

ALLIGATOR DIETS IN RELATION TO MARSH SALINITY

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Abstract: Three hundred and fourteen large alligators (*Alligator mississippiensis*) collected in the marshes of southwest Louisiana in conjunction with 1972 and 1973 autumn hunting seasons were examined for food contents. Foods were categorized by year and by marsh type. Vertebrates were the most important foods consumed, of which mammals comprised the largest percentage by weight. Arthropods and fish were important foods in the more saline areas. Thirteen percent of the adult females contained alligator eggs or egg shells in their stomach.

Proc. Annual Conf. S.E. Assoc. Fish & Wildlife Agencies 31:36-40

The underlying theme in the development of Louisiana's long range alligator management program features a closely controlled harvest providing landowners with an economic incentive to protect and maintain quality marshlands. The 1972 and 1973 harvest programs allowed almost unlimited potential for obtaining fresh carcasses for scientific study. Our study reports food contents found in two series of stomachs collected on successive years and comprised almost wholly of adult alligators (>1.8 m total length).

General alligator food habit investigations have been conducted in Louisiana by Kellogg (1929), McIlhenny (1935), O'Neil (1949), Giles and Childs (1949), and Valentine et al. (1972). However, these studies did not relate marsh types to food consumption nor present data solely for adult size class animals.

We wish to thank all who worked to make this project successful. Field assistance was provided by a number of Louisiana Department of Wildlife and Fisheries personnel, Louisiana Tech University students, and Federal Refuge personnel. W. Guthrie Perry deserves special credit for collecting a large number of field samples and for identifying fish and arthropods.

METHODS AND MATERIALS

Alligator stomachs were collected from Cameron Parish in 1972. This area encompassed over 200,000 ha of coastal marsh. The hunt and data collecting area was extended in 1973 to include the parishes of Cameron, Calcasieu, and Vermillion, covering slightly less than 400,000 ha. The area was bounded by the Gulf of Mexico to the south, Texas state line to the west, Vermilion Bay to the east and the Intracoastal Canal to the north. Approximately 100,000 alligators inhabited the privately owned property open to hunting.

The vegetative type classification of brackish, intermediate, and fresh as described by Chabreck (1970) was used as a means of marsh classification. Generally, the brackish marsh was located nearer the Gulf of Mexico and experienced higher salinity levels than did the other two types. The intermediate marsh generally was a band separating fresh from brackish. Fresh marshes lie further inland and are not usually affected by tidal action.

Two series of stomachs were collected, 202 in 1972 and 112 in 1973. All were taken from freshly killed hunter harvested alligators. Whole body weights and total body lengths were taken prior to skinning. After skinning was completed, the stomach was removed, tagged, and preserved by either freezing or injection and immersion with a formalin solution.

Stomach contents were removed, weighed, and volumetrically measured by water displacement. The contents were separated by individual food items. Then the weight and displacement of individual food items were recorded. We chose to present our data by percentage weight and percent frequency of occurrence. Volumetric measurements were determined but were not used in analyses. Our data, also supported by Chabreck (1971) showed that weight and volumetric measurements were similar. An average of four man-hours was required to complete the laboratory work and record keeping for each stomach.

Major criteria used for mammal identification were hair characteristics, skull characters, dental formulae, and in some instances feet or nail characteristics. A microscopic slide collection of known mammal hairs were prepared for hair identification. References used to identify mammals included Stains (1958), Mathiak (1938), and Schwartz and Schwartz (1959).

Rainfall data were collected at the Rockefeller Refuge headquarters weather station.

RESULTS

The average length of all alligators included in this study was 2.2 m. Eighteen percent were immature (<1.8 m), with the majority of immatures being in the 1.5 m - 1.7 m class. No appreciable differences were found in mean lengths among marsh types or between years. Females comprised 24 percent of the sample.

Twenty percent of the 314 animals examined were shot free swimming. The majority (80 percent) were taken by baited hook and line, a factor which contributed a slight bias to our data. The favorite baits used were grackles (*Cassidix mexicanus*) and black birds (*Agelaius phoeniceus*). Shad (*Dorosoma* sp.) and mullet (*Mugil cephalus*) were used to a lesser degree in one brackish marsh area. Therefore, the percentage of these species in the diet are overstated. We attempted to delete bait items from the analysis but it was impossible to differentiate prey from bait.

Rainfall totaled 63.2 cm for the June-September period in 1972, 6.6 cm above average for the quarter. Rainfall in 1973 was much greater, 85.8 cm for June-September or 29.2 cm above average.

Food Items

This report only involves autumn foods consumed. Chabreck (1971) reported little relation between foods eaten by young alligators and organisms available. We did not relate food availability to food consumption because of Chabreck's findings and the extreme size (400,000 ha) of our study area.

Food items from stomachs in the fresh marsh average 552 g, in the intermediate 531 g, and in brackish 224 g.

Fresh Marsh. Mammals were the major food items eaten by alligators in the freshwater areas, with nutria (*Myocastor coypus*) being the most important species represented (Tables 1 and 2). Seventy-two percent of the stomachs contained mammals in

Table 1. Foods found in 202 alligator stomachs taken from three marsh types of southwest Louisiana, September 1972.

Type Food	Fresh Marsh (72)			Intermediate Marsh (53)			Brackish Marsh (75)		
	Frequency	Percent	Weight	Frequency	Percent	Weight	Frequency	Percent	Weight
Mammals	72.2	79.1	49.1	40.6	22.7	20.7			
Nutria (<i>Myocastor</i>)	65.9	65.6	41.8	25.7	22.7	20.7			
Mink (<i>Mustela</i>)	2.8	0.2	1.8	2.5	0	0			
Rabbit (<i>Sylvilagus</i>)	1.4	2.8	7.3	2.0	0	0			
Muskrat (<i>Ondatra</i>)	6.9	1.8	0	0	0	0			
Raccoon (<i>Procyon</i>)	4.2	7.6	7.3	2.4	0	0			
Opossum (<i>Didelphis</i>)	0	0	1.8	0.2	0	0			
Armadillo (<i>Dasypus</i>)	1.4	1.1	1.8	7.7	0	0			
Deer (<i>Odocoileus</i>)	0	0	1.8	0.1	0	0			
Rice rat (<i>Oryzomys</i>)	1.4	Tr.	0	0	0	0			
Birds	44.4	8.6	50.9	9.5	14.7	4.6			
Grackle (<i>Cassidix</i>)	11.1	1.2	27.2	7.2	4.0	2.5			
Blackbird (<i>Agelaius</i>)	22.2	1.1	9.1	0.6	0	0			
Common gallinule (<i>Gallinula</i>)	1.4	Tr.	5.5	Tr.	1.3	1.0			
Least bittern (<i>Ixobrychus</i>)	0.4	0	0	0	1.3	0.5			
Green heron (<i>Butorides</i>)	1.4	Tr.	1.8	Tr.	1.5	0.8			
Purple gallinule (<i>Porphyryula</i>)	0.3	0	1.8	1.6	0	0			
Birds, unidentified	8.3	0.9	7.2	0.1	6.8	Tr.			
Reptiles and amphibians	35.3	1.5	36.4	2.5	9.8	1.0			
Mud turtle (<i>Kinosternon</i>)	0	0	1.8	Tr.	1.3	0.1			
Cooter turtle (<i>Pseudemys</i>)	0	0	5.6	0.1	0	0			
Turtles, unidentified	11.1	0.1	1.8	Tr.	2.7	Tr.			
Water snakes (<i>Natrix</i>)	16.7	0.6	7.3	1.3	4.0	Tr.			
Cottonmouth (<i>Achirostodon</i>)	1.4	Tr.	0	0	0	0			
Ribbon snake (<i>Thamnophis</i>)	0	0	1.8	Tr.	0	0			
Brown snake (<i>Storeria</i>)	1.4	Tr.	1.8	Tr.	0	0			
Mud snake (<i>Furcraea</i>)	1.4	0.1	0	0	0	0			
Snakes, unidentified	9.7	Tr.	10.9	Tr.	1.3	Tr.			
Alligator parts	1.4	0.7	1.8	0.7	0	0			
Alligator eggs	1.4	Tr.	7.3	0.4	2.7	0.9			
Bullfrog (<i>Rana</i>)	0	0	3.6	Tr.	0	0			
Fish	25.0	4.8	36.4	12.6	58.7	33.2			
Mullet (<i>Mugil</i>)	2.8	1.1	1.8	Tr.	14.7	11.0			
Catfish (<i>Ictalurus</i>)	0	0	1.8	0.3	1.3	0.6			
Garfish (<i>Lepisosteus</i>)	8.3	2.2	9.1	5.7	2.7	0.4			
Bowfin (<i>Amia</i>)	0	0	1.8	3.5	2.7	0.5			
Shad (<i>Dorosoma</i>)	5.6	0.8	1.8	1.4	15.3	12.1			
Sheepshead minnow (<i>Cyprinodon</i>)	0	0	1.8	Tr.	5.3	0.5			
Anchovy (<i>Anchoa</i>)	0	0	1.8	Tr.	4.0	0.5			
Drum (<i>Aplodinotus</i>)	0	0	16.4	1.6	0	0			
Drum (<i>Pogonias</i>)	0	0	0	0	1.3	Tr.			
Menhaden (<i>Brevoortia</i>)	0	0	0	0	5.3	5.0			
Sailfin molly (<i>Mollisnesia</i>)	0	0	0	0	2.7	Tr.			
Silversides (<i>Atherinidae</i>)	0	0	0	0	2.7	Tr.			
Fishes, unidentified	11.1	0.7	12.7	0.1	24.0	5.0			
Arthropods	80.6	6.3	80.0	15.5	86.7	30.7			
Crawfish (<i>Procambarus</i>)	51.4	2.8	32.7	2.5	30.7	2.0			
Blue crab (<i>Callinectes</i>)	19.4	3.5	56.4	13.0	80.0	28.4			
Fiddler crab (<i>Uca</i>)	0	0	1.8	Tr.	0	0			
Shrimp (<i>Penaeus</i>)	2.8	Tr.	1.8	Tr.	16.0	0.1			
Shrimp (<i>Palaemonetes</i>)	2.8	Tr.	1.8	Tr.	2.7	Tr.			
Insects and spiders	30.6	Tr.	12.7	Tr.	22.7	0.2			
Mollusks	6.9	Tr.	5.4	0.1	1.3	Tr.			
Gastropods	6.9	Tr.	3.6	0.1	0	0			
Clam (<i>Rangia</i>)	0	0	1.8	Tr.	1.3	Tr.			
Plant material	94.4	3.2	74.5	6.1	88.0	7.7			
Non-foods	41.7	0.6	21.8	12.5	53.3	1.5			
Unidentifiable debris	20.8	0.9	3.6	0.6	5.3	0.6			

Table 2. Foods found in 112 alligator stomachs taken from three marsh types of southwest Louisiana, September 1973.

Type Food	Fresh Marsh (67)			Intermediate Marsh (34)			Brackish Marsh (11)		
	Frequency	Percent	Weight	Frequency	Percent	Weight	Frequency	Percent	Weight
Mammals	53.7		64.9	55.9		61.7	63.6		42.0
Nutria (<i>Myocastor</i>)	49.3		55.5	47.1		56.4	54.5		42.0
Mink (<i>Mustela</i>)	1.5		2.8	5.9		Tr.	0		0
Rabbit (<i>Sylvilagus</i>)	1.5		3.2	2.9		3.5	0		0
Muskrat (<i>Ondatra</i>)	0		0	5.9		1.0	9.1		Tr.
Raccoon (<i>Procyon</i>)	0		0	5.9		0.8	0		0
Opossum (<i>Didelphis</i>)	3.0		3.4	0		0	0		0
Birds	49.3		4.5	58.8		9.7	9.1		0.6
Crackle (<i>Cassidix</i>)	32.8		2.8	38.2		6.8	0		0
Blackbird (<i>Agelaius</i>)	14.9		1.5	3.8		1.1	9.1		0.6
Common gallinule (<i>Gallinula</i>)	1.5		0.2	0		0	0		0
Mottled duck (<i>Anas</i>)	0		0	5.9		1.0	0		0
Purple martin (<i>Progne</i>)	0		0	2.9		0.3	0		0
Blue jay (<i>Cyanocitta</i>)	0		0	2.9		0.5	0		0
Birds, unidentified	3.0		Tr.	5.9		Tr.	0		0
Reptiles	38.8		2.9	44.1		2.7	27.3		4.9
Mud turtle (<i>Kinosternon</i>)	20.9		0.8	26.5		1.5	27.3		1.2
Turtles, unidentified	3.0		Tr.	2.9		Tr.	0		0
Water snakes (<i>Natrix</i>)	9.0		1.6	5.9		Tr.	9.1		1.7
Cottonmouth (<i>Aghistrodon</i>)	1.5		0.1	0		0	0		0
Ribbon snake (<i>Thamnophis</i>)	0		0	0		0	9.1		2.0
Snakes, unidentified	10.4		0.1	3.8		0.2	0		0
Alligator eggs	3.0		0.3	2.9		1.0	0		0
Fish	94.3		5.8	47.1		5.5	54.5		20.5
Mullet (<i>Mugil</i>)	6.0		1.0	14.7		1.7	27.3		16.6
Catfish (<i>Ictalurus</i>)	11.9		2.2	2.9		0.2	0		0
Garfish (<i>Lepisosteus</i>)	4.4		0.3	2.9		1.4	0		0
Bowfin (<i>Amia</i>)	3.0		0.6	2.9		0.7	0		0
Sunfish (<i>Lepomis</i>)	6.0		1.5	2.9		1.1	0		0
Shad (<i>Dorosoma</i>)	0		0	2.9		0	9.1		2.1
Sheepshead minnow (<i>Cyprinodon</i>)	0		0	0		0	9.1		0.4
Anchovy (<i>Anchoa</i>)	0		0	0		0	9.1		0.4
Fishes, unidentified	9.0		0.2	20.6		0.4	27.3		1.0
Arthropods	94.0		12.8	97.1		13.4	90.9		23.8
Crawfish (<i>Procambarus</i>)	91.0		11.7	97.1		12.3	90.9		10.2
Blue crab (<i>Callinectes</i>)	13.4		1.0	17.6		1.1	27.3		2.4
Fiddler crab (<i>Uca</i>)	0		0	2.9		Tr.	0		0
Shrimp (<i>Penaeus</i>)	0		0	5.9		Tr.	9.1		11.0
Shrimp (<i>Palaemonetes</i>)	1.5		Tr.	2.9		Tr.	9.1		0.2
Insects and spiders	28.4		0.1	17.6		Tr.	0		0
Snails	4.5		Tr.	0		0	0		0
Plant material	67.2		4.4	67.6		1.5	81.8		6.3
Non-foods	25.4		0.3	20.6		0.4	9.1		Tr.
Unidentifiable debris	7.5		4.3	17.6		5.1	9.1		1.9

1972 making up 79 percent of the total weight and 54 percent contained mammals in 1973 accounting for 65 percent of the weight. Mink (*Mustela vison*), rabbit (*Sylvilagus aquaticus*), muskrat (*Ondatra zibethicus*), and opossum (*Didelphis virginiana*) were represented both years. Raccoon (*Procyon lotor*), armadillo (*Dasyfus novemcinctus*), and rice rats (*Oryzomys palustris*) were represented only in 1972.

Arthropods followed mammals in importance both years. Eighty-one percent in 1972 and 94 percent in 1973 contained arthropods although by weight they amounted to 6.3 and 12.8 percent. Crawfish (*Procambarus clarki*) and blue crabs (*Callinectes sapidus*) made up the bulk of the volume present. Insects, while occurring frequently made up only trace amounts volumetrically.

Fish were found in 25 percent of the samples in 1972 (4.8% by weight) and 34 percent (5.8% by weight) in 1973. Gar (*Lepisosteus* sp.), mullet, and shad were the only identifiable species represented in 1972. Catfish (*Ictalurus* sp.) mullet, sunfish (*Lepomis* sp.), gar, and bowfin (*Amia calva*), in order of frequency were important in 1973.

Birds were identified in 44 and 49 percent for 1972 and 1973 respectively. However, percentage by weight was rather small, about 4 percent each year. The presence of birds used as bait precluded a detailed listing of species.

Reptiles were fairly well represented, 33 percent occurrence and 1.5 percent by weight for 1972 and 39 percent occurrence and 3 percent by weight for 1973. Snakes were more prevalent both years than were turtles. Alligator eggs were found in the stomachs of 3 mature females.

Plant material was found in a large percentage of the stomachs, 94 percent in 1972 and 67 percent in 1973 and accounted for 3 and 4 percent of the total weight.

Intermediate Marsh. The diet of alligators in the intermediate marsh closely resembled that determined for the fresh marsh. The order of importance was mammals, arthropods, fish, birds, and reptiles.

Mammals were more important in 1973 when nutria accounted for 56 percent of the weight of foods examined. There was a lesser dependence on nutria (26% by weight) in 1972, compensated for by a larger representation of different mammalian species and more evenly distributed frequency of occurrence. White-tailed deer (*Odocoileus virginianus*) was recorded for one stomach in 1972.

Arthropods made up 16 percent in 1972 and 13 percent in 1973 of the diets by weight and occurred in 80 and 97 percent of the stomachs respectively. Blue crabs were more important in 1972 while crawfish made up 92 percent of the arthropods in 1973.

Fish ranked higher in weight and occurrence than in the fresh marsh. The same species as listed for the fresh marsh were found in the intermediate with the addition of three species, sheepshead minnow (*Cyprinodon variegatus*), anchovy (*Anchoa* sp.), and drum (*Aplodinotus* sp.).

Birds comprised 10 percent of the list by weight each year and were found in over one-half of the stomachs. It should be restated that birds were used heavily as bait.

Reptiles were found in about the same order of occurrence and percentage weight as for the fresh marsh. One bullfrog (*Rana catesbeiana*), the only amphibian identified in 314 stomachs, was found in 1973. Alligator eggs were discovered in 5 alligators, all mature females.

Plant material was found in 75 percent of stomachs in 1972 and 68 percent in 1973 and comprised 6 and 2 percent by weight.

Non-foods ranked high in 1972, 22 percent frequency and 13 percent by weight. One very large "garbage dump" alligator had no items of any food value in his stomach but ate vast quantities of plastics, jars, metal objects, pillow stuffing, and miscellaneous debris. This one animal significantly exaggerated non-food representation.

Brackish Marsh. Mammals were not as important in the more saline areas when compared to fresh or intermediate marshes. Nutria was the only mammal found in 1972, occurring in 23 percent of the stomachs and accounting for 21 percent by weight. Mammals were detected in 64 percent of the 1973 samples and accounted for 42 percent by weight. Nutria made up the bulk with muskrat being found as a trace in only one alligator.

Arthropods ranked second to mammals in weight and were higher in frequency of occurrence. Blue crabs were the most important species in 1972 (60% frequency and 28% by weight). Crawfish occurred in 91 percent for 1973 and were fairly high in weight (10%). White shrimp (*Penaeus setiferus*) and blue crabs followed crawfish in order of occurrence.

Fish were third in importance in brackish marshes. In 1972, 59 percent contained fish which amounted to 33 percent of their diet by weight. Fish were not as important in 1973 but still rated 20 percent by weight and 55 percent by frequency of occurrence. Four species of saltwater fishes in addition to the types found in the intermediate marshes were catalogued for brackish marshes.

Reptiles ranked above birds in 1973, exactly opposite for 1972. Reptiles were low in frequency of occurrence (9%) and percentage weight (1%) in 1972 and moderate in 1973, 27 and 5 percent respectively. Two adult females contained alligator eggs in their stomachs. Birds were found in 15 percent in 1972 and comprised 5 percent by weight. In 1973, birds were found in 1 of 11 samples and made up less than 1 percent by weight.

Plant material was higher in occurrence (88 and 82%) and percentage weight (8 and 6%) than for either fresh or intermediate marshes.

DISCUSSION

Our basic conclusion is that larger size alligators prefer vertebrates although they will eat about anything available to them. Mammals in general and nutria in particular rated number one as prey species. Alligators exhibit opportunistic selectivity in their eating habits tempered by prey species vulnerability and availability.

Non-food items occurred in 29 percent of the stomachs and were more prevalent in 1972 when marsh water levels were normal.

Water levels were about average in 1972 and greatly above average in 1973. The high water in 1973 resulted in oxygen depletions and massive fish die-offs. Surprisingly, fish were more heavily used in 1972 than in 1973, when tremendous numbers of dead fish were available. The high water in 1973 displaced mammals, reptiles, and amphibians from their usual niches and probably affected the availability of arthropods by dispersing them. Fewer species of mammals were represented in 1973 stomachs.

Data collected in 1972 indicated a direct correlation between foods taken and marsh type. Vertebrates made up 89 percent by weight of the foods represented from the fresh marsh, 65 percent from intermediate and 59 percent from brackish marshes. Crustacean representation was directly proportional to marsh water salt content—brackish—31 percent, intermediate—16 percent, and fresh—6 percent.

Vertebrates comprised 78 percent by weight of foods identified from the fresh marsh, 80 percent from intermediate, and 68 percent from brackish marshes in 1973. Crustaceans accounted for 13 percent, 13 percent, and 24 percent respectively for the fresh, intermediate, and brackish marshes.

The absence of popular game fish species in alligator diets should relieve sports-fishermen who have voiced concern that alligators might deplete game fish populations. Indications are that these fast swimmers are not vulnerable as prey species.

Conversely, trappers' concerns that alligators take a considerable amount of furbearers were confirmed by this study. The predator-prey relationship is not well understood relative to prey species population structure.

The revelation that 13 percent of adult female stomachs contained alligator eggs, egg shells, or well-formed young holds special significance and deserves further study. Males contained no alligator eggs in their stomachs. Field observations of reproductive tracts conducted in conjunction with the food habit study indicated that females which nested for the year in question as well as non-productive females contained eggs and/or shell remnants in their stomachs. The fact that nesting females normally open the nest and liberate the young is well documented, although the degree of maternal behavior exhibited by the parent is not fully understood. The contribution of non-nesting females to nest opening is poorly understood.

The frequency of occurrence of plant material was consistently high both years and in all marsh types and probably was a byproduct of grasping for carnivorous type fare. Vegetation accounted for 5 percent of the weight of all items eaten.

LITERATURE CITED

- Chabreck, R. H. 1970. Marsh zones and vegetative types in the Louisiana coastal marshes. Unpubl. Ph.D. Dissertation, La. State Univ., Baton Rouge. 113 pp.
- 1971. The foods and feeding habits of alligators from fresh and saline environments in Louisiana. Proc. Annual Conf. Southeastern Assoc. Game and Fish Comm. 25:117-124.
- Giles, L. W., and V. L. Childes. 1949. Alligator management on the Sabine National Wildlife Refuge. J. Wildl. Manage. 13(1):16-28.
- Kellogg, R. 1929. The habits and economic importance of alligators. U.S. Dept. Agr. Tech. Bull. 147. 36 pp.
- Mathiak, H. A. 1938. A key to hairs of the mammals of southern Michigan. J. Wildl. Manage. 2(4):251-268.
- McIlhenny, E. A. 1935. The alligator's life history. The Christopher Publishing House, Boston. 117 pp.
- O'Neil, T. 1949. The muskrat in the Louisiana coastal marshes. Louisiana Wildlife and Fisheries Comm., New Orleans. 152 pp.
- Schwartz, C. W., and E. R. Schwartz. 1959. The wild mammals of Missouri. The Univ. of Missouri Press, Kansas City. 341 pp.
- Stains, H. J. 1958. Field key to guard hair of middle western furbearers. J. Wildl. Manage. 22(1):95-97.
- Valentine, J. M., J. R., Walther, K. M. McCartney, and L. M. Ivy. 1972. Alligator diets on the Sabine National Wildlife Refuge, Louisiana. J. Wildl. Manage. 36(3):809-815.