Control Burn Activities in Everglades National Park

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INTRODUCTION

SINCE the mid-1960's Everglades National Park (E.N.P.) has received considerable attention in the news media concerning such problems as: lack of water; extensive alligator poaching; threats of pollution from the proposed Big Cypress Jet-port; and great fires sweeping through the frequently drought stricken area. With regard to fire, many would assume from the press writings, that all fire was deleterious to the Park. The inaccuracy of this concept will be discussed in this paper.

The National Park Service (N.P.S.) in the early 1960's recognized the need for a control burn program in the pinelands of the Park. Everglades, in undertaking this project, was the first park within the N.P.S. to enter into this field of resource management. And it did so with caution, feeling that a serious "snafoo" could jeopordize the fledging project's existence. This sort of reservation was well justified as the concept of resource management in the N.P.S. at that time was to keep the parks "pristine" by preventing fires (or putting them out as soon as possible) and the exploitation and destruction of vegetation and terrestrial wildlife. Initiating a control burn program was precedent setting, if not somewhat adventuristic, and would probably not have come about until much later had not the wisdom and necessity of control burning been demonstrated for many years in pine stands throughout the Southeast.

However, only a fraction of the E.N.P. is vegetated by pinewoods—what of the Everglades themselves, for which the Park was named? Craighead (1971) states, "Fire is the most important single factor in perpetuating the pineland. . . . It maintains the sedges and grasses of the glades. . . ." In another recent writing (Robertson 1971) this matter is referred to as follows, ". . . natural disturbances, mainly hurricanes near the coast and fire in the interior, largely determine what plants will grow at a given spot. There is no evidence that either the rules of the game or the gross pattern of natural plant cover in South Florida have differed materially during historical times."

The beliefs of these authors are widely held by numerous other natural resources investigators in this part of Florida. In view of this, a statement by former U.S. Secretary of the Interior, Stuart L. Udall (1966), is of important significance as follows: "The biotic associations within each park should be maintained—or where necessary, re-created—as nearly as possible in the condition that prevailed when the area was first visited by White Man. A National Park should thus represent a vignette of Primitive America. We are learning that protection alone is not enough. Sound resource management programs based upon current knowledge and supplemented by research are essential to ensure that the long range objectives and goals of the National Park Service will be fulfilled."

This mandate is still held to by the N.P.S. It is for this reason and others cited above that a proper resource management program in E.N.P. must necessarily include a control burn program covering all fire dependent habitats within the Park. This paper will discuss the use of fire within the pinelands as well as what has occurred in recent times to expand control burn activities into other fire habitats within the Park.

AREA

Geology and Soil

Everglades National Park, approximately 1,300,000 acres in size, is the third largest U.S. National Park. This park is situated on the southwestern tip of Florida and is for the most part underlain by marine limestones of the Pleistocene Epoch. In areas where this limestone is exposed it is possible to observe its highly pitted and eroded surface. However, most of the area is covered with deposits of peat and calcitic or marl soils. These deposits are all of organic orgins and vary from a few inches to more than 10 feet in depth (Craighead 1971).

The slope of the land within the Park is in a general southerly direction. Maximum elevations of 7 to 8 feet are found in northern areas while readings of 2 feet and less are common in the southern areas. The average drop in elevation from north to south is approximately 3 inches per mile.

CLIMATE

All of the Park is situated south of the 25th parallel. For this reason and also due to the influence of the nearby waters of the Gulf of Mexico and the Gulf Stream of the Atlantic Ocean the climate of the area is subtropical in nature. Rainfall is usually quite seasonal with some 60 to 80 percent of it occurring between mid May and late October (Craighead 1971). The remaining months of the year are occasioned by infrequent and usually quite light rains, thus creating what is locally known as the "dry season." In perhaps 2 years out of every 10 the "dry season" is extremely accentuated creating serious fire conditions. In other years the "dry season" never really does become dry. The reason for this variability is due to the great year to year differences in rainfall. At the Royal Palm Ranger Station, for instance, 1952 through 1969 weather records show annual minimum and maximum rainfalls of 28.7 inches and 95.3 inches respectively with an average of some 58.8 inches for that period (Craighead 1971). Other stations within the Park and in surrounding areas show similar variation in annual precipitation totals.

There are indications that a pattern or cycle is present in these year to year variations (Thomas 1971). Computer studies of hundreds of thousands of precipitation entries from South Florida stations, dating back to the late 1800's, indicate that wet years reoccur more or less on a 5 year cycle and that the climate of the area has not changed noticeably during the period of record.

In years of heavy rainfall much of the freshwater terrestrial part of the Park is submerged for the greater part of the year. During drought periods the converse is true. Both conditions of course have significant effects on plant communities and the occurrence of fires.

Frosts and hurricanes are two other climatic manifestations which occur with a fair amount of frequency in the South Florida area. These phenomena are also important in shaping the vegetative communities of the area.

Vegetation

In general the vegetation within the Park contains elements of both tropical and temperate climates. Tropical vegetation predominates in coastal areas (i.e. mangrove forests, coastal hardwood hammocks, etc.) while the inland areas (glades, pinelands, etc.) are covered by a mixture of species from both climatic zones (Robertson 1962). In traveling through the area one is never within a specific plant community for very long since most of these communities are patch-quilted together over great expanses of land. This seemingly confusing pattern reflects the different elevations (with relation to the "wet season" high water mark) at which these various communities grow. Elevation is important in that it determines whether or not an area floods and the duration of flooding (Robertson 1971). Other important determinants of plant distribution are the rising sea level, fires, and Man. All of these, as well as flooding, are believed to have been considerably influential in shaping the plant communities of South Florida for at least the last 2,000 to 3,000 years. In essence these communities (with their distribution patterns and endemic fauna) represent a point of dynamic balance achieved through the interaction of the available flora and the enviromental elements just mentioned.

In order to relate the control burn activities that have or are scheduled to take place within E.N.P. the area has been divided up into several major habitat types or zones (Fig. 1). These follow rather closely the "physiographic regions" described by Craighead (1971).

Mangroves:—This zone of the Park is approximately 337,000 acres in extent (Table 1). The extensive mangrove forest of this

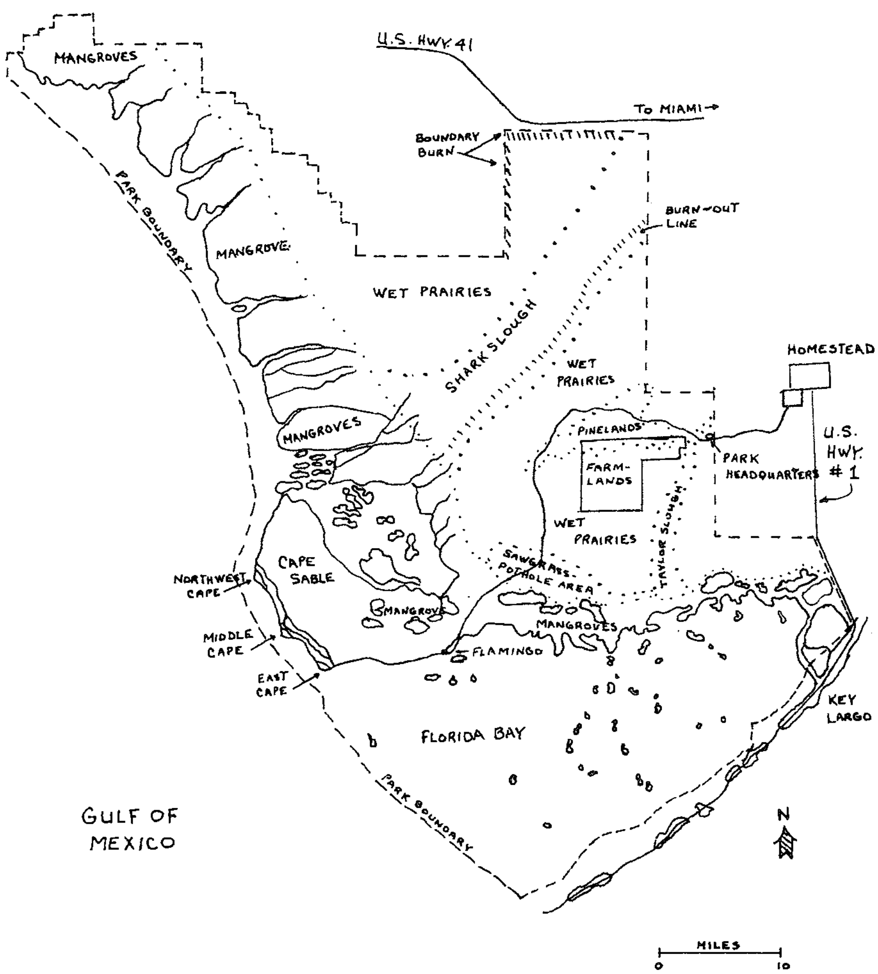

FIG. 1. Schematic map of the major habitat types within Everglades National Park and the 1971 control burn locations.

area borders almost the entire coast of the Park, varying in width from less than a mile to as much as 20 miles. Tree species most common to this forest, which is considered a non-fire type habitat, are red mangrove (*Rizophora mangle*), white mangrove (*Laguncularia racemosa*), black mangrove (*Avicennia nitida*), and buttonwood (*Conocarpus erecta*).

TABLE 1. MAJOR HABITAT TYPES WITHIN EVERGLADES NATIONAL PARK.

Habitat type	Acreage per type	Estimated percent burnable	Estimated number of burnable acres
Mangrove Zone	(tot.-337,000)	—	—
Mangroves	230,000	0	—
Estuarine Marshes	84,000	80	67,000
Coastal Prairie and Hammock	23,000	33	8,000
Wet Prairies	334,000	75	253,000
Sloughs	(tot.-109,000)	60	65,000
Shark Slough	99,000	—	—
Taylor Slough	10,000	—	—
Pinelands	21,000	90	19,000
Farmlands (inholdings)	22,000	0	—
Marine and Estuarine	477,000	0	—
Totals	1,300,000	—	412,000*

* This figure represents approximately 50 percent of the estimated 823,000 acres of terrestrial land within the Park.

Within the mangrove zone exist two other distinct plant communities that are of considerable importance. One of these, the coastal hammock and prairie community, occurs from Northwest Cape eastward along Florida Bay shoreline to the Upper Florida Keys (Craighead 1971). The prairies and tropical forest hammocks of this community occupy the high ground (1 to 3 feet msl) within the mangrove zone. Buttonwood, Jamaica dogwood (*Piscidia piscipula*) and sable palm (*Sabal palmetto*) are the most common trees within the hammocks which also contain a number of brushy species such as: bumelia (*Bumelia celastrina*), Joewood (*Jacquinia keyensis*), cat's claw (*Pithecellobium unguis-cati*), bay cedar (*Suriana maritima*), white stopper (*Eugenia axillaris*), randia (*Randia aculeata*), sea ox-eye (*Borrichia frutescens*), and dildo (*Acanthocerus floridanus*) and opuntia (*Opuntia dillenii*) cacti, century plant (*Agave decipens*) and Spanish dagger (*Yucca aloifolia*).

Coastal prairie areas are vegetated by grasses such as spartina (*Spartina* spp.), bunch grass (*Sporabalis* spp.) and panic grass (*Panicum* spp.). The lowest prairie areas are often covered by batis (*Batis maritima*) and other halophitic plants. Higher prairie areas, such as Highland Beach and the "Capes" of Cape Sable, support scattered clumps of many of the brushy species and cactus like plants that are common to the coastal hammocks as well as sea oats (*Uniola* spp.), broomsedges (*Andropogen* spp.), salt grass (*Distichlis spicata*), brunch grass, panic grass, poor man's patch (*Mentzelia floridana*), sea purslane (*Sesuvium maritima*) and moonflower vine (*Calonyction tuba*) (Craighead 1971).

Within the hammock and prairie community of the mangrove zone are the remains of a considerable number of aboriginal habitation sites. Exactly what influence these early inhabitants had on the area is not known but it seems likely that through the use of fire they may have maintained some prairie areas. More certain is the effect that white settlers had on the area. These persons came to the area to farm and fish and to make charcoal. The presence of axe cut tree stumps in many prairie areas is evidence of their effect on plant distributions in this area. Persons who knew this country before it became a part of E.N.P. tell of the frequency of man caused fires in this area, such fires being used to clear areas for farming and to enhance the range for white-tailed deer (*Odocoileus virginianus*). However, since the early 1950's very little fire has occurred and forested areas are rapidly expanding in many places. This trend is occasionally arrested or set back temporarily by the passage of severe hurricanes such as happened in 1960 and 1965 (Craighead 1971).

The estaurine or coastal marsh community is another distinct habitat within the mangrove zone, one that appears to be quite fire dependent. This community, which is generally found several miles inland from the coast, is dissected by many streams and rivers leading from the inland fresh water marshes to the Gulf of Mexico. For this reason it is a plant community that is broken up into hundreds of islands (some of which are several hundred acres in size) that are isolated from each other by tree lined streams.

The predominant plant species of this marsh are: spartina, juncus (*Juncus roemerianus*), and fringerush (*Fimbristylis castanea*), with sawgrass (*Cladium jamaicense*) patches occupying areas less saline and slightly higher in elevation (Craighead 1971).

In the absence of fire this habitat is invaded by mangroves, buttonwoods and other swamp hardwoods. However, enough fire has occurred within this zone since the formation of the Park to keep sizeable portions of the marsh free from woodyplant incursions. These fires are believed to result both from lightning and poachers (of deer and alligators).

Wet Prairie:—This zone which is almost equal to the mangrove zone in size (referred to by Craighead 1971, as the "freshwater swamp") could probably be considered either a prairie or a swamp depending on whether one visits it during periods of drought or flood or during the dry or wet seasons. In general it is vegetated by grasses, sedges and rushes that are 3 to 4 feet or less in height. Some areas of the wet prairie are broken up by numerous islands of trees that occupy either rock outcroppings (terrestrial hardwood hammocks), elevated accumulations of organic soils (bayheads or willowheads) or bedrock depressions (cypress heads). Most of these tree islands are vegetated by young stands that are in various stages of recovery from devastations caused by severe wildfires that have occurred within the past 50 to 70 years. It appears that in times pre-dating these wildfires, heavy stands of sawgrass (6 to 10 feet in height and impossible to walk through) were more common than they presently are. This decrease in acreage of heavy sawgrass is believed due to the loss (by fire) of the deep peat deposits on which this plant thrives best (Craighead 1971).

Sawgrass Slough:—The wet prairie discussed above is dissected by the Shark and Taylor Sloughs (Fig. 1). Of these the Shark Slough is by far the largest and represents the southernmost extension of the "true Everglades." Both areas occupy troughs in the limestone bedrock of the Park and for this reason are flooded more deeply and for greater lengths of time than the surrounding wet prairie habitat.

The "true Everglades" extends from the southern shore of Lake Okeechobee to the headwaters of the Shark River in E.N.P.—a distance of approximately 100 miles. Northern portions of this vast sawgrass marsh are as much as 40 miles wide while in the Park the maximum width is some 10 miles. Only about 7 percent of the Everglades is within E.N.P., the rest of the area now either farmed or set aside for development (44 percent), or impounded and serving as a water storage area (49 percent) (Schneider 1966).

The Park segment for the Everglades differs considerably from much of the Everglades lying further north. Most of the northern portion is (or was) almost a continuous unbroken cover of heavy sawgrass, while the area in the Park is characterized as being broken up into linear patches or "strands" of heavy sawgrass that are separated by spike rush (*Eleocharis cellulose*) and open water aquatic communities. This distribution pattern is also present in Taylor Slough but divisions within these vegetation types are less distinct in that area.

Sawgrass strands often have a bayhead or terrestrial hardwood hammock at their upstream ends. The bayheads generally are composed of species such as red bay (*Persea borbonia*), sweet bay (*Magnolia virginiana*), dahoon holly (*Ilex cassine*), pond apple (*Annona glabra*), coco-plum (*Chrysobalanus icaco*) and wax myrtle (*Myrica cerifera*). Terrestrial tree islands are located on rock outcroppings and support such species as: strangler fig (*Ficus aurea*), false mastic (*Mastichodendron foetidissimum*), gumbo limbo (*Bursera simaruba*), wild tamarind (*Lysiloma bahamensis*) and poisonwood (*Metopium toxiferum*). Often these terrestrial tree islands are subtended at their southern end by a long tear shaped stand of bay trees and other swamp hardwoods. Many of the terrestrial tree islands in the Shark Slough were dwelling sites of aboriginals and were even cleared of trees within historical times for purposes of farming.

Serious alterations of the hydrology of the area, and subsequently its ecology, began in 1913 with the digging of the first drainage canal in the Everglades. Additional canals have been dug up to the early 1970's, resulting in still lower water tables. This drying out of the glades has had a significant effect on the severity and frequency of fires in the Park. Soil or peat destroying burns have been recorded from the 1920's, 1937, 1945, 1946, 1947, 1951, 1952, 1962 and 1965 (Craighead 1971). During these fires tremendous expanses of sawgrass were burned out to be replaced by shallow-water aquatic communities or spike rush communities. The extent of the diminution of the sawgrass type within the Park is appreciated when considering that this now fairly minor plant community once occupied the greatest area of all the freshwater plant communities within the Park (Craighead 1971).

Pinelands:—Lying between the Shark and Taylor sloughs is a higher ridge of limestone predominantly vegetated by slash pine (*Pinus elliottii* var. *densa*). The 21,000 acres occupied by this forest seem almost insignificant in relation to the size of the other larger areas just discussed. It is however an important habitat in that it represents the largest remnant of what was once a forest that extended some 55 miles from North Miami to Mahogany Hammock in E.N.P. (Craighead 1971). It is a forest that is also unique within the U.S. due to its understory of stunted tropical hardwoods and palms (Robertson 1971). Within this forest are species of both tropical and temperate origins, many of which are dependent upon fire for their maintenance. Some typical woody species encountered are: bustic (*Dipholis salicifolia*), blolly (*Torrubia logifolia*), myrsine (*Rapanea guianensis*), sumac (*Rhus copallina*), saw palmetto (*Serenoa repens*), poisonwood and sable palm (Craighead 1971). Grasses such as: fire grass (*Andropogon cabonisii*), purple muhley grass (*Muhlenbergia filifera*) and *Sorghastrum secundum* bloom prolifically for a year or so after each fire.

Some 125 hardwood hammocks are within the pinelands of the Park, many of which contain rare or unique orchids and other types of plants (Craighead 1971). Some typical woody plants within these hammocks are: wild tamarind, poisonwood, gumbo limbo, mahogany (*Swietenia mahogoni*), live oak (*Quercus virginiana*), dove plum (*Coccoloba diversifolia*) and Simpson's stopper (*Eugenia simpsonii*). Most of these hammocks have suffered severe drought period burn-offs during this century. For this reason the great majority of them now support only young stands of trees.

Most of the pines are also of young age since much of this forest was logged during the late 1930's and early 1940's. Only in the marginal pinelands near the west end of the pine ridge is there an absence of stumps, allowing for the speculation that this area may still be virgin. In general most of this pine forest is fully stocked, with overstocking evident in some areas.

BURNING ACTIVITIES

The writer was involved in control burn activities in E.N.P. from 1966 through 1971. This period was marked mostly by a continuation of control burns within the pinelands and the fighting of several relatively small wildfires. It was not until 1971 that control burning was initiated in other fire dependent habitats. None of these activities were ever conducted with a great deal of sophistication with respect to programming of activities and collecting of data. This was due mainly to the writer's involvements in many other activities such as outside threats to the welfare of the Park and to nearby Biscayne National Monument. Also during this period there was a lack of funds to acquire the equipment and manpower necessary for conducting more meaningful work. And this perhaps was due to the fact that the time was just not right within the N.P.S.

However, in late 1970 and early 1971 there was a notable change. For this reason it was very heartening to learn, through recent correspondence with the current management biologist of the Park, that a "revolution" in resource management is now taking place, particularly with respect to the use of fire in habitat management.

Pinewoods:—Although reproduction is obviously not a problem in this relatively young stand it was convenient to record observations relating to this subject. Between 1966 and 1971 only 2 years of heavy seedfall were recorded, (1966 and 1969). The results of the 1966 seedfall can best be observed in the Fire Block A* which had been control burned in January, 1966. In this area there are now many 2- to 3-foot seedlings dating from the late August through October seedfall of 1966. Other blocks, which had not burned a few months prior to this seedfall, have few seedlings dating from 1966. This same phenomenon was repeated following the October, 1969 seedfall. Some 6 months before this seedfall Blocks C and D and some scattered pine areas near Park Headquarters had been burned. All of these areas exhibited numerous new seedlings by December of 1969. One survey near Headquarters produced an average count of some 8,000 to 10,000 seedlings/acre. In Block

* One of the 10 units (A through J) into which two-thirds of the pineland was divided for purposes of control burning. The remaining third is mostly marginal pine at the west end of the pineland ridge.

A (with a 3½ year rough) however, new seedlings were almost non-existent and in pine areas with roughs of 10 years or more no new seedlings were observed.

Some observations of the effect of flooding on regeneration were also taken during and after the 1969 seed year. From mid-May through early November of that year some 40 to 50 percent of the pineland area in general was flooded, and as much as 60 percent of Block D (burned in April of that year) was inundated. A seedling survey in Block D in January of 1970 indicated that no seedlings were present on lands flooded during the seedfall period. High seedling densities were found in non-flooded areas. Therefore flooding can be an important additional factor in regeneration within low lying parts of the Park pinelands.

It was also observed, after several control burns, that seedlings less than 2 to 3 years of age had a very low survival rate and that no seedlings of less than 1 year lived through the burns.

At present it is generally felt by investigators who have worked in the pinelands (i.e. Craighead and Robertson), that the optimum control burn rotation period for a given area within the stand would range between 3 to 5 years. However, a number of areas outside the control blocks have had "no-fire" periods for much longer lengths of time. The first control burn of such an area took place near the Pine Island residence area of the Park in December, 1968. It was estimated that this area had been fire free for 20 or more years. During this period hardwoods such as poisonwood, false mastic and live oak had grown to heights of from one-half to two-thirds the height of the pine overstory and herbaceous ground cover was virtually non-existent. The ground however was covered with a layer of moist duff some 2 to 4 inches thick. The mid-day fire in this small 4 to 5 acre area crept slowly over the ground consuming the upper 1 to 3 inches of duff. Though the fire was not very intense sufficient heat was generated to girdle most of the hardwoods except some of the live oaks with diameters greater than 2 inches. Some 2 to 3 months after the fire there was a considerable bloom of grasses and other herbaceous species, apparently having originated from seeds that had lain dormant since the last fire of 20 or more years earlier. A second control burn in this area 2 years later (1970) killed the oaks that had survived the first fire and consumed what remained of the original duff layer.

The control burning of pineland areas formerly thought unreclaimable (due to the long absence of fire and heavy hardwood buildup) has since occurred in several other areas of the Park with similar satisfactory results.

Sawgrass:—The burning of sawgrass strands in the Shark Slough during the early months of 1971 was initiated to prepare for what appeared to be an impending and very severe fire season. One critical consideration leading up to this action was the far below normal precipitation recorded over all of South Florida during the last half of 1970. As a result water levels within the Park were far below normal when the winter dry season began. It was therefore decided in December of 1970 that a fire hazard reduction program should be planned and implemented. One of the primary objectives of this program was to protect the vegetation and peat deposits of the Shark Slough. This was to be accomplished through the burning of heavy fuels in Park boundary areas bordering the Slough and by burning out a line of sawgrass strands on the east side of the Slough. While burning this line it was decided to include additional strands, in particular those that contained sizeable terrestrial hardwood tree islands.

When the fire hazard reduction program was initiated there was considerable question as to its feasability. Mainly in doubt was whether or not it was possible to safely burn in areas where one could not rely on man-made fire breaks and fire fighting machinery to control the limits of set fires. The writer also had doubts but had witnessed the results of two earlier burns which seemed to indicate that there was a good chance of success. One burn occurred on 30 and 31 July 1968 in the lower Taylor Slough area. This fire, which appeared to have been lightning caused, burned in heavy sawgrass which was at that time standing in an estimated 8 to 12 inches of water. Some 6 months later this area exhibited a healthy new stand of 3 to 5 foot high sawgrass. A second burn took place in the upper Taylor Slough area near the Royal Palm Visitor Center and Park

Headquarters in December, 1969. Here some 800 to 1,000 acres of wet prairie type vegetation were controlled burned, using the water covered center of the Slough as a natural firebreak. This operation proved highly successful.

With these experiences for assurance, a test burn was conducted on 21 December 1970 in dense sawgrass southwest of the Shark Slough Lookout Tower. From 18 to 25 inches of water covered the ground at this time, yet the fire burned some 7 or 8 hours before burning out in the early night hours. A second test was conducted on a mile long sawgrass strand on January 18 with 15 to 20 inches of surface water present. This also proved successful with the fire burning only to the limits of the dense sawgrass and not crossing to other nearby strands. In addition, it was noted in both test burns, that no harm was done to the swamp and terrestrial hardwood tree areas at the north end of the strands.

Due to these successful experiments it was decided on 21 January 1971 to proceed with the burning out of a line of sawgrass strands (Figs. 2, 3, 4 and 5). This 20 mile long line was successfully completed by 2 men transported by helicopter in a period of 3 days. All of the burning was conducted between the hours of 10 A.M. and 4 P.M.

Additional burns were conducted in February and March to break up the fuel continuity in the central and western areas of the Slough and to protect the sizeable tree islands within these areas (Fig. 6). At this time it was noted that the strands that had been burned in January were exhibiting considerable regrowth (Fig. 7).

The final hazard reduction burn in the Shark Slough took place on 17 March 1971. At this time there was standing water 2 to 4 inches deep around the strands while the strands themselves were still very damp but no longer inundated.

The boundary burning phase of the fire hazard reduction program occurred in January and February of 1971. During this period pockets of heavy fuels were burned out along 18 miles of Park boundary (Fig. 1). This was accomplished through the use of manmade firebreaks, with fire fighting equipment and machinery available for back-up purposes. Some of the fires burned from ¼ to

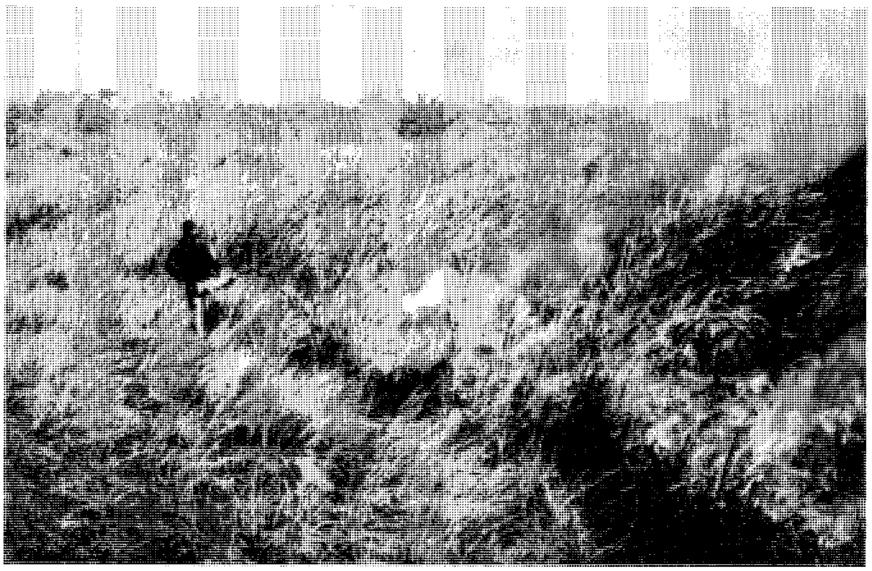

FIG. 2. Lighting a sawgrass strand at the upstream (north) end. In the lower left hand corner is sparse spikerush. The ranger is standing in dense spikerush while lighting the heavy sawgrass (7 to 9 ft high) to his right. In the background are swamp hardwoods which surround a terrestrial hardwood hammock (tallest trees in left background). Water depths range from 8 to 12 inches.

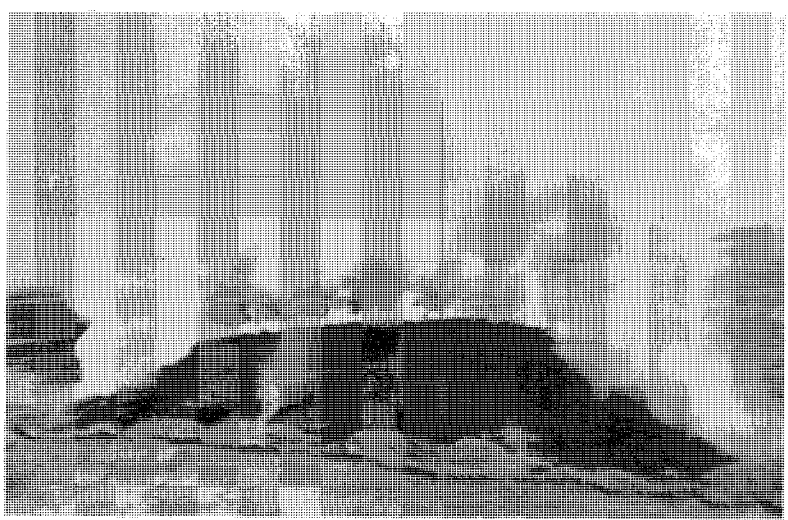

FIG. 3. A set fire burning diagonally across the south end of a sawgrass strand measuring approximately 3/5 mile in width and 4 miles in length. Forward speed of the fire is an estimated 5 miles per hour. The fire is not able to back into the wind and thinner sawgrass at the edge of the strand. In the foreground is a distinct boundary between the strand and the open water aquatic community.

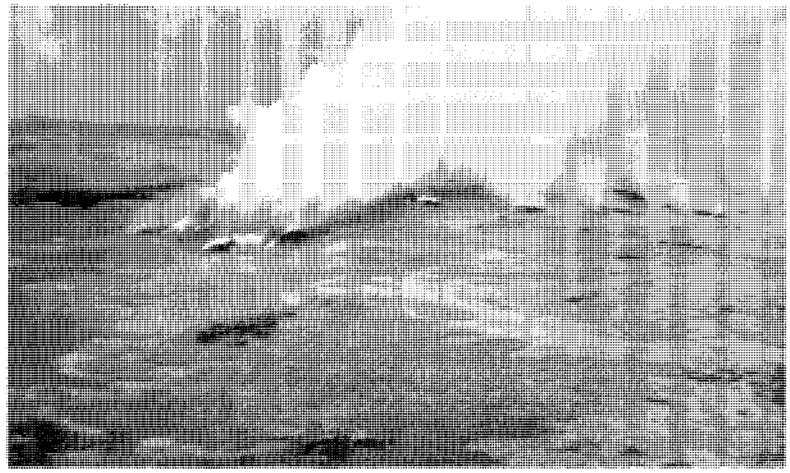

FIG. 4. Burning out a line of sawgrass strands along the east flank of the Shark Slough. Most strands in this particular area were relatively small, thus necessitating many individual ignitions. Smoke is being carried to the southwest, away from the urban centers of South Florida.

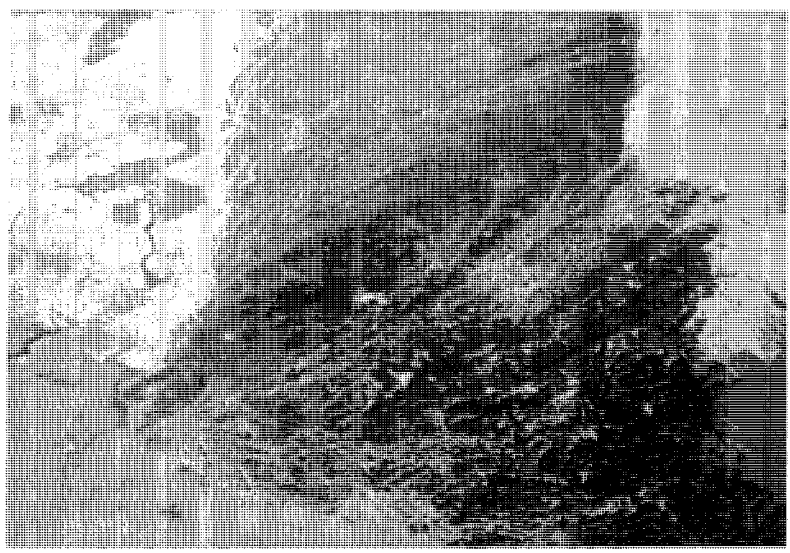

FIG. 5. A burned sawgrass strand at the headwaters of the Shark River. Photo was taken 7 days after the control burn. Evident is the difference in completeness of combustion between head and flank fires, with the dark center area representing the head fire zone. The lighter bands are composed of unburned sawgrass. This pattern is believed to be due to wind gusts. The edges of the strand were completely consumed on the upwind (right) side while considerable margin remained unburned on the downwind (left) flank. Width of the burned area is approximately ⅝ mile.

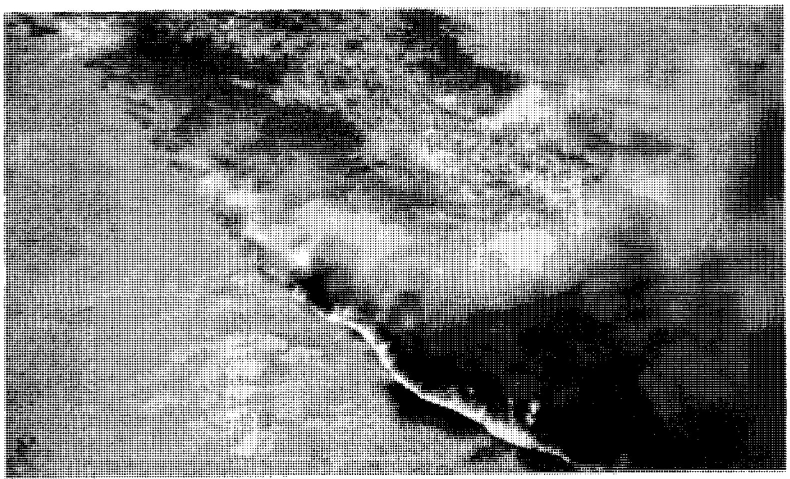

FIG. 6. A terrestrial tree island minutes after the burning off of the heavy sawgrass around it. The swamp hardwood strand subtending the circular island of terrestrial trees was slightly scorched along the margins. This fire took place in mid-March when only 2 to 3 inches of water covered the ground around the strand. The ground within the strand was very wet but free of standing water.

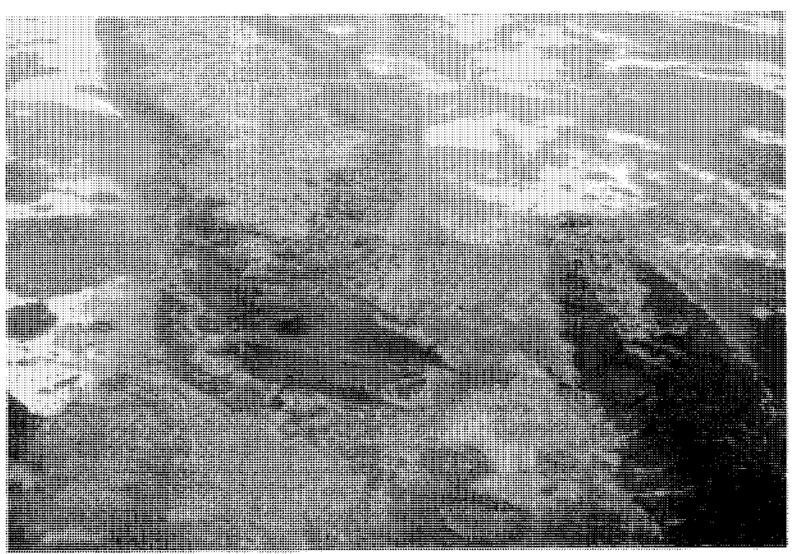

FIG. 7. Two sawgrass strands 7 weeks after being control burned. The dark colored new sawgrass growth surrounds the light colored swamp hardwood stands. The unburned sawgrass between the two strands was not dense enough to carry fire over standing water.

½-mile into the Park but none continued burning for more than 12 hours.

Some post-fire season burns of sawgrass strands in the Shark Slough were conducted during the hot summer months of 1971. These also proved successful with no incidences of fires jumping from strand to strand. Water depths during these burns ranged from 6 to 12 inches.

In April, 1971 observations and photographs were taken of several of the strands burned in January and February (Fig. 8). At this time the sawgrass regrowth was some 3 to 5 feet high and flower stalks were present in considerable numbers. Earlier observations of the recovery of sawgrass after wildfires indicate that flowering does not occur until approximately 2 years after a fire (Craighead 1971). The exception in the case of the 1971 burns is believed to be due to the fact that a high percentage of flower stalk buds were at or

FIG. 8. Sawgrass regrowth in early June, some 4 months after the control burn of a sawgrass strand in the Shark Slough. The new sawgrass is 4 to 5 feet high and seed stalks are present. In the right background is a small clump of swamp hardwood trees killed in the burn.

below the surface of the water when the sawgrass strands were burned.

Altogether some 55 strands of 5 acres or more in area were burned. An estimated 20 to 30 sawgrass patches of less than 5 acres were also burned. The burned strands ranged in length from .05 to 4.5-miles and from .01 to .7 mile in width. The largest strand contained 890 acres while 2 were 200 to 400 acres, 11 were 100 to 200 acres, 12 were 50 to 100 acres, 11 were 20 to 50 acres, and 19 were 5 to 20 acres in size respectively. A total of 5,500 acres of sawgrass strand vegetation was involved in these burns, of which 20 percent (1,100 acres) was in unburnable swamp and terrestrial hardwoods.

Wildlife mortalities were not observed during the burn-off of the sawgrass strands nor in the post fire inspections immediately after. However, it was observed that deer became more numerous in the burned strands once the new sawgrass shoots began to appear. Frequently it was observed that the deer had pulled these shoots out of the ground and consumed their tender, white-colored basal portions.

Vista Clearing Burns:—Roadside vistas, in several areas along the 38 mile highway between the Park entrance and Flamingo, are gradually being obscured by rank, road shoulder growths of such species as buttonwood, wax myrtle and red mangrove. In the past few years the over-committed Park maintenance crew has fallen considerably behind in keeping abreast of this problem. For this reason it was decided in September of 1971 to experiment with the use of fire in roadside brush clearing. Several sites were selected in the fire dependent sawgrass-pothole habitat in the vicinity of West Lake and Nine-mile Pond (Fig. 1). This area, which might be considered as a unique subdivision of the wet prairie, was cited by Craighead (1971) as a habitat type which would gradually disappear in the absence of fire due to encroachments of woody plants.

Vista clearing burns were conducted in the area mentioned on 9 September 1971. During the afternoon of this day seven stretches of roadside brush were burned that ranged in length from 30 to 300 yards. The fire burned very hotly in the sawgrass and sedges that were intermixed with the screen of brush. Some fires burned for 20 or more yards out into the surrounding sawgrass pot-hole country, even though there was some 4 to 8 inches of standing water in this area. A fire near Nine-mile Pond burned continuously until put out by a heavy shower on the night of 11 September. In the 50-hour period of its existence it had burned over water while backing into easterly and southerly winds. As it backed into these winds it circumvented many potholes and islands of mangrove and swamp hardwood trees. Small clumps of these trees were severely scorched as were the margins of larger tree aggregations.

Coastal Prairie:—East, Middle and Northwest Capes are three sand points along the southwest coast of Cape Sable (Fig. 1). These capes and the beaches uniting them are host each summer to hundreds of nesting loggerhead turtles (*Caretta caretta caretta*). For this reason, and also due to its isolation, this beach is considered one of the largest and least disturbed sea turtle rookeries in the United States. Along these beaches there is at present an outbreak of the non-native tree Australian pine (*Casuarina equisetifolia*), which threatens to destroy the suitability of the area for sea turtle nesting (Fig. 9). These trees became established in this area following Hurricane Donna of 1960 (Craighead 1971). Their origin is believed to be from seeds brought into this area on the tides and winds of this hurricane. It appears then that this plant will be a problem at the Capes as long as colonies of the plant continue to exist in areas near the Park.

The heaviest growth of Australian pine are found at the seaward edge of the prairies behind the three capes. Each of these prairies (described under "Coastal Prairies and Hammocks") is some 400 to 500 acres in area and is backed on the landward side by a narrow ridge of coastal hammock vegetation. Behind this forest the land slopes sharply to near sea level where one encounters the coastal mangrove forest.

The drought of late 1970 and early 1971 was more severe on these capes than on the mainland. In early April it was observed that little green-colored ground vegetation remained in these areas and grasses had been heavily browsed by rodents. On 10 May a man-caused fire burned off the prairie at Northwest Cape. When this cape was visited 2 days later it was noted that ashes approximately

FIG. 9. Fire-killed Australian pines along the coast at Northwest Cape. Fire scorched Spanish bayonet and sabal palm are also evident. The drought season wildfire in this area incinerated completely almost all of the herbaceous ground cover and stems and branches of brushy surface.

1 inch in depth covered the entire area, with 2 to 3 inch depths encountered in clumps of burned out century and Spanish bayonet plants. The only remaining greenery present in the entire area was in the tropical hammock on the landward side of the prairie. Trunks of sable palms had been charcoaled by the fire to as much as a half-inch in depth. All grasses and almost all brush species had been completely incinerated in the fire (Fig. 9). Virtually no grass stubble remained as the fire had burned the grasses off to below ground level.

It is difficult to assess the wildlife casualties of this fire—however, the remains of 15 to 20 fire-killed Florida box turtles (*Terrapene carolina bauri*) and 6 diamond back terrapin turtles (*Malaclemys terrapin macrospilota*) were observed.

On 17 May an estimated 2 to 3 inch rain fell on the Capes. The most obvious immediate effect at Northwest Cape was that all of the ashes had been washed into the low lying areas. It was also noted several days after this rain that the sprouts of spider lilies (*Hymenocallis* spp.) began to appear as well as scattered patches of an unidenti-

FIG. 10. Start of the control burn at Middle Cape. Ground cover is just beginning to "green-up." Sabal palms and century plant cacti are common on this prairie. In the right background is the Middle Cape hammock forest.

fied grass (common name is "fire-grass" but it is not an andropogon).

Observations of the Australian pines near the beach (Fig. 9) indicated that an estimated 60 to 70 percent had been killed by the fire. This is judged to be perhaps the only good feature of this severe wildfire.

Shortly after observing the results of the Northwest Cape fire it was decided to control burn the almost identical prairie area at Middle Cape. The purpose of this burn was to further test the feasability of using fire to control Australian pine and to compare the results of a control burn with the Northwest Cape wildfire.

Moisture conditions at Middle Cape were much improved by early June with a noticeable greening of the ground cover beginning to take place. For this reason the area was burned on 8 June, the entire operation requiring less than 4 hours time (Fig. 10).

In watching the progress of this burn it was evident that there would be marked differences in its effect upon the vegetation as compared to the fire at Northwest Cape. While the fire was in progress, for instance, one could see that it was burning only the tops off the grasses and the brushy plants were being scorched but not consumed (Fig. 11). The trunks of sable palms were only charcoaled to depths of ⅛ inch or less and little scorching of trees on the hammock ridge was observed. Only one fire killed diamond-back rattlesnake (*Crotalus adamanteus*) and three Florida box turtles were found in the aftermath of the control burn.

Some 2 months later both capes were again visited in order to make some general comparative evaluations of postfire vegetation recovery (Figs. 12 and 13). The most obvious difference between these two areas was in the composition of the herbaceous ground cover. In the Northwest Cape area very little grass was observed. Instead the ground was predominantly covered by herba-

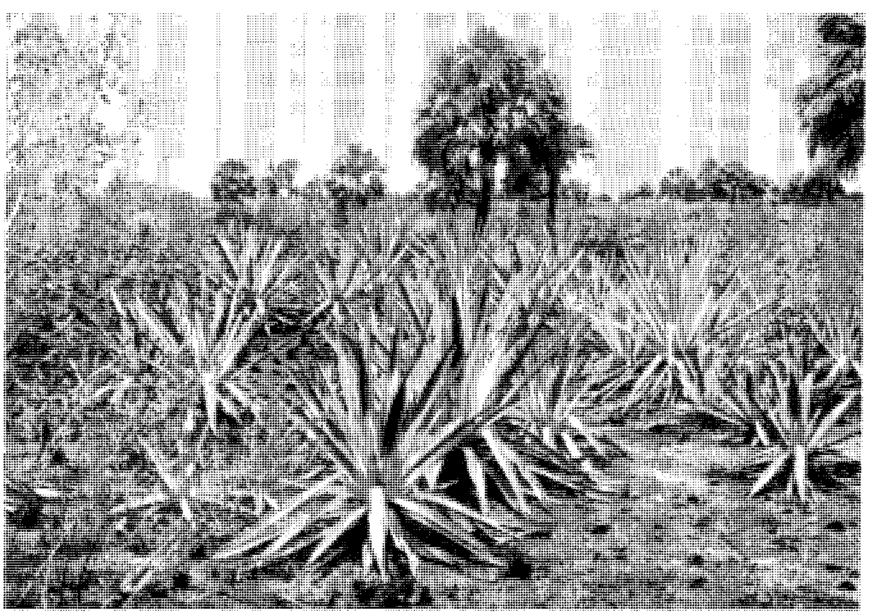

FIG. 11. The coastal prairie at Middle Cape 2 days after being control burned. Many grass tussocks are visible as well as scorched century plants and bushes. Sabal palms show very little scorching.

Fig. 12. A portion of the Middle Cape prairie 2 months after the control burn. New ground cover is composed of grasses as well as other types of herbaceous plants. Fire-pruned brush is evident in the background and foreground.

ceous annuals. At Middle Cape such plants were also present but the ground was predominantly re-vegetated by species of grasses and sedges. The resprouting of brush species was common at Middle Cape but absent at Northwest Cape.

Summary:—The total acreage of areas control burned in E.N.P. during 1971 was 13,500 (Bancroft and Elliot 1972). Of this 2,750 acres was in the pinelands, 450 acres in coastal prairie and 10,300 acres in sawgrass slough and wet prairie.

DISCUSSION

Had this paper been presented 1 year earlier it would have been necessary to include in this section numerous recommendations for things such as continued research, an expanded burning program, hiring more manpower, etc. However, the situation has changed considerably during the past few months—to the point that a lengthy

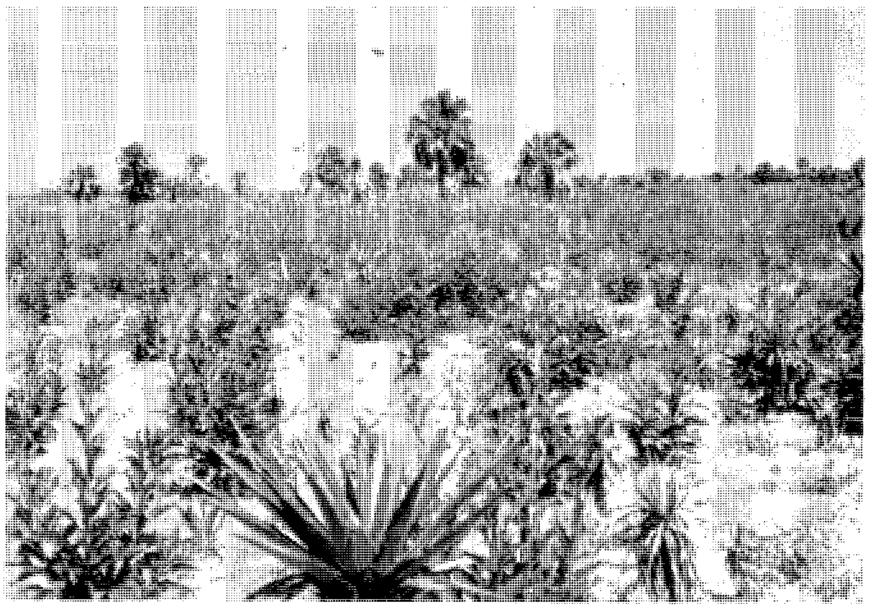

FIG. 13. A portion of the Northwest Cape prairie approximately 3 months after the passing of a wildfire (taken the same day as photo in Fig. 12). Ground cover consists mainly of Spanish bayonet, century plant, and Composits, Boraginids and other annuals. Some grass cover is present but it is very sparse in relation to that found at Middle Cape.

list of recommendations no longer seems necessary. In February of this year, for instance, a man-caused fire in the western third of the Park pinelands was allowed to burn out at roads and natural fire breaks rather than being stopped by direct attack (Bancroft and Elliott 1972). This burn lasted 6 days and covered an area approximately 15,400 acres in size. This unprecedented event was in keeping with a new fire fighting policy initiated in the Park. Such policy allows for the consideration of permitting wildfires to continue burning until put out by indirect means, unless moisture and fuel conditions are prohibitively dangerous.

Additionally there are control burn plans for the next 12 months which include: (1) continuance of the control burning in the pinelands; (2) burning in the coastal prairie near Flamingo; (3) burning the Fox Lake marsh area for maintenance of the rare Cape Sable seaside sparrow; (4) burning in the coastal marshes; (5) burning the coastal prairie at East Cape; (6) and experimenting with the use of control burns in eliminating exotic plants such as Australian pine and Brazilian pepper (*Shinus terebinthfolius*).

All of this work is to be carried out on a year-round basis by a designated, full-time resource management crew.

In addition a contract has recently been made with the Biology Department of the University of Miami to conduct fire studies with the Park. This research will cover subjects such as fire temperature and behavior and the effects of fire on insect, small mammal and bird populations. These studies will be conducted in several of the major fire dependent habitats.

All of these management and research programs and more will be necessary to maintain and restore the fire dependent habitats within the Park. The restoration aspect is perhaps the most important objective since, as pointed out earlier, so much of the area has been altered from its pre-whiteman condition. Serious hammock and peat destroying fires must be kept out of the Park for numerous decades to allow for the full recovery of fire altered habitats. To accomplish this a continuous control burn program will be necessary in all fire habitats (approximately 438,000 acres in total). Fuel concentrations will have to be kept at low levels and the intrusions of hardwoods into glades and prairie areas continuously counteracted. This will require the control burning of considerable acreages annually, perhaps some 80,000 to 100,000 acres. This annual rate is based on the estimation that most fire dependent habitats in the Park require a burn rotation period somewhere between 3 to 6 years. The shorter rotation periods would be required for areas where fuel concentrations build up rapidly (such as the heavy sawgrass areas) while longer rotation periods could be used in areas of less rank vegetation.

How to accomplish all this burning with perhaps less than six men available on a year-round basis may seem to be begging the impossible. However, in a few years time this could become a routine accomplishment. Of critical importance in the achievement of such a level of management finesse is the development of a "woodsman's savvy" of the country among the members of the resource management crew. This would include: knowledge of where the dense fuel areas and natural fire breaks are; what areas dry off first and which hold water the longest; and when it is best to burn off a given area. The collection of information and gaining of experiences necessary for the development of this "savvy" are already taking place. As an example, wet season burns in pinelands, prairie and sawgrass slough areas were successfully carried out in 1971. Such burns proved that opportunities for control burning in the Park are present throughout much of the year and that relatively little manpower is necessary to accomplish such work.

It is possible to envision therefore that within a few short years a small crew of woods-wise, resource managers will be able to maintain all of the fire habitat areas in the Park and be well on the way to restoring fire dependent areas. These things will no doubt eventually come to pass as there is much momentum in that direction. What is important for now is that in E.N.P. there has been a recognition of the need for positive action with respect to maintaining the various fire dependent habitats within the area. Destructive wildfires are no longer accepted as inevitable. Instead a program is being initiated to eliminate conditions that enable such fires to occur.

Pollution:—All the motivation and "savvy" necessary for an excellent control burn program would be worth very little if there was strong public feeling against such activity on an issue such as air pollution. The possibility for such a reaction was evident during the long period of glades fires (outside the Park) in the spring of 1971. During this time there was considerable public concern over the smoke and haze generated by such fires. Persons of the local business community were even quoted by the press as having said that the air pollution from these fires was causing a considerable decrease in numbers of tourists (tourism is South Florida's primary industry). Some of these men asked state and local officials to utilize fleets of water bomber airplanes or whatever means possible to extinguish these fires. And additionally, there were suggestions that ways should be found to keep fire out of the glades permanently.

The latter suggestion would of course be impossible as well as totally undesirable. The only feasible solution is a well managed control burn program for all of the fire type habitats in South

Florida as well as those within the Park. The Governor of Florida, Reubin Askew, has in fact recently endorsed a proposal for the creation of such a program (Bull. Ecol. Soc., 1972).

There are also indications that support could be obtained from the local citizenry. As an example, in June 1971 this writer presented a fire ecology talk to the Environmental Committee of the Greater Miami Chamber of Commerce. The general reaction to the talk was one of surprise and enthusiasm. To the persons present it was surprising to hear a N.P.S. biologist advocate (and illustrate with slides) that fire was a necessary element of the Everglades ecology. But they were quite enthused to hear that, with a control burn program for the Everglades and other local fire dependent habitats, it would be possible to avert glades fire smoke pollution problems almost entirely.

The reason for such a possibility is that throughout much of the year the heavily populated urban centers of the Florida East Coast are upwind from the fire habitat areas (the prevailing winds being easterly). Control burns therefore could be carried out during much of the year when favorable winds are blowing.

Fire ecology slide talks were also delivered to university student groups and several conservation groups. In all instances these talks generated considerable discussion as well as general expressions of support for the control burn concept. For this reason it is felt that public support for this program could be obtained if sufficient informational and educational efforts were made. It is highly important that this be accomplished in order to assure that the control burn program is able to expand and continue. To succeed in this, state, federal and local government agencies will have to work in unison.

SUMMARY

Control burning activities within Everglades National Park have expanded notably within the last year and a half. Prior to that time such activities were confined strictly to the pinelands habitat of the Park. The control burn program is now being broadened to include all fire dependent habitats within the Park, covering approximately

438,000 acres. With several well trained and experienced men it should be possible to place this entire area on a 3 to 6 year burning rotation. Such burning can be carried on throughout most of the year except perhaps during extremely dry periods. Air pollution problems due to the presence of nearby urban centers is not anticipated due to the favorable wind patterns that exist in South Florida. Nevertheless it is anticipated that the securing of public understanding and support will be an important element in the success and continuance of the program.

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