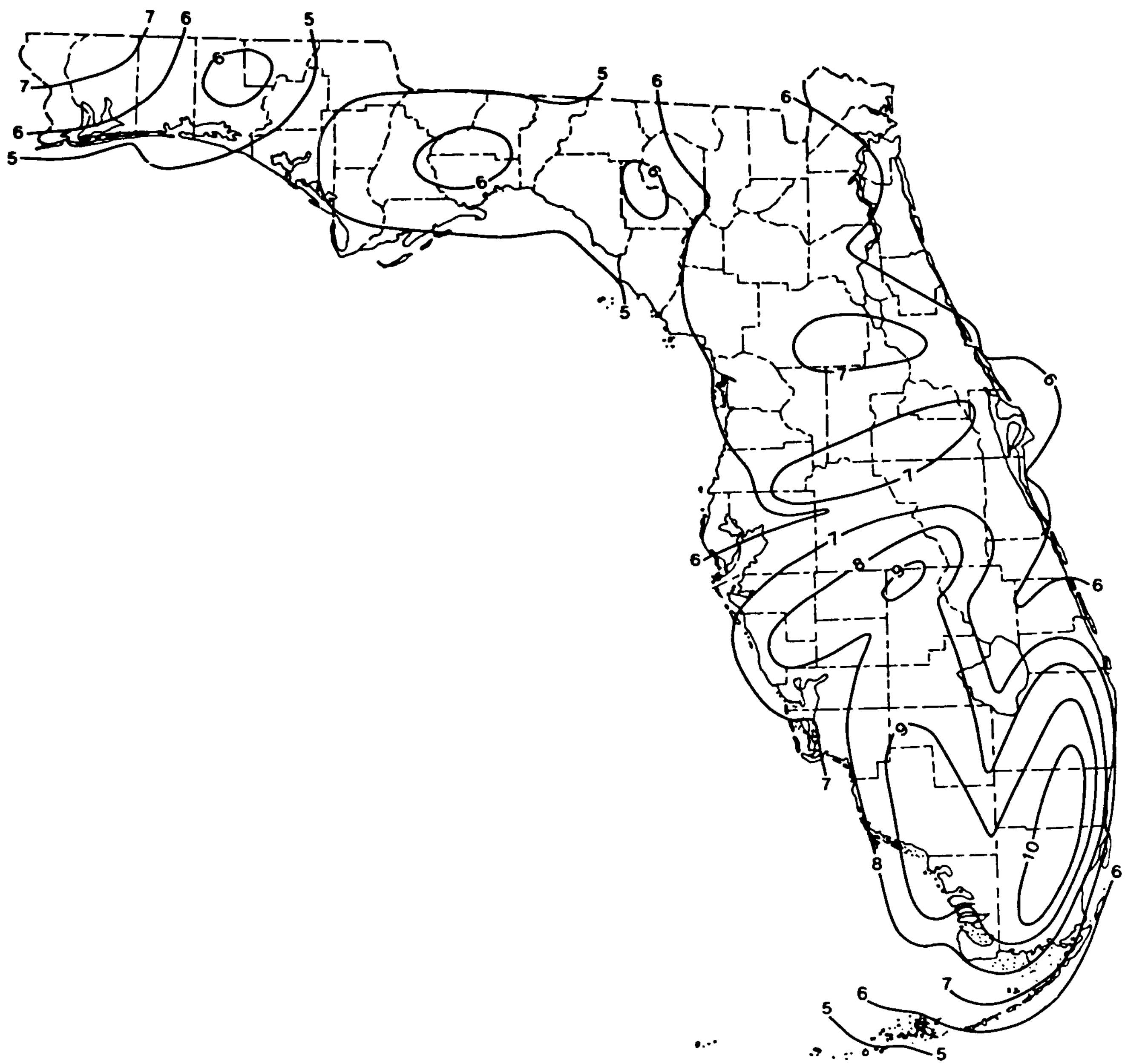


Figure 11. 1951-1980 normal mean June isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

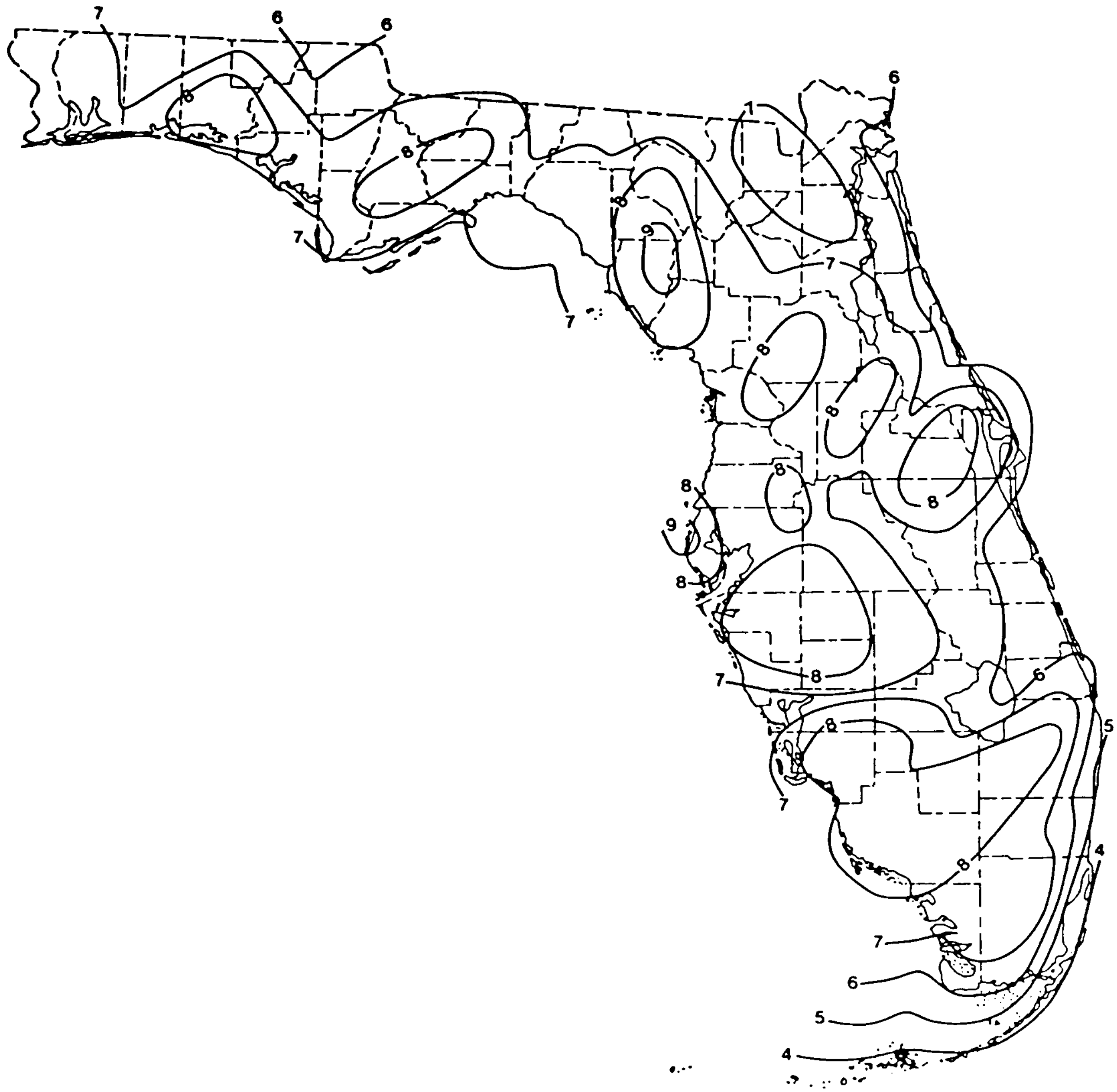


Figure 12. 1951-1980 normal mean July isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

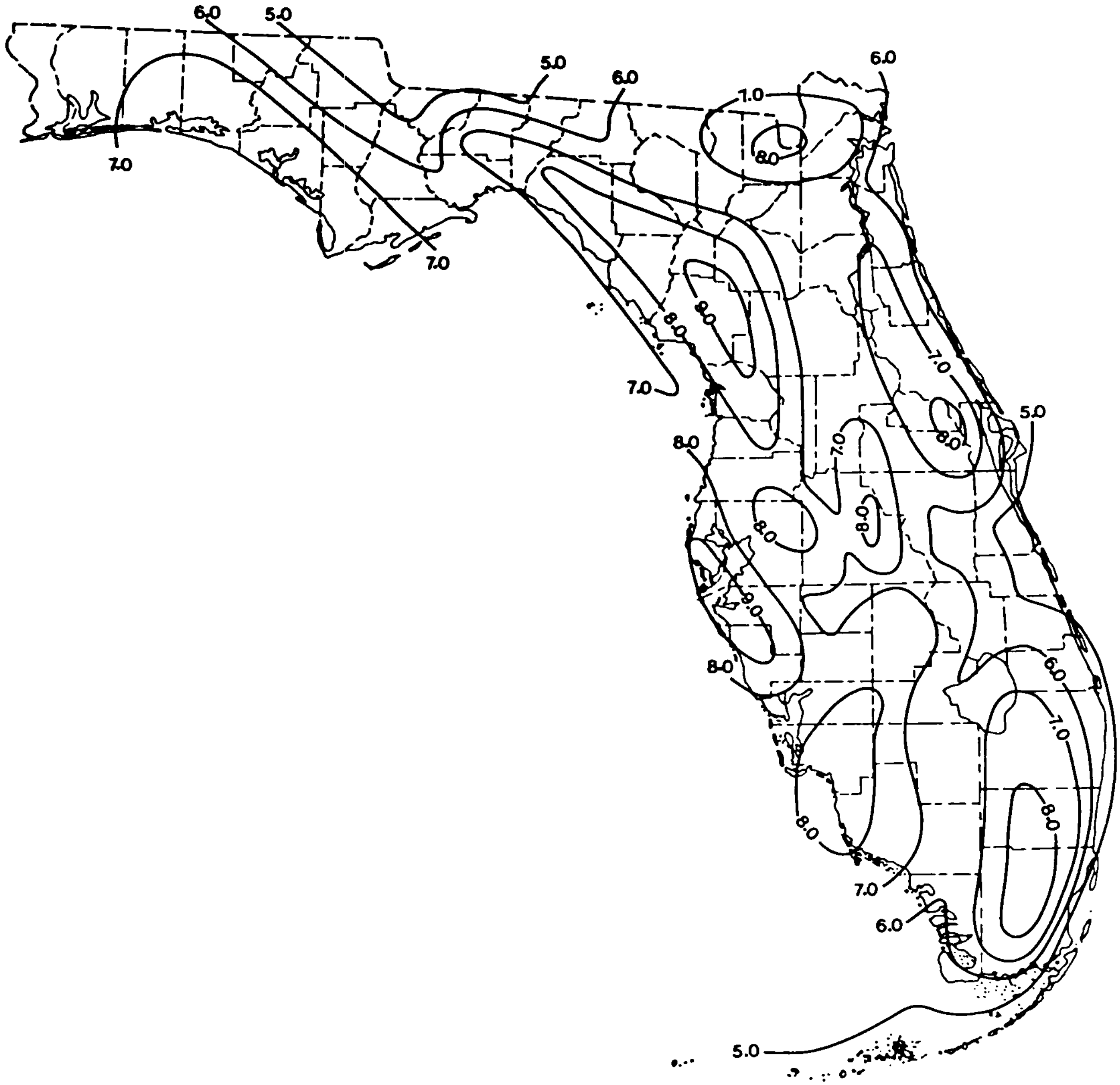


Figure 13. 1951-1980 normal mean August isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

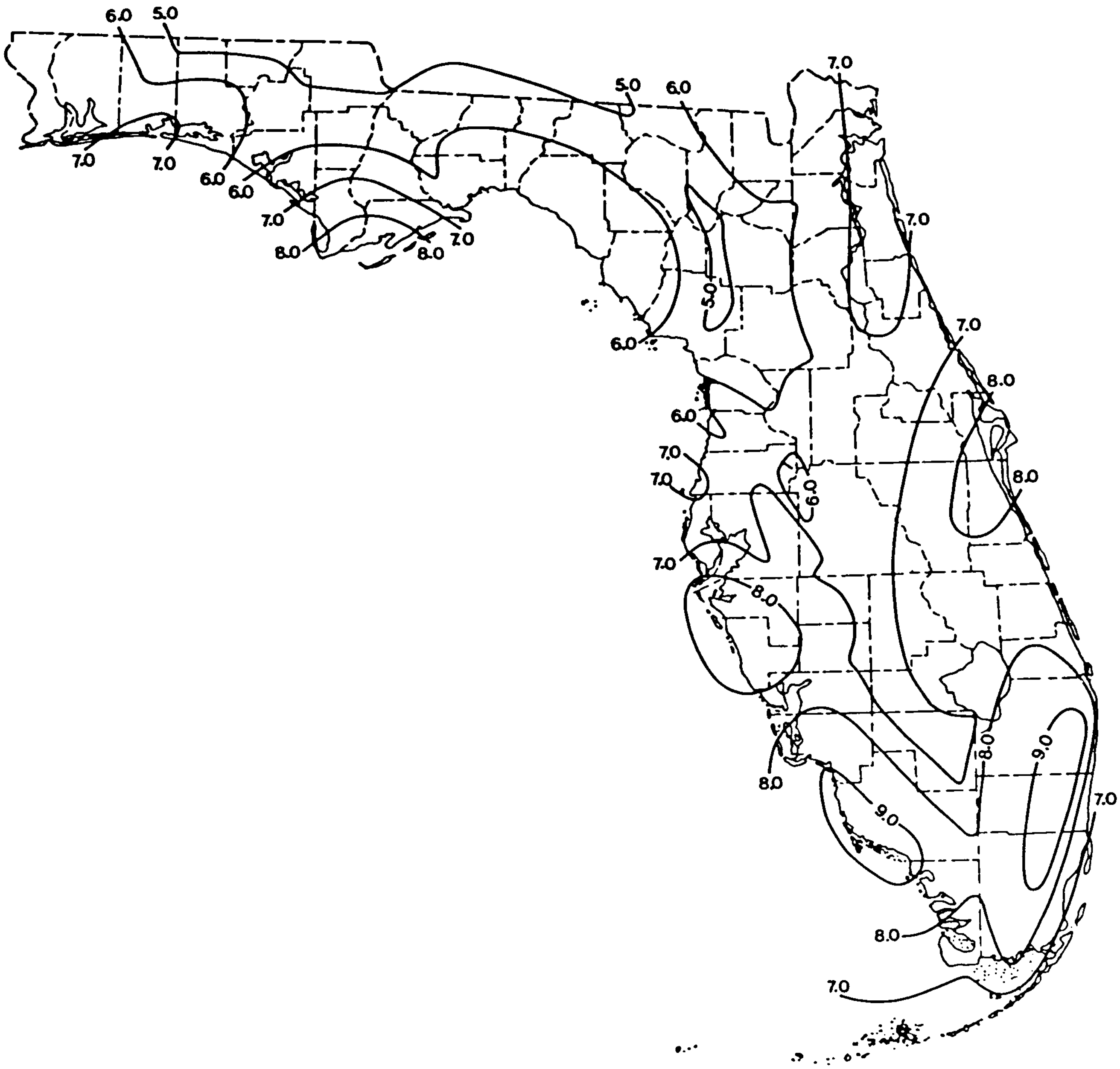


Figure 14. 1951-1980 normal mean September isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

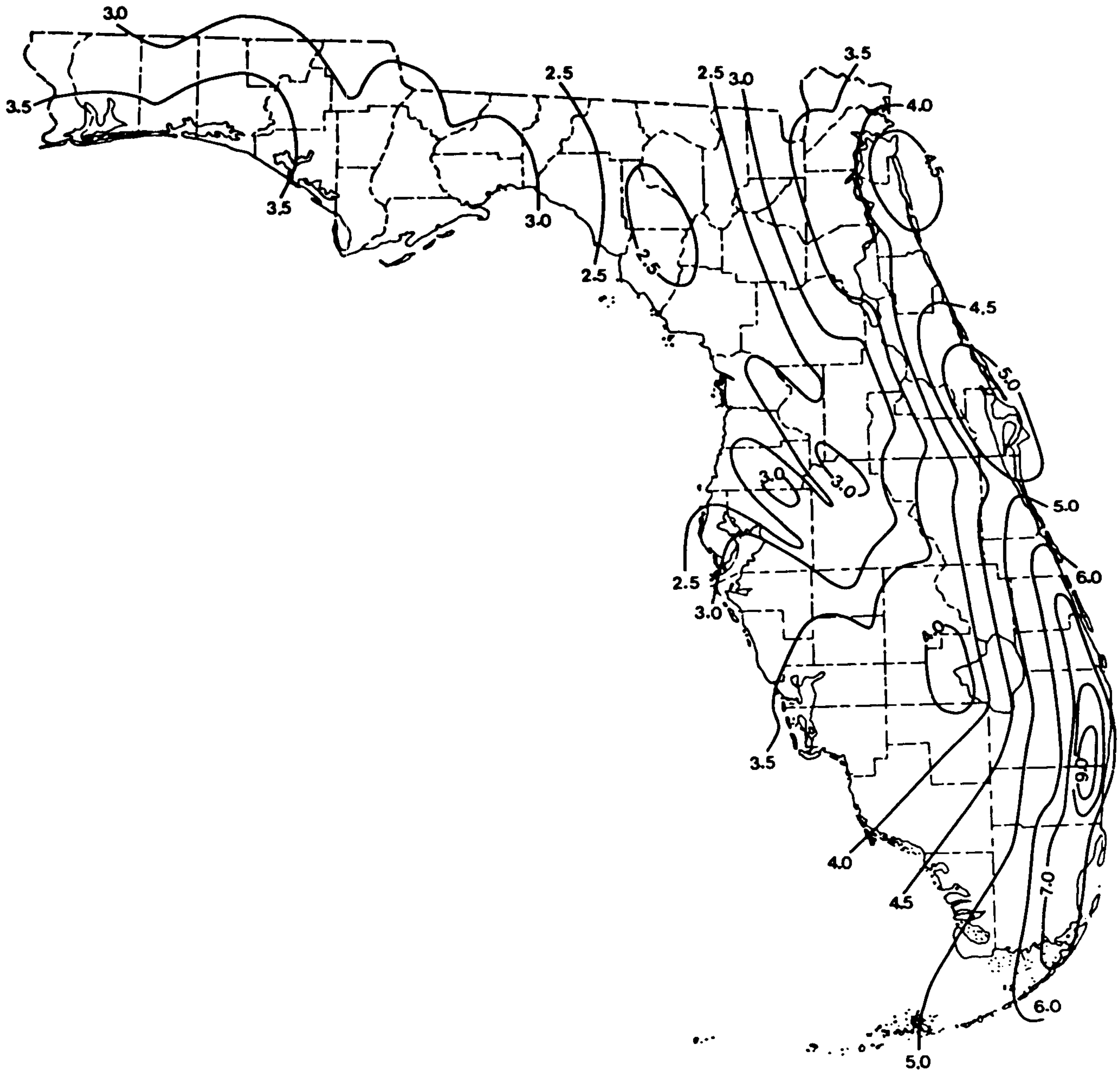


Figure 15. 1951-1980 normal mean October isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

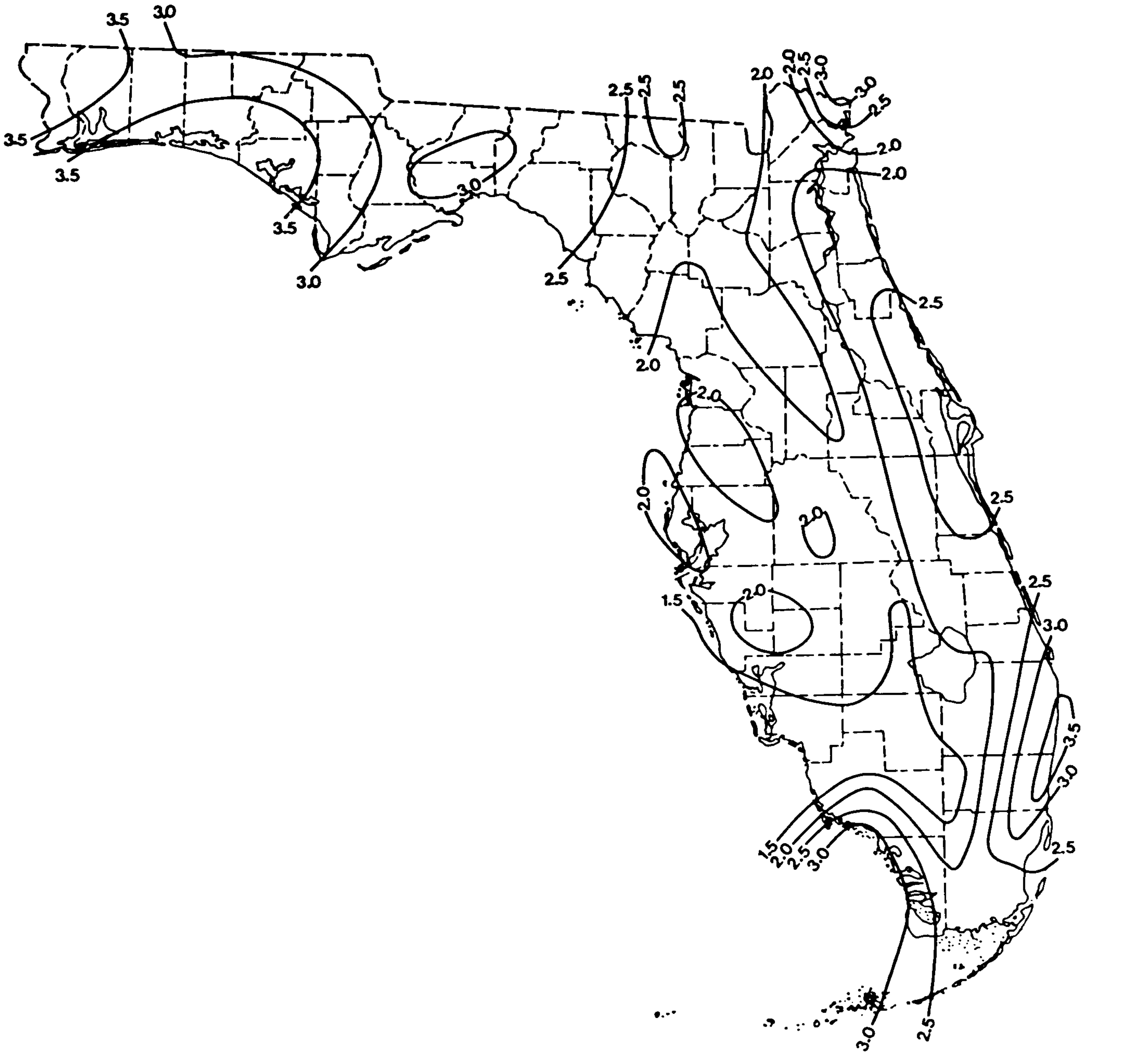


Figure 16. 1951-1980 normal mean November isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

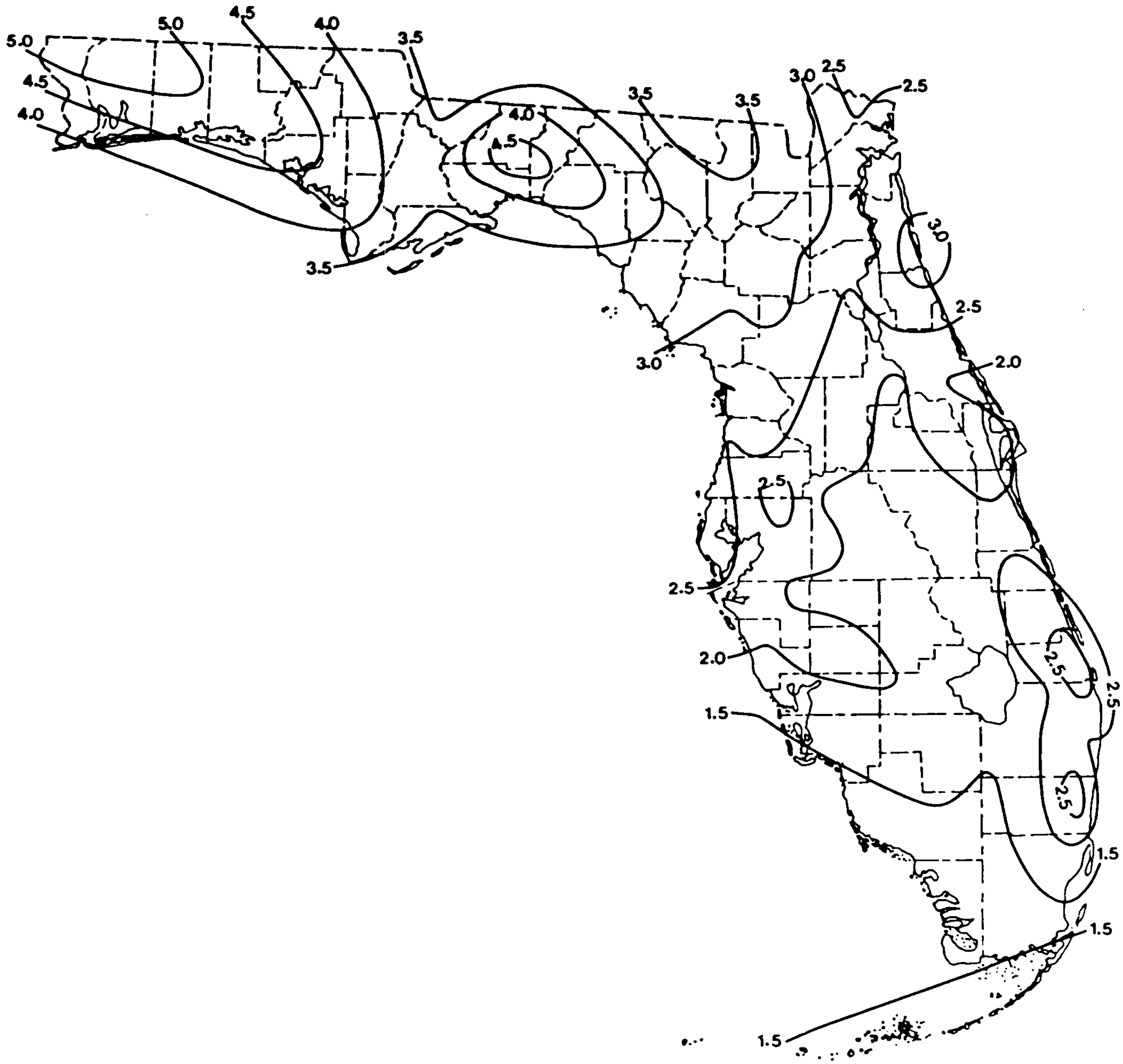


Figure 17. 1951-1980 normal mean December isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

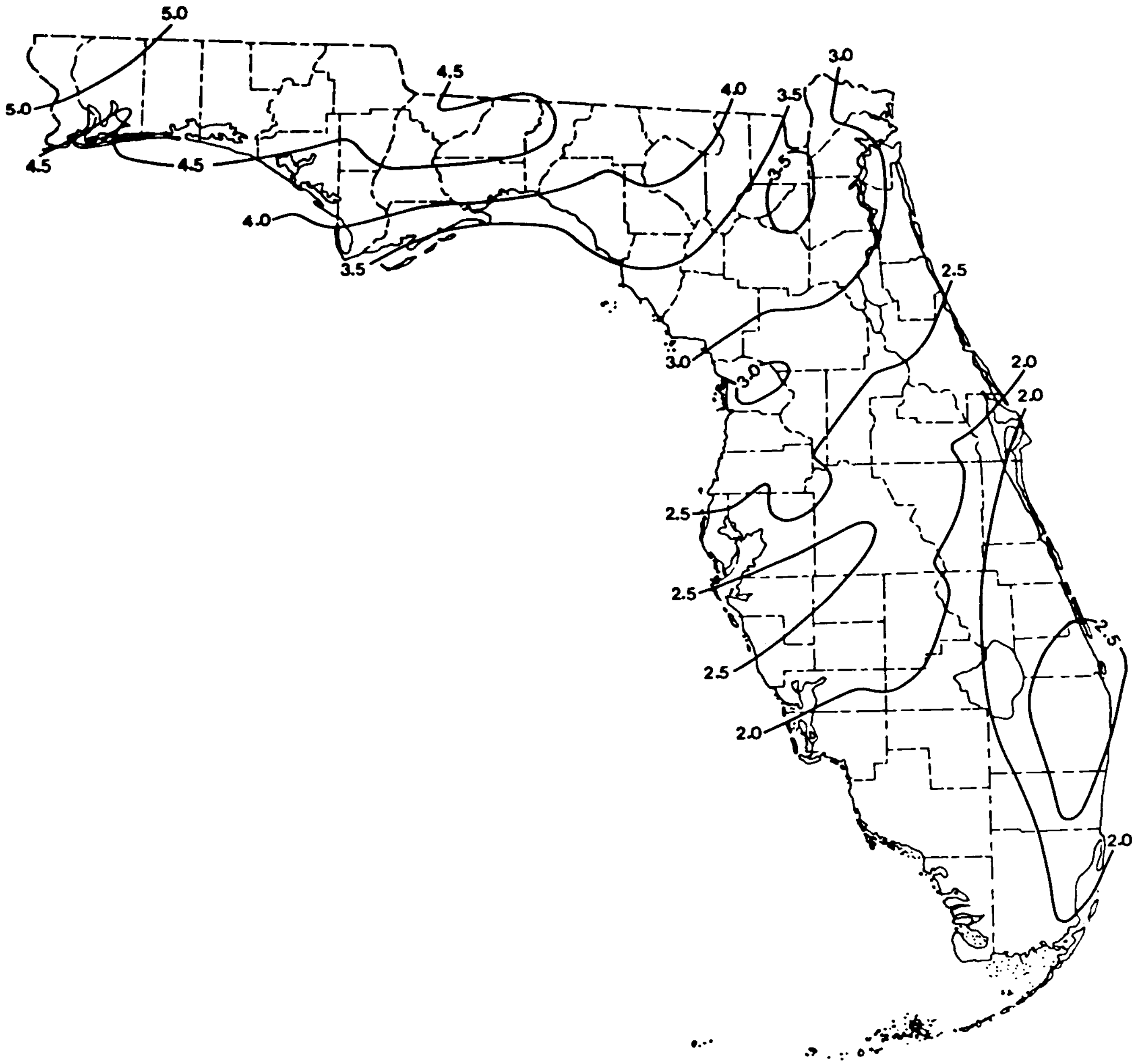


Figure 18. 1951-1980 normal mean January isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

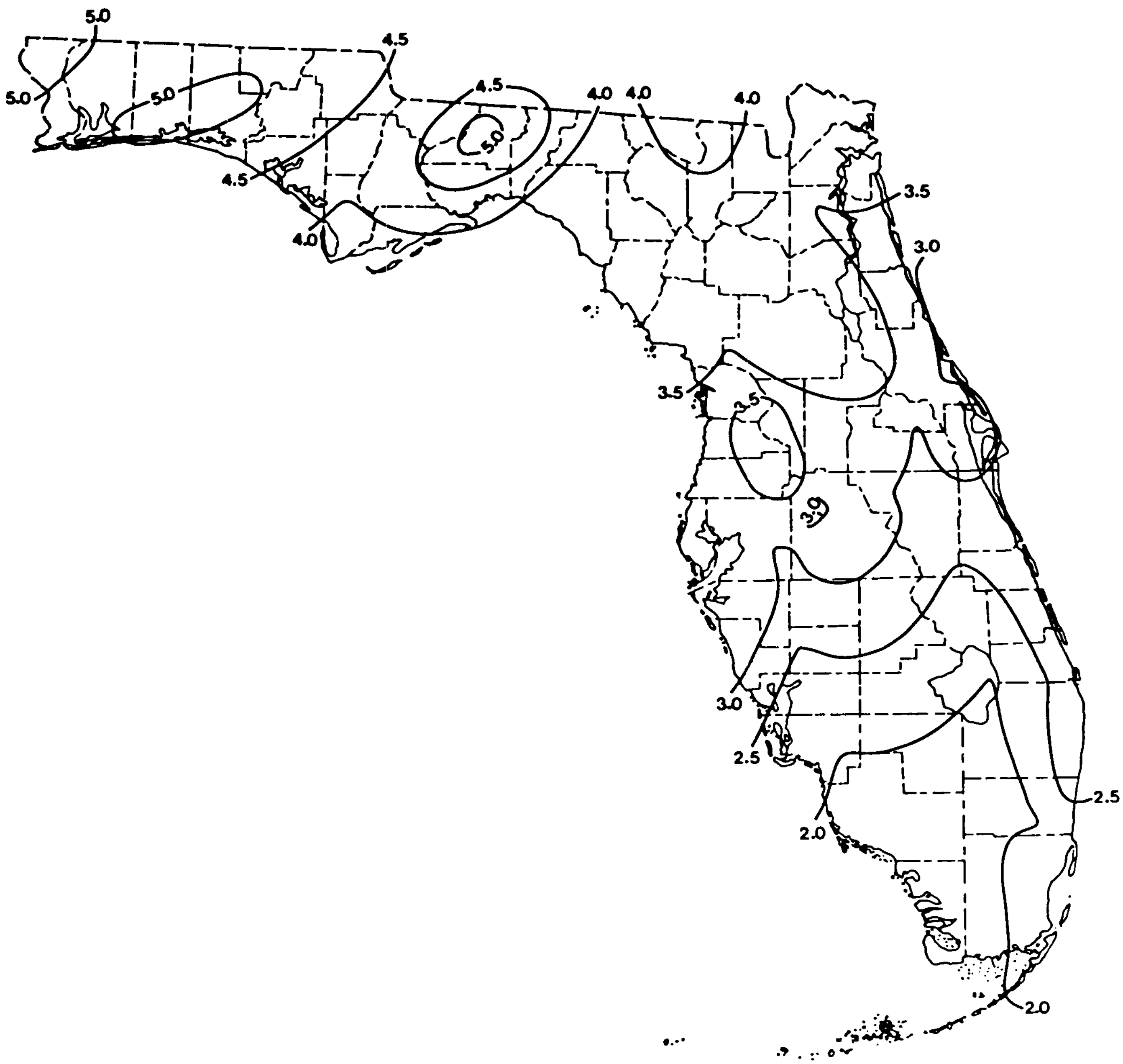


Figure 19. 1951-1980 normal mean February isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

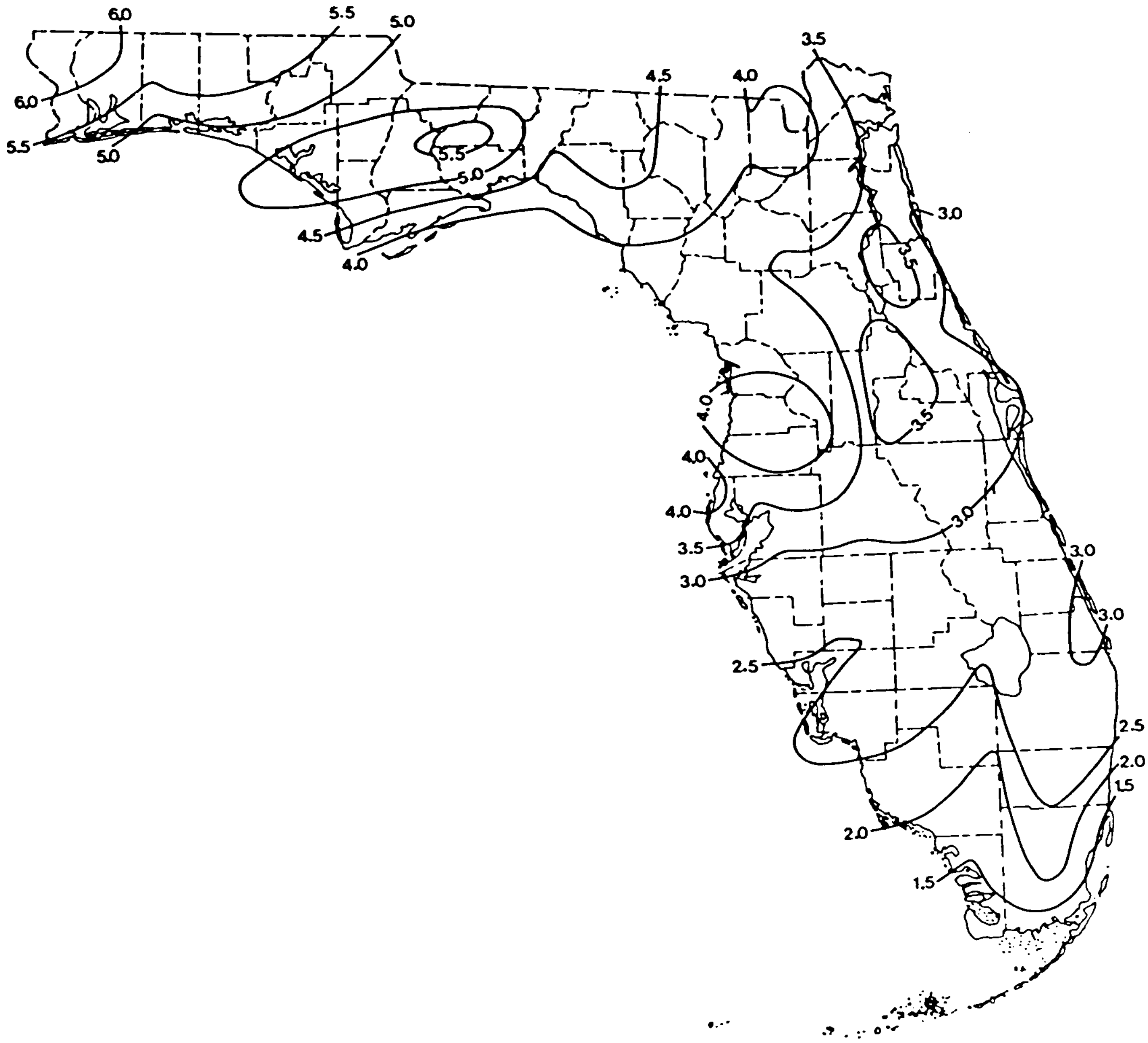


Figure 20. 1951-1980 normal mean March isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

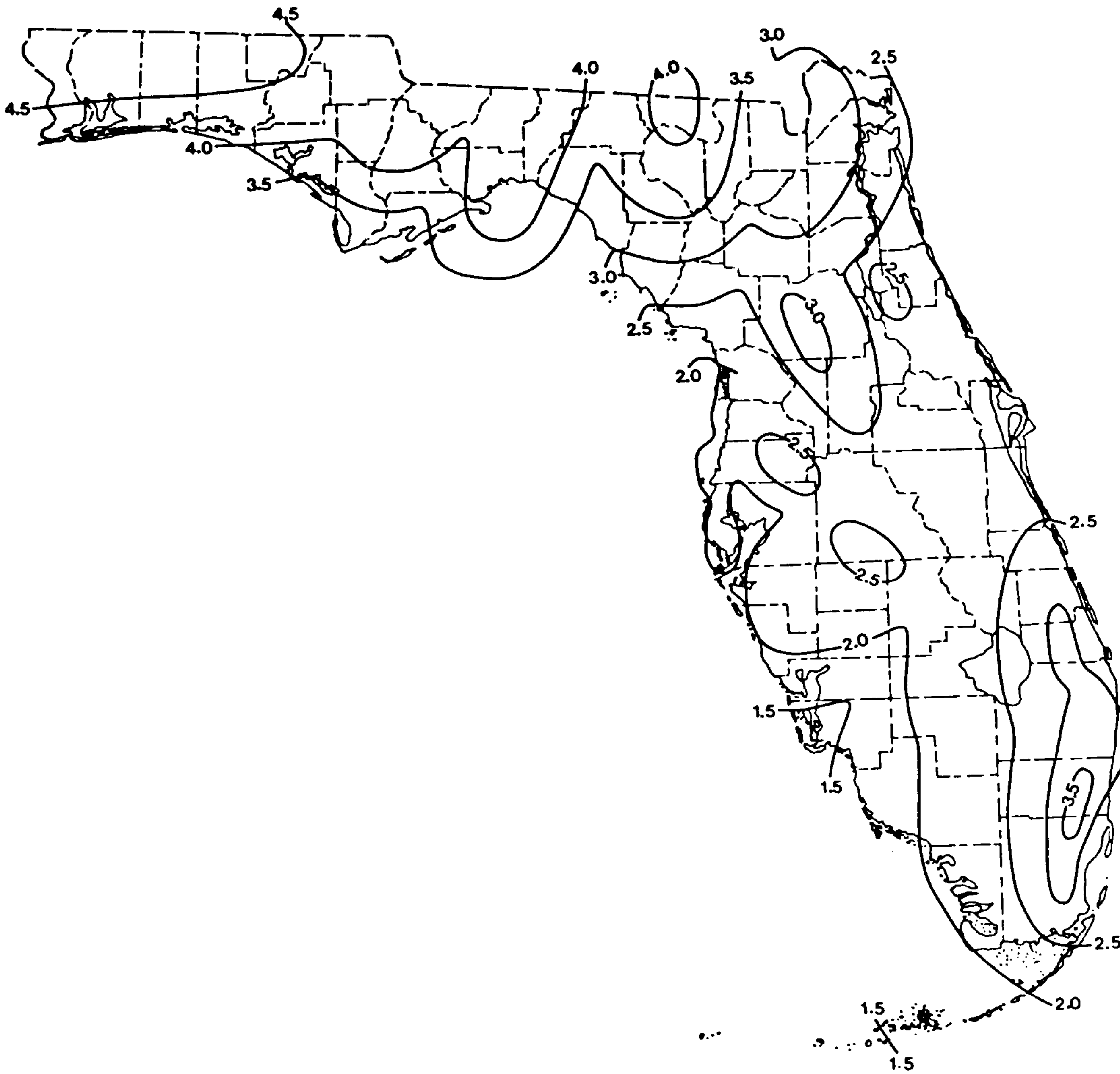


Figure 21. 1951-1980 normal mean April isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

2.3 MEAN ANNUAL ISOHYETALS LEGEND EXPLANATION

The mean annual isohyetals (rainfall contours) shown on the atlas maps were compiled by the author from mean annual precipitation totals from the period of 1951-1980 for all Florida National Weather Service climatological stations with a period of record dating back to at least 1951. The contour interval on the atlas maps is one inch. The 30 year period from 1951-1980 is the latest period of record for establishing climatological normal means. A small scale version of the mean annual isohyetals for Florida is shown in Figure 22. The contour interval on this figure is 2 inches.

2.4 PRECIPITATION INTENSITY AND CYCLES

The Florida west coast is the thunderstorm capital of the United States (see Figure 23). Thunderstorms are characterized by short-term high intensity rainfall, and rainfall intensities of up to 15 inches per hour for a 1 minute period have been measured within the study area (Palik 1978). A rainfall intensity and duration graph for St. Petersburg is shown in Figure 24. This figure shows the probability of various rainfall intensities in the St. Petersburg area based on a 10-year study period from 1973-1982.

Long-term climatological patterns indicate that precipitation is cyclic in nature (Figures 25 and 26). In the Tampa Bay region, a dry cycle that prevailed across the area in the 1970's apparently has ended. A period of above normal precipitation is anticipated over the next several years. Wetland areas that have remained dry during the 1970's could revert to their natural state. Short-term periods of heavy rainfall could present large scale flooding problems in floodplain areas if the water table is already saturated.

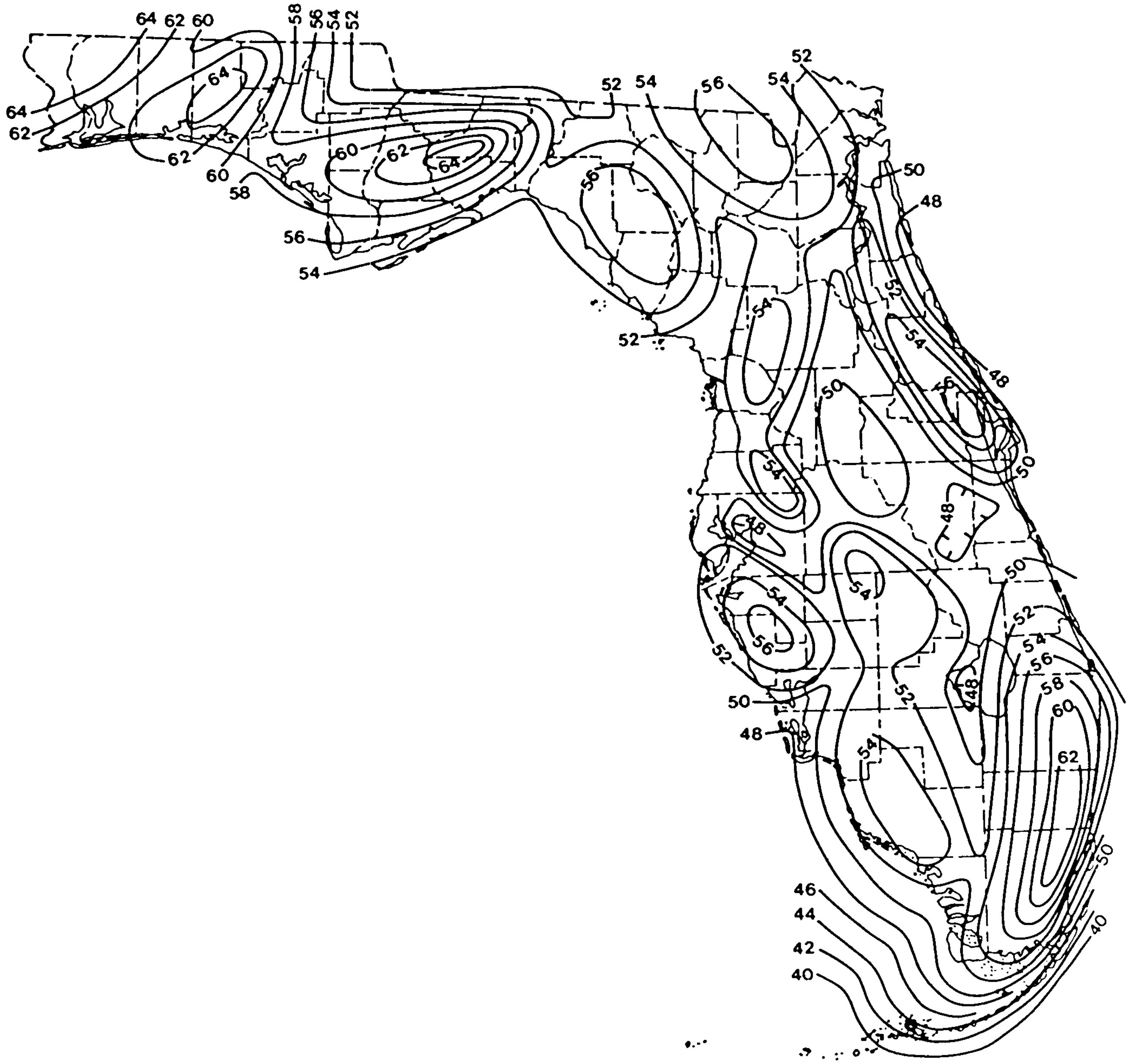


Figure 22. 1951-1980 normal mean annual isohyetal (rainfall contour) map of Florida; rainfall in inches (Palik 1982c).

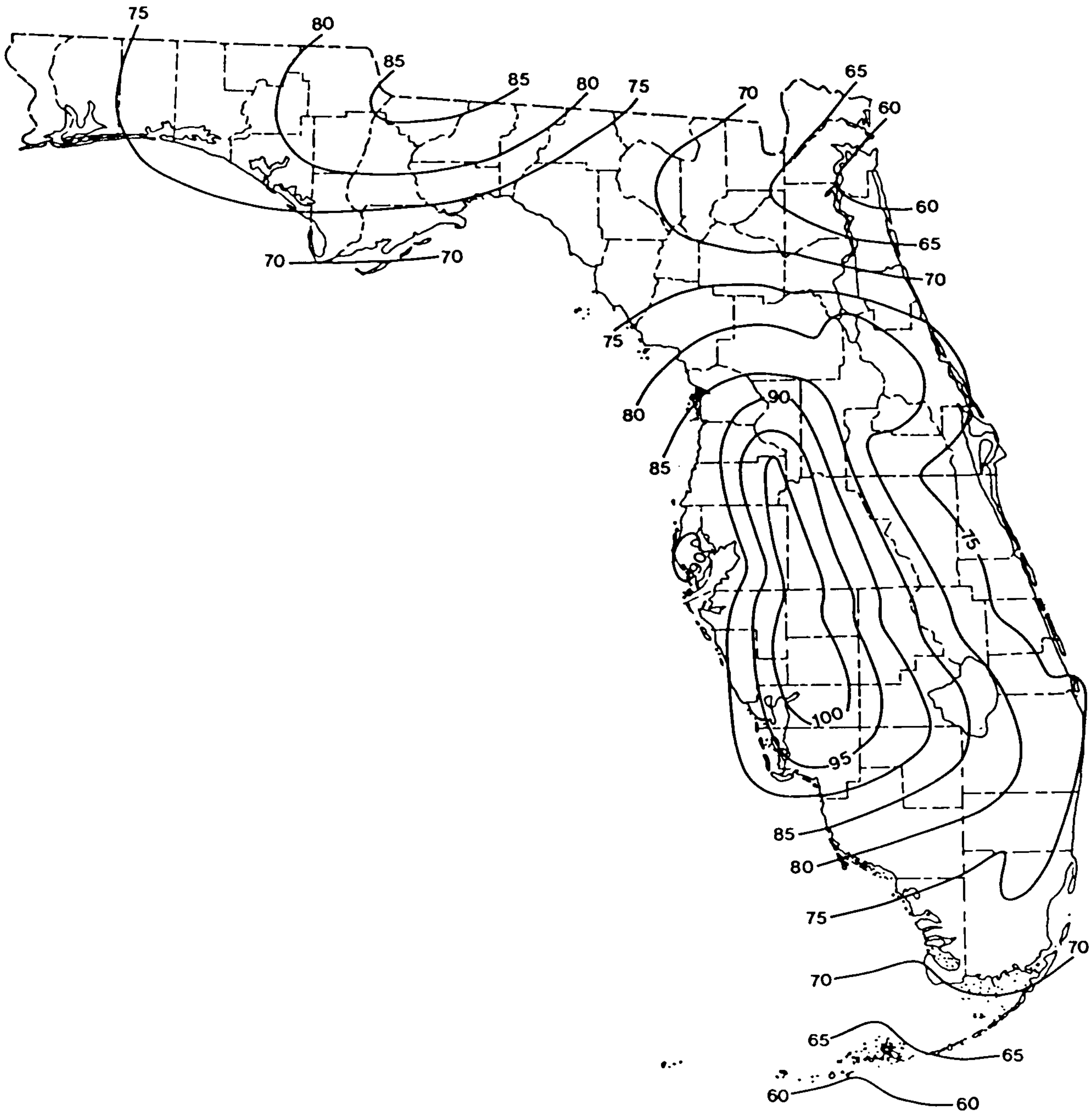


Figure 23. Mean annual number of thunderstorm days for Florida, 1941-70 (Palik 1978).

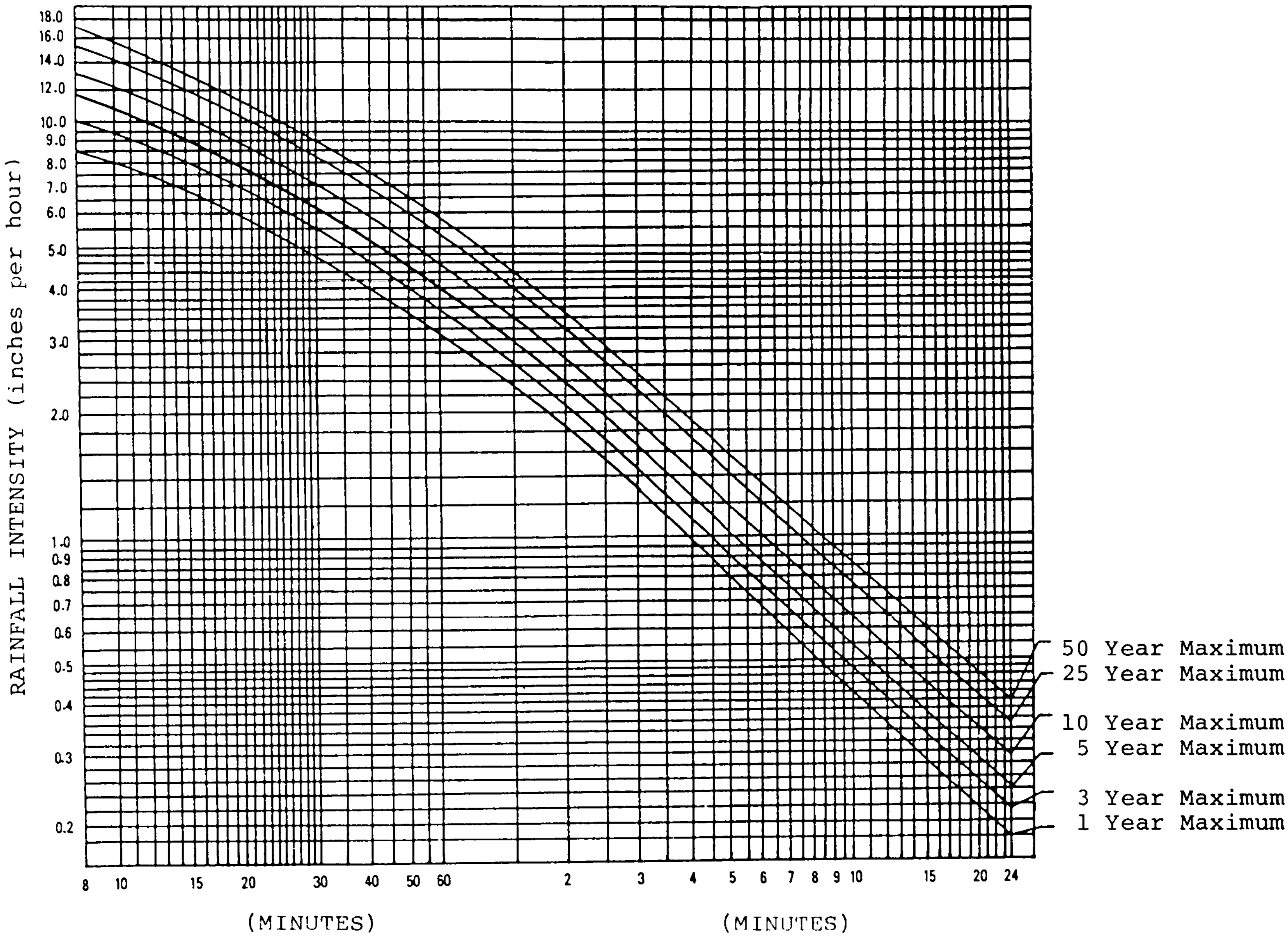


Figure 24. St. Petersburg rainfall intensity and duration graph (Palik 1978).

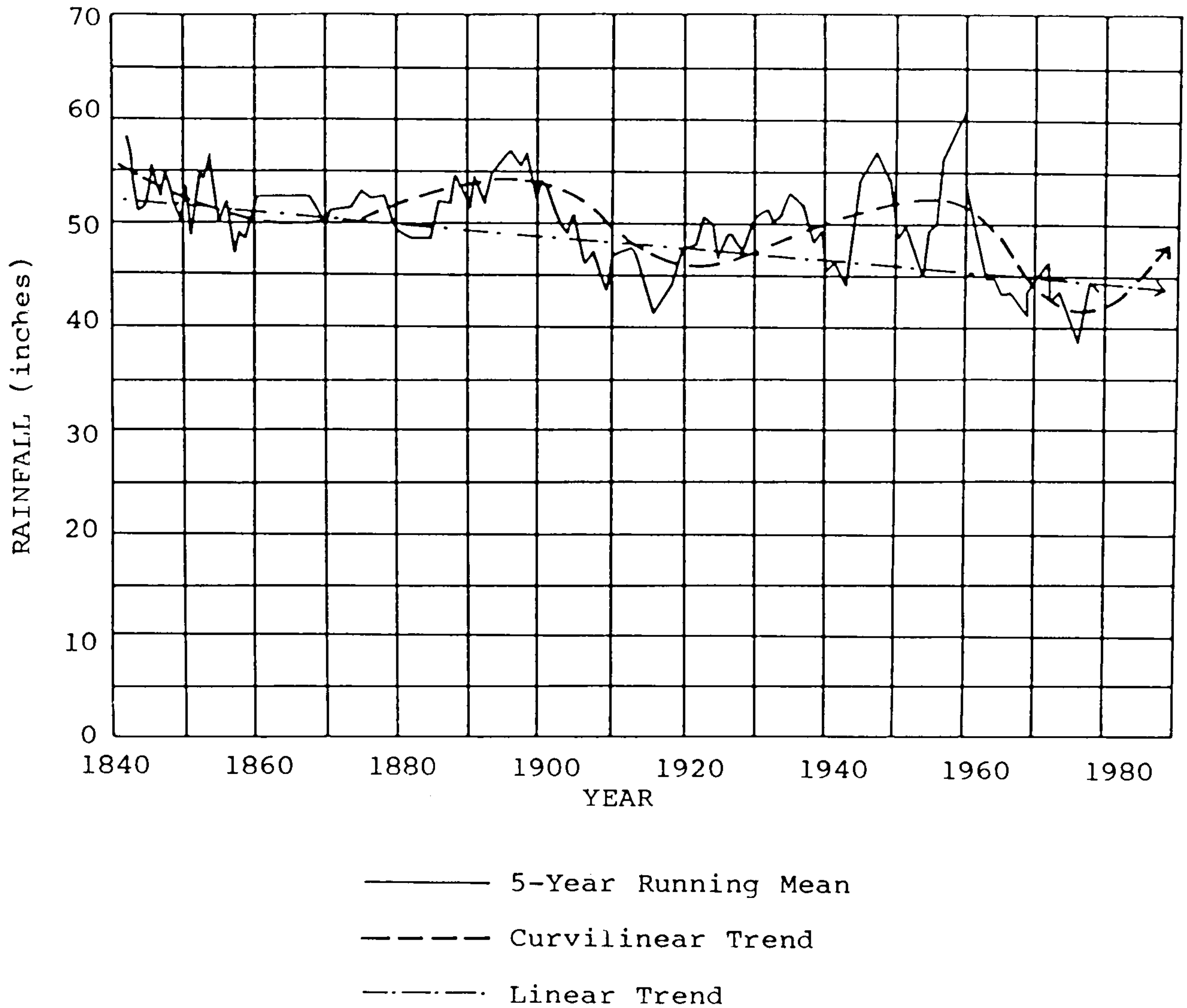


Figure 25. Trend analysis of annual Tampa precipitation (1839-1980); precipitation in inches (Palik 1982e).

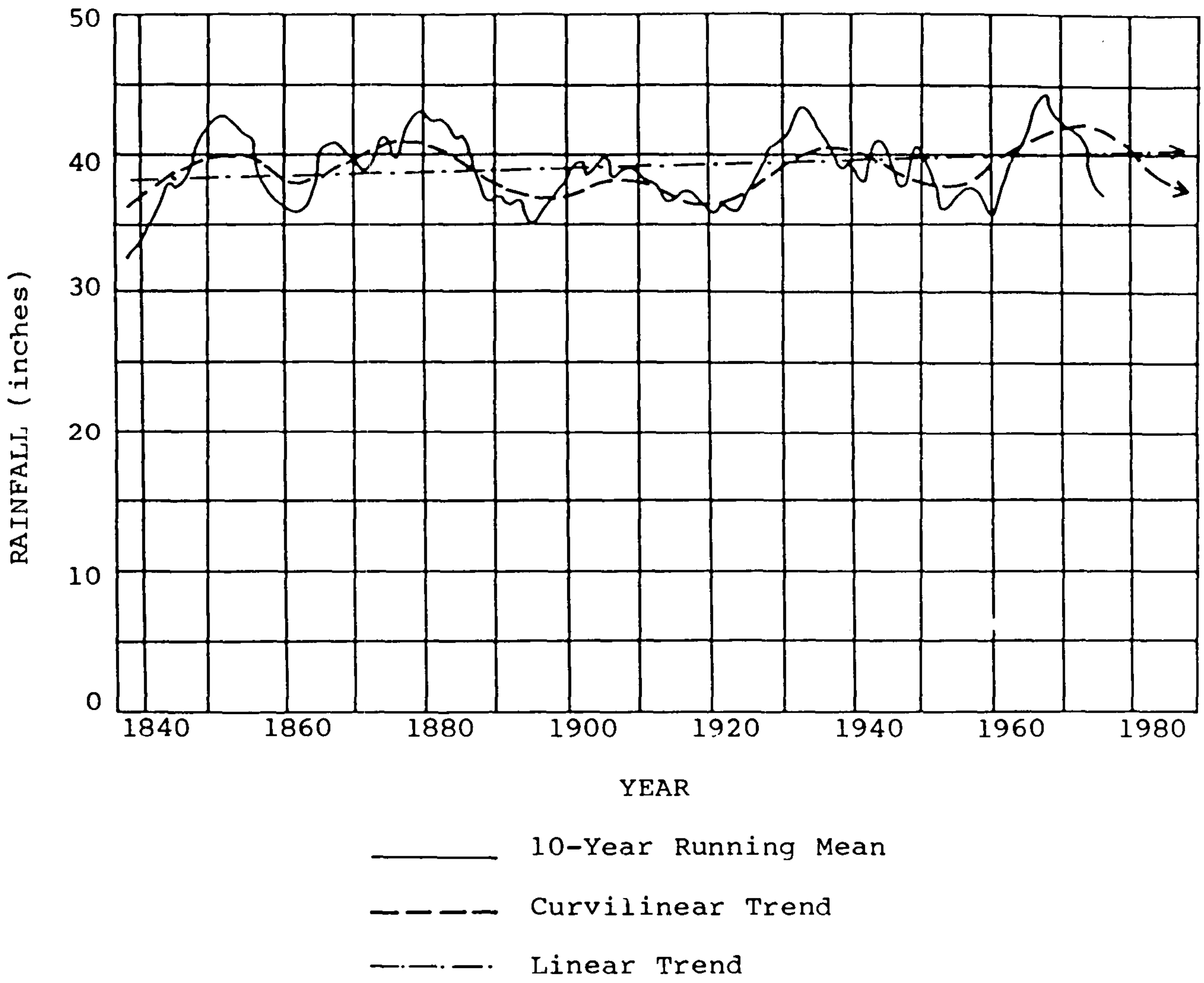


Figure 26. Trend analysis of annual Key West precipitation (1833-1980); precipitation in inches (Palik 1982d).

3. CLIMATOLOGICAL STATIONS

3.1 BACKGROUND

The National Weather Service, U.S. Geological Survey, Water Management Districts, U.S. Soil Conservation Survey, U.S. Air Force and various private corporations and individuals all operate climatological stations in the southwest Florida study region.

The National Weather Service climatological stations have the longest period of record and provide the only detailed climatological data for the last Weather Bureau normal period from 1951-1980.

3.2 NATIONAL WEATHER SERVICE 30-YEAR CLIMATOLOGICAL STATIONS

A list of the National Weather Service climatological stations that have at least 30 years of continuous data are shown in Table 47 and are located on the atlas maps. The normal mean monthly precipitation for the period of 1951-1980 for these stations is shown in Table 48.

Table 47. National Weather Service climatological stations with 30 years or more data present in southwest Florida.

No. on map	Station	County	Latitude	Longitude	Elev.	Temperature (1st year of record)	Precip. (1st year of record)	Evap. (1st year of record)
1	St. Leo	Pasco	28°20'	82°16'	190	1894	1892	-0-
2	Hillsborough R. State Park	Hillsborough	28°09'	82°14'	53	1924	1924	-0-
3	Tampa International Airport	Hillsborough	27°58'	82°32'	19	1889	1889	-0-
4	Plant City	Hillsborough	28°01'	82°08'	121	1896	1896	-0-
5	Tarpon Springs Sewage Plant	Pinellas	28°09'	82°45'	8	1885	1890	-0-
6	Clearwater	Pinellas	27°58'	82°49'	65	1947	1947	-0-*
7	St. Petersburg	Pinellas	27°46'	82°38'	8	1914	1914	-0-
8	Bradenton 5 ESE	Manatee	27°27'	82°28'	5			-0-
9	Myakka River State Park	Sarasota	27°14'	82°19'	20	1955	1943	-0-
10	Punta Gorda 4	Charlotte	26°55'	82°00'	20			-0-
11	Arcadia	De Soto	27°14'	81°51'	63	1903	1900	-0-
12	Fort Myers Airport	Lee	26°35'	81°52'	15	1891	1891	-0-
13	Naples 2 NE	Collier	26°10'	81°47'	4	1940	1940	-0-
14	Everglades	Collier	25°51'	81°23'	5	1926	1926	-0-
15	Tavernier	Monroe	25°00'	80°31'	7	1936	1936	-0-
16	Key West	Monroe	24°33'	81°45'	4	1835	1835	-0-

* Station discontinued

Table 48. Normal mean monthly precipitation for National Weather Service Climatological Stations in southwest Florida, 1951 - 1980; precipitation in inches (Palik 1982c).

No. on map	Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
11	Arcadia (08-0228)	2.17	2.64	2.69	2.13	4.28	7.76	8.26	7.30	7.35	3.95	1.97	2.19	52.69
8	Bradenton 5 ESE (08-0945)	2.77	3.03	2.92	2.02	3.24	7.38	8.82	9.60	8.45	3.10	1.97	2.37	55.69
6	Clearwater (08-1362)	2.35	3.35	4.13	2.08	2.37	5.35	8.96	8.96	6.57	2.66	2.27	2.65	51.70
14	Everglades (08-2850)	1.51	1.82	1.87	2.01	4.97	9.77	8.40	7.14	9.31	4.08	3.00	1.34	55.22
12	Fort Myers (08-3186)	1.89	2.06	2.85	1.52	4.11	8.72	8.57	8.58	8.56	3.86	1.35	1.57	53.64
2	Hillsborough River St. Park (08-3986)	2.58	3.45	3.95	2.29	4.47	8.31	8.08	8.35	7.18	3.10	2.09	2.71	56.56
16	Key West WSO (08-4570)	1.74	1.92	1.31	1.48	3.22	5.04	3.68	4.80	6.50	4.76	3.23	1.73	39.41
9	Myakka River State Park (08-6065)	2.60	3.06	2.90	2.23	3.90	8.28	8.40	9.23	8.66	3.41	2.17	2.07	56.91
13	Naples 2 NE (08-6078)	1.91	2.00	2.27	1.67	4.55	7.83	8.07	8.52	9.23	3.96	1.24	1.44	52.69
4	Plant City (08-7205)	2.52	3.33	3.78	2.11	4.12	7.07	8.10	8.68	6.70	2.83	2.02	2.23	53.49
10	Punta Gorda 4 ENE (08-7397)	2.12	2.31	2.38	1.75	4.03	7.79	6.98	7.51	7.53	3.75	1.59	1.79	49.53
1	St. Leo (08-7851)	2.60	3.66	4.19	2.75	4.78	6.89	8.05	7.62	6.23	2.52	2.21	2.44	53.94
7	St. Petersburg (08-7886)	2.44	3.13	3.69	2.28	3.32	6.12	8.06	8.73	7.60	3.08	2.10	2.55	53.10
3	Tampa WSO (08-8788)	2.17	3.04	3.46	1.82	3.38	5.29	7.35	7.64	6.23	2.34	1.87	2.14	46.73
5	Tarpon Springs Sewage Plant (08-8824)	2.65	3.31	4.01	2.11	3.20	5.18	8.07	8.55	7.22	2.46	2.08	2.86	51.70
15	Tavernier (08-8841)	1.94	2.03	1.33	2.17	4.96	7.14	4.21	4.46	6.97	7.05	2.05	1.88	46.19

4. PREVAILING WINDS

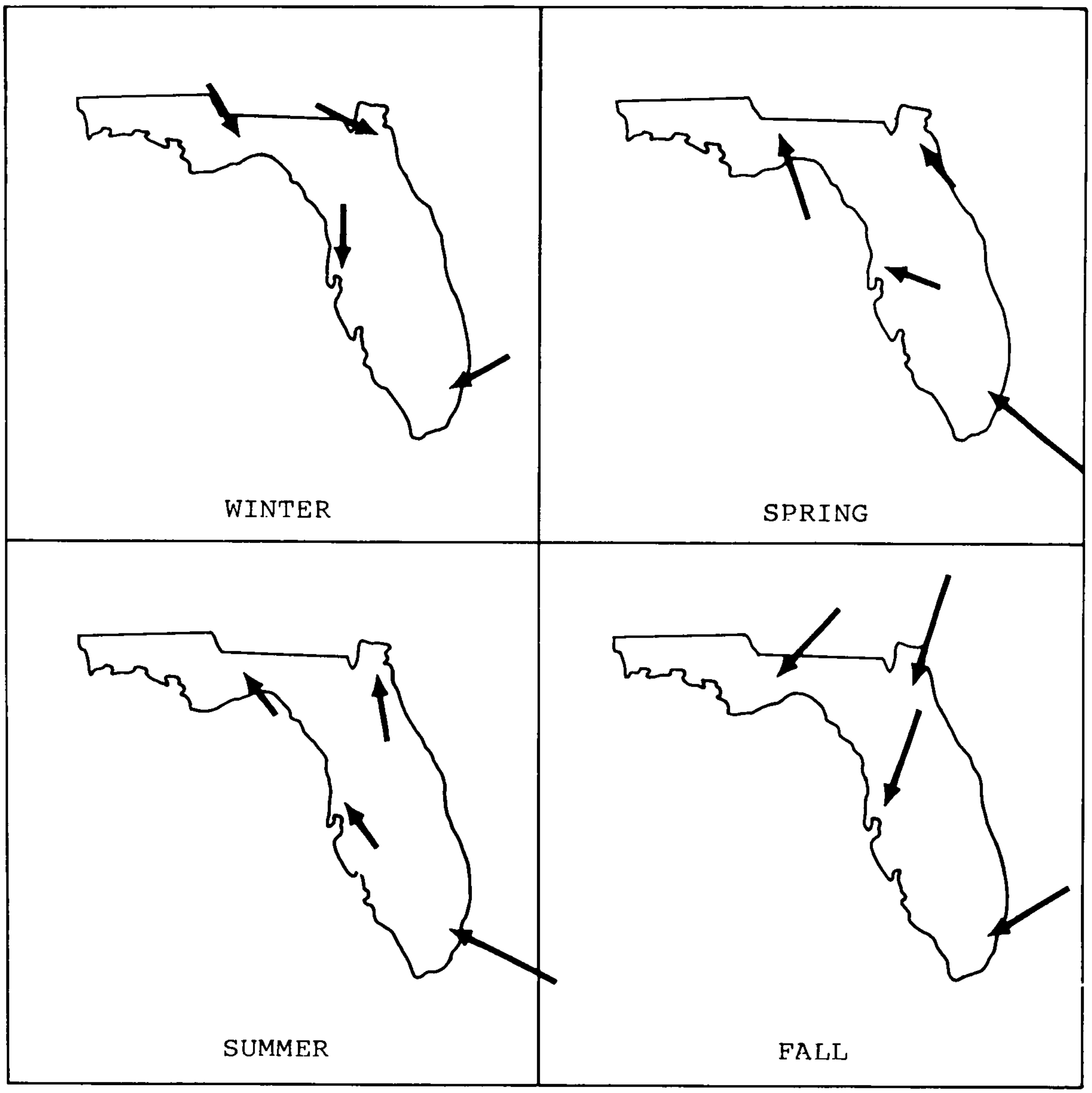
4.1 BACKGROUND

Surface wind patterns in southwest Florida result from the interaction of diurnal winds (land and sea breezes) with large scale surface atmospheric pressure patterns. Surface winds across southwest Florida can be classified into three primary wind seasons: fall-winter, spring, and summer. During fall and winter, a generally moderate northeasterly flow prevails across southwest Florida. During the springtime, a moderate southerly wind flow prevails across the region, and during the late spring and early summer, a light and variable southerly wind pattern is present over the region. The resultant seasonal surface winds for Florida are shown in Figure 27. Surface winds in late spring and early summer reflect local land and sea breeze patterns. During the middle and late summer, a southeasterly subtropical trade wind prevails across the southwest Florida area. The monthly prevailing wind directions and average wind speeds for Tampa, Ft. Myers, and Key West are shown in Table 49.

4.2 WIND ROSE STATION LEGEND EXPLANATION

Annual wind roses located on the southwest Florida atlas maps are compiled from wind summaries for southwest Florida located at the National Climatic Center. The six wind rose stations located on the atlas maps are shown in Figure 28.

Concentric circles on the wind roses represent 5 percent frequency intervals. The average wind speed (mph) is shown along the outer circumference for each direction.



WIND SPEED SCALE: 1" = 10 MPH

Figure 27. Resultant mid-season surface winds at four locations: Jacksonville, Miami, Tallahassee, Tampa (Gutfreund 1978).

Period of Record: Based on hourly observations, 1951-60.

Table 49. Prevailing wind directions and average wind speeds for Tampa, Ft. Myers Myers and Key West, Florida from 1958-1976 (National Climatic Center 1981a,b,c).

MONTH	TAMPA		FT. MYERS		KEY WEST	
	Prevailing wind dir.	Avg. wind speed (mph)	Prevailing wind dir.	Avg. wind speed (mph)	Prevailing wind dir.	Avg. wind speed(mph)
January	N	8.9	E	8.5	NE	12.1
February	E	9.4	E	9.1	SE	12.2
March	S	9.7	SW	9.4	SE	12.6
April	ENE	9.6	E	9.0	ESE	12.8
May	E	9.0	E	8.2	ESE	10.8
June	E	8.3	E	7.4	SE	9.7
July	E	7.5	ESE	6.8	ESE	9.9
August	ENE	7.2	E	6.8	ESE	9.6
September	ENE	8.1	E	7.7	ESE	10.1
October	NNE	8.8	NE	8.5	ENE	11.3
November	NNE	8.6	NE	8.3	ENE	12.1
December	N	8.7	NE	8.2	NE	12.1
Annual	E	8.7	E	8.2	ESE	11.3

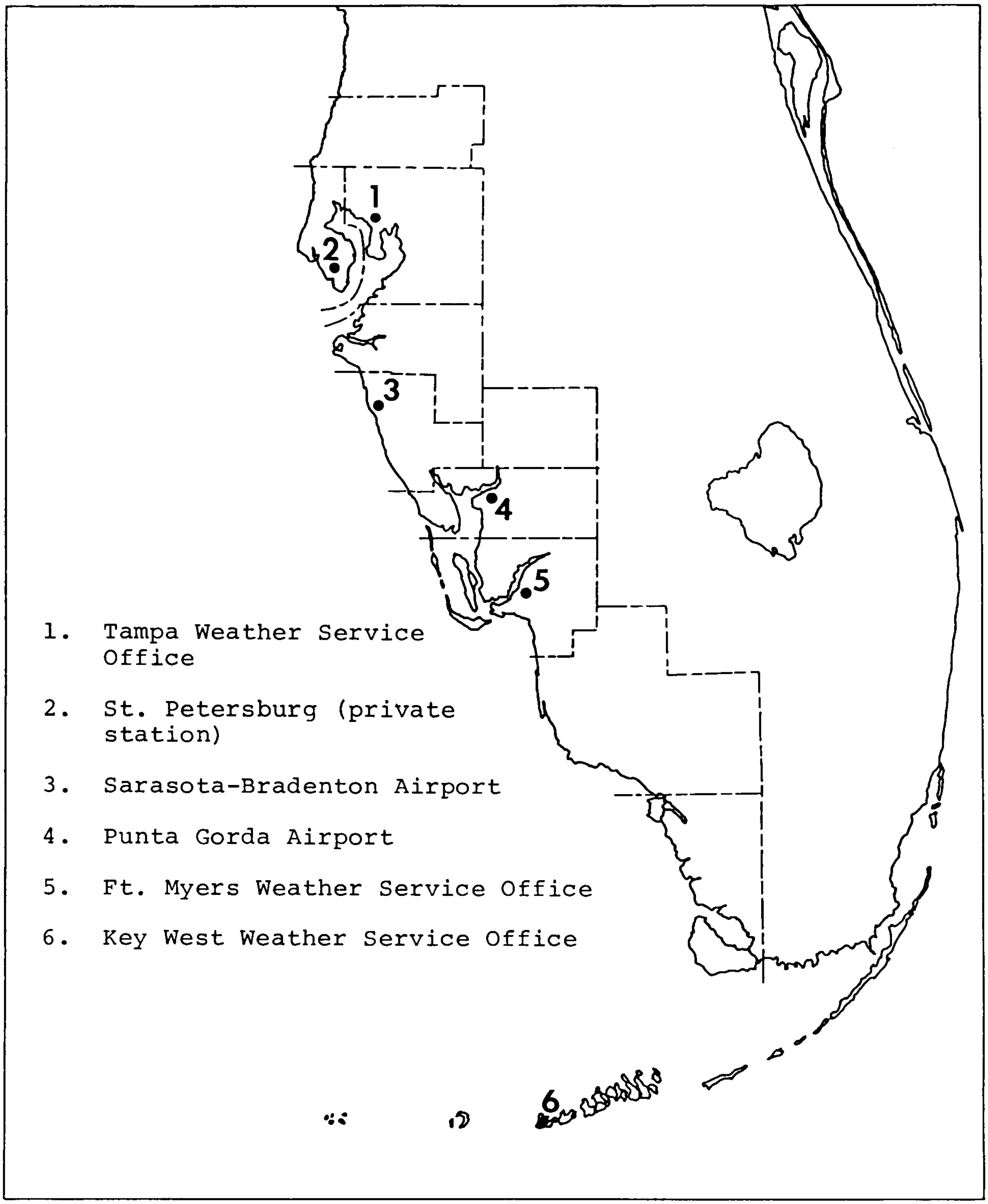


Figure 28. Southwest Florida wind rose stations.

5. CURRENTS

5.1 BACKGROUND

There is a noticeable lack of reliable current data available for the southwest Florida coastal waters. A summary of available current data study sites for the Eastern Gulf of Mexico is shown in Figure 29.

The New England Coastal Engineers, Inc., under contract with the U.S. Bureau of Land Management, have developed a computer model named GAL which simulates geostrophic (wind induced) surface currents off the southwest coast of Florida. Individual current roses from this model are plotted on the atlas maps. The predicted currents for the three wind seasons off southwest Florida (spring, summer, fall-winter) are shown in Figures 30-32.

A moderate south-southeast current prevails in the spring months, a light south-southeast current in summer, and a northeast current during the fall and winter months in the northeast Gulf of Mexico.

5.2 OFFSHORE SURFACE CURRENT ROSES LEGEND

The current roses show the resultant current direction and velocity for each of the three major wind seasons (spring, summer and fall-winter). The length of each vector is proportional to the velocity. Concentric circles on most of the current roses represent a resultant current of 3 centimeters per second, unless otherwise noted.

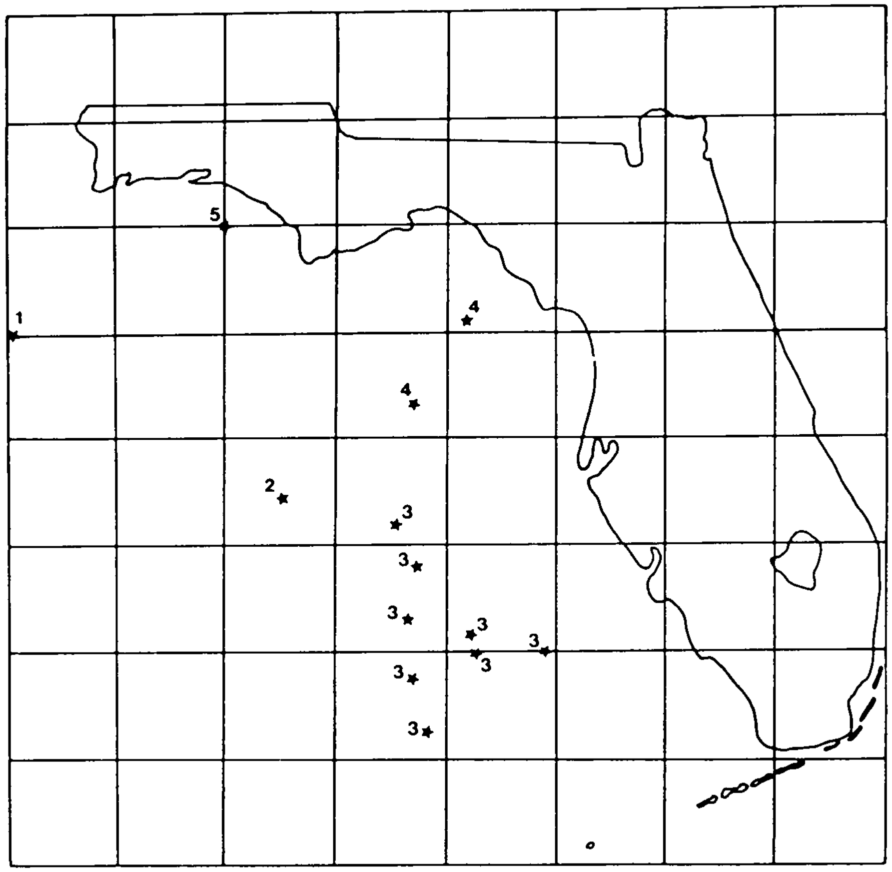


Figure 29. Location map of current data available for the eastern Gulf of Mexico (New England Coastal Engineers 1981).

1. Molinari, R.L., Mayer, D., and F. Chew. 1979. Physical oceanographic conditions at a potential OTEC site in the Gulf of Mexico near 29° N and 88° W. NOAA Tech. Mem. ERL AOML-41. Washington, D.C.

2. Molinari, R.L., and D. Mayer. 1980. Physical oceanographic conditions at a potential OTEC site in the Gulf of Mexico near 27.5° N and 85.5° W. NOAA Tech. Mem. ERL AOML-42. Washington, D.C.

3. Niiler, P.P., and C.J. Koblinsky. 1980. Direct measurement of circulation on west Florida continental shelf, January 1973 - May 1975. NOAA west Florida shelf dynamics project, reference 79-13. Washington, D.C.

4. Sturges, W., and C. Horton. 1979. Circulation in the Gulf of Mexico, a concise summary prepared as a working document for the conference on the role of organics in the marine environment. Florida State University, Dept. of Oceanography, Tallahassee, Fla.

5. Tolbert, W.H., and G.G. Salsman. 1980. Surface circulation of the eastern Gulf of Mexico as determined by drift bottle studies. Washington, D.C.

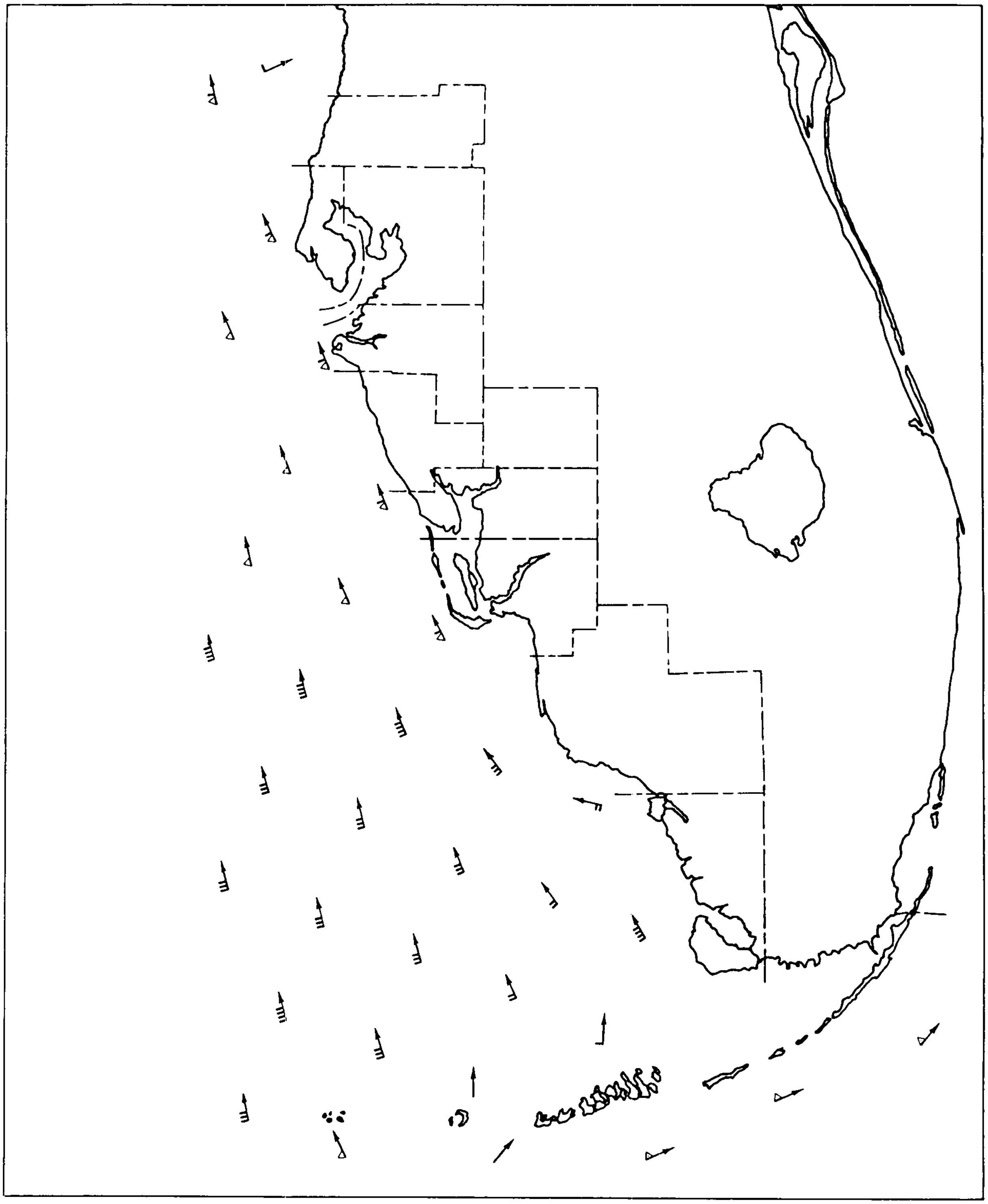


Figure 30. Mean spring surface currents off southwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 60 cm/s (adapted from New England Coastal Engineers 1982).

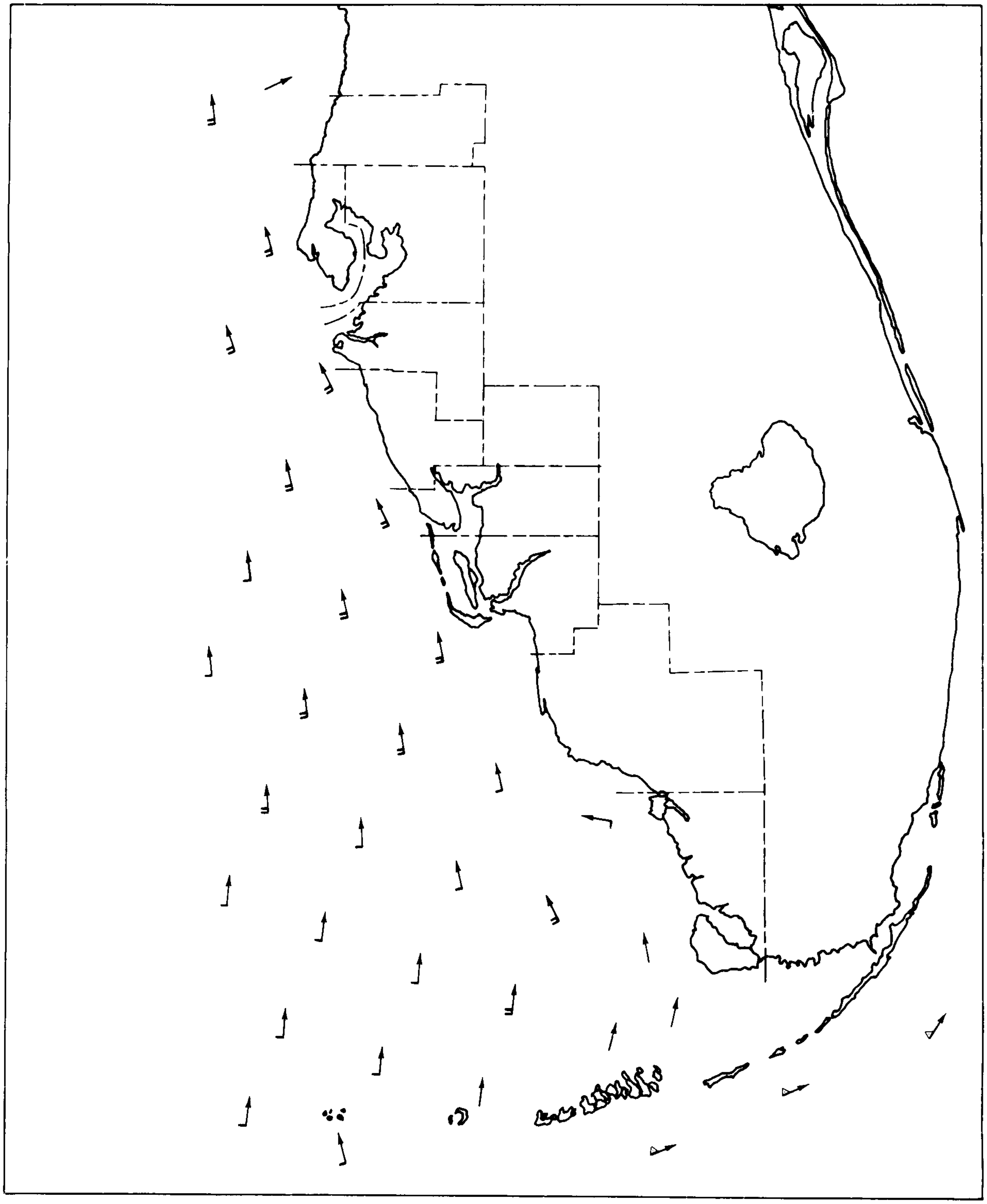


Figure 31. Mean summer surface currents off southwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 60 cm/s (adapted from New England Coastal Engineers 1982).

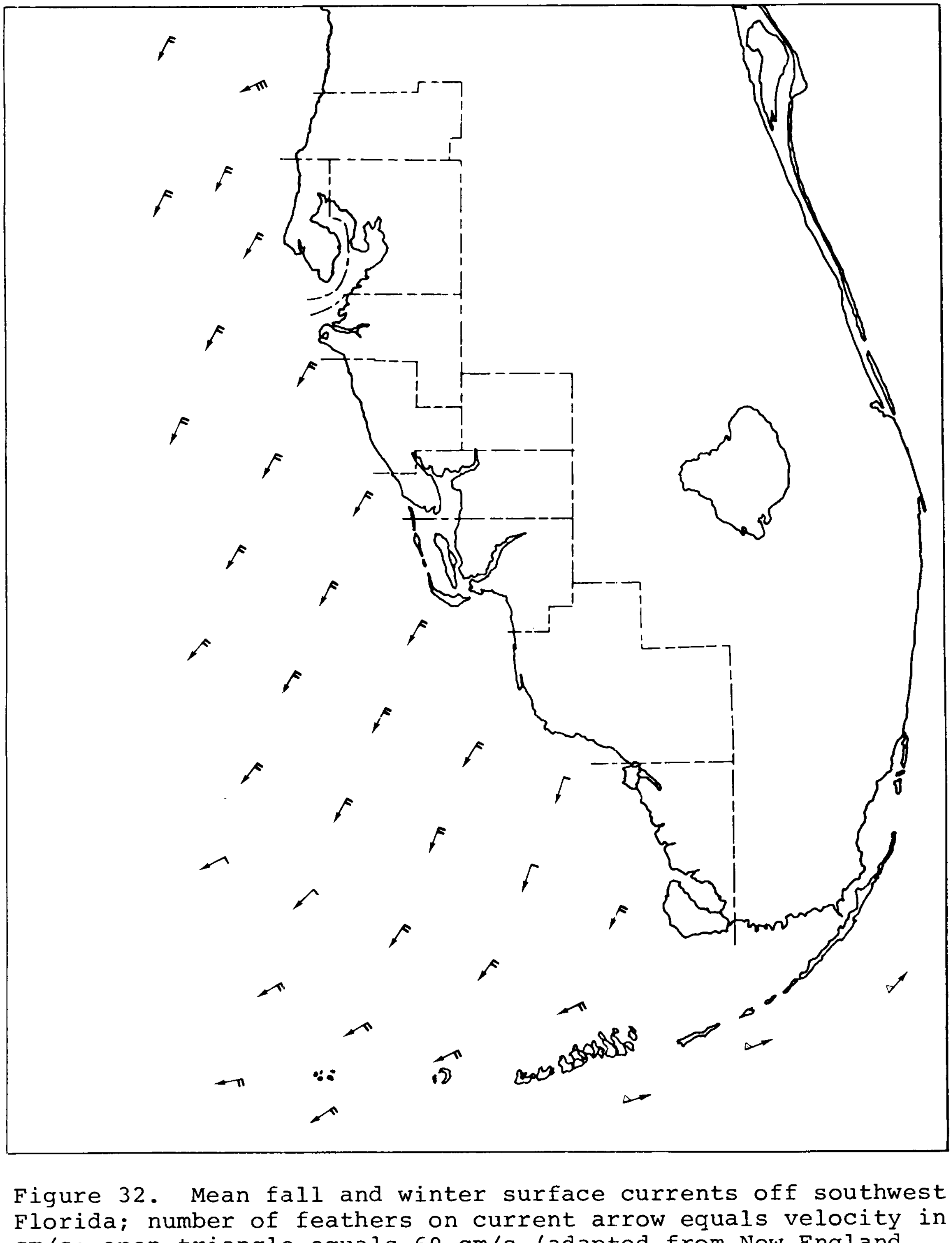


Figure 32. Mean fall and winter surface currents off southwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 60 cm/s (adapted from New England Coastal Engineers 1982).

6. HURRICANES AND TROPICAL STORMS

6.1 BACKGROUND

Because of its geographic location in the sub-tropics, Florida is the most vulnerable State in the U.S. to hurricanes. With more and more development occurring in Florida's coastal region, the potential for catastrophic hurricane damage to manmade structures is increasing every year.

A cyclone is a surface weather system in which the barometric pressure diminishes progressively from the edges to the center of the storm. In the northern hemisphere, the winds around a cyclone flow counterclockwise into the center of the vortex. A tropical storm is a tropical cyclone with winds of 38 miles per hour or higher, but less than 74 miles per hour. A hurricane is a tropical cyclone accompanied by winds of 74 miles per hour or higher. Hurricanes develop only over tropical oceans and occur in all tropical oceans except the South Atlantic.

The Atlantic hurricane season runs from June through November, although tropical storms have been recorded in all months of the year. The relative frequency of hurricane distribution, by time of year, in impacting southwest Florida is shown in Figure 33.

The study area is most susceptible to early and late season storms that originate in the northwest Caribbean Sea and Gulf of Mexico. Mid-hurricane season storms, which usually originate as disturbances moving off the African continent (Cape Verde type storms), are most likely to affect the Keys, sparing the Gulf coast of Florida.

6.2 HURRICANE INUNDATION ZONES

The atlas maps depict the maximum areas subject to flooding for Saffir/Simpson category 1-5 hurricanes. The inundation zones represent a composite of the worst case of overland storm surges for each Saffir/Simpson category for storms approaching from all possible directions. The principal computer model for the compilation is the numerical storm surge prediction model SLOSH which is short for Sea, Lake and Overland Surges from Hurricanes. The SLOSH model predicts overland surge heights with selected pressure, size, forward speed, track and wind information from hypothetical hurricanes. This model permits resultant tidal surge to be superimposed on a locale's shoreline configuration incorporating its unique physical characteristics. The model predicts offshore surge heights as well as surge heights over land.

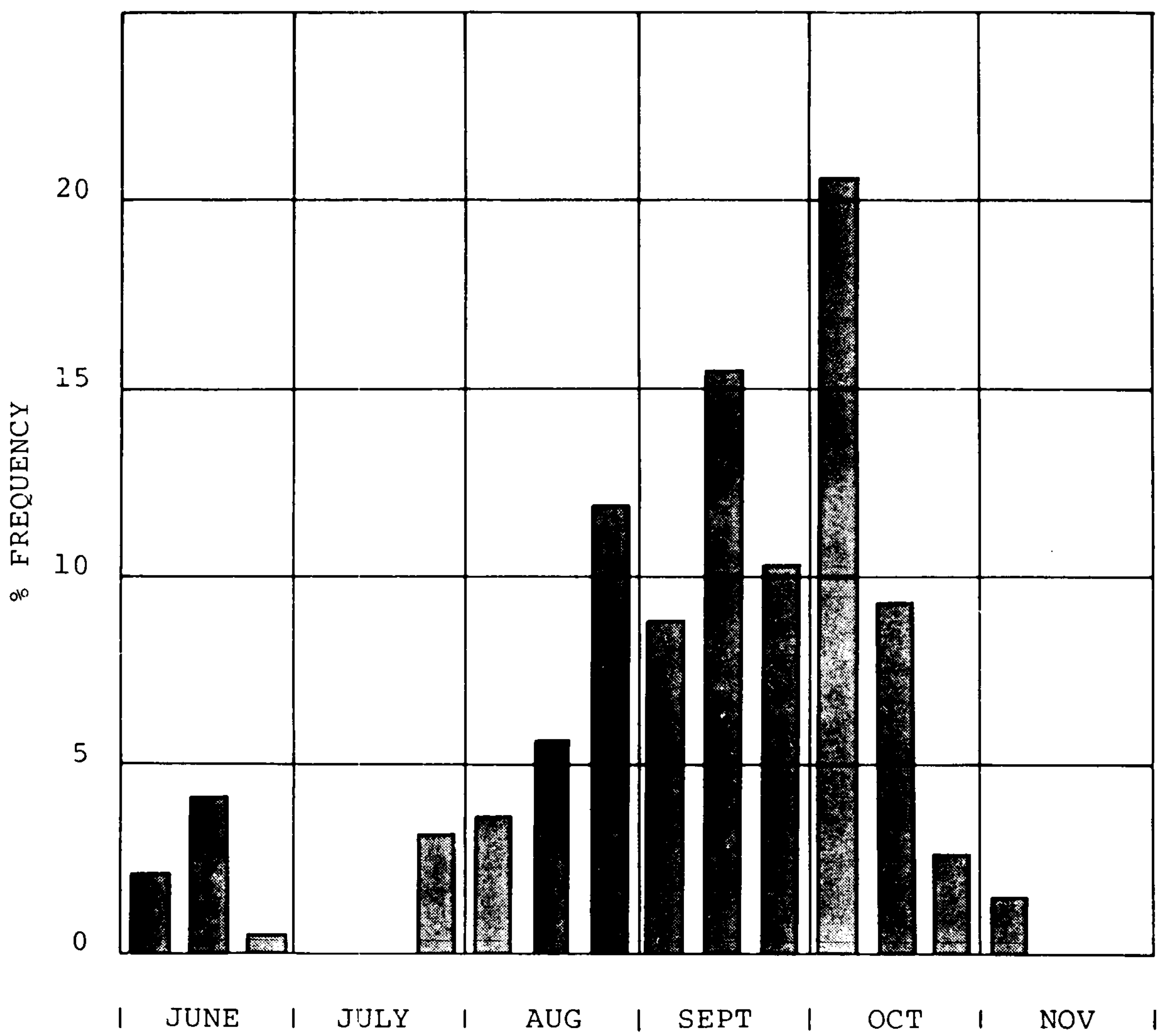


Figure 33. Frequency distribution of hurricanes by time of year in southwest Florida, from 1871 - 1980 (Neumann et al. 1981).

Two separate SLOSH models have been developed and run for southwest Florida: the Tampa Bay and Charlotte Harbor Basin models. The models were developed by the Techniques Development Lab of the National Oceanic and Atmospheric Administration (NOAA) under the direction of Dr. Chester P. Jelesnianski (Southwest Florida Regional Planning Council 1981). For the Florida atlas, data from the SLOSH models were plotted on the 1:62,500 scale National Ocean Survey storm, color-coded, elevation maps, photographically reduced to 1:100,000 scale, and scribed on the atlas base maps. In northern Pasco County and the Florida Keys, SPLASH (Special Program to List Amplitudes of Surges from Hurricanes) model data developed by the Techniques Development Lab under the direction of Dr. Chester P. Jelesnianski were used to delineate the hurricane inundation zones.

The Saffir/Simpson hurricane intensity scale is used by the National Weather Service to classify hurricanes according to intensity. The scale was developed by Herbert Saffir, a consulting engineer and Dr. Robert H. Simpson, former National Hurricane Center Director, and projects 1-5 scale assessment categories as follows:

Category No. 1: Winds of 74 to 95 mph. Damage primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. Storm surge 4 to 5 feet above normal. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

Category No. 2: Winds of 96 to 110 mph. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Storm surge 6 to 8 feet above normal. Coastal roads and low-lying escape routes inland cut by rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

Category No. 3: Winds of 111 to 130 mph. Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. Storm surge 9 to 12 feet above normal. Serious flooding at coast and many smaller structures near coast destroyed; large structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.

Category No. 4: Winds of 131 to 155 mph. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows, and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. Storm surge 13 to 18 feet above normal. Flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences on low ground within 2 miles of shore.

Category No. 5: Winds greater than 155 mph. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings over-turned or blown away. Complete destruction of mobile homes. Storm surge greater than 18 feet above normal. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Lowlying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.

Dr. Neil Frank, Director of the National Hurricane Center, has adapted atmospheric pressure ranges to the Saffir/Simpson Scale. These pressure ranges along with a numerical break-down of wind and storm surge ranges, are shown in Table 50.

Table 50. Saffir/Simpson hurricane intensity scale matrix (Southwest Florida Regional Planning Council 1981).

SCALE NUMBER	CENTRAL PRESSURES MILLIBARS	INCHES	WINDS (MPH)	SURGE (FT.)	DAMAGE
1	$\geq$ 980	$\geq$ 28.94	74- 95	4 - 5	Minimal
2	965-979	28.50 - 28.91	96-110	6 - 8	Moderate
3	945-964	27.91 - 28.47	111-130	9 - 12	Extensive
4	920-944	27.17 - 27.88	131-155	13 - 18	Extreme
5	< 920	< 27.17	155+	18+	Catastrophic

6.3 HURRICANE AND TROPICAL STORM PROBABILITY

The probability of a hurricane impacting any portion of the coastline along southwest Florida can only be approximated due to the lack of a sufficient data base. In the 1800's and early 1900's, there were few climatological stations with barometers and/or anemometers to record the passage of such storms. Only during the last 15 years have geostationary meteorological satellites been available to track hurricanes accurately.

The National Hurricane Center has plotted the paths of hurricanes that have occurred annually since 1871 (Newman et al. 1981). Prior to 1967 these plots represented a compromise in positions as reported in various references. The probability of hurricanes impacting southwest Florida has been estimated by Neumann et al. (1981) for Saffir/Simpson category 1-5 hurricanes passing within 50 miles of the southwest Florida coast. The cumulative probability of Saffir/Simpson category 1-5 hurricane force winds affecting each mapped area is shown on the individual atlas maps. It must be noted that hurricanes are rare events and their return periods vary considerably. In the Tampa Bay area, it has been 62 years since the last major hurricane hit the region. However, in 1848, two hurricanes hit the region within 3 weeks of each other.

7. HYDROLOGIC UNITS

7.1 BACKGROUND

A hydrologic unit is a geographic area that forms a part of a national system for cataloging hydrologic and other information (Heath and Conover 1981). Hydrologic unit boundaries coincide with drainage basin boundaries, but also include adjoining water bodies not associated with the drainage basins. The hydrologic unit code is an eight-digit number representing the region, subregion, accounting, and cataloging units. The regions and subregions are used by the U.S. Water Resources Council for water and land resources planning. The accounting and cataloging units are used by the U.S. Geological Survey for managing the National Water Data Network.

7.2 HYDROLOGIC UNIT WATER BUDGET

The water budget is a convenient method for accounting for the inflow and outflow of water in a hydrologic system. To calculate a budget, one estimates the value of each component of the basic hydrologic cycle equation:

$$S = P - (R + ET)$$

Where:

S = change in storage (inches)
P = precipitation (inches)
R = runoff (inches)
ET = evapotranspiration (inches)

A water budget has been developed by the author for each of the hydrologic units for peninsular southwest Florida and is shown in Table 51. The methodology of estimating the variables in this budget is described below:

<u>Precipitation</u>: The monthly precipitation for each hydrologic unit has been estimated by the author using the mean aerial precipitation for the period from 1951-1980 (Figures 10-21).

<u>Evapotranspiration</u>: Evapotranspiration is defined as water that is evaporated back into the atmosphere from the land and water surfaces and is transpired back into the atmosphere by plants.

Evapotranspiration was calculated for each hydrologic unit by using the following equation (Fractional Evaporation - Equivalent Formula) which was found by the U.S. Soil Conservation Service to be most appropriate for Florida: ET = (0.0082 Ta - 0.1900) X RS/1500 (Spier et al. 1969) where ET = potential evapotranspiration in inches per month, Ta = the average monthly temperature in degrees fahrenheit and Rs = averge monthly solar radiation in langleys).

Runoff: Runoff is defined as that part of the precipitation that occurs in streams and includes water that flows over the ground surface to streams. Runoff was computed by distributing the total streamflow over the area of each hydrologic unit.

Storage: Water in storage was calculated by subtracting the monthly totals of runoff and evapotranspiration from that of precipitation.

Accumulated Storage: Accumulated storage is the change in storage for the year as reflected by changes in ground water levels (ground water inflow and outflow, which amounts to approximately 2 percent of a water budget, is difficult to estimate and has not been used in the calculation of this water budget).

Table 51. Southwest Florida mean monthly hydrologic unit water budgets; figures represent inches (U.S. Geological Survey 1981b).

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100207					
January	2.7	1.7	0.5	0.5	0.5
February	3.3	1.9	0.4	1.0	1.5
March	4.0	2.9	1.0	0.1	1.6
April	2.2	3.7	0.5	-2.0	-0.4
May	3.3	4.7	0.5	-1.9	-2.3
June	5.8	4.6	1.0	0.2	-2.1
July	8.0	4.5	1.4	2.1	0.0
August	8.2	4.1	1.5	2.6	2.6
September	6.7	3.6	3.1	0.0	2.6
October	2.3	3.0	2.0	-2.7	-0.1
November	2.1	2.1	0.7	-0.7	-0.8
December	2.7	1.6	0.3	0.8	0.0
Annual totals	51.3	38.4	12.9	0.0	0.0
Hydrologic Unit 03100205					
January	2.6	1.8	0.5	0.3	0.3
February	3.3	2.0	0.4	0.9	1.2
March	3.9	3.1	0.9	-0.1	1.1
April	2.3	4.0	0.5	-2.2	-1.1
May	4.4	5.0	0.5	-1.1	-2.2
June	7.5	4.9	1.0	1.6	-0.6
July	8.0	4.8	1.4	1.8	1.2
August	8.0	4.4	1.4	2.2	3.4
September	6.7	3.8	3.0	-0.1	3.3
October	2.3	3.2	2.0	-2.9	0.4
November	2.1	2.3	0.7	-0.9	-0.5
December	2.5	1.7	0.3	0.5	0.0
Annual totals	53.6	41.0	12.6	0.0	0.0

(continued)

Table 51 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100206					
January	2.3	1.6	0.6	0.1	0.1
February	3.1	1.8	0.4	0.9	1.0
March	3.5	2.8	1.1	-0.4	0.6
April	2.0	3.6	0.6	-2.2	-1.6
May	3.2	4.4	0.5	-1.7	-3.3
June	6.0	4.3	1.1	0.6	-2.7
July	8.2	4.3	1.6	2.3	-0.4
August	8.1	3.9	1.6	2.6	2.2
September	7.1	3.3	3.4	0.4	2.6
October	2.9	2.8	2.3	-2.2	0.4
November	2.0	2.0	0.8	-0.8	-0.4
December	2.4	1.6	0.4	0.4	0.0
Annual totals	50.8	36.4	14.4	0.0	0.0
Hydrologic Unit 03100204					
January	2.5	1.6	0.6	0.3	0.3
February	3.1	1.9	0.4	0.8	1.1
March	3.4	2.8	1.1	-0.5	0.6
April	2.3	3.6	0.6	-1.9	-1.3
May	4.1	4.5	0.6	-1.0	-2.3
June	6.5	4.4	1.2	0.9	-1.4
July	8.4	4.3	1.6	2.5	1.1
August	8.0	4.0	1.7	2.3	3.4
September	7.1	3.4	3.6	0.1	3.5
October	2.4	2.9	2.4	-2.9	0.6
November	1.9	2.0	0.8	-0.9	-0.3
December	2.3	1.6	0.4	0.3	0.0
Annual totals	52.0	37.0	15.0	0.0	0.0

(continued)

Table 51 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100203					
January	2.6	1.7	0.6	0.3	0.3
February	3.0	1.9	0.5	0.6	0.9
March	3.2	2.9	1.2	-0.9	0.0
April	2.2	3.7	0.6	-2.1	-2.1
May	3.9	4.5	0.6	-1.2	-3.3
June	7.1	4.3	1.2	1.6	-1.7
July	8.7	4.4	1.7	2.6	0.9
August	7.9	4.1	1.7	2.1	3.0
September	7.4	3.5	3.7	0.2	3.2
October	3.2	2.9	2.4	-2.1	1.1
November	1.8	2.1	0.8	-1.1	0.0
December	2.1	1.7	0.4	0.0	0.0
Annual totals	53.1	37.7	15.4	0.0	0.0
Hydrologic Unit 03100202					
January	2.7	1.9	0.5	0.3	0.3
February	3.1	2.1	0.4	0.6	0.9
March	3.0	3.2	1.0	-1.2	-0.3
April	2.2	4.1	0.6	-2.5	-2.8
May	3.8	5.0	0.5	-1.7	-4.5
June	7.5	4.8	1.0	1.7	-2.8
July	8.7	4.9	1.5	2.3	-0.5
August	8.7	4.5	1.5	2.7	2.2
September	8.1	3.9	3.2	1.0	3.2
October	3.3	3.3	2.1	-2.1	1.1
November	1.9	2.3	0.7	-1.1	0.0
December	2.1	1.8	0.3	0.0	0.0
Annual totals	55.1	41.8	13.3	0.0	0.0

(continued)

Table 51 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100201					
January	2.6	1.6	0.9	0.1	0.1
February	3.0	1.7	0.6	0.7	0.8
March	2.8	2.6	1.6	-1.4	-0.6
April	2.0	3.2	0.9	-2.1	-2.7
May	3.5	3.8	0.8	-1.1	-3.8
June	7.9	3.6	1.7	2.6	-1.2
July	8.1	3.8	2.4	1.9	0.7
August	9.1	3.6	2.4	3.1	3.8
September	8.4	3.0	5.2	0.2	4.0
October	3.3	2.5	3.4	-2.6	1.4
November	1.8	1.9	1.2	-1.3	0.1
December	2.0	1.5	0.6	-0.1	0.0
Annual totals	54.5	32.8	21.7	0.0	0.0
Hydrologic Unit 03100102					
January	2.4	1.9	0.6	-0.1	-0.1
February	2.7	2.1	0.4	0.2	0.1
March	2.8	3.2	1.1	-1.5	-1.4
April	2.2	4.0	0.6	-2.4	-3.8
May	4.0	4.8	0.5	-1.3	-5.1
June	8.2	4.5	1.1	2.6	-2.5
July	8.2	4.7	1.5	2.0	-0.5
August	8.5	4.5	1.6	2.4	1.9
September	8.2	3.7	3.3	1.2	3.1
October	3.5	3.1	2.2	-1.8	1.3
November	2.1	2.3	0.8	-1.0	0.3
December	2.0	1.9	0.4	-0.3	0.0
Annual totals	54.8	40.7	14.1	0.0	0.0

(continued)

Table 51 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100101					
January	2.3	1.9	0.5	-0.1	-0.1
February	2.8	2.1	0.4	0.3	0.2
March	3.0	3.1	0.9	-1.0	-0.8
April	2.3	4.0	0.5	-2.2	-3.0
May	4.5	4.7	0.5	-0.7	-3.7
June	8.2	4.4	0.9	2.9	-0.8
July	8.1	4.7	1.3	2.1	1.3
August	7.3	4.4	1.3	1.6	2.9
September	7.0	3.7	2.9	0.4	3.3
October	3.1	3.1	1.9	-1.9	1.4
November	1.8	2.3	0.7	01.2	0.2
December	2.0	1.8	0.4	-0.2	0.0
Annual totals	52.4	40.2	12.2	0.0	0.0
Hydrologic Unit 03100103					
January	2.0	1.4	0.8	-0.2	-0.2
February	2.3	1.5	0.6	0.2	0.0
March	2.6	2.2	1.6	-1.2	-1.2
April	1.6	2.9	0.8	-2.1	-3.3
May	3.9	3.3	0.8	-0.2	-3.5
June	7.5	3.2	1.6	2.7	-0.8
July	7.5	3.4	2.3	1.8	1.0
August	7.8	3.2	2.3	2.3	3.3
September	7.9	2.6	5.0	0.3	3.6
October	3.6	2.2	3.3	-1.9	1.7
November	1.3	1.6	1.1	-1.4	0.3
December	1.6	1.4	0.5	-0.3	0.0
Annual totals	49.6	28.9	20.7	0.0	0.0

(continued)

Table 51 (concluded)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03090205					
January	1.9	2.0	0.4	-0.5	-0.5
February	2.2	2.2	0.3	-0.3	-0.8
March	2.7	3.3	0.8	-1.4	-2.2
April	1.9	4.2	0.4	-2.7	-4.9
May	4.6	4.8	0.4	-0.6	-5.5
June	8.7	4.5	0.8	3.4	-2.1
July	8.0	4.8	1.1	2.1	0.0
August	7.7	4.5	1.1	2.1	2.1
September	7.1	3.8	2.4	0.9	3.0
October	3.9	3.2	1.6	-0.9	2.1
November	1.4	2.4	0.6	-1.6	0.5
December	1.8	2.0	0.3	-0.5	0.0
Annual totals	51.9	41.7	10.2	0.0	0.0
Hydrologic Unit 03090204					
January	1.7	2.2	0.3	-0.8	-0.8
February	1.9	2.5	0.2	-0.8	-1.6
March	2.2	3.6	0.6	-2.0	-3.6
April	2.0	4.6	0.3	-2.9	-6.5
May	5.0	5.3	0.3	-0.6	-7.1
June	9.3	5.0	0.6	3.7	-3.4
July	8.4	5.3	0.8	2.3	1.1
August	7.3	5.0	0.8	1.5	0.4
September	8.6	4.1	1.8	2.7	3.0
October	4.2	3.5	1.2	-0.5	2.6
November	1.5	2.7	0.4	-1.6	1.0
December	1.4	2.2	0.2	-1.0	0.0
Annual totals	53.5	46.0	7.5	0.0	0.0

7.3 U.S. GEOLOGICAL SURVEY HYDROLOGIC UNIT LEGEND EXPLANATION

U.S. Geological Survey hydrologic units coincide with drainage basin boundaries and include adjoining water bodies not associated with the drainage basins. The boundaries of the hydrologic units for Florida are shown in Figure 34.

7.4 U.S. GEOLOGICAL SURVEY STREAM GAGING STATION LEGEND EXPLANATION

The U.S. Geological Survey maintains an active stream gaging network in southwest Florida. Data collected at each station consists of records of water elevation stage and measurements of discharge. Records of stage are obtained from a water-stage recorder that produces a continuous graphical output on chart paper or on a punched-tape recorder. Measurements of discharge are made with a current meter. Rating tables are developed for each station, which give the discharge for any stage (water elevation). The daily mean discharge is determined from the mean daily stage as based on the station's rating table. Monthly and yearly mean discharges represent arithmetical means of daily discharges. The locations of the active U.S. Geological Survey stream gaging stations are shown on the atlas maps.

7.5 U.S. GEOLOGICAL SURVEY STREAM GAGE AND WATER QUALITY STATION LEGEND EXPLANATION

Monthly water quality samples are taken at a number of the U.S. Geological Survey stream gaging stations. The locations of these stations, as well as the mean specific conductivity (mmhos), are shown on the individual atlas maps. The average specific conductivity of south Florida streams and canals is shown in Figure 35.

7.6 U.S. GEOLOGICAL SURVEY GROUND WATER OBSERVATION AND WATER QUALITY WELLS LEGEND EXPLANATION

The U.S. Geological Survey maintains an active ground water observation well network where monthly water elevation levels are recorded. At selected ground water observation wells, monthly water quality samples are taken. The locations of these ground water observation wells where water quality samples are taken monthly, as well as their mean annual specific conductance (mmhos) and chloride levels (mg/l), are shown on the individual atlas maps.

Figure 34. Hydrologic unit map of Florida (after Heath and Conover 1981).

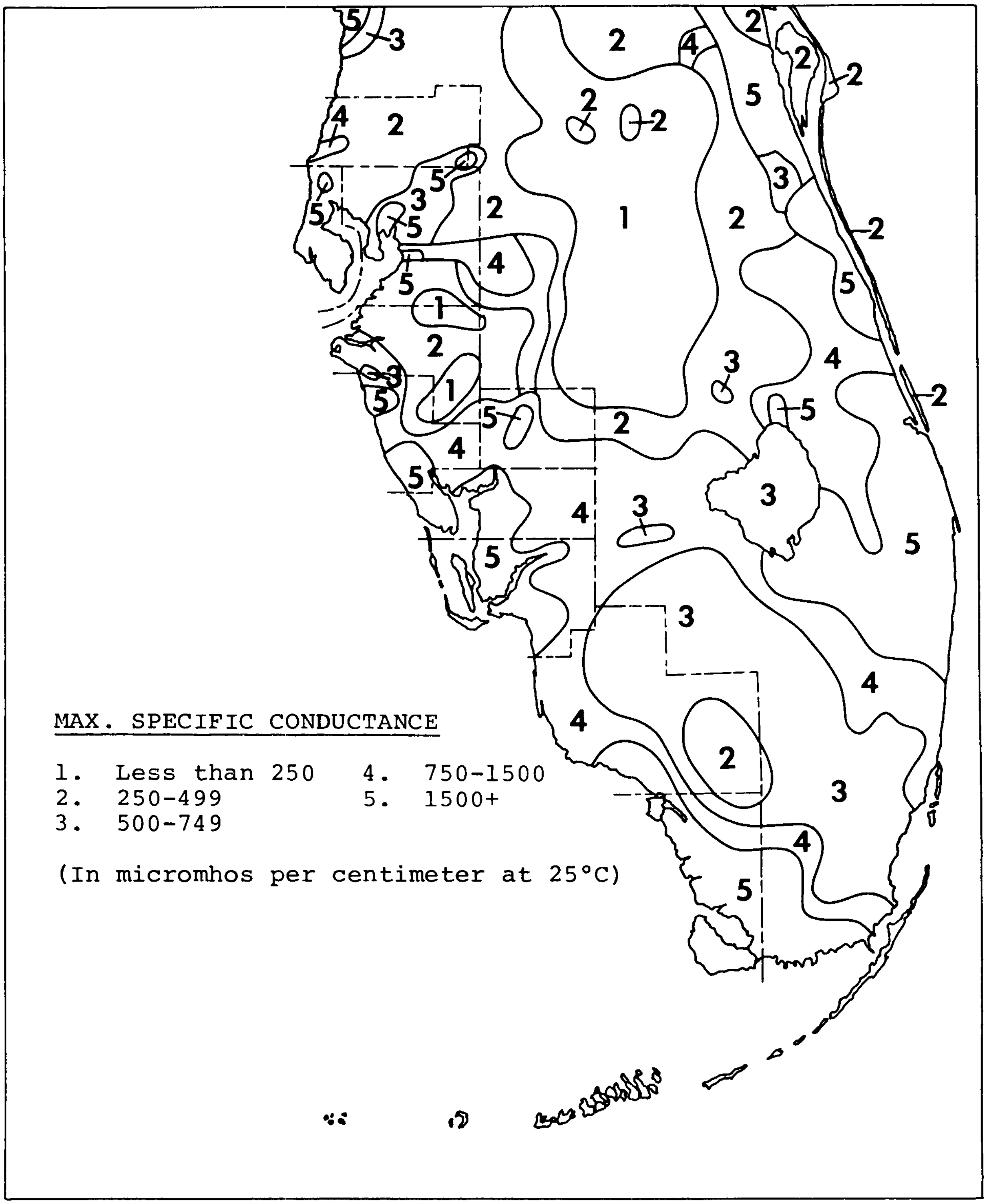


Figure 35. Specific conductance of water in south Florida streams and canals (Slack and Kaufman 1973).

7.7 FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION FIXED WATER QUALITY STATIONS LEGEND EXPLANATION

The Florida Department of Environmental Regulation has established a permanent fixed surface water quality station network. Since the stations are relatively new, the period of record is insufficient to establish long-term means. A general water quality description of waters within U.S. Geological Survey hydrologic units as determined by the Florida Department of Environmental Regulation is shown in Table 52. The location of Florida Department of Environmental Regulation fixed surface water quality stations is shown on the individual atlas maps.

7.8 WATER USE

The estimated water use in southwest Florida by county is shown in Table 53. The primary water users in southwest Florida are: (1) agriculture (spray irrigation), (2) municipal water supply systems, and (3) industry.

Table 52. Southwest Florida water quality for June 1979 to December 1981 (Hand and Jackman 1982).

Hydrologic unit	Water body	Location	Type of Problem: Dis-solved oxygen	Fecal coli-form	Chloro-phyll	Total phos-phorous	Total nitro-gen	Biolog-ical diver-sity index
03100207	Anclote - Pithlachascotee		Good	Good	-	Good	Fair	Good
03100205	Hillsborough River	Pemberton	Good	Fair	-	Fair	Fair	Good
		Lake Thonotosassa	Good	Good	Poor	Poor	Fair	Fair
03100206	Tampa Bay	Tampa Bay	Good	Fair	Good	Fair	Good	-
		Old T.B.	Good	Fair	Fair	Poor	Good	-
		Hills. Bay	Good	Poor	Fair	Poor	Good	-
03100204	Alafia River	North Prong	Good	Fair	-	Poor	Poor	Poor
		South Prong	Good	Fair	-	Poor	Fair	Good
		Main Section	Fair	Fair	-	Poor	Fair	Good
03100203	Little Manatee River		Good	Fair	Good	Poor	Fair	-
03100202	Manatee River		Good	Good	-	-	-	Good
03100201	Sarasota Bay	Sarasota Bay	Good	Good	Good	Fair	Fair	Good
		Phillippi Creek	Fair	Poor	-	Poor	Fair	-
		Whitaker	Fair	Poor	-	Poor	Poor	-
03100102	Myakka River		Fair	Fair	Good	Fair	Fair	Good
03100101	Peace River		Good	Good	Fair	Poor	Fair	Good
03100103	Charlotte Harbor		Good	Good	Fair	Fair	Fair	Good
03090205	Caloosahatchee River		Fair	Good	-	Fair	Fair	Good
03090204	SW Florida		Fair	Good	-	Good	Fair	Good

WATER QUALITY PROGRAM	Units	SCREENING LEVELS: Good	Fair	Poor
Dissolved oxygen	mg/l	>5.0	3.5-5.5	<3.5
Fecal Coliform	mpn/100 mi	<100	100-300	>500
Chlorophyll	ug/l	<15	15-50	>50
Total Phosphorous	mg/l	<.1	.1-.5	>.5
Total Nitrogen	mg/l	<.7	.7-3.5	>3.5
Diversity Index	Shannon Weaver	>2	1.2	<1

Table 53. Estimated water use in Southwest Florida in 1980; millions of gallons per day (Leach 1982).

County	Public supply fresh	Rural fresh	Industrial (self-supplied)		Irriga-tion fresh	Thermo-electric power generation		Total		Total all water
			fresh	saline		fresh	saline	fresh	saline	
Pasco	11.92	7.71	15.83	-	20.07	0.26	1339.0	55.79	1339.0	1394.79
Pinellas	102.85	3.39	0.89	-	9.21	0.11	800.0	116.45	800.0	916.45
Hillsborough	84.70	10.22	26.77	38.39	72.88	2.77	2180.3	197.34	2218.69	2416.03
Manatee	20.86	5.38	0.19	-	65.60	3.60	-	95.63	-	95.63
Sarasota	19.54	1.64	0.10	-	20.80	-	-	42.08	-	42.08
De Soto	0.71	2.15	0.53	-	34.34	-	-	37.73	-	37.73
Charlotte	4.93	1.24	0.00	-	24.99	-	-	31.16	-	31.16
Lee	29.84	6.31	4.09	-	46.42	487.56	-	574.22	-	574.22
Collier	19.30	2.56	2.33	-	86.59	-	-	111.14	-	111.14
Monroe	3.76	0.00	0.00	-	0.49	0.20	79.0	4.45	79.00	83.45
Total	298.41	40.60	50.73	38.39	381.39	494.5	4398.3	1265.99	4436.69	5702.68

8. MEAN ANNUAL COASTAL SALINITY

Mean annual coastal salinities located off the southwest Florida coast range from 20-35 parts per thousand. The data plotted on the atlas maps were collected by the National Marine Fisheries Service (it must be noted that coastal salinities vary considerably throughout the year).

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11. GLOSSARY

anemometer - An instrument which measures wind speed and direction.

aquifer - A subsurface body of ground water.

Atlantic Ridge - A semi-permanent ridge of high pressure which extends westward over the western Atlantic from the Azores high during the summer.

barometer - An instrument which measures atmospheric pressure.

climatology - The science that studies long-term weather trends that prevail over a period of years.

convective thunderstorm - A type of thunderstorm which develops as the result of differential heating of the earth's surface by the sun. These thunderstorms form over areas of intense local heating. Warm air is lifted upwards over these areas above the level of free convection where it rises freely.

convergence - Process where airflow flowing into an area of low pressure converges and is forced upward since it can not flow downward due to the earth's surface.

diurnal - Daily.

Eocene - A geologic epoch occurring some 36-58 million years before the present and characterized by the development of the modern types of mammals.

geostationary meteorological satellite - A meteorological satellite which is located some 22,500 miles above the earth's surface and whose orbital velocity matches that of the earth's surface giving the impression that the satellite is remaining stationary over a fixed location. These satellites telemeter satellite photos and infra-red temperature data to ground-based satellite receiving stations.

hydrology - The science dealing with the properties, distribution, and circulation of water.

Miocene - A geologic epoch occurring 13-25 million years before the present and characterized by the development of abundant grazing mammals.

Oligocene - A geologic epoch occuring 25-36 million years before the present and characterized by the development of large running mammals.

pH - The pH of a solution is a measure of the hydrogen ion activity and is expressed as the negative logarithm (base 10) of the effective hydrogen ion concentration. A pH of 0 - 6.9 indicates an acid, a pH of 7.0 a neutral solution, and a pH of 7.1 - 14.0 a base.

resultant - Net or average.

salinity - Salinity is a measure of alkaline salts in solution and is normally expressed in parts per thousand (0/00).

specific conductivity - Specific conductance or "electric conductance," as it is sometimes called, is a measure of the ability of water to conduct an electrical current. It is the reciprocal of the resistance in ohms measured between opposite faces of a centimeter cube of an aqueous solution and is expressed in micromhos per centimeter at 25° C.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

U.S. DEPARTMENT OF THE INTERIOR

MINERALS MANAGEMENT SERVICE

U.S. FISH AND WILDLIFE