FOOD HABITS, GROWTH, AND MORTALITY IN NESTING MARSH HAWKS

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INTRODUCTION

The Marsh Hawk, *Circus cyaneus hudsonius*, is one of the most common of the birds of prey. It can be found living in marsh areas throughout most of the United States. This hawk is the only member of the group known as harriers that can be found living in North America.

In the early spring of 1961, a study was undertaken of some marsh hawks which were nesting in Washington County, New York. This study consisted of three main parts. The first portion of the study was on mortality rates among eggs and nestlings. The second phase of the study was to determine the growth rate of young marsh hawks during nest life. The last part of the study was to determine the type and quantity of food being fed to the nestlings by the adult female.

A review of the literature on marsh hawks revealed that many studies have been made on the food habits of this species. Most researchers agree, however, that the food habits vary greatly according to the prey species available, the season and the locality. The literature on mortality rates is limited, and literature on systematic growth-rate studies seems to be lacking entirely.

THE STUDY AREAS

The study took place in two marshes located in Washington County, New York. Most of the data was acquired in Wood Creek marsh which is located in Kingsbury Township. The more exact location of this marsh is 43 degrees, 19 minutes, 15 seconds, north latitude and 73 degrees, 31 minutes, west longitude. The nearest obvious landmarks are the Champlain Canal, which borders the northwest side, and Wood Creek, which borders the east side of the marsh.

A lesser amount of data was acquired in Dead Creek marsh, which is located in Argyle Township at 43 degrees, 17 minutes, north latitude and 73 degrees, 31 minutes, 30 seconds, west longitude.

Wood Creek marsh was the location for the growth-rate and food-habit studies. Marsh hawk nests from both marshes were utilized in the mortality study.

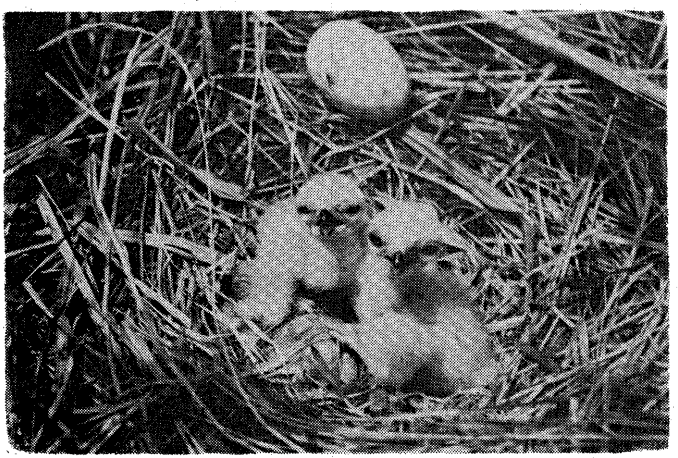
Both marshes appeared to be in the same approximate stage of succession. The water level was low and open water could be seen in very few places. The greater area of each marsh consisted of dead, wind-blown cattails (*Typha*) and scattered growths of *Spirea*. Underneath the dead cattails, the mud varied from a few inches to about two feet in depth. The wetter areas contained a new growth of cattails which were green and erect. The water level in the area of the growing cattails varied from a few inches to about fifteen inches in depth.

The four nests studied in Wood Creek marsh were arranged in a north-south line. The distance between nests varied from approximately forty to about two hundred yards.

The remaining two nests used in this study were approximately one hundred and fifty yards apart on an imaginary east-west line in Dead Creek marsh.

MATERIALS AND METHODS

The study concerning the mortality rate among eggs and young was begun on May 21, 1961. The first of six nests was discovered on that date, and each was kept under weekly observation from time of discovery until it was destroyed or until the young attained flight. On each trip to the marsh, a record was made of the number of healthy-looking eggs present, the number of eggs destroyed or missing, the number of young present and alive, and the number of young dead or missing. In this manner, egg and young losses were recorded shortly after they occurred.



The predator becomes the prey. This is nest #3 located in Wood Creek Marsh and included in the mortality study. It was completely destroyed after three of the six eggs therein had hatched.

The growth rate study was made on four young hawks living in one of the nests (nest 5) used in the mortality study. Daily visits were made to this nest as the eggs approached hatching. When each hawk was one day old, daily weights and measurements were begun and repeated approximately every twenty-four hours. After each nestling reached the age of 14 days, daily measurements were discontinued and replaced by less frequent weight and measurement taking. All measurement taking ceased after July 22nd because the three oldest birds flew away and the fourth was found dead.

The indvidual weights were recorded in grams. A triple beam balance was used. At first the young could be easily weighed by placing them on the platform of the scale. As they became more active it was necessary to place them in containers to be weighed. Each day, the container was weighed and this weight was subtracted from the totals.

All linear measurements were recorded in millimeters and made with the aid of simple tools such as calipers, dividers, a wooden board, and a meter stick.

Measurements were made of each bird's length, and this was considered to be the distance from the tip of the bill to the tip of the longest rectrix (or pygostyle, before the tail feathers began to grow). To accomplish this

task, the bird was placed flat on its dorsal side on a wooden board. The commisure of the bill was brought parallel to this board.

The extent of each hawk was measured from tip to tip of the longest primaries of the outstretched wings as the bird lay on its dorsal side on a wooden board. The wings were gripped at the "wrist" joints to accomplish this task.

In addition, the right wing was measured from the end of the carpometacarpus where it joins the ulmare to the end of the phalanges of the third digit. When the primaries began to grow from the third digit, the measurement was made to the tip of the longest primary. This chord measurement was made without straightening the curvature of the wing.

Measurements were made of the tail, bill, and tarsus. The tail measurements were made from the tip of the longest rectrix to the point between the middle rectrices where they emerge from the skin. The bill measurements were made in a straight line from the tip of the upper mandible to the anterior edge of the cere. Tarsus measurements were made from the point of the joint between the tibia and the tarsometatarsus to the point of the joint at the base of the middle toe in front.

Dividers and calipers were used to make all linear measurements except length and extent. For these two measurements the distances were marked on the board and measured with a meter stick.

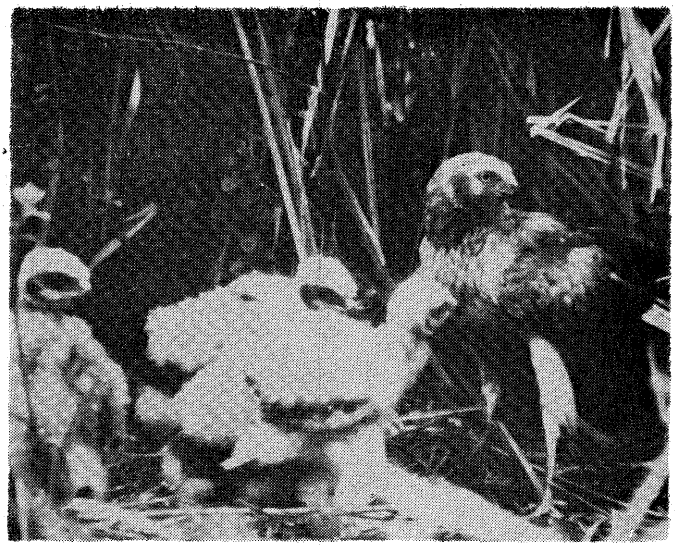
For the food-habits study, observations were made from a blind erected on the ground thirty feet from the nest occupied by the four young hawks used in the growth-rate study. The blind was a wooden frame approximately six feet high and three feet square, covered by a green cloth which blended with the *Spirea* that surrounded the bottom half. Observations were made from the blind on July 12 (2 hours), July 13, (4 hours and 15 minutes), July 15 (7 Hours and 45 minutes), July 20 (3 hours), and July 22 (2 hours), a total of 19 hours. These observations were made so as to cover all of the daylight hours between 7 a.m. and 9 p.m. at least once. During this time a record was kept of the species and quantities of prey brought to the nestlings by the adult female.

RESULTS AND DISCUSSION

Mortality

As with certain other ground nesters, the marsh hawk seems to have a high mortality rate. Hammond and Henry (1949) studied the success of marsh hawk nests in North Dakota. They observed 60 nests and found that 43 nests or 72 percent hatched. They also observed 303 eggs and found that 175 eggs or 58 percent hatched. Of the 175 young that hatched only 50 were surviving at 28 days. This is a mortality rate at 71 percent for young in the nest. The over-all mortality rate, if we consider each egg as a potential hawk, (egg loss plus nestling loss) was 83 percent.

Wagner (1933) found that marsh hawks banded just before flying showed a mortality rate of 34 percent. This was over a period of one year and nine months. Most of these losses seemed to be due to hunters and predators. He further concluded that most hunters shoot hawks without bothering to retrieve them. These hawks and the ones which die by other means have a slim chance of being reported. It therefore appeared probable that very few of the banded hawks lived one full year.



A good provider and her family. This in nest #5 located in Wood Creek Marsh and included in both the mortality and food-habit studies. This mother brought to her four nestlings an average of 1.3 prey per hour. This figure does not include the prey she consumed herself.

Craighead and Craighead (1956) studied mortality in many species of hawks and found marsh hawks to show the greatest variation in productivity. They found that the failure of marsh hawk eggs to hatch was 22 percent in observations conducted in 1942 and 100 percent in 1948. The Craigheads also found the juvenile mortality (in the nest) to be 11 percent in 1942.

As stated earlier, six nests were found and they contained a total of 28 eggs. Two nests and the 9 eggs therein were destroyed before any hatching occurred. The remaining four nests and the 19 eggs therein showed a 63 percent hatchability. Of the 12 young hawks which were hatched, five (two in one nest and three in another) lived to fly. In total, four nests were completely destroyed, two before hatching and two after some hatching had occurred. This constitutes a nest loss of 66-2/3 percent. The total loss was 7 nestlings plus 16 eggs from the original 28 eggs. If each of the 28 eggs was fertilized and therefore represented a potential young hawk, then the mortality rate was 82 percent (Table 1).

TABLE 1
ANALYSIS OF EGG AND YOUNG LOSS FOR EACH NEST

Nest No.	Total No of Eggs Destroyed	Total No. of young Destroyed	Total Loss	Young Surviving	Mortality Rate in Per Cent
1	2	3	5	-	100
2	3	-	3	-	100
3	3	3	6	-	100
4	6	-	6	-	100
5	1	1	2	3	40
6	1	-	1	2	33
Total	16	7	23	5	82

Evidence of predation was found at the scene in practically every case of egg and young loss. This evidence consisted of egg shells broken into many pieces, missing young, deranged nests, and eggs that appeared as though a hole was poked in them. These holes were approximately one inch in diameter. The contents of the broken eggs were always missing.

On numerous occasions, crows and farm dogs were noticed in the general locality of both study areas. Two particular dogs frequented the Wood Creek marsh and another pair was often observed in the Dead Creek area. It was noticed that the dogs always appeared to be hunting. Besides the crows and dogs, it is believed that a number of mammalian and avian predators nocturnally roamed the marsh areas in search of food. Because of the many possibilities involved, it would be difficult to draw precise conclusions concerning the exact cause for each of the destroyed nests, eggs, and nestlings.

Growth Rates

As previously stated, a search of the literature did not reveal any systematic study of young marsh hawk growth rates. However, Craighead and Craighead (1956) did weigh 30 male and 13 female marsh hawks to find an average weight for this species. The weights of the 43 birds averaged 521 grams. This compares favorably with weights taken in this study of 28 day old hawks which averaged 510 grams. Another investigator, Shelly (1935) studied growth in captive marsh hawks but detailed measurements were not made.

Weight. The greatest increase in weight was during the second week, when the young averaged a daily gain of 24 grams. During the fourth and third weeks the average daily gain diminished to 18 and 16 grams respectively. The week of slowest weight increase was the first week, when each nestling gained an average of 11 grams per day.

Length. The greatest increase in length occurred during the second week. The length of each hawk increased on an average of 13mm per day at this time. The average daily increase was 10mm and 9mm during the fourth and third weeks respectively. The period of slowest growth in length was during the first week, when each nestling averaged a daily increase of 8mm.

Extent The extent measurement showed the greatest increase during the second week. During this time, each nestling's wingspread averaged a daily increase of 36mm. During the third week, the increase diminished to 30mm daily. The extent growth averaged 26mm and 16mm daily during the fourth and first weeks respectively.

Wing. The wing measurement increased most rapidly during the third week because of the fast developing primaries. The average daily increase during this time was 10mm. Wing growth was almost as rapid during the fourth week when the daily increase averaged 9mm. This average was 8mm during the second week and the slowest wing growth was during the fiirst week, when the nestlings averaged an increase of 2mm daily.

Tarsus. The tarsus averaged 4mm of daily growth for the second week, 3mm for the first week, 2mm for the third week and 1mm for the fourth week.

Beak. The beak grew most rapidly during the first week. At that time

the average daily increase was less than 1mm. The beak growth rate steadily diminished during the second, third and fourth weeks.

Tail. No tail feathers could be noticed during the first week. By the end of the second week the rectrices had grown a total of 17mm. These feathers averaged a daily increase of 6mm and 8mm during the third and fourth weeks respectively.

If one considers the measurements of weight, length, and extent as being most indicative of general growth, it can be concluded that the second week was the period of most rapid growth for nestlings. Also, in this respect, the period of slowest growth occurred during the first week of nest life. (Nest life for the four nestlings in this study varied in duration from 25 to 29 days). Average and extreme measurements and the ages at which they were made may be seen by consulting Tables 2 and 3.

TABLE 2
AVERAGE GROWTH RATE OF YOUNG MARSH HAWKS

Age (days)	Weight (gm)	Length (mm)	Extent (mm)
1	25(21-27)	91(89-95)	92(89-101)
2	32(28-35)	97(95-101)	100(95-108)
3	41(37-47)	108(101-114)	122(114-127)
4	52(45-58)	115(113-117)	139(127-152)
5	66(61-75)	122(120-127)	158(146-171)
6	86(80-100)	134(127-139)	184(170-192)
7	102(87-108)	145(140-156)	204(190-215)
8	128(118-136)	150(145-156)	241(219-266)
9	159(143-189)	166(152-175)	272(254-280)
10	180(164-204)	178(165-185)	302(292-310)
11	206(188-236)	193(180-205)	339(327-345)
12	228(205-264)	207(195-215)	380(365-390)
13	249(232-274)	223(218-235)	419(400-435)
14	273(247-312)	237(227-260)	455(437-465)
21	387(329-477)	299(287-323)	665(646-710)
24	442(371-578)	324(310-342)	739(716-784)
28*	510(423-597)	368(355-380)	849(811-887)

*Averages for the twenty-eighth day are based on data gathered from two individuals. All other averages are based on data obtained from four individuals.

TABLE 3
AVERAGE GROWTH RATE OF YOUNG MARSH HAWKS

Age (days)	Wing (mm)	Beak (mm)	Tarsus (mm)	Tail (mm)
1	19(17-20)	6(6-7)	18(14-22)	—
2	20(18-21)	7(6-7)	19(14-23)	—
3	22(19-24)	8(7-8)	24(23-25)	—
4	24(22-27)	8(8-8)	28(26-30)	—
5	28(26-29)	8(8-9)	30(28-32)	—
6	32(30-33)	9(9-10)	34(31-38)	—
7	36(34-38)	10(9-10)	38(35-40)	—
8	42(40-43)	10(9-11)	42(38-45)	—
9	50(46-54)	11(10-11)	47(44-49)	—
10	57(55-59)	11(10-12)	53(51-56)	—
11	65(64-66)	11(11-12)	55(51-58)	5(4-7)
12	73(72-73)	12(11-13)	60(59-63)	9(8-10)
13	82(80-85)	13(12-13)	65(63-68)	12(11-14)
14	94(92-95)	13(12-14)	68(65-71)	17(12-20)
21	166(154-177)	15(14-16)	82(78-89)	61(52-66)
24	193(186-205)	16(15-16)	84(80-90)	81(64-90)
28*	230(220-240)	16(16-16)	89(86-92)	116(115-116)

*Averages for the twenty-eight day are based on data gathered from two individuals. All other averages are based on data obtained from four individuals.

FOOD HABITS

A review of the literature reveals that the diet of marsh hawks may vary according to the time of year, the prey species available, and the geographical location.

Studies conducted by Fisher (1893) and McAtee (1935) showed that mice and other small rodents were the primary foods of marsh hawks. These studies were based on stomachs collected from many parts of the United States. Breckenridge (1935) found that passerines and mice, in that order, were primary marsh hawk foods. He also stated that most of the food, if considered by weight, was striped ground squirrels and young cottontails. Errington and Breckenridge (1936) found that squirrels were taken in greater numbers than mice in summer at Madison, Wisconsin. Randall (1940), in Pennsylvania, found mice to be the primary food during the year except for June and July. During those months, mice were second to passerines. Sowls (1948), at Delta, Manitoba, found the principal foods of march hawks to be mice and fledgling blackbirds. Hecht (1951), also at Delta, found that meadow mice were the principal food with nestling redwing blackbirds second, young American Coots third, and young muskrats fourth. He also found that marsh hawks consumed other birds and mammals in lesser numbers. Craighead and Craighead (1956) found the summer diet of marsh hawks to consist of over 50 percent meadow mice, about 30 percent small and medium-sized birds, and rabbits, ground squirrels, and rats in small numbers.

During the 19 hours spent in the blind observing food habits, 24 visits to the nest by the adult female were recorded. She carried a prey to the young on each visit. The prey recorded were 19 meadow mice (*Microtus*), 4 meadow jumping mice (*Zapus*) and one passerine bird. On the basis of these observations, the mother hawk brought to the four nestlings an average of 1.3 prey per hour. This figure does not include the prey that must have been consumed by the mother hawk on her trips to and from the nest. The figure also does not include the prey caught and consumed by the adult male. Other observations (though informal) made throughout the spring and summer in both marshes showed the marsh hawk diet to be exclusively mice. (This is interesting to note because further observations made throughout the summer, fall, and winter indicated that Wood Creek marsh had a high pheasant population. No evidence of any kind was found that would indicate marsh hawk predation upon pheasants took place.

The meadow mouse population in Wood Creek marsh during the summer of 1961 was suspected to have been at its peak. The almost complete absence of meadow mice the following summer, 1962, helped to further substantiate this suspicion.

Admittedly, the food habit data gathered in this study is limited. However, on the basis of the observations that were made, it appeared that the abundance of pheasants was insignificant to the marsh hawks studied. They seemed to show a decided preference for preying on the abundant meadow mice.

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