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A STUDY OF IMMATURE ALLIGATORS ON ROCKEFELLER REFUGE, LOUISIANA

by

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ABSTRACT

A telemetric study was conducted on immature alligators (*Alligator mississipiensis*) on Rockefeller Refuge from 27 March, 1973 through 5 March, 1974. Thirty alligators, 17 females and 13 males, were captured, tagged, marked for identification, and outfitted with color-coded neck-collar radio transmitters. A directional receiving unit was used to follow their daily movement. The size of the animals ranged from 3'6-1/4" to 5'10-3/4". Minimum home range sizes, daily activity patterns, and habitat preferences were determined for the alligators under investigation. Readings taken during the winter dormancy period indicated that immature alligators were considerably more active during cold periods than were adult alligators.

INTRODUCTION

Aldo Leopold (1933) in his classic treatise on Game Management related, "The maximum population (game species) of any given piece of land depends; therefore, not only on its environmental types or composition, but also on the interspersion of these types in relation to the cruising radius of the species. Composition and interspersion are thus the two principal determinants of potential abundance of game range." The best method for determining "cruising radius" and habitat preference and then relating these two factors to interspersion of environmental types is through radio telemetry.

Various studies have documented alligator movement patterns and habitat preference under natural conditions (Chabreck, 1965; Joanen and McNease, 1970, 1972). Murphy and Brisbin (1972) described the distribution of alligators in response to thermal gradients in a reactor cooling reservoir. However, these studies were not involved specifically with immature animals.

Using guideline information provided in the previously mentioned studies and applying this information to the basic concepts outlined by Leopold, an investigation was initiated to monitor immature alligators with radio telemetry gear. The objectives of the study were to:

1. Monitor daily and seasonal movements of individual alligators.
2. Relate movements and activity patterns to habitat preferences.
3. Determine the minimum home range of individual alligators.
4. Develop management recommendations.

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DESCRIPTION OF STUDY AREA

This study was conducted on Rockefeller Refuge and adjoining privately owned marshland in southwestern Louisiana. The refuge is owned and operated by the Louisiana Wild Life and Fisheries Commission and encompasses 85,000 acres. It is bounded on the south by the Gulf of Mexico and on the north by the Grand Chenier-Pecan Island stranded beach ridge complex.

Marsh elevation averages approximately 1.1 feet above mean sea level. Tide water enters the refuge from the Gulf of Mexico through five separate channels and then spreads out to various parts of the refuge. The average tidal variation is one foot; however, high tides frequently inundate the marshes with salt water. Marsh areas in the northeastern section of the refuge and adjacent privately owned marshes are further influenced by a freshwater canal system emanating from the Grand Lake-White Lake complex.

Three marsh types; brackish, intermediate, and fresh; were used by the alligators under study. The marsh types were described in a previous paper by Joanen and McNease (1972).

STUDY PROCEDURE

Telemetry Equipment

VHF tracking transmitters and receivers were constructed for this study by Sidney L. Markusen, Electronic Specialties, Esko, Minnesota. The transmitters were equipped with 12-inch whip type antennae and emitted pulsed signals in the 151.100 to 151.210 megacycle range.

The transmitting components, batteries, and antenna were mounted on a neck collar attachment constructed of heavy rubberized fabric, which was 1-3/4 inches in width, 1/8 inch in thickness and adjustable from 10-1/2 to 20 inches in circumference. Total weight of the radio package and neck collar ranged from 351 to 391 grams (waterproofed and taped). Two mercury batteries, with a theoretical life of 100 days, provided the power source. All transmitters were encapsulated in epoxy resin, which served as a waterproofing agent, in addition to being sealed within an aluminum case.

Portable VHF tracking receivers with corresponding channels tuned to the frequencies of the transmitters were used for the duration of this study. A two-element Yagi hand-held directional antenna was the only antenna used. Total weight of the receiver, carrying box, earphones, and antenna was 14 pounds.

Approximately two days before attaching the collar assembly to an alligator, the transmitters were activated. Exposed wiring was then wrapped with vinyl electrical tape in order to protect it from abrasion. The entire neck collar transmitting unit, with the exception of the antenna, was then dipped twice in coal tar epoxy to serve as a waterproofing agent. The transmitter was checked periodically to insure that it was functioning properly before it was attached to the alligator.

A Silva Ranger compass, with luminous points for night readings, was used for obtaining compass bearings.

Acreage figures were calculated by using a modified acreage grid.

Method of Capturing and Marking.

Alligators used in this study were captured and tagged as described by Chabreck (1963).

A diligent effort was made to instrument equal numbers of males and females for each habitat type, especially during the elementary stages of this study.

Transmitter Attachment

All transmitters were attached in the field at the point of capture. Two different methods were used to attach the radio collars.

Method 1. The collar was adjusted to fit the neck of the alligator. Wooden strips were cut to fit laterally to the four dorsal neck scutes located just posterior to the head and then attached to the collar with vinyl tape. These wooden strips kept the collar in a fixed position with the antenna in an upright position on the dorsal part of the neck. Also, to insure that the antenna remained in its upright position, the collar was tied with nylon line threaded into small holes drilled through four scutes on the neck. The collar was attached by seating two Belknap pop rivets with backup spacers into prearranged holes located near the ends of the collar. Excess collar material was then trimmed off. Thirty minutes were required to attach the collar.

Method 2. The last twelve of the alligators monitored had their transmitters attached by simply tying down the radio and its 1-3/4″ x 7″ belt base to the dorsal neck scutes. The collar belting was cut off so that it extended only about two inches from the sides of the component box, a wooden strip was firmly attached to the two distal ends of the belting for attachment purposes, and the radio via belting base was tied securely to the neck through holes bored through the base of four large dorsal neck scutes. This new innovation in attachment proved durable, was much simpler to apply than the conventional neck collar method, and was more than likely more comfortable to the alligator.

During the period of attachment, a sack was placed over the head of the alligator to keep it calm. The radio signal was checked prior to release of each animal. Each collar was color-coded for identifying individual animals, especially if a radio should malfunction.

Tracking Procedure

One hundred and forty-eight field monitoring trips were accomplished during this investigation. Forty percent of the field trips were made in spring, 28 percent in summer, 24 percent in autumn, and 8 percent in winter.

Few nighttime readings were accomplished during this investigation. In general, immature alligators tended to be more active during the various segments of a representative diurnal period than did adult alligators monitored in previous telemetry studies (Joanen and McNease, 1970, 1972). Therefore, the time of day that a particular set of readings were made and the prevailing weather conditions at the time of reading were not nearly so critical as for adult alligators.

Transportation employed to monitor the radio equipped alligators included outboard boats, automobiles, helicopters, and fixed wing aircraft.

Triangulation method of plotting alligator locations was used almost exclusively.

Climatological Data

Basic climatological information was collected from a U. S. Weather Service Field Station located at the Refuge Headquarters complex. A seven-day continuous reading Ryan temperature recorder monitored daily air temperature fluctuations and also water temperature at a depth of approximately 24 inches. General notes recorded at the time a field trip began included: information on prevailing weather conditions, air and surface water temperature readings, and water depths in the various areas utilized by alligators.

Description of Terms

Several terms used frequently in the discussion of this paper should be defined so that there will be no misconception concerning terminology. *Minimum home range* - the acreage included within an area enclosed by connecting the outside points of an animal's plotted movement. *Activity center* - a small area of concentrated activity, occupying a considerable time interval, within a larger home range complex. *Minimum daily distance traveled* - linear distance traveled during a 24-hour period; example, distance moved from Point A at 10 AM on June 1 to Point B at 10 AM on June 2. *Natural marsh* - refers to areas characterized by dense marsh vegetation, primarily wiregrass, *Spartina patens,* interlaced with shallow marsh lakes, small potholes, ditches, and land-locked ponds. Natural marsh made up 63 percent of the study area. *Impoundment* - shallow freshwater impounded areas managed primarily for waterfowl and characterized by large open water areas; with water levels regulated by pumps. Impoundments, ranging in size from 80 to 1,770 acres, constituted 22 percent of the study area. *Deep water areas* - canals and natural bayous characterized by relatively deep water; these made up approximately 15 percent of the study area. *Fix* - a known location of any one animal under study.

RESULTS AND DISCUSSION

Thirty (30) immature alligators were studied using radio-tracking gear during the 344-day period of 27 March, 1973 through 5 March, 1974 (Tables 1 and 2). Eleven-hundred (1,100) individual locations were plotted on a total of 148 days. An F test indicated a non-significant statistical difference for number of fixes by sex ($P>0.05$, $F=0.1223$ with 1 and 28 degrees of freedom). Therefore, the data were not considered to be biased toward either sex. Transmitter life varied from 10 to 152 days and averaged 98 days.

Efforts were directed towards determining the response of alligators to marsh management procedures and documenting various aspects of the life history of immature alligators.

Water Availability

Water levels in the marsh ranged from slightly above average to extremely high (flooded) for the entire period covered by this report (Figure 1). The first eight months of the study were characterized by abnormally high water levels. Only during the ninth (December) and twelfth (March) months of the study did the water levels approach normal depths. Tropical Storm Delia in September, coupled with storm tides and heavy rain at the beginning and towards the end of the study, set the stage for the high water experienced.

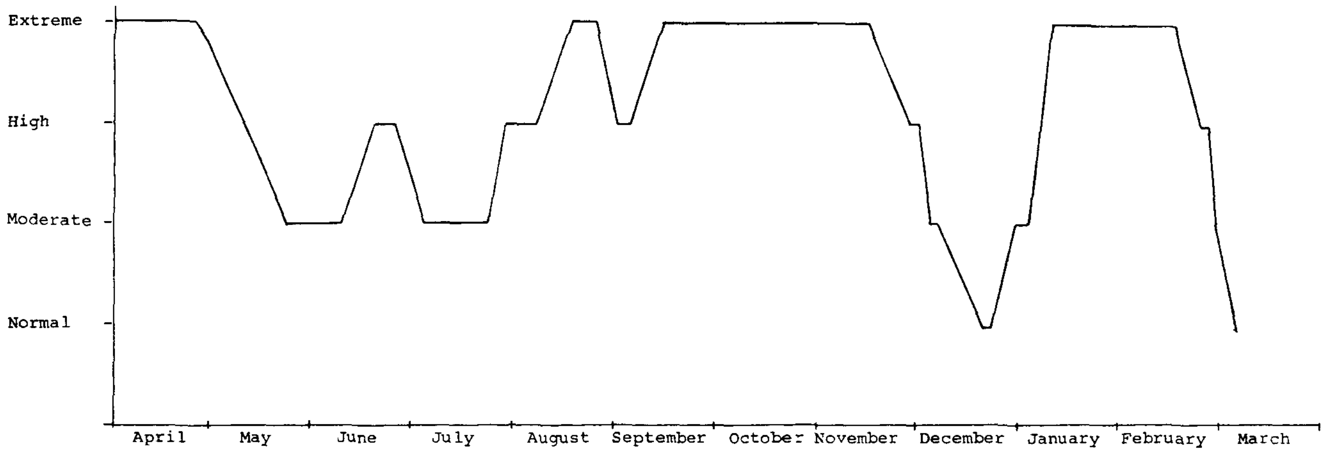
Table 1. Length, Weight, and radio time for immature female alligators on Rockefeller Refuge, 1973-1974.

Date Instrumented	Total Length	Weight (lbs.)	Date Last Radio Contact	Radio Days
3/27/73	4'4-1/2"	16.0	7/31/73	127
3/28/73	5'1-1/2"	27.0	5/7/73	41
3/31/73	5'4"	27.0	5/18/73	49
3/31/73	4'1-1/2"	13.0	8/13/73	136
3/31/73	4'10-1/4"	21.2	8/29/73	152
3/31/73	4'9-3/4"	20.5	6/1/73	63
6/15/73	4'7-1/4"	20.4	10/30/73	138
6/15/73	5'8-1/4"	32.9	10/20/73	128
6/15/73	5'1-3/4"	28.1	9/22/73	100
8/2/73	5'3"	40.5	11/7/73	98
8/25/73	4'11"	22.8	12/26/73	124
8/25/73	5'10-3/4"	41.4	11/3/73	71
10/11/73	3'11-3/4"	14.0	1/29/74	111
10/11/73	5'8-1/4"	39.0	10/20/73	10
10/11/73	4'0"	13.0	2/19/74	132
10/11/73	4'8"	21.0	2/19/74	132
10/11/73	3'9-1/4"	11.0	2/14/74	127

Table 2. Length, weight, and radio time for immature male alligators on Rockefeller Refuge, 1973-1974.

Date Instrumented	Total Length	Weight (lbs.)	Date Last Radio Contact	Radio Days
3/27/73	3'11-1/2"	12.0	8/18/73	145
3/27/73	4'10"	24.0	5/7/73	42
3/28/73	4'2-1/2"	13.0	7/14/73	109
3/28/73	5'10"	46.0	6/9/73	74
3/31/73	5'5-3/4"	28.5	5/16/73	47
3/31/73	3'10-3/4"	9.8	5/7/73	38
6/15/73	5'1/2"	25.7	10/13/73	121
6/15/73	4'4-3/4"	14.8	10/6/73	114
6/15/73	4'3-1/4"	15.1	10/24/73	132
8/2/73	5'4-1/2"	29.9	9/15/73	45
8/2/73	3'6-1/4"	8.2	10/31/73	91
8/25/73	5'10-1/2"	42.3	12/6/73	104
10/11/73	5'6"	31.0	3/5/74	146

FIGURE 1 - MARSH WATER LEVELS FOR THE PERIOD APRIL 19, 1973 THROUGH MARCH 5, 1974,
ROCKEFELLER REFUGE



Extreme - 7"+ above marsh floor level.
High - 4" to 7" above marsh floor level.
Moderate - 2" to 4" above marsh floor level.
Normal - -1" to 2" in relation to marsh floor.

Figure 1. Marsh water levels for the period April 19, 1973 through March 5, 1974, Rockefeller Refuge.

Water levels in impoundments remained excessively high except for late July and late August (dried briefly). Pumping simply could not keep ahead of the water that accrued in impounded areas. Normally, freshwater impoundments are dewatered from mid-June through August and then reflooded in early September.

In all probability the extended periods when surplus water was available tended to inflate movement and range size and influence habitat preferences. There were instances where alligators used areas that would have been unavailable to them in a normal water situation. Chabreck (1965) related that alligator movement increases whenever marshes are flooded. He further noted that immature alligators seem to respond to flooding more than do adults.

Environmental Factors

The effects of temperature on alligator activity has been reported on by Giles and Childs (1949), Chabreck (1965), Joanen and McNease (1970, 1972), and Smith (1972).

This study demonstrated that immature alligators were consistently more active over a wider range of environmental conditions than were adult alligators inhabiting the same general area. This proved especially true during the summer and winter.

Smith (1972) reported that alligators in Texas changed their activity times seasonally, being active throughout the day in winter and spring. He reported a change to nocturnal activity for the hot summer months. He further noted that alligators are active over the temperature range 26 to 37° C. (79 to 98° F.) with a preferred body temperature of 32 to 35° C. Our findings indicate that 84 to 86° F. is the optimum environmental temperature range for the alligator (approximating average summer water temperature). Tom Coulson (Personal Communication) maintains his alligator environmental chambers at 82° F., roughly the same temperature as the average summer air temperature for New Orleans.

Immature alligators spent a considerable amount of time basking (removed from water) during spring and autumn and during warm periods in winter. As was noted by Smith, during hot weather, free ranging alligators escaped high temperatures by seeking deep water.

Our telemetry equipment proved ideal in determining activity patterns in relation to climatic conditions. Considering that our equipment only detected a signal when an alligator was at least partly emerged from the water and that all readings were diurnal, then correlations can be drawn from the type of response elicited by alligators to varying climatic conditions.

If one considers thermoregulation to be the primary function of many of an immature alligator's loafing activities, a look at temperature data and its relationship to activities should give an insight into why alligators react in such a predictable manner to various temperature stimuli. Table 3 lists average water and air temperature by season and also describes the more prevalent thermoregulatory responses. Table 4 goes a step further and quantifies our success at locating alligators in relation to climatic conditions for each season of the year.

Based on our success at locating instrumented alligators, the relative difference between air and water temperature greatly affected daily activity patterns. Also, the interrelationship of cloud cover and wind speed and/or direction with temperature factors likewise affected them (Table 4).

Generally speaking, immature alligators were more active during the spring and autumn when the air temperature was greater than that of the water and with no cloud cover and moderate winds out of the southeast quadrant. Southeast winds tended to bring in warm gulf air.

Conversely, during the summer alligators were more active when the air temperature was less than water temperature. Significantly more animals were read during the summer period whenever winds were out of the northeast quadrant at less than 10 miles per hour and when skies were overcast.

Almost all winter fixes were made when air temperature was greater than that of the water. Warm, southeasterly winds (10-20 mph) and partly cloudy skies tended to offer the right conditions to stimulate activity during winter.

Table 3. Average seasonal air and water temperature and thermoregulatory responses exhibited by immature alligators.

Season	Average temperature Ambient	Water	Prevalent thermoregulatory responses (daytime)
Spring	72.2° F.	73.1° F.	Terrestrial bask, aquatic bask, considerable travel.
Summer	82.6° F.	84.1° F.	Aquatic bask, considerable time submerged, active at night.
Autumn	77.6° F.	78.1° F.	Same as spring except not as much terrestrial basking.
Winter	59.4° F.	63.2° F.	Submerged and semi-dormant, basking during warm spells.

Table 4. Percentage of alligators located (average/season) as related to climatic conditions.

Climatic condition	Percent of locations by season Spring	Summer	Autumn	Winter
Temperature				
Air temperature water	63	28	86	91
Air temperature water	33	62	6	0
Air temperature = water	4	10	8	9
Wind Direction				
North - East	20	45	31	0
East - South	43	11	43	71
South - West	13	21	7	16
West - North	24	16	11	13
Calm	0	7	8	0
Cloud Cover				
Clear	45	33	65	31
Partly Cloudy	33	20	22	40
Overcast	22	47	13	29

Range Size

Limitations of weight and size of radio-collars dictated that miniature components be used, hence light weight batteries with corresponding short life spans. The minimum home range figures expressed are probably on the conservative side. The average life of all units was 98 days and animals probably moved outside that range at some time during the period when radios were not functional.

Minimum home range size for 15 immature female alligators (Table 5) varied from 29.7 acres to 1,523.5 acres and averaged 438.6 acres. This appears quite large when compared to the average range size of 21 acres reported for adult female alligators by Joanen and McNease (1970).

Minimum home range sizes for 11 immature male alligators (Table 6) varied from 60.6 to 1,493.8 acres and averaged 564.9 acres. The average minimum home range size of 2,157.7 acres reported for adult male alligators in a previous study (Joanen and McNease, 1972) greatly exceeded the 564.9 acres recorded for immature males in this study. However, immature males exhibited a larger average minimum home range size than did either adult or immature female alligators monitored by telemetry (Joanen and McNease, 1970).

TABLE 5 - HOME RANGE SIZES, HABITAT PREFERENCE AND DAILY DISTANCE TRAVELED FOR IMMATURE FEMALE ALLIGATORS ON ROCKEFELLER REFUGE, 1973-1974

Unit Number	Number of Fixes	Home Range Size (A.)	Season of Year	Average Daily Distance Traveled (Ft.)	Habitat Preference (Percent of Locations) Impoundment	Impoundment Canal	Marsh Lake	Natural Marsh	Marsh Bayou	Canal
3	72	439.0	Spring	529.9	74.5	5.9	-	-	-	19.6
			Summer	1,136.4	14.3	-	-	-	-	85.7
5	15	473.4	Spring	1,820.0	86.7	13.3	-	-	-	-
10	28	1,523.5	Spring	1,896.4	10.7	-	60.7	10.7	-	17.9
9	67	287.7	Spring	810.7	2.0	9.8	54.9	31.4	2.0	-
			Summer	450.0	-	-	50.0	18.8	31.3	-
8	62	1,162.3	Spring	717.1	70.0	20.0	-	10.0	-	-
			Summer	243.8	5.8	-	38.5	40.4	-	15.4
12	37	1,345.5	Spring	846.2	5.4	-	62.2	16.2	-	16.2
2B	49	96.8	Summer	535.7	-	-	-	-	-	100.0
			Autumn	937.5	41.7	-	-	-	-	58.3
7B	37	200.0	Spring	400.0	-	-	100.0	-	-	-
			Summer	895.0	-	-	42.9	35.7	21.4	-
			Autumn	-	-	-	50.0	50.0	-	-

TABLE 5 - CONTINUED

Unit Number	Number of Fixes	Home Range Size (A.)	Season of Year	Average Daily Distance Traveled (Ft.)	Habitat Preference (Percent of Locations)					
					Impoundment	Impoundment Canal	Marsh Lake	Natural Marsh	Marsh Bayou	Canal
4B	42	156.1	Spring	700.0	-	-	100.0	-	-	-
			Summer	932.1	10.5	47.4	2.6	39.5	-	-
12B	31	167.7	Summer	883.3	-	20.0	20.0	53.3	6.7	-
			Autumn	910.0	-	-	25.0	43.8	31.3	-
5C	34	350.9	Summer	2,500.0	-	-	-	60.0	40.0	-
			Autumn	-	-	-	7.1	67.9	21.4	3.6
			Winter	-	-	-	-	100.0*	-	-
6B	10	-	Summer	-	25.0	50.0	-	25.0	-	-
			Autumn	-	100.0	-	-	-	-	-
9C	40	29.7	Autumn	395.8	-	-	-	57.6	33.3	9.1
			Winter	250.0	-	-	-	42.9	57.1	-
11B	3	-	Autumn	-	-	-	-	-	100.0*	-
3C	38	192.2	Autumn	907.7	-	-	12.5	50.0	37.5	-
			Winter	550.0	-	-	-	33.3	66.7	-

TABLE 5 - CONTINUED

Unit Number	Number of Fixes	Home Range Size (A.)	Season of Year	Average Daily Distance Traveled (Ft.)	Habitat Preference (Percent of Locations)					
					Impoundment	Impoundment Canal	Marsh Lake	Natural Marsh	Marsh Bayou	Canal
1B	36	56.8	Autumn	409.1	-	-	-	89.3	10.7	-
			Winter	562.5	-	-	-	100.0	-	-
6C	40	98.0	Autumn	608.8	-	-	-	34.4	62.5	3.1
			Winter	-	-	-	-	62.5	37.5	-
TOTAL	641	6,579.6								
AVERAGE	37.7	438.6								

*Insufficient data to meet requirements of study.

TABLE 6 - HOME RANGE SIZES, HABITAT PREFERENCE AND DAILY DISTANCE TRAVELED FOR IMMATURE MALE ALLIGATORS ON ROCKEFELLER REFUGE, 1973-1974

Unit Number	Number of Fixes	Home Range Size (A.)	Season of Year	Average Daily Distance Traveled (Ft.)	Habitat Preference (Percent of Locations)					
					Impoundment	Impoundment Canal	Marsh Lake	Natural Marsh	Marsh Bayou	Canal
6	70	912.0	Spring	697.5	60.9	6.5	-	23.9	-	8.7
			Summer	650.0	-	-	-	52.1	-	47.8
4	25	320.3	Spring	1,066.7	88.0	8.0	-	-	-	4.0
1	72	641.1	Spring	929.7	61.8	9.1	-	25.5	-	3.6
			Summer	854.6	-	-	-	70.6	-	29.4
2	46	*	Spring	876.0	91.3	8.7	-	-	-	-
7	23	1,493.8	Spring	1,100.0	8.7	-	39.1	43.4	-	8.7
11	27	358.6	Spring	980.0	81.5	7.4	7.4	3.7	-	-
5B	33	1,096.5	Spring	1,550.0	33.3	33.3	-	-	-	33.3
			Summer	907.1	23.1	-	3.8	3.8	69.2	-
			Autumn	-	-	-	-	-	100.0	-
10B	35	165.1	Spring	-	-	-	100.0**	-	-	-
			Summer	1,050.0	-	-	65.5	20.7	13.8	-
			Autumn	-	-	-	50.0	25.0	25.0	-

TABLE 6 - CONTINUED

Unit Number	Number of Fixes	Home Range Size (A.)	Season of Year	Average Daily Distance Traveled (Ft.)	Habitat Preference (Percent of Locations)					
					Impoundment	Impoundment Canal	Marsh Lake	Natural Marsh	Marsh Bayou	Canal
8B	44	218.0	Spring	-	33.3	66.7	-	-	-	-
			Summer	625.0	-	-	-	11.8	-	88.2
			Autumn	-	-	-	-	14.3	-	85.7
2C	11	-	Summer	1,344.0	-	-	-	18.2	72.7	9.1
9B	19	60.6	Summer	800.0	-	-	100.0	-	-	-
			Autumn	-	-	-	16.7	83.3	-	-
3B	17	843.7	Summer	-	-	-	-	28.6	71.4	-
			Autumn	450.0	20.0	-	-	10.0	-	70.0
4C	37	104.5	Autumn	756.3	-	-	-	28.6	67.9	3.6
			Winter	-	-	-	-	-	100.0	-
TOTAL	459	6,214.2								
AVERAGE	35.3	564.9								

*Moved 32.7 air-line miles from point of capture between 6/9/73 and 4/3/74.
**Insufficient data to meet requirements of study.

When home range data for male and female alligators were subjected to analysis of variance, the difference was not statistically significant ($P>0.05$, $F=0.4361$ with 1 and 24 degrees of freedom), because of the high degree of variation evidenced in Tables 5 and 6. There was no correlation between length of alligator and range size for the 3′, 4′, and 5′ size classes.

Daily Activity

Male daily movements were consistently smaller than those for females. However, the difference between male and female daily distance traveled data was not statistically significant (analysis of variance, $P>0.05$, $F=0.3190$ with 1 and 39 degrees of freedom).

Daily movement data, averaged by season, are presented in Figure 2. Males and females showed the same trend in seasonal movement patterns, with the larger daily movements being exhibited in the spring and decreasing thereafter as the seasons progressed. Summer showed a slight drop from the spring. Autumn movement dropped quite drastically from the summer average. When these differences in movement were analyzed by season, they proved non-significant ($P>0.05$, for males $F=0.490$ with 2 and 165 degrees of freedom; for females $F=1.310$ with 3 and 249 degrees of freedom). Wide variation in observations were evident for both sexes.

Female daily winter movements averaged 454 feet, indicating that immatures became very active during warm spells and then dormant during cold snaps. Insufficient data were collected to draw conclusions on winter activities for males.

Immature alligators showed a remarkable ability to traverse large distances in a relatively short time. Four hundred and ten daily distance movements (sexes combined) were tallied during the study. A breakdown of daily distances traveled are presented in Table 7.

Movement Patterns

Generalized trends in movement patterns give an insight into the reason that males showed larger home ranges than did females while exhibiting slightly smaller daily distance traveled figures. Almost half (46%) of the males exhibited two or more widely separated centers of activity within a larger overall home range complex while only 27 percent of the females showed definite multiple temporary range centers.

Important also, 54 percent of the males demonstrated no clear activity centers with random movement fairly equally distributed over all of the range. Conversely, 73 percent of the females showed considerable movement in one concentrated activity center (usually towards the center of the range) with occasional random movements outward.

Differences in habitat utilization by males and females was partly responsible for different movement patterns and range sizes. The affinity of females for natural marsh where extended travel was relatively difficult probably tended to restrict movement and home range sizes. The preference of males was for deep water areas, which offered convenient, unimpeded travel lanes. Also, heavy usage of impoundments in the spring tended to elevate range sizes of males.

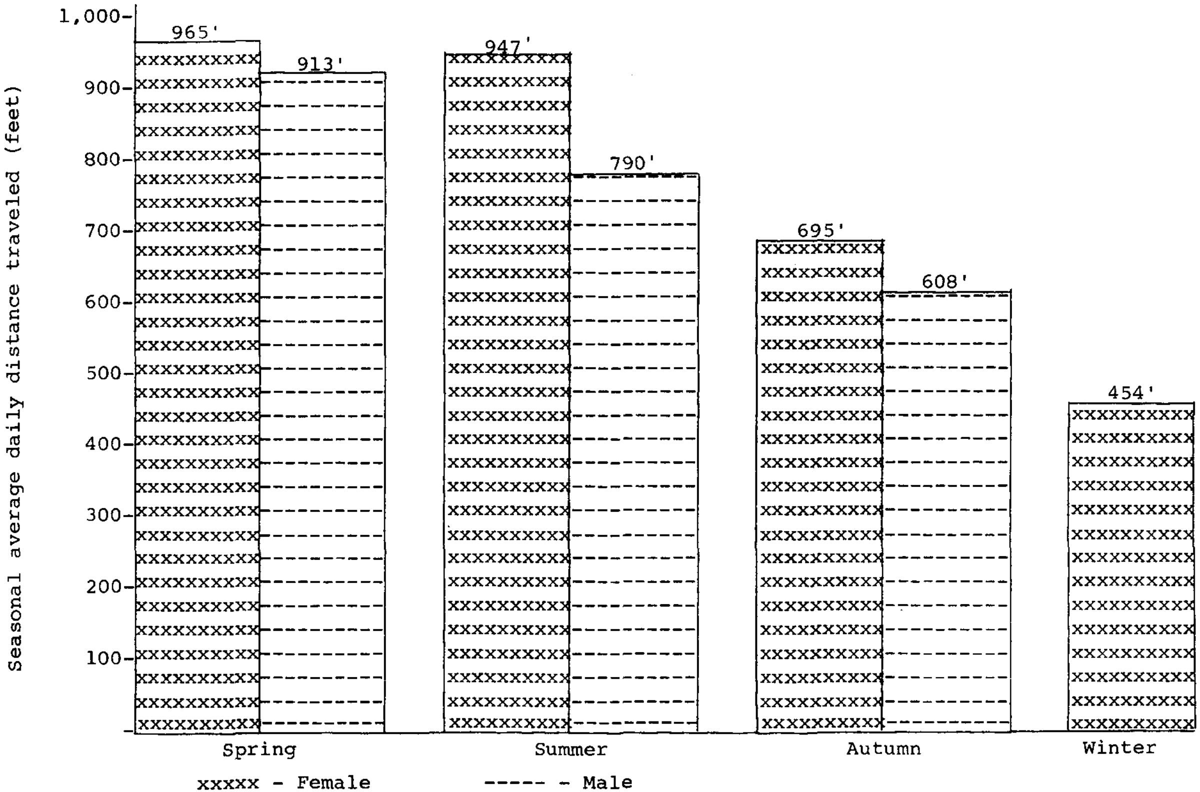


Figure 2. Average daily distance moved by season for immature alligators, Rockefeller Refuge, 1973-1974.

Table 7. Percentage and number of instances of daily travel falling within arbitrarily set foot class intervals.

Daily Distance Traveled	No. Instances	Percent of Instances
8,500′+	2	0.5
5,001′-8,499′	3	0.7
3,001′-5,000′	9	2.2
2,001′-3,000′	27	6.6
1,001′-2,000′	89	21.7
501′-1,000′	74	18.1
1′-500′	59	14.4
No Movement	147	35.8

Habitat Preference

The most important aspect of this study involved habitat preference and more specifically the differential preference exhibited by females when compared to males.

Figures 3 and 4 describe mean habitat preferences according to sex and season and also compare habitat preference to habitat availability. Tables 5 and 6 describe individual alligator habitat preference by season of the year.

A statistical comparison of immature female alligator usage of impoundments, natural marsh and deep water areas revealed differences that were highly significant ($P > 0.01$, $F = 7.2453$ with 2 and 189 degrees of freedom). Orthogonal comparisons supported by data in Figure 3 indicated that natural marsh areas received high usage for all seasons ($P > 0.01$, $F = 13.6296$ with 1 and 189 degrees of freedom). However, when habitat preference was compared to availability, the percentage of natural marsh use was consistent with the amount of natural marsh available (i.e., a definite preference was not exhibited for natural marsh). Natural marsh usage remained consistent for all seasons except the summer when it dropped down moderately.

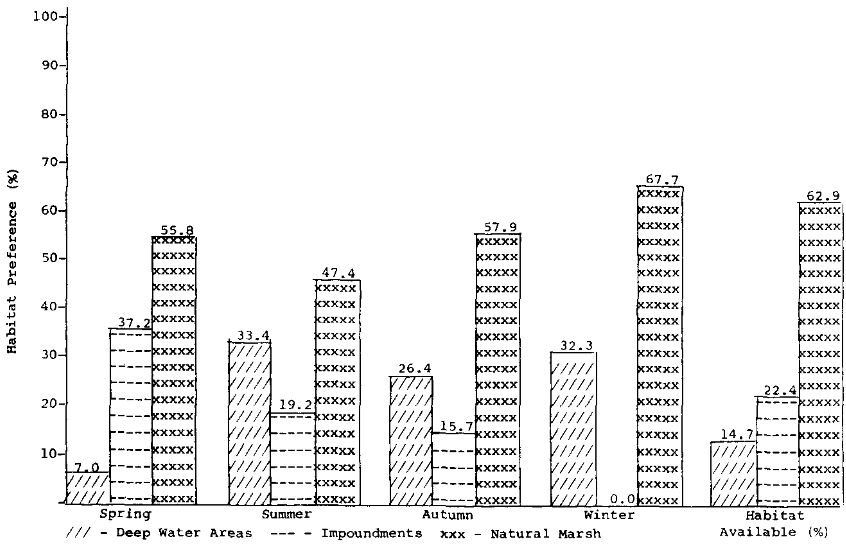


Figure 3. Habitat preference of immature female alligators by season, 1973-1974.

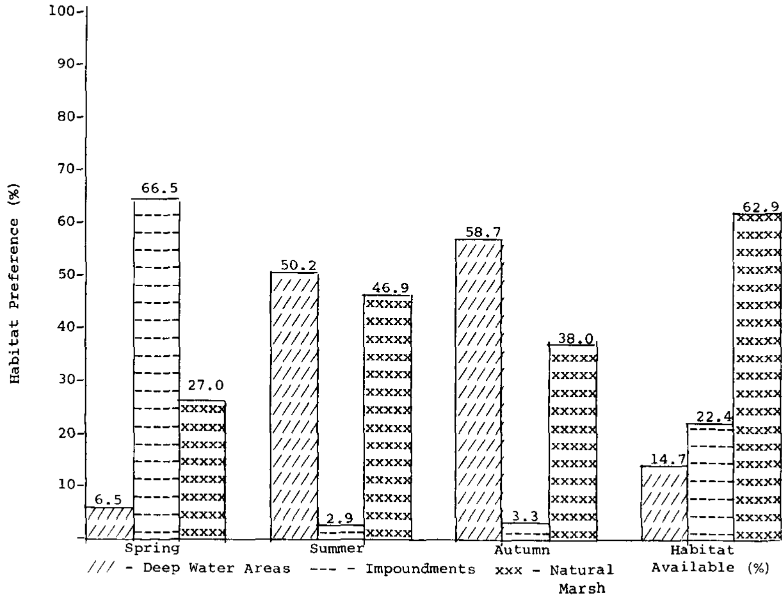


Figure 4. Habitat preference of immature male alligators by season, 1973-1974.

Immature females showed a definite preference for deep water areas during the summer, autumn, and winter and an avoidance of this type in the spring. They demonstrated a slight preference for impoundments in the spring, slight indifference for summer and absolute avoidance of impounded areas for autumn and winter.

Immature male alligators showed a marked preference for deep water areas during summer and autumn and a slight avoidance for spring (Figure 4). Impoundments were used heavily (66.5%) in the spring and were virtually deserted in other seasons.

Usage by males of natural marsh areas was substandard for all seasons when compared to availability.

The interspersion of habitat types and topographical features within any given habitat type greatly affect utilization by alligators. Generally, the intermediate marsh type with its super-abundance and widely interspersed water areas seems to be preferred by immature alligators of both sexes as well as adult females. Also, fresh and slightly brackish marshes bordering this zone were preferred.

The interrelationship of temperature factors, interspersion of water areas, water levels, and the availability of food chain organisms probably influenced habitat preference more than any other variables.

Management Implications

Previous studies (Joanen and McNease, 1970, 1972) pointed out the importance of water level control in the management of the American alligator. Management procedures advocated in these previous studies apply also to immature alligators.

Impoundment drawdowns should be timed to coincide with the exit of alligators from these areas. As this exodus was found to occur in late spring, initiation of drawdowns should begin no earlier than mid-May. All surface water should be removed about mid-June. A drawdown at this time would also benefit crawfish (Perry, Joanen, and McNease, 1970), nesting waterfowl, variety of shorebirds, fur animals, and water dependent organisms.

Salt water intrusion is a problem which is especially detrimental to young alligators (Louisiana Wild Life and Fisheries Commission 14th Biennial Report, 1970-71).

This report demonstrated that a two-month exposure of very young alligators to waters of 10 and 13 parts per thousand salt content was lethal. Control of extended periods of salt water exposure would certainly benefit alligators, especially the younger size classes.

Harvest regulations should be set to preserve as many immature females as possible. A season beginning in September and according to guide lines set-forth in the 1970 paper by Joanen and McNease, would preserve adult females as well as protect a large segment of the immature females. Immature female habitat preference for natural marsh in autumn (58%) indicates that only 40 percent of the immature female segment of a population would be available if hunting were restricted to deep water bayous, canals, and dredged natural water bodies. Data collected during Louisiana's 1972 experimental alligator season (Palmisano, Joanen, and McNease, 1973) tended to verify the assumptions presented above. Immature females constituted 29.6 percent of the immature size class of alligators harvested.

SUMMARY AND CONCLUSIONS

A telemetry study was conducted on Rockefeller Refuge from 27 March, 1973 through 5 March, 1974 to gather information on the movements and activity patterns of immature alligators. Seventeen females and 13 males were monitored during this period, involving 1,100 fixes.

Immature alligators were found to be consistently more active over a wider range of environmental conditions than were adult alligators.

Minimum home range sizes varied from 29.7 acres to 1,523.5 acres and averaged 438.6 acres for 15 immature female alligators. Immature males ranged from 60.6 acres to 1,493.8 acres and averaged 564.9 acres.

A comparison of daily movement data revealed that males and females exhibited the same trends in seasonal movements but that female movement was slightly greater than males for each season. Immature alligators showed a remarkable ability to traverse large distances in a relatively short time.

Habitat preference for males and females differed appreciably.

Management practices which would benefit immature alligators were determined to be: (a) proper control of water levels, (b) proper timing of impoundment drawdowns, (c) control of salt water intrusion, (d) stringent controls of harvest regulations to protect immature female alligators, (e) the interspersion of habitat types and topographical features within any given habitat type greatly affect utilization by alligators.

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IMMOBILIZATION OF WHITE-TAILED DEER WITH SUCCINYLCHOLINE CHLORIDE: SUCCESS RATE, REACTIONS OF DEER AND SOME PHYSIOLOGICAL EFFECTS

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ABSTRACT

A total of 276 attempts was made to immobilize white-tailed deer *(Odocoileus virginianus)* using succinylcholine chloride (SC). SC was injected in powder form by dart in 256 deer (mostly free-ranging) and in solution in 20 deer (all captive). Details of dose levels, age, sex, bodyweight, whether immobilized, time interval injection to immobilization and survival rates were recorded. For the SC solution injected animals, packed cell volumes (PCV) were recorded prior to and at several intervals after injection. Among those deer injected with powdered SC, a 64.1 percent capture rate was obtained (63.6 percent for adults, 65.5 percent for fawns). Fatalities were recorded in 8.6 percent of attempts with adults and in 13.8 percent of attempts with fawns. The non-lethal, successful, dose range for adults was 0.078 to 0.265 mg/kg. The lethal dose range for adults was 0.141 to 0.298 mg/kg; the lethal dose range for fawns was 0.176 to 0.229 mg/kg. Reaction times varied from less than one minute to 23 minutes (mean = 6.19 + 0.31 S.E.). For SC injected as a solution, mean knockdown time was 9.35 minutes (Range = 4 to 23 minutes). Time from knockdown to recovery average 37.5 minutes (Range = 19 to 86 minutes). All injections ranging from 3.8 to 6 mg SC in solution successfully induced immobilization. PCV's tended to drop after injection of SC.

INTRODUCTION

The ability to use remotely-injected drugs to capture live animals is useful to the wildlife manager and to the researcher. Many drugs are available for capture of wild animals. Among these succinylcholine chloride (SC) has proved useful and Liscinsky et al. (1969) have developed a relatively simple method for delivering the drug. Despite the fact that a large number of reports are available on the use of SC few data are available on effective and lethal dose rates for Cervidae. A review of available literature indicates the following are effective dose ranges (expressed in mg/kg): Moose *(Alces alces)*, 0.044 to 0.077 (Bergerud et al. 1964), 0.035 to 0.048 (Houston 1969); elk *(Cervus canadensis)*, 0.088 to 0.264 (Flook et al. 1962); caribou *(Rangifer tarandus)*, 0.055 to 0.143 (Bererud et al. 1964); red deer *(Cervus elaphus)*, 0.113 to 0.293 (Taylor and Magnussen 1965); black-tailed deer *(Odocoileus hemionus columbianus)*, 0.154 to 0.308 (Miller (1968); white-tailed deer *(Odcoileus virginianus)*, 0.033 to 0.119 (Pistey and Wright 1961); and fallow deer *(Dama dama)*, 0.066 (Pistsey and Wright 1959). The above relate to solutions of SC. Data are available on effective dose rates for