THE FOODS AND FEEDING HABITS OF ALLIGATORS FROM FRESH AND SALINE ENVIRONMENTS IN LOUISIANA

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ABSTRACT

Samples from fresh and saline waters in Louisiana showed little relation between foods eaten by young alligators and organisms available in these environments. Crustaceans were the principal foods in both freshwater and saline areas. Alligator stomachs from a freshwater area contained more than 6 times as much food as those from an adjacent saline area. The stomach capacity in the freshwater area was twice as great as in the saline area. The study suggests that young alligators which remain for extended periods in saline areas will have reduced growth rates as a result of reduced food intake.

INTRODUCTION

The American alligator (*Alligator mississipiensis*) occurs in various habitat types, including inland streams, lakes and ponds; river bottoms and swamps; and coastal marshes. Highest concentrations are generally found in freshwater areas (Chabreck, 1971); however, alligators are frequently found in saline waters in coastal areas.

While capturing and tagging alligators for growth studies, I have noticed that certain individuals were much lighter in weight than others of the same length, and suspected that the weight difference was related to the saline water conditions. One alligator captured in a saltwater canal was particularly sluggish and badly emaciated. The alligator was transferred to freshwater holding pen and within a day began accepting food. After one month, the alligator had regained the lost weight and could hardly be distinguished from others in the pen.

Alligators usually have their greatest growth rate during the first 5 or 6 years of life (McIlhenny, 1935); and vigorous, rapidly growing young depend on the availability and consumption of large amounts of food. This study was undertaken to compare foods and feeding habits of young alligators under fresh and saline conditions.

Food habit studies have been made on alligators in Louisiana by Kellogg (1929), McIlhenny (1935), O'Neal (1949), and Giles and Childs (1949). However, most data from immature and adult animals are grouped together. Also, no attempts were made to relate food availability and consumption to water salinity.

STUDY METHODS

Field Procedures

All animals were captured at night with a wire snare mounted on a long pole as described in an earlier report (Chabreck, 1963). Only immature alligators, less than 6 feet (1.8 m.) long, were used for this study. The alligators were taken as they were found and no attempts were made to select certain individuals.

Ten alligators were taken in a fresh area and 10 in a saline area. After capture the animals were killed, weighed, measured, sexed and their stomachs were removed; stomachs were tagged and preserved by freezing.

Aquatic populations in the collection area were sampled with a cast net, 8 feet (2.44 meters) in diameter and having 0.5-inch bar mesh (12 mm.). Ten net samples were taken at each collection location, and the specimens captured were preserved in formalin for future examination.

Laboratory Procedures

A small slit was made in the stomach and its contents removed and weighed. The volume of the stomach contents was measured by water displacement, and stomach capacity was determined by filling the stomach with measured amounts of water.

Since material removed from the stomach was in all stages of digestion, the identification of each individual particle was not possible, and the volume and weight of individual food items could not be ascertained. However, the number of individuals of each species occurring in the stomach was listed.

In order to determine the amount of each food item taken, I attempted to determine the weight of the particular item when eaten by the alligator. Weighing the parts found in the stomach was usually unsatisfactory, since most were badly multilated or partially digested. Therefore, the diet was reconstructed by measuring the length of remaining portions of individuals, then capturing live individuals of similar sizes for weight determinations.

The data on food consumption and stomach capacity were compared between the two areas using the t-test (Li, 1964).

DESCRIPTION OF THE AREA

Alligators taken for this report were collected on the Rockefeller Wildlife Refuge in southwestern Louisiana in August, 1967. The refuge is owned by the Louisiana Wild Life and Fisheries Commission and contains one of the highest known concentrations of alligators. The refuge borders the Gulf of Mexico and consists of coastal marshes with water salinities ranging from fresh to highly saline. Low salinities were recorded over most of the refuge earlier in the year, but increased in the tidal areas by late summer.

Most of the freshwater areas are marsh impoundments constructed as part of a waterfowl management program (Chabreck, 1960). These impoundments when flooded on a year-round basis, are very attractive to alligators. The freshwater study area was a shallow impoundment, having water 10 inches (25.4 cm) deep with a salt content of 0.6 ppt.

The saline area sampled was a canal adjacent to the impoundment and water salinites ranged from 3.2 to 16.1 ppt. This area was about 6 miles (10 km) inland from the Gulf of Mexico, but drained into the Gulf and provided a means of access for marine organisms.

RESULTS AND DISCUSSION

Size of Alligators Examined

The lengths of alligators taken for the study ranged from 34.0 inches (0.86 m.) to 66.7 inches (1.69 m.) and averaged 41.6 inches (1.06 m.) in the freshwater area (Table 1) and 45.7 inches (1.17 m.) in the saline area (Table 2). The weights of the animals examined were more variable and ranged from 1.31 kg. to 12.2 kg. Weights in the freshwater area averaged 3.4 kg. and in the saline area, 4.49 kg. Because of the variation in the sizes of alligators from both areas, no significant differences were found in the mean weights or lengths.

Food Items

Freshwater Area

Crawfish (*Procambarus clarki*) was the major freshwater food item of alligators examined during this study and made up 61.0 percent of the food eaten (Table 3). Although water bugs (Belostomatidae) ranked highest in total numbers eaten, the combined weight of 213 water bugs was less than 10 percent of the weight of 55 crawfish eaten by the same 10 alligators. Other invertebrates made up less than 1 percent of the diet in freshwater.

Fogarty and Albury (1967) examined the stomach contents of small alligators from freshwater in Florida and found that the ampullarid snail (*Pomacea paludosa*) comprised 65.8 percent of the stomach con-

TABLE 1. Body measurements of alligators from freshwater environment.

Total Length (Inches)	Sex	Live Weight (kg)	Weight Stomach Contents (Gr)	Stomach Capacity (ml)	Volume Stomach Contents (ml)	Water Salinity (ppt)
34.0 (0.86 m.)	M	1.32	21.5	38	21	0.6
35.0 (0.89 m.)		1.76	41.5	87	49	0.6
37.0 (0.94 m.)	M	2.09	49.8	66	44	0.6
37.0 (0.94 m.)	M	2.20	179.0	219	188	0.6
38.5 (0.98 m.)		2.42	21.1	63	26	0.6
42.7 (1.08 m.)	M	3.74	255.5	315	245	0.6
43.5 (1.10 m.)	M	3.52	54.5	89	65	0.6
45.0 (1.14 m.)	F	3.96	79.1	126	77	0.6
51.5 (1.31 m.)	M	6.37	188.4	268	187	0.6
51.5 (1.31 m.)	M	7.03	183.5	253	195	0.6
41.6 (1.06 m.)*		3.44*	107.4*	152.4*	109.7*	

* Average.

TABLE 2. Body measurements of alligators from saline environment.

Total Length (Inches)	Sex	Live Weight (kg)	Weight Stomach Contents (Gr)	Stomach Capacity (ml)	Volume Stomach Contents (ml)	Water Salinity (ppt)
35.0 (0.89 m.)	F	2.00	13.6	37	19	4.4
36.3 (0.92 m.)	M	2.00	18.5	40	18	4.4
37.3 (0.95 m.)	M	2.00	4.6	52	4	4.4
43.7 (1.11 m.)	M	3.41	0.4	35	0.5	4.4
44.5 (1.13 m.)	F	3.74	22.9	53	30	4.4
45.5 (1.15 m.)	F	4.34	63.8	98	52	16.1
46.3 (1.18 m.)	F	4.01	13.8	72	22	4.0
48.0 (1.22 m.)	F	4.34	5.8	64	12	16.1
53.5 (1.37 m.)	M	7.03	24.0	103	27	3.2
66.7 (1.69 m.)	F	12.31	8.3	208	14	3.2
45.7 (1.16 m.)*		4.52*	17.6*	76.2*	19.9*	

* Average.

tents. My study area was outside the range of this species, and no other gastropods were found in the stomach. They reported that the crawfish comprised 31.9 percent of the stomach contents and that although water bugs were found in a number of stomachs, they made up only a small percentage of the total food.

Giles and Childs (1949) examined the stomach contents of alligators of various sizes and from different water salinities on the Sabine National Wildlife Refuge in Louisiana. They reported that crawfish made up the bulk of the food of smaller alligators.

Vertebrates were important food items during my study in the freshwater area (Table 3). On a weight basis, vertebrates made up one-third of the food consumed and were found in 60 percent of the stomachs. Birds were the major items among the vertebrates consumed. Kellogg (1929), Giles and Childs (1949) and Fogarty and Albury (1967) reported that invertebrates made up a higher percentage of the food of small alligators than did vertebrates. Giles and Childs (1949) found that vertebrates were more common in the diet of large alligators than in small.

Saline Area

The diet of alligators collected in saline waters consisted primarily of crustaceans (Table 3). Half of the diet was composed of blue crabs

TABLE 3. Food items of alligators * from fresh and saline environments.

	Fresh				Saline			
	No. Eaten	Percentage Frequency	Mean Live Wt.(Gr)	Total Wt.(Gr)	No. Eaten	Percentage Frequency	Mean Live Wt.(Gr)	Total Wt.(Gr)
ARTHROPODA								
INSECTA								
Belostomatidae (Water bugs)	213	80	0.3	63.9	1	10	0.3	0.3
Coleoptera (Water beetles)	5	30	0.2	1.0	57	70	0.2	11.4
Mantidae (Praying mantis)	1	10	0.9	0.9	.	..	..	..
Nepidae (Water scorpion)	1	10	1.1	1.1	.	..	..	..
Unidentified pupa	1	10	0.3	0.3	.	..	..	..
Unidentified egg mass	2	20	0.5	1.0	.	..	..	..
CRUSTACEA								
Procambarus clarki (Crawfish)	55	100	13.5	742.5	5	30	5.7	28.5
Callinectes sapidus (Blue crab)	..	..	..	..	3	30	30.8	92.4
Uca pugnax (Fiddler crab)	..	..	..	..	4	30	6.2	24.8
Palaemonetes sp. (Grass shrimp)	1	10	0.2	0.2	.	..	..	..
ARACHNIDA								
Araneae (Spider)	4	40	0.4	0.4	.	..	..	..
CHORDATA								
AVES								
Cassidix mexicanus (Boat-tailed grackle)	1	10	145.0	145.0	.	..	..	..
Unidentified birds	2	20	96.0	192.0	.	..	..	..
REPTILIA								
Natrix sp. (Water snake)	1	10	1.8	1.8	.	..	..	..
OSTEICHTHYES								
Cyprinadon varigatus (Sheepshead minnow)	1	10	0.9	0.9	.	..	..	..
Pogonias cromis (Black drum)	..	..	..	..	1	10	28.7	28.7
Unidentified fish	1	10	0.9	0.9	.	..	..	..

* Includes 10 alligators from a freshwater area and 10 from a saline area.

(*Callinectes sapidus*), and about one-fourth was made up of crawfish and fiddler crabs (*Uca pugnax*). The remainder consisted of fish and insects. Insects were the most numerous items present and consisted almost entirely of coleoptera, mostly of the genus, *Dytiscus*.

These findings agree with the studies by Giles and Childs (1949) and O'Neal (1949) which were made in brackish marshes in Louisiana. In this particular environment, crustaceans were the main food of alligators and blue crabs were the major item eaten.

Comparison of Foods Between Areas

Crustaceans were the major food of small alligators in both fresh and saline environments. Crawfish was the most abundant food item in the freshwater area and blue crabs in the saline. Insects were common in the stomach contents from both areas; however, the small size of individuals in this group resulted in the low total weight of insects.

Vertebrates were more abundant in the diet from the freshwater area. Vertebrate remains were found in 60 percent of the alligators from freshwater areas and in only 10 percent of those from saline waters.

Food Availability

Birds and mammals were abundant in the study area during the time that the collections were made; however, no attempt was made to determine population levels. The area has a very large bird population in winter, but at the time of the study, migratory birds were at a minimum. Palmisano (1968) described bird usage and reported that many species nest in the area.

Rodents were the most abundant group of mammals with the rice rat (*Oryzomys palustris*), muskrat (*Ondatra zibethica*) and nutria (*Myocastor coypus*) as common representatives. Swamp rabbits (*Sylvilagus aquaticus*) and raccoons (*Procyon lotor*) were other mammals common to the area. The study areas were adjacent, and no differences were noted in the bird and mammal populations. I believe that alligators in the two areas had an equal opportunity to capture them for food.

Amphibians and reptiles were abundant in the freshwater area, but no sampling was done to determine the relative abundance of the various species. Populations in the saline area were minimal.

Cast net samples showed considerable variation in aquatic fauna (Table 4). Animal mass, on a weight basis, was over twice as abundant in the saline waters sampled as in the fresh. Of the 16 species taken, only the striped mullet was captured in both areas. Also, sampling showed that this was the major species in both areas.

Quantity of Stomach Contents

Both weight and volumetric measurements were made of the food contained in each stomach (Tables 1 and 2). The results of these measurements were very similar and show a highly significant difference ($P < 0.01$) in food intake between the two groups of animals. The stomachs of alligators feeding in the freshwater area contained about 6 times the amount of food as those in the saline area. Stomach contents from alligators in fresh conditions averaged 107.4 grams of material and those from saline only 17.6 grams.

Stomach Capacity

Although the sample included alligators of similar sizes from both fresh and saline environments, significant differences ($P<0.05$) were found between the stomach capacities of the two areas. Stomach capacities in the freshwater area were twice those of the saline area, averaging 152.4 ml. and 76.2 ml. respectively (Tables 1 and 2).

The capacity of the stomach is generally considered indicative of the level of food intake. Tamate, *et al.* (1962) found that the stomach capacity of dairy calves fed a concentrated diet was less than one-half the capacity of calves fed a bulky diet.

TABLE 4. Aquatic fauna captured in cast net samples of fresh and saline environments.

Species	Fresh No. Captured	Fresh Mean Live Wt. (Gr)	Fresh Total Wt. (Gr)	Saline No. Captured	Saline Mean Live Wt. (Gr)	Saline Total Wt. (Gr)
CRUSTACEA						
Cambarellus sp. (Crawfish)	5	0.26	1.3	.	. . .	. .
Palaemonetes sp. (Grass shrimp)	18	0.22	4.0	.	. . .	. .
Penaeus setiferus (White shrip)	.	. . .	. .	7	7.34	51.4
Callinectes sapidus (Blue crab)	.	. . .	. .	3	2.97	8.9
INSECTA						
Belastomatidae (Water bug)	3	0.18	0.5	.	. . .	. .
Libellulidae (Dragonfly numph)	2	0.26	0.5	.	. . .	. .
Coenagrionidae (Damsefly numph)	1	0.04	0.1	.	. . .	. .
Dytiscidae (Water beetles)	2	0.07	0.1	.	. . .	. .
OSTEICHTHYES						
Menidia beryllina (Tidewater silverside)	1	0.38	0.4	.	. . .	. .
Cyprinodon variegatus (Sheepshead minnow)	1	0.84	0.8	.	. . .	. .
Mugil cephalus (Striped mullet)	1	114.30	114.3	4	57.75	231.0
Gambusia affinis (Mosquitofish)	24	0.14	3.4	.	. . .	. .
Brevoortia patronus (Menhaden)	.	. . .	. .	7	4.71	33.0
Archosargus probatocephalus (Sheepshead)	.	. . .	. .	1	7.80	7.8
Anchoa mitchilli (Bay anchovy)	.	. . .	. .	1	0.91	0.9
Micropogon undulatus (Atlantic croaker)	.	. . .	. .	1	9.72	9.7
TOTAL	58	. . .	125.4	24	. . .	342.7

The smaller stomach capacity of alligators from the saline environment suggests that the lower level of food intake, as found when the collections were made, had been going on for some time.

SUMMARY AND CONCLUSIONS

Species captured with the cast net were, in general, the same as those found in the alligator stomachs. However, stomach content analysis suggests differential vulnerability among species or selectivity by alligators, since animals did not appear in the same ratios in the net samples as in the stomach content.

Crawfish (*Procambarus clarki*) were noticeably absent in the cast net samples, yet made up a large portion of the stomach contents. The data suggest that this species was low in availability, but highly vulnerable to feeding alligators. Also, alligators may have been very selective for crawfish. Water bugs (Belostomatidae) were possible in this same category.

Although statistical analysis showed no significant differences in the mean length and weight of alligators from fresh and saline environments, food consumption and stomach capacities were significantly greater in the fresh area. However, water salinities began increasing in the saline area only a short time prior to the study, and the weights at the time of collection may still have reflected the effects of freshwater conditions. Also, it is possible that the alligators had recently arrived at the saline area when collected.

Growth is greatly affected by the quality and quantity of food consumed, and if the food consumption rate shown by alligators in the fresh area can be considered normal, animals remaining under saline conditions for extended periods should have reduced growth rates and possibly weight losses.

Most animals have a definite range of water salinity tolerance and can survive out of this range for only short periods. The cast net samples during this study showed almost completely different species in the different environments (Table 4). The literature contains very little information on the effects of various salinity levels on food consumption and growth in animals. Weeth and Heverland (1961) experimented with young cattle and found that food intake was significantly reduced when they were placed on drinking water having sodium chloride content greater than 12.0 ppt. They did not speculate as to possible reason other than the loss of appetite.

The reason for the reduced alligator food intake in the saline area is not fully understood. Food availability did not appear to be a problem. Items found in the stomach were abundant in the saline waters, particularly blue crabs and fishes. The study suggests that even at low water salinity levels, physiological changes occur within young alligators which result in reduced feeding.

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A NEW METHOD FOR CAPTURING ALLIGATORS USING ELECTRICITY

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ABSTRACT

A study was initiated on Rockefeller Wildlife Refuge in order to investigate the possibility of using an electrical current as an aid in capturing alligators. A modified 110-220 volts-A.C. fish shocking unit and a 110-220 volts-D.C. pulsating unit were used in this study.

Best results were obtained with the 110-220 volts-D.C. pulsating unit. This method is limited to areas of low water salinity and best results were obtained when the animal was partially exposed and the unit could be applied directly. Mortality occurred where alligators were repeatedly shocked and also if the prod was applied to the under surface of the stomach. The best results were obtained by applying the shock to the side of the neck just anterior to the front legs. Alligators were completely immobilized for approximately 15-25 minutes.

Field test were limited as the unit was found to be greatly affected by salinity.

INTRODUCTION

Methods of capturing alligators have been previously described by Chabreck (1963) and Jones (1965). The method described by Chabreck has been successfully employed on wild alligators at Rockefeller Wildlife Refuge, Grand Chenier, Louisiana. Over a ten-year period, approximately 2,500 animals ranging in length from 3 to 12½ feet have been captured using this method. However, alligators in our display pens and those in confinement have always been difficult to catch using this method. Capturing alligators in concrete pools usually results in much damage to the alligator, danger to the handlers, and is often time consuming. This was especially true while handling extremely large alligators in close confinement and under crowded conditions.

Due to the problems involved in capturing large animals, a method using various types of electrical current was tried in order to immobilize alligators for short periods of time. This permitted the handlers time to capture the animal and remove him from the pen with no serious damage to the animal or the handlers.

The field and tank studies were conducted on Rockefeller Refuge. The marshes of the refuge, excluding the salt marsh, support good populations of alligators. Also, approximately 20 alligators ranging in length from two to twelve feet were maintained in tanks as display animals at the main headquarters site.

MATERIALS

The units used in the alligator shocking trials were modified forms of A.C. (Alternating Current) and D.C. (Direct Current) fish shockers.