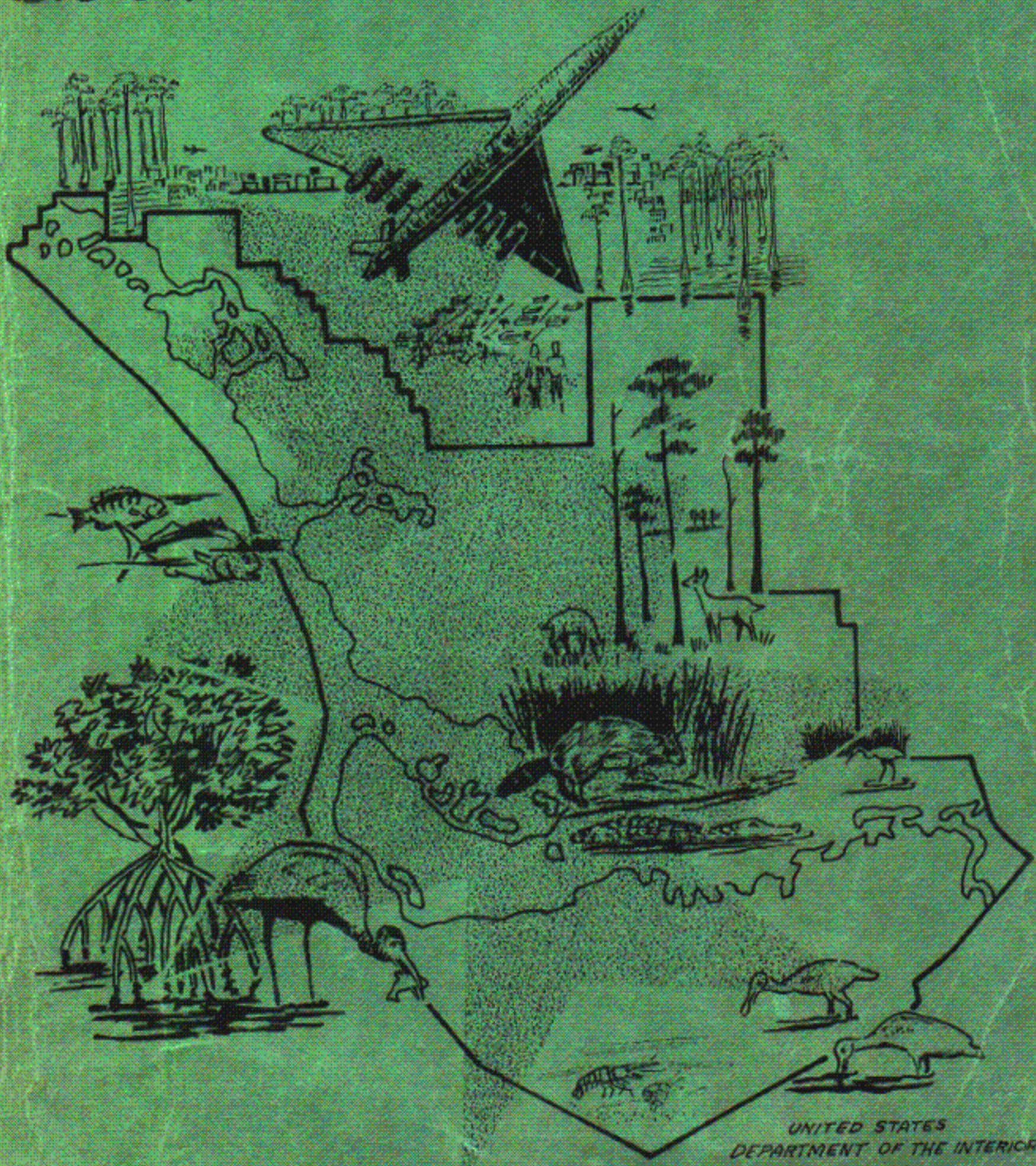
ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT



UNITED STATES
DEPARTMENT OF THE INTERIOR

The Department of the Interior wishes to acknowledge the many contributions made to this report by personnel of other agencies of the Federal Government and of the State of Florida. The Department is especially grateful for the contributions made by personnel of the Department of Transportation. Insofar as differences exist, the Department of the Interior accepts full responsibility for this report and its conclusions.

ENVIRONMENTAL IMPACT OF

THE BIG CYPRESS SWAMP JETPORT

By

United States

Department of the Interior

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FINDINGS AND RECOMMENDATIONS

Development of the proposed jetport and its attendant facilities will lead to land drainage and development for agriculture, industry, housing, transportation, and services in the Big Cypress Swamp which will inexorably destroy the south Florida ecosystem and thus the Everglades National Park.

There are three alternatives for future action:

1. Proceed with staged development of training, cargo, and commercial facilities. Regardless of efforts for land-use regulation, the result will be the destruction of the south Florida ecosystem. Estimates of lesser damage are not believed to be realistic.

2. Proceed with final development and use of a training facility of one runway, with no expansion for additional use. Obtain an alternative site for expansion, probably through an exchange of excess lands at the current site for public lands at a new site. Permit no new or improved surface access to the current site. This alternative would not preclude eventual development of lands in the vicinity of the current site. It could, however, reduce pressures for development and secure time for the formation of sufficient public interest in environmental conservation to achieve effective planning and land-use regulation.

3. An alternative site be obtained capable of handling the training operation as well as the fully developed commercial facility; and that when appropriate, the training activities at the present site be abandoned and transferred to the new site. Permit no new or improved surface access to the current site. This would inhibit greatly the forces tending toward development in Big Cypress Swamp and would give an impetus to developing effective land-use controls which could lead to permanent protection of the south Florida ecosystem.

SUMMARY OF ENVIRONMENTAL IMPACTS

In simplified form, the following represents the views of the study group on environmental impacts of the jetport and its associated developments.

Phase 1. The Training Facility

1. The construction of each training strip will destroy about 400 acres of natural habitat of the Big Cypress Swamp.

2. No significant problems are expected from sewage, industrial wastes or pesticides in the training phase, since they will be very limited. Air pollutants from engine exhausts will be substantial in an environment which has not previously been degraded by local activity. The effect of such pollutants on a natural aquatic system is almost entirely unknown. There may be adverse effects on the Indians. The introduction of air pollutants may increase the incidence of local fog under some weather conditions.

3. The Miccosukees will suddenly and involuntarily be subjected to round-the-clock noise levels commonly experienced by urbanites who live very near airports in many cities. There will be frequent high level noise intrusion on the wilderness character of the northern part of Everglades National Park and even more on the Big Cypress and Conservation Area No. 3.

4. A severe bird strike problem may develop within the airport boundaries, over Conservation Area No. 3, and in the quadrant southwest from the training strip. This would involve large water birds, including several rare and endangered species at altitudes ranging from ground to 2,000 feet. Small animals which seek refuge on the runways in flood periods will add to this problem when they are crushed and attract carrion-eating birds.

5. With sufficient culverts provided through runways, ramps, roads, and other facilities, interference with overland flow will be negligible.

6. The combination of bird strikes, pest insect problems and incidence of small animals on runways will probably lead to drainage of at least part of the jetport property. This is the Federal Aviation Administration recommendation in wetland areas for control of bird strikes. The Dade County Port Authority has announced no such plans, but has the capability and authority to construct canals for drainage within and without the port boundary, and use eminent domain authority on exterior lands. To be effective, any drainage effort would have to cover a large area using a grid of drainage canals. Drainage canals would, however, almost surely be prohibited in Conservation Area No. 3, on which much of south Florida depends for water; birds would continue feeding there, probably in increased numbers. Drainage would materially increase the occurrence of fires.

7. Construction and imminent operation of the first training strip have elevated surrounding land prices and sales. Economic and social preasures for further development within and without the port property will mount rapidly, the one encouraging the other. Such development for housing, trade or industry will inexorably lead to land drainage outside the jetport property. Land development and drainage will be accompanied by increased nutrients in the water, will alter the hydroperiod, and will promote eutrophication. To the extent and at the rate these changes take place, the south Florida ecosystem will be altered.

Phase 2. Cargo Handling

1. The volumes of aircraft exhaust emissions, and subsequent pollution of the surface waters, will increase according to the air traffic, the extent of which is not known to us.

The advent of heavy auto traffic will add to the air pollution load, and probably will be a more important source of pollutants than aircraft.

Sewage and industrial wastes will no longer be insignificant. A large number of airport employees will be required, as well as flight maintenance operations and, possibly, some aviation-oriented industries. This situation will require the provision of full waste treatment facilities, including removal of dissolved nutrients if

the ecosystem is to be protected. A system capable of treating a wide range of materials will be essential at this time, both on-port and for the surrounding area. An analysis of the possible alternative waste treatment systems will have to be made, with initial construction of some essential portion of the total treatment plan (for full development) becoming operational in the cargo phase.

If adequate treatment is not provided, then deterioration of water quality will ensue, including eutrophication and introduction of toxic materials.

With large scale human occupation of the area, heavy use of pesticides and fertilizers, both within and without the jetport, will occur. Further increase in pesticides in the aquatic system would add to the biological magnification problems, and possibly lead to the destruction of several birds which are at the higher levels of the food chain. Extensive use of fertilizers will lead to eutrophication.

2. The numbers of flights will increase and traffic will be in all quadrants. Noise will be a common characteristic of much of the Big Cypress, Conservation Area No. 3, the park, and all Indian lands.

3. Bird strikes will increase because of the added numbers of flights and the flight patterns being extended into all quadrants.

4. An improved highway corridor will be necessary for transport of cargo and personnel. If sufficient culverts and bridges are provided, interference with southward flow of water can be minimized. The corridor will destroy the habitat it occupies, will increase developmental pressures, and will intrude on the social and economic life of the Miccosukees.

5. In this stage, development outside the port will be vigorous. Pressures for land drainage will be administratively insurmountable. The canal systems will be decisive for the ecosystems of the Big Cypress and the western portion of the park. We know of no conventional drainage method which could simulate natural flows and prevent this. Should storage reservoirs be built, the waters they contain would be subject to such intense competition--economically and administratively--and to such high evapotranspiration losses, that there would be little likelihood of maintaining the hydroperiod of the Big Cypress and of the western park.

In this phase, the adverse effects on the ecosystem of massive technological intrusion and general inability to implement plans for protection of environment, will become evident. Since the Big Cypress is actually a portion of the Everglades ecosystem, the effects of its deterioration will be reflected over a much larger area.

A given ecosystem cannot indefinitely be reduced in size and complexity and still survive. As parts are successively removed or altered, biologic balances are continually changed and the stability of the system is undermined. The degree and rate of land drainage, eutrophication and alteration of the hydroperiod will be greater than similar changes brought about by the airport as a training facility. Thus the degree and rate of destruction of the ecosystem will be increased.

Phase 3. Full Development

All environmental problems will be at maximum with full development. Noise levels will be excessive throughout the ecosystem. Auto traffic will be very dense along the corridor, and parking facilities for thousands of automobiles will be in use.

The high-speed ground transport system will be in full operation, with individual units traversing the Everglades at very frequent intervals. Thus, the roar of jet engines will be added to the noise background at ground level, and their exhaust materials will be trailed across the landscape.

Sewage waste volume from the jetport would be in the order of 4 million gallons per day; industrial wastes would be about 1.5 mgpd. Surrounding urban areas would vastly increase the volumes of daily wastes. Despite the availability of adequate technology, there is no

precedent which would indicate that legal, administrative, or social practice would in fact result in the maintenance of water control and water quality necessary for continued operation of the natural ecosystem.

Any resemblance of the new hydroperiod of the entire Big Cypress drainage to the present one would be accidental and incidental. Thus, the single most significant element of the natural, complex, and highly diverse environment--the hydroperiod--would be lost. The interaction of water, plants, and animals would bear little resemblance to its present condition and the south Florida ecosystem as it presently functions would be destroyed.

The Miccosukee tribe will be totally absorbed in the intensive development, with virtual elimination of their social customs and way of life.

INTRODUCTION

In September of 1968 construction started on a new aviation facility in the Big Cypress Swamp of Florida about 36 miles west of Miami. The construction is being carried out by the Dade County Port Authority, an official arm of Metropolitan Dade County government. The Authority is purchasing, mostly through condemnation, 39 square miles of land in Dade and Collier Counties. The first runway of this complex, oriented east-west, is nearing completion and will be used initially as a training facility by commercial airlines.

The jetport lies only 6 miles from the northern boundary of Everglades National Park. The port and the industrial, residential, and transportation complex which would probably grow up around it have potentially a significant influence on the national park as well as the Big Cypress Swamp and Conservation Area No. 3. This influence would be exercised primarily through effects upon the quantity, quality, and seasonal distribution of surface water drainage from the airport and surrounding developed areas.

The purpose of this report is to assess the impact of this airport and associated developments on the ecosystem--of which Everglades National Park is a part. The report is based upon the existing information known to local professionals who

collectively possess broad experience in the south Florida environment. Three levels of jetport development are considered, the initial construction which is designed primarily for training, a possible intermediate level at which the jetport would be used for cargo, and finally a level of full development which would serve commercial transportation needs, relieving Miami International Airport of some of its expected pressures.

The report does not make specific recommendations but instead describes the anticipated environmental effects at the various levels of development and considers some alternative methods of development which appear to be open.

This report considers losses and gains to the environment, rather than losses and gains to the economy. The report also attempts to indicate the nature of costs and benefits in terms of the broad and long-lasting environmental effects of the jetport plan. It is designed, hopefully, to point a direction of thinking which might also be used when considering developments of this magnitude in other areas. The relationship of the airport to the Everglades ecosystem and to Everglades National Park is a problem typical of the impingement of technological development on special environmental features.

The confrontation between transportation technology and environment is especially acute in this case because the environment involved is unique in the nation, as exemplified by the establishment therein of Everglades National Park. The problem is compounded by the fact that the airport would be larger than any now existing--about five times the size of Kennedy International Airport in New York.

This report deals with the environmental difficulties that are expected to be associated with the development of this jetport and not primarily with other severe problems which the park is experiencing. Some of the other problems are discussed, however, as examples of difficulties which might be experienced from the jetport and to indicate that the burdens of the park are already great.

ECOLOGY AND FUNCTIONING OF THE ECOSYSTEM

1. Physical Environment.

A. Land Relief.

The Okeechobee-Everglades and Big Cypress drainage basins occupy about 70% of the coastal lowland of south Florida. The highest elevations in this lowland are about 20 feet above mean sea level. These occur along the north shore of Lake Okeechobee and on the sandy coastal ridge of the west coast. Between the west coast ridge and a lower ridge bordering the east coast the Okeechobee-Everglades and Big Cypress basins slope gently south and southwest from Lake Okeechobee for a distance of about 100 miles to Florida Bay and the Gulf of Mexico.

Lake Okeechobee averages 14'-15' in depth with its bottom lying at mean sea level. The original southern (muck) rim of the lake ranged from about 14.5 to 21' above mean sea level. From Lake Okeechobee to Florida Bay the seaward slope of the land averages about one foot to every six miles, or two inches per mile.

The extreme flatness of this land has three effects which are important to the ecology of the area. First, fresh water run-off from north to south is exceedingly slow, being of the order of one half mile per day. This is critically important

to Everglades National Park, because the period of wetness (the hydroperiod) in the park is thereby extended 3 or 4 months beyond the actual rainfall period.

Second, the flatness of the basin results in the distribution of shallow sheets of water over very large areas. Drainage which lowers surface water even a few inches can dry thousands of acres. Conversely, raising water levels a few inches by means such as pumping, can inundate thousands of acres.

Third, the nearly horizontal plane of the basin intersects the plane of sea level at an almost imperceptible angle. The consequence of this is that minor variations in sea level will affect the line of salt water penetration over a broad zone of the shore. Penetration inland with a rising sea level will be even greater when the head of fresh water is low. Forces affecting penetration of sea water also include sea level changes due to lunar effect, winds including hurricanes, as well as the presence or absence of fresh water run-off.

B. Physiographic Provinces and their Vegetation.

Figure 1 defines the major physiographic provinces of south Florida. Each province has its own characteristic vegetation pattern.

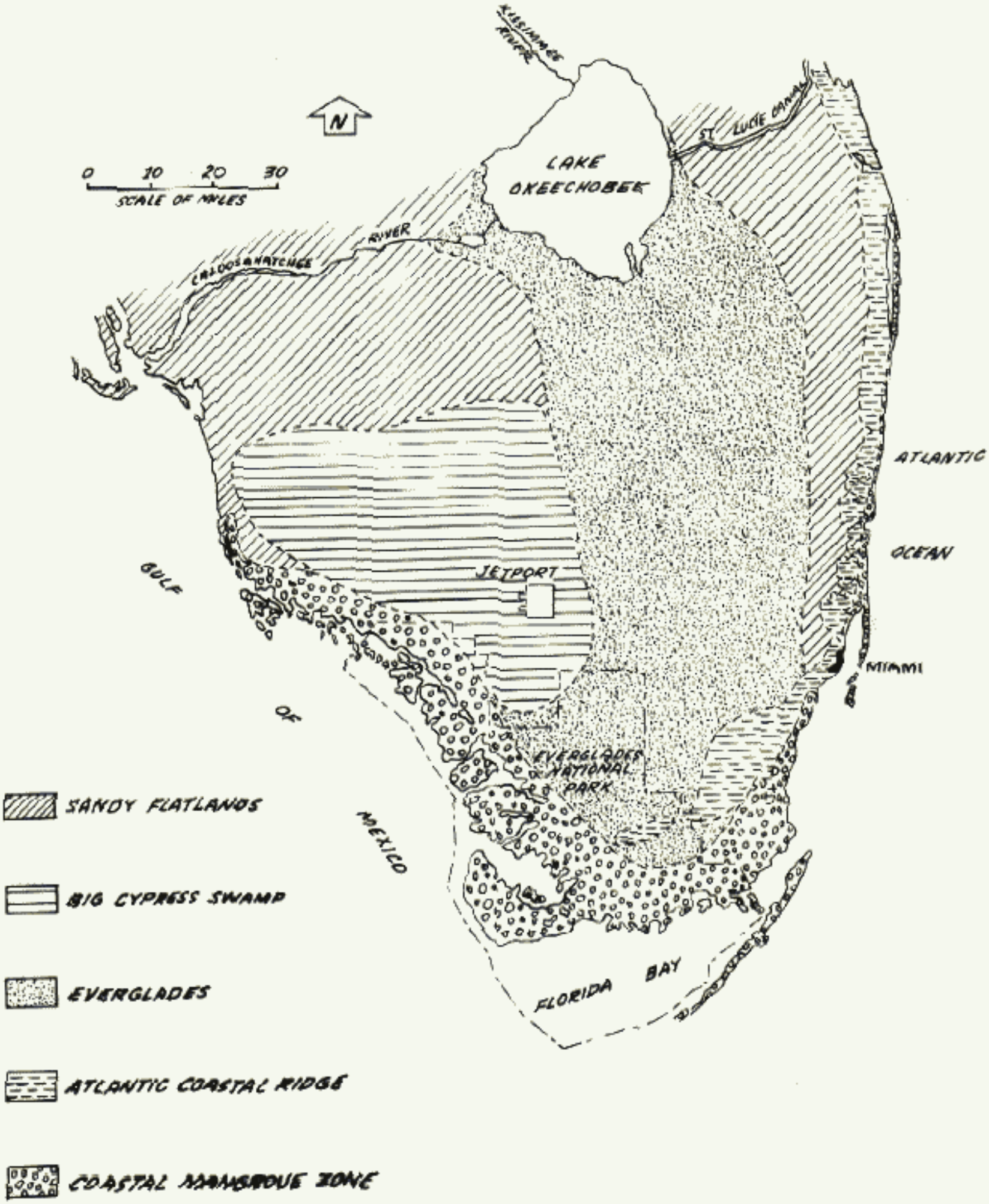


FIGURE 1 – TOPOGRAPHIC-ECOLOGIC MAP OF SOUTHERN FLORIDA

In the 4,000 square mile Everglades Province, sawgrass comprises 65 to 70% of the vegetation. Wet prairie and slough communities occupy the deepest channels. Interspersed through the Everglades are tree islands containing a mix of species such as wax myrtle, bay, hackberry, wild tamarind, cabbage palm and occasional oaks. These occur where there is enough height above the perennial water table to allow some soil aeration, usually only 1 to 2 feet above the level of sawgrass.

The vegetation of the 1,200 square mile Big Cypress Swamp differs considerably from that of the sawgrass Everglades, even though both areas are parts of a single ecological entity. In the Big Cypress, large trees, open elongated forests of medium-sized trees, and large areas of stunted cypress grow in marsh-like, seasonally flooded prairie. Cypress does not cover all of the region for there are some areas of higher pineland and wet prairie.

The 1,300 square mile coastal mangrove zone consists largely of red mangroves, with black and white mangroves and buttonwood making up the bulk of the remaining vegetation.

The coastal ridges once supported typical upland vegetation, principally pine forests with scattered hardwood hammocks, but little of the original vegetation remains.

C. Geology and Soils.

The Florida Everglades basin is underlain chiefly by limestone. There are two contemporaneous formations. The highly porous Miami Oolite, with large eroded surface areas of pinnacle rock, underlies the east half whereas the harder, less porous, Tamiami formation underlies the west half, including the Big Cypress.

A thin blanket of gray calcareous marl covers vast areas of these formations. In the upper glades, beds of peat and muck have built up over the marl. In the lower glades, the marl is often the only covering over the limestone, or is interbedded with layers of peat, or underlies thin layers of peat.

The peat and muck soils overlying the limestone average about 7 feet deep over large parts of the agricultural area in the northern Everglades, thinning to 2 to 3 feet near the north levee of Conservation Area No. 3 and feathering to nearly nothing a few miles south of the Tamiami Trail. Peat

and muck materials occur irregularly in pockets in the limestone south of the "feather edge." In the coastal mangrove zone, peat of sawgrass and mangrove origin lies in deeper beds that are often interbedded with marls.

Peat and muck formations of the Everglades play a major role in prolonging the duration of the hydroperiod by storing water and helping to maintain high water tables in the region.

The peculiar physiographic and biologic circumstances in south Florida have been described in voluminous detail. The brief sketch above, however, is designed primarily to preface a discussion of the ecological interrelationships on which the jetport and all associated developments will impinge.

D. Hydrology.

Summer thunderstorms, of marine origin, produce the highly erratic seasonal rainfall and runoff characteristic of south Florida. Winter and spring normally constitute the dry season. In the summer and fall, hurricanes and tropical storms often produce exceptional rainfalls, sometimes as much as 20 inches within a 48-hour period. The rainfall averages 57.0 inches per year in the Big Cypress and lower Everglades.

The monthly rainfall, on the average, ranges from a low of 1.0 inch in December to 9.7 inches in September. About 85 percent of the rainfall occurs from May to October.

High temperatures and humidities are characteristic of the area. Temperatures are moderately high from May through September and moderate the rest of the year with occasional light frosts during the winter months. Monthly averages range from 68° Fahrenheit in December to 85° in August. Year-round the relative humidity varies from about 50 percent during daylight hours to nearly 100 percent at night.

A highly significant climatological-ecological factor in the Everglades and Big Cypress basins is the large evapotranspiration loss which consumes about 75 percent to 95 percent of the annual rainfall. In some years, evapotranspiration exceeds rainfall.

The overland flow in south Florida courses in many directions (Figure 2). For portrayal, those flows into Everglades National Park will be used. Flows which have been measured come from: (1) The Everglades, (2) Big Cypress Swamp, and (3) Taylor Slough. A hydrograph of monthly mean flows into the park are shown, for their periods of record (Figure 3).

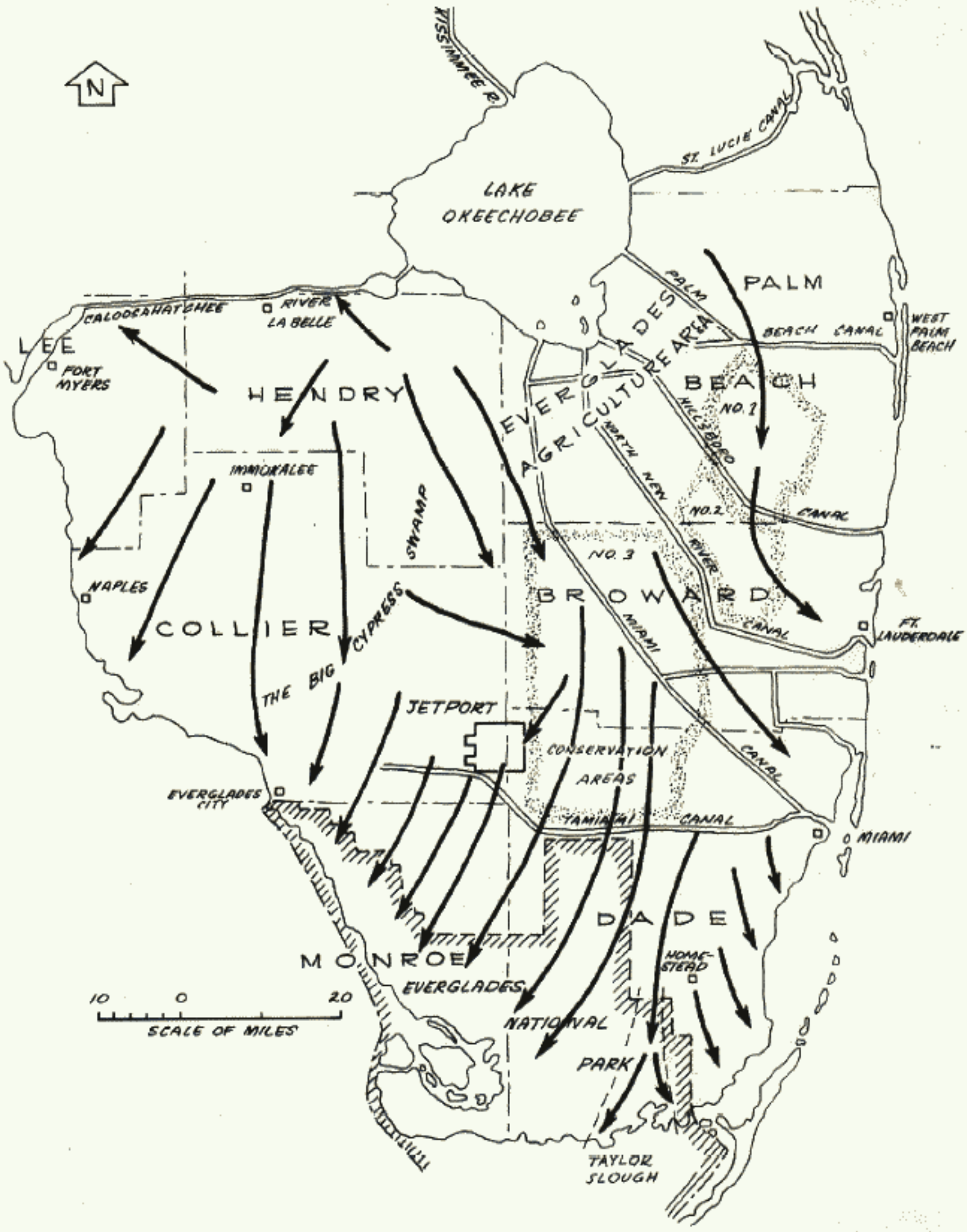


FIGURE 2 - WATER FLOW

FIGURE 3 - HYDROGRAPHS OF MONTHLY MEAN DISCHARGE THROUGH THE TAMIAMI CANAL OUTLETS AND IN TAYLOR SLOUGH.

TAMIAMI CANAL OUTLETS

DISCHARGE, CUBIC FEET PER SECOND

TAYLOR SLOUGH
1,000
0

MONROE TO CARNESTOWN
3,000
2,000
1,000
0

1960 61 62 63 64 65 66 67 68

DISCHARGE, CUBIC FEET PER SECOND

JETPORT TO MONROE
2,000
1,000
0

JETPORT
1,000
0

SHARK RIVER SLOUGH
4000
3,000
2,000
1,000
0

1940 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68

The seasonal variation of flow is easily discernible. For comparison, the average annual flow into the park from four areas is:

Average Annual Overland Flow and Percentage of Total Flow into Everglades National Park

Basin	Flow Section	Annual Flow Acre-feet	Percent of Total Flow
Everglades	Into Shark River Slough	260,000	41
Big Cypress	From Jetport area	41,000	6
Big Cypress	From Jetport to Monroe area	112,000	18
Big Cypress	From Monroe to Carnestown area	195,000	31
Taylor Slough	From Taylor Slough	26,000	4
	TOTAL	634,000	100

It should be noted that the Everglades flow into the Shark River Slough had already been greatly reduced when records were started in 1940.

The 260,000 acre-feet in the table is the calculated amount which serves as the park's minimum water demand from Conservation Area No. 3A to Shark Slough.

2. Salient Features of the Big Cypress Environment.

The Big Cypress is a wilderness area of sloughs, cypress strands, pine islands, and hammocks, roughly 30 by 40 miles in extent and located west of the Everglades, principally within Collier County. It is an intricate mosaic of marsh and lowland

forest types. The pattern of this mosaic is determined mainly by the length of the hydroperiod and the frequency of fire at a given site.

The major forest types are bald cypress, slash pine, cabbage palm, and mixed hardwoods. The important herbaceous types include the sawgrass marshes, usually with a scattering of small cypress trees, and mixed grass-sedge marshes that are located on higher ground and contain no sawgrass. These latter mentioned areas are generally known as prairies.

The predominance of cypress gives the area its name, although much of the cypress has little timber value. It is generally small in size and found in low densities on areas that are marginal for mature cypress growth due to thin soil and frequent fire. Locations characterized by deeper soil and a longer hydroperiod support forests of large cypress trees. These occur as linear belts along drainage sloughs (cypress strands), and as islands that are known locally as cypress heads. The latter commonly indicate the locations of depressions in the underlying limestone.

Cypress of commercial size was lumbered in the 1940's and early 1950's. Some cutover areas show good regeneration. Others, where severe fires followed lumbering, now have dense

growth of willow and red maple brush. Stands of custard apple and pop ash forest with abundant epiphytes often occur around permanent ponds within the cypress heads and strands. At places, belts of swamp hardwood species including bay, magnolia, red maple and cocoplum, form an outer zone bordering the cypress strands.

One strand is particularly important. It carries the name Fahkahatchee. It is the major drainage slough of the southwestern Big Cypress and supports a mixed stand of cypress and native royal palm, a forest type which is unique on earth.

Pine forests of the Big Cypress occupy sites that are slightly higher and consequently have a shorter hydroperiod and higher fire frequency. The more accessible stands of pine were also cut over in the early 1950's. Cabbage palms are commonly mixed with pines in open stands or as island groves in the prairies.

A mature upland hardwood forest is developed in only a few scattered hammocks whose slight topographic elevation minimizes flooding. These areas are often surrounded by sloughs which reduce the likelihood of fire. In this forest type, West Indian trees such as gumbo limbo, wild tamarind,

mastic and Jamaica dogwood share dominance with oak, hackberry, red mulberry and other more common trees of the southeastern United States. Vegetation found in the immediate area of the jetport consists primarily of small cypress growing in saw-grass marsh, with numerous cypress heads and occasional hardwood hammocks also present.

Most of the Big Cypress has been little disturbed by people and within it are nearly all of the wildlife species native to semi-tropical Florida. The entire area is low and flat and experiences extreme seasonal variation of surface water levels. During the summer most of the ground surface of the Big Cypress is inundated by a shallow sheet of water. In the usual winter-spring dry season, however, surface water is restricted--as it is in the Everglades--to a few ponds and sloughs. Wildfires at this time are often frequent and widespread.

Because access to much of the Big Cypress is difficult, botanical exploration of the area is still incomplete. The area is known to include a number of species found nowhere else in the United States. Florida Royal Palms are still relatively common in the Fahkahatchee Strand, despite the removal of many trees for landscaping in southern Florida

cities. Elsewhere this palm occurs naturally only as small stands at three locations in Everglades National Park where its presence is believed due to the activities of aboriginal Indians. Wright's palm, a tropical species with a limited range in Florida, is found along the fringes of the Fahkahatchee Strand. A botanical feature of major interest in the Big Cypress is the abundance and diversity of epiphytic plants that is unmatched outside the tropics. These "air plants" include some 25 species of orchids, 3 species of peperomia, 12 species of bromeliads (wild pineapples) and about 15 species of epiphytic ferns. Since several new orchids and bromeliads have been discovered in recent years it seems likely that the present list is almost surely incomplete. About 10 orchids and several plants of other groups are species unknown in the United States outside the Big Cypress. Although the native epiphytes are under protection by Florida law, large scale collecting by private enthusiasts and commercial dealers has seriously depleted many areas.

The Big Cypress may well be thought of as an aquatic rather than a terrestrial environment. Water levels are above the ground surface about 70 percent of the time in low-lying areas (Figure 4), and over most of the areas 3-4 months in the normal

year. The surface drainage features convey water to the estuaries that lie to the west and southwest of the Big Cypress. As in other parts of this vast, flat land, drainage patterns are not easily definable. In the vicinity of the jetport overland flow to the south begins at a very low drainage divide about 7 miles north of the Tamiami Trail. At present, an east-west levee, about 3.5 miles long, roughly parallels this low ridge. The land contours, in the vicinity of the jetport, show the irregularities of the surface (Figure 5). In this area the gradient of the water surface approximates the slope of the ground surface and drops on the average about 5 inches per mile as one proceeds south. The overland flow is intercepted by Tamiami Canal and then flows eastward or westward in the canal to the nearest culvert under the Tamiami Trail (U. S. Highway 41) most of which are spaced at about one-mile intervals. After flowing through a culvert, the water spreads out and continues its sheet flow in a southerly or southwesterly direction into the estuaries of Everglades National Park.

The most important fact about the Big Cypress Swamp is that it is an integral part of the biological functioning of the south Florida ecosystem. Many animal species are sufficiently mobile to utilize the whole region of Everglades,

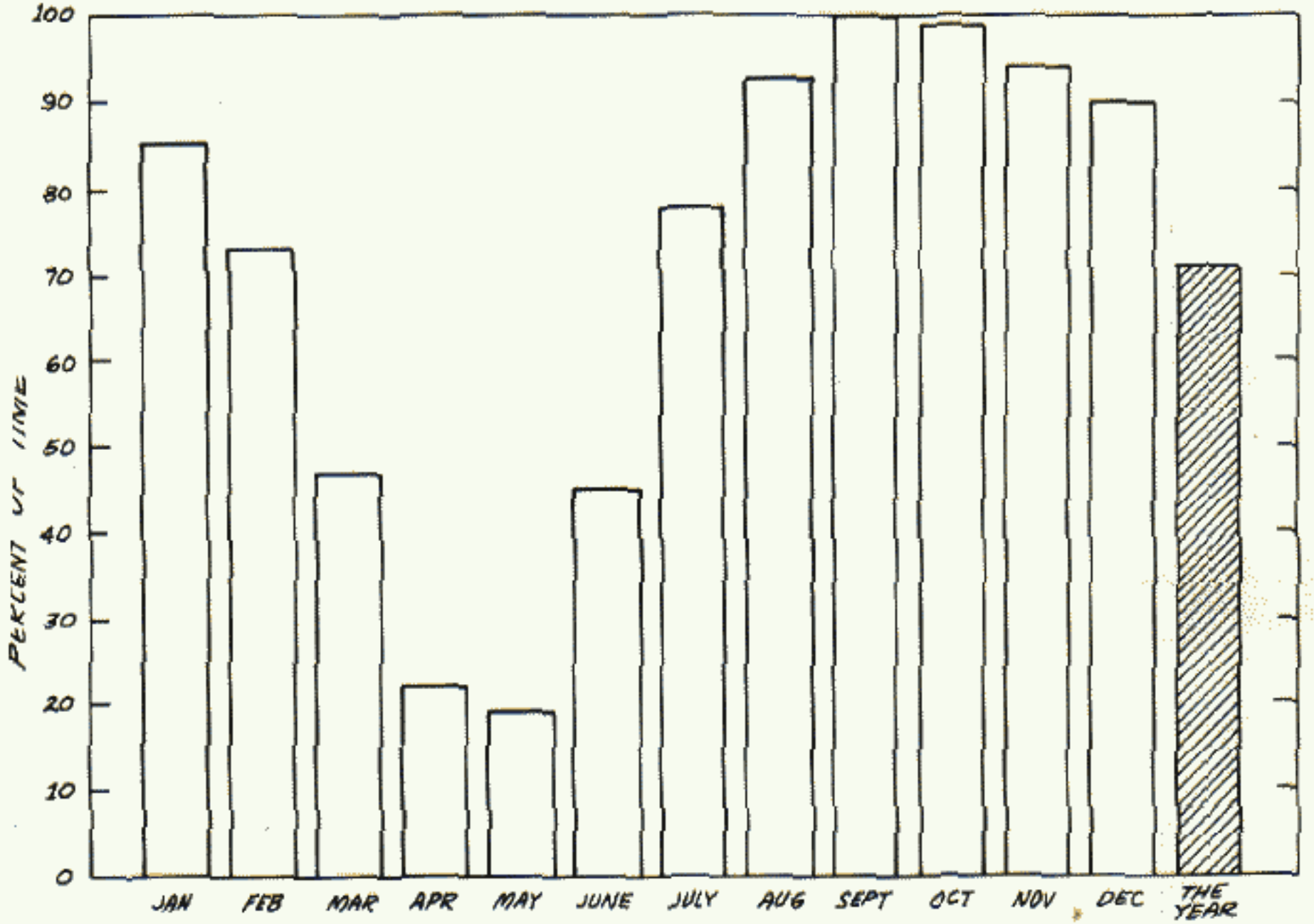


FIGURE 4 - GRAPH SHOWING THE PERCENT OF TIME THAT WATER WAS ABOVE THE GROUND SURFACE IN THE SLOUGHS OF BIG CYPRESS SWAMP (FROM WATER LEVELS IN THE ADJACENT TAMIAMI CANAL FOR THE PERIOD 1941 TO 1968).

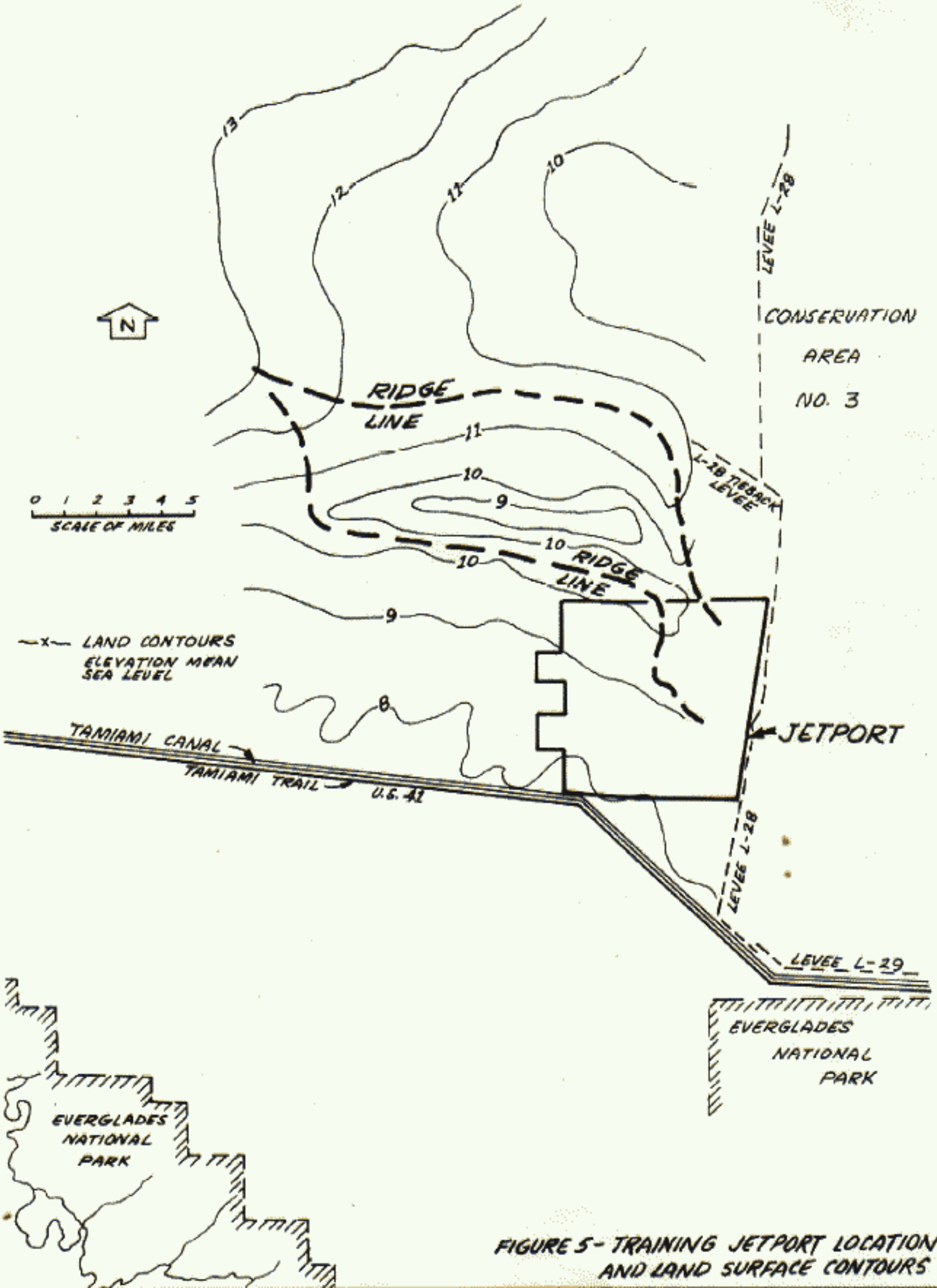


FIGURE 5 - TRAINING JETPORT LOCATION AND LAND SURFACE CONTOURS

cypress swamp and mangrove coastal glades at some time during their life cycle.

3. Dynamics of the Everglades Ecosystem

The interrelationships between the major local features in the Everglades ecosystem are diagrammatically shown in Figure 6. In the fresh water zone, hammocks or small islands of trees, stand one to two feet above the surrounding land and are usually bordered by much larger areas of sawgrass and wet prairie. Within 5 to 10 miles of the coast the vegetative zonation is quite different, being affected materially by seasonal penetration of salt water from the Florida Bay and the Gulf of Mexico. There the sawgrass tends to be replaced by salt tolerant woody plants such as mangroves.

We cannot emphasize too strongly the ecologic significance of small differences in elevation of land or water in the Everglades. For example, whereas hammocks are elevated only one to two feet above the adjacent sawgrass marsh this small variation has a major influence on the vegetation and fauna. Because of the small differences in elevation of the terrain, seasonal changes in water levels result in widespread inundation, alternating with widespread drying in which only the holes and ponds retain water. To comprehend Everglades ecology, one must

be sensitive to very small differences in elevation.

As we have indicated the limestone base in the Everglades is very porous. As water levels rise or fall, they do so freely, such that reference to a particular level as 'ground' or 'surface' water is often a matter of semantics.

A second diagrammatic cross-section, in an east-west direction, is shown in Figure 7. The diagram shows two major differences between the Everglades province and the Big Cypress: for one, peat soil is much thinner to the west; the dominant vegetation is cypress rather than sawgrass.

South Florida has a relatively long dry season in winter and spring, despite the intense rains of summer. Not enough rain falls on the average during the summer to maintain surface waters in the dry season, owing to heavy evapotranspiration losses. Any particular region may experience a water deficit during the normal 6 months dry season and must depend on other regions for water to offset its scarcity.

Under original conditions the overflow from Lake Okeechobee moved southward in the Everglades as a thin sheet of water over vast areas. This overflow was prolonged by the large amount of

FIGURE 6-

NORTH TO SOUTH COMMUNITIES
DIAGRAMMATIC

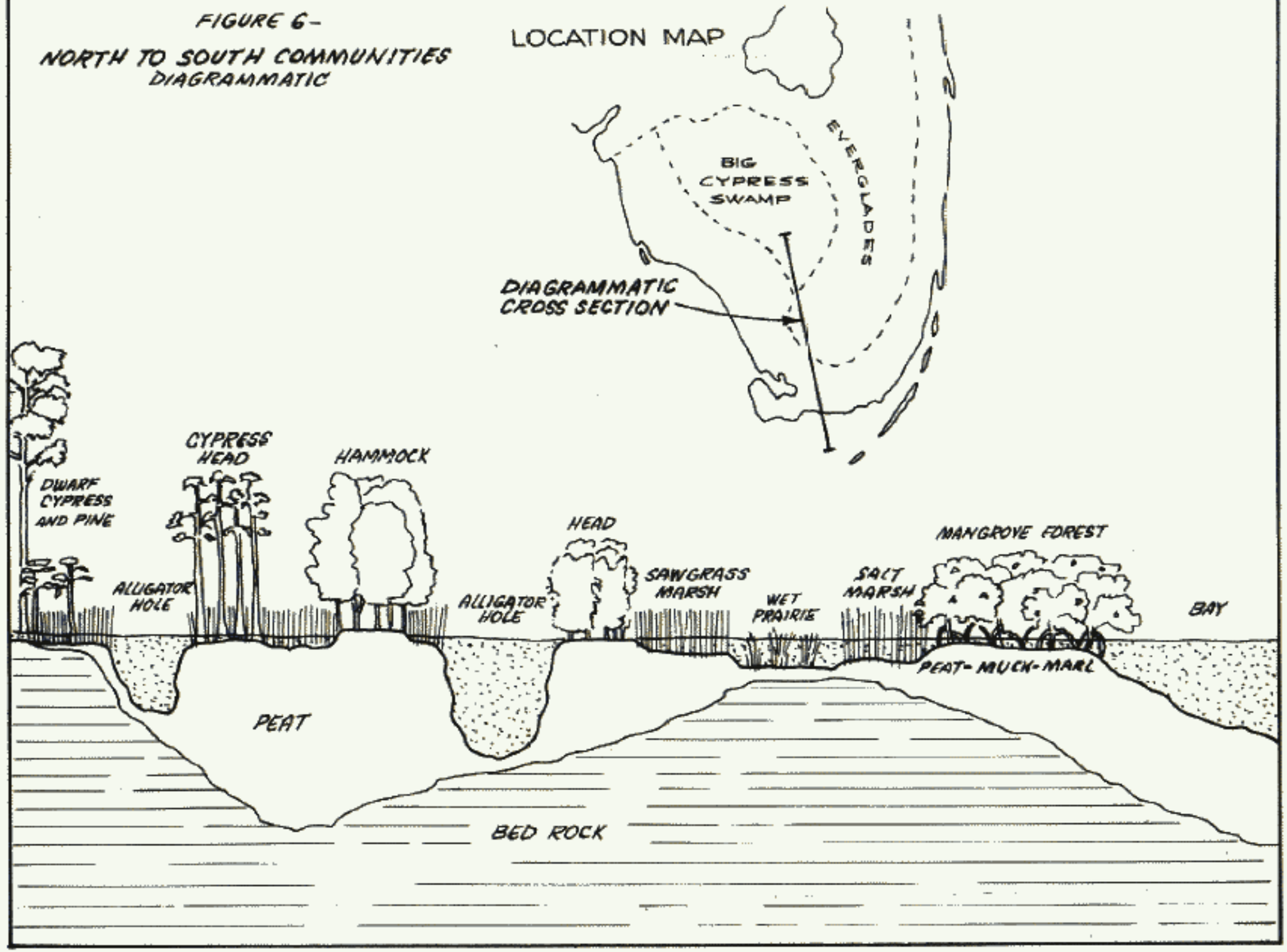
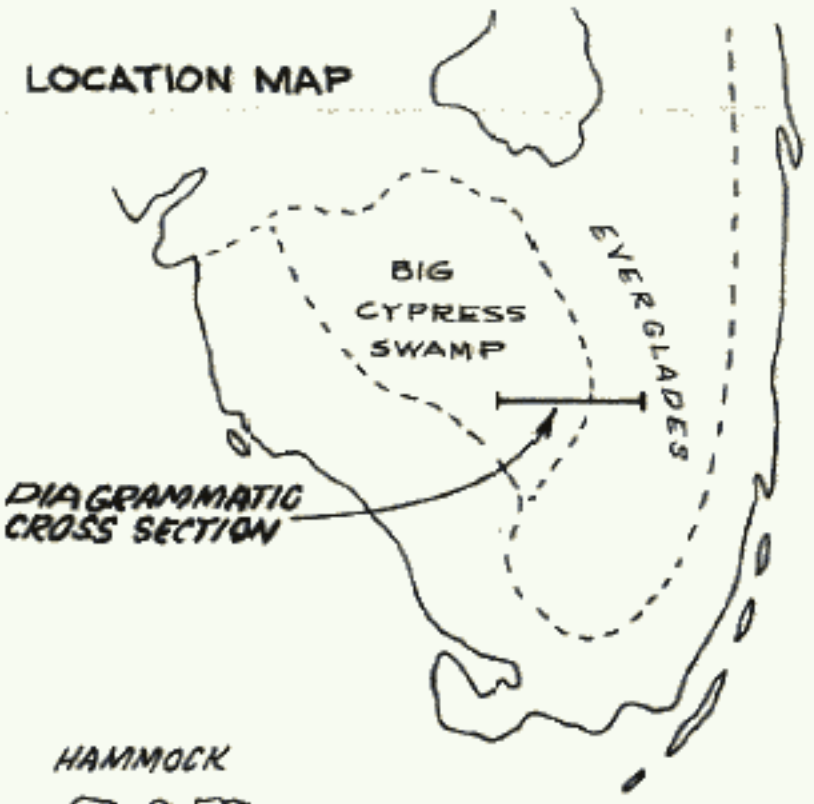
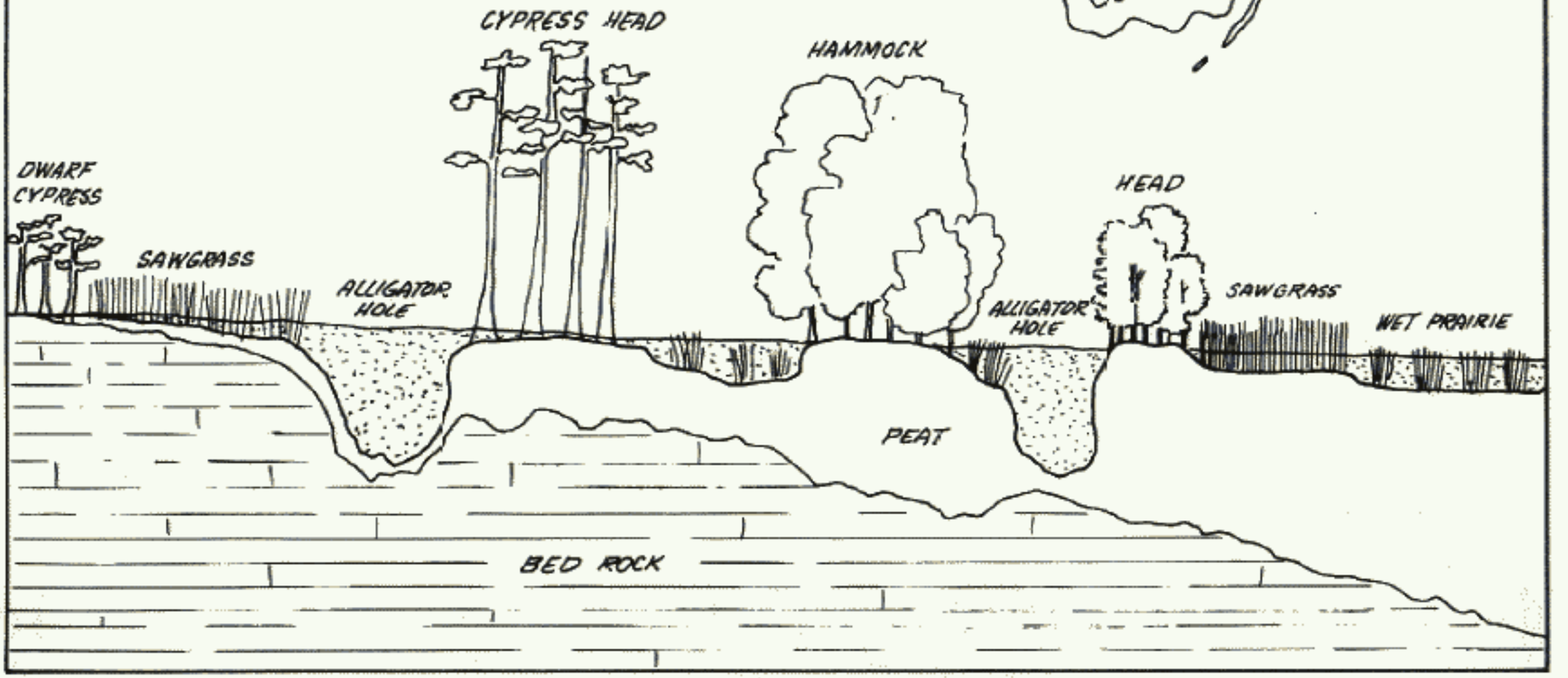


FIGURE 7-

EAST TO WEST COMMUNITIES
DIAGRAMMATIC





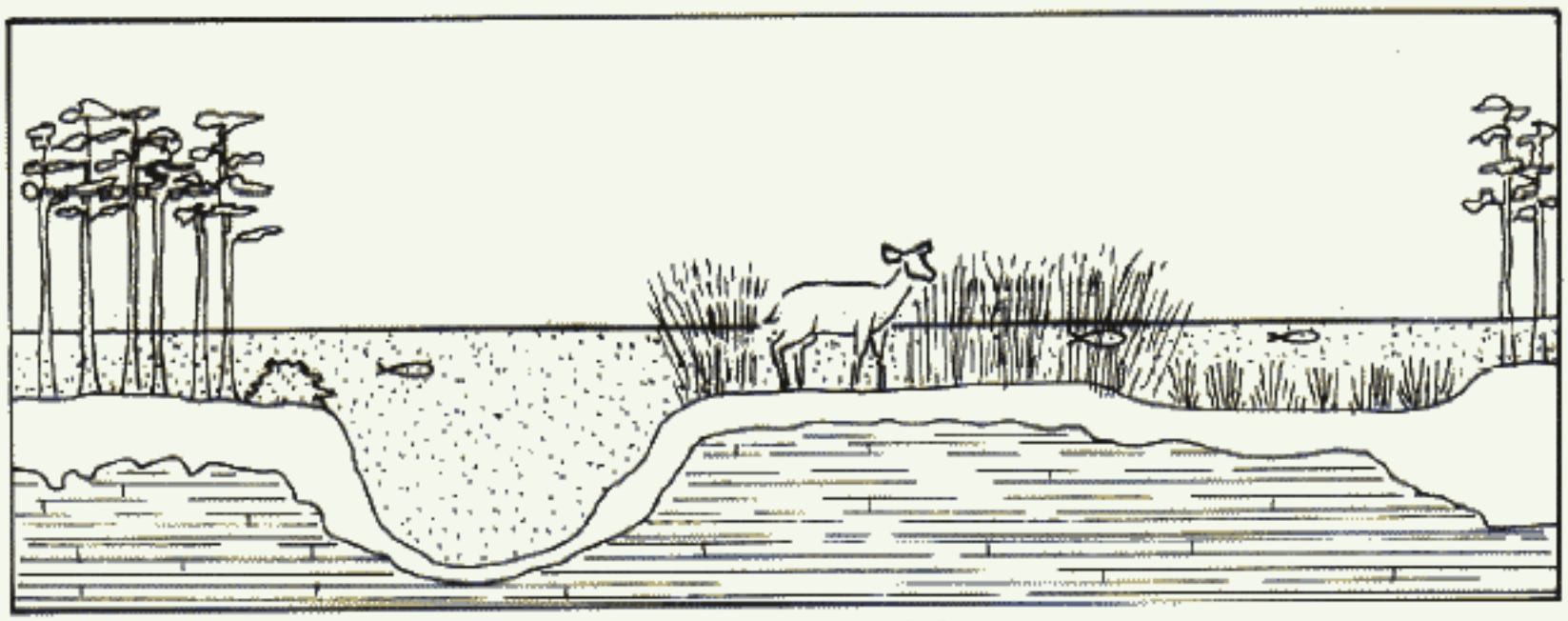
water from the Kissimmee River which drained into the lake. The overflow from the lake provided water needed to overcome the evapotranspiration deficit in the southern Everglades and to maintain its hydroperiod which originally was 9 months or longer in duration in average years.

During the normal rainy season, June through October, production of fishes, crustaceans, etc., in the aquatic communities is at maximum. Water levels normally remain high through November and then begin to decline gradually in the marshes, prairies, and glades areas. In the period March through May the water levels reach their lowest point. At this time aquatic animals become concentrated in the deeper depressions. Some of these are holes that large alligators dig and maintain as their dry season refuges. Others are topographic depressions, such as solution holes in the limestone, or depressions formed where wildfires have burned out deep pockets of peat. Such holes are critical to the Everglades ecosystem, because they are the refugia in which necessary broodstocks of small fishes, crustaceans, and other aquatic animals survive the dry season. The drastic reduction of the alligator population by poaching has greatly decreased the number of drought survival holes available to smaller organisms.

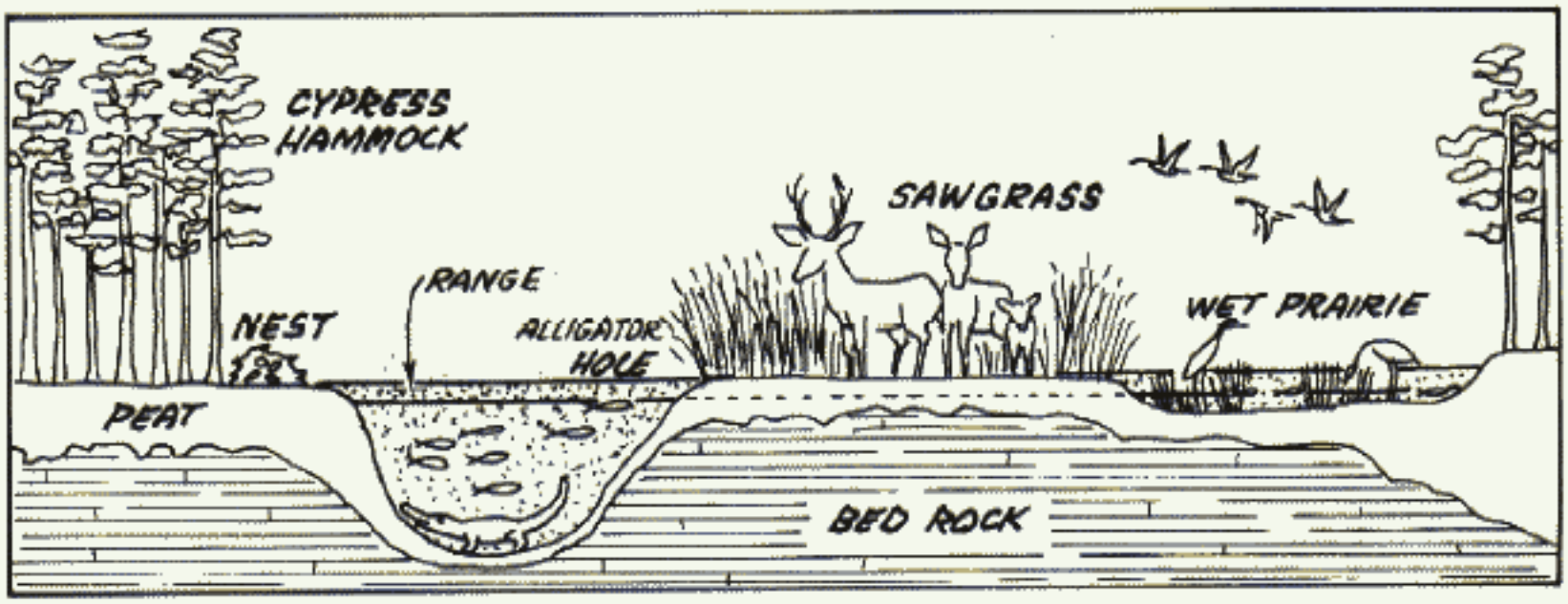
Figure 8 depicts diagrammatically an optimum range of water level and some effects of high and low extremes. The optimum range is depicted in the center diagram. When the water table gets too low; peat dries and is subject to deep burning by wildfires; alligators become easily accessible and poaching increases; the area and volume of water to sustain the small aquatic organisms that form the base of the food chain is restricted and the population of such creatures decreases radically; water needed to sustain fishes, alligators, and other species is available only in the deeper depressions; the oxygen content of the water in these holes is depleted due to organic decomposition and fish kills result.

On the other hand, excessively high water also has adverse effects: alligator nests are flooded and the eggs fail to hatch; terrestrial animals such as deer and wild hogs are forced to compete for space and food on the few areas remaining above water.

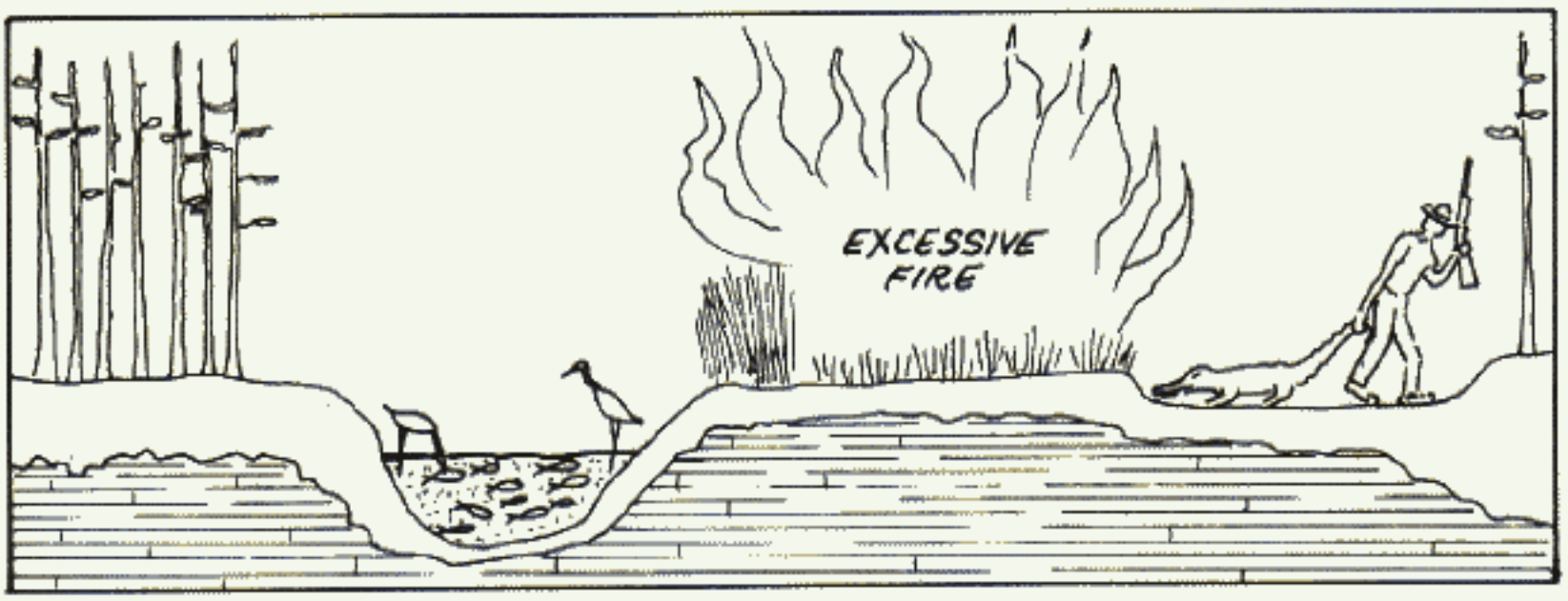
A balance, at optimum range, of water levels is clearly required in the glades. In the summer wet period, extensive areas must be inundated to permit the expansion of the aquatic populations--phytoplankton, crustaceans and fishes. Subsequently, water levels must recede to concentrate the summer production of food organisms sufficiently. This supply of food



FLOOD WATER LEVEL



OPTIMUM WATER LEVEL RANGE



DROUGHT WATER LEVEL

FIGURE 8- WATER LEVEL EFFECTS

period of drying in which aquatic organisms are concentrated in a steadily diminishing volume of surface water. This seasonal wet-dry cycle must coincide with the natural reproductive cycles of the predatory fishes, amphibians, reptiles, birds, and mammals that feed upon small aquatic animals. Otherwise, the reproduction of these larger animals at the top of food chains will fail. Excessively high or low water can cause reproductive failure.

Figure 9 illustrates the relation between water levels in the Shark Slough, populations of small fishes, and nesting *success of wood ibis in the 1965-66 and 1966-67 seasons.* Severe drought in the spring of 1965 eliminated most survival holes for small aquatic life and recovery of these populations was slow when the area flooded again in the summer and fall of 1965. Consequently, fish populations did not reach sufficient density to support successful wood ibis nesting in the following winter-spring dry period and the colonies in Everglades National Park produced only a few young. With much less severe drought in the spring of 1966, aquatic populations started from a higher base, built up to much greater densities, and wood ibis nested successfully in the winter of 1966-67.

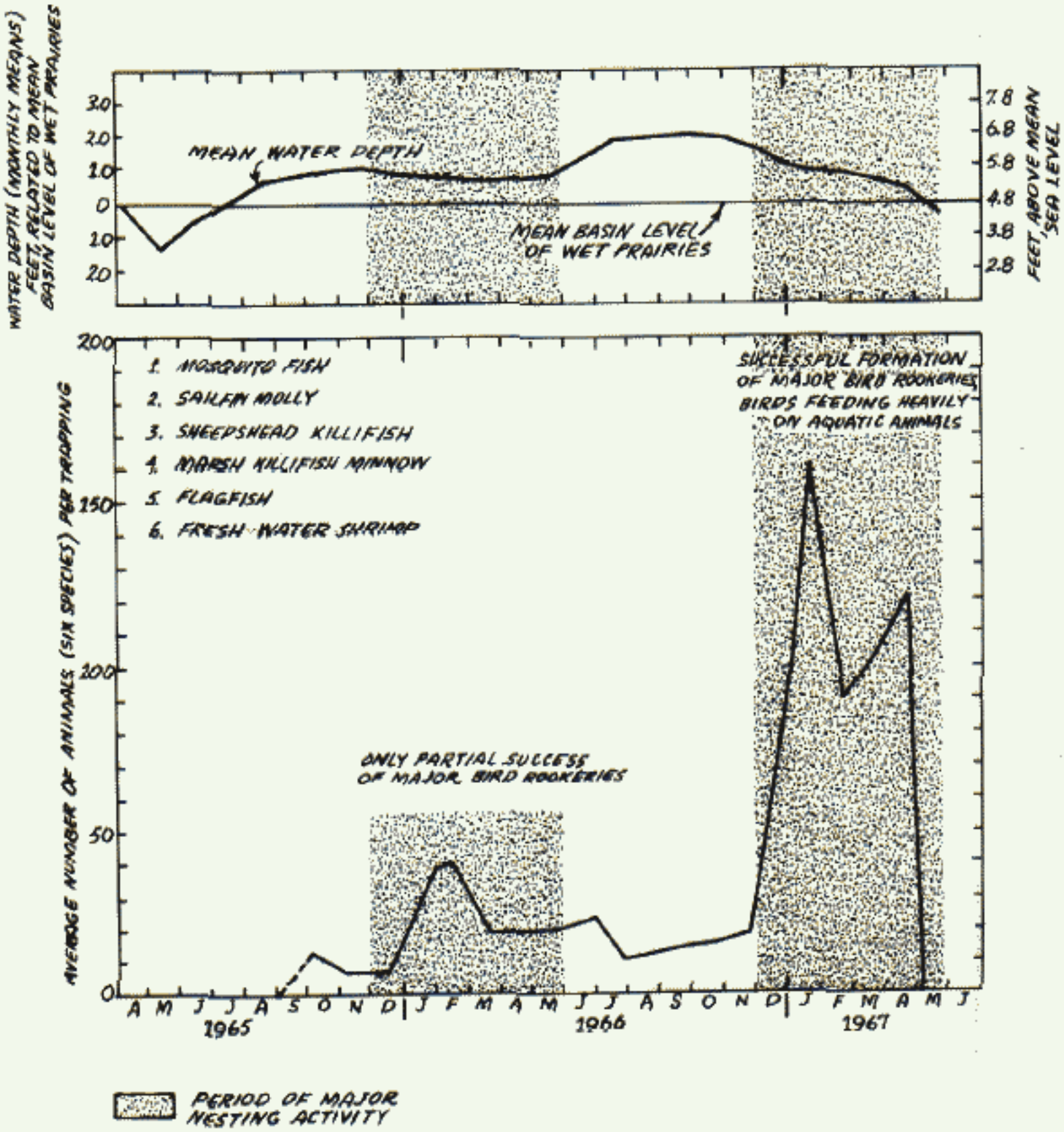


FIGURE 9- COMPARISON OF SEASONAL VARIATIONS IN POPULATIONS OF AQUATIC ANIMALS AND WADING BIRDS WITH AN INDEX OF WATER DEPTHS IN UPPER SHARK RIVER SLOUGH

The Everglades vegetation also is highly dependent upon the seasonal fluctuations of water levels. Alterations in the regime of wet-dry conditions have already produced changes in major vegetation types.

A study of a succession of aerial photographs of the Shark Slough from 1940 to 1964 shows a decrease of about 13 percent in the acreage of wet prairie communities--in 1940 wet prairies occupied one third of the upper slough; by 1964 they covered less than one fifth of this region. Concurrently, the sawgrass marshes increased from 59 to 72 percent. In the lower slough the reduction of wet prairies was not so great-- decrease being only 4 percent in the 24 years. Here, however, the wood species increased, from 17 to 23 percent of the area.

Before the advent of man, fire probably played an important part in maintaining the ecosystem. Lightning fires were probably frequent during the dry season but usually did not burn down into the peat. The usual fires probably burned only the above ground parts of the sawgrass. The roots were protected by the moist peat in which they rested. Only in exceptionally dry years did the peat dry sufficiently to burn at depth. In instances when the peat is ignited, fires burn until the peat is consumed or rising water of the succeeding rainy season puts

out the fire. This wildfire factor is also believed to have been important in maintaining many other ecosystems such as the almost treeless prairies of the west and the jackpine forests of the north.

The interplay of fresh water run-off and tides, both lunar and wind, is very critical in the mangrove-estuarine zone. An obvious example of this is the salt-tolerant vegetation along the coast. Not so obvious, but well demonstrated is the dependency of hundreds of marine species on this brackish area. Typically, the marine species occupy the area as juveniles, taking advantage of the protection it affords them by lowered salinities, grass communities and mangrove roots. The area also supplies a vital source of food as discussed later in the section on the coastal-mangrove zone. Its production of marine species constitutes a resource of tremendous value throughout the Florida keys.

AIRPORT PLANS FOR DEVELOPMENT

1. South Florida Air Traffic Problems.

Air traffic at Miami International Airport is moving toward the saturation point. Although an expansion is being planned by the Dade County Port Authority, it is estimated that even this measure may be inadequate to meet the needs of air traffic by 1973. Miami International Airport is the base for 32 scheduled commercial airlines. There are four major runways totalling 34,380 feet or 6.5 miles. The daily average of takeoffs and landings is 1,200 which is 8,400 per week and 440, 000 per year. This amounts to one airplane landing or taking off every 72 seconds, 24 hours a day, and 365 days a year. In 1968 the airport accommodated about 445,000 operations and ranked eleventh in the Nation in terms of the number of takeoffs and landings per year. For comparative purposes, Chicago O'Hare ranked No. 1 with 691,000, New York Kennedy, No. 8 with 465,000, and Washington National, No. 26 with 346,000.

We are advised by the Department of Transportation that approximately one-quarter of Miami International's present operations are training and transitioning operations involving heavy jet transport aircraft. Miami International Airport is

not only a major service point for 32 scheduled air carriers, also a significant maintenance, overhaul, or a training center for the below named major air carriers:

Airlift International
Braniff International
Delta Airlines
Eastern Airlines
National Airlines
Northeast Airlines
Northwest Airlines
Pan American Airlines
United Airlines

The total number of annual training operations resulting from the activity of the foregoing companies is presently in excess of 300,000. Because training operations take second priority at Miami International Airport to regular scheduled flights and because night training flights are not permitted after 10 p.m. because of their noise factor, about two-thirds of that total is presently being accomplished at other area airports such as at Freeport in the Bahamas.

Miami is a unique terminal point within the National Air Transportation System. Its "end-of-line" location in the Nation's domestic system dictates overnighting of both crews and aircraft which, in turn, encourages several carriers to not only concentrate substantial maintenance operations at the location, but also pilot training and proficiency activity. The carriers'

ability to use both idle aircraft and idle crews during night-time hours is understandably viable and desirable. This characteristic--operations conducted dominantly at night--would accompany the transfer of training and transition activity from Miami International Airport to the new jetport.

According to present plans, somewhat more than half the training operations which would be initially shifted to the new jetport would not originate at Miami International but at other southern airports. Therefore, the use of the first landing strip now under construction would relieve Miami International of only a part of its training operations.

Probably the most effective way of reducing the conflict for airport use would be to move the pilot and crew training programs from Miami International Airport. Therefore, the first phase of the jetport's use was envisioned as a training facility.

2. Plans.

Site Selection

A number of considerations led the Dade County Port Authority to seek a new airport site that was removed from the Miami Metropolitan area. Because the operations from Miami International Airport are over congested residential and industrial

areas there are many complaints of noise. These arguments are powerful enough to force curtailment of training flights during night hours. Training flights are noisier than normal flight operations because a plane in the traffic pattern for repeated landings maintains a longer and lower altitude than a plane on a commercial flight which begins to climb to a cruising altitude.

Complaints from residents near some airports have led to noise abatement regulations requiring pilots to reduce power on take-off. A take-off is the most critical time of the entire flight since the plane has a heavy load of passengers or cargo and a full load of fuel and is in a nose-high attitude. It does not have enough altitude for maneuverability in the event of failure of one or more engines. To reduce power as a partial solution to noise abatement is to invite disaster. Airports without surrounding congested areas give a margin of safety and increase the peace of mind of passengers, pilots, and those on the ground.

Another factor in remote site selection is, of course, the question of moving passengers and cargo to and from the site when development extends beyond the training operation. The Dade County Port Authority concept would utilize high speed road and

rail transport to meet these needs.

The Big Cypress location, some 36 miles west of Miami, was presumably chosen partly because of a balance between these opposed needs. Land costs were a factor as well as the desire of Collier County to share the potential economic benefits.

The goal of the Dade County Port Authority as described in its 1968 Annual Report is to develop the site into a large commercial facility. The Deputy Director has outlined plans for three phases of development, (1) training, (2) cargo, and (3) full commercial international operations.

Phase 1. The Training Facility.

At its nearest point, the airport property (Figure 10) is 6 miles from the Everglades National Park. The first (training) runway is one mile north of the south boundary of the jetport. It runs due east and west with two miles of airport property remaining at each end. This 10,500 foot long runway is nearly complete at the time of writing this report. A second runway is planned parallel to the first and one mile to the north; construction is expected to start either later this year or within a year from now. Unofficial plans call for it to

be the same length, but it will lie more to the east, about 3,800 feet from the east boundary.

The training facility reportedly will be used for business and commercial jets, primarily 707's, 727, 747, DC-8 but also including the smaller business jets, Lears, Saberliners and Gulf Streams. The traffic pattern at the beginning of the training operation is planned to circle north of the single runway. When the second runway is built, traffic for the first runway would circle to the south and that of the second runway would circle to the north. The visual flight traffic pattern of the south runway would extend five to six miles south of the runway, and the instrument flight pattern six to seven miles south, passing just north of the boundary of the national park. The pattern altitudes are expected to be 1,500 feet visual and 2,500 feet instrument, above sea level.

As an estimate of aircraft altitudes on leaving the airport property, it will be noted that the Federal Aviation Administration regulation 120.171 requires for certification that an air carrier be capable of climbing at gross load at a minimum rate of 20 to 1. This is 264 feet of altitude for every mile of distance. In the case of 707's 727's, DC-8's, and

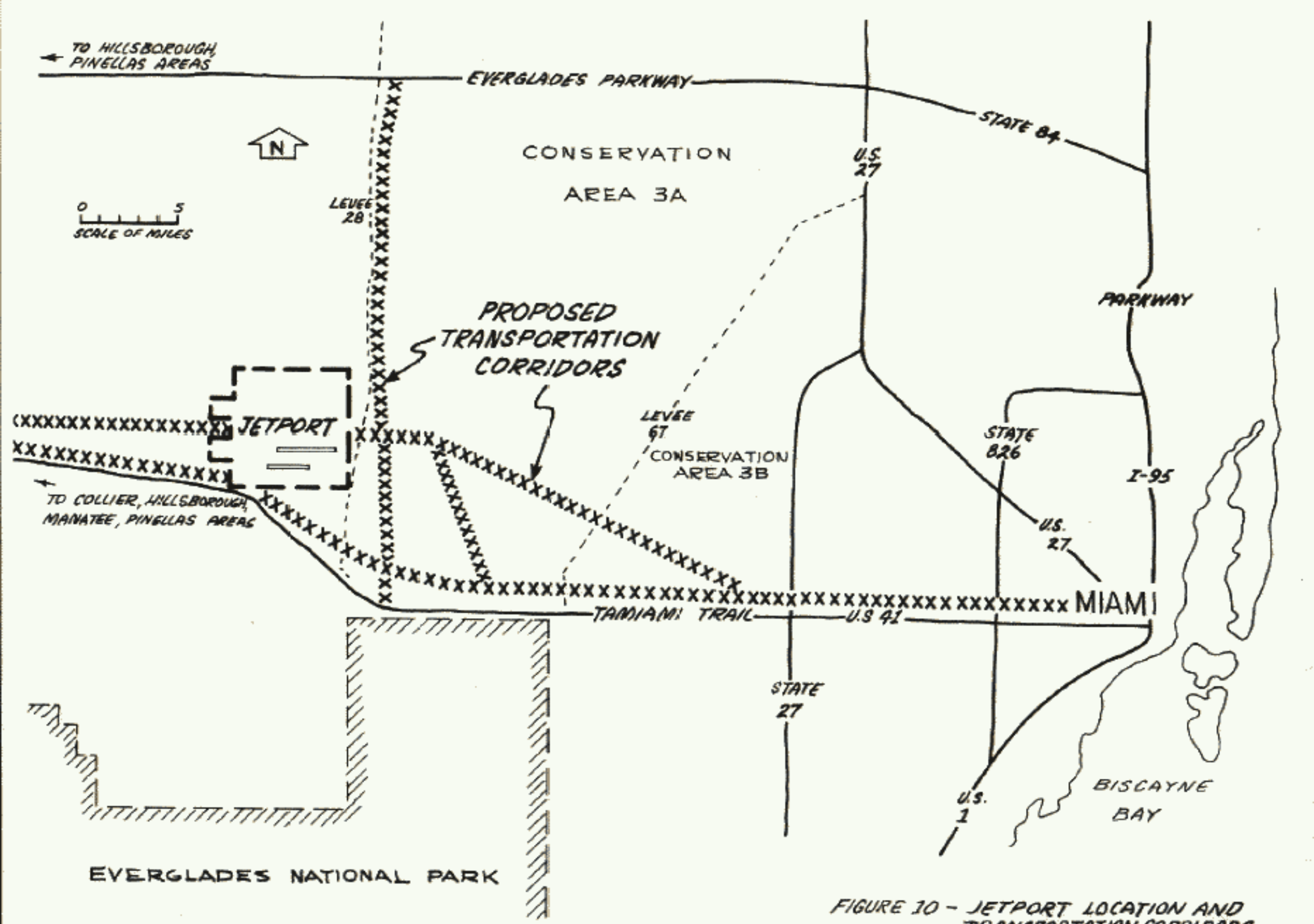


FIGURE 10 - JETPORT LOCATION AND TRANSPORTATION CORRIDORS

DC-9's, the climb rate at gross load is actually about 700 feet per mile. This climb rate would place a plane approximately at the following elevations, at the airport boundaries:

	Takeoff to East	Takeoff to West
Runway No. 1	1,400 feet	1,400 feet
Runway No. 2	400 feet	Training Pattern Altitude

The training facility is planned to operate on a 24-hour basis beginning with the opening of the first runway in December 1969. More than 160,000 take-offs and landings are expected the first year. This averages one flight every three and one-third minutes, 24 hours a day for 365 days a year. One runway is expected to handle flights at 50-second intervals over short periods but would require an average of 80 seconds over extended periods.

A typical training flight would consist of take-off from Miami International Airport flying to a training area over water either off the east or west coast where various maneuvers would be practiced. These include approaches to stalls, engine-out and other procedures required in emergency situations. The aircraft would then move to the new training facility to shoot approximately ten approaches, that is 20 take-offs and landings

or low approaches, before returning to Miami International Airport. Some training flights might terminate at the new facility with the plane being met there by another crew to start another training flight.

The routes to and from Miami International Airport apparently have not been worked out in detail. Federal Aviation Administration officials at Miami stated that these routes would probably not be worked out before September 1969. The Port Authority Deputy Director said that "all park overflights are expected to be above 3,000 feet. Even training flights, not normally over the park, are expected to be above 2,000 feet."

The 1968 Dade County Port Authority's Report said that "When pilot training and transition transfer to the new airport it will take the overload off Miami International where from 35 to 42 percent of total take-offs and landings are for training flights." Both the Federal Aviation Administration and the Port Authority indicated that requests for flight training at the new site already received would provide sufficient volume and traffic to saturate one runway in the first year of operation.

During the initial training stage no ground services other than those required in emergency situations are planned.

There is contemplated in this phase no fueling, maintenance or overnight basing of aircraft. Both Federal Aviation Administration personnel and Dade County Port Authority planners have stated that probably no more than 10 people will be working on the field at one time during the training operation. This number seems unreasonably small. The control tower will be operated by Federal Aviation Administration controllers but the agency will be reimbursed by the Dade County Port Authority.

Navigation Aids.

The only instrument-approach facility presently planned at the new airport is an instrument landing system (ILS). The ILS uses ground radio transmitters which emit highly directional course and glide slope signals providing extremely accurate alignment and descent information during the approach to the runway. This places the aircraft in a position to land under lower ceiling and visibility conditions than is possible when using other facilities. The aircraft intercepts the signal some distance from the approach end of the runway, at an altitude of 1,500 feet. By following the course and glide slope indicators the pilot is able to maintain a steady and accurate course and rate of descent as he approaches a landing configuration. In training it is common practice to make a lower

approach, that is to follow the course and glide slope indicators to a published minimum altitude, then to declare a misapproach and follow published procedures for another approach rather than to make an actual touchdown.

Airport Surveillance Radar (ASR) which provides positioning of aircraft by azimuth and range data is used for terminal approach and departure control. Such a system is planned for the new facility, but final Federal Aviation Administration approval has not yet been received. The system is designed for a range of 50 miles. The system at Miami International Airport could be used concurrently but its use would be extremely limited. It could detect planes in the area of the new jetport at no lower than 4,000 - 5,000 feet above mean sea level. Using ASR the air traffic controller places the aircraft in a position to land or to intercept the ILS or other approach aids.

In addition to these systems, there will be approach lighting on each runway. It is for the first runway that the Federal Aviation Administration granted funds in the amount of $163,202 on August 5, 1969, while this report was in preparation.

Phase 2. Cargo Handling.

According to the Deputy Director of the Dade County Port Authority, the second stage of development of operations of the new airport will be for cargo handling. This stage would not require a high speed ground transport system, but would require an adequate ground transportation system to Metropolitan Miami and other communities in south Florida. In the absence of a high speed transport system providing a convenient means for airport workers to get to their jobs, residential areas could be expected to spring up nearby.

In 1968, Miami International Airport handled 169,000 tons of cargo, about 60 percent of which was international. The total cargo poundage increased about 12 percent over the previous year and that rate of increase has been steady over the past few years. In 1975 the area's cargo tonnage is forecast to be about 240,000 tons.

The cargo phase of development would require extensive ground service facilities for fuel, maintenance, overnight housing and cargo handling and a substantial number of personnel. This phase of development would greatly increase the amount of air traffic as well as the services to be supplied and the number

of people to perform those services.

For this second stage the air traffic routes are not worked out in detail, but it seems clear that the flights would move in all directions. Air traffic controllers using the radar surveillance would vector the incoming and departing aircraft according to traffic requirements. This method of traffic control is apparently used with increasing frequency as compared with the method of following published approach or departure routes.

The number of runways required for the second phase of development could not be ascertained. Dade County Port Authority officials state that there is land enough for six runways but if, as they hope, a transportation corridor should go through the middle of the airport property, it is possible there may be room for only four runways. Early press releases indicated runways as much as six miles in length.

Phase 3. Full Development Stage.

The Dade County Port Authority's Annual Report for fiscal year 1968 states that "The airport is large enough to easily construct six east-west runways, however, facility master plans will not be completed until the environmental plan is

finalized. Only the progress of aviation and requirements of passenger air travel, cargo air transportation, ground transportation, new remote terminal concept and computer technology will determine how much of the original plan will resemble the original concept."

The report further states "The four largest airports in the nation, San Francisco, Washington International, Kennedy, and Los Angeles, can fit within the jetport boundary with room to spare for the Washington Dules Airport! It is larger in size than the land area of the entire city of Miami. The site size will make it possible for us to develop pollution free facilities and permit appropriate state agencies to control surrounding growth and to use the airport site and related transportation corridor as a buffer to protect the Everglades National Park."

The full development of this jetport envisions handling 50 million passengers, and one million aircraft operations annually. In comparison, Chicago's O'Hare Airport, the nation's busiest, recorded 691,000 operations in 1968. Passengers at Miami International Airport approached 10 million in 1968. It is contemplated that parking space for 30,000 automobiles will be needed for an annual flow in and out of the jetport of 25 million persons. This flow would be in addition to those passengers who would utilize

the mass transit systems.

The Dade County Port Authority was given authority to acquire lands or easements outside of the present 39-square mile boundary by agreement between Dade and Collier Counties reached on June 17, 1968. This agreement states, among other things, that "The Port Authority shall have the authority and is hereby authorized, under the pertinent constitutional and statutory provisions, to acquire by the exercise of eminent domain or otherwise the fee simple title, or lesser interest within its discretion, in the name of Dade County for the use and benefit of the Port Authority, in and to lands situated in Collier County, Florida." This authority extends to lands other than those in the 39-square miles, "for the purposes of road access and egress necessary to serve the airport, for drainage, and for aerial navigation easements necessary for the safety of air traffic using the airport as recommended or required by the Federal agency having jurisdiction over the operation of airports."

Further, the agreement states that the "Port Authority shall have the obligation and the powers as necessary to meet the same, of providing directly or indirectly all facilities deemed necessary in its discretion to meet the needs of the aviation industry....(including) runways, taxiways, ramps, aprons, aerial

navigation aids and controls, hangars, terminals, administration buildings, cargo and fuel storage areas, facilities for the operating, servicing and repairing and parking and testing of aircraft and the loading and unloading of passengers, mail and cargo, electric, gas, water, sewer and communication utilities, storm sewer and drainage installations, restaurants, bars, public lodging accommodations, local surface and air transport to and from the airport complex and other facilities of aeronautical and non-aeronautical nature necessary or incidental to the comfort and convenience of the traveling public and to the operation and maintenance of an airport and as such operation and maintenance may from time to time change to meet more efficiently the public needs as they arise in the future development of air transportation and the aviation industry."

Present plans call for the completion of the facility and its transformation from strictly a training field to a commercial facility by 1980. The first runway with its taxiways and access roads is costing $5 million. By the time the first plane lands over $10 million will be invested or earmarked for the facilities. Subsequent development over the next several years will require further investment of $25 million to $150 million.

3. Collateral Developments.

A. The Transportation Corridor.

A ground transportation corridor, 800 to 1,000 feet wide or more, possibly dissecting the jetport property and reaching from the east to the west coast of the state has been suggested by the Dade County Port Authority to the State Road Department. Several alternative routes for the transportation corridor are under consideration (Figure 10). Since the new jetport is northwest of Miami some decrease in distance would result from a nearly straight line route from Miami to the jetport, proceeding across Conservation Area No. 3. Such an alignment through Conservation Area No. 3 would present considerable disadvantage to the operation of the conservation area and therefore to the Central and Southern Florida Flood Control District, as its chairman has repeatedly stated. The route currently being given most consideration is that parallel to the Tamiami Trail, adjacent to the north boundary of Everglades National Park. A representative of the Bureau of Public Roads has stated that the north jog to the airport from the Tamiami Trail would add $6 million to $8 million to the cost, and would add six minutes to travel time. There are other alternatives, however, the Tamiami Trail route is the only one presently being studied.

The ground transportation corridor, according to the 1968 Annual Report of the Port Authority,. . . "would be used for conventional vehicular and rail traffic and would be able to serve future needs of high speed transportation such as the high speed air-cushioned bus operated on a guide road between 150 to 250 miles per hour."

The high speed ground system would be novel. By use of jet engines, the system would move passengers at high speeds as required. The Department of Transportation has granted $200,000 to Systems Group of TRW, Inc., to study the feasibility of such a system, including route location, terminals, and equipment selection.

The corridor would also provide right-of-way for I-75 when it is extended from the west coast to Miami, and for such utilities as electric power, phone lines, fuel pipelines, water and sewage lines, etc.

The Department of Transportation submitted the following information:

> "Extension of Interstate Highway I-75: In 1968 Congress authorized the inclusion of an additional 1,500 miles in the Interstate and Defense Highway System. This addition was predicated in part on the need for an extension of I-75 in Florida south from Tampa to Naples and thence east to Miami.

Route selection is currently underway for the Tampa-Naples portion of this extension. The east-west route from Naples to Miami has not yet been selected. Alternatives which will probably be considered include routes along two existing roadways: Tamiami Trail and Alligator Alley. The state of Florida has not yet proposed a specific route to the Federal Highway Administration, and no such request or approval is anticipated until sometime next year at the earliest.

"High Speed Ground Access Study: The Federal Railroad Administration has awarded a $200 thousand study contract to TRW Systems to investigate the feasibility of advanced technology high-speed ground transit systems in south Florida. One application to be considered for such syatems is their potential use to provide airport access to the new jetport, if it should be expanded to commercial operations. Other potential applications for consideration relate to inter-urban travel. Various types of systems and vehicles will be evaluated.

"The ultimate use of linear electric motors to propel tracked air cushion vehicles is a probable goal of the studies. These will not be available for several years. A range of short-term vehicle types which would be compatible with the guide tract for the ultimate system will be studied. One such possibility to be considered would involve the use of aircraft turbo-fan engines; we recognize that this would involve noise problems which would require careful examination, and the TRW study will report on this. There may be alternative short-term solutions which would avoid such a noise problem, and they will also be covered in the report.

"Present plans call for co-location and concurrent construction of the ground access guideway and the I-75 highway, so that the total effect on environment of construction of the highway and the ground access guideway should be no greater than if the highway alone were constructed. The guideway should contribute no chemical pollution. The embankment, as with the highway, can have sufficient elevated sections, culverts, or bridges to insure no disruption of the flow of water.

"The study report is expected in December (1969), and will include a discussion of the probable environmental effects as well as other relevant characteristics of the systems to be analyzed.

"There has been no approval to participate in the construction of any such system. No application for any such program has been received. None is anticipated until after the study report is available. Tentatively, the FRA assumes that guideway design and construction would require about three years after initiation of a project, and that operation with linear conduction motors would not be feasible before the 1975-77 period."

B. The Surrounding Area.

Large aviation facilities almost universally induce residential, commercial and industrial growth around them. Extensive areas for such growth lie all around the airport, except to the east where Conservation Area No. Three will prohibit growth. Development of the area is expected to accompany and be accelerated by the expansion of the jetport facilities.

Provisions exist for limited regulations of developments beyond the present boundaries of the jetport. In the Dade-Collier agreement of June 1968, it is stated that "lands lying within a peripheral strip not exceeding three land sections in width, abutting and outside of the boundaries of the total airport complex shall be zoned or rezoned...with due regard to the function and purpose of the airport and in particular, noise abatement and high restriction controls..." A clear

interpretation of what developments would be allowed in the three-mile zone could not be obtained.

Development beyond the three-mile zone is a matter of prime significance to the Big Cypress and the dependent ecosystem. In respect to this, the Deputy Director of the Dade County Port Authority has stated that the type of urban areas we know today in south Florida will not be sufficient for the 21st Century. "The population explosion combined with our unequalled natural and human attractions makes this inevitable. Our 1,000-foot wide transportation corridor coming in between here (Fort Myers) and Naples will serve both the east and the west coasts. But it will do a great deal more than provide access to and from the jetport and between the Gulf and the Atlantic here in south Florida. This great transportation corridor will permit the orderly, planned growth of population. Most of this growing population will live along a subsystem of transportation corridors extending north into Collier and other counties and south into Dade and Monroe Counties."

Judging from the general rapid growth of Florida, the attractiveness of south Florida to newcomers, and the prevalent attitudes which equate progress with growth, it is felt that the

Deputy Director is correct. It is expected that development will commence collaterally with the training operation and accelerate rapidly with increasing use of the jetport.

Figures of a million or more population have recently been cited by individuals and by the press. This may be a realistic estimate from a long-range view but within the framework of the airport development period, and based on personnel required, it is expected that 150,000 is a more reasonable estimate. In addition to residential occupation of the area, certainly the Dade-Collier agreements emphasize the probability of extensive commercial and industrial development of unforeseeable kinds. There is talk of the area becoming the State's largest industrial site, and of construction of a 50-mile long canal from the Gulf to the airport are for commercial shipping purposes.

Land prices have greatly increased in the Big Cypress. Classified advertisements on Big Cypress acreage are numerous in south Florida newspapers. In 1961, many sales were made at prices averaging $150 per acre. In 1968, after the jetport site had been selected, three particular sales of 30, 160, and 200 acres were made at $422, $275, and $750 per acre. This spread

of prices appears to be related to a highly speculative period. More recent advertising makes small parcels of one and one-fourth to 10 acres available at $450 to $650 per acre. These lands lie north and west of the airport and are not accessible by road.

Development of the Big Cypress is of prime importance to the resources therein and to the western part of Everglades National Park. Certainly in the important matter of maintaining natural drainages through the Big Cypress and to the western part of the park, development can be critical. Practices utilized for opening south Florida wetlands to development unanimously involve construction of drainage canals to the coast. Since this would be catastrophic to the park, we sought the opinion of officials of the Bureau of Planning, Florida Department of Administration, as to statutory base for planning and implementation thereof. Their summary is quoted below:

> Land Development Controls.
>
> "Existing Controls - With recent passage of the law subsequently identified as Chapter 69-139, Florida Statues, units of local government are now authorized to use most of the basic planning and development control devices. Principal devices now available, by virtue of Chapter 69-139 and otherwise, include:
>
> "(1) Purchase - not limited to exercise by units of local government, the authority to purchase either fee title or development rights to areas designated for protec-

tion represents the optimum solution in terms of guaranteeing control of development in the future.

"(2) Zoning - By exercise of the police power, local jurisdictions can control the use of land and certain related aspects of development. However, this device is limited in its effectiveness because an attempt to prohibit development by use of the police power is subject to challenge on constitutional due process grounds.

"(3) Subdivision Regulations - This device permits the local jurisdiction to regulate the lay-out of streets, lots, and service facilities in new subdivisions according to duly adopted policies and standards.

"(4) Extension of Services - In some instances, where certain public services such as public sewer or water were essential to urban development, the nature and timing of development has been influenced by policies controlling the extension of said services.

"(5) Access - Public investment in new or improved roads and highways can be an effective device to control the location of new development. The routing of I-75 and the location of access points thereon will have a major impact on development potential for nearby properties. Policy decisions in this area will require careful coordination among local, State and Federal interests.

"(6) Planning

(a) Local - As a practical matter,'comprehensive' planning by the local jurisdictions will influence urban development in at least two significant ways: (1) by providing the means for coordinating all relevant public policy and investment decisions; and (2) by advising potential developers of said decisions thereby influencing their plans for development investments.

(b) Regional - Recognizing that many of the factors essential to effective local planning have a geographical significance that transcends individual political jurisdictions, the Legislature has provided and many areas now use authority for two or more units of local

government to enter cooperative agreements whereby problems of regional significance can be studied on a multijurisdictional basis. However, at present, there is no authority for regional planning agencies to exercise powers necessary for planning implementation, although 69-139 appears to authorize 'joint' enforcement of zoning, subdivision regulations and building codes.

"Existing Political Structure -Staff of the State Bureau of Planning has identified the area critical to the continued existence of south Florida's natural ecological system as including a large portion of Collier County, smaller portions of Monroe and Dade Counties, and possibly part of Hendry County. Additionally, some types of jurisdiction are exercised in the general area by the Dade County Port Authority, the Central and Southern Florida Flood Control District, the Indian reservation, and, of course, the State and Federal governments. Each of these jurisdictions has authority and responsibilities peculiar to its status within the political hierarchy. Assuming that future regulation of development activities in south Florida will be guided by common objectives, fragmentation of political jurisdiction tends to exaggerate several aspects of the problem.

"(1) Allocation of responsibility - beyond the basic decision as to which types of regulation will be undertaken by Federal agencies and which types will be assigned to the state, there is a more difficult problem in allocating state responsibilities among state agencies, counties, and special districts.

"(2) Uniformity of policies and standards - if there is any division at all in the responsibility for regulating development, as there must be if traditional attitudes toward local autonomy prevail, what system can be devised to identify 'the public interest' and to articulate the goals, objectives, and standards necessary to protect that interest?

"(3) Political responsiveness - to what extent will political decision makers in south Florida be asked to forego possible local economic (urban) development in order to protect a 'national' resource? It is quite possible that the greater the burden of protection placed on local

officials, the more pressure local economic interests will apply to effect a change in office holders, thereby rendering a system of development controls based on local police power that much more unstable.

"Possible Solutions

Potential courses of action for the exercise of development controls in south Florida range between two extremes. On the one hand, the traditional role of municipal and county governments could be accepted and efforts confined to some technical assistance aimed at encouraging the counties involved to perfect their zoning, planning and related activities. On the other hand Congress, acknowledging that the only justification for extraordinary action is found in the fact that Everglades National Park boundaries do not encompass sufficient area to guarantee permanent protection of the park, could authorize extension of park boundaries to include the critical area. Intermediate solutions may offer a more attractive course of action.

"(1) Special district - The Central and Southern Florida Flood Control District was created and given special powers to fulfill a specific public need. A similar concept might be applied to devise adequate protection for the park and surrounding areas.

"(2) Review of local development control decisions - The State has the power to regulate the means by which local jurisdictions control development. Through this power, the State might require decisions affecting the critical area to be processed through a special review board created to enforce special development standards.

"(3) State regulation of activities tending to modify existing water flow and quality conditions. No permit for development would be granted if the conditions critical to the park might be adversely affected.

"(4) Transfer of development control activities in the critical area to a three-county planning council, thereby leaving the responsibility in the hands of local officials while assuring a uniform approach."

The above quotations represent the opinion of officials of the State Bureau of Planning.

THREATS TO THE ECOSYSTEM

1. Introduction

Having previously described the general ecology and the functioning of the ecosystem in south Florida and the status and plans for the jetport, the following sections discuss the anticipated impacts of the construction and development activity on the ecosystem. This discussion is set up in respect to the three levels of jetport development—the training stage, the intermediate cargo stage including the construction of a high-speed highway to the east and west coasts, and finally, the full development stage. The impacts are discussed in relation to present effects of construction procedures and practices, using present technology. Finally, construction practices which represent more advanced technology and a development policy more specifically aimed at protection of the environment, even though at a somewhat increased monetary cost, are discussed.

This approach is used whenever possible in relation to impacts of the construction. Some items are however of such nature that differences between the three levels of development are not applicable or information is not sufficient to make the necessary estimates.

2. History of Everglades Drainage.

For more than 5000 years water that accumulated seasonally on the Kissimmee prairies flowed via the Kissimmee River into Lake Okeechobee. At times the lake spilled over its southern rim and this flow together with local rainfall commenced the almost imperceptibly slow journey south through the Everglades, eventually to pass through the coastal zone to Florida Bay and the Gulf of Mexico. The Kissimmee River-Lake Okeechobee-Everglades drainage area tributary to the present Everglades National Park originally encompassed about 9000 square miles.

The literature of the mid-1800's refers to a century-old tradition that draining of the Everglades was contemplated and indeed undertaken by either the Spanish government or an association of Spanish subjects in Cuba. Although no authentic trace of these drainage works has been found, it is interesting to note that some of the old maps seem to indicate cuts or canals from the Everglades. During the war with the Seminoles (1836-1842), a canal was found on the northeast shore of Lake Flirt (now drained and farmed) leading to the prairie of Lake Hicpochee and in the direction of Lake Okeechobee, a work believed to have been too large to have been undertaken by the early Indians of Florida.

Shortly after attaining statehood in 1845, Florida requested Congress to undertake a survey of the Everglades with a view to reclamation. Buckingham Smith, a prominent citizen of St. Augustine, at the direction of the Secretary of the Treasury undertook a reconnaissance of the Everglades and submitted a report (1848) indicating optimism on the matter of drainage of the vast area. Smith further stated that such an undertaking if successful would be of great benefit to the country. Under the provisions of the Federal Swamp and Overflow Lands Act of 1850, Florida received some 20,000,000 acres of swamp and overflowed lands, among which was included the Everglades. In 1851 the Florida Legislature passed an act accepting the grant and providing for a board of internal improvement. In 1855, the Florida Legislature passed a new act creating the Trustees of the Internal Improvement Fund, the main trust being the drainage and reclamation of swamp and overflowed lands.

During the next 25 years little progress was made toward accomplishing what both Federal and State governments considered to be of great importance in the development of Florida. The first comprehensive drainage plan was implemented by a contract

entered into between the Trustees of the Internal Improvement Fund and Hamilton Disston, on February 26, 1881. This contract envisioned the permanent lowering of Lake Okeechobee and lakes in the headwaters of the Kissimmee River. It was believed this would also result in lowering water levels in the Everglades along the southern rim of the lake. It should be noted that the lowering of Lake Okeechobee was the point of this whole drainage scheme. Disston's efforts for the next several years centered in the upper Kissimmee River basin although his dredgmen first attempted to lower the lake by cutting canals from the Caloosahatchee River to Lake Flirt; and from Lake Flirt to Lake Hicpochee and thence into Lake Okeechobee. These canals which varied from 24 to 46 feet in width and from 4 to 10 feet in depth were probably completed by 1885. Some attempts were made to divert water from the lake to the area of the Big Cypress west of the Everglades. Disston's channel to the Caloosahatchee River represents the first reduction in natural flow to the present Everglades National Park.

By 1905, it was apparent that efforts to drain and reclaim the lands, under the jurisdiction of the Trustees since 1855, were in essence ineffectual, if not a total failure. The Florida Legislature created the Everglades Drainage District in 1905 and for the next two decades, amid controversy as to methods, canals were dug and levees built.

It was during this period that three small coastal rivers—Hillsborough, North New River and Miami—were extended into the Everglades and connected with Lake Okeechobee. Two overland canals—the West Palm Beach and St. Lucie—were dug from the lake to tidewater. These channels across the ancient floodway of the Everglades and the canals intercepted or reduced the normal southward flow and moved it away from the present park area and to the ocean. The third major disruption in the park's water supply resulted from the construction of levees around the southern perimeter of Lake Okeechobee between 1921 and 1926.

A need for these levees arose when drainage of the Everglades along the southern rim of the lake resulted in general subsidence of peat to 4.5 feet below the original natural elevation.

In 1926 and again in 1928, severe hurricanes passed over Lake Okeechobee and the poorly constructed levees failed to withstand the wind tides that these storms generated. Immense volumes of water swept into the Everglades farming area causing great loss of life and extensive property damage.

As a result of these disastrous storms the first Federal water control program for the area was initiated. The Corps of Engineers began the construction of improved outlet works and protective levees at Lake Okeechobee. These works were completed about 1937.

While the Lake Okeechobee levees prevented reoccurrence of the 1926 and 1928 disasters, they also forever blocked the natural flow of water from the far reaches of the Kissimmee River through the Everglades to the park. The water which once flowed south toward Florida Bay was now diverted to the Gulf of Mexico and the Atlantic Ocean via canals and canalized rivers. Land which was historically inundated by water spilling out of the Lake Okeechobee basin was now deprived of excess water and began to dry. As it dried the danger of fire increased. By the early 1940's great areas of the Everglades were afire and in many areas the peat soil cover had been destroyed leaving bare rock exposed. In other areas peat subsided due to biochemical oxidation, compaction, and loss of the buoyant force of ground water as well as fires. In the Everglades agricultural area, peat, which formed over a period of 5000 years, is doomed to extinction. In 1912, 95% of this organic soil was over 5 feet in depth while today

only about 45% is that deep. It is estimated that by the year 2000 only about 12% will be over 3 feet in depth and 45% less than 1 foot in depth.

Man had struggled for about 100 years to "reclaim" the Everglades. Yet, while only a small segment was profitably farmed, much valuable land had been allowed to burn away, and the flora and fauna of the entire Everglades including that within the newly authorized national park had been seriously affected.

In 1947, the year Everglades National Park was established, an unusually wet rainy season and two wet hurricanes combined to once again inundate the Everglades, fill Lake Okeechobee, and cause $60,000,000 damage. This flood led to a comprehensive plan for overall water control in central and southern Florida.

The plan, prepared by the U. S. Army Corps of Engineers, was approved by the State of Florida in February 1948 and Congress authorized the Central and Southern Florida Flood Control Project as a part of the Flood Control Act in June 1948. The Corps was charged with design and construction

and the Central and Southern Florida Flood Control District, created by the State of Florida in 1949, was made responsible for the operation and maintenance of essential works of the project. Construction began in 1949 with priority given to eastern perimeter levees of the conservation areas (Figure 11). In the period 1954 to 1959, most of the agricultural area works were completed and additional work on the conservation areas continued.

With the completion of Levee 29 along the north park boundary and closure of the Structure 12 gates in 1962, the little remaining Everglades area still tributary to the park was blocked and henceforth flow would be artificially controlled. The River of Grass, after 5000 years, had ceased to flow.

A few gates were opened briefly in April 1964, but no significant releases to the park were made until November 1965. This prolonged stoppage of water flow intensified the controversy over the water supply for the park.

This brief history shows what can be expected in the future of south Florida's water and the ecosystems it supports.

If the Big Cypress Swamp area is developed it will be drained. Drainage practices now used throughout south Florida will presumably be used here. The area will be latticed with a system of secondary canals leading to large, long, primary canals which will rapidly remove water during rainfall periods. Unless some of this water is impounded for later use, it will all have to be vented directly into the coastal area of the park.

Removal of surface waters will result in greatly reduced ground water levels in the Big Cypress Swamp during the dry season. This, together with withdrawal for water supply purposes will reduce water levels to a point where much of the rainfall will be required just for ground water recharge—thus greatly reducing the total volume of water available to the park.

Drainage of the Big Cypress Swamp then will result in a complete alteration of the ecosystem. Overland sheet flow normally flowing into the park from the Big Cypress will cease. Drainage facilities to prevent flooding will remove excess rainfall when it occurs and unnaturally dump it into the park's estuaries. The hydroperiod of the

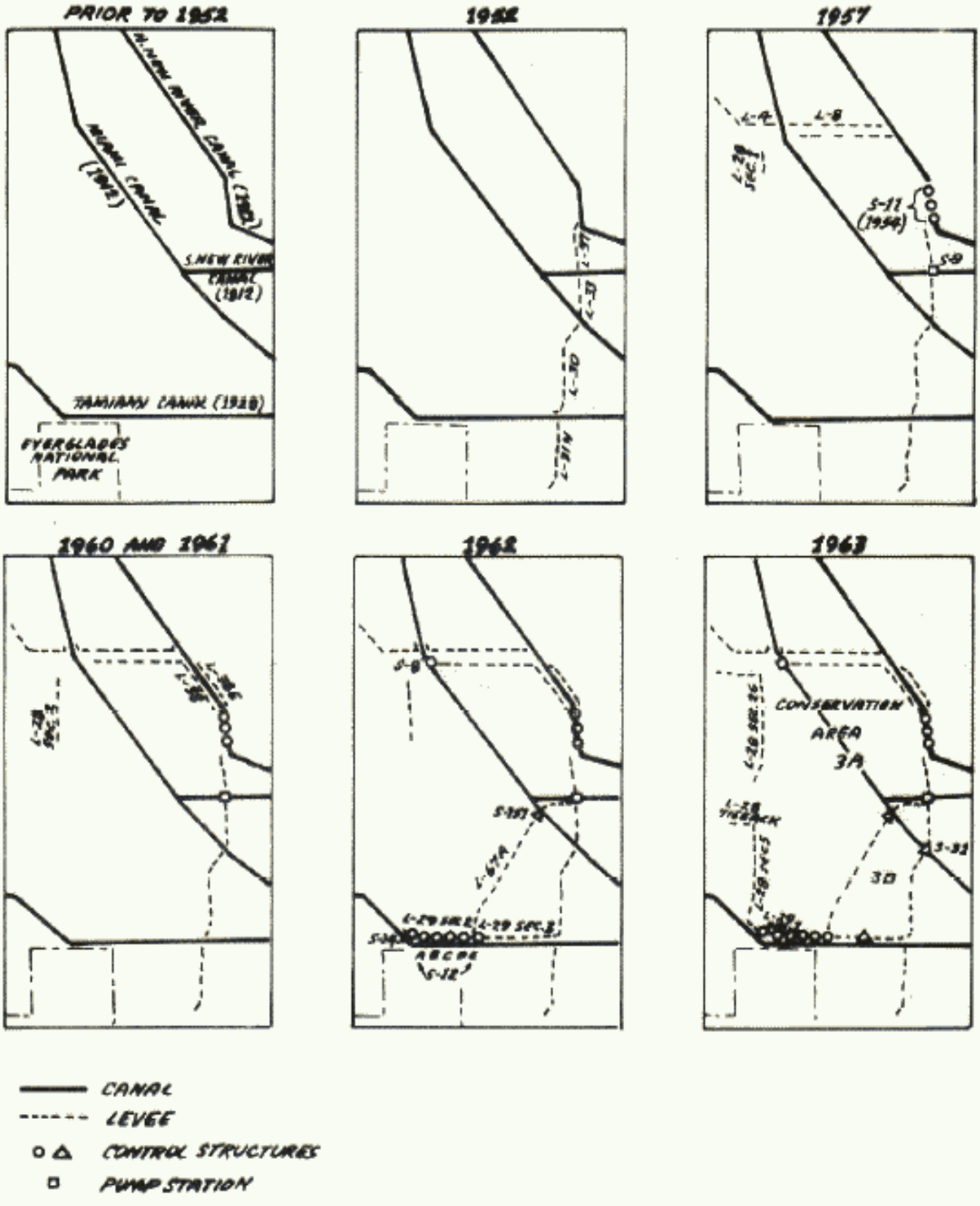


FIGURE 22— PROGRESS OF CONSTRUCTION OF WATER-CONTROL WORKS THAT FORMED CONSERVATION AREA NO. 3. DATES IN PARENTHESES ARE YEAR OF COMPLETION.

ecosystem will be shortened from the present 8 or 9 months to 4 or 5 months thus destroying the ecosystem of both the Big Cypress Swamp and its coastal zone.

3. Water Quality.

A complete discussion of water quality in the Big Cypress would require data on seasonal variations in water quantity, water temperature, plant and animal communities, land use, and other parameters for which there is presently a dearth of knowledge. Many intricate and sensitive interrelationships between the various components of the Big Cypress ecosystem are largely unknown, but almost certainly they are integrated around a common need for quality water. This discussion is limited, however, to an analysis of obvious threats to good quality water that could be expected from possible developments in and near the Big Cypress. Of primary concern are the threats posed by: (1) waste treatment practices; (2) pesticides; (3) and fallout from jet exhausts.

A. Waste and Waste Treatment

When the airport is used solely as a training facility and staffed with fewer than 100 people, the probable quantity of sewage would be of the magnitude of

10,000 gallons per day. It may be assumed that no industrial waste will be produced at this level of development since maintenance operations will be conducted elsewhere. Present engineering practice would suggest that this small amount of domestic waste could be handled by a package disposal plant located on the grounds of the jetport. The effluent from the sewage disposal plant could be discharged into an oxidation pond and decrease still further the level of organics in the waste product. Such treatment, however, would not alter significantly the content of nitrogen or phosphorus compounds which readily lead to the overenrichment (eutrophication) of Florida fresh waters. Total removal of these nutrients may be required to prevent serious damage, even in the limited volumes of treated effluent produced.

The amount of waste which would have to be handled at the second stage of jetport development is simply a volume that is intermediate between that produced during the training phase and ultimate development. In the last development stage it will be necessary to dispose of an estimated 4 million gallons of domestic waste per day. In addition, the fully implemented commercial jetport would include plane washing

and servicing facilities. With regard to this, the approximate characteristics of the industrial waste discharged from Miami International Airport is reported as follows:

Miami International Airport
Industrial Waste Characterization

(Average Volume = 1.5 mgd for 10,000,000 passengers per year)

Component	Raw ppm	Pre-treated and blended (ppm)
ph	8.7	7.0
M. Alkalinity	184	74
Chlorides	46	46
Sulphates	170	520
Total Solids	1628	500
Suspended Solids	754	35
Ether Soluble Oils	733	31
Phenols	119	79
BOD	666	250
TOC		121
COD		450
Total Cyanide		0
Total Chromates		4 lbs. per day
Total Nitrogen		4 - 5
Total Phosphorus		5.0

For such effluent, pretreatment is needed to remove oils and grease and to convert cyanide and chromates into nontoxic forms. After this pretreatment, the industrial waste can be combined with domestic waste for normal and advanced treatment.

The combined industrial and domestic wastes from the Everglades jetport at full development are projected to average 5.5 million gallons per day with the following characteristics:

Everglades Jetport (Fully Developed)
Anticipated Combined Pretreated Industrial
And Untreated Domestic Waste Characteristics
(5.5 mgd)

ph	7.0 - 7.5
5-day - 20°C - BOD	250 - 300 ppm
Ether Soluble Oils	30 - 50 ppm
Total Nitrogen	30 - 40 ppm
Total Phosphorus	5 ppm
Total Cyanide	0
Total Chromates	4 lbs. per day

More potentially harmful to the ecosystem than the waste effluent from the jetport is the volume of waste generated by the urbanization of the area surrounding the jetport and the ultimate means for disposing of this waste. There can be no question that residential and commercial development will follow, or accompany, the development of the commercial jetport. Employees working at the jetport, who may total well over 100,000, will desire to locate nearby to avoid time lost by travel. Service type facilities would be required, resulting in an expanding community requiring additional housing, shopping areas, etc. The amount of waste produced by such a community would approximate present levels of waste production.

This varies from about 5.0 mgd (million gallons per day) for a community housing 50,000 people to about 200.0 mgd for a city of one million. The disposal of these waste products could precipitate numerous changes in the ecosystem, many of them being adverse and irreversible.

As an indication of the existing general quality of the fresh water in the Everglades National Park, the range and median values of nitrate, sulfate, calcium, dissolved solids, and iron from three regions within the park were compared with values from various waters of the United States that support a mixed fish fauna. These five dissolved chemical constituents become pollutants when their concentrations become excessive. The median value of concentrations of the five constituents at Tamiami Canal and Taylor and Shark River sloughs are lower in every instance than they were in 95 percent of the comparative United States waters. The data used here for comparison represent typical waters of the United States previous to the heavy pollution of recent years. This comparison indicates in a general way that the fresh waters of the park are presently unpolluted in terms of the above five constituents.

Background levels of total nitrogen and total phosphorus in the northern part of the Everglades National Park average, respectively, 1.0 - 5.0 ppm nitrogen and 0.01 - 0.50 ppm phosphorus. Findings of the Florida Game and Fresh Water Fish Commission in the upper St. Johns River marsh area in 1965, confirm equally low levels of both nitrogen and phosphorus in comparable habitats.

The anticipated nitrogen and phosphorus content of combined industrial and domestic wastes prior to treatment at the fully developed jetport was estimated by the Federal Water Pollution Control Administration on the basis of a very limited number of grab samples from the existing Miami International Airport. These few samples indicate a magnitude of 30.0 to 40.0 ppm of total nitrogen and more than 5.0 ppm of total phosphorus.

Waste effluents containing nitrogen and phosphorus compounds are usually not treated for removal of dissolved materials. When such effluents are released into lakes and swamps the nutrients become readily available, frequently causing large and usually detrimental algal blooms, a process referred to as eutrophication.

Without special treatment to remove nitrogen and phosphorus from any domestic and industrial waste reaching the Big Cypress-Everglades area, eutrophication will ensue. The extent of this will depend on the size of the airport and adjacent developments and the waste treatment received. As a result of eutrophication the less desirable planktonic algae will increase in relation to the more desirable epiphytic algae. These will form large blooms that will tend to deoxygenate the water at night, and, over an extended period of time, will silt over the bottom substrata. Alteration of water quality and microflora will, in turn, result in changes in the animal life, and, if the increase in eutrophication is not limited, will seriously damage the ecosystem in the Everglades and Big Cypress Swamp.

It is not possible to give unequivocal values that represent the maximum allowable increase in nutrients that would not disturb the ecosystem of the south Florida environment. It should be stated that the water quality standards adopted by the States, and especially Florida, are standards which are set up for different purposes than are considered here. Generally, water quality and effluent

standards are governed by a desire to maintain water of such quality that it will not endanger public health. There is considerable difference between these standards and those which would be required to maintain an ecosystem of the particular character extant in southern Florida and the Everglades National Park. Even those standards applying to general fish and wildlife values may not be appropriate to the biologic system of this particular area.

The technology is available, however, for tertiary treatment resulting in virtually complete removal of dissolved nutrients, but with cost increasing geometrically as efficiency of treatment increases. Tertiary treatment of this kind is now in operation at Lake Tahoe, Nevada, to minimize eutrophication of the lake. Large cities around the shores of the Great Lakes are also turning to more sophisticated treatment practices in an effort to reduce the critical eutrophication occurring there.

At least four alternatives are available for decreasing eutrophication from jetport waste. One would be to hold the jetport at the training stage. This would result in some local eutrophication, but because of the relatively small

volume of waste released (10,000 gpd), influence on the environment can be contained and damage to the ecosystem would be limited. A second alternative would be complete tertiary treatment of all effluent to keep the dissolved solids, especially those containing phosphorus and nitrogen, down to acceptable levels. A third alternative would be to use deep wells for the disposal of treated effluent. A fourth alternative would involve piping treated effluent either westward or southwestward for disposal in the Gulf of Mexico.

Some aspects of these alternatives can be visualized at least in a general way. With regard to complete tertiary treatment to bring harmful effluent levels down to predetermined standards, some general estimates of effectiveness might be obtained from the experience at Lake Tahoe. Also, there is evidence to indicate that phosphorus, in some areas, may be the controlling element of the eutrophication process. If applicable, adequate reduction of the phosphorus content in waste effluent may make complete removal of the nitrogen unnecessary. As to introducing the treated effluent into deep wells, there are in south Florida certain ground

waters which are sufficiently mineralized so that they cannot be used for domestic or agricultural use. Industrial waste is now being put into deep wells near Lake Okeechobee, and the Florida Geological Survey is investigating such procedures in test wells in Dade County. The State Geologist has stated that a very porous aquifer exists under most of the Everglades region at depths of 1,500 feet or more, and that this zone has the capability of receiving large amounts of water which could be diffused into underground saline waters, eventually to find its way into the ocean or the Gulf of Mexico. These waters are under artesian pressure which would necessitate pumping to inject effluent into the strata.

With regard to piping effluent westward or southwestward to the Gulf of Mexico, it is necessary to consider the effects of any effluent pipeline across the northwest part of Everglades National Park. The drop in elevation is not sufficient to move a large quantity of effluent by gravity flow to the gulf; therefore, pumping stations would be required. The pipeline could follow the present road system passing north of the park boundary. The total length

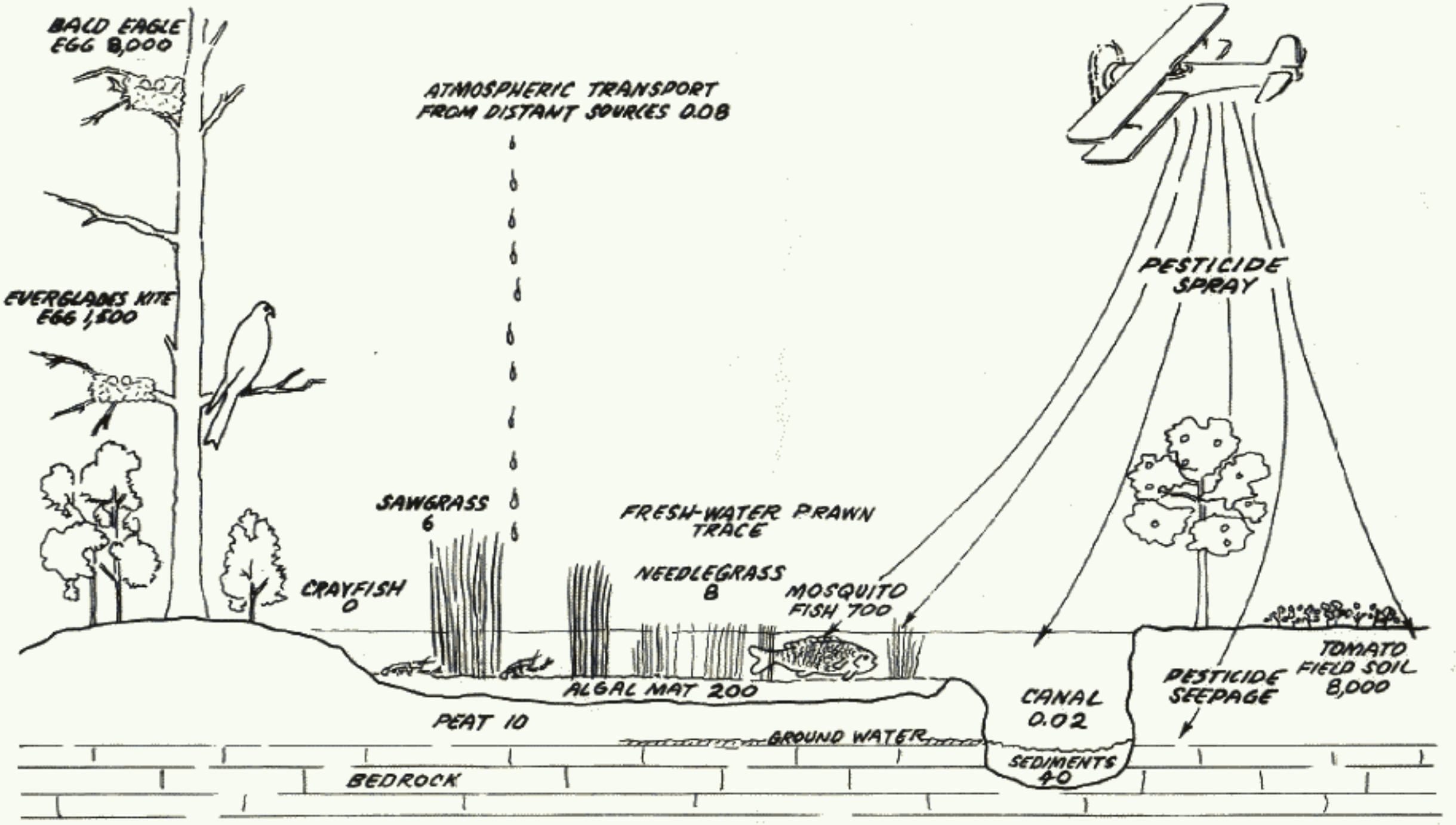
of pipe required for such a route would be greater than if a southwesterly course directly to the gulf were taken. The use of a pipeline, of course, would deprive the park of the water employed in the treatment process. A disposal system that would permit re-use of the treated waste waters would be advantageous to the park and thus appears to offer desirable possibilities. To determine which of these alternatives would be the most advantageous, from both the standpoint of cost and environmental protection, would require detailed studies.

One method of developing a waste treatment facility would be to build an initial sewage disposal plant with capacity larger than that called for by immediate design criteria. Such a plant should be supervised by a resident engineer. It would be desirable to prepare, during the initial stage of development, an engineering plan for construction of a sewage disposal system adequate to take care of the second stage of airport development. An optimum planning procedure, which is generally not followed in this country, would be to prepare a master waste treatment plan which included all three stages of airport development and

provided for increments of construction as progressive parts of the master plan. This would entail an estimate not only of the quantity but also the distribution of waste sources. This implies that the master plan would deal with all of the aspects of land development, within and outside the airport limits, including population densities, placement of residential and industrial properties, water supply and sewerage for each of the units, and the administrative and regulatory procedures by which the master plan can be imposed. It is doubtful that such a planning effort can be successfully implemented before serious and possibly terminal damage occurs to the Big Cypress and Everglades National Park.

B. Pesticides

In considering the threat from pesticides to the Big Cypress-Everglades area, the concentration of DDT and other hard pesticides in the environmental components must be examined as shown in Figure 12. Biological magnification has been demonstrated by the U. S. Geological Survey in the aquatic ecosystems of south Florida. Persistent pesticides, such as DDT, are inadvertently introduced into the water of



BIOLOGICAL MAGNIFICATION OF DDT IN EVERGLADES
PARTS PER BILLION

FIGURE 22

the environment by rainfall and inflow originating from agricultural and urban regions. The atmospheric distribution of pesticides is now worldwide but, in the immediate region of agricultural or urban use, the fallout is heavier.

Pesticides are incorporated from the water into the algal mats that form the base of the food chains for many aquatic animals. These toxins move through the food chains with negligible loss and become highly concentrated in the terminal organisms of each chain. Residues in the eggs of such birds as the bald eagle and Everglades kite are only slightly lower than those that have been shown experimentally to interfere with egg hatching. When exposed to high concentrations of DDT, females produce excessively thin-shelled eggs which easily crack during incubation. This biological magnification of pesticides has been known to be a threat to the marsh ecosystem of Long Island, New York, and to the aquatic life and birds of Lake Michigan, but only recently has the threat to the ecosystem of south Florida been called to public attention.

The concentration of pesticides in wildlife endangers man when he consumes the products of his hunting and fishing

efforts. Much of the Nation is aware of excessive DDT values in the coho salmon of Lake Michigan, but few are aware that in areas in Florida such as Lake Apopka, Florida, fish are occasionally unsafe to eat because the residues of hard pesticides exceed the Federal criterion of 5 parts per million in fish and meat products, established as a maximum level for human consumption.

In the Big Cypress-Everglades ecosystem the pesticidal content of deer, turkey, wild hogs, quail, and fish is currently being examined. The relatively high concentration of DDT existing in the animals of south Florida represents an accumulative threat for years to come. Chronic disease and partial sterility, typical of pesticide carriers, may be overlooked until whole populations wither. Certainly, for some species in the wild, the tissue level of hard pesticides is near the critical point of their survival.

Man is not to be overlooked as a component of this environment. Studies of the human community in Dade County show a mean concentration of 8 ppm of DDT in human blood. Knowledge of this matter is thus far very minimal; certainly more investigation is required to determine what effects, if any, there are on man.

The use of pesticides in Florida for agriculture, in homes, on lawns, gardens and turf, and in mosquito control exceeds 40 million pounds per year. This total includes chlorinated hydrocarbons such as DDT, organo-phosphates such as parathion, and carbamates such as Sevin. In Dade County, with a population of 1.5 million people, approximately 5 million pounds of these pesticides are used annually, including 1 million pounds of DDT and other hard pesticides. The amount used annually is increasing as urbanization and agriculture increase.

A population of 150,000 people settling into communities in the vicinity of the jetport will affect an increase in the amounts of pesticides used in south Florida. The urban-industrial-agricultural development of the Big Cypress-Everglades region will use about 500,000 pounds of these toxins. This would create an important addition to what is now reaching the ecosystem by aerial drift and runoff. The additional pesticidal burden will likely prove disastrous to some species, especially among the marsh birds and other terminal food-chain animals.

Even at present rates of application in Florida, components of the ecosystem in the Big Cypress-Everglades region will, in time, undoubtedly be irreversibly damaged.

C. Air Pollution

Not until the late 1950's was attention focused on aircraft as a source of air pollution. This coincided with the introduction of turbojet aircraft with their highly visible exhaust plumes during arrival and departure movements. Blankets of jet airplane exhaust became common at large airports. The odor of fuel permeated the surrounding area at ground level. Exhaust trails followed jets high into the air—and man wondered what might be the consequences. More correctly, some men wonder. Others are concerned and motivated to wave a flag of caution. Most simply ignore the situation.

The few that have become motivated have initiated limited studies of the problem. A report entitled, "Nature and Control of Aircraft Engine Exhaust Emissions" has been submitted to Congress by the Secretary of Health, Education, and Welfare in accordance with the provisions of the Air Quality Act of 1967. This report summarizes the available knowledge of the subject and concludes that the future will see an increase in the contribution of aircraft emissions to the total atmospheric pollution burden of the community.

In a report on air pollution emissions from jet aircraft in the New York Metropolitan Area, the U. S. Public Health Service and the Department of the Air Force compared emissions from aircraft with the total air pollution in this metropolitan area. Conclusions from this study indicated that air pollutants from aircraft engines amounted to only a small percentage of the total air pollutants. It was emphasized, however, that emissions from aircraft heavier than those currently in operation, such as the Boeing 747 and other developing models, may cause a significant impact on air pollution, particularly near airports.

Studies have shown that emissions from aircraft consist primarily of carbon monoxide, nitrogen oxides, hydrocarbons, aldehydes, and particulates. Nearly 8,000 tons per year of such aircraft pollutants were estimated to have been emitted over the New York Metropolitan Area in 1967, of the following composition:

Aircraft pollutant emissions	Tons per year
Carbon monoxide	2,653
Nitrogen oxide	1,510
Hydrocarbons	2,614
Aldehydes	239
Particulates	832
Total	7,848

As a maximum operating training facility, the Everglades Airport is expected to accommodate about 350,000 annual aircraft emissions upon the environment, according to the Department of Transportation, should approximate about 3,400 tons of emission, with the following probable composition:

Pollutant emission	Approximate tons
Carbon monoxide	1,140
Nitrogen oxide	660
Hydrocarbons	1,140
Aldehydes	105
Particulates	350
Total	3,395

The Department of Transportation explains that:

> "Over 99 percent of the weight of the kerosene-type fuel consumed by a jet engine is exhausted in the form of invisible nonpollutant gaseous products such as carbon dioxide, water vapor, oxygen, nitrogen, and excess air; all normal atmospheric constituents. Less than one percent consists of visible particulate and invisible gaseous pollutants. About one-half percent is visible particulate material (smoke) which consists of pure carbon and organic compounds. The invisible gaseous pollutants include unburned hydrocarbons, carbon monoxide, aldehydes, and nitrogen oxides which are present only in trace quantities."

Unfortunately, the biological sciences have not kept pace with engineering accomplishments so there are few data

available to support the growing belief that aircraft emissions will have important adverse effects on the Big Cypress-Everglades ecosystem. To say that there will be no effects, however, would challenge logic and reflect ignorance of environmental principles. In the nearly pristine conditions of the Big Cypress-Everglades area, such pollution tonnage (as estimated from the New York study) would suddenly comprise a very high percentage of the total air pollutants.

The damages to the Big Cypress that are likely to result from aircraft emissions are not quantifiable at present. In addition to impairing the air man breathes, air pollution affects the normal respiratory functions of plant growth. Such effects have been measured under controlled conditions. Other studies have demonstrated measured changes in water quality when air pollutants combine with exposed water surfaces. Fallout material from jet emissions would blanket many square miles of the aquatic environment surrounding the jetport and be carried groundward in the rainfall.

Certain hydrocarbons and their derivatives, particularly the phenols, are known to be highly toxic to aquatic organisms. Conceivably, under proper atmospheric conditions, the pollutant

concentrations in water areas near the landing and take-off approaches at the jetport could reach lethal limits for many animal species. If the biological magnification phenomenon characteristic of some pesticides occurs with respect to the accumulation of certain air pollutants below the lethal limits, mortality of higher animal forms, especially birds that feed on aquatic forms, could become catastrophic.

Earlier this year the Federal Water Pollution Control Administration obtained water samples from open water areas adjacent to the Miami International Airport. Analyses of the samples, which were taken from areas within the take-off and landing approach zone, showed that the chemical oxygen demand consistently exceeded 24 ppm and reached a high of 158 ppm near an aircraft taxi service area. Such values are not conclusive as to origin but they do indicate that some material, whether from aircraft or not, was present and was affecting water quality. Such figures lend support to a need for intensive studies of this potentially dangerous phenomenon.

There is a possibility that air pollutants could increase the frequency of ground fog in the vicinity of the

jetport. Meteorologic conditions near the ground in Big Cypress Swamp differ from other southern Florida airport locations due to large areas of water surface especially near Conservation Area No. 3.

Air pollution will also increase in proportion to the number of automobiles using the jetport access road and the port area. Whether or not a high-speed transportation facility is built, the increase of automobile travel in the Big Cypress area associated with the jetport in the cargo and full development stages would cause a significant increase in pollutant emissions.

4. Wildlife.

Rare and Endangered Bird Species.

A critical aspect of the effects of the development on wildlife is its potential impact upon the species which depend on the south Florida ecosystem for their survival in the United States. There are 12 birds included in the list of rare and endangered fish and wildlife of the United States which occur in the Big Cypress Swamp. See Table 1. Most of them also occur in the park estuaries that receive drainage from this area.

Eastern Brown Pelican. Several colonies, with a combined total of about 500 birds, breed in the Gulf Coast estuaries downstream from the Big Cypress. The reproductive physiology of the brown pelican appears to be highly susceptible to the effects of residues of persistent pesticides. Large populations in coastal Texas and Louisiana have disappeared during the past 10 years. In 1969, colonies on islands off southern California and Baja California experienced a complete failure of reproduction which was attributed to pesticides. Wholesale population declines elsewhere (see also Bald Eagle, Osprey) give an added significance to the southern Florida populations which are still reproducing successfully.

Florida Great White Heron. A few pairs nest in the estuaries near colonies of great blue herons. Seasonally (March-August), great white herons range north into the Big Cypress area from their principal breeding grounds in Florida Bay and the Florida Keys. Individual birds occur in fair numbers (high count, about 50) in the Gulf estuaries and less commonly (high count, about 15) in the interior Big Cypress.

Wood Ibis (Stork). This species breeds in the United States only in peninsular Florida (Figure 13), where its population has declined by at least 80 percent since 1940 because of drainage and gradual loss of habitat. Two-thirds of the wood ibis found in the United States breed in the Big Cypress in winter (late November to May). The National Audubon Society's Corkscrew Swamp Sanctuary protects the largest nesting colony, but wood ibis breeding at Corkscrew Swamp feed throughout the Big Cypress. At various times in recent years, smaller colonies have nested in at least 6 other Big Cypress localities. Because they feed by groping, rather than by sight, the feeding efficiency of wood ibis depends directly upon number of food items per volume of water, and their breeding and migration are closely tied to the seasonal hydrologic cycle. In south Florida, wood ibis can obtain enough food to breed successfully only in winter when dense populations of fish 1 inch to 5 inches long (concentrated by lowering of water level) are available for a period of about 4 months. Both unseasonal winter rains and early droughts have caused nesting failures. Wood ibis leave southern Florida in summer (as rising water makes feeding difficult) and disperse throughout the coastal plain of the southeastern United States.

An additional 15 to 20 percent of the United States population of wood ibis breed in the southern part of Everglades National Park. These birds regularly feed in the coastal estuaries directly downstream from the Big Cypress for 2 to 3 months in late fall and early winter while enroute to their nesting areas. Also, in years when an early drought in their usual feeding grounds threatens their breeding success (most recently in the spring of 1967), wood ibis make one-way flights as long as 45 miles from park nesting colonies to feed in the eastern Big Cypress along Levee 28 in the immediate area of the jetport.

Roseate Spoonbill. This species nests in Florida only in Florida Bay, but large numbers of immature and sub-adult spoonbills feed in the Big Cypress and its associated estuaries during much of the year (Figure 14). Sub-adults of the Florida Bay population numbering 6-700 (roseate spoonbills require 3 years to reach maturity) concentrate in summer in the Ten Thousand Islands region of the Big Cypress estuary and move to interior estuarine areas to feed in late fall and early winter. From midwinter to spring, sub-adults, plus fledged young, disperse northward from the Florida Bay

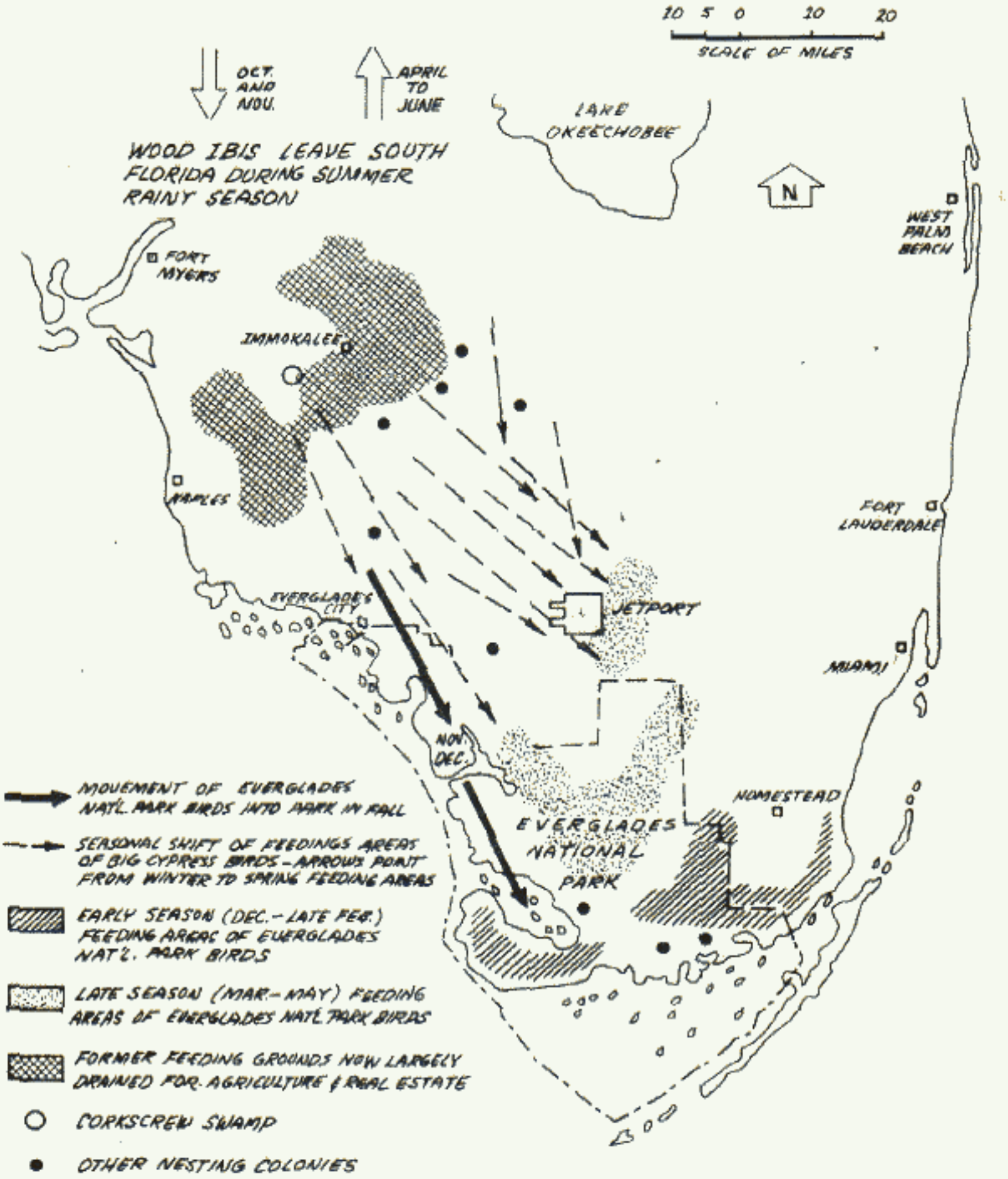


FIGURE 13- SEASONAL PATTERN OF WOOD IBIS OCCURRENCE IN SOUTH FLORIDA

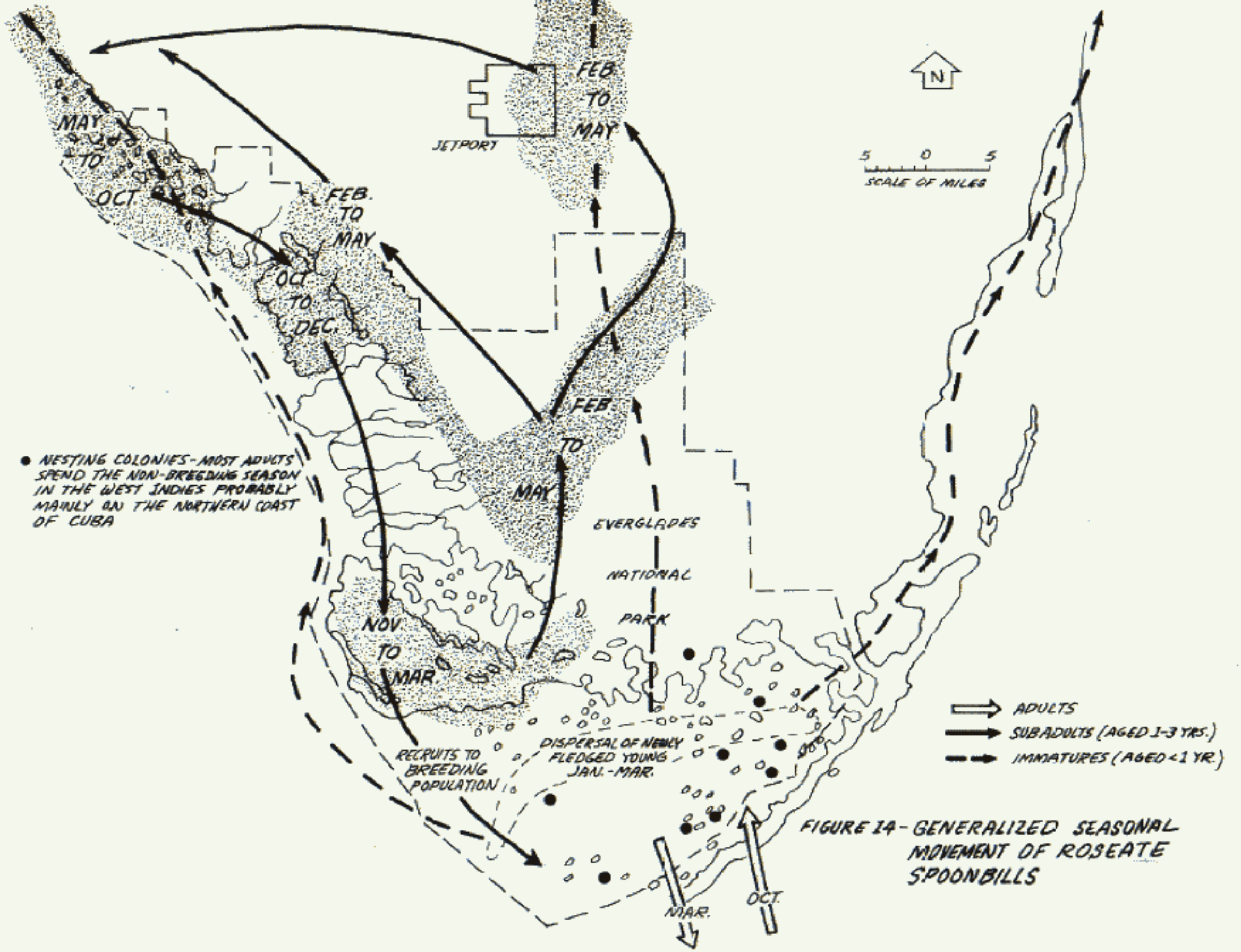


FIGURE 14 - GENERALIZED SEASONAL MOVEMENT OF ROSEATE SPOONBILLS

colonies and feed heavily in the eastern Big Cypress and adjacent Everglades. Figure 14 depicts the generalized seasonal movements of roseate spoonbills in southern Florida.

Florida Everglades Kite. The main habitat of this species is in Loxahatchee National Wildlife Refuge (Conservation Area No. 1), and Conservation Area No. 2A (see fig. 2), where permanent flooding favors high populations of the marsh snail, Pomacea paludosa, which is the Everglades kite's only known food. Scattered individuals (mainly immature birds) range widely over the Everglades and into the eastern Big Cypress at times of high water in summer and early fall, and feed wherever snails are available.

Southern Bald Eagle. The history of this species since the early 1950's is one of widespread nesting failure and rapid disappearance from most of its former range. The estimated 125 breeding pairs that nest in south Florida and interior central Florida appear to be the only population of southern bald eagles that is still reproducing at a rate adequate to maintain itself. About 20 percent of this population inhabits the Big Cypress and the coastal estuaries whose

ecology is influenced by drainage from the Big Cypress. Most bald eagle nests in the Big Cypress interior are located in the transition area between the eastern Big Cypress and the Everglades. These include three recently active nests on or near the jetport lands.

American Osprey. It has become evident within the past 3 or 4 years that ospreys are decreasing rapidly in the same pattern earlier shown by bald eagles. Formerly abundant populations of the Great Lakes, the New Jersey coast, and Long Island Sound are declining to extinction levels because of wholesale nesting failures apparently resulting from environmental pollution by persistent pesticides. A less rapid decline has been reported for the population of Chesapeake Bay. As with the bald eagle, it appears the osprey's last stand in the eastern United States may be made in south Florida, where a still-thriving population estimated at 1,000 adults occurs south of the line Cape Romano-Big Cypress-Cape Florida. Roughly 40 percent of these inhabit the Big Cypress area, principally in its downstream estuaries.

American Peregrine Falcon. The peregrine falcon became extinct as a breeding species in eastern temperate

North America in the early 1960's. It survives in the Arctic, whence populations migrate annually through the eastern United States to winter mainly in South America. Part of this flight, estimated at 75 birds, passes through the Gulf Coast estuaries of the Big Cypress during spring and fall. A lesser flight, of possibly 20 birds, follows the eastern edge of the Big Cypress. Occasional birds winter both on the coast and in the interior, when suitable concentrations of prey species (ducks, shorebirds) are present.

Florida Sandhill Crane. Sandhill cranes are permanent residents throughout the pine and prairie regions of the Big Cypress and a few pairs also breed in coastal marshes downstream from the Big Cypress.

Cape Sable Sparrow. This rare, relict species is known only from downstream areas of the Big Cypress drainage where small colonies occur in the tenuous belt of Spartina marsh found along the interface between the Big Cypress and the coastal mangrove swamps. The population estimate of 500, denoted in the Rare and Endangered Species list (Table 1), apparently assumes a more or less continuous distribution in suitable habitat. The distribution, in fact, is highly

discontinuous and the actual known population of Cape Sable sparrows is less than 100 individuals. The species appears to be extremely vulnerable to any disturbance of its habitat, either by fire or by inland extension of the mangrove belt.

Short-tailed Hawk. The short-tailed hawk is found in the United States only in scattered areas of peninsular Florida where the total population may not exceed 150 adults. Perhaps 30 of these breed in the Big Cypress. Additional birds, migrants from central and northern Florida, probably winter in the Big Cypress.

Red-cockaded Woodpecker. This species is closely limited to mature pine forest and has disappeared from much of its former range as pine forests were cut over. Pine tracts of the southern and northeastern Big Cypress harbor what is probably the largest remaining population of the southern Florida subspecies.

In addition to those species officially listed as rare and endangered, substantial portions of the total United States population of at least 4 other rare or otherwise notable bird species are seasonal or year-round inhabitants of the Big Cypress area.

Table 1. *Estimated occurrence of rare and endangered bird species in the Big Cypress area*

Species	U.S. population (estimated number breeding adults	No. (and % total U.S. breeding in: Big Cypress	Big Cypress estuary 1/	No. feeding (bird-days/yr) in: Big Cypress	Big Cypress estuary
Eastern Brown Pelican	16,000	-----	500 (3%)	-----	Resident
Florida Great White Heron	1,600	-----	10 (1%)	1,500	11,000
Wood Ibis	12,000	7,800 (65%)	-----	1,650,000	315,000
Roseate Spoonbill	4,500	-----	-----	20,000	106,500
Florida Everglades Kite	*100*	-----	-----	<100	-----
Southern Bald Eagle	350	14 (4%)	36 (10%)	Resident	Resident
American Osprey	1,000 2/	30 (3%)	370 (37%)	Resident	Resident
American Peregrine Falcon	5,000 3/	-----	-----	300	900
Florida Sandhill Crane	2,500	200 (8%)	20 (1%)	Resident	Resident
Cape Sable Sparrow	500 3/	-----	(100%)	-----	-----
Short-tailed Hawk	150	25 (17%)	5 (3%)	7,200	1,800

1/ Roughly Lostmans River to Cape Romano.
2/ Estimated population in southern Florida.
3/ From BSFW list of Rare and Endangered Species. Estimates probably too high.

White Pelican. Most of the white pelicans that breed east of the Continental Divide winter in southwestern Florida. This population, totaling 4,000 to 5,000 birds, feeds in estuaries of the Big Cypress drainage in late fall before moving farther south. Similar feeding activity, usually involving fewer birds, occurs along the headwaters of southwest coast rivers in March-April, just before the northward migration.

Anhinga. The anhinga has a wide range in the southern United States, but one of its chief population centers is the Big Cypress where it nests commonly in many cypress sloughs and ponds. The population there is estimated at around 1,000 adults.

Swallow-tailed Kite. Once widespread in the United States, swallow-tailed kites are now largely confined to less disturbed parts of the Florida peninsula. The estimated 350 adults that breed in the Big Cypress and its estuaries probably represent at least one-quarter of the United States population. The species is migratory and is found in the area from late February or March to early September.

Limpkin. Limpkins, found in the United States only in peninsular Florida and southeastern Georgia, are

particularly common in the Big Cypress. The population there probably exceeds 1,000 adults.

Most of the birds discussed above are already hard-pressed and have small, generally declining, populations in the United States. Continued reduction or degradation of their remaining habitat is certain to cause further population declines and, ultimately, extinction. If development of the jetport and lands around it causes significant environmental damage through drainage, eutrophication, pesticide pollution, or other adverse change, then heavy losses to birds that now depend upon habitat in the Big Cypress and its downstream estuaries are inevitable. The endangered species that seem most precariously situated are the Cape Sable sparrow and wood ibis. Assuming full development, the former species is likely to become extinct in a few years through elimination of its habitat by encroaching mangroves, as the volume and distribution of upland flow from the Big Cypress changes.

The United States stands to lose at least 50 percent of its wood ibis population if the critical feeding grounds in the Big Cypress are drained. In this species and other wading birds that nest in dense colonies, social stimulation plays

a major role in nesting success. Below some lower limit of colony size, nesting often fails regardless of ecological conditions. This exact point of no return for a wood ibis population is not known.

Effects upon other bird species will develop more slowly as productivity declines and pollution increases in the estuaries that receive drainage from the fully developed Big Cypress. The existing load of persistent pesticide residues in Everglades National Park estuaries is near the level at which biological damage to the susceptible species (brown pelican, bald eagle, osprey) at the top of food chains becomes predictable.

Common and Rare Mammals.

South Florida has only 30 to 35 species of native mammals. Nearly all the land mammals are species that are widely distributed in the southeastern United States or even more extensively in North America. Although the general biology of most of these species is well known, few have been studied in detail locally, or in habitats resembling those found in south Florida. Exceptions would be such species as the fox squirrel, the white-tailed deer and the round-tailed muskrat.

Four mammals found in the area under discussion—the mangrove fox squirrel, the manatee, the Florida panther, and the Everglades mink—are considered rare and endangered species. The habitat preferences, population status and distribution of these four, as well as several other common or conspicuous forms, are listed in Table 2.

Additional comments on some of these species are as follows:

Manatee. Populations at present appear to be stable. The future status of these animals is uncertain, however, as their ability to survive under modified water conditions has not been determined. The present United States population will become an increasingly important representative of this species as these animals disappear in other areas of their range (such as Central America) where they are exploited intensively as a source of meat.

Florida Panther. Little is known about this rare and endangered subspecies since it is usually active only during the night hours. It is believed, however, that an individual panther requires a territory several square miles in size to sustain itself. The destruction of the

Table 2. Some Common and Rare Mammals found in the Big Cypress Swamp Jetport Area

Species	Big Cypress Population	State Pop.	% of Pop.	Distribution	Preferred Habitat	Future Trends
			RARE and ENDANGERED MAMMALS			
Florida Manatee *(Sea Cow)*		unknown	?	Everglades National Park, Biscayne Bay, St. Johns River	Marine & estaurine	Will probably survive with protection & maintenance of estuarine areas.
Mangrove Fox Squirrel	unknown	unknown	unknown	In area west of the Everglades & south of the Caloosahatchee River.	In mangrove forests	Unable to estimate
Panther (Florida)	125 (1 per 10 sq. mi.)	100-300	75%	Sporadically distributed statewide mainly Everglades	Mixture of swamps, hammocks, flatwoods, and sand pine-scrub oak type when in relatively inaccessible condition	Population on decline due to encroachment into inaccessible areas.
Everglades Mink	Rare—Population Unknown	unknown	?	Everglades area	Aquatic habitats, swamps, marsh, lakes, *ponds*, *bays*, rivers, coastlines	Population declining due to encroachment and loss of habitat.

OTHER MAMMALS

Species	Big Cypress Population	State Pop.	% of Pop.	Distribution	Preferred Habitat	Future Trends
Wildhog	300 - 500	17,000	3%	Sporadically statewide (not a game animal in Collier Co.)	Mixture of flatwoods, hammocks, sand pine-scrubcak, swamp, fresh-water marsh, & pineoak uplands	Needs constant re-stocking or could easily be killed out.
Bobcat	400 - 500 (1 per 2 sq. mi.)	unknown	--	Statewide	Mixture of swamps, hammocks, flatwoods, & sand, pine-scruboak types	Population on decline due to loss of habitat.
Marsh Rabbits	Common Populations unknown	unknown	--	Statewide	Mixture of swamps, hammocks, marshes, wet prairies, wet pine flatwoods, mangrove swamps.	Population at peak and fluctuating.
Round-tailed Muskrat	Common in Restricted areas	unknown	--	Statewide in restricted areas	Aquatic habitats, swamps, marsh, lakes, ponds, rivers.	Population static or on decline due to drainage

Species	Big Cypress Population	State Pop.	Percent of Pop.	Distribution	Preferred Habitat	Future Trends
Otter	Common Population Unknown	unknown	--	Statewide	Aquatic habitats, swamps, fresh-water marshes, lakes, ponds, rivers, bays & coastlines	Population on decline due to drainage & loss of habitat.
Squirrel - Grey	150,000	5,000,000	3%	Statewide	Mature forest stands in swamps, hammocks & around towns where trees are abundant. No. 1 small game in Fla.	Population is at its peak and is declining due to destruction of hardwoods.
Black Bear	80-100	1,000	8-10%	Sporadically Distributed Statewide	Mixture of swamps, hammocks, flat-woods, and sand pine-scruboak types when in relatively inacces-sible condition	Will remain constant for 10-15 years then go down in numbers from human population pressure.
White Tailed Deer	7,000	300,000	3%	Statewide	Mixture of flat-woods, sand pine-scruboak, pine-oak uplands, swamp, hammocks and fresh-water marsh. No. 1 big game in Fla.	Population on the increase since screw worm fly larvae eradication program.

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Bobcat	400 - 500 (1 per 2 sq. mi.)	unknown	--	Statewide	Mixture of swamps, hammocks, flatwoods, & sand, pine-scruboak types	Population on decline due to loss of habitat.
Marsh Rabbits	Common Populations unknown	unknown	--	Statewide	Mixture of swamps, hammocks, marshes, wet prairies, wet pine flatwoods, mangrove swamps.	Population at peak and fluctuating.
Round-tailed Muskrat	Common in Restricted areas	unknown	--	Statewide in restricted areas	Aquatic habitats, swamps, marsh, lakes, ponds, rivers.	Population static or on decline due to drainage

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White Tailed Deer	7,000	300,000	3%	Statewide	Mixture of flat-woods, sand pine-scruboak, pine-oak uplands, swamp, hammocks and fresh-water marsh. No. 1 big game in Fla.	Population on the increase since screw worm fly larvae eradication program.

OTHER MAMMALS

Species	Big Cypress Population	State Pop.	% of Pop.	Distribution	Preferred Habitat	Future Trends
Raccoon	80,000 (1 per 10 acres)	unknown	--	Statewide	Mixture of swamps, hammocks, flatwoods and sand pine-scruboak types	Population is at peak and fluctuating
Opossum	Common	unknown	--	Statewide	Mixture of swamps, hammocks, flatwoods and sand pine-scruboak types	Population is at peak and fluctuating.

Big Cypress Swamp, where an estimated 75 percent of the total (Florida) population is now found, would likely bring about its extinction.

Everglades Mink. This is another species which could very likely be pushed toward extinction if the Big Cypress Swamp were destroyed. The development of this area, with associated drainage activities and water pollution, would disrupt the food chain and destroy the habitat upon which this animal depends for its survival.

Round-tailed Muskrat and the Otter. The populations of these animals would no doubt be severely affected in and adjacent to the jetport site. As in the case of the Everglades Mink, this would be due primarily to the loss of habitat and the disruption or destruction of the aquatic food chains on which these animals are dependent.

Black Bear and Bobcat. These two species are highly intolerant of close association with man and would be some of the first animals to disappear from the Big Cypress Swamp as it is drained and developed.

Amphibians and Reptiles

A total of 15 to 20 amphibians and 55 to 60 reptiles are present in the area under discussion. Little is known of the life history of a great majority of these species, but many of them, due to their great numbers (frogs, box turtles, anoles, etc.) and/or size (alligators, diamondback rattlesnakes, etc.) are important members of food chains within the Everglades ecosystem. Modification or destruction of this ecosystem would likely have considerable effect on the distribution and numbers of most of these species—in particular the rare and endangered American alligator.

Little is known about alligator numbers in the Big Cypress Swamp except from wildlife officers. They regard the swamp as one of the areas most subject to alligator poaching. Alligators in this area occur in the cypress heads which have some water year round. Low-water periods render these heads and thus the alligator more accessible to man's modern transportation. Artificially altered water level would not only increase this activity but would alter the habitat itself, thus lowering numbers further or even eliminating the species from the Big Cypress Swamp.

Game Birds.

A number of birds, often regarded as game species, reside or spend a portion of the year in the Big Cypress Swamp area. Those most commonly known are listed in Table 3.

It can be expected that turkey, quail, and perhaps doves might increase in numbers as the jetport and adjacent areas begin to be developed. This would be due primarily to drainage activities which would create a greater abundance of the dry habitat conditions that these species prefer. However, in the later stages of development, when pavement, homes, and other buildings replace trees, shrubs, and grasses, these birds will inevitably disappear.

Waterfowl, on the other hand, will no doubt be adversely affected during a much earlier phase of development—the drainage stage. Such activities will deprive these birds of feeding and nesting habitat. Waterfowl that winter in the estuaries along the Gulf Coast will also eventually be affected when the jetport and adjacent lands approach full development. The alterations in the seasonal flow of the surface water, and in its quantity and quality, will affect the plants and organisms upon which these aquatic birds depend for their subsistence.

Table 3. --Game birds found in the Big Cypress Swamp area

Species	Big Cypress Population	State Pop.	Percent of Pop.	Distribution	Preferred Habitat	Future Trends
Turkey	5,000	80,000	6%	Statewide	Swamp, hammocks, flatwoods. No. 2 big game in Fla.	May increase to 100,000 and population will fluctuate.
Quail	80,000	8,000,000	1%	Statewide	Agriculture lands, flatwoods and pine-oak uplands where controlled burning *practiced.*	Population on decline statewide due to loss of habitat.
Dove	60,000	12,000,000	.5%	Statewide	Croplands and residential areas. Some located in all types of habitat.	Population at peak and will fluctuate.
Waterfowl(Mallards, Scaup, Widgeon, Teal, Ringnecks, Pintails, etc.)	2,000	5,000,000	Trace	Statewide	Aquatic habitats, swamps, freshwater marsh, lakes, ponds, rivers, bays, coastlines.	Will fluctuate. On decline at present time due to drainage.

A great majority of the animals discussed in the three subheadings above are dependent upon aquatic-based food chains for their survival. Their relationships within, and their dependency upon the ecosystem are phenomena that have developed very gradually over a period of many thousands of years. Sudden and large-scale alterations of this ecosystem (such as would occur with development of the jetport and satellite development) can certainly be expected to have a serious impact on all wildlife that are dependent upon its stability and productivity for their welfare and survival.

5. The Coastal-Mangrove Zone

The seasonal fresh water run-off from the Big Cypress passes into a broad mangrove-dominated estuarine zone along the coast (Figure 15). This zone comprises about 430 square miles, including its mangrove forests, prairies, and estuaries, as compared to the 1,200 square miles of the Big Cypress tributary area. The coastal zone within the influence of Big Cypress drainage contains about one third of the total mangrove-estuarine complex of Everglades National Park. It also includes about 1/3 of the proposed Cape Romano-Ten Thousand Islands Aquatic Preserve—the establishment of which is now under consideration by the State of Florida. The limits of the Big Cypress

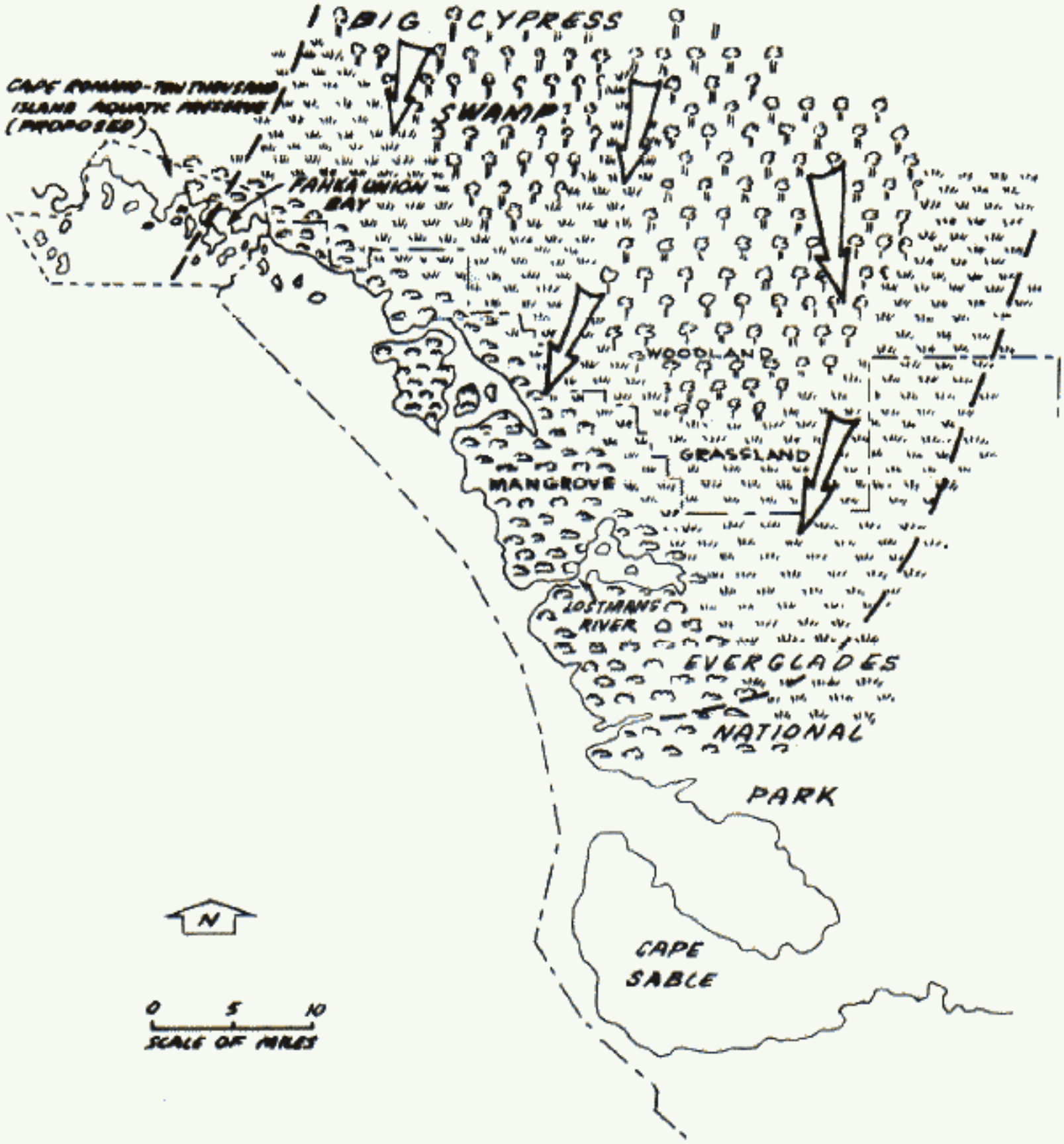


FIGURE 15- MANGROVE ESTUARINE ZONE

drainage within the coastal mangrove zone are poorly defined; the coastal zone that is subject to its influence extends approximately from Lostmans River on the south to Fahka Union Bay on the north.

Within the 430 square mile area, perhaps 40% consists of mangrove, 20% of higher uplands, and 40% of ponds, streams and bays. The area includes all of the northwest portion of Everglades National Park, and somewhat beyond. It includes about half of the coast area known as the Ten Thousand Islands.

The coastal zone is characterized by levels of productivity and species diversity as high as can be found within the continental United States. In addition to its very large bird populations which have been treated elsewhere in this report, the area produces or maintains hundreds of species of aquatic organisms.

Studies of this remote and generally primitive area have been few, but one unpublished series of collections of the aquatic life in the area listed 44 species of fishes, 43 species of mollusks, 7 species of echinoderms, and 65 species of crustaceans. The observed numbers of species would undoubtedly be greatly enlarged if collections were made of smaller

more obscure creatures, many of which are vital links in the food chains of the ecosystem.

Some of the better known aquatic species which occur in this area are:

Manatee (rare and endangered species)
loggerhead turtle (nearing rare and endangered status)
alligator (rare and endangered species)
mullet
tarpon
snook
sheepshead
spotted sea trout
channel bass (red fish)
mangrove snapper
popano
black drum
flounder
grunt
yellow tail
oyster
blue crabs
stone crabs
spiny lobster
pink shrimp

Many more species known to be important forage organisms, such as anchovies, mojarra, pin fish, killifish, mosquitofish, crayfish, and grass shrimp are abundant here.

Mollusks include conchs, murex, whelks, tulips, Junonia, cones, ark, southern quahog, sunray venus, angel wing, razor clam, oysters and many others.

Any nearly complete list of species of the area would demonstrate a multitude of species and an ecosystem of great diversity and complexity.

Sport fishermen make extensive use of the area. Although no overall study of sport fishing has been made, examination of figures derived from studies made at Flamingo (Everglades National Park) suggests that present use is in the order of 40,000 or more fishermen per year. It is important to note that Everglades City, a popular launching site, is about 10 miles farther from Miami than Flamingo.

The average annual production of the ten top commercial fish species is in excess of one million pounds. Members of this group include: bluefish, channel bass, grouper, king mackerel, mullet, pompano, sea trout, spanish mackerel, mangrove snapper and stone crab. Some of these, even though taken in the offshore waters, are dependent on the food organisms produced within the coastal zone.

The importance of the mangrove-estuarine zone of the coast, as denoted by the abundance and diversity of the species present, is related to the fact that it provides a protective harbor (especially for juvenile organisms) and rich sources of food.

In general, many of the marine species occupy some portion of the protective brackish coastal zone as juveniles, but later move seaward. Protection within the estuary is derived from the lower salinities and the grasses and mangrove roots which afford abundant shelter. Some species, such as the fresh water killifishes, and mosquitofishes, remain within the area throughout their life. Some marine species do likewise, including many forage species and the popular spotted sea trout. It is well known that fishes such as tarpon, snook, mullet, redfish and others move freely to the open Gulf as they grow.

The importance of the mangrove estuarine zone is dramatically illustrated in the life cycle of the pink shrimp which supports the commercial fisheries of the Sanibel and Tortugas grounds (Figure 16). Extensive research conducted by the Institute of Marine Sciences, University of Miami, and the U. S. Bureau of Commercial Fisheries has shown that the pink shrimp spawn on the fishing grounds and that the newly spawned larvae migrate to the coastal estuarine areas. Here, because of the abundant food and the protection afforded by estuarine conditions, the larval shrimp develop through the post-juvenile stages and then migrate seaward to the above mentioned fishing grounds where they support

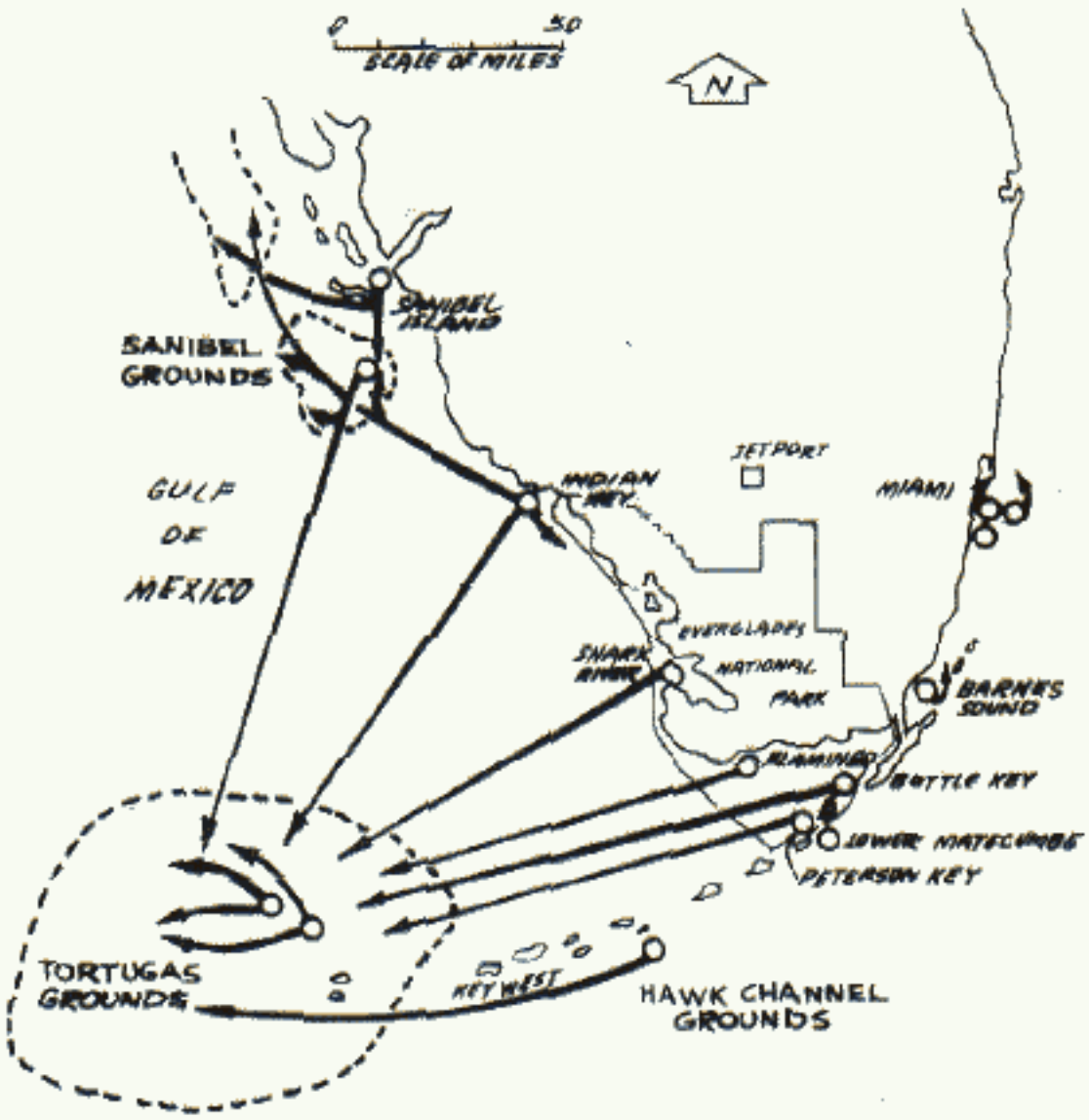


FIGURE 16 - RELEASE-RECOVERY SITES OF MARKED PINK SHRIMP IN THE WATERS OF SOUTH FLORIDA, 1958-63.

the valuable commercial fisheries present there. An interruption of this life cycle through a loss of the coastal estuarine areas will severely deplete if not totally eliminate the 6.36 million dollar (1967) shrimp fisheries. This knowledge demonstrates a direct ecological link of the coastal zone with thousands of square miles of the Gulf of Mexico.

That the richness of the estuarine system is to a large degree dependent on red mangrove and on brackish water conditions has been demonstrated in recent studies made of such habitat in Everglades National Park. The aims of the study were "to estimate the annual production of dead plant material by the three main producers—red mangrove, sawgrass and blackrush; to investigate the mechanisms by which such material enters the food web and the rate at which this proceeds; to determine, as far as possible, fluctuations in the quantity, nature, and origin of the dead plant nutrient materials of the river; and, to ascertain the potential nutritive value of dead material if consumed at any specific stage of decomposition."

An essential finding was that mangroves occupied about 65% of the study area, but produced 85% of the dead plant material. About 5% of the annual leaf production by mangroves is consumed by terrestrial grazers. The remainder eventually

enters the aquatic system as debris and is an important energy source for the food chain. Debris of mangrove origin accounted for between 35 and 60 percent of the total suspended material each month.

As the plant debris degrades, it becomes relatively rich in protein, probably as a result of buildup of microbial populations which use the debris as a nutrient source. An important element in the degradation process is that it proceeds more rapidly in brackish water than in fresh water or under subaerial conditions.

The study also demonstrated that the energy source provided by mangroves is important not only within the mangrove zone but extends well beyond the forest and into the adjacent bays and coastal areas. The dead plant materials from these trees is transported from the mangrove forests to the bays and coastal areas principally in the months November through February, when northeast winds blow coastal waters off shore, causing gravity drainage of fresh and brackish detritus-laden waters from the marshes. The material is then available to many species which are unable to tolerate estuarine conditions.

Any construction or development activity in the Big Cypress Swamp which leads to its drainage will alter the hydroperiod in the coastal zone. This would result in faster run-off during the wet season, and an extension of the dry period. Even if the annual volume of run-off passing through the coastal zone is unchanged, the seasonality of flow would be drastically altered.

All of the organisms in the coastal zone are adapted to a long period of brackish water conditions that extends beyond the rainy season. If these conditions do not continue, spawning periods and estuarine nursery activities will be out of phase with the artificially created hydroperiod. The rapid degradation of mangrove detritus that occurs under brackish conditions will also be reduced and the detrital food chain markedly disrupted. With these disruptions, the estuarine and offshore Gulf waters would probably be unable to support the high population levels of aquatic species that they now do.

6. Noise Pollution

Through no detailed noise studies have been made relative to the effect of aircraft noise upon the jetport's surrounding environment, the Federal Aviation Administration

has estimated the level of such noise, and the scope of areas affected outside the boundaries of the jetport has been identified. Their projections are based on the airport functioning as a training facility accomodating 225,000 annual operations while a single runway facility, and 350,000 annual operations when equipped with a second runway. The Federal Aviation Administration's estimate shows that a perceived noise decibel (PNdb) level of 100 (Zone 2) will extend westward from the jetport's west boundary a distance of about 6 miles and eastward from its east boundary about 7 miles over Conservation Area No. 3. Laterally, the same noise level will occur at a point about one-quarter mile south of the jetport's southernmost boundary, or when viewed from the tranquility interest of the Everglades National Park, at a point about 5 3/4 miles north of the northernmost boundary of the park.

As previously indicated, while the jetport operates as a single runway facility, its serving traffic pattern will lie to the north, thus the foregoing represents the Federal Aviation Administration's estimate of the degree of initial noise intrusion on the park except for occasional transitioning overflights. However, when a second runway is added, a southern

traffic pattern must be utilized (Figure 17). This will cause aircraft to fly parallel to the park's northern boundary at a distance of about one mile and generally at an altitude of 2,500 feet. During that time, the noise level directly below the aircraft will approximate 78 to 82 PNdb's.

For further understanding of the above, community response to noise exposure is approximately as follows:

PNdb level	Response
Below 100 (Zone 1)	Essentially no complaints are to be expected; however, noise may interfere occasionally with certain residential activity.
100-114 (Zone 2)	Individuals may complain, perhaps vigorously. Conservative group action is possible.
115 and over (Zone 3)	Individual reaction will likely include repeated vigorous complaints. Concerted group action might be expected.

The two-runway training complex would occupy the southern third of the total jetport complex. From the airfield viewpoint, expansion of the jetport to its ultimate operational capacity merely requires the construction of additional runways in the middle and northern thirds of the complex. Thus from the noise standpoint, expansion of the airport causes additional noise to the north.

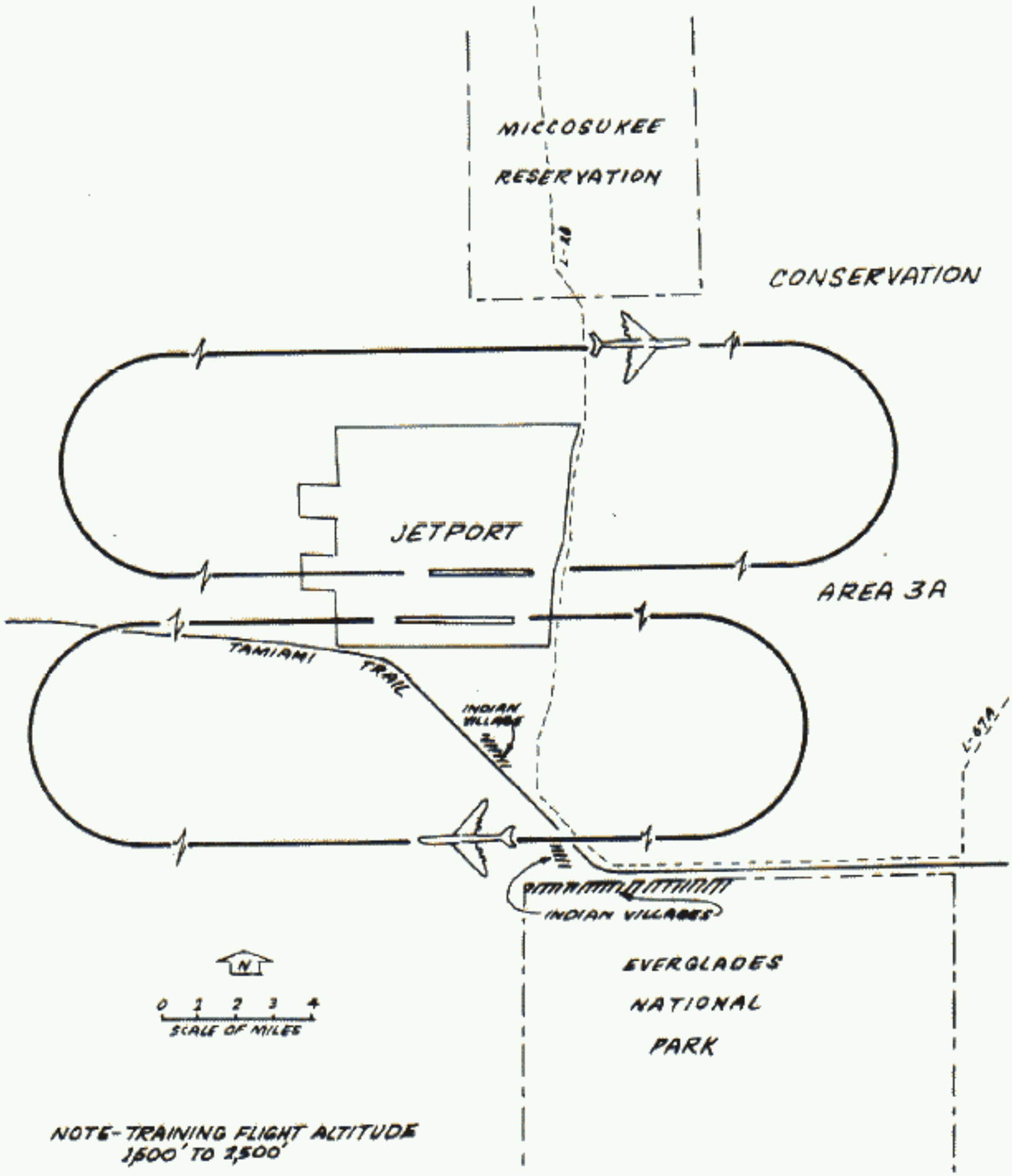
Aerospace Technology reports that during takeoff present-day jet aircraft produce noise levels in the 120 PNdb range, three miles away.

Shurcliff in SST and Sonic Boom Handbook (1968) states:

> "I am deeply worried about the SST's sideline noise during take-off . . . populated areas abreast of the runway will be flooded with noise that exceeds today's noise level, generated by DC-8's and 707's, by a very, very wide margin."
>
> "The Concorde '. . . may show a rather startling 124 PNdb figure during approach . . . '"
>
> "'Aircraft noise in the range of 100-110 PNdb is considered as unacceptable in the vicinity of metropolitan airports.' Each increment of 20 on the PNdb scale represents a factor of 100 in loudness. Thus a PNdb 124 loudness is more than a hundred times a PNdb 100 loudness."

Aircraft utilizing the south runway would pass close to the northern border of the Everglades National Park, and almost directly over Indian villages near the Tamiami Trail and in the Big Cypress. All aircraft from both runways would pass directly over Conservation Area No. 3A, immediately to the east of the runways. Regardless of wind direction or changing of the takeoff-landing orientation, the above pattern apparently would remain firm. Flying altitudes for these training flights will range from 1,500 to 2,500 feet.

Complaints about excessive noise from aircraft normally originate from residents living within or close to the operating flight patterns. The location of this jetport adjacent to



NOTE- TRAINING FLIGHT ALTITUDE
1,500' TO 2,500'

FIGURE 17 - TRAINING FLIGHT PATTERNS

Conservation Area No. 3 and Everglades National Park was selected with this factor in mind. Some additional buffering is planned for those areas west and north of the jetport.

The existing population density near the area bounded by the flight patterns is extremely low. Indian families presently constitute the major "people" element to be affected by noise pollution from training activites. Although the tribal population is small compared to an urban community, noise introsion into their wilderness existence will be very great indeed, if not intolerable.

The intrusion of aircraft noise into the Everglades National Park must also be recognized as a major impact. In fact, in authorizing the park, Congress specifically noted the "wilderness" character of the area and clearly demonstrated an intent to preserve the wilderness atmosphere. This intent has recently been more positively emphasized by enactment of the "Wilderness Act" which requires, in effect, that large, publicly owned roadless land areas be evaluated and, if they meet certain criteria, preserved in such state. A major portion of the park is now being evaluated for this purpose. Noise intrusion from aircraft would not be compatible with this concept.

Little is factually known of the effect of aircraft noise on wildlife. The Department of Transportation submitted the following information:

> "Low aircraft flights over large ground concentrations of birdlife are common at many of the Nation's airports. Universally at these locations, the birdlife reaction has dwindled to complete disinterest following relatively short periods of noise exposure. The probability that a comparable reaction will occur at this airport site is enhanced by observations that the noise from fast-moving vehicles along the Tamiami Trail and upon the interior roadways of the Park very often fail to flush birdlife from the adjacent canals and roadsides, only 50 to 75 feet away.
>
> "During recent noise measurement tests conducted within the Park, observation was made of birdlife reaction to a B-720 jet aircraft flying directly overhead at levels ranging downward from 5,000' to 500'. In each instance a binocular search was made over a wide area of open bay and mangrove cover which was observed to be bird populated. Twelve overflights by the aircraft failed to flush the birdlife at any time. Moreover, those visible upon the ground did not appear to become disturbed, even when the overflight was conducted at the 500-foot altitude with the aircraft under power climb configuration.
>
> "The aforementioned tests were conducted primarily to determine the noise levels imposed on the Park from overflying jet aircraft at various altitudes. The test plane made two passes over two different locations from opposite directions. The resulting noise levels are indicated below:

Flight altitude	Average decibel level	
	Location No. 1	Location No. 2
5,000 feet	70	70
4,000 "	77.5	73

Flight altitude	Average decibel level: Location No. 1	Location No. 2
3,000 feet	80	75
2,000 "	83.5	80.5
1,000 "	81.5	83.0
500 "	94.0	96.5

"Location No. 1 was the observation tower at Anhinga Trail Site 12. Location No. 2 was in Whitewater Bay at the extreme southern boundary of the Park. The latter was chosen by Park officials as representative of a large marshy and open water area where birdlife would be exposed to both direct and reflected noise. The tower site was chosen because of its heavy ground cover, the fact that lectures are given along the trail, and because the site is the closest developed public facility to the boundaries of the airport (approximately 32 miles).

"As a byproduct of the foregoing tests at Whitewater Bay, an ambient noise level measurement of 72 decibels was obtained. This reading was obtained while floating in a boat and in part is due to the sound of wave action against the side of the boat. An ambient reading of 60 decibels was obtained at the Anhinga Trail Site.

"The only time aircraft using the training airport are expected to overfly the Park will be while transitioning to and from high altitude training areas over open waters off the coast. At such times the aircraft should be well above 3,000 feet and there is no foreseeable need for low level operations over the Park. Normal conversational levels are in the neighborhood of 50 to 70 PNdb. This fact, when coupled with existing ambient noise levels in the Park in the range of 60 to 70 decibels, suggests that overflights over the Park will rarely interfere with speech communication on the ground and never at flight levels above 3,000 feet."

A National Park Service biologist who observed the above-mentioned test from Anhinga Trail stated that there were few

birds and no bird concentration in that area during the test. Further, he stated that the effect of wind at the time on the monitoring instrument made it difficult to get true noise readings on the aircraft, and all the observers, including the technician operating the instrument, agreed that local conditions at the time prevented an adequate test.

The study team concludes that the testing conditions cited by the Federal Aviation Administration above constitute an inadequate measure of the effect of aircraft noise on wildlife. The team also agrees that experience at other airports suggests that aircraft noise will usually not interfere with birdlife except perhaps during nesting of some species. However, the lack of birdlife reaction to noise indicates that the incidence of noise will not reduce the likelihood of airstrikes, as discussed elsewhere in this report.

The expanded and fully developed commercial jetport will most certainly compound the noise intrusion into the park, but probably not in direct proportion to the number of increased operations. Runway orientation, climatic conditions, and aircraft characteristics will all affect future flight patterns. When the operations expand to the present level of Miami International Airport (400,000

aircraft movements annually) the effects of environmental noise pollution will become more apparent. An aircraft movement once every minute, 24 hours a day, 365 days a year, can hardly be unnoticed. Complaints from people increase as the frequency of noise occurrence increases. Animal response may well be the same.

Noise restrictions, being planned by the Federal Aviation Administration, may solve some of the present problems of noise pollution, but experience would indicate that noise suppressants are not able to keep pace with new generations of jet aircraft engines and a major breakthrough in this field of research is not in sight.

It appears that aircraft noise will most certainly intrude into the park and destroy the wilderness character of much of the area. Physiological damage to wild bird and animal populations may be a possibility and the noise will, without question, severely affect the lives of the Indians along the Trail—to their own and the Nation's detriment.

THREATS TO PEOPLE

1. Bird Strikes

Table 4 summarizes occurrence in the near vicinity of the Big Cypress Swamp Jetport of birds that represent a potential strike hazard to aircraft. We assume that more distant parts of the approach and departure patterns will normally be flown at altitudes above 2,000 feet where bird strikes become much less likely. We would point out, however, that aircraft approaching the jetport from any direction must overfly extensive swamps and marshes where concentrations of feeding water birds occur at times. Particularly in winter, along distant approaches from the southwestern quadrant, these flocks may exceed 50,000 and may include numbers of white pelicans and wood ibis, species that habitually soar to high altitude. Aircraft have recorded damaging strikes of large soaring birds at altitudes above 5,000 feet.

The potential bird strike problem at the Big Cypress Jetport has two main aspects: (1) the predictable hazard that will result from the seasonal feeding movements of flocks of large water birds in the immediate area; and (2) hazards that may arise because habitat changes introduced by the jetport attract certain wildlife species.

As described elsewhere in this report, large numbers of wading birds regularly feed in the Big Cypress from late fall through the

Table 4. ---Some parameters of the potential bird strike hazard in the area of the Big Cypress Swamp Jetport

Species	Weight (pounds)	Flight Habit	Seasonal Occurrence in Jetport Area	Estimated Max. No. Likely at One Time	Comment
White Pelican	10-17+	Soar to > 2000'	Oct.-Dec.;Mar.-April	150	Much more common over Gulf approaches to jetport
Anhinga	About 3	Soar to > 1000'	All year	25	May soar in thermals over runways. Some nest in area.
Great Blue Heron	5-8	Usually fly at < 200'	All year	15	Usually solitary. Some nest in jetport area
Common Egret	About 2	Usually fly at < 200'	Flocks late Feb.-May; Some all year	2,500	Some nest in jetport area.
Small Herons	.75-1.25	Usually fly at < 200'	Flocks late Feb.-May; Some all year	5,000	Some nest in jetport area.
Wood Ibis	6-7	Soar to > 1000'	Dec.-May	500	May soar in thermals over runways.
White Ibis	About 1.75	Usually fly at < 200'	Flocks Feb.-May; Some all year	20,000	Flocks sometimes soar to 1000'
Roseate Spoonbill	About 2.5	Usually fly at < 500'	Mar.-May	200	More common over Gulf approaches to jetport.

Table 4. (continued)

Species	Weight (pounds)	Flight Habit	Seasonal Occurrence in Jetport Area	Estimated Max. No. Likely at One Time	Comment
Ducks	1-2.5	Usually fly at < 500'	Nov.-May	1,500	May be attracted to borrow ponds
Turkey Vulture	3-4	Soar to > 1000'	All Year	100	May soar over runways. Will be attracted by carrion on runways
Black Vulture	2.5-4	Soar to > 1000'	All Year	100	May soar over runways. Will be attracted by carrion on runways
Bald Eagle	7-10	Soar to > 1000'	All Year	5-10	May soar over runways. Will be attracted by carrion on runways.
Osprey	About 4	Usually fly at < 500'; sometimes soar higher	All Year	5-10	May be attracted to borrow ponds
Common Crow	About .75	Usually fly at < 100'	All Year	25	Will be attracted by carrion on runways.
Boat-tailed Grackle	.25-.5	Usually fly at < 100'	All Year	150	Will be attracted by carrion on runways.

winter, except in years of extreme flood or extreme drought. In their usual pattern, the birds feed intensively in local areas for a few days to several weeks (commonly in massed flocks that may include 10,000 individuals of a dozen species) and then move to another area. The ecological basis for this pattern is the concentration of aquatic food organisms in local ponded areas as the surface water drops during the winder dry season. In average years, feeding wading birds tend to move seasonally from northwest to southeast across the Big Cypress and into the western part of Conservation Area No. 3A, where considerable activity usually persists until rising water from May-June rains disperses aquatic animals.

Around the jetport, heavy feeding by wading birds may be expected to start about mid-February in average yeras, and as early as December in dry years. In very wet years, such as the winter of 1968-69, when there is a continuous sheet of surface water through much of the winter, wading bird concentrations in the area may not reach significant size. Feeding in the jetport area and along the west edge of Conservation Area No. 3A may be expected to continue as long as the deepest sloughs hold appreciable amounts of surface water--two or three months in average years and less in dry years. Locally, feeding is likely to begin wherever water flow is restricted, as at culvert mouths and along the margins of canals and borrow pits,

and flocks will move from these places to adjacent marshes, ponds, and sloughs as the surface water falls. During times of heavy feeding, there will be continual movements of bird flocks over short distances and at low altitudes from one feeding spot to another and from feeding grounds to local loafing areas and night roosts. Considerable daily in-out traffic of birds that are nesting elsewhere will also occur. A large part of the in-out flight is likely to be made up of wood ibis, which are birds that soar to high altitudes on thermals, and then glide off the tops of these rising air currents in the direction of their destination. Experience around other airports suggests that birds probably will continue to feed as they always have in the area of the jetport, despite the noise and disturbance of jetport operations, as long as ecological conditions are not greatly changed.

Possible bird strike hazards from the attraction of wildlife to the jetport area are more difficult to predict but could become important under certain conditions. The developed area of the jetport will tend to attract wildlife for several reasons. As noted above, culvert openings, cleared areas along the runways, and the edges of borrow ponds and canals are likely to attract herons because they offer favorable feeding opportunities. Indeed, we were told by FAA personnel that the edges of some jetport borrow

ponds will be sloped specifically to provide feeding places for water birds. Any interruption of surface flow by land fill is likely to attract flocks of wading birds if it results in ponds that persist after the surrounding country dries. The deep borrow ponds may attract waterfowl, and, if they develop fish populations, ospreys will fish there. Thermal air currents rising from the extensive flat surfaces of the jetport runways, roofs, and roads will attract soaring birds, especially when the area around the runways is flooded. When surrounding areas are wet, natural thermal convection currents are sporadic whereas such thermals will be more frequent and intense over the runways.

Potentially the most serious problem of wildlife attraction is the invasion of the jetport runways by terrestrial animals. Unofficial plans obtained from the firm of consulting engineers show that the training runway will be enclosed by ordinary 2-inch mesh chain link security fence 6 feet high and topped with a 1-foot slanting section of barbed wire. A supply of fence of this type is stockpiled at the jetport site. As shown in the plans, the fence will be located well away from the edges of the runway fill leaving approximately 625 acres of unaltered land surface within the fence. About 370 acres of this area will be cleared of natural vegetation (small cypress trees) and the remainder will be left undisturbed.

The fence presumably is intended to keep larger animals off the runway, but its effectiveness is open to some question. Mature deer, for example, are readily able to jump a 7-foot fence, if they have any reason to do so. Elsewhere in southern Florida, deer appear to be attracted to the fertilized grass strips on road shoulders. Grassy runway shoulders may be a comparable attractant. The plans available to us show that the bottom of the fence will be about two inches above the natural land surface. Because the ground in this area has an intricate microrelief of two feet or more due to solution holes in the underlying limestone, it seems likely that such animals as marsh rabbits, otters, raccoons, turtles, and even fair-sized alligators may be able to get under the fence at many places.

The problem that may arise from large numbers of small animals has apparently not been considered. The normal movement of forms abundant in the area, such as various frogs, and the attraction of such animals as snakes and small mammals to the filled areas as flood refuges may be expected to bring numbers of these animals into the vicinity of the runway. The planned fence will not restrict movement of animals of this size, and considerable populations of some forms are likely to continue to live inside

the fence. Such small animals may pose no direct hazard to aircraft, even if numbers invade the runways, but any appreciable quantity killed on the runways will attract carrion-feeding birds (bald eagles, turkey vultures, black vultures, common crows, boat-tailed grackles). Special fencing to control the problem will probably be necessary.

Pilots of commercial and military aircraft are directed to report all bird strikes, but the authorities who have charge of these records agree that strikes other than those which alarm the pilots often go unreported. Bird strikes reported at U. S. commercial airports totaled 601 in 1966, 640 in 1967, and 529 in 1968. In the same period, pilots reported 10 stikes at Miami International Airport. Pilots at Homestead Air Force Base reported six bird strikes from July 1968 through May 1969. Most strikes at the two airports occurred over runways and did little reported damage to the aircraft. The reported altitude of strikes ranged from ground level to 5,000 feet, but most occurred below 1,000 feet. Strikes seem to have involved a wide variety of birds, but the recorded details are extremely sketchy.

The FAA takes a different view of the subject. They submitted the following:

"In the judgment of the Federal Aviation Administration, the Everglades site does not present an undue hazard to safe aircraft operations nor will it represent a significant threat to the population of endangered species within its vicinity.

"This judgment derives from reviews of the actual bird strikes that have occurred throughout the State of Florida during the past three years, review of bird strikes at other major airports throughout the Nation which are like situated in marshy environments, and from past studies of damage to aircraft resulting from bird strikes.

"During the period 1966-1968, 27 bird strikes were reported to have occurred in Florida. They occurred in the vicinity of 5 airports--Miami International (13), West Palm Beach (1), Fort Myers (2), Jacksonville (8), and Tampa (3). During the same period approximately 10.5 million aircraft operations were recorded at the 19 Florida airports equipped with FAA control towers. No reliable operational data are available to factually determine how many additional aircraft operations occurred at other airports within the State (264) not equipped with control towers but nationally it is known that about 40 percent of the Nation's total aircraft operations occur at private and public airports which are not tower equipped. Accordingly, the total aircraft operations in the State of Florida during the abovestated period is more probably in the magnitude of 14.7 million. If so, the past frequency of bird-plane strikes within Florida during the past 3 years is in the general range of 1 strike for every 545,000 aircraft operations. Application of that frequency ratio to a 2-runway training and transition airport accommodating 350,000 annual aircraft operations results in an annual mathematical probability of 0.64 bird-aircraft incidents.

"The potential risk of bird-plane strikes at the Huntsville-Madison County Airport, Alabama, has been evaluated several times by the Government. The site of this airport is environmentally similar to the Everglades Airport in that it lies in a marshy environment populated

> with large flocks of waterfowl. The findings of each study were that the waterfowl did not represent an undue hazard to aircraft primarily because the adjacent refuge provides an ample food supply which, in turn, negates waterfowl concentrations in the airport's immediate vicinity resulting from their search for food. The study's conclusions have since been substantiated in fact with no bird-plane strikes having occurred since the airport's opening in late 1966."

The experience at other southern Florida airports and at the new Huntsville-Madison County Airport in northern Alabama is not applicable to conditions existing in the Big Cypress, in the opinion of the study group.

Other airports in southern Florida are almost entirely surrounded by urban and agricultural areas. Birds, except for a few small land birds, seldom occur over the runways or in large areas around the runways. Persistent concentrations of even a few hundred birds of any species are infrequent along most of the approaches. It seems obvious that the chance of a bird strike is very much less around these airports than in the Big Cypress.

The new Huntsville-Madison County Airport (Ala.) is located near Wheeler National Wildlife Refuge, where large numbers of geese and ducks congregate in winter (peak of about 125,000 during the one winter of study). However, the situation with

2. Indian Tribes

In the early 1500's the Creek Nation was made up of two language groups. One was the Muskogee and the other was the Hitchiti-speaking group, which later adopted the name of "Mikasuke" (Miccosukee). The present day Miccosukee Indians at one time were located in what is now the Carolinas and Georgia. Later they settled in north Florida in the town of Miccosukee, which is between Tallahassee, Florida, and Thomasville, Georgia. Here the Miccosukee Indians intermingled and married among the Seminole and the aboriginal Indian tribes of ancient Florida: Timucua, Teqesta, Apalachee, and Calusa. However, the Miccosukee retained their own identity and language. The Miccosukees were traditionally hunters and fisherman in contrast to the Muskogee Indians who were farmers and animal raisers. Also, it was the Miccosukee Tribe that furnished most of the battle leaders in the Seminole Wars of the 1800's.

As the settlers continued to arrive from the north, the Miccosukee Indians moved southward from north Florida. In south Florida, they built log cabins as they had built in their former home in the north. They wore buckskin clothing and, overall, little culture changes took place. Later, influenced by contact with European settlers and materials they brought, adaptations

took place. In the 1800's the garments became heavily beaded with colorful conbinations of handsewn print fabrics. As they retreated further into the subtropical Everglades to avoid being sent to Indian reservations in the west, dramatic changes became evident. The warmer climate influenced the elimination of buck-skin as a raw material for clothing. Styles were influenced almost exclusively by trade fabrics. Since foot or wagon travel was almost impossible through the Everglades' swamps, dugout canoes, hewed from cypress trees, were their most common mode of transportation.

Most of the present day Miccosukee Indians live in the vicinity of the northern boundary of the Everglades National Park. When the National Park was established, these Indians were asked to settle on lands in Broward and West Palm Beach Counties. This area was designated as the Florida State Indian Reservation and was set aside as a perpetual reservation for the use and benefit of all the Indians of Florida. However, most of the Miccosukee Indians prefer to live along the Tamiami Trail, in that area extending from the western limits of Miami to Naples, some 100 miles to the west.

In the past, the Miccosukees made a bare subsistence by selling Indian-made dolls, jackets, drums, and other artifacts

and by hunting, fishing, and light gardening. The swift and extensive economic development of south Florida, beginning at the turn of the century, had a most significant effect on the Miccosukees. Construction mushroomed and interconnecting highways found their way through the formerly impenetrable Indian lands. The subtropic Everglades began to accept the non-Indian and, with the coming of modern civilization, problems accompanied progress. The primitive resources of the Indians were markedly reduced. New laws prohibited some of the old ways of obtaining food as land areas shrank in availability. Some Indians began to work on vegetable farms in the area and others engaged in part-time occupations. During the period from November to March, the Indian men still go into the Everglades and hunt frogs which they sell in Miami where frog legs are a common item on dinner menus. They still depend to a large extent on fish and wildlife resources of the area to supplement their daily subsistence requirements.

From an isolated community, that was nearly self-sufficient, the Miccosukee people have been thrust into the rush of the 20th century. Need developed for more money, education, and all that is associated with the white man's present-day way of life. Much

of the land on which they once roamed and hunted was developed, "posted", and eliminated as a source for their livelihood.

Their leaders could see the need to seek assistance from outside sources to protect themselves from the rush of developers and to prepare themselves for the future. After several years of confusion and resistance to the attempts of the Federal and State governments to help them, the Miccosukee Indian people agreed to consult with the government. The State of Florida contributed greatly to the development of the tribe and the Bureau of Indian Affairs offered its assistance and guidance. After numerous discussions with tribal members, it was mutually agreed to organize the Miccosukee Tribe under a constitution. On January 11, 1962, the Miccosukee Constitution was approved by the Secretary of the Interior and the Tribe was officially organized and recognized. Members of the tribe, although in many cases related by blood to members of the Seminole Tribe of Florida, have no direct connection with the Seminole Tribe organization of Florida. Membership in the Miccosukee Tribe is open to Indians of at least half Miccosukee or Seminole Indian blood, and who are not enrolled as members of any other tribe of Indians. At the present time, there are approximately 230 enrolled Miccosukee Indians and about the same number of non-enrolled Indians living in the general area along the Tamiami Trail.

Of the 88 Miccosukee families censused in 1968, 74 had an annual income of less than $3,000. Of this number, 34 had incomes of less than $1,000, 15 incomes from $1,000 to $2,000, and 25 had incomes between $2,000 and $3,000. This income is often supplemented by fish and wildlife resources to a considerable degree. The ability to utilize fish and wildlife as food sources is especially important to those families whose cash income is substandard. Until 1962, the Miccosukee Indian children did not attend school. After the tribe was formally organized, the Bureau of Indian Affairs and the Dade County School Board mutually supported a school program. The Miccosukee Indian children are accepted in the Dade County school system. However, tribal leaders are of the opinion that the language barrier and the age of those beginning school for the first time will require much preparatory work before the children can be expected to function properly in the alien atmosphere of a public school. For this reason, a preparatory school administered by the Bureau of Indian Affairs has been provided. Students through the fourth and fifth grade level, who range in age from 6 to 18, receive schooling in this facility prior to enrollment in public schools.

In 1962, the Bureau of Indian Affairs, with cooperation of the National Park Service, acquired the use rights of a small area of the northern boundary of Everglades National Park to be used as a home area for the Miccosukee Indians. It is in this area that the school and other facilities provided for the benefit of the Indians are located. Also in this area, through the cooperation of the Bureau of Indian Affairs and the Tribal Housing Authority, it was possible to build homes for the Miccosukee people. "Modern Chickees" were built. These are quite large and well ventilated wood frame buildings with wooden floors, electric lights, hot water, electric ranges, and complete sanitary facilities. The roofs are thatched with palm fronds and are quite comfortable and ideally constructed for this area of the country.

The tribe has vigorously pursued a program of self-betterment. In December 1964, it opened a modern restaurant, beautiful in architectural design and situated approximately 35 miles west of Miami along U. S. Highway 41. The interior of the restaurant displays many beautiful pieces of Indian art work. Immediately adjacent is a modern service station and grocery store. These enterprises provide employment for many of the members of the tribe and the Indians hope avenues will become open to them so

that they can continue to expand and provide more employment for their own people. Individual members of the tribe also operate small arts and crafts shops from which may be purchased the colorful skirts, jackets, and other handcrafted apparel produced by the Indians.

With regard to land resources of the tribe, the State of Florida has dedicated in perpetuity three parcels of land (Home Area) adjacent to U. S. 41 (Tamiami Trail) as indicated on the attached map (Figure 18). This total land is appraised at $23,500, yet the tribe has invested $159,000 in facilities on this area. Also shown in Figure 18 are 104,800 acres of Indian land that is held in trust by the State. The Miccosukee portion of this area is 76,800 acres, and include the mineral resources on those areas. It would seem, then, that because of the nature of their dependency on the small areas of land available to them, the impact of both highway construction and the jetport will be very serious. If the 1,000 foot right-of-way along the Tamiami Trail is actually taken over for the transportation facility, it would necessitate the relocation of Indian enterprises located along this road.

If highway I-75 were to be constructed due east from the jetport (across Conservation Area No. 3), it would have the

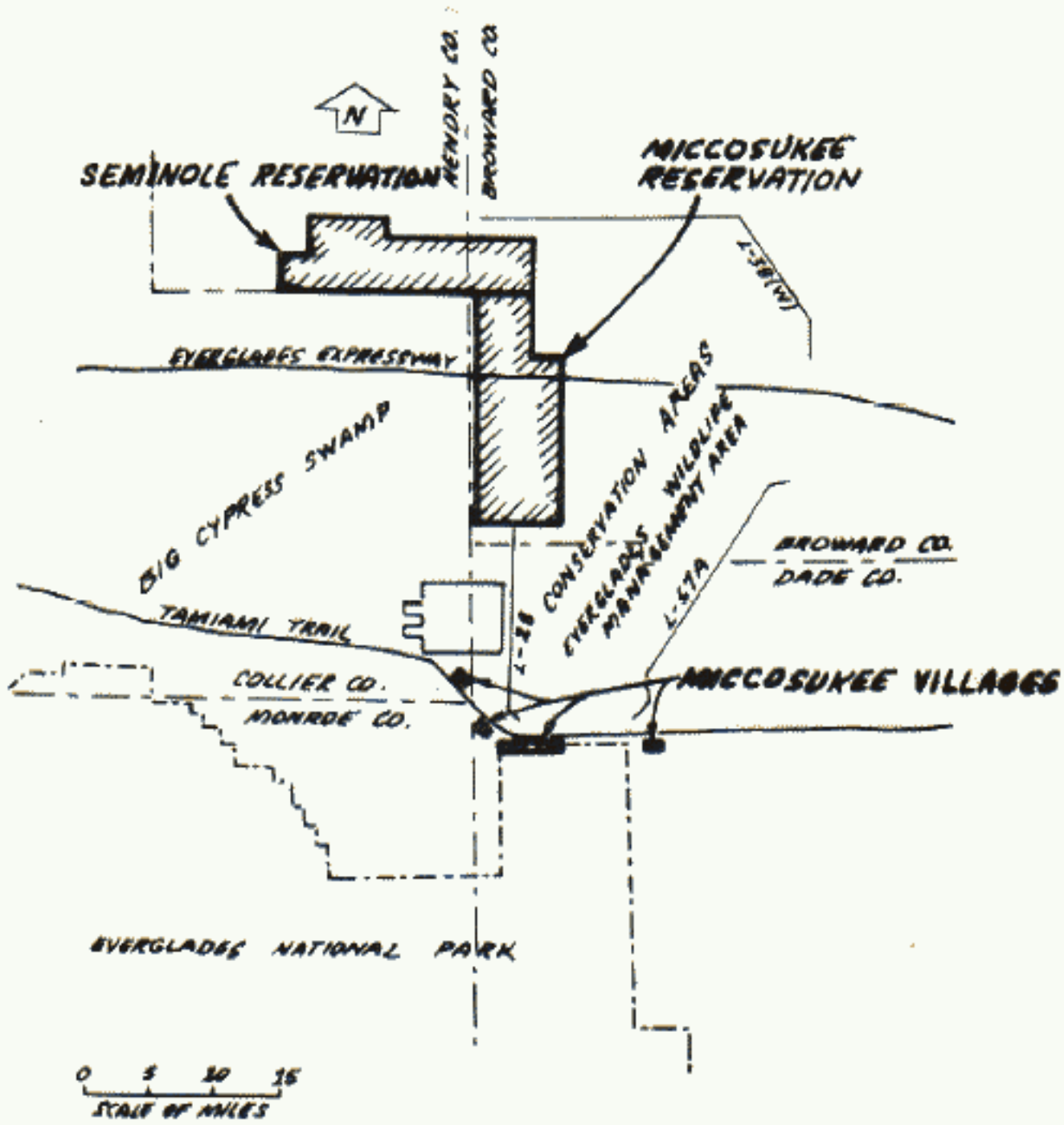


FIGURE 18 - INDIAN LANDS

effect of detouring traffic away from the Indian enterprises and possibly forcing their commercial facilities to close from lack of business. Some automobile tourists would probably still travel U. S. 41 to visit the Indian villages, but whether or not the number would be sufficient to maintain their enterprises is questionable. The way the Miccosukee Indians themselves regard the development of the jetport has probably been best expressed by their chairman, Buffalo Tiger, who said, "We don't think that we have any chance of stopping the jetport from being put there, but we do think the Federal Government should do something for us Miccosukees. Everybody talks about progress--but progress is ruining the Indian. It is just another example of the white man's cheating the Indians of their birthright. We have 486 Miccosukees in this area. The Miccosukees like to fish and hunt. We have villages along the Tamiami Trail where we make our living. All this will go. The game in the Everglades will be chased away by the screaming of the jet engines. There will be no fish in the canals and streams and soon there will be no business for us on the Tamiami Trail."

The conclusions reached by Chief Buffalo Tiger can be better visualized on the accompanying map (Figure 18) showing the lands held by the Indians, the main parcel of which is immediately

north of the jetport, and the three parcels along the Tamiami Trail that are extremely vulnerable to changes in the highway construction along that route.

Throughout their history, the Miccosukees have moved from place to place because their home lands in the vastness of the Everglades wilderness were coveted by others. Now there is no further line of retreat.

The Seminole Tribe of Florida may be only slightly better off because of the greater distance from the jetport to their reservation lands. Their future is tied to the future of the surface water--its quantity, quality, and distribution. Further developments increase the demand on this resource, which in turn jeopardizes the Seminole enterprises and way of life.

3. Public Areas

The high quality of the south Florida environment has supported the establishment of many types and sizes of facilities to serve both resident and out-of-state visitors. These areas include both established and proposed national and state parks, county parks, county recreation and access areas, private recreation and access areas, wildlife refuges, bird sanctuaries, aquatic preserves, Flood Control District conservation and recreation areas, private campgrounds, wildlife and fish management areas, etc.

One can easily see from the marked map (Figure 19) that a list of their names would be quite lengthy indeed.

There has been little need for public attention to access and preservation of recreation values in the Big Cypress until recently. Now posted land, weekend camps, and hunting camps are increasing as the private sector acquires the means of transportation necessary to make use of this area which was once used only by the Indians and a few hunters. Most recently, the jetport has added to the pressures, especially those relating to land speculation. No longer is this area open by mutual consent to the public. As further development occurs in and around the Big Cypress Jetport, more of this area will be closed, but most importantly, the necessary natural resource base of land and water will be degraded or eliminated for public use. Further, disruption of this resource base will eventually destroy many other south Florida public use areas to which they are interlinked within a common hydrologic system. Drainage or pollution of the waters in one portion of this system will necessarily have adverse effects on other areas of the system.

Some say that the jetport will increase public recreational access to many areas--and it will--until such time that this

easy access brings about the inevitable residential and commercial and other developments. Then the ecosystems will be destroyed, and a quality recreational environment will be gone.

Easy access can create an additional problem--one of overusing the resource. The delicate aquatic ecosystem in the vicinity of the jetport surely cannot withstand the dense crowds such as are found along the Atlantic coastal beaches or in the TVA reservoir areas. Such congestion, and the associated pollution, would very seriously alter the very nature of this land and the recreational benefits it now offers.

4. Fire and Smoke Hazard

The Big Cypress is subject to extensive wildfires in the winter and spring of most years. Commonly, in years of severe drought (most recently 1945, 1950, 1951, 1956, 1962 and 1965), half or more of the area has burned. Enough area to represent a substantial wildfire hazard is burnable for at least 4 to 6 months in average years and longer in dry years. Statistics on wildfire occurrence are available only for the year July 1, 1968 - June 30, 1969 (a period of unusually high water) during which the Florida Board of Forestry recorded a total of 43 small wildfires in eastern Collier County (east of State Route 840A).

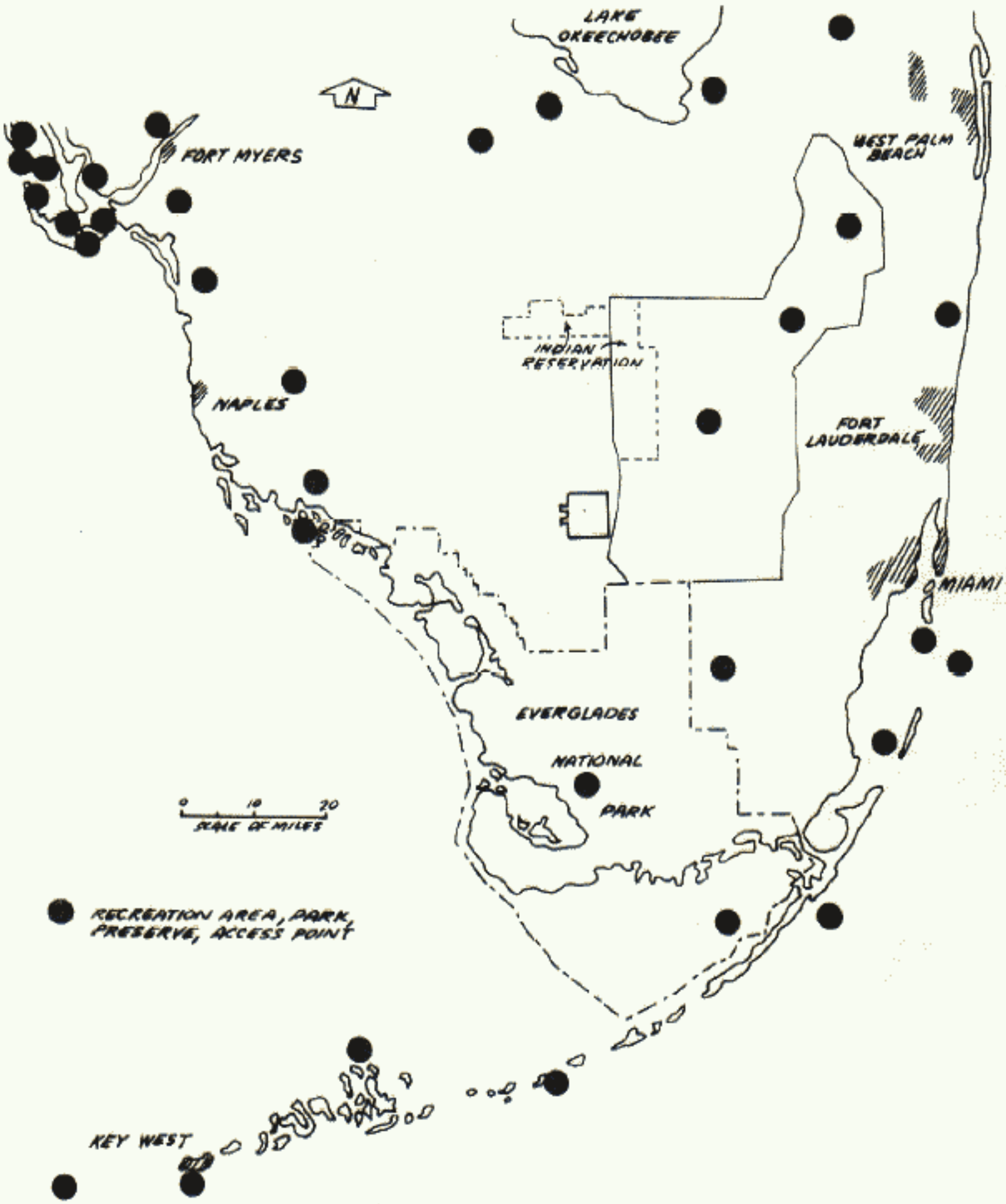


FIGURE 19 - EXISTING AND PROPOSED PUBLIC AREAS

Because construction of the training runway coincided with a wet winter, jetport planners may not have appreciated fully that dense smoke from wildfires has sometimes persisted in the Big Cypress for weeks in dry years. Smoke has forced closing of highways across the area and, on occasion, it has interfered seriously with traffic at Miami and Fort Lauderdale airports. Existing airports have been affected only when westerly winds carried smoke from wildfires over the east coast. By contrast, the Big Cypress Swamp Jetport is surrounded by burnable, mainly roadless, wild land extending more than 50 miles in almost every direction. Its operations will be vulnerable to drift smoke from every quarter.

Natural fires set by lightning occur in the Big Cypress, but most fires in the area are man-caused, and the probability of man-caused wildfires is more or less directly proportional to the number of people at large in the area. Thus, wildfire incidence is likely to increase as population around the jetport increases. Any drainage of the area in development of the jetport and its surroundings will tend to lengthen the period during which vegetation is burnable and to decrease the number and efficiency of natural barriers to the spread of wildfire. To sum up: (1) In an unaltered setting, smoke from wildfires

seems certain to be a considerable problem to jetport operations at times. (2) The principal changes likely from further development in the area will tend to intensify the problem.

The Port Authority has indicated that it will undertake to control wildfires on the jetport proper by developing a fire-fighting force patterned on that of Everglades National Park. Such an approach probably is feasible for the relatively small area involved. However, fire control on jetport lands alone only begins to meet the problem, because smoke affecting operation of the jetport could originate from wildfires almost anywhere in the miles of burnable wild land that surrounds the jetport on every side. State and local agencies in this section of Florida have seldom been able to attempt fire control on roadless wild lands, usually confining their activities to the protection of developed areas against wildfire. Expansion of intensive fire control to cover all the Big Cypress and the adjacent wild lands from which a serious smoke hazard might originate would be quite expensive, and it is not entirely clear where the responsibility for such an operation should lie. Given the almost explosive flammability of the available natural fuel in drought times, it is not likely that even intensive effort could completely eliminate wildfires. Moreover, successful fire control merely sets the

stage for more intense (and doubtless smokier) fires in later years, because of the continuing build-up of fuel.

The remaining possibility is to undertake control of wildfires by habitat manipulation, either by holding higher water levels or by prescribed burning at times chosen to avoid creating a smoke hazard at the jetport. The former approach would require a system of water control facilities; it undoubtedly would be attended by adverse ecological changes, both in areas where water was held and in the downstream areas deprived of water; and it is doubtful that enough water is available for such a procedure to be effective for fire control in dry years. A prescribed burning program would be preferable ecologically, but it would be expensive and it doubtless would encounter many operational difficulties, because of the very large area involved and the strong necessity to minimize smoke. In short, there does not appear to be an easy, obvious, inexpensive means to control the potential smoke hazard at the Big Cypress Swamp Jetport.

CONCLUSIONS

The construction of the airstrip for training in south Florida presents an issue in the public interest. Public interest consists of two general aspects, a monetary consideration and a nonmonetary one. The monetary or financial gains which result from development in the modern sense--urban, agricultural, and industrial--are monetary gains which redound primarily to the locality and, to some lesser extent, to the adjoining region and the Nation. The public interest in the preservation of an environment is primarily a nonmonetary one; it is one that affects a large part of the whole society and in a diffused way.

The south Florida problem is merely one example of an issue which sooner or later must be faced by the Nation as a whole. How are the diffused but general costs to society to be balanced against the local, more direct and usually monetary, benefits to a small portion of the society? Concurrently, the society must ask itself whether the primary measure of progress will indefinitely be the degree of expansion of development, such as housing, trade, and urbanization, even at the expense of a varied and, at least in part, a natural landscape.

Some benefits to society flow from failure to develop, but this entails a cost. To reap the benefits of nondevelopment

--benefits which accrue generally to a broad part of society--may often put a burden on a small segment of society. Under such circumstances, public policy must be so restated or redefined that the equities are redistributed. At the present time, the operation of public policy in dealing with redistribution of such equities is inconsistent and ill-defined.

The second main conclusion of this report is that the benefit to society accruing from the maintenance of an ecosystem is of a different order than that due to the preservation of a few species. The effects of the jetport and the surrounding development should not be thought of in terms of the possible elimination of some rare and endangered species such as alligator, wood stork, and others. These, however, can be thought of as indicators or touchstones as to what is happening to the total ecosystem. Unfortunate as it would be to lose some of these rare species, the problem is a larger one. Society has an interest in the functioning of an ecosystem as a whole. The substitution of a controlled state of a biologic community for a naturally functioning ecosystem leads to one or more of the following consequences: (a) More controls and increased management are necessary to keep the new unnatural system in reasonable balance; (b) unforeseen consequences are usually costly and often long

continued; (c) these costs are usually borne by the public through the expenditure of tax revenue from a large part of society to compensate for unforeseen consequences of actions taken to benefit a small segment of a society.

The third main conclusion is that ecosystem destruction in south Florida will take place through the medium of water control, through land drainage and changed rates of discharge. It will come about through decrease in quality of water by both eutrophication and by the introduction of pollutants, such as pesticides.

The fourth main conclusion is that the training airport is intolerable, not because of its flight operations, but rather because the collateral effects of its use will lead inexorably to urbanization and drainage which would destroy the ecosystem. The development in the surrounding land is already beginning, as a result merely of the probability that the airport will grow in size and importance. Assuming the present types and operation of land-use controls, this development tendency will proceed uncurbed. Planning procedures and their application are presently not sufficiently uniform, sophisticated, effective, or enforceable to provide any optimism that use of the jetport for training would proceed without concomitant land development and thence

by stages to destruction of the ecosystem. So long as the training airport is in use, pressures and plans for its expansion will continue and will inexorably and surely lead to ecosystem destruction completely. Elimination of the training airport will inhibit land speculation and allow time for formation of public awareness of environmental degradation which is the prerequisite for effective and practical action in the field of planning and land-use control.

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Many knowledgeable people, largely representing the environmental professions, have helped in the preparation of this report. Importantly, most of these people live and work in south Florida and are most familiar with its ecosystem. Their names are:

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