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AN EVALUATION OF WATER MANAGEMENT PRACTICES FOR OPTIMUM WILDLIFE BENEFITS IN CONSERVATION AREA 3A

By:
James L. Schortemeyer

GAME AND FRESH WATER FISH COMMISSION
FT. LAUDERDALE, FLORIDA

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ABSTRACT

The Everglades originally occupied approximately 2.5 million acres. Today only about 50% remains undeveloped. Of this 50% the largest leveed unit is Conservation Area 3A (480,000 acres). The protection of this and other units of the Everglades is coordinated by the U.S. Army Corps of Engineers, the South Florida Water Management District, and the Florida Game and Fresh Water Fish Commission.

Severe problems have occurred in the past with the presence of high and low water levels on the area. The south end of Area 3A has been flooded for extended periods causing destruction of tree islands, mortality to deer and other mammals, and nest flooding for alligators and turtles. The northern end has been over drained causing destructive peat fires, mortality to key wildlife species, and destruction of tree island habitat. In addition, low water levels in the Conservation Areas allow the ocean's saltwater to enter the Biscayne aquifer, the sole water source for Southeast Florida.

Ten basic categories of wildlife were identified and optimum sawgrass water levels for each category were established based on available information and expertise. Optimum levels varied widely between wildlife groups but a theoretical schedule providing maximum benefits was designed based on the average levels of six groups. These levels ranged from 1.38 ft to -0.05 ft.

Water levels in CA3A are currently determined by a three gauge average. In order to more accurately evaluate water depths over the entire area nine more gauges were utilized. To determine the average water depths at each gauge, four, two-mile-long transects, oriented at right angles to each other, were planned. Transects and temporary gauges were established in October. Each location was sampled three times beginning in November 1979 and ending in January 1980. Along each transect five water and peat depths were taken at half-mile intervals sampling whatever community types were present (sawgrass, prairie, slough, cattails).

Theoretical water depths at maximum regulation schedule were estimated for all gauges. At five of the gauges water depths exceeded the optimum level for wildlife by at least 0.66 ft. Included in these five are gauges 43, 44, 63, 64, and 65. The latter three are currently used to determine the stage average. Five other gauges were at least 0.16 ft below the optimum level established for wildlife and the remaining two gauges were within 0.07 ft. Estimated sawgrass water depths over the entire area were 1.69 ft or 0.31 ft above the optimum level established for wildlife. The data indicate that many of the adverse impacts caused by water levels in CA3A have been aggravated by uneven distribution of water. We recommend that the gauges at the higher elevations be incorporated into the three-gauge-stage-average using recent water distribution data.

The current regulation schedule with its accompanying water depths exceeds the optimum depths for wildlife. However, recognizing the cyclic nature of water conditions in south Florida, it has primarily been the poor distribution of water within CA3A that has been detrimental to wildlife. Water depths more compatible to wildlife are recommended. The Corps should explore ways to improve its capability to remain within an established range of water levels.

INTRODUCTION

The Everglades in its original state occupied approximately 2.5 million acres south of Lake Okeechobee. This region has been aptly described as a "River of Grass" by Douglas 1951. Historically the area was dominated by the sedge commonly referred to as Sawgrass. Today only about 50% of the Everglades remains undeveloped. Conservation Area 3 represents the largest remaining unit of the Everglades which is currently protected. Of the 914 square miles (585,000 acres) in the Conservation Area, 750 square miles (480,000 acres) lie in that portion of the pool known as 3A. Due to its size and location pool 3A is critical to the proper management of the fish and wildlife resources of the Everglades. Since the completion of the pool a number of incidents have illustrated the shortcomings of existing management programs. High water has caused mortality to deer and other mammals. In addition it has destroyed tree island habitat and caused nest flooding for alligators and turtles. Extremely low water levels have caused destructive peat fires, mortality to key wildlife species such as alligators and destruction of crucial tree island habitat.

The need for a re-evaluation of the existing interim schedule was again illustrated during the fall of 1979. During that year abnormally high water levels placed the deer herd in a stress situation and appropriate agencies acted to minimize the impact of these water levels on the deer herd. At the same time the U.S. Army Corps of Engineers agreed to review the regulation schedule for Conservation Area 3A (CA3A). The review will consider all aspects of the multi-objective functions of CA3A. As part of this review the Game and Fresh Water Fish Commission has compiled this report which deals with the fish and wildlife resources of CA3A and the impact of various water management practices on these resources.

In order to adequately evaluate the water management practices and make recommendations for the future, six major study areas were identified. These study areas include 1) documentation of historical information; 2) compilation of information on recent peat losses in CA3A; 3) optimum water level conditions for wildlife habitats; 4) optimum water level conditions for key wildlife species; 5) an analysis of ground water depths related to gauge readings; and 6) an analysis and synthesis of the information contained in the remaining five studies.

HISTORICAL INFORMATION

General

Detailed accounts of the Everglades prior to 1900 are sketchy at best. There are two basic reasons for these sketchy accounts. First, the term Everglades and the corresponding area are poorly understood even today. As a result, Everglades City lies approximately 30 miles west of the Everglades and only about 20% of Everglades National Park is true Everglades. Therefore, it is often unclear if early accounts refer to the Everglades or to adjacent areas. Secondly, most early accounts of the area were written by parties involved in other primary tasks. Most early explorations were part of the war effort against the Seminole Nation and accounts of the area are incidental to this effort (Tebeau 1967). These early accounts present a contrasting picture and led Davis (1943) to conclude that changes were taking place prior to drainage efforts. These changes were due to cyclic fluctuations of water levels. As a result of these fluctuations tree islands increased in size and number in some years and were reduced in extent in other years. Regardless of these shortcomings, the early references to keys or islands and the utilization of these sites by the Tequesta Indians support the fact that these islands were elevated above normal water levels during historic times and were historically important to both man and wildlife. One of the earliest proposals to drain the Everglades was submitted by Buckingham Smith (1848). This report

concluded that the entire Everglades could be drained once channels were cut through the rock ridges on the coast. The Civil War delayed actual dredging activities until 1882. However, in this year the first dredging operation was initiated and between 1882 and 1928, 440 miles of canals and 47 miles of levees were constructed (Loveless, 1959). Most of these projects were completed under the auspices of the Everglades Drainage District, a state agency.

The inadequacies of these early efforts were clearly illustrated by a number of catastrophic events. In 1926, a hurricane struck Miami and Lake Okeechobee, incurring severe property damage and large loss of life at Moore Haven. In September 1928, a similar, more destructive hurricane passed over Lake Okeechobee and wind-driven lake water breached the southern muck levee killing over 2,000 people. During the 1930's and early 1940's a number of severe droughts caused destructive peat fires in the Everglades and increased the problem of saltwater intrusion along the east coast although the human population was still low. In 1947, two hurricanes, one in September and the other in October struck the Everglades region after a period of heavy rainfall. The resultant flooding and heavy winds caused extensive property damage. As a result of these problems a joint federal-state project was authorized by Congress in 1948. An integral feature of the Central and Southern Florida Project for Flood Control and Other Purposes was the creation of three water conservation areas in the heart of the Everglades. These areas were designed to provide for storage of water, for prevention of flood damages, for use by municipal, urban and agricultural interests, for fresh water recharge of ground water tables to prevent saltwater intrusion, and for fish and wildlife preservation.

Efforts which began in the 1920's to set aside the lower Everglades as a National Park were successfully culminated at about the same time. In 1944, the State of Florida set aside 385,693 acres of land and 461,482 acres of water for wildlife conservation, to be transferred to the National Park when it came into existence. In April 1947, the state legislature provided two million dollars to

acquire private inholdings in the park and on December 6, 1947, the park was formally dedicated. At the same time a 99,200-acre State Indian Reservation within park boundaries was relocated to state lands in northwest Broward County, primarily in what is today CA3A.

Thus, by 1950, most of the major decisions affecting the Everglades basin had already been reached. These decisions set aside approximately half of the original Everglades to be protected in a more or less natural state either in Everglades National Park or the conservation areas (Figure 1). Fish and wildlife enhancement was recognized as a primary reason for the creation of the National Park while it was listed as one of many additional benefits to be derived from the "Flood Control Project."

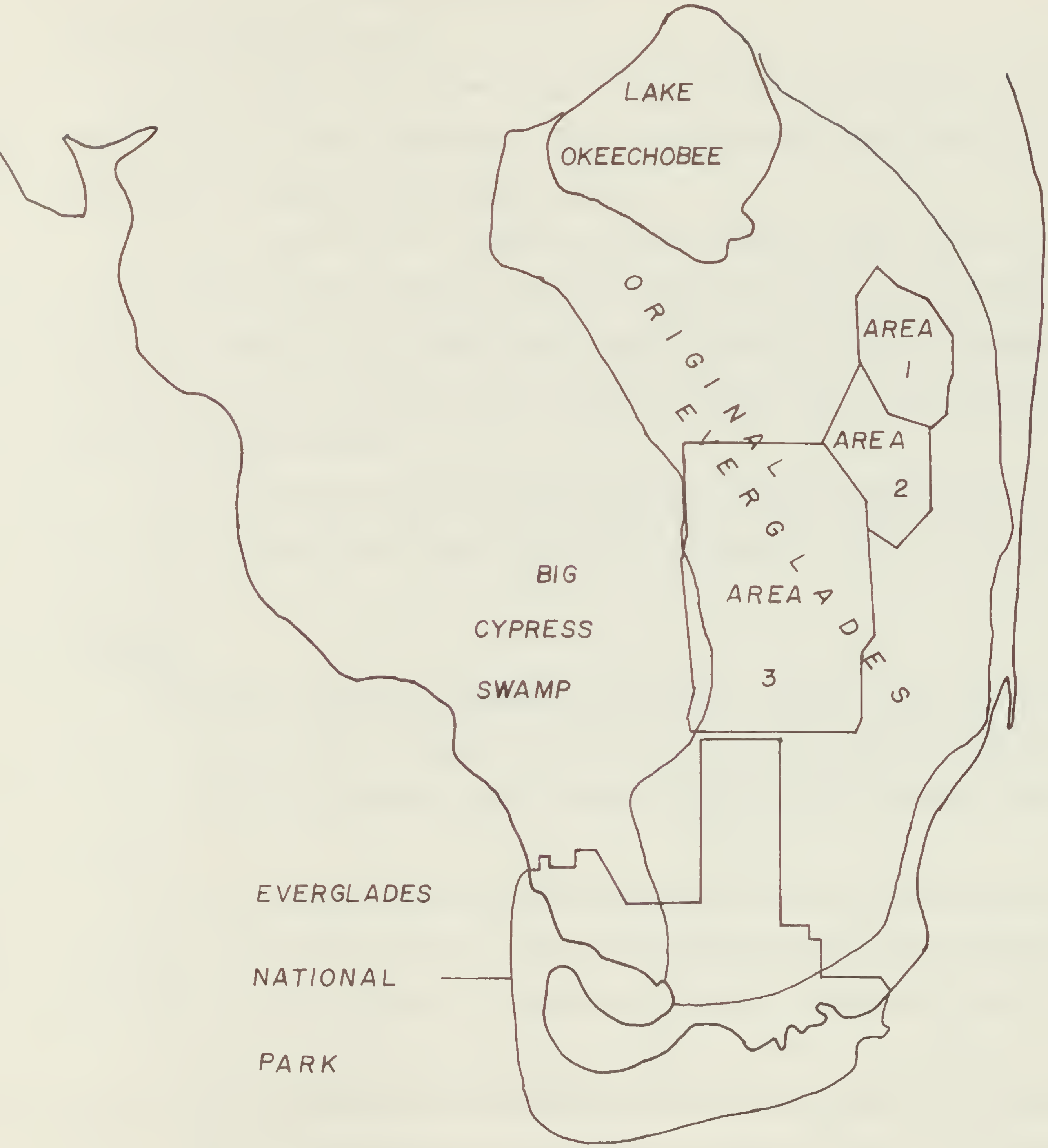
Conservation Area 3A

Conservation Area 3 is the largest single unit of Everglades protected at the present time. Conservation Area 3 is a shallow, basin typical of the Everglades, lying in western Broward and northwestern Dade counties. The area is approximately 39 miles long and 24 miles wide. It is bounded on the north by the Palm Beach County line on the south by Tamiami Trail and on the east by U.S. 27. The western boundary is formed by the L-28 levee located slightly east of Collier County. The area is basically flat with slight differences in elevations accounting for different plant communities locally. The land slopes almost imperceptibly in a southeasterly direction from 13 ft M.S.L. in the northwestern end to six ft M.S.L. in the southeastern end.

Construction

Following approval of the joint state-federal program known as the Central and Southern Florida Flood Control Project, the necessary lands and/or easements were acquired for the construction and operation of the conservation areas. Construction of the levees began in 1949 and Conservation Area 3 became functional in 1962. Completion of Conservation Area 3 required construction of an interior

Figure 1
DELINEATION OF ORIGINAL
EVERGLADES WITH MAJOR
PROTECTED AREAS OUTLINED



levee known as L-67. This levee divides the pool into two units known as 3A and 3B. This levee was necessary to reduce water losses through extremely porous rock substrata in the region known as 3B.

Major Structures of Pool 3A

A brief summary of the major structures of pool 3A is provided for a better understanding of project functions. Figure 2 shows existing improvements and topography as reported by the Corps in 1960.

Pool 3A is surrounded by a series of levees including L-38W, L-68, and L-67 on the east, L-29 on the south, L-28 on the west and L-4 and L-5 on the north. Three pump stations (S-8, S-9 and S-140) have the capability to pump water into the area. The S-11 structures, L-28 and L-28 interceptor can deliver water by gravity flow into the area.

The S-12 structures and S-151 provide gravity discharge from the area. The Miami Canal and Alligator Alley borrow canals redistribute water within Conservation Area 3.

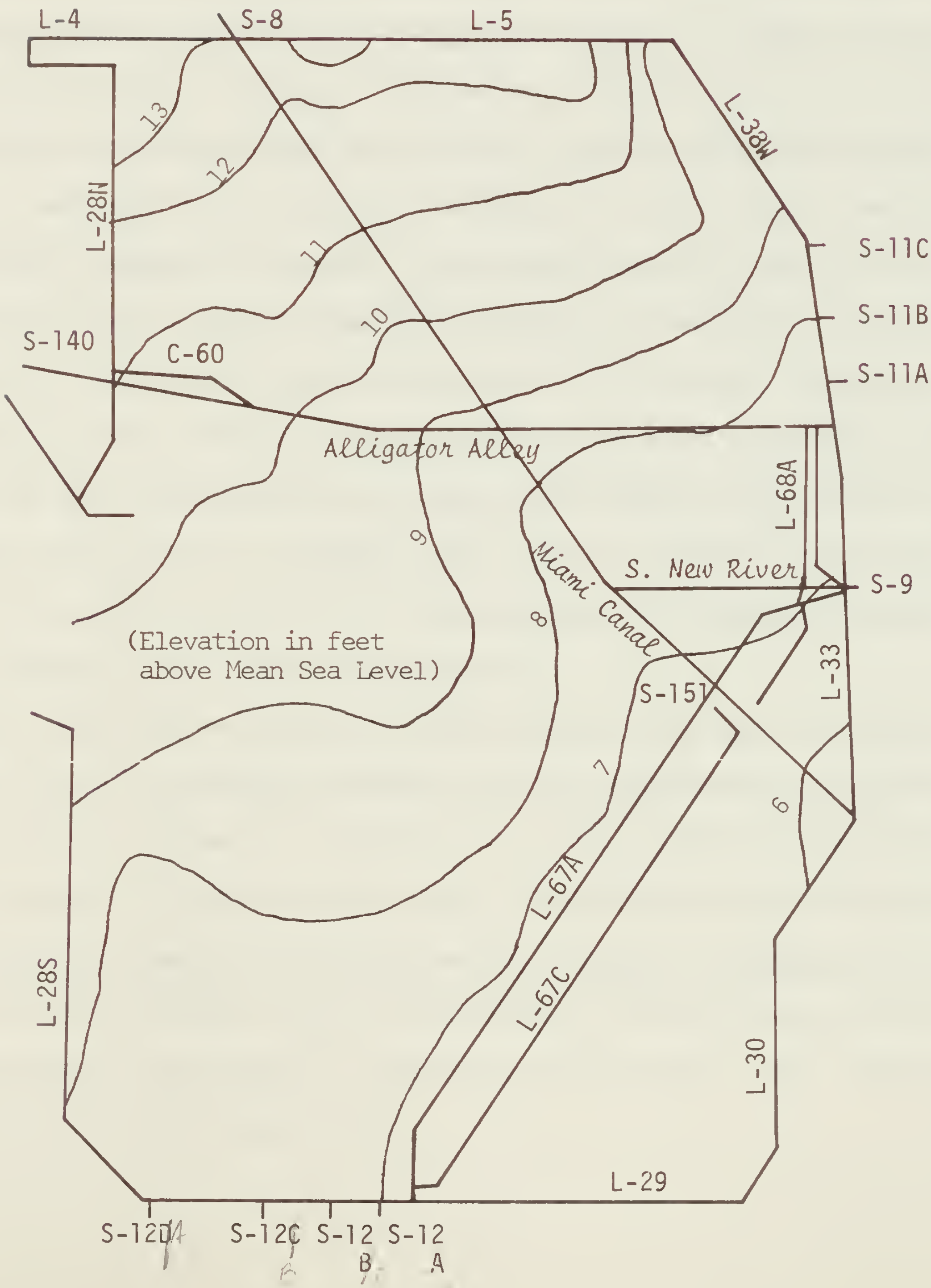
Management

Conservation Area 3A is managed by three primary agencies. These agencies are the U.S. Army Corps of Engineers (Corps), the South Florida Water Management District (District), and the Florida Game and Fresh Water Fish Commission (Commission).

The Corps designed and constructed the project and actively participates in management of the water resources. The Corps established the original regulation schedule and has the authority to review and adjust that schedule as necessary.

The District is the primary management agency for CA3A. The necessary easements and land acquisitions are obtained by the District as needed. The Commission, under a cooperative agreement with the District, manages the area for recreation, fish and wildlife. These functions are carried out concurrently with the District's management of the water resources of the area.

Figure 2
EXISTING IMPROVEMENTS AND 1960
TOPOGRAPHY FOR CONSERVATION AREA 3



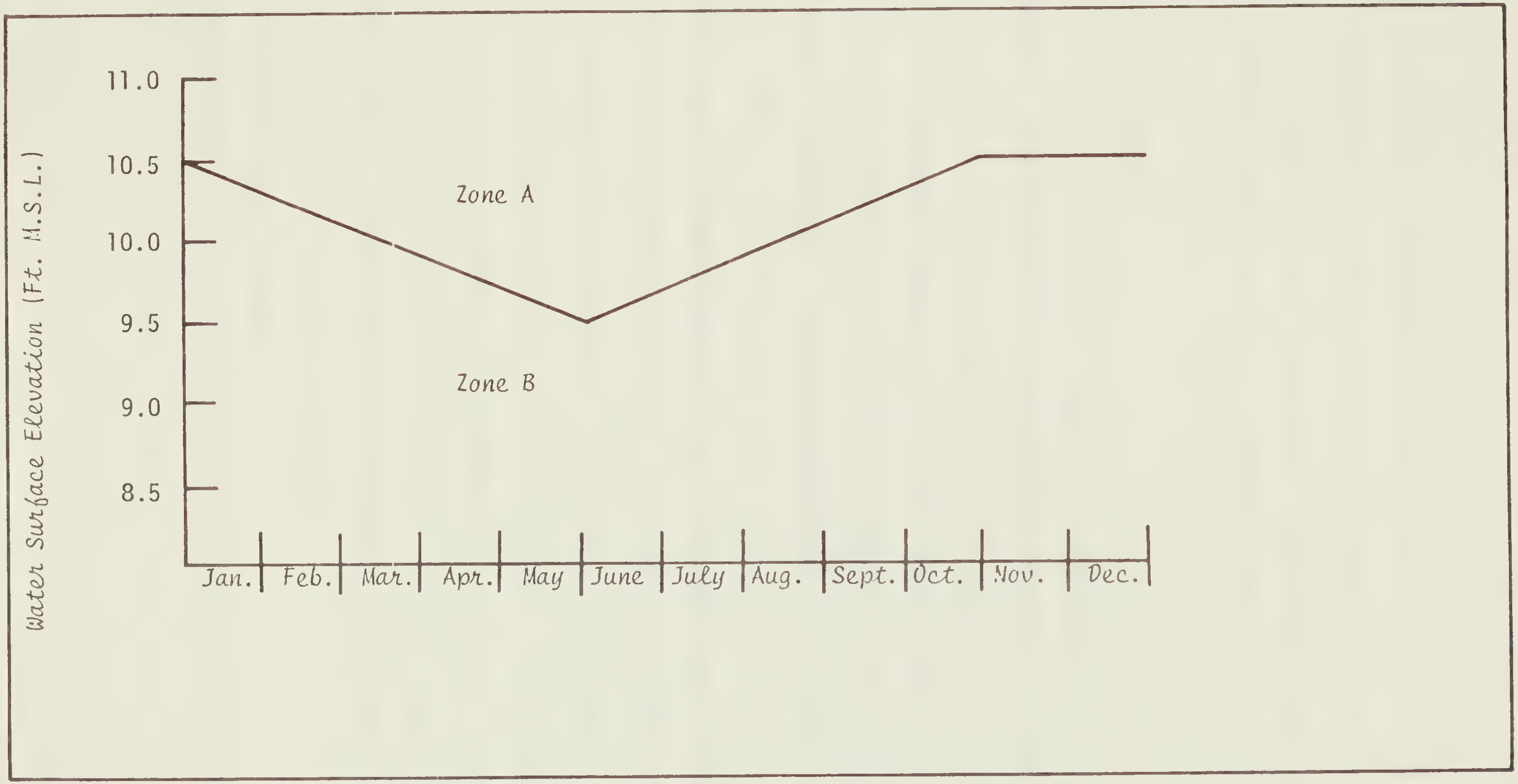
Regulation Schedule

With the major structures completed by 1962 an interim schedule was established for CA3A. This schedule, as determined by a three-gauge-average, fluctuates from 9.5 to 10.5 ft M.S.L. (Figure 3). The schedule reaches a low of 9.5 ft on 31 May and from this date levels increase gradually to a maximum level of 10.5 ft on 1 November. The level remains constant during November and December and then, beginning in January, decreases to the minimum level of 9.5 ft on 31 May.

Actual stages rarely equal the regulation schedule. A graph of the regulation schedule developed by the Corps in 1960 refers to Zone A and Zone B. Zone A is that portion of the graph above the schedule. This graph was distributed as the regulation schedule by the Corps on 30 November 1979 and contains some notes concerning water management practices. Specifically, the notes state that when water levels fall in Zone A (above schedule), releases up to the maximum capacity at S-12 and S-151 will be initiated when requested by the Corps in emergencies. When the water level is in Zone A or B, releases can be made only upon mutual agreement between the Corps and the District to meet water demands for the project and the Everglades National Park. The graph also contains a note which states that during droughts, an optimum floor level will be agreed upon for ecological purposes below which no releases from storage are permitted.

Since that graph was drafted in 1960 significant changes have occurred. First water deliveries to Everglades National Park were guaranteed by two separate agreements and then by Federal Law (PL 91-282). The law states that Everglades National Park will receive 315,000 acre-feet annually except during water shortages when it will receive 16.5 percent of total deliveries from CA3A. Although both this document and the 1960 schedule allow for curtailment of water deliveries during droughts, this apparently did not occur, even during low water years in 1971, 1973 and 1974 when severe peat fires plagued CA3A.

Figure 3
CONSERVATION AREA 3A
REGULATION SCHEDULE



Additionally, in discussions regarding regulation schedules, there does not appear to be a clearly defined mechanism for curtailing or restricting input into CA3A during high water periods. Management of water levels in pool 3A are accomplished by a joint Corps-District effort. Generally, the Corps is responsible for taking corrective action when 3A is above regulation. Beyond this, the District has routine administration over delivering or receiving water from adjacent landowners or users.

Criteria for Regulation Schedule

When the original schedule for CA3A was implemented a number of factors were considered. Apparently, the primary factor was the limitation on the amount of water which could be safely stored on the area. It was determined that water levels would have to be maintained low enough to protect marsh vegetation which reduces wind tides during hurricanes. Other criteria called for the storage of adequate water to meet the demands of various project water uses. The fluctuating schedule provides for these two benefits to the maximum practical extent.

When the schedule was initiated, gauges located on the perimeter of the area were utilized to determine the average pool level. These gauges included: S-11A Tailwater, S-151 Headwater and S-12C Headwater. At a later time, apparently in the late '60's, the three-gauge-average currently in use was adopted. These gauges, all in the interior of CA3A, are now referred to as numbers 63, 64, and 65. The gauges were changed because all involved agencies concurred that interior gauges would better reflect marsh water levels and would not be subjected to the radical changes found in canals caused by pumping or gravity discharges.

Water Related Wildlife and Habitat Problems

Since the creation of CA3A abnormal water levels have caused a number of problems for both wildlife and wildlife habitat. Generally speaking habitat problems are more critical since they tend to alter conditions for a relatively long term. Mortality to animal species caused by short term high or low water has less impact because most species occurring on the area are adjusted to these changes and can

compensate when favorable conditions return.

Habitat problems caused by prolonged periods of high water include destruction of natural tree islands and successional changes from wet prairies to sloughs. These changes are most apparent in the extreme southern end of pool 3A. Loss of tree islands reduces habitat diversity, reduces available nesting areas and eliminates high ground areas essential for terrestrial animals found in association with tree islands.

Temporary high water has caused stress and mortality to deer, destruction of alligator and turtle nests, and disruption of feeding patterns and the nesting success of wading birds.

Temporary low water levels cause a disruption of food availability for wading birds, alligators and other aquatic organisms. This may lead to nesting failure in some instances, although this has not been well documented. The mortality which is encountered by aquatic organisms under these low water conditions is generally quickly compensated by their high reproductive capabilities when normal levels return.

Extended and severe droughts have a more pronounced impact on the area. The droughts, such as those experienced in 1971, 1973, and 1974, caused direct mortality to a number of adult animals normally able to withstand such conditions. For example, during these years a number of alligator carcasses and "burned out" alligator caves were observed where peat fires had actually caused direct mortality to adult alligators.

More importantly, oxidation and peat fires have caused the destruction of tree islands and the important tree island ecotone. These losses may never be replaced, even when proper water levels are returned to the area.

PEAT LOSSES IN CONSERVATION
AREA 3A 1970-1980

Introduction

Peat losses due to oxidation and fire were significant in CA3A during the 1970's. Lowered water tables north of Alligator Alley were largely responsible for the devastating fires which struck the area beginning in 1971 and ending in 1977. Because peat losses particularly around tree islands have a dramatic impact on wildlife habitat this historical aspect of CA3A is treated separately from other aspects.

Methods

Peat depths and potential peat losses in CA3A were only a minor concern in 1970. As a result, documentation of peat losses in that area during the 1970's is the result of either related studies or actual field observations during or shortly after a peat fire in a given area. In order to document peat losses during this time period and to estimate the magnitude of losses over the entire area four basic approaches are utilized. The reliability of each method varies but when combined they should provide an estimate of the overall problem.

Knowledge gained from field observations during the 1970's was used to document the geographic location and chronological occurrence of significant peat fires in CA3A. Peat losses were estimated by direct measurement on established study plots, by comparing average ground levels at individual gauges with ground levels reported at the time of gauge installation, by comparing water depths on areas subjected to peat fires to adjacent areas not subjected to peat fires, and by measuring losses on an active peat fire.

In 1971 six study plots were established in CA3A to document the impact of known levels of ORV use on Everglades vegetation. Each of these plots was subjected to various levels of ORV use (airboat and halftrack). In addition, a portion

of each plot was left undisturbed as a control. Metal stakes were used to mark permanent subplots or sample points associated with both control and treatment areas. Peat depths were recorded in 1971 at each of these stakes. The stakes were re-measured in 1979-80 and changes were compared by study plot.

During the present study water levels were monitored at 12 gauges in CA3A. In conjunction with this water level analysis, peat depths were measured and ground elevations for each vegetation type were estimated. Vegetation types, gauge locations, and number of sample points are discussed in detail in the section on water depth analysis. Peat depths were measured with a steel rod inserted vertically into the ground until the bedrock was reached. At seven of the 12 gauges, estimates of current ground levels could then be compared to the ground levels determined by survey at the time of installation. Average peat depths were calculated for each gauge and depths in areas of peat fires were compared to depths outside of peat fire areas.

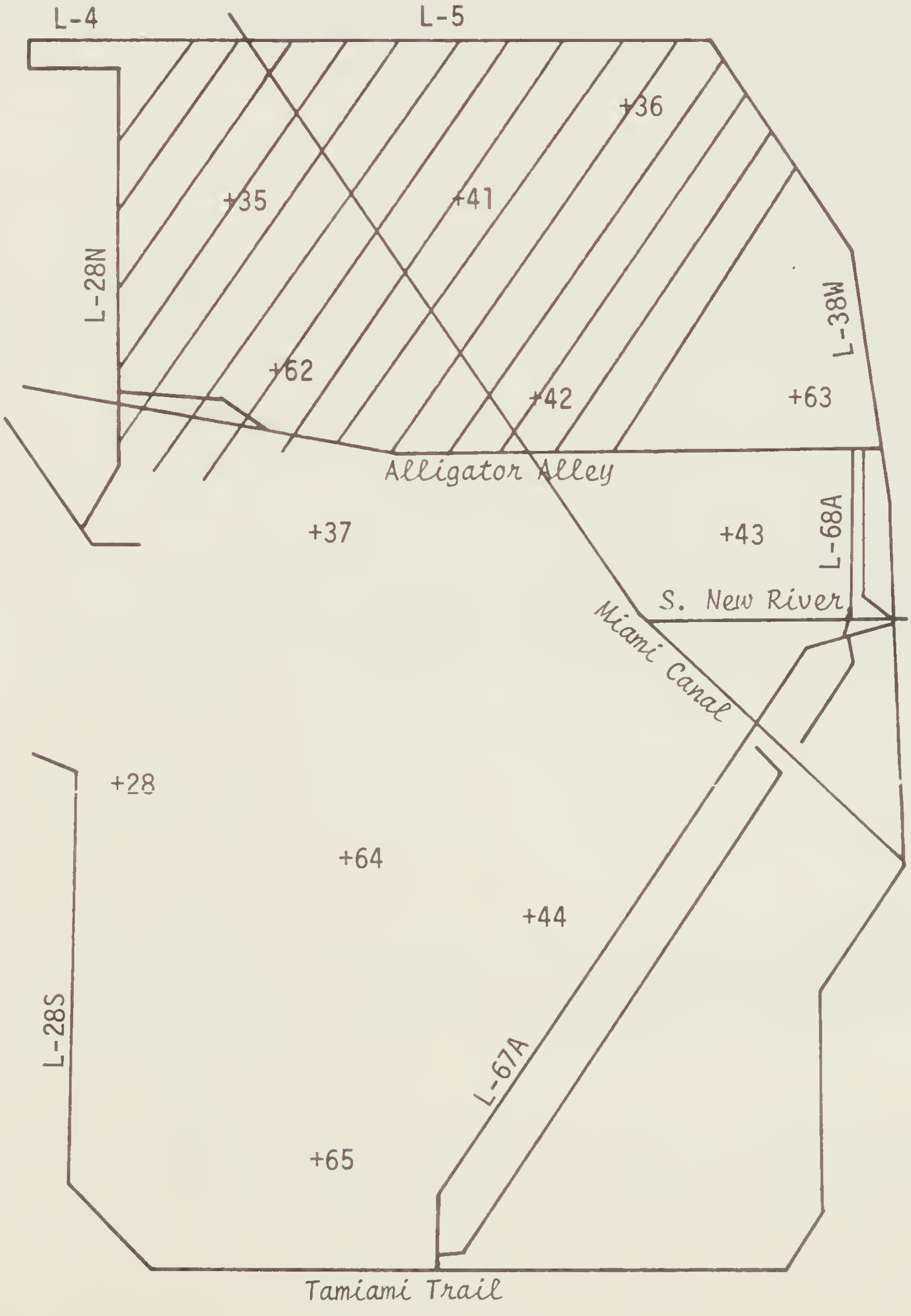
In 1977, a single peat fire of short duration burned a portion of CA3A just east of L-28. This fire was closely monitored to gain information on the magnitude of the fire and factors affecting peat fires in the Everglades. As a result several locations were marked throughout the burn area and peat depth changes were recorded by using steel rods placed in the ground to measure relative peat levels as the fire progressed. In addition, peat losses were measured in random locations by measuring the depression in burned areas. Finally, a single area where severe peat fires were observed in 1974 was inspected four years later. In 1978, vegetation differences were used to delineate areas subjected to peat fires from unburned areas. Water depths from unburned areas were compared to water depths in burned areas to provide an estimate of peat losses at this location. By using a series of unrelated methods to estimate peat losses in CA3A an estimate of the severity of the peat fires in this region can be developed.

Results & Discussion

During the past decade peat fires were documented in CA3A in 1971, 1973, 1974 and 1977. No peat fires are known to have occurred during the remaining years. Figure 4 shows that portion of CA3A where peat fires occurred during the 1970's and the general location of water gauges used in the present study. Generally, peat fires occurred over most of CA3A north of Alligator Alley, although the extreme southeastern portion was not subjected to peat fires. In addition peat fires did occur just east of L-28 and south of Alligator Alley in 1973.

While pre-fire conditions have not been established for the peat resource in this area several comparisons of peat depth can be made for gauges lying within this area and those outside the area of recorded peat fires. This can be done by comparing peat depths recorded at the 12 study gauges (Table 1). Gauges 35, 36, 41, 42 and 62 are located within the area of reported peat fires. The average peat depth recorded for all sawgrass communities at these five gauges in 1980 is 1.71 ft; the average peat depth in sawgrass communities for the remaining seven gauges is 2.98 ft. If peat depths were equal across the area prior to 1970 this difference would represent an average loss of 1.27 ft. A second method of comparing peat depths is to check the indicated ground level in 1980 against the ground elevation reported at the time of installation. Figures for this are available for seven of the 12 gauges studied in this report. These comparisons are presented in Table 2. Gauges 35, 36 and 62 are within peat fire areas while gauges 37, 63, 64 and 65 lie in areas not affected by peat fires. The three gauges where peat fires occurred show a net loss of 0.5 ft ground elevation while the remaining gauges show a net gain of 0.1 ft. This represents an average loss of 0.5 ft ground elevation compared to the difference in average peat depths of 1.27 ft. While the accuracy of these methods is less than desirable, the data seem to indicate that substantial peat losses did occur in the vicinity of gauges 35, 36, 41, 42, and 62.

Figure 4
GENERAL LOCATION OF PEAT FIRES IN CONSERVATION AREA 3A AND WATER GAUGES USED IN PRESENT STUDY



Summary of Conservation Area 3A Peat Depths in Feet by Vegetation Type and Gauge Location, 1979

	28		35		36		37		41		42	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
SS	14	1.59	9	1.37	17	1.71	11	2.12	11	1.64	11	2.00
SC			1	0.83					2	1.72		
SM							6	2.17				
SA									1	2.26		
SB									2	1.27		
SE									1	3.84		
Avg. Sawgrass	14	1.59	10	1.32	17	1.71	17	2.14	17	1.77	11	2.00
AN												
AM												
AB												
AA												
AL												
AR			1	0.61								
Avg. Slough			1	0.61								
PM	2	0.87	6	1.46			9	1.93	4	1.45	7	1.86
PA			1	0.71								
PE	1	1.76	1	1.99			7	1.68			4	1.88
PT												
PB	11	1.55					1	1.50	5	1.17		
Avg. Prairies	14	1.47	8	1.43			17	1.80	9	1.30	11	1.87
CC			1	0.51	1	1.11			2	1.02		
CM			1	0.69								
CA												
CN												
CL												
CB												
CS			5	0.72					2	0.98		
Avg. Cattail			7	0.69	1	1.11			4	1.00		
VS			5	0.70								
VP			1	1.25								
LS			1	6.29								
Avg. All	28	1.53	33	1.24	18	1.67	34	1.97	30	1.53	22	1.94

Table 1 (Contd)

Summary of Conservation Area 3A Peat Depths in Feet by Vegetation Type and Gauge Location, 1979

	43		44		62		63		64		65	
	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$
SS	14	3.02	17	4.27	11	1.76	17	2.40	17	3.80	17	3.67
SC	2	2.85					2	1.94				
SM												
SA												
SB												
SE												
Avg. Sawgrass	16	3.0	17	4.27	11	1.76	19	2.35	17	3.80	17	3.67
AN	4	2.91	12	4.03							16	3.23
AM	2	1.61					1	4.02				
AB	1	3.48	2	3.71					1	3.37	1	3.12
AA	3	2.32										
AL							1	1.99				
AR												
Avg. Slough	10	2.53	14	3.98			2	3.01	1	3.37	17	3.22
PM	4	3.13	3	4.29	7	1.59	7	2.53	5	3.68		
PA												
PE			1	3.98			4	1.58	6	3.32		
PT												
PB					7	1.44			5	3.29		
PP							1	2.22				
Avg. Prairies	4	3.13	4	4.21	14	1.52	12	2.19	16	3.43		
CC					1	0.73						
CM	2	3.28			2	1.36						
CA	1	1.51					1	1.42				
CN	2	2.40										
CL												
CB	1	2.91										
CS	2	2.56	1	4.10	2	1.10	1	1.16	1	3.69		
Avg. Cattail	8	2.61	1	4.10	5	1.13	2	1.29	1	3.69		
VS												
VP												
LS												
Avg. All	38	2.81	36	4.15	30	1.54	35	2.27	35	3.62	34	3.45

Table 2

A Comparison of Ground Level Elevations at Selected Gauges in Conservation Area 3A

Gauges	(A)Elevation In Feet MSL At Time Of Installation[1]	(B)Indicated Average Ground Level In Feet For Sawgrass 1979[2]	Difference In Feet (B-A)
35	11.6	11.0	-0.6
36	10.7	10.2	-0.5
37	9.3	9.6	+0.3
62	10.6	10.3	-0.3
63	8.9	8.8	-0.1
64	8.2	8.3	+0.1
65	7.4	7.6	+0.2

1. From South Florida Water Management District Drawing CA 22
2. Derived by subtracting average sawgrass water levels from gauge reading at selected times.

Since peat depths may have differed prior to peat fires in the past decade the difference of 1.27 ft observed between gauges subjected to peat fires and gauges not subjected to peat fires could be simply an indication of differences existing prior to fire and not a result of peat fires and oxidation. The average change observed in ground elevation is also subject to considerable error since two different methods were used to determine ground elevation. The initial elevations were determined by third order surveys while the recent elevations were simply average water depths in sawgrass communities subtracted from a gauge reading of water elevations in feet above mean sea level. At the present time the indicated loss of 0.5 ft seems to indicate substantial peat losses at these locations although actual losses may be quite different from those indicated. The difference of 1.27 ft observed between areas appears to represent a combination of peat losses combined with initial differences in peat levels.

In 1971 six ORV study plots were established north of Alligator Alley. One plot was established on an existing 1971 peat burn, four in sawgrass strands, and one on a wet prairie (Figure 5). Plot 25 was established on a location where a peat fire had occurred in 1971. The plot and all measurements were established after the peat fires burned the area in 1971. Plots 27, 38, 53 and 60 were established in sawgrass strands in late 1971. These plots were not subjected to peat fires in 1971 but were in later years. Plot 61 was established on a wet prairie dominated by maidencane and was not subjected to peat fires in 1971. This plot was also subjected to peat fires in later years. Table 3 summarizes peat losses combined for treatments and controls and for all study plots. Because actual levels of vehicle use over CA3A were unknown, these figures may not represent a true average of peat losses over the area. Average peat losses which were significant ranged from 0.28 ft on plot 38 to 0.59 ft on plot 27. Losses for all plots combined average 0.28 ft, which was significant.

Figure 5
LOCATION OF ESTABLISHED PLOTS WITH
MEASURED PEAT DEPTHS 1971 - 1980

Table 3

Summary of Changes in Peat Depths
For All Treatments Combined On Study
Plots Established In 1971 and Checked In 1979

Plot	Number of Measurements	Changes in Feet	Significant Decrease
25	51	-0.32	Yes**
27	44	-0.59	Yes**
38	61	-0.28	Yes**
53	52	-0.09	No
60	56	-0.37	Yes**
61	53	-0.12	No
All Plots	317	-0.28	Yes**

* Signigicant at .95 level
** Signigicant at .99 level

As stated earlier peat fires were widespread in 1971, 1973 and 1974. In 1974, severe localized burns were observed in the area surrounding Ledbetter's Camp, which is north of Alligator Alley and east of the Miami Canal (Figure 6). These peat fires created several deep depressions which, when checked in 1978, were still quite evident. These depressions were characterized by open water with cattail and maidencane common in localized areas. Water depths on these depressions averaged 1.08 ft compared to 0.26 ft in adjacent unburned vegetation. Peat losses estimated four years after the fires would be the difference between these two figures or 0.82 ft.

In 1977 a single peat fire was observed in CA3A. This peat fire burned approximately 5,000 acres just east of L-28 and south of the oil pipeline (Figure 7). Peat losses from this fire which burned from 4 May through 6 May were measured at 22 locations. A total of 220 readings were recorded on this area and average losses by location ranged from 0.25 ft to 0.69 ft. Average peat losses during this fire were 0.46 ft.

To determine the exact magnitude of peat losses in CA3A during the 1970's would have required substantial investments of manpower and capital. In addition, considerable foresight would have been necessary in order to sample the correct areas. Fortunately, enough data and observations exist to document the severity of the problem.

Peat losses measured at six study plots, established in 1971 and rechecked in 1979, averaged 0.28 ft. Peat losses measured in 1978 on an area which had a severe burn in 1974 averaged 0.82 ft. A single fire in 1977 burned approximately 5,000 acres and consumed an average of 0.46 ft. Peat losses were estimated to be 0.50 ft at three water level gauges within the area subjected to peat fires. Gauges outside this area showed a net gain of 0.1 ft. These data indicate that peat losses over the entire area subjected to peat fires ranged from no loss to levels approaching 1 ft. Average losses are estimated at a minimum of 0.25 ft.

Figure 6
AREA OF SEVERE PEAT FIRES AROUND
LEDBETTER'S CAMP, 1974

Figure 7
APPROXIMATE AREA OF 1977
PEAT FIRE

WILDLIFE HABITATS

Protection and enhancement of natural wildlife habitats in the Everglades are essential to proper wildlife management in CA3A. This section divides wildlife habitats into the four major categories already listed, namely, sawgrass strands, sloughs, prairies and tree islands. Each of these communities may be stressed or altered by drought, fire or flood caused by extreme water level fluctuations. Sawgrass communities, by their nature, seem to be quite resistant to change and, even after extremely unfavorable conditions, will very soon dominate an area if favorable conditions return. Dineen (1972) recognized the adaptable and resistant nature of sawgrass. Recovery of CA3A north of Alligator Alley since the peat fires of the early 1970's has reinforced this concept. During this time period fires destroyed a number of sawgrass strands and this area was dominated locally by plants such as dog fennel, pigweed, Senecio, saltbush, broomsedge and cattail. However as 1980 approached, favorable water conditions returned and sawgrass is once again the dominant plant in the north end of CA3A. For this reason sawgrass would be a poor plant community to select as an indicator of water level impacts on wildlife habitats. More sensitive habitats may be found in tree island communities, prairies and sloughs. From a wildlife habitat standpoint we feel that maintenance and enhancement of wet prairies and tree islands are critical to good wildlife populations. Furthermore, we believe that Exhibit B of the Draft Water Use and Supply Development Plan contains an adequate analysis of historical conditions at selected gauges and our analysis utilizes information contained therein.

To relate these findings to the water depth analysis the following comments are deemed appropriate. The 12 gauges analyzed may be divided into three similar groups as follows: A) 43, 44, 63, 64, 65; B) 28, 42, 37; and C) 35, 36, 41, 62. These three groups are analyzed on a historical basis and on theoretical conditions based on the water depth analysis. The historical basis is limited to that time span since pool 3A has been functional.

Historical

The gauges in Zone A represent areas where deeper water levels have been encountered since CA3A has been operational (Figure 8). Tree islands in these areas have been either periodically or permanently flooded, causing considerable damage to the woody vegetation. Water levels in the marsh have been sufficiently high so that wet prairie areas have been reduced in size and now occupy only the higher elevations.

Water levels in Zone B have been intermediate in nature and both wet prairies and tree islands have flourished. Of particular interest for this area has been the documented occurrence of two diverse endangered species. In late 1979 and early 1980 a substantial number of Everglade kites were found in the L-28 gap. Also in mid-1979 for the second time in recent years documented panther sign was discovered in this area indicating at least two different animals to be present.

In addition, the area also supports good populations of wading birds, waterfowl and frogs. While not as abundant as on drier sites deer are common in this area especially in areas where tree islands are abundant. This area appears to have conditions which are near optimum for wildlife and wildlife habitats.

Water levels in Zone C are generally indicated to be less than 0.82 ft at regulation schedule. If regulation schedules were maintained accurately these levels would be sufficient to maintain good prairie and tree island communities. However, Zone C is almost identical to the area described in the section on peat fires. This is the area subjected to devastating peat fires in the 1970's. Although the sawgrass strands and prairies have staged a remarkable recovery the tree islands still bear the scars of these fires. Virtually every island has been altered by peat fires. At the present time most of the islands in this area have woody vegetation which is restricted to the extremely high elevations previously found on the north end of a typical island. Loveless, (1959), described this portion of the island as comprising about 5% of the total. The remaining 95% of these islands

Figure 8
VEGETATION ZONES IN CONSERVATION AREA 3A
SHOWING AREAS AFFECTED BY
DIFFERENT WATER LEVELS

were in the form of a teardrop, oriented in a southerly direction. This portion of the island was at an intermediate elevation between the surrounding marsh and the highest portion of the island. The loss of these intermediate zones over such a large area will certainly have a long term impact on the area's wildlife resources. These are the areas where severe peat fires, consuming as much as 0.8 ft to 1.0 ft of soil, destroyed not only the trees but the critical elevations necessary to re-establish woody vegetation.

Theoretical

If the current regulation schedule were closely approximated, the following habitat conditions could be expected in each of the zones:

Zone A Conditions similar to those experienced in the historical case would be encountered. The severity and duration of flooding would increase; therefore, damage and loss of tree island and prairie habitat would be more pronounced.

Zone B Water levels in this zone would be sufficient to cause some loss of tree island habitat and prairie habitat due to prolonged flooding.

Zone C The tree islands and prairies would flourish under this schedule provided it was precisely followed. Severe droughts and fluctuations from the established schedule would cause further peat fires and habitat losses.

The impact of the internal water control structures, S-339 and S-340, is not considered in this analysis. The impact of these structures is considered in the summary and analysis.

OPTIMUM WATER LEVELS FOR WILDLIFE

In order to determine optimum water levels for wildlife a workshop was held in December 1979, with selected professionals in attendance. The purpose of the workshop was to determine optimum water levels for key species or groups of Everglades wildlife. The wildlife groups or species selected were waterfowl, alligator, pig frog, wood stork, largemouth bass, passerine birds, Everglade kite, and deer.

Methods

In order to develop optimum water levels certain guidelines were established to provide uniform analysis. The water levels derived are theoretical levels in sawgrass strands. It is assumed that wet prairies are approximately 0.33 ft below this level and that sloughs are approximately 0.5 ft below sawgrass levels. Tree islands are assumed to be 1.5 ft to 2 ft above the level of sawgrass strands. While a great deal of concern was expressed about the meaning of "average sawgrass water levels," no conclusive definition was reached. There seemed to be a general consensus that the term referred to desired sawgrass water levels over major portions of the pool at a given time. At the same time it was recognized that water levels would not be identical over the entire pool and that these differences would be essential to certain species. The optimum water levels were derived using a combined approach. This combined approach recognized that ideal water levels would protect key wildlife habitats and also provide favorable feeding conditions for selected wildlife species. When the water levels were drafted for the eight categories listed above a total of ten hydroperiods resulted. This occurred because the waterfowl category was divided into diving and dabbling ducks and the largemouth bass category was divided into a good canal fishery and a good marsh fishery. Animal groups and species are identified by scientific name in Appendix A.

These water levels were plotted on standard annual graph paper divided into one year by days. Water levels were plotted in feet relative to sawgrass ground level to the nearest 0.05 ft. Subsequent analyses and comparisons were derived by computing the approximate depths indicated by each graph on the first and 15th day of each month. In the initial workshop maximum and minimum levels were plotted for six of the original ten classes. Maximum and minimum water depths were placed on the remaining classes by using the average difference between the optimum and either extreme for those categories where maximum and minimum depths were initially plotted (Table 4).

Results

Figure 9 depicts desired water levels for deer. As might be expected, these levels are relatively low with optimum depths ranging from ground level during the peak fawning season (March through July) to 0.8 ft during December. The maximum depths are only slightly higher with a peak of 1.0 ft in December and a minimum of 0.25 ft from March through June. Minimum water levels ranged from a high 0.5 ft from mid-September through December to a low -1.0 ft on 31 May.

These levels were derived taking into consideration the following major factors:

A) Significant portions of the area should be dry during and after the peak fawning season.

B) Little or no water on the area actually provides the best conditions for deer.

C) Protection of the habitat necessitates the presence of surface water on the area the majority of the time. For these reasons, the maximum and minimum levels generally represent a fairly constricted band around the optimum levels. Any amount of water significantly greater would reduce the carrying capacity of the area while levels significantly below the optimum would cause habitat degradation as well as temporary increases in deer numbers.

Figure 10 shows desired water levels for alligators, passerine birds and the pig frogs. The water levels for these three are identical with optimum with optimum water levels ranging from 1.25 ft in November through December to a low of 0.25 ft on 31 May. Maximum and minimum levels generally differ from the optimum by approximately 0.75 ft. For the pig frog and alligator wet conditions mean good food production and

Table 4

Acceptable Deviations from Optimum Sawgrass
Water Levels for Selected Wildlife Categories[1]

	Jan 1	Jan 15	Feb 1	Feb 15	Mar 1	Mar 15	Apr 1	Apr 15	May 1	May 15	Jun 1	Jun 15	Jul 1	Jul 15	Aug 1	Aug 15	Sep 1	Sep 15	Oct 1	Oct 15	Nov 1	Nov 15	Dec 1	Dec 15
Opt-Min																								
Deer	0.30	0.25	0.20	0.20	0.15	0.25	0.45	0.55	0.70	0.85	0.95	0.75	0.55	0.35	0.10	0.10	0.10	0.05	0.10	0.15	0.20	0.25	0.30	0.30
Alligator, Passerine Birds, Pig Frog	0.75	0.75	0.70	0.70	0.70	0.65	0.65	0.80	0.95	1.15	1.25	1.15	1.00	0.90	0.80	0.70	0.55	0.45	0.55	0.65	0.75	0.75	0.75	0.75
Wood Stork	0.35	0.35	0.35	0.35	0.30	0.25	0.25	0.25	0.25	0.20	0.25	0.25	0.25	0.25	0.25	0.30	0.30	0.35	0.35	0.45	0.50	0.50	0.45	0.40
Kite	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Average[2]	0.48	0.46	0.44	0.44	0.41	0.41	0.46	0.53	0.60	0.68	0.74	0.66	0.58	0.50	0.41	0.40	0.36	0.34	0.38	0.44	0.49	0.50	0.50	0.49
Max-Opt																								
Deer	0.20	0.15	0.10	0.10	0.20	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.35	0.35	0.25	0.15	0.05	0.10	0.10	0.15	0.15	0.20	0.20
Alligator, Passerine Birds, Pig Frog	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Wood Stork	0.35	0.35	0.30	0.30	0.25	0.30	0.25	0.25	0.30	0.30	0.25	0.25	0.25	0.30	0.35	0.35	0.35	0.45	0.45	0.50	0.50	0.50	0.45	0.40
Kite	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Average[2]	0.45	0.44	0.41	0.41	0.43	0.45	0.44	0.44	0.45	0.45	0.44	0.44	0.44	0.48	0.49	0.46	0.44	0.44	0.45	0.46	0.48	0.48	0.48	0.46

1 In Feet
2 Applied to remaining wildlife categories

Figure 9
RECOMMENDED SAWGRASS WATER
LEVELS FOR DEER

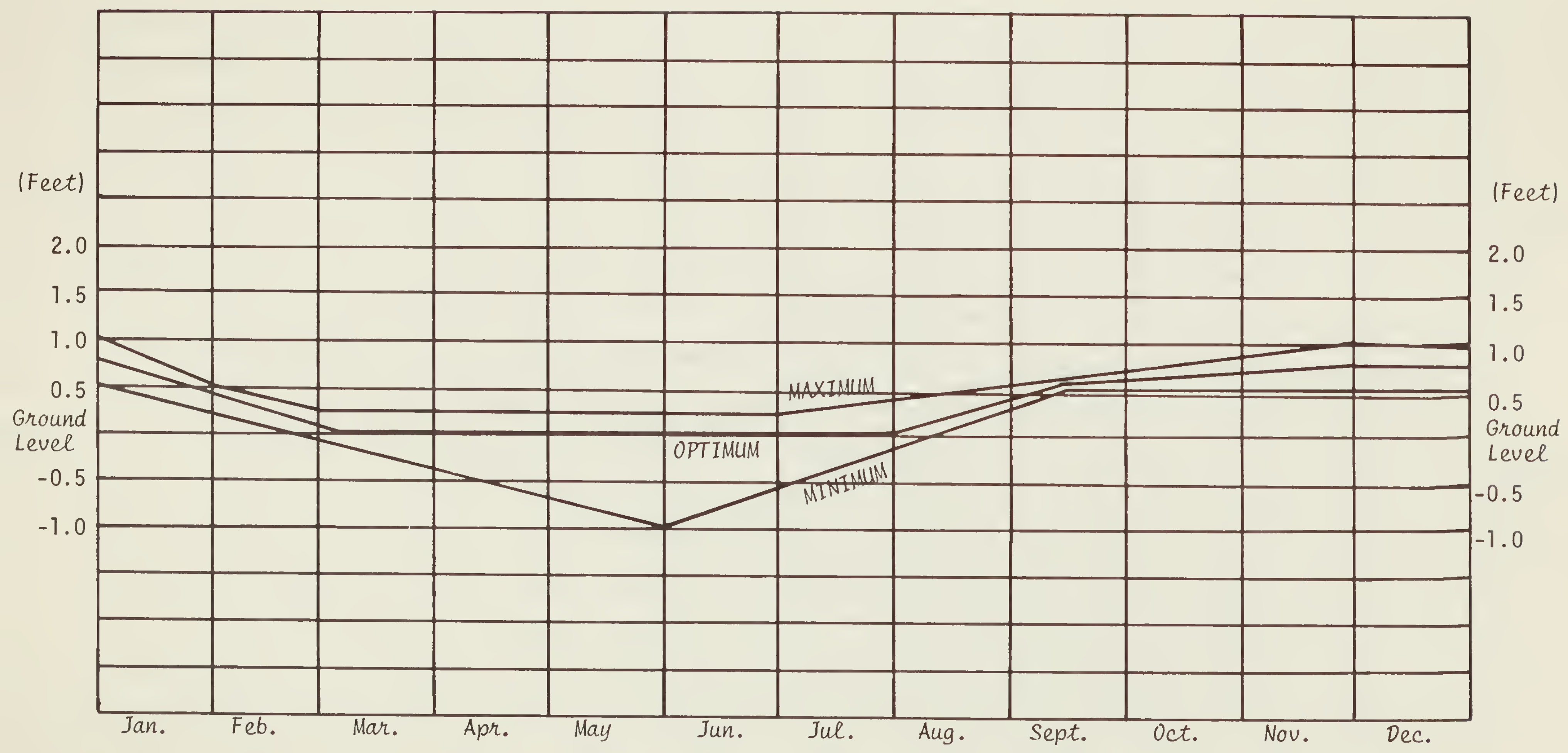
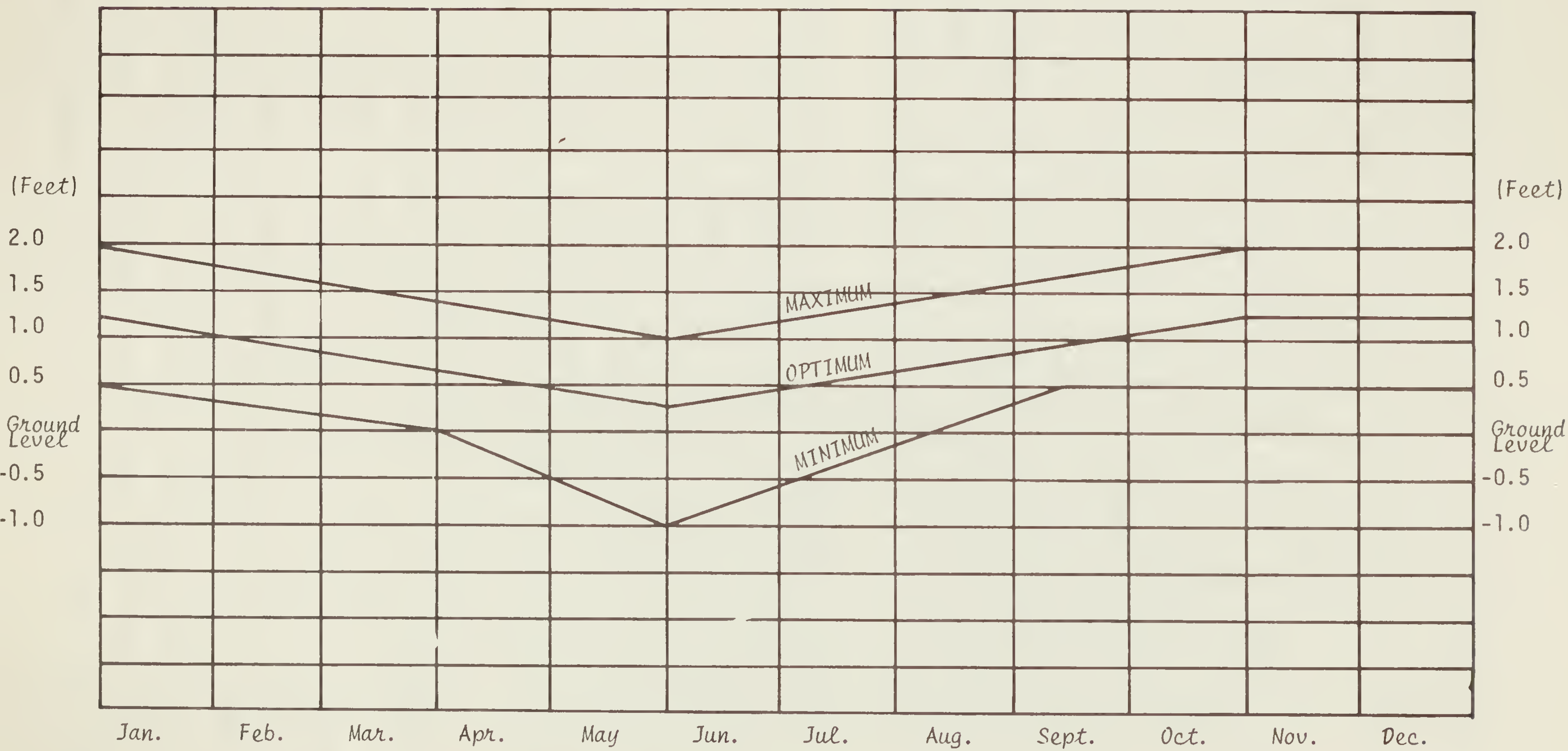


Figure 10
RECOMMENDED SAWGRASS
WATER LEVELS FOR
ALLIGATOR, PASSERINE BIRDS
AND PIG FROG



fluctuating water levels help concentrate food supplies. Severe habitat alterations would occur if water levels exceeded these maximum and minimum bounds. Passerine birds were included in this graph because it was felt that they could tolerate a fairly wide range of depths if major habitats were protected.

Optimum water levels for the Everglade kite are depicted in Figure 11. Optimum water levels range from a low of 1.5 ft on 31 May to a high of 3.0 ft during November and December. These levels were chosen because they represent water levels in areas where the Everglade kite is doing well at the present time. Fluctuations of 0.5 ft generally appear to be acceptable on these areas and therefore the maximum and minimum levels are 0.5 ft from the optimum. While these water levels may be beneficial to the kite on a short term basis, they do exceed levels conducive to a number of Everglades habitats, particularly tree islands and wet prairies.

Figure 12 depicts desired water levels for the wood stork. These water levels would provide good conditions for most wading birds, including suitable nesting habitat. Optimum water levels fluctuate from a peak level of 1.5 ft in November to a low of -0.25 ft in June. These levels would provide food production during July through November and would concentrate these food supplies in late winter and spring. Acceptable levels generally deviate less than 0.5 ft from the optimum. These levels reflect the necessity to have some feeding opportunities throughout the year with maximum opportunity during and just after nesting season.

Figure 13 shows desired water levels to produce two types of largemouth bass fisheries. The lower water levels would produce a good bass fishery with "lunker" bass frequently occurring in the canals. Optimum water levels for this fishery range from 2.0 ft in November through December to 0.25 ft on 31 May. Under these conditions good annual production would occur in the marsh. Good sized bass could be caught consistently and raised in the marsh under a higher water regime known as the marsh lunker fishery. Optimum water levels for this fishery range from 3.5 ft, in November through December, to a low of 1.65 ft on 31 May. Both of these schedules

Figure 11
RECOMMENDED SAWGRASS
WATER LEVELS FOR
EVERGLADE KITE

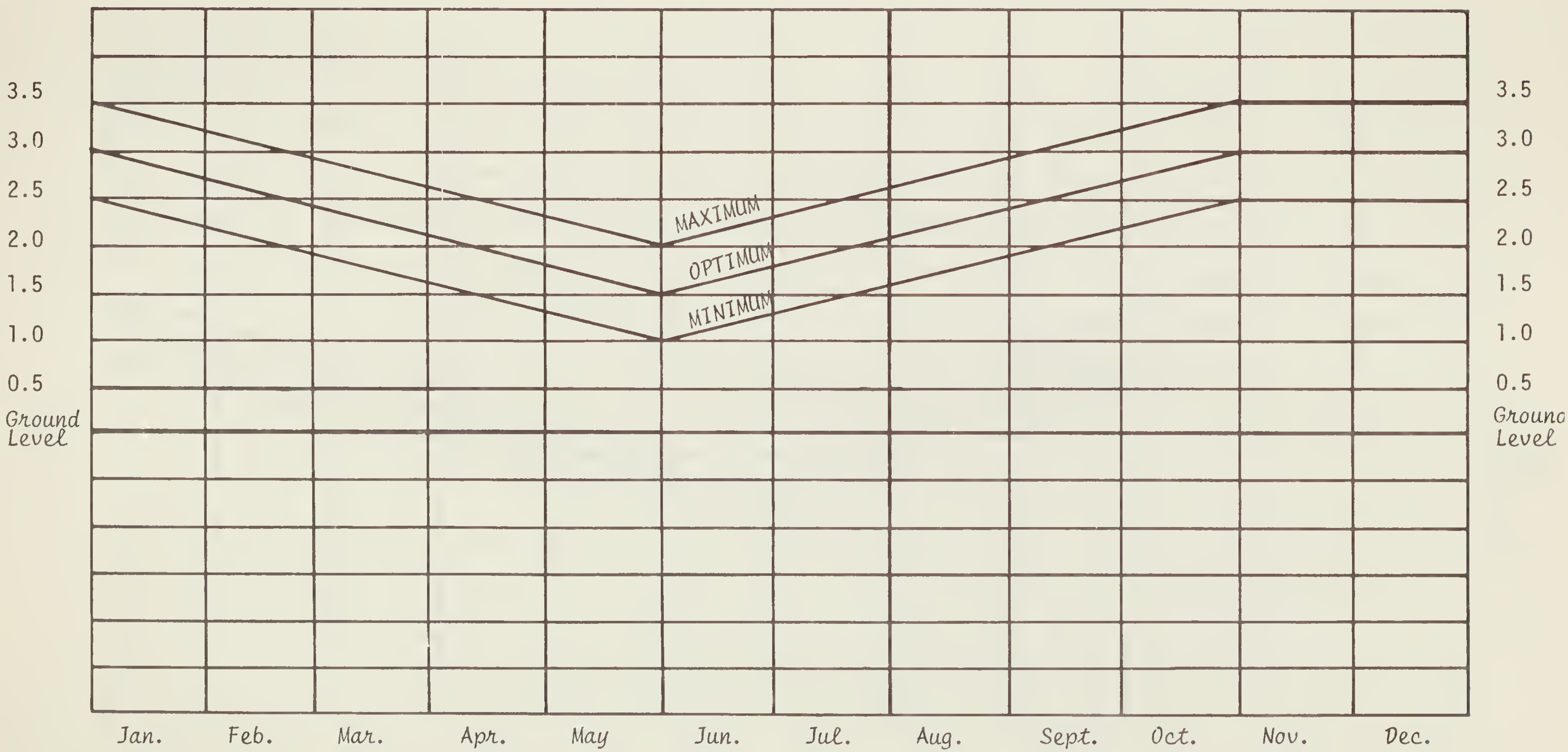


Figure 12
RECOMMENDED SAWGRASS
WATER LEVELS FOR
WOOD STORK

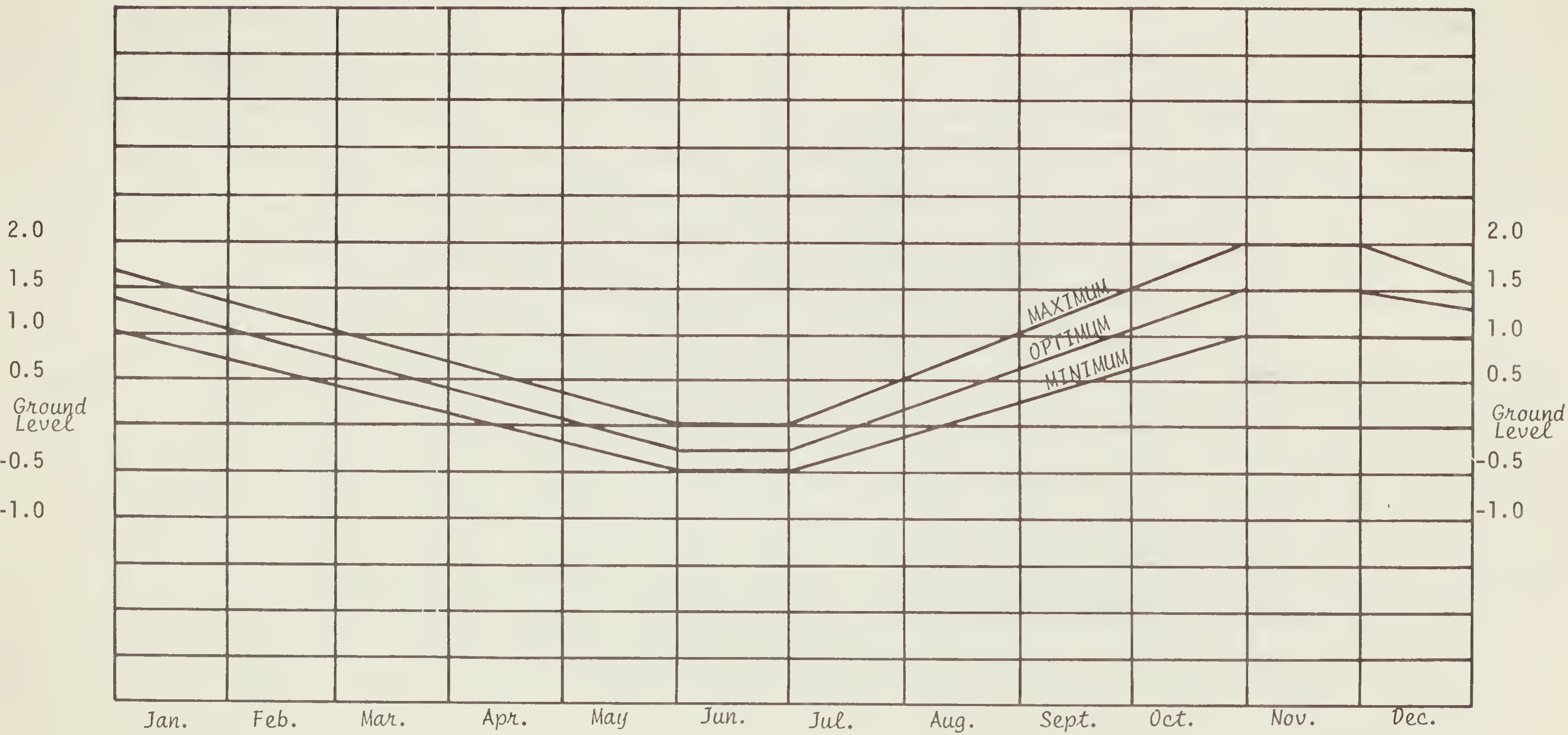
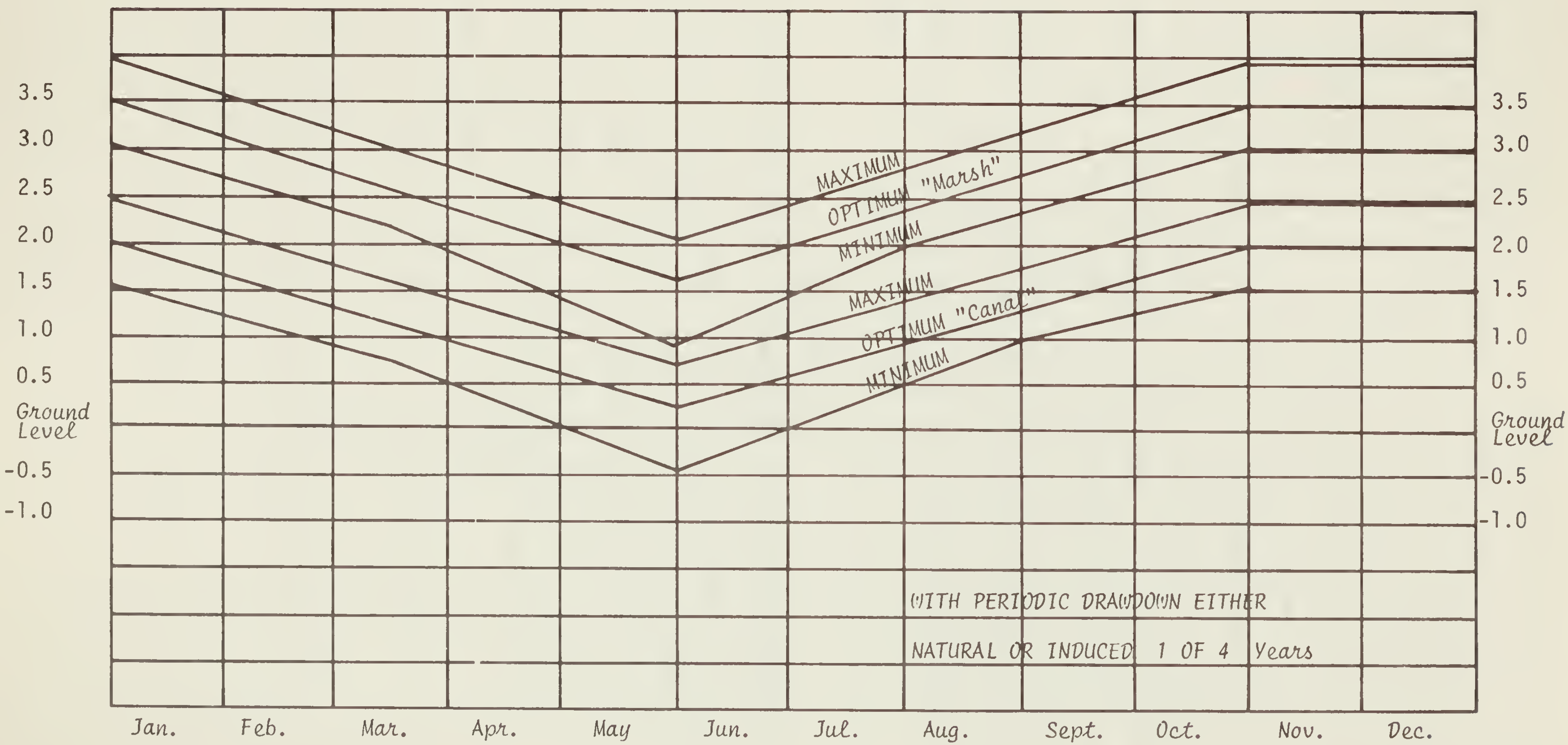


Figure 13
RECOMMENDED SAWGRASS
WATER LEVELS FOR
LARGEMOUTH BASS



would function best with a periodic drawdown initiated once every four years. Maximum and minimum levels for both categories were derived by using the average difference between the optimum and the maximum or the minimum as determined in Table 4. Minimum levels ranged from 0.34 ft to 0.74 ft below the optimum while maximum levels varied from 0.41 ft to 0.49 ft above the optimum level. Desired water levels for waterfowl are shown in Figures 14 & 15. Figure 14 represents water levels for "diving" ducks while Figure 15 represents desired water levels for dabbling ducks. For diving ducks, water levels fluctuate from a high of 1.75 ft on 1 November to a low of -0.4 ft in April and May. Water levels for dabbling ducks fluctuate from 1.25 ft on 1 November to -0.4 ft in April and May. Water levels for both groups are relatively low to insure proper food production in late spring and early summer. Maximum and minimum levels were derived in the same manner described earlier for the bass fishery.

Discussion

Once the optimum water levels have been plotted for the ten categories of wildlife, it becomes apparent that a given location in the Everglades cannot provide optimum conditions for all wildlife simultaneously. When the different categories are compared to each other, four are considerably higher or lower than the remaining groups. These four groups are both categories of bass, the Everglade kite and deer. The remaining six categories have significant areas of compatibility when maximum and minimum water levels are compared.

Since there is no basis for weighing the different categories, all categories were considered to have an equal value for purposes of comparison. To determine which water level combination is best for wildlife, five proposed water schedules were examined. These schedules were derived by comparing optimum water levels for different categories on the first and 15th of each month. These figures are presented in Table 5. The proposed water schedules included (I) a simple arithmetic

Figure 14
RECOMMENDED SAWGRASS
WATER LEVELS FOR
DIVING DUCKS

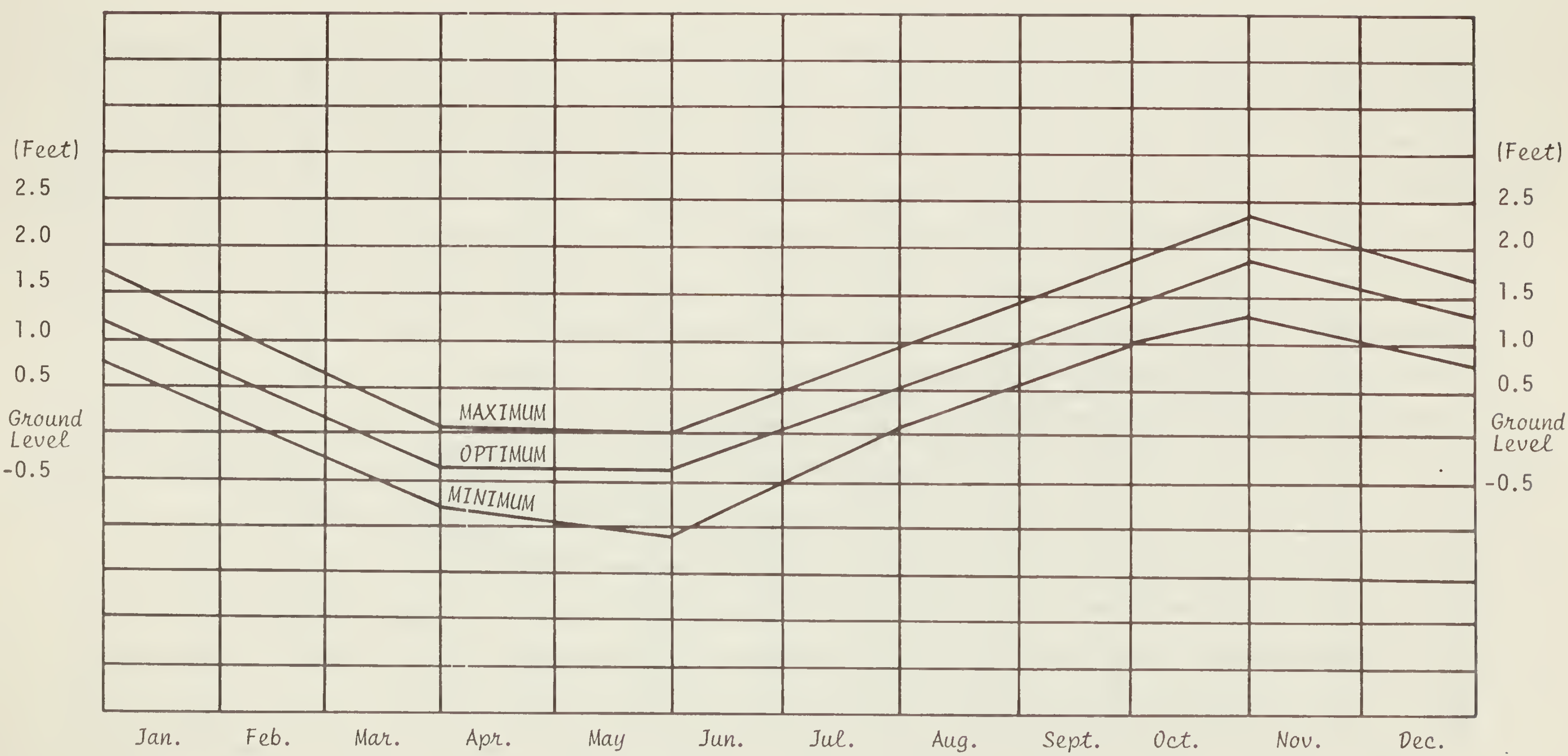


Figure 15
RECOMMENDED SAWGRASS
WATER LEVELS FOR
DABBLING DUCKS

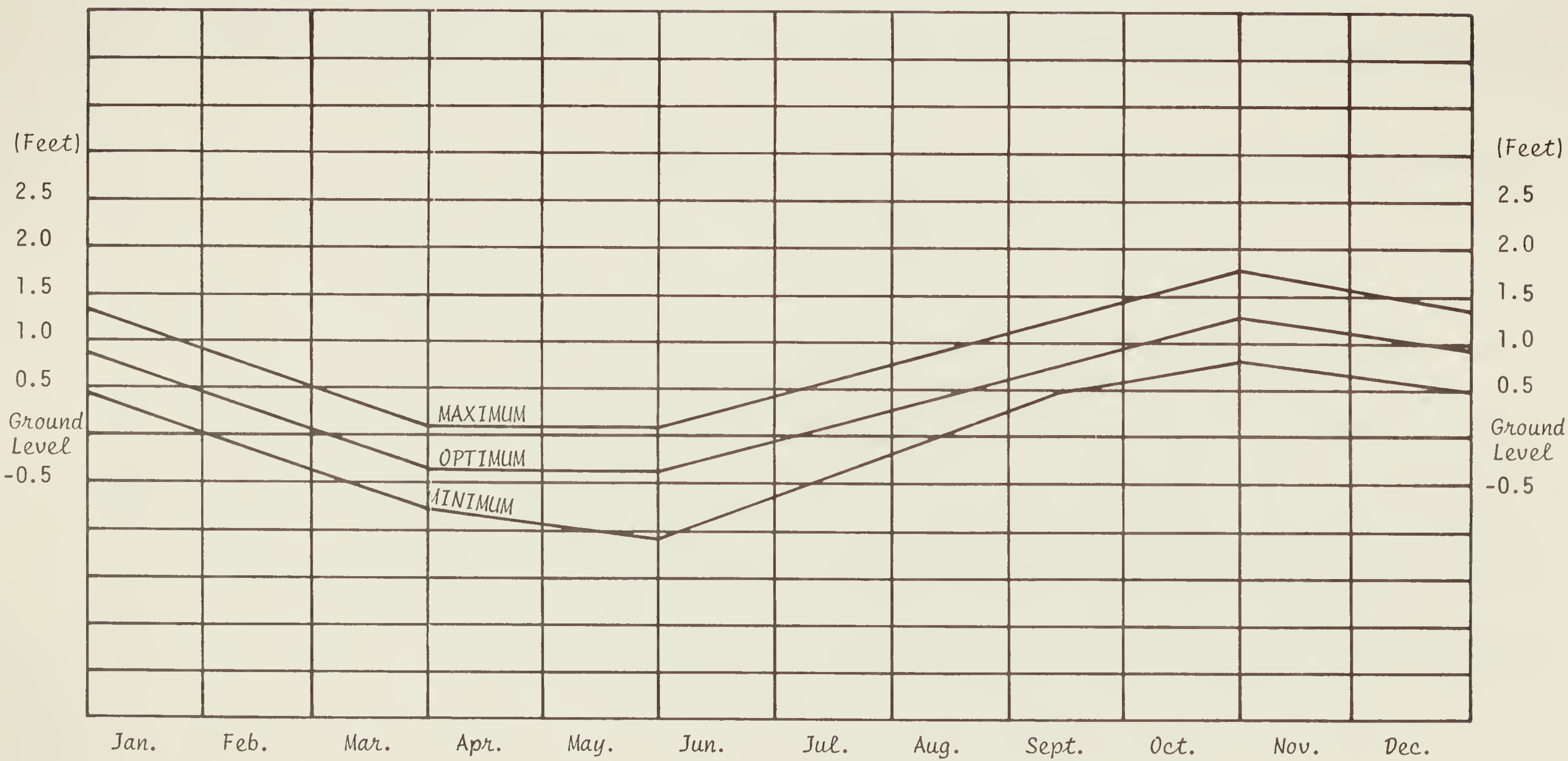


Table 5

Optimum Sawgrass Water Levels For Selected
Everglades Wildlife Species (in Feet)

Species	Jan 1	Jan 15	Feb 1	Feb 15	Mar 1	Mar 15	Apr 1	Apr 15	May 1	May 15	Jun 1	Jun 15	Jul 1	Jul 15	Aug 1	Aug 15	Sep 1	Sep 15	Oct 1	Oct 15	Nov 1	Nov 15	Dec 1	Dec 15
Everglade Kite	3.00	2.85	2.70	2.55	2.40	2.25	2.10	1.95	1.80	1.65	1.50	1.65	1.80	1.90	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.00	3.00	3.00
Wood Stork	1.35	1.20	1.05	0.90	0.70	0.55	0.35	0.25	0.05	-0.10	-0.25	-0.25	-0.25	-0.05	0.20	0.40	0.60	0.80	1.05	1.25	1.50	1.50	1.50	1.40
Alligator	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.15	1.25	1.25	1.25	1.25
Passerine Birds	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.15	1.25	1.25	1.25	1.25
Pig Frog	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.15	1.25	1.25	1.25	1.25
Bass (Canal)	2.00	1.85	1.65	1.45	1.30	1.15	0.95	0.75	0.60	0.40	0.25	0.40	0.60	0.75	0.95	1.10	1.30	1.45	1.65	1.80	2.00	2.00	2.00	2.00
Bass (Lunker Marsh)	3.50	3.30	3.10	2.95	2.75	2.60	2.40	2.20	2.00	1.80	1.65	1.80	2.00	2.10	2.35	2.55	2.75	2.95	3.10	3.35	3.50	3.50	3.50	3.50
Deer	0.80	0.60	0.40	0.25	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.40	0.55	0.60	0.65	0.70	0.75	0.80	0.80
Ducks (Dabbler)	0.85	0.65	0.45	0.25	0.05	-0.15	-0.40	-0.40	-0.40	-0.40	-0.40	-0.25	-0.05	0.10	0.25	0.45	0.60	0.75	0.80	1.10	1.25	1.20	1.05	1.00

Table 5 (Cont'd)

Optimum Sawgrass Water Levels For Selected Everglades Wildlife Species (in Feet)

Species	Jan 1	Jan 15	Feb 1	Feb 15	Mar 1	Mar 15	Apr 1	Apr 15	May 1	May 15	Jun 1	Jun 15	Jul 1	Jul 15	Aug 1	Aug 15	Sep 1	Sep 15	Oct 1	Oct 15	Nov 1	Nov 15	Dec 1	Dec 15
Ducks (Divers)	1.20	0.95	0.65	0.40	0.15	-0.10	-0.40	-0.40	-0.40	-0.40	-0.40	-0.20	0.00	0.25	0.45	0.70	0.85	1.10	1.25	1.55	1.75	1.65	1.45	1.40
Average All	1.65	1.49	1.32	1.16	1.00	0.86	0.70	0.60	0.50	0.40	0.31	0.42	0.55	0.67	0.83	0.99	1.15	1.30	1.43	1.60	1.75	1.74	1.71	1.69
Average All (Minus Bass Lunker Marsh)	1.44	1.28	1.12	0.96	0.80	0.66	0.51	0.42	0.33	0.24	0.16	0.27	0.38	0.51	0.66	0.82	0.97	1.12	1.24	1.41	1.55	1.54	1.51	1.48
Average All (Minus Bass, Kite)(Lunker Marsh)	1.24	1.08	0.92	0.76	0.60	0.46	0.31	0.23	0.15	0.07	-0.01	0.09	0.21	0.34	0.48	0.64	0.79	0.94	1.06	1.23	1.37	1.36	1.32	1.29
Average All (Minus Bass, Kite, Deer)	1.19	1.04	0.88	0.73	0.58	0.43	0.25	0.18	0.10	-0.03	-0.05	0.06	0.24	0.42	0.51	0.63	0.77	1.01	1.14	1.31	1.38	1.35	1.29	1.26
Median	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.20	1.38	1.38	1.35	1.33

average of water levels for all categories, (II) an arithmetic average for all categories except the lunker bass (marsh), (III) an arithmetic average of all categories except the Everglade kite and lunker bass (marsh), (IV) the median values for all groups, and (V) the average of six of the ten categories (the four left out include both bass categories, the Everglade kite and deer) (Figure 16).

To determine the relative benefits of these five schedules they were compared to the maximum and minimum values for each category on the first and 15th of each month (Table 6). If a particular schedule was at or between the maximum and minimum for a given category at a particular time a value of one was assigned. When this a schedule fell outside acceptable levels a value of zero was assigned. When this was done a possible of 24 points could be accrued in each wildlife category. The total points, divided by 24, would represent the percentage of time schedules were compatible.

All of the proposed schedules fall outside acceptable limits for both the Everglade kite and lunker bass (marsh) during all time intervals. The proposed schedules are at least partially compatible with all remaining categories. Of the five schedules, two appear to offer the most benefits to wildlife. These are Schedules III and V. These two schedules are quite similar. Schedule V is the most compatible when compared to individual categories. It is concluded that this schedule will provide the most benefits for wildlife.

The recommended water schedule for wildlife is shown in Figure 17. Under this schedule water levels would reach a peak of approximately 1.38 ft on 1 November and then decrease gradually to a low of -0.05 ft on 1 June. After 1 June water levels would increase gradually to the November high.

This schedule will provide many essential elements conducive to good wildlife populations. Some of the more important ones in terms of CA3A are:

1) The levels are low enough in spring and early summer to allow significant drying out of the marsh and subsequent rejuvenation of the habitat.

2) Water levels are sufficiently high to allow good production of invertebrates and small fish on an annual basis.

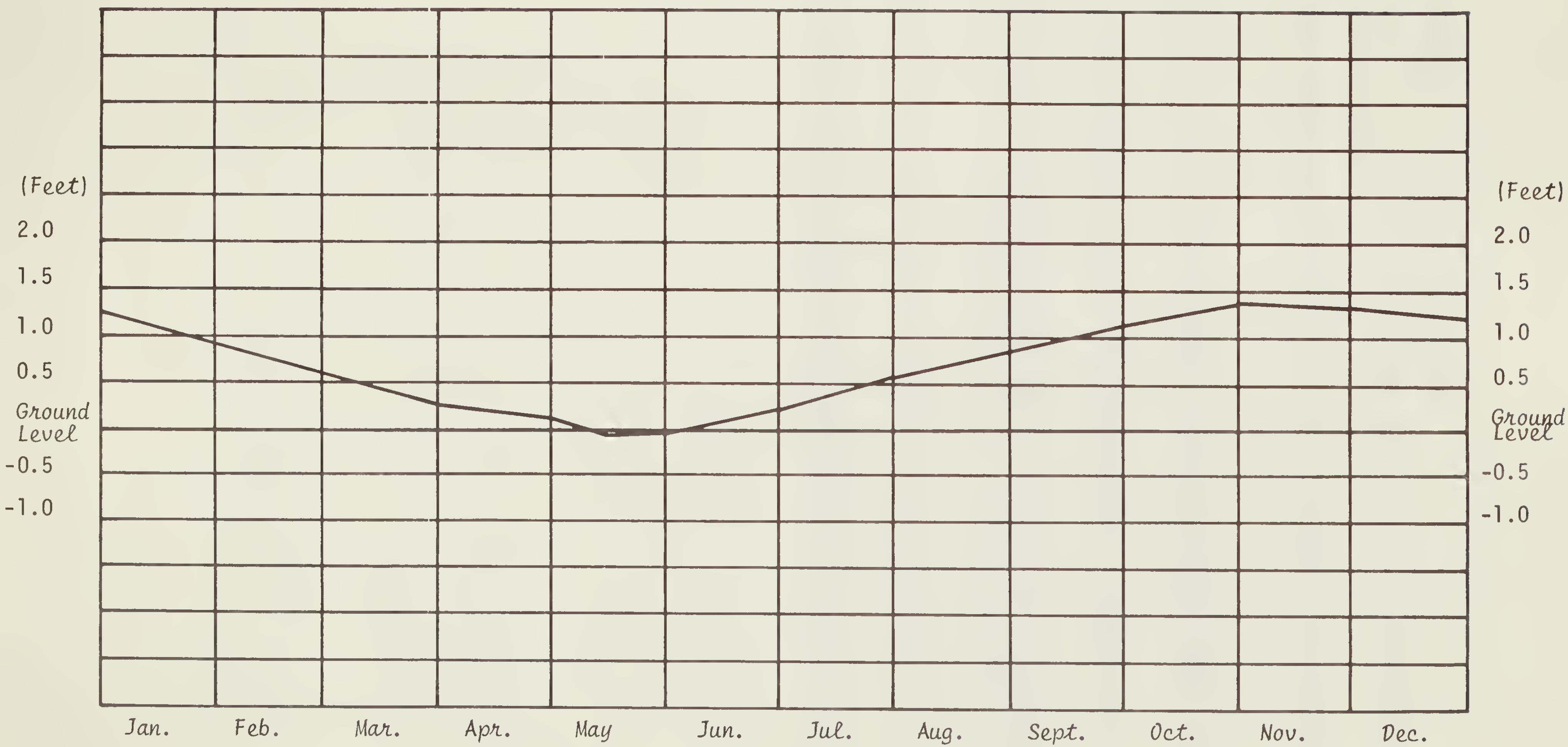
Figure 16
FIVE POSSIBLE SAWGRASS
WATER LEVEL SCHEDULES WHEN
MANAGED FOR WILDLIFE

Table 6

Percentage Compatibility of Wildlife Benefits for Five proposed Water Schedules

	Everglade Kite	Wood Stork	Alligator	Passerine Birds	Pig Frog	Bass (Canal)	Bass (Marsh)	Deer	Ducks (Puddle)	Ducks (Divers)	Average of all categories
Average of all recommended water levels	0.00	0.42	1.00	1.00	1.00	1.00	0.00	0.00	0.40	0.50	0.50
Average of all recommended water levels minus Bass (Lunker, Marsh)	0.00	0.67	1.00	1.00	1.00	0.67	0.00	0.80	0.46	0.58	0.55
Average of all recommended water levels minus Bass (Lunker, Marsh) & Everglade Kite	0.00	0.88	1.00	1.00	1.00	0.29	0.00	0.29	0.67	0.75	0.59
Median value of all recommended water levels	0.00	0.62	1.00	1.00	1.00	0.46	0.00	0.40	0.50	0.58	0.52
Average of recommended water levels minus Bass, Everglade Kite & Deer	0.00	0.88	1.00	1.00	1.00	0.25	0.00	0.29	0.71	0.83	0.60

Figure 17
RECOMMENDED SAWGRASS WATER
LEVEL SCHEDULE PROVIDING MAXIMUM
WILDLIFE BENEFITS



3) Natural tree islands should do well under this regime since they will be protected from flooding and excessive peat fires.

4) Water levels should increase at a slow enough rate to allow good nesting success and reproduction for alligators and other reptiles.

5) Decreasing water levels in spring should provide reasonably good fawning sites, and continued low water through early summer should provide good fawn survival rates.

6) Annual fluctuations of less than 1.5 ft should help stabilize wildlife populations by providing a more stable environment and should prevent sudden and dramatic changes caused by drastic fluctuations in water levels.

7) Declining water levels should provide good opportunities for wading birds to feed since the levels are low enough to concentrate food supplies.

8) The lowest water levels recommended will still provide a significant number of areas within CA3A which will hold standing water. These areas will act as reservoirs for fish and invertebrates and will serve as feeding areas for wading birds.

9) Wetter portions of CA3A should continue to provide good conditions for the Everglade kite.

10) Production of yearling bass should be good over major portions of the area and the canals and deeper sloughs should produce healthy populations of "lunker" bass.

WATER DEPTH ANALYSIS

Water levels in CA3A are currently determined by utilizing a three gauge average. This average is then compared to a regulation schedule to determine management strategies. The three gauge average is measured in feet above mean sea level (MSL) and does not by itself indicate actual water depths above ground level. The purpose of this study is to provide baseline information on ground water levels in CA3A by habitat type and location. This information can then be correlated to regulation schedule and actual gauge readings to determine hydrological conditions on the area.

Methods

In order to determine water levels in CA3A, a series of transects were established at eight existing gauge locations and four new gauge locations that were selected for this study. Figure 18 shows the locations of the 12 gauges utilized and transects established to sample water depths. Transects were oriented at right angles to each other. Each transect originated at the gauge and terminated at a point either 2.0 miles from the gauge or before any man-made obstruction, such as canals, roads and levees, was encountered.

The transects at gauge 36 were only 1/2 mile long since dense sawgrass impeded travel by airboat. All transects were established on north-south and east-west axes and sample stations were established at 1/2 mile intervals along each transect. An airboat was used to travel to and from gauges and to establish transects. A stop watch and constant airboat speed were used to measure distance between sample points.

Sample points and temporary gauges were established by placing 1"x2"x8' treated pine into the peat soil and then marking these stakes with survey flagging. Table 7 summarizes gauge location, number of sample points and gauge name.

Figure 18
LOCATION OF GAUGES AND TRANSECTS
SAMPLED IN CONSERVATION AREA 3A

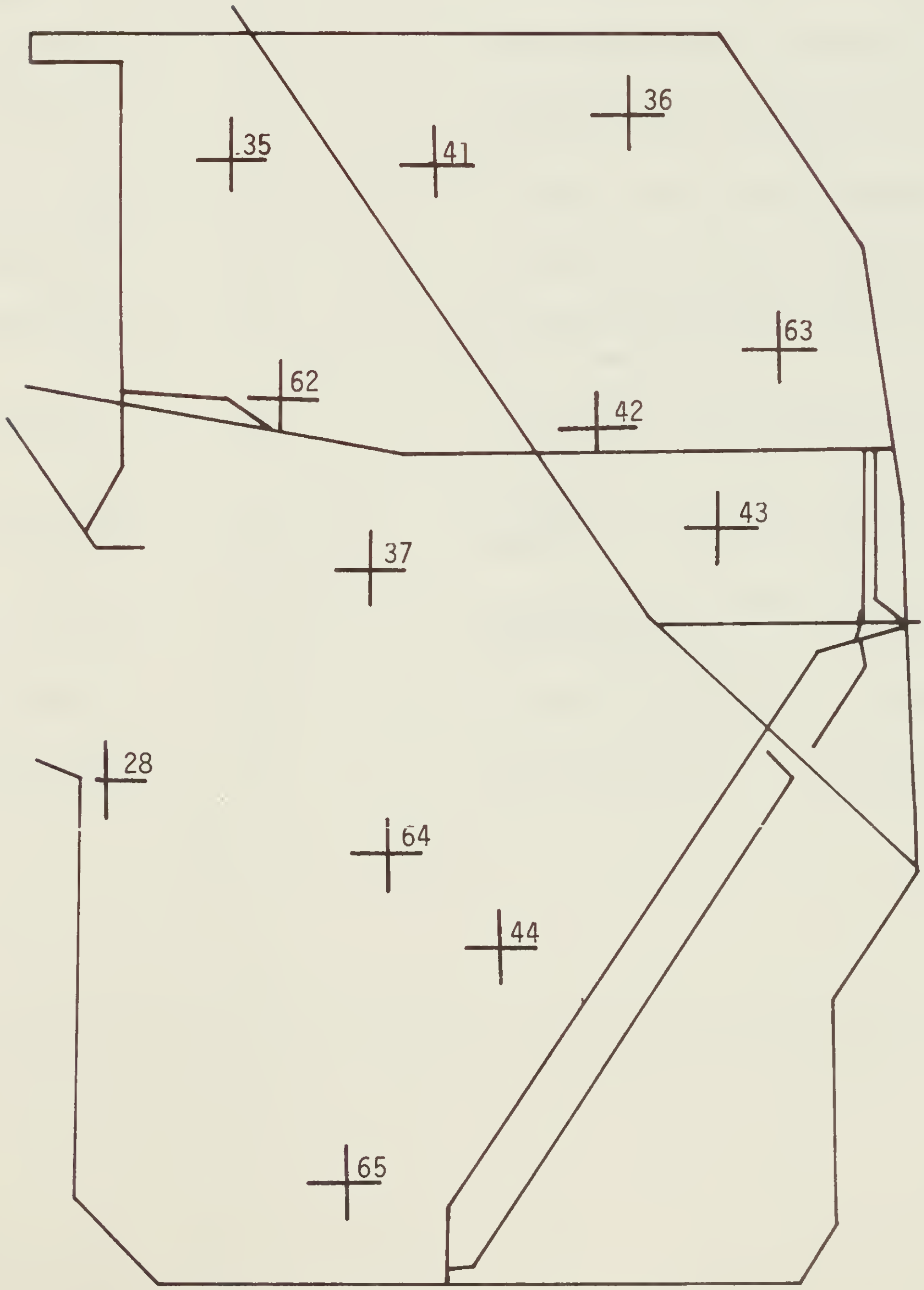


Table 7

Approximate Location,
Number of Sample Points
and Name of Study Gauges

Number	Name	Number of Sample Points	Location
62	Deer	15	1.5 miles NE of Bridge 11 on Alligator Alley
63	5 Mile Head	17	3 miles N of Bridge 5 on Alligator Alley
64	Hog Head	17	Dade-Broward line 10 miles E of L-28
65	Skinner	17	3.5 miles N of Tamiami Trail 2.5 miles W of L-67
35	Lone Palm	17	5 miles S of S-8 Pump Station
36	Sawgrass	17	5 miles S of L-5 and 5 miles W of Terrytown
37	Possum Head	17	5 miles S of Alligator Alley and 5.5 miles W of Miami Canal
28	Cypress	14	1 mile N of Dade-Broward line 1/2 mile E of L-28
41	Lemon Head	17	5 miles S of L-5 and 3 miles E of Miami Canal
42	Deer Island	11	.5 miles N of Alligator Alley, 1 mile E of Miami Canal
43	Rookery	17	3 miles S of Bridge 6 on Alligator Alley
44	Everglade Kite	17	Dade-Broward line 2 miles W of L-67

Vegetation communities were identified utilizing the four major plant associations identified by Loveless (1959) in CA3A. Generally, tree island communities were not sampled but additional plant communities were sampled in disturbed areas. The three major plant communities sampled were sawgrass strands, sloughs, and prairies. Plant communities were identified by visual observation. A two letter system was developed to characterize plant communities by type and important species. Plant communities dominated by sawgrass were designated S___. If other species accounted for less than 5% of the community biomass, the community was designated SS. If species other than sawgrass accounted for more than 5% of the biomass the second most frequent species was identified by the second letter. For example, a sawgrass strand with myrtles common was identified as SM. Plant species are identified by scientific name in Appendix B.

Communities with over 50% open water and mostly floating or submerged vegetation were identified as sloughs and denoted by A___. The major plant species observed was then identified by the second letter. Thus a slough dominated by white water lily (*Nymphaea odorata*) was identified as AN. Communities with low stature emergent vegetation occupying over 50% of the area were identified as prairies P___. A prairie dominated by maidencane was designated PM. At each sample station five water level measurements were taken in each community type identified.

Plant communities were selected on relative abundance in the vicinity of each sample point. Generally two or three plant communities at each station were sampled. In some areas dense sawgrass dominated the sample station and only that community was sampled.

Transects and temporary gauges were established in October. Each location was sampled three times beginning in November 1979 and ending in January 1980. All 12 stations were sampled within a two day period to minimize the influence of water level changes caused by rainfall or other environmental factors. Sampling was conducted on 1 and 2 November, 29 and 30 November, and 3 and 4 January. These sampling dates are referred to as the November, December, and January samples, respectively.

Results

Water depths were recorded monthly during November and December 1979 and January 1980 at 193 sample points in CA3A. A total of 29 plant community types were identified and sampled. Tree islands were not sampled as a community type although some islands destroyed by fire or inundated by high water may have been sampled as a different vegetation type. The symbols for the different plant communities, their frequency of occurrence and characteristic plant species are listed in Table 8.

A total of 406 plant communities were sampled during the study. Sawgrass communities accounted for 48% of all samples while prairies were 29% and sloughs 11% of all samples. Thus the major plant communities described by Loveless account for 88% of all communities sampled. Communities such as broomsedge or cattail which are generally caused by a disturbance accounted for the remaining 12% of the communities sampled.

Tables 9, 10 and 11 summarize average water depths by plant communities for all gauges sampled during November, December, and January. Gauge 35 was not sampled in January since it was not accessible by airboat due to low water conditions. Average water depths for all communities ranged from 3.11 ft at gauge 43 in December to 0.28 ft at gauge 41 in January. Table 12 shows the gauge readings at the time samples were taken.

Theoretical or average ground levels were recorded for major vegetation types (sawgrass, sloughs, prairies and cattails) by subtracting the average water depth for each community from the corresponding gauge reading. Doing this for each of three periods yielded three values for each gauge, except gauge 35, which was sampled only twice. An average of these values yields the best estimate of average ground level for a particular plant community at a particular location (Table 13).

Table 8

Plant Community Symbols, Frequency of Occurrence, and Characteristics of Major Habitats Sampled in CA3A in 1979-80

Plant Community Symbol	Frequency of Occurrence	Characteristics
SS	177	Sawgrass dominant; Sawgrass greater than 95% of biomass
SA	1	Sawgrass dominant; Sawgrass less than 95% of biomass, broomsedge common
SB	2	Sawgrass dominant; Sawgrass less than 95% of biomass, saltbush common
SC	8	Sawgrass dominant; Sawgrass less than 95% of biomass, cattail common
SE	1	Sawgrass dominant; Sawgrass less than 95% of biomass, dog fennel common
SM	7	Sawgrass dominant; Sawgrass less than 95% of biomass, wax myrtle common
	196	All Sawgrass
AA	3	Slough with arrowhead dominant
AB	5	Slough with bladderwort dominant
AL	1	Slough with ludwigia dominant
AM	3	Slough with maidencane dominant
AN	33	Slough with white water lily dominant
AR	1	Slough with beakrush dominant
	46	All Sloughs

Table 8 (Cont'd)

Plant Community Symbols, Frequency of Occurrence, and Characteristics of Major Habitats Sampled in CA3A in 1979-80

Plant Community Symbol	Frequency of Occurrence	Characteristics
PA	1	Prairie with arrowhead dominant
PB	30	Prairie with beakrush dominant (*Rhynchospora sp.*)
PE	24	Prairie with spikerush dominant (*Eleocharis sp.*)
PM	60	Prairie with maidencane dominant
PP	2	Prairie with pickerel weed dominant
	117	All Prairies
CC	8	Cattail dominant with no other vegetation apparent
CA	2	Cattail dominant with arrowhead common
CB	1	Cattail dominant with beakrush common
CL	1	Cattail dominant with lemon bacopa common
CM	6	Cattail dominant with maidencane common
CN	3	Cattail dominant with water lily common
CS	16	Cattail dominant with sawgrass common
	37	All Cattail

Table 8 (Cont'd)

Plant Community Symbols, Frequency of Occurrence, and Characteristics of Major Habitats Sampled in CA3A in 1979-80

Plant Community Symbol	Frequency of Occurrence	Characteristics
LS	1	Primrose willow dominant with sawgrass common
VP	1	Broomsedge dominant with maidencane common
VS	7	Broomsedge dominant with sawgrass common
WC	1	Willow trees with cattail common
	406	Total Communities Sampled

Table 9

Summary of Water Depths in Feet by Vegetation and by Gauge Location

November

	28		35		36		37		41		42	
	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$
SS	14	1.18	12	0.62	17	0.50	11	0.93	15	0.44	11	1.05
SC			1	0.55					2	0.37		
SM							6	0.76				
SA									1	0.35		
SB									2	0.26		
SE									1	0.23		
Avg. Sawgrass	14	1.18	13	0.62	17	0.50	17	0.87	21	0.40	11	1.05
AN												
AM												
AB												
AA												
AL			1	1.04								
AR												
Avg. Slough			1	1.04								
PM	2	1.25	6	0.66			9	1.25	8	0.71	7	1.17
PA			1	0.79								
PE	1	1.31	1	0.72			7	1.13			4	1.15
PB	11	1.43					1	1.29	5	0.36		
PP			1	0.74								
Avg. Prairie	14	1.40	9	0.69			17	1.20	13	0.57	11	1.16
CC			1	0.87	1	0.96			2	0.94		
CM			1	0.69								
CA												
CN												
CL												
CB												
CS			5	0.68					2	0.49		
Avg. Cattail			7	0.71	1	0.96			4	0.72		
VS			6	0.26								
VP			1	0.50								
LS			1	0.91								
WC												
Avg. All	28	1.29	38	0.61	18	0.52	34	1.04	38	0.50	22	1.11

Table 9 (Cont'd)

Summary of Water Depths in Feet by Vegetation and by Gauge Location

November

	43 N	43 $\overline{X}$	44 N	44 $\overline{X}$	62 N	62 $\overline{X}$	63 N	63 $\overline{X}$	64 N	64 $\overline{X}$	65 N	65 $\overline{X}$
SS	15	2.81	17	2.61	14	0.82	17	1.93	17	1.76	17	2.18
SC	3	2.87					2	1.75				
SM					1	0.85						
SA												
SB												
SE												
Avg. Sawgrass	18	2.82	17	2.61	15	0.82	19	1.76	17	1.76	17	2.18
AN	4	3.04	12	2.90			1	1.98			16	2.56
AM	3	2.88										
AB	1	2.81	2	2.93							1	2.60
AA	3	2.75							1	2.32		
AL							1	1.98				
AR												
Avg. Slough	11	2.90	14	2.91			2	1.98	1	2.32	17	2.56
PM	6	2.64	3	2.70	7	0.85	7	1.69	5	1.85		
PA												
PE			1	2.93			4	2.03	6	2.15		
PB					8	0.81			5	2.29		
PP							1	1.62				
Avg. Prairie	6	2.64	4	2.76	15	0.83	12	1.79	16	2.10		
CC	2	3.29			2	0.83						
CM	2	2.72			3	0.94						
CA	1	3.05					1	1.44				
CN	3	2.87										
CL	1	3.01										
CB	1	2.28										
CS	4	2.66	1	2.45	2	0.90	1	1.98	1	1.82		
Avg. Cattail	14	2.83	1	2.45	7	0.90	2	1.71	1	1.82		
VS					1	0.24						
VP												
LS												
WC	1	2.10										
Avg. All	50	2.81	36	2.74	38	0.82	35	1.78	35	1.93	34	2.38

Table 10

Summary of Water Depths in Feet by Vegetation and by Gauge Location December

	28		35		36		37		41		42	
	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$
SS	14	1.14	12	0.54	17	0.65	10	0.88	13	0.41	11	1.21
SC			1	0.51					2	0.52		
SM							6	0.73				
SA									1	0.33		
SB									2	0.28		
SE									1	0.31		
Avg. Sawgrass	14	1.14	13	0.53	17	0.65	16	0.83	19	0.40	11	1.21
AN												
AM												
AB												
AA												
AL												
AR			1	0.91								
Avg. Slough			1	0.91								
PM	2	1.11	6	0.59			9	1.28	6	0.63	7	1.27
PA			1	0.40								
PE	1	1.16	1	0.67			6	1.09			4	1.39
PB	11	1.27					1	1.48	5	0.41		
PP			1	0.85								
Avg. Prairie	14	1.21	9	0.60			16	1.22	11	0.53	11	1.31
CC			1	0.72	1	1.42			2	0.70		
CM			1	0.53								
CA												
CN												
CL												
CB												
CS			5	0.61					2	0.44		
Avg. Cattail			7	0.62	1	1.42			4	0.57		
VS			6	0.18								
VP			1	0.48								
LS			1	0.45								
WC												
Avg. All	28	1.78	38	0.51	18	0.69	32	1.02	34	0.46	22	1.26

Table 10 (Cont'd)

Summary of Water Depths in Feet by
Vegetation and by Gauge Location
December

	43 N	43 $\overline{X}$	44 N	44 $\overline{X}$	62 N	62 $\overline{X}$	63 N	63 $\overline{X}$	64 N	64 $\overline{X}$	65 N	65 $\overline{X}$
SS	15	3.10	17	2.76	14	0.68	17	2.11	17	1.94	17	2.38
SC	2	3.42					2	2.21				
SM					1	0.27						
SA												
SB												
SE												
Avg. Sawgrass	17	3.14	17	2.76	15	0.65	19	2.12	17	1.94	17	2.38
AN	4	3.25	12	3.04			1	2.30			16	2.76
AM	3	3.24										
AB	1	3.33	2	3.12					1	2.28	1	2.68
AA	3	3.09										
AL							1	2.45				
AR												
Avg. Slough	11	3.21	14	3.05			2	2.38	1	2.28	17	2.76
PM	6	2.88	3	2.81	7	0.75	7	2.00	5	2.04		
PA												
PE			1	3.03			4	2.41	6	2.19		
PB					8	0.62			5	2.36		
PP							1	2.13				
Avg. Prairie	6	2.88	4	2.86	15	0.68	12	2.15	16	2.20		
CC	2	3.59			2	0.70						
CM	2	3.02			3	0.94						
CA	1	3.10					1	1.95				
CN	3	3.11										
CL	1	3.43										
CB	1	2.68										
CS	2	2.76	1	2.96	2	0.73	1	2.45	1	1.78		
Avg. Cattail	12	3.11	1	2.96	7	0.81	2	2.20	1	1.78		
VS					1	0.13						
VP												
LS												
WC												
Avg. All	46	3.12	36	2.89	1	0.13	35	2.15	35	2.06	34	2.50

Table 11

Summary of Water Depths in Feet by
Vegetation and by Gauge Location
January

	28		35		36		37		41		42	
	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$
SS	14	1.00			17	0.41	11	0.93	13	0.19	11	0.96
SC									2	0.23		
SM							6	0.69				
SA									1	0.22		
SB									2	0.06		
SE									1	0.06		
Avg. Sawgrass	14	1.00			17	0.41	17	0.84	19	0.18	11	0.96
AN												
AM												
AB												
AA												
AL												
AR												
Avg. Slough												
PM	2	1.21					9	1.22	6	0.32	7	1.03
PA												
PE	1	1.10					7	1.08			4	1.09
PB	11	1.28					1	1.46	5	0.19		
PP												
Avg. Prairie	14	1.26					17	1.18	11	0.27	11	1.05
CC					1	1.08			2	0.70		
CM												
CA												
CN												
CL												
CB												
CS									2	0.27		
Avg. Cattail					1	1.08			4	0.48		
VS												
VP												
LS												
WC												
Avg. All	28	1.13			18	0.45	34	1.01	34	0.24	22	1.01

Table 11 (Cont'd)

Summary of Water Depths in Feet by
Vegetation and by Gauge Location
January

	43		44		62		63		64		65	
	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$	N	$\overline{X}$
SS	15	2.81	17	2.69	14	0.52	17	1.71	17	1.89	17	2.49
SC	2	3.14					2	1.70				
SM					1	0.72						
SA												
SB												
SE												
Avg. Sawgrass	17	2.85	17	2.69	15	0.54	19	1.71	17	1.89	17	2.49
AN	4	3.02	12	3.03			1	1.92			16	2.78
AM	3	2.92										
AB	1	2.97	2	3.03					1	2.36	1	2.80
AA	3	2.78										
AL							1	1.91				
AR												
Avg. Slough	11	2.92	14	3.03			2	1.90	1	2.36	17	2.78
PM	6	2.68	3	2.91	7	0.65	7	1.59	5	1.98		
PA												
PE			1	2.91			4	1.98	6	2.24		
PB					8	0.54			5	2.30		
PP							1	1.64				
Avg. Prairie	6	2.68	4	2.91	15	0.59	12	1.86	16	2.18		
CC	2	3.42			2	0.62						
CM	2	2.75			3	0.86						
CA	1	2.85					1	1.48				
CN	3	2.93										
CL	1	3.15										
CB	1	2.57										
CS	2	2.70	1	2.83	2	0.65	1	2.19	1	2.46		
Avg. Cattail	12	2.92	1	2.83	7	0.73	2	1.84	1	2.46		
VS					1	0.05						
VP												
LS												
WC												
Avg. All	46	2.86	36	2.85	38	0.58	35	1.73	35	2.05	34	2.64

Table 12

Gauge Readings at Date
of Field Sampling
(in Feet)

Gauge	November	December	January
28_1	10.42	10.34	10.32
35_1	11.60	11.48	---
36_1	10.73	10.86	10.65
37_1	10.50	10.48	10.45
41_2	0.61	0.66	0.51
42_2	1.12	1.25	1.02
43_2	2.85	3.15	2.82
44_2	2.90	3.04	3.08
62_1	11.10	11.00	10.88
63_1	10.52	10.86	10.46
64_1	10.10	10.20	10.26
65_1	9.84	9.98	10.15

1. In feet above mean sea level

2. In feet above ground level

Table 13

Average Ground Level for
Major Plant Communities by Gauge Location

Gauge	Sawgrass Communities		Sloughs		Prairies		Cattails	
	Range	Average	Range	Average	Range	Average	Range	Average
28_1	(9.20-9.32)	9.25			(9.03-9.10)	9.06		
35_1	(10.95-10.98)	10.96	(10.56-10.57)	10.57	(10.88-10.91)	10.89	(10.86-10.89)	10.88
36_1	(10.21-10.24)	10.23					(9.44-9.77)	9.59
37_1	(9.61-9.65)	9.63			(9.26-9.30)	9.28		
41_2	(0.21-0.26)	0.24			(0.03-0.24)	0.13	(-0.11/0.09)	-0.02
42_2	(0.03-0.07)	0.05			(-0.09/-0.03)	-0.06		
43_2	(-0.03/-0.03)	0.004	(-0.13/-0.05)	-0.07	(0.14-0.27)	0.21	(-0.10-0.04)	-0.01
44_2	(0.28-0.39)	0.32	(-0.01-0.05)	0.01	(0.14-0.17)	0.16	(0.08-0.46)	0.26
62_1	(10.28-10.35)	10.32			(10.27-10.32)	10.29	(10.15-10.20)	10.18
63_1	(8.74-8.76)	8.75	(8.48-8.55)	8.52	(8.60-8.73)	8.68	(8.62-8.81)	8.70
64_1	(8.26-8.37)	8.32	(7.78-7.92)	7.87	(8.00-8.08)	8.03	(7.80-8.42)	8.17
65_1	(7.60-7.66)	7.64	(7.22-7.36)	7.28				

1. Feet above mean sea level at gauge

2. Feet above ground level at gauge

Discussion

Water depths were analyzed three times in late 1979 and early 1980. For the purposes of this report we are interested in the relationship between ground water depths and the three-gauge-average used to determine regulation schedule. The short time span sampled and the large geographical area involved may severely restrict the accuracy of any predictions. In the absence of better indicators these models can be utilized to compare actual water levels with predicted levels for various pool stages.

Optimum sawgrass water levels were developed for a variety of wildlife species and a single schedule was derived which provided optimum benefits for a wide range of species. These levels ranged from a peak of 1.38 ft to a low of -0.05 ft. Using the values obtained for average sawgrass ground level at each gauge and comparing this to the gauge reading we can calculate the actual water depth at each gauge. This figure can then be adjusted by an amount equal to the difference between the maximum regulation schedule and the actual three-gauge-average. This adjusted figure represents sawgrass depths expected at each gauge at maximum regulation schedule (Table 14). The average of the three monthly theoretical levels represents the estimated level at regulation schedule.

At five of the gauges water levels exceed the optimum level by at least 0.66 ft; these five are gauges 43, 44, 63, 64, and 65. Gauges 63, 64, and 65 are currently used to determine the stage average. Five gauges were at least 0.16 ft below the optimum level established for wildlife and the remaining two gauges were within 0.07

The average of the 12 gauges is 1.64 ft or 0.26 ft above the optimum level or depth established for wildlife.

A different approach or analysis can be used by simply taking average water depths by plant community and comparing these to the current three-gauge-average. These averages can then be adjusted to an estimated average water depth at regulation schedule. Table 15 shows average water depths by month and plant community type for all gauges combined. For November and December all 12 gauges are included

Table 14

Observed Sawgrass Water Depths
and Theoretical Sawgrass Water Depths in Feet
at Maximum Regulation Schedule

	November		December		January		Estimated Depth at Maximum Schedule
Gauge	Observed	Theoretical	Observed	Theoretical	Observed	Theoretical	
28	1.17	1.52	1.09	1.24	1.07	1.28	1.35
35	0.64	0.99	0.52	0.67			0.83
36	0.50	0.85	0.63	0.78	0.42	0.63	0.76
37	0.87	1.22	0.85	1.00	0.82	1.03	1.08
41	0.37	0.72	0.41	0.56	0.27	0.48	0.59
42	1.06	1.41	1.20	1.35	0.97	1.18	1.31
43	2.85	3.20	3.15	3.30	2.82	3.03	3.17
44	2.58	2.93	2.72	2.87	2.76	2.97	2.92
62	0.78	1.13	0.68	0.83	0.56	0.77	0.91
63	1.77	2.12	2.11	2.26	1.71	1.92	2.10
64	1.78	2.13	1.88	2.03	1.94	2.15	2.10
65	2.20	2.55	2.34	2.49	2.51	2.72	2.59

Table 15

Average Water Depths by
Plant Community and Month
(in Feet)

Plant Community	Sample Size	November Avg. Water Depth	95% Confidence Limits	Sample Size	December Avg. Water Depth	95% Confidence Limits	Sample Size	January[1] Avg. Water Depth	95% Confidence Limits
SA	1	0.35	----	1	0.33	----	1	0.22	----
SB	2	0.26	----	2	0.28	----	1	0.14	----
SC	8	1.68	(0.72-2.64)	7	1.83	(0.59-3.07)	6	1.69	(0.32-3.06)
SE	1	0.23	----	1	0.31	----	-	----	----
SM	7	0.77	(0.69-0.86)	7	0.67	(0.48-0.86)	7	0.69	(0.58-0.80)
SS	177	1.45	(1.33-1.57)	174	1.57	(1.43-1.71)	159	1.53	(1.38-1.67)
All Sawgrass Strands	196	1.41		192	1.52		174	1.49	

[1]Data from gauge 35 unavailable

and for January only 11 gauges are used since gauge 35 was not sampled. Average water depths for all sawgrass communities varied from 1.41 ft in November to 1.52 ft in December.

Table 16 shows theoretical average sawgrass community water depths for each of the dates sampled if CA3A were at regulation schedule. This is done by simply adding the differences between the observed stages and the maximum level for the area (10.5 ft MSL). When this was done theoretical sawgrass levels in CA3A were 1.73 ft for pure sawgrass strands and 1.69 ft for all sawgrass areas. These figures are comparable to the 1.64 ft derived by using a 12 gauge average. The levels for pure sawgrass and all sawgrass combined are 0.35 ft and 0.31 ft above the optimum figure for wildlife (1.38 ft).

Table 16

Average Sawgrass Community Water Depths Assuming the 3 Gauge Average for Conservation Area 3 Equalled 10.5 ft MSL

Vegetation Type	November	December	January[1]	Average
SS	1.80	1.72	1.67	1.73
All Sawgrass	1.76	1.67	1.63	1.69

[1]Adjusted to 12 gauge average

CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing, the following conclusions and recommendations are made regarding CA3A.

Conclusions

Peat Losses

1) Substantial peat losses occurred in CA3A during the period 1970-1980. Peat fires were confined to the northern one-third of the area.

2) Peat losses were estimated by a number of methods of varying accuracy. Losses measured on six established plots north of Alligator Alley averaged 0.28 ft. Losses measured during a peat fire in 1977 averaged 0.46 ft while losses around water gauges appear to be approximately 0.5 ft. Losses at a localized, severe peat fire in 1974 averaged approximately 0.82 ft when compared to surrounding levels in 1978. Based on the above estimates we believe the northern one-third of CA3A sustained overall peat losses in excess of 0.25 ft.

3) In addition to extensive peat losses occurring over large acreages, the most detrimental peat losses were sustained around tree islands in CA3A. Intermediate elevations surrounding most tree islands in the northern one-third of CA3A were destroyed by peat fires. These intermediate elevations accounted for 95% of the islands before the fires. Consequently, the size of many tree islands has been significantly reduced.

Wildlife Habitats

Wildlife habitats were analyzed on both a historical and theoretical basis. Crucial habitats were identified as prairies and tree islands. Sawgrass strands, while critical because of the land area they occupy, cannot be evaluated easily because they have the ability to withstand extreme fluctuations in water levels.

1) Tree islands, in the northern one-third of the area, especially the portions comprising the intermediate elevations, were severely damaged by peat fires during

the 1970's. These losses will cause a long term adverse impact on the wildlife resources of CA3A.

2) Tree islands in the southern and eastern one-third of the area have been damaged by high water levels of variable duration. These damages are probably reversible with a change in water levels on the area.

3) Wet prairies in the northern one-third of the area were damaged severely during the drought years of the '70's. With a return to more normal water levels these prairies have exhibited good recovery over much of the area.

4) Wet prairies have been displaced by sloughs on the wetter portions of the area in the southern and eastern one-third of the area.

5) Wet prairies and tree islands in the central portion of the area are in generally good condition, apparently in response to favorable conditions in recent history.

6) Sawgrass, the most important plant community, has proven to be the tough and adaptable plant described by Dineen (1972). While sawgrass communities have deteriorated in local situations due to water level extremes, they have shown a tremendous capability to regain their former dominance when normal water levels return.

Optimum Levels for Wildlife

1) Optimum depths varied widely between groups but a theoretical hydrological regimen providing maximum benefits was designed based on the average depths of six groups. These depths ranged from 1.38 ft to -0.05 ft.

Water Depth Analysis

1) Water depths were analyzed three times during 1979-80 and correlated to existing gauges. Water levels fluctuated widely over the area with differences ranging as much as 2.95 ft at a given point in time.

2) Water gauges were correlated to theoretical levels at the top end of the regulation schedule. At regulation schedule, water depths were substantially above

optimum levels for wildlife at five gauges, at the optimum level at two gauges, and below the optimum at five gauges. When compared to general conditions favorable to wildlife habitats, water depths were too deep at five gauges, too shallow at four gauges and at desirable levels at three gauges.

Structures 339 and 340 and Redistribution of Water Within CA3A

This report does not attempt to analyze the impact of Structures 339 and 340 on water levels and wildlife in CA3A. The data, however, do indicate that many of the adverse impacts caused by water levels in CA3A have been aggravated by uneven distribution of water within CA3A. More even distribution of water within pool 3A is a necessary condition for improved wildlife populations on the area. This statement is made relative to conditions as they existed prior to 1980, and we recognize that water levels should not and will not be identical over the entire area. In fact, divergent water levels insure optimum water depths on some portions of the area for a variety of wildlife species and insure that wading birds will have good feeding conditions for extended time periods. Conditions as they existed in the recent past have caused differences of such a magnitude that severe wildlife habitat losses have been sustained, causing long term damage to the area.

General

With development and population growth in South Florida, management of the wildlife resources becomes a more difficult task. Even today, areas adjacent to CA3A often provide crucial habitat to wildlife species on a short term basis when CA3A has either too little or too much water. While some of these areas may appear insignificant because they are only utilized occasionally by wildlife, they do provide essential habitat when CA3A has either extremely high or low water tables. Additional development continues to eliminate these areas as wildlife habitats and with these losses it becomes essential to manage the wildlife resources of CA3A more efficiently. Only by better management of CA3A and by promotion of compatible land uses adjacent to CA3A can the wildlife resources be maintained at historic levels.

Recommendations

1) Wildlife and wildlife habitats in CA3A should be considered water users on an equal basis with other users.

2) The current regulation schedule, with its accompanying water depths, exceeds the optimum depths desired for wildlife. However, recognizing the cyclic nature of water conditions in south Florida, the current schedule, using gauges 63, 64, and 65, appears to constitute an upper limit which should not be exceeded. The most dramatic adverse impacts on wildlife such as deer and alligators have occurred when the current schedule has been exceeded.

3) It is primarily the poor distribution of water that is detrimental to wildlife over a longer time period due to habitat degradation. It is recommended that eight gauges (62, 63, 64, 65, 28, 35, 36, and 37) be incorporated into the regulation schedule, thus providing a more accurate interpretation of hydrological conditions over a greater portion of CA3A.

4) Water regulation schedules should be determined by application of the information set forth in Figure 19. Figure 19 gives a recommended range of water depths which should be applied to as much of the area as possible. This figure depicts maximum, minimum, and optimum depths for wildlife. Improved distribution of water within CA3A will expand the good wildlife habitat found in Zone B, Figure 7.

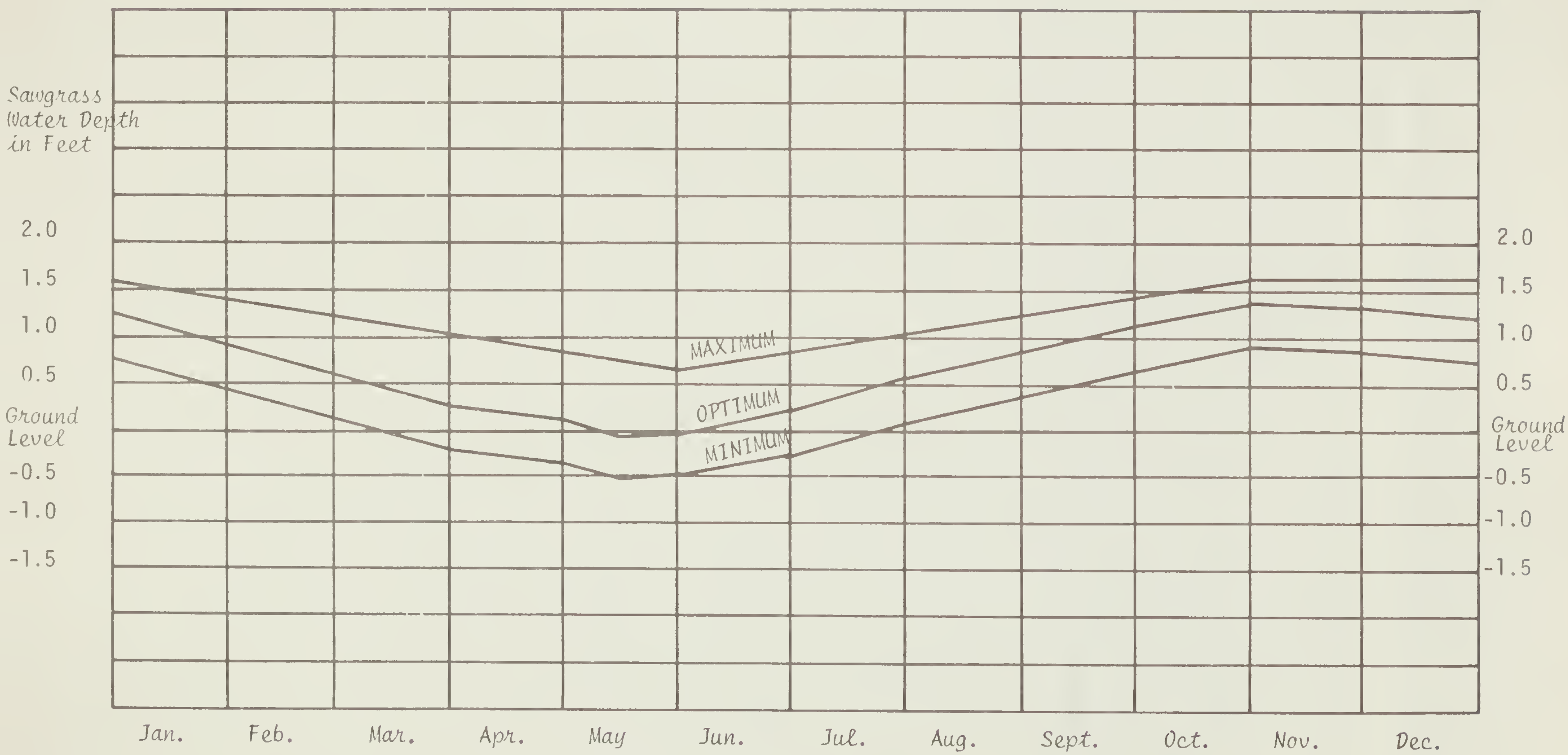
5) We recommend that the schedule for CA3A be re-evaluated on a periodic basis to insure maximum benefits for wildlife and wildlife habitats.

6) Methods to improve the capability to stay within our proposed range of water depths should be initiated. We recommend the following:

a) Installation and operation of additional physical structures as needed.

b) Methods to predict when water depths will deviate from the proposed range should be improved. Based on accurate predictions, early actions should be initiated to minimize the magnitude and duration of these deviations.

Figure 19
RECOMMENDED WATER DEPTHS
FOR WILDLIFE IN
CONSERVATION AREA 3



c) Improvements should be made to schedule releases and inputs into the area in a manner more compatible to wildlife and conducive to expansion of Zone B, Figure 7.

d) If water levels exceed schedule, inputs should be restricted to volumes not in excess of planned discharges.

e) If water levels recede below the lower limits outlined in Figure 19, discharges from the area should be restricted. In addition, an absolute low level should be established which is above the levels experienced in 1971, 1973, and 1974, and below which no discharges shall be made from CA3A.

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APPENDIX A

Fish and Wildlife Cited

	COMMON NAME	SCIENTIFIC NAME	SUBFAMILY	FAMILY	ORDER
1	Florida panther	*Felis concolor*			
2	White-tailed deer	*Odocoileus virginianus*			
3	Alligator	*Alligator mississipiensis*			
4	Turtles			Cheloniidae Chelydridae Kinosterninae Testudinidae	
5	Dabbling ducks		Anatinae		
6	Diving ducks		Aythyinae		
7	Everglade kite	*Rostrhamus sociabilis*			
8	Passerine birds				Passeriformes
9	Wading birds				Ciconiiformes
10	Wood stork	*Mycteria americana*			
11	Largemouth bass	*Micropterus salmoides*			
12	Pig frog	*Rana grylio*			

APPENDIX B

Plants Cited

COMMON NAME	SCIENTIFIC NAME
Arrowhead	*Sagittaria lancifolia*
Bladderwort	*Utricularia sp.*
Beakrush	*Rhynchospora sp.*
Broomsedge	*Andropogon virginicus*
Cattail	*Typha sp.*
Dog fennel	*Eupatorium capillifolium*
Lemon bacopa	*Bacopa caroliniana*
Maidencane	*Panicum hemitomon*
Pickerel weed	*Pontederia lanceolata*
Pigweed	*Acnida cannabinus*
Primrose willow	*Ludwigia peruviana*
Red ludwigia	*Ludwigia repens*
Saltbush	*Baccharis glomeruliflora*
Sawgrass	*Cladium jamaicensis*
Senecio	*Senecio glabellus*
Spikerush	*Eleocharis cellulosa*
Wax myrtle	*Myrica cerifera*
White water lily	*Nymphaea odorata*
Willow	*Salix amphibia*