ALLIGATOR RESEARCH IN FLORIDA: A PROGRESS REPORT[1]

By Tommy C. Hines,[2] *Game and Fresh Water Fish Commission,* Fort Lauderdale, Florida, Michael J. Fogarty, *Game and Fresh Water Fish Commission, Wildlife Research Projects,* Gainesville, Florida, and L. Carlton Chappell, *Game and Fresh Water Fish Commission,* West Palm Beach, Florida.

ABSTRACT

Since the summer of 1965, an alligator research program has been conducted in the Everglades of southern Florida. This report describes the progress of the program. Various capture and marking techniques are described and evaluated. Data on growth rates, movement, homing tendencies, and sex and age interpretation from approximately 1,000 tagged alligators are presented. Life history observations, including population trends, activity surrounding a "gator hole", and the effect of water level fluctuation are reported. Man's influences on the alligator population, both from the standpoints of habitat manipulation and poaching, are discussed.

INTRODUCTION

In order to learn more about the ecology and life processes of the alligator in the Everglades of south Florida, study was designed to determine its basic life history and the factors which limit its productivity. In meeting the objectives of the study, alligators have been captured, measured, marked and released, and later recaptured. Recapture data has indicated movement of young and adults and their growth rates. Observations of the life history of the alligator have provided information on nesting, effects of fluctuating water levels on productivity, and population trends.

This preliminary report discusses the findings of the study and progress of the alligator investigations in the Everglades.

DESCRIPTION OF THE AREA

The Everglades is a vast fresh-water marsh nearly 100 miles long and 30 to 40 miles wide. (Fig. 1). It once occupied in area of about 3,100 square miles, but sections in the northern and eastern portions have been drained for agricultural uses. The remaining habitat is under the jurisdiction of the Central and Southern Florida Flood Control District and the National Park Service. In 1948, 1½ million acres in the southern Everglades was dedicated as the Everglades National Park. The wildlife in Conservation Areas 1, 2, and 3 of the Central and Southern Florida Flood Control District is managed by two agencies, the U. S. Fish and Wildlife Service and the Game and Fresh Water Fish Commission. In 1951, the Loxahatchee National Wildlife Refuge was established in the 140,000 acre Conservation Area 1. In 1952, the Everglades Wildlife Management Area was established in Conservation Areas 2 and 3. The Florida Game and Fresh Water Fish Commission manages the wildlife in this 725,300 acre marsh.

The geologic history of the Everglades is relatively short. Cooke (1939) considered the calcareous marine limestone deposits underlying the lower peninsula to be of recent geologic origin. Carbon-14 dating methods have shown that the oldest and deepest peat soils near the southern edge of Lake Okeechobee are only about 5,000 years old (Stephens, 1956). The peat deposits become thinner toward the southern end of the Everglades. Much of the Everglades National Park lacks the peat mantle, leaving the limestone exposed.

The Everglades is filled with a variety of plant life which impedes the flow of water from Lake Okeechobee to the Gulf of Mexico. Loveless (1959) estimated that

[1]A contribution of Federal Aid to Wildlife Restoration Program, Florida Pittman-Robertson Project W-41-R.

[2]Mr. Hines' present address is Tennessee Game and Fish Commission, Buffalo Springs Game Farm, Route 1, Rutledge, Tennessee.

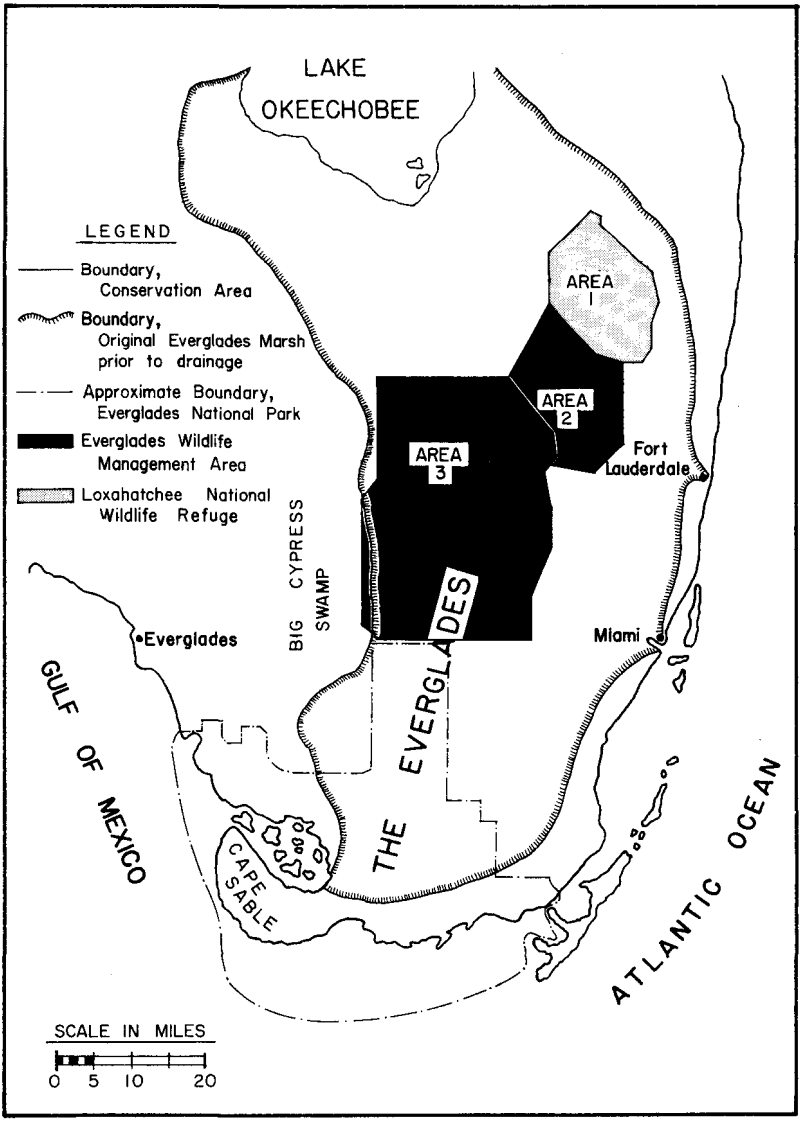

Fig. 1. Lower Florida showing extent of the original marsh prior to drainage in 1882 the boundaries of the Everglades National Park and the Conservation Areas.

70 percent of the marsh was covered with sawgrass *(Cladium Jamaicensis)*. . In the northern Everglades sawgrass occurs in almost pure stands while farther south the stands are relatively sparse and associated with other common species, mainly flag *(Sagittaria lancifolia)*, maidencane *(Panicum hemitomon)*, pickerelweed *(Pontederia lanceolata)*, and cattails *(Typha spp.)*.

Slightly elevated sites with growths of low shrubs and trees, called heads, hammocks, or tree islands interrupt the otherwise homogeneous grass marsh. These islands range in size from only a few square feet to 300 acres or more. They are generally strand-like in outline and are elevated from a few inches to three of our feet above the adjacent marsh. Higher portions of the tree islands support strangler figs *(Ficus aurea)*, hackberry *(Celtis laevigata)*, and cabbage palmetto *(Sabal palmetto)* while the lower sites contain wax myrtle *(Myrica cerifera)* dahoon holly *(Ilex cassine)*, elderberry *(Sambucus simpsonii)* and redbay *(Persea borbonia)*. Willox *(Salix sp.)*, commonly seen as pure stands in disturbed areas near canal edges, also grows near the waterline of the tree islands along with buttonbush *(Cephalanthus occidentalis)*.

Coursing between tree islands are narrow, natural drainage channels called sloughs. These remain wet throughout the year. The sloughs are oriented north-south and parallel the drainage pattern of the Everglades. White waterlily *(Nymphae ordorata)*, floating-heart *(Nymphoides aquaticum)*, and beakrush *(Rhynchospora tracyi)* are the predominant plant species (Loveless, 1959).

Over the years, extensive flooding and extreme drought have characterized the weather of the Everglades. Annual rainfall is very seasonal with about 75 percent of the mean annual precipitation of 53.5 inches occurring from June through October (Davis, 1943). Since 1962, when the levee system surrounding the Conservation Areas was completed, the seasonality of south Florida's rainfall seems to be creating a situation that may be a severe limiting factor in the alligator's life history, namely nest destruction because of high water during the summer. This is discussed in detail later in the paper.

METHODS AND MATERIALS

Capture Techniques

Most alligators were captured by two-man teams operating either from airboats or 14 foot fiberglass boats powered by 20 horsepower outboard motors depending on water depth. Many small alligators were captured by hand during the day and night but the wariness of larger animals required a night technique. A 100-watt aircraft landing lamp, attached to a hard hat, powered by a 12-volt wet-cell automobile battery provided a strong light source that reflected the red-orange glow of the alligator's eyes at distances to more than 300 yards. Alligators were captured by slowly maneuvering the boat up behind the animal and placing a snare mounted on a stout pole around its neck. A quick jerk on the pole tightened the snare. This method was described by Chabreck, 1963. Kleflock swivel-snares (Animal Tag Company of America, Lititz, Pa.) were used.

When capturing large alligators in the marsh, the alligator holes were found from an aircraft, either a Bell Helicopter or a Piper PA18 Super Cub. An observer directed a ground crew, in a half-track marsh vehicle, to the alligator hole. Sections of electrical conduit were used to probe through the ground, which formed the roof of the alligator's den. If the den was active, repeated probing brought the alligator to the surface. A noose was then slipped over its neck and the alligator pulled from the hole.

Tagging

Several tagging methods (Fig. 2) were tested to find a technique that was both lasting and visible at night with portable lighting. Chabreck (1963) used toe clipping and removal of dorsal scutes. We have tried these but preferred to use something more visible. However, scute and toe clipping was used on small alligators that would not hold a tag.

Jones (1965) described a nylon tag attached through a neck scute by means of a

Figure 2A. Pop Rivet.

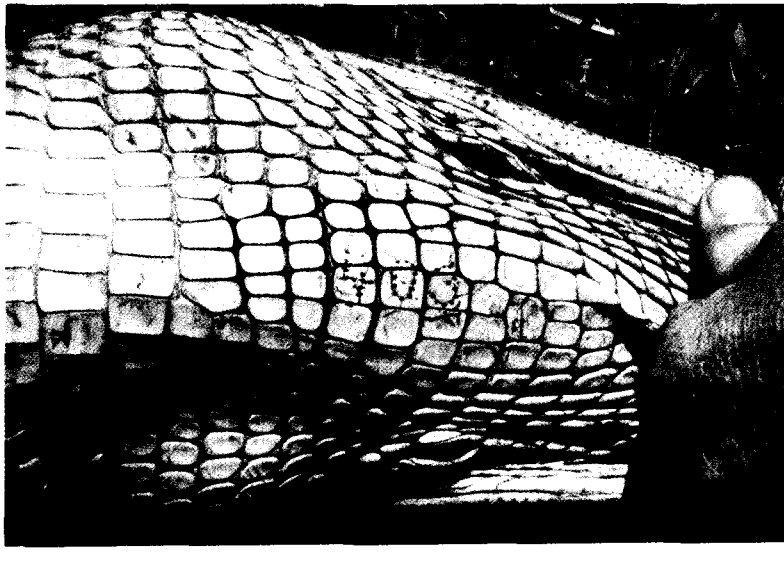

Figure 2B. Tattoo

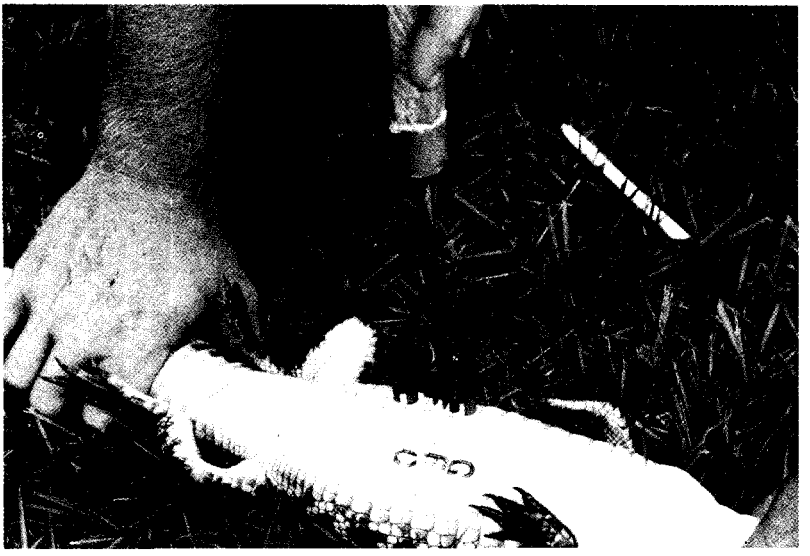

Figure 2C. Brand

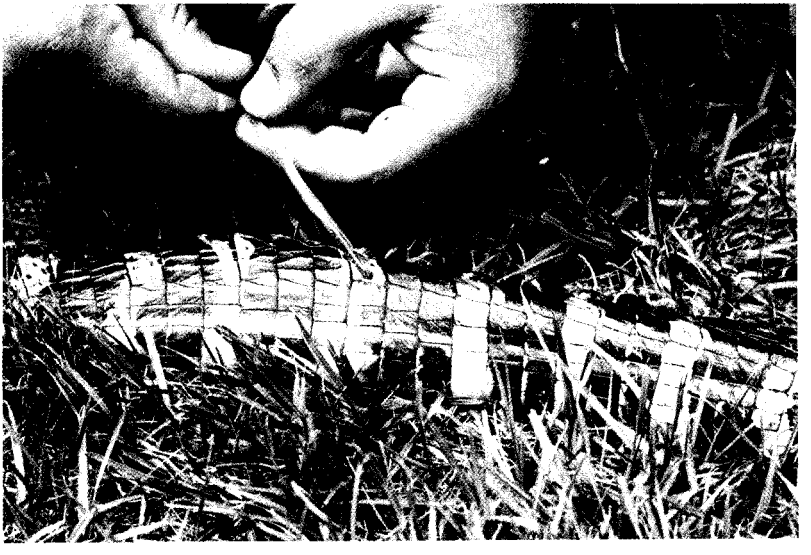

Figure 2D. Tube Tag

pop rivet (Fig. 2A). The tag was obtained from the Floy Tag and Manufacturing Co., Inc., Seattle, Washington. The rivet was expanded with a Pop Rivitool (PRG410) from Sears and Roebuck. A hand drill with a 1/8 inch bit was used to drill the hole in the neck scute. This tag was used effectively on alligators over five feet long.

Tatooing (Fig. 2B) and branding (Fig. 2C) were tried but abandoned. The marks were not visible on the ventral surface of a swimming animal and lacked permanence. One alligator that was recovered five months after being tattooed retained only faint traces of the mark.

A tag attached through the anterior-most single dorsal tail scute has proven permanent and visible at night. The tagging technique was a piece of 1/8 inch diameter neoprene tubing into which was inserted a numbered money fish-jaw tag (National Band and Tag Co., Newport, Kentucky). The tube containing the tag was then pushed through a hole made in the tail by an ordinary ice pick (Fig. 2D). A knot was tied in the tube to secure the tag in the tail. Alligators marked in this manner have been recaptured 27 months after the release and the tag has shown no wear, but there have been alligators caught under 19 inches long which have shown signs of this tag pulling out. Transflex Tubing (No. 3002, Size 4) for this tag was supplied by the Minnesota Mining and Manufacturing Co., Freehold, New Jersey.

Transects

Because of the large area involved we have not attempted to estimate the alligator population in the Everglades but in order to get some idea of the status of the species, permanent transects were established to indicate population trends. Some of these were run on a monthly basis and some only during certain times of the year. A Norelco "150" cartridge-type portable tape recorder was carried and each alligator sighted was approached close enough so that the length to the nearest foot was estimated. Those that sank before a size estimate was made were recorded as unknown. It was not difficult to estimate the size if one was close enough to see the alligator's head. Snout length was used to judge total length, since the length of the snout in inches roughly corresponded to the total length in feet (Chabreck, 1966).

Presently, there are four permanently established transect lines (Fig. 3).

The Alligator Alley (Table 1) and L-39 (Table 2) Transects are canals and were run at night using a outboard motorboat. Both transects are between 11 and 12 miles long. The high numbers of 2, 3, and 4 foot alligators probably indicated a preference for the deep water canals by the young alligators. Members of these size classes made up 75.6 and 62.4 percent of the total alligators counted on these two transects, respectively. These data are based only on known size-class alligators.

The Shark River Valley Loop Road Transect (Table 3) in the Everglades National Park was usually run in April and May during daylight hours either on foot or by automobile. Low water in the marsh during these months concentrated the alligators in the canal. Counts made in April and May 1967 totaled 107 and 85 alligators, respectively. A count made on 19 June 1967 after the rainy season began totaled only 22 alligators. This probably indicated dispersion because of the rising water level.

The Miami Canal Transect (Table 4) was flown in the Super Cub at 100 feet altitude. The early Miami Canal flights in 1954 were divided into two legs. The first leg included approximately 24 miles within Conservation Area 3: the second leg included a 15½ mile section of the canal north of Conservation Area 3. This area because of its inaccessibility had a natural barrier to poaching and consequently large numbers of alligators were seen there. The 24 mile portion of the canal within the Conservation Area averaged 2.6 alligators per mile when flown on 22 March 1954. In the 15-mile section north of Conservation Area 3, 6. 8 alligators per mile were seen. On 5 April 1965, 11 years later, the 24-mile section of the canal was flown again. The average number of alligators sighted was 0.88 per mile. On 12 April 1967, the number sighted was 1.8 per mile and on 12 April 1968, 1.6 alligators per mile were sighted (Table 5).

The portion of the canal which lies within the Conservation Area is still very similar habitat to what it was when the transect was flown in 1954; consequently,

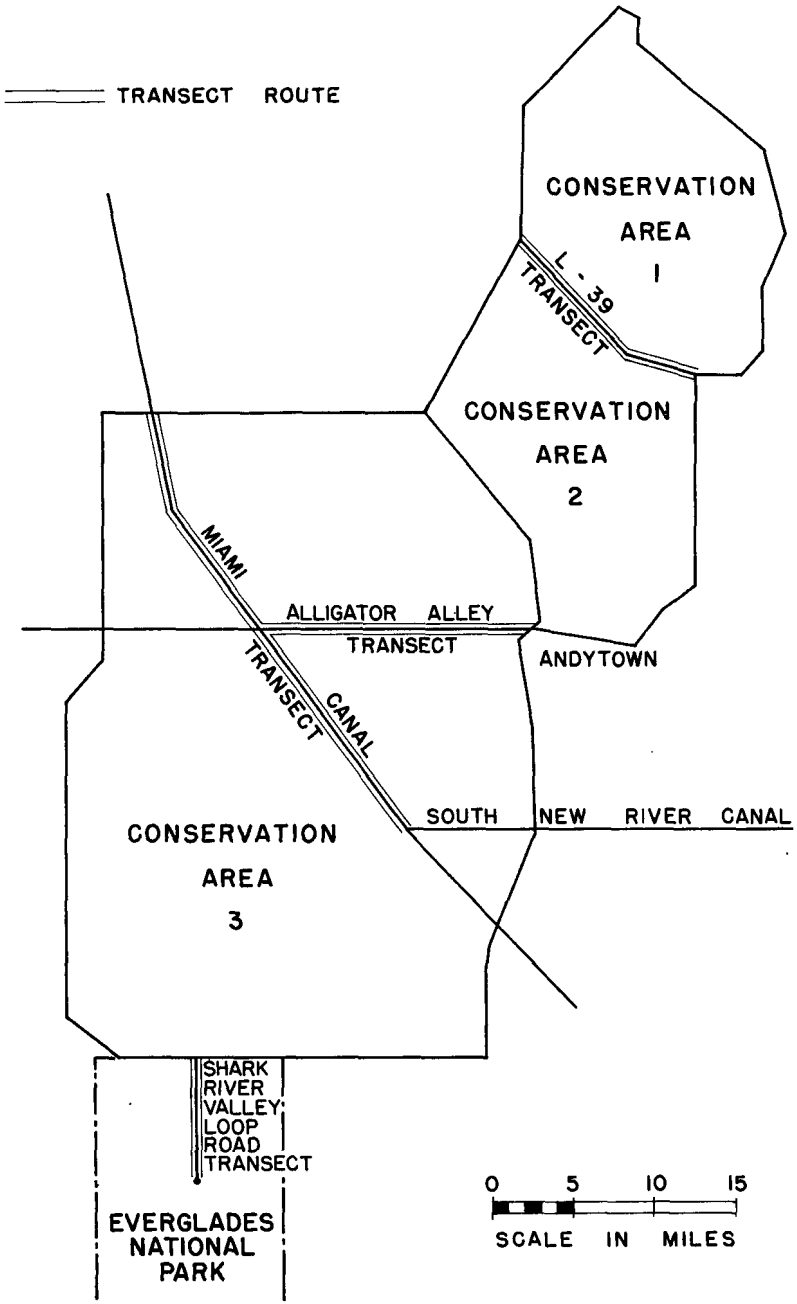

Fig. 3. Locations of transect routes.

TABLE 1
Alligator Alley Transect

Length to Nearest Foot

Month & Year	1	2	3	4	5	6	7	8	9	10	Unknown	Total
April 67	2	48	58	28	10	6	0	2	0	0	23	174
June 67	1	7	8	3	1	1	0	0	0	0	30	118
Aug. 67	1	7	8	3	1	1	0	0	0	0	12	33
Jan. 68	2	5	5	3	1	0	0	0	0	0	13	29
Feb. 68	0	3	9	7	0	1	0	1	0	0	9	30
Mar. 68	1	3	17	9	2	1	1	0	0	0	20	54
April 68	0	3	51	17	2	2	0	0	0	0	11	86
May 68	0	2	27	11	3	0	3	1	0	0	18	65
June 68	0	0	6	6	0	0	1	2	0	0	12	27

TABLE 2
L-39 Canal Transect

Length to Nearest Foot

Month & Year	1	2	3	4	5	6	7	8	9	10+ over	Unknown	Total
May 67	0	18	53	31	18	10	10	6	1	2	0	149
July 67	0	4	8	5	3	7	1	1	0	0	22	51
Aug. 67	1	9	13	16	7	4	2	1	0	0	10	63
Nov. 67	1	10	9	8	11	11	5	2	1	1	22	80
Mar. 68	2	5	5	3	1	0	0	0	0	0	18	34
Apr. 68	1	7	7	3	2	2	1	0	0	0	22	46
May 68	12	9	17	14	4	5	9	3	3	0	8	84
June 68	9	15	11	12	7	5	2	2	0	0	11	74

TABLE 3
Shark River Valley Loop Road Transect

Length to Nearest Foot

Month & Year	1	2	3	4	5	6	7	8	9	10+ over	Unknown	Total
April 67	0	8	20	10	12	18	9	13	2	7	8	107
May 67	1	0	2	1	18	16	6	36	1	4	0	85

TABLE 4
Miami Canal Transect

Length to Nearest Foot

Month & Year	1	2	3	4	5	6	7	8	9	10 plus	Unknown	Total
April 65	0	0	0	3	0	6	0	8	0	4	0	21
April 67	0	0	0	1	7	4	3	8	2	3	0	28
May 67	0	0	5	0	0	0	2	1	0	11	0	19
June 67	0	0	0	1	0	0	1	1	2	1	0	6
April 68	0	7	0	1	3	5	3	1	2	1	0	23

TABLE 5
Miami Canal Transect

Date	No Miles Transect	Total No. Gators	No Gators Sighted/Mile
03/22/54	24-1/2	65	2.60
03/11/55	24-1/2	60	2.40
04/05/65	24-1/2	21	0.88
04/12/67	15	28	1.80
04/11/68	15	23	1.60

these comparisons may at least be used as an index. If the decrease from an average of 2.5 alligators per mile to 1.6 alligators per mile is taken as a representative decrease for the entire Conservation Area, then this would represent a decrease slightly over 30 percent since 1954.

Growth Rate

We observed growth rates of several immature alligators and found the mean growth rate of 33 recaptured specimens to be 1.16 inches per month. A "t" test (from Steel and Torrie, 1960) was applied to to the data. The resulting analysis indicated that the mean monthly growth rate fell with the 95 percent probability level.

$$\text{Size of sample - } N = 33$$

$$\text{Sum of factors - } SX = 36.84$$

$$\text{Mean - } X = 1.116$$

$$SX^2 = 52.5024$$

$$(SX)^2 = 1357.1856$$

$$\text{Sum of squares - } SS = \frac{SX^2 - (SX)^2}{N}$$

$$= 52.5024 - 41.1268$$

$$= 11.3756$$

$$\text{Sample variance - } s^2 = \frac{SS}{df}$$

$$= 0.3555$$

$$\text{Sample error - } S = \frac{S}{x \sqrt{N}}$$

$$= 0.1036$$

$$\text{Confidence Limits - CL} = 1.116 \pm t_{95} \times 0.1036$$

$$= 0.905 - 1.327$$

$$t_{95} = 2.042 \text{ with 32 degrees of freedom}$$

This statistical analysis shows that a one inch per month growth rate is an acceptable criterion for estimating the age of alligators in south Florida until they reach sexual maturity or six feet in length.

Although few mature alligators have been recaptured, no growth pattern was noted that would facilitate age determination.

Sexing Methods

Chabreck (1963) described a useful method of separating sexes based on a penis character. The clitoris of female alligators less than 30 inches long resembles a penis. However, with experience it can be distinguished from a penis by its flacidity and the absence of a sheath.

In about 1,000 specimens examined, the sex ratio was 80 percent males and 20 percent females. This unbalanced sex ratio probably resulted from two sources of error. One, was that small alligators may have been sexed incorrectly. Several recaptured alligators were found to have been sexed wrong the first time. The other,

that the majority of alligators were captured from a canal. This biased the sex ratio because we found the majority of the mature females were marsh residents. Considering samples that were sexed since the inclusion of these data, the male to female ratio by percent was 65:35.

OBSERVATIONS ON LIFE HISTORY

Alligator Holes

When water in the marsh receded during a dry period, the alligators either retreated to a canal or into a hole which had been wallowed in the marsh. If the hole is occupied, its center is relatively free of vegetation. Willows and other shrubs grow around the edge. A den or cave, associated with the hole, extends 10 to 15 feet from the edge of the hole beneath the willow roots. These holes serve as refuges for the alligators during dry periods. Some holes have been kept open by large alligators for many years.

During severe drought, alligators remained in the caves as the water in the adjacent hole dried up. The caves retained some water many weeks after the surrounding area had dried. During this period, the food supply of the alligator was limited and they became sluggish and entered a semidormant condition if the drought was prolonged. We have observed large alligators in this situation with only a few inches of water for as long as a month. It was obvious that no food was present, but the alligators apparently survived.

Alligator holes are important to the ecology of the marsh. The willows and other vegetation that surround a hole are a source of food and cover for wildlife. They serve as aquatic reservoirs during the frequent droughts which characterize the Everglades. Ligas (1960) in his study on the Everglades bullfrog *(Rana grylio)* noted the importance of the alligator holes to the frog population during the dry periods. The concentration of fish within those holes also furnished food for the wading birds.

Movement

Our data demonstrates a homing instinct in immature alligators (Table 6). One instance of homing involved the capture of a 14-inch alligator from among what appeared to be his siblings. The alligator was tagged and removed to a location at least three miles away. One month later the alligator was recaptured at the original capture site.

Chabreck (1965) noted a homing instinct in small alligators. He maintained that the attraction of the young alligator to the nest site was not broken until the second year. He also felt that alligators in the interior of the marsh might not break these ties until the third year. Many observations were made of two size clases in alligator holes during this study. Thus, it appears that the nest bonds are generally broken the second year. On occasion a third size class was noted in holes. However, this was during the season when the only available water was in the alligator holes and probably these individuals moved to these sources of deep water.

Young alligators over 40 inches long moved about a great deal. This was best illustrated by the tremendous influx of immature alligators into the canals during the dry period.

Water level fluctuation affected the movement of the alligator. During periods when the marsh was flooded, transect data showed stable populations in the canals, but as the water in the marsh receded the canals experienced striking increases in populations. These increases were largely made up of immature individuals that had recently left the nest areas, and mature males. Alligators migrated toward the deep water with the receding water levels. Individuals which were in the interior of the marsh retreated to alligator holes and remained until the drought was over.

TABLE 6
Homing of Immature Alligators

Alligator Number	*No. Days Between Captures*	*Distance (Miles in Returning to Original Capture Location*
GFC-160	29	3.0
GFC-205	108	1.5
GFC-226	42	4.5
GFC-260	159	0.4
GFC-265	165	8.5
GFC-263	55	6.5
GFC-289	15	0.2
GFC-291	15	0.2
GFC-297	15	0.2
GFC-298	15	0.2
GFC-299	15	0.2
GFC-332	700	2.0
GFC-338	15	0.1
GFC-405	280	5.0
GFC-459	15	0.1
GFC-753	399	2.0
GFC-1336	329	1.0
GFC-1349	204	None
GFC-1383	135	None
GFC-1393	93	1.0
GFC-2967	161	7.0
GFC-2981	256	0.5
GFC-2985	153	1.0
GFC-2990	153	1.0
GFC-4978	850	7.0

DISCUSSION

Effects of Drought, Flood, and Fluctuating Water Levels

During the dry spring of 1967, many holes containing alligators were observed. Although the food supply was short and the available water only amounted to a few inches, adult alligators appeared in good health. But we noted the population was adversely affected if the drought was prolonged. Records kept on alligator holes during a dry period showed the number of young steadily declined. In one 10-day period the number of 12 to 15 inch long young in a single hole decreased from approximately 45 to less than 25. As the water level dropped, the young were concentrated, and exposed to predation. Since these holes served as retreats during the first two years of the young alligator's life, their drying up undoubtedly had an impact upon the preceding year's reproduction.

Observations on the effect of fluctuating water levels in regard to nesting were also made during the spring of 1967. Nesting activities were at a peak during the latter part of the dry period. On June 21, 1967 we found three nests in the north end of Area 3. At that time there was almost no water in the surrounding marsh. Within a few days the rainy season began and in two weeks the water depth around the nests had risen to 22 inches. This completely inundated the nests, preventing the eggs from hatching.

In December 1962, the last levee was finished, completely enclosing the 865,300 acres within Conservation Areas 1, 2 and 3. This is, for the most part, prime alligator habitat. One of the main purposes of the Conservation Areas is the prevention of flood and drought. (The term "Conservation Area" was coined by the Flood Control District and the U. S. Army Corps of Engineers and means *water* conservation.) This

is accomplished by pumping excess water from the surrounding agricultural and urban areas into the Conservation Areas during periods of heavy rainfall and distributing the storage to those who need it during dry months. Since rainfall is seasonal, all of the storage and natural collection (rainfall) occurs from June through October. The combined collection of water in the Conservation Areas from both rainfall and pumping may be producing an annual flood situation in the Everglades. The average annual rainfall experienced in the Everglades and the southwest coast from data since 1915 amounts to 53.49 inches per year. Rainfall in south Florida has been below normal every year since the levee system was completed except 1966 when it was only 2.43 inches above normal. Alligator nests were lost due to high water in the spring of 1967 even through rainfall in the Everglades region was 7.70 inches below normal. This seems to be the result of the seasonal rainfall and unwanted water, though relatively scarce in 1967, being pumped into the Conservation Areas for storage during months of alligator nesting.

The effects of a prolonged wet period on the alligator production is difficult to predict, now that this portion of the Everglades is completely diked. The wet year of 1966 was preceded and followed by subnormal rainfall years. But the wet period of 1957 lasted four consecutive years and the rainfall averaged 10.55 inches per year above normal. As of this writing, 17 nests have been found in the northwest section of Conservation Area 3. On 13 June 1968 water levels in this marsh averaged eight inches. On 8 July 1968 after nest completion and egg laying, water averaged about 28 inches deep. Sixteen of the nests which had been constructed in the marsh interior had already drowned. One, which was built on higher ground near the edge of a canal levee, was destroyed by a hog.

Habitat Destruction and Alteration

Records of inventories of alligator populations in and around the Conservation Areas document losses of habitat. The best example is probably the area north of Conservation Area 3 which as late as 1954 harbored impressive numbers of alligators. Presently this same area has been virtually destroyed as alligator habitat. The increasing human population of southern Florida has pushed surburbia into areas that only a few years ago were prime alligator habitat.

In discussing the effects of the alligator on the plant ecology of the Everglades National Park (Craighead, 1968) pointed out that the habitat in the Park has been severely altered by drought and flood. This is also true of the Conservation Areas. There is evidence that the cumulative effect of the annual flood and drought cycles is being felt by the alligator population. Flood and drought have always been common in the Everglades. However, both extremes may become annual phenomena. The activities of man, mainly the drainage and diking projects, are largely responsible.

Drainage projects have also created hundreds of miles of canals that would appear to benefit the alligator during dry periods. But whatever benefits might accrue from increased reservoirs of deep water would probably be offset by their making the alligators more vulnerable to poaching.

Hunting

Alligators which were thought to represent a threat to livestock were killed by the early white settlers, but it was not until the beginning of the nineteenth century that the destruction began in earnest. Audubon (1931) reported that many thousands were killed along the shores of the Red River in Louisiana for sport and hides, and stated that "many squatters and strolling Indians followed for a time no other business."

In 1855, a market developed in Europe where there was a great demand for shoes, boots, and saddlebags made from alligator hides (Stevenson, 1904).

During the Civil War, alligators were killed for shoe leather. There was some demand for their flesh, and the oil which when rendered from the fat was used in lubricating steam engines and the machinery of the cotton industry (Audubon, 1931).

After the war, the demand declined, but in 1870 leather products of alligator hide again became fashionable and have remained so to the present time (Chabreck,

1967). Constant demand, high prices offered for hides, the relative ease in poaching alligators, and the only token punishments administered to convicted violators when protection is enforced have all contributed to the tremendous drain on this natural resource. This drain is exemplified by the following estimates concerning the reduction of the alligator population over the last 168 years.

Smith (1893) figured 2,500,000 alligators were killed in Florida between 1800 and 1891. Stevenson (1904) reported the output of tanneries of the U. S. approximated 140,000 hides annually by 1902, with Florida and Louisiana providing 22 and 20 per cent respectively. McIlhenny (1935) estimated that from 3 to 3½ million were harvested in Louisiana between 1880 and 1933. Tax records of the Louisiana Wildlife and Fisheries Commission show that 314,404 alligators were handled from 1939 to 1955 (Chabreck, 1967). Georgia tax records indicate a 10,000 per year harvest from 1922 through 1926 (Kellogg, 1929). Kellogg (1929) maintained the total number of alligators taken in Florida up to 1929 was about 50,000 per year. Allen and Neill (1949) disagreed with these figures and stated, from hide dealer information, that 190,000 skins were handled in Florida in 1929. The number handled per year declined until 1943, when only 6,800 skins were purchased from hunters. In the next six years, the species was protected in Florida during its breeding season, and specimens under four feet in length were protected at all times of the year. Allen and Neill (1949) believed that the increase in kill after the alligator was protected indicated a marked recovery in that portion of the animal's range (Fig. 4). This is not necessarily the case and would more likely represent an increase in hunting pressure because of the price paid for hides. In 1947, dealers paid $13.30 for a prime seven-foot hide.

In the past 15 to 20 years hunting pressure has increased as a result of the development of the airboat and the digging of additional canals. The airboat enables the hunter to cover many miles in a relatively short time, and the canals offer deep water where the alligators tend to concentrate, making them vulnerable to poachers. These two developments coincide with an increase in demand for the hides which have resulted in tremendous pressure on the population.

CONCLUSIONS

The unbalanced sex ratio and the length of time required to reach sexual maturity are inherited disadvantages to the animal's productivity. However, this was no problem historically for the population reached incredible numbers before man's activities became so apparent (Simpson, 1920; Holt and Sutton, 1926; Romans, 1962). Drainage projects have destroyed or altered much of its habitat. In addition, the interference into the natural water level fluctuation in the Everglades may be creating an annual drought and flood phenomenon. This vitally affects productivity by increasing immature mortality. As water levels rise during the spring season, there is an indication that nest flooding is a serious problem. The construction of new canals through the Conservation Areas combined with the recently increased carrying capacity of parts of the old drainage system provide rapid run-off of the water in the marsh during and after the rainy season. Consequently, areas that were flooded when alligators were nesting in June are dry by November except for water standing in alligator holes. Immature alligators concentrate in these last sources of water and are exposed to excessive predation, both from natural predators and probably from larger alligators.

The pressure on the immature portion of the population is increased even more by the selection of prime hides (three to seven feet long) by the poacher. Over a period of time, the cumulative effects of these factors have surely been responsible for the decline in the alligator population.

Although our knowledge is only fragmentary, it is clear that the major cause of the decline of the alligator is due to man's altering of the habitat combined with excessive hunting pressure. The problem of management of the species centers around maintaining quality habitat and control of the harvest.

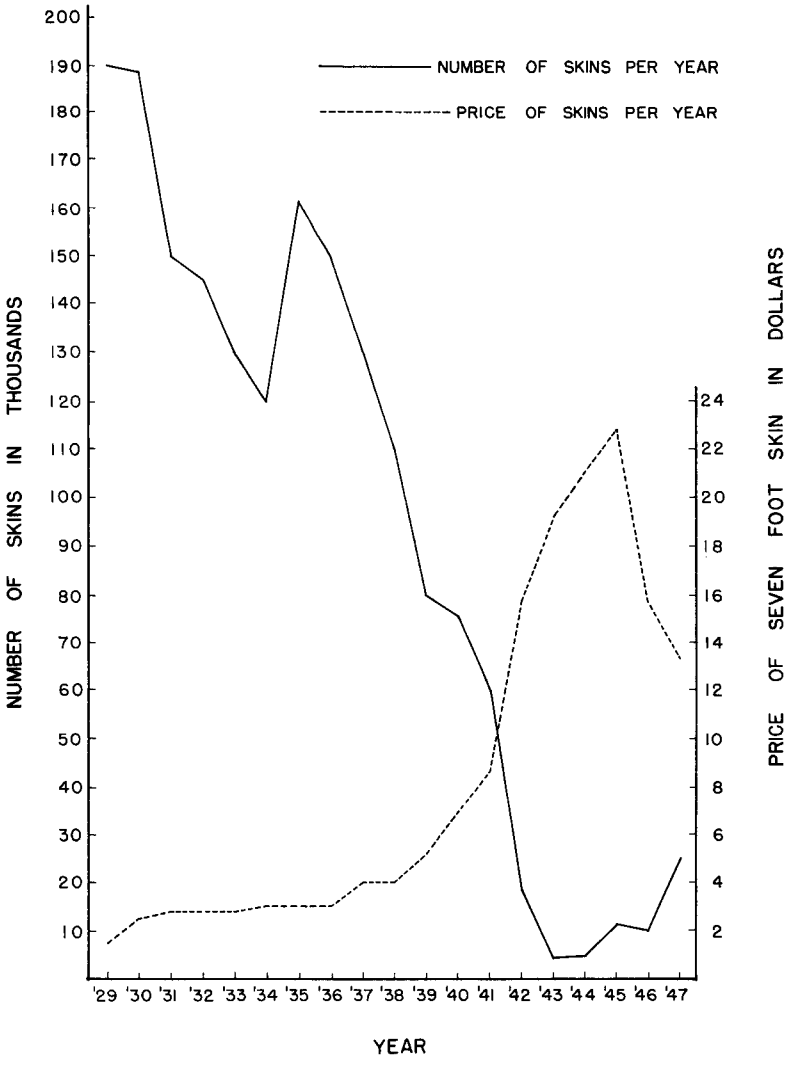

Fig. 4. The relationship between harvest rate and the price paid for a seven-foot hide; from hide dealer reports data in Allen and Neill, 1949.

The preservation of habitat is a straight forward objective that needs no explanation, but proper management of existing habitat, mainly the Everglades, is hinged upon correct water management rather than "flood control".

The alligator existed in the Everglades in greater numbers in the past. Its influence and place in the ecology of the Everglades are significant. There is a distinct possibility that man has the potential to erase the alligator from the Florida scene. However, he also has the capability to keep the alligator as part of the fauna of Florida in the foreseeable future.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to the following persons for the assistance they gave, either during the course of the study or during the preparation of this report: To Messrs. J. David Albury and John H. Chenowith for their aid in the collection of data; to the Wildlife Officers of the Everglades Region, Game and Fresh Water Fish Commission, for extending to us both manpower and equipment in our efforts to capture large alligators from the marsh interior; to Mr. Stuart Bentler, Department of Architecture, University of Florida, Gainesville, for illustrating the line-drawn figures used in this report; to Mr. Fred J. Waldinger, Fisheries Biologist, Game and Fresh Water Fish Commission, for the statistical analysis of the alligator growth rate data; and to Mr. Lovett E. Williams, Jr., Project Leader, Wildlife Research Projects, Game and Fresh Water Fish Commission, Gainesville, for the critical review and helpful suggestions he made during the preparation of this manuscript.

LITERATURE CITED

Allen, E. Ross and W. T. Neill. 1949. Increasing abundance of the alligator in the eastern portion of its range. Herpetologica. 5(6):109-112.

Audubon, J. J. 1931. Observations of the natural history of the alligator. La. Conser. Review 2(3):3-8.

Chabreck, R. H. 1963. Methods of capturing, marking, and sexing alligators. Proc. 17th Ann. Conf. S. E. Assn. Game and Fish Comm.: 47-50.

_____ 1965. The movement of alligators in Louisiana. Proc. 19th Ann. Conf. S. E. Assn. Game and Fish Comm.: 102-110.

_____ 1966. Methods of determining the size and composition of alligator populations in Louisiana. 20th Ann. Conf. S. E. Assn. Game and Fish Comm.: 105-112.

_____ 1967. The American alligator – past, present and future. 21st Ann. Conf. S. E. Assn. Game and Fish Comm. (In print).

Craighead, F. C. 1968. The role of the alligator in shaping plant communities and maintaining wildlife in the southern Everglades. Fla. Naturalist 41(1):2-7 and 41(2):69-74.

Cooke, C. W. 1939. Scenery of Florida. Fla. Geol. Surv., Geol. Bull. 17. 118 p.

Davis, J. H. 1943. The natural features of southern Florida. Fla. Geol. Surv., Biol. Bull. 25. 311 p.

Holt, E. G. and G. Sutton. 1926. Notes on birds observed in southern Florida. Annals of the Carnegie Museum. 16:409-439.

Jones, F. K., Jr. 1965. Techniques and methods used to capture and tag alligators in Florida 19th Ann. Conf. S. E. Assn. Game and Fish Comm.: 98-101.

Kellogg, Remington, 1929. The habits and economic importance of alligators. U. S. D. A. Bull. 147. 36 p.

Ligas, F. J. 1960, The Everglades bullfrog – life history and management. 14th Ann. Conf. S. E. Assn. Game and Fish Comm.: 9-14.

Loveless, C. M. 1959. The Everglades deer herd – life history and management. Fla. Game and Fresh Water Fish Comm., Tech. Bull. 6. 104 p.

McIlhenny, E. A. 1935. The alligator's life history. The Christopher Publishing House, Boston. 117 p.

Romans, Benard. 1962. A concise natural history of east and west Florida. University of Florida Press, Gainesville. 342 p.

Simpson, C. T. 1920. In lower Florida wilds. Putnam, New York. 404 p.

Small, J. K. 1933. Manual of the southeastern flora. University of North Carolina Press, Chapel Hill. 1554 p.

Smith, H. M. 1893. Notes of the alligator industry. Bull. U. S. Fish Comm. 11:343-345.

Steel, R. C. D. and J. H. Torrie, 1960. Principles and procedures of statistics. McGraw-Hill, New York. 481 p.

Stephens, J. C. 1956. Subsidence of organic soils in the Florida Everglades. Soil Sci. Ann. Proc. 20:77-80.

Stevenson, C. H. 1904. Utilization of the skins of aquatic animals. U. S. Comm. Fish and Fisheries Rpt. 1902:281-352.