

LOCOMOTION, MAINTENANCE AND FEEDING BEHAVIOR OF THE GREAT BLUE HERON IN NORTHERN NEW YORK

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INTRODUCTION

This paper follows a preliminary study of the maintenance and feeding behavior of the Great Blue Heron (*Ardea herodias herodias*) initiated by Parker and Maxwell (1969). Maintenance behavior, as used in this paper, includes movements concerned with preening, scratching, shaking, bill cleaning, stretching, sun-bathing, defecation, sleeping, yawning, relaxation, and alert position. Maintenance activities concerning perching, alert position, scratching, shaking, bill wiping, care of the feet, stretching and throat pulsation in this colony were described previously by Parker and Maxwell.

The objectives of this study were: (1) to observe and photograph feeding and maintenance behavior; (2) to find the feeding grounds for the colony; and (3) to find the types of food being fed to young herons in the nest. Specific comparisons of the behaviors between the Great Blue Heron, the Black-crowned Night Heron (*Nycticorax nycticorax*) and the Green Heron (*Butorides virescens*) were made and summarized.

STUDY AREA

On Ironsides Island (Jefferson County, New York) in the St. Lawrence River, field observations, totaling 600 hours, were made of a well-established Great Blue Heron nesting colony during the spring and summer of 1969. The island is five miles down river from Alexandria Bay, New York. The colony encompasses an area approximately 630×225 feet (3.25 acres) on the northeast end of this 18 acre island (Fig. 1). Ironsides Island, composed of red granite partially covered with sandy soil, has vegetation exhibiting an elm-ash-oak edaphic climax. The nests were situated in the highest branches of the American elms (*Ulmus americana*), red maples (*Acer rubrum*), northern red oaks (*Quercus rubra*) and white ash (*Fraxinus americana*). There were 44 trees with 255 nests giving an average of six nests per tree (Table 1). These trees are located in or adjacent to a swamp (Fig. 2). The maximum depth in the swamp, in early summer, was one foot when the water covered most of the land area under the trees and later in the summer was dry except for a few low lying areas.

In regard to selection of nest sites, Bent (1926) indicated the main object to be gained was security for the eggs and young in remote and inaccessible areas. Other studies on island heronies, Lahrman (1957) in Saskatchewan, Canada, and Behle (1958) in the Great Salt Lake, Utah, found Great Blue Herons nesting on the ground. Their studies indicated

that predation was minimal on island heronies. Neither predation nor its effects were found on Ironsides Island.

The colony had 255 nests, which were counted in early spring before the leaves were out. Of the 255 counted, observations were made of 130 active nests during this study. The number of young in the nest ranged from one to five giving a population of 280 in the colony. Benning (1968) reported that there were 110 active nests with 240 young in 1967.

TABLE 1

Nest trees in the 3.25 acre Great Blue Heron colony on Ironsides Island.

Species	Trees in colony	Trees with a nest or nests	Ave. tree height
American Elm	16	12	70 ft.
Northern Red Oak	13	13	65 ft.
Red Maple	12	5	60 ft.
White Ash	5	5	60 ft.
Dead (unknown)	10	9	70 ft.
	<u>56</u>	<u>44</u>	

METHODS AND MATERIALS

An elevated blind was constructed for observations. It was built atop 36 feet of scaffolding and consisted of a four by six foot plywood floor with burlap sides and roof. The blind was located on a high ridge at the southwest corner of the heronry, affording an excellent view of the colony. Photographs were taken with a 15 to 60X zoom telescope adapted to a single lens reflex camera and a super eight motion picture camera with a one to three zoom lens. Observations were also made from a 12 foot outboard motor boat powered with a 10 horsepower engine. The boat was used to find the location of the herons' feeding grounds and for observing methods of obtaining food.

LOCOMOTION

Walking. — Walking involved bringing one foot forward smoothly and unhurriedly as the heron advanced, body erect, head and neck extended. As the foot was brought forward the phalanges were relaxed and then spread before being placed down. Most of the walking observations occurred while the herons fed in the shallow waters of nearby marsh lands. Walking observed in the heronry were of both young and adults as they moved around on the tree branches and in the nests. The young nestlings walked awkwardly in a crouched position for several weeks. As they matured they assumed the movement described for the adult and sometimes flapped their wings for balance.

Flight. — On long flights the neck was retracted in an S-shape, with

the legs and feet extended backwards in line with the body. Bent (1926) indicated the legs act as a rudder because the tail was too short for this purpose. On short flights the Great Blue Heron was observed with its head and neck extended. The head was elevated slightly above the level of the back. This type of flight was observed when the heron became alarmed and left the nest site. In the marsh lands the heron exhibited this type of flight when scared, but the head and neck were extended for only a short time.

Attempts have been made to record wing-flap rates and speed with varying results given by different investigators. From results obtained in this study the number of wingbeats per second varied under different conditions. Motion picture film was used to determine the wingbeats per second from the formula:

$$\frac{\text{Frames/second}}{\text{Frames/beat}} = \text{beats/second (Palmer, 1962)}.$$

On long flights 2.3 wingbeats per second were recorded while on a short flight when the heron was hurried 3.2 wingbeats per second were calculated. Blake (1948) reported 2.1 wingbeats per second for the Great Blue Heron. Palmer (1962) reported a cruising speed in the range of 19–29 miles per hour, and 30 miles per hour when pressed. Palmer (1962) gave a speed range of 18–21 miles per hour with 2.6 wingbeats per second for the Black-crowned Night Heron and for the Green Heron a speed range of 20–34 miles per hour with 2.8 wingbeats per second.

After three weeks in the nest, the young started pre-flight training which consisted of repeated flapping of the wings. At this stage their underparts were almost featherless but their primaries, secondaries and scapular feathers were well developed. At about five weeks of age in the final stages of feather development the most mature nestling climbed to an adjacent limb where wing flapping continued for several hours at a time. After the first heron left the nest the others usually followed in a day or two. In about a week to ten days following their first venture from the nest, their feathers and muscles were nearly fully developed for flight. Their first flight was very awkward as they seemed to drop from the nest to become air borne. Gliding was observed not only when landing but during sustained flights and flights against strong winds. On windy days the heron approached the nest in a long spiral glide facing the wind.

Take-off. — Certain intention movements (see Daanje, 1960) were associated with take-off in the Great Blue Heron. Turning to one side and slight extension of the wings were obvious intention movements observed.

The following descriptions of a typical take-off and landing were made with the aid of motion picture film. Slight variations of the following

description were observed in some birds.

1. The body was brought to a semi-vertical position with the wings slightly extended.
2. Legs were bent.
3. The head and neck were somewhat withdrawn.
4. The body was thrust forward and upward by the extension of the legs as the wings extended outward and upward.
5. The head and neck were extended forward with the body.
6. The legs and feet were brought together and formed a straight line with the body.
7. The head and neck were retracted as the heron gained altitude.

Landing. — The Great Blue Heron appeared to execute the following movement while landing:

1. The approach was made at a long glide; the feet and legs trailed with the neck and head retracted.
2. The head and neck were then extended and elevated above the body.
3. The legs dangled down and slightly back until a few seconds before landing when they were brought forward.
4. The tail feathers were spread.
5. As the legs swung forward the wings stroked vigorously to decrease the approach speed.
6. The head and neck were retracted slightly just before the feet made contact with the perch.
7. As the feet grasped the perch the head and neck extended slightly to the perched position and the wings continued to beat until balance was established.

MAINTENANCE BEHAVIOR

Alert position. — When disturbed the Great Blue Heron assumed an alert position. Disturbances in or near the heronry from boats, planes, and humans stimulated a rapid alert response in the beginning of this study. As the adults, and later the young, became conditioned to their surroundings they reacted less intensely. Away from the island the birds were very wary and usually responded to the slightest disturbance.

Preening. — Preening was one of the most frequently observed activities of the Great Blue Heron. It was not found to be done at any one particular time, but was observed at daybreak, following eating, flight, feeding of the young, and usually following a period of relaxation. It occupied a large percentage of their time while in the perched position (See Table 2). During one eight hour period of observation, the Great Blue Heron was found to devote 21 percent of the time to preening. This

compared to the 20 percent of time devoted to preening in the Black-crowned Night Heron (Maxwell and Putnam, 1968). The Great Blue Heron used its bill with ease to preen all areas of the body with exception of the head and posterior neck. During breast region preening, the neck was extended and bent downward while the head and bill were brought backward perpendicular to the breast and abdominal feathers. The Great Blue Heron appeared to nibble his feathers or smooth them by holding them between the mandibles; however, he did not intentionally pull the feathers from his body.

The next most common area of preening was the underwing and side area, which usually occurred together. The wing was opened slightly and drooped; the bill was extended deep into the feathers, and nibbling was evident. The individual feathers were pulled in a stroking motion than, almost flicking them, allowed to fall back into place. The primaries and upperwing were preened by running the mandible the length of the feathers (Fig. 3). The upperwing coverts were usually nibbled and stroked first.

TABLE 2

Frequency and percentage of time devoted to preening in each major body area: A comparison of five Black-crowned Night Herons^a observed 7.7 hours and six Great Blue Herons observed 8 hours.

Region	Total preening time (minutes)		Percentage of total preening time	
	GBH	BCNH	GBH	BCNH
Breast	30	24	29	26
Underwing and sides .	26	21	25	23
Neck	20	18	20	19
Upperwing	10	9	10	10
Primaries	8	9	8	10
Back	4	6	4	6
Head	2	3	2	3
Tail	2	3	2	3

^a Maxwell and Putnam (1968).

In order to preen the back and tail feathers the head was turned to one side with the top tilted on an angle. The feathers of this area were nibbled and stroked with the bill.

The neck feathers were erect while the neck was bent, with the head

and bill pointed downward to preen individual feathers of the anterior and side neck (Fig. 4). This was done with a slow even stroke. The head and posterior neck feathers were preened by placing the head between the wing and side of the body and rotating the head in and out. This was completed in a few seconds.

Meyerriecks (1960) reported that in most cases the final act of preening in the Green Heron was the rubbing of the bill over the oil gland. This behavior was not observed in this study. However the heron's bill had a powdery down appearance following a preening bout.

Young herons, from the time they were a few days old, seemed to spend most of their waking hours preening. Their main activity appeared to be picking at the chitinous covering of the shafts of their growing feathers.

Scratching. — Great Blue Herons scratch the head and neck areas directly (Simmons, 1957) ("Vornherum" of Heinroth, 1930) by raising the leg straight up to meet the lowered head (Fig. 5). The Great Blue Heron used the pectinated claw on the middle toe to make contact with the scratched areas. As the heron worked on the head and neck areas, the head was rotated with the crest fully erect. Scratching appeared more often as an isolated action rather than strictly being associated with preening.

Shaking. — The body was moved vigorously back and forth around the anterior-posterior axis as the wings moved in and out slightly (Fig. 6). On slow motion movie film the wings appeared to drop a little with the in and out movement of the wings. The shaking ended with the wings brought in towards the body, the head and neck extended and rotated several times. Shaking sessions were observed from three to twelve seconds in length. Although a similar behavior was described of the Green Heron by Meyerriecks (1960), he also reported that at times shaking out occurred just prior to flight and that shaking out in flight was rare. Shaking out prior to and during flight were not observed in this study of the Great Blue Heron.

Bill cleaning. — Bill cleaning was accomplished by lifting the foot upward and forward, extending the pectinated claw of the middle toe and flicking material from the bill. After or during a preening bout tiny feathers sometimes stuck on the tip of the bill and the heron removed them in the manner described. In this study bill cleaning was observed to occur less frequently than bill wiping which was described in Parker and Maxwell (1969).

Stretching. — Stretching occurred during a preening bout or as an isolated incident. Two methods of stretching were observed. In one method the body was bent forward horizontally, the neck and head were placed in the perched position, weight was shifted to one leg, and then the wing and leg of the opposite side were stretched. The leg, without the weight, was bent until the femur and tibiotarsus were paral-

lel with the ilium and each other (Parker and Maxwell, 1969). Extension of the wing down and out was followed by an outward extension of the leg and fanning of the wing feathers (Fig. 7). There was no tendency for the heron to stretch one wing more often than the other or to have a set pattern of one leg then the other.

In the second method of stretching, the Great Blue Heron began from a perched position, fully extended the head and neck, in contrast to the first method, and raised the humeri above the horizontal body. Stretching in this manner was observed more often in nestlings than adults.

Sun-bathing. — When sun-bathing the heron stood erect with its head and neck fully extended facing the sun. The wings were opened about halfway and slightly drooped so that the tips nearly touched each other in front of the body (Fig. 8). Sunning periods lasted for several minutes. One heron was observed sunning for 22 minutes with only occasional movement of the head. Frequently the sun-bathing heron opened and closed the wings while still in the fully extended position. Hauser (1957) listed the Green Heron as a "voluntary" sun-bather, but she did not illustrate or describe the position.

Defecation. — The defecating bird lowered the posterior end of its body, elevated its tail, partially opened its wings for balance and then slightly raised its head and neck. Not only did defecation occur in the perched position but also in flight. Defecation sometimes occurred just a few seconds after take-off. The young nestlings voided into the nest up to fledging at which time they elevated the rump and defecated over the edge. Because there appeared to be no attempt at nest sanitation the odor became pungent. The trees and ground under them became completely whitewashed with the excrement, which is probably the cause of nest tree die-off in heron colonies.

Sleeping. — The sleeping heron usually rested its head on the fully retracted neck, dropped the wings slightly, and closed the eyelids for varying periods of time. Observations were made of herons sleeping on branches with one leg raised so that only one foot was visible as it protruded from the fluffed feathers. Long periods of time without moving were observed in this position. An occasional passing boat or plane would often disturb the sleeping heron. The disturbances would cause little concern since the sleeping position was assumed readily. After the young fledged, adults were seen spending most of the daylight hours sleeping or resting on islands apart from Ironsides.

Yawning. — This movement occurred most frequently following long periods of inactivity. The heron's bill was opened wide with the eyes opened and slightly bulged. This behavior was similar to that of the Black-crowned Night Heron and the Green Heron. The observations made indicated that yawning occurred irregularly and was apparently not influenced by external factors.

Relaxation. — The Great Blue Heron remained in the perched position

for extended periods of time. The only movement might be an occasional turn of the head. Observations early in the nesting season indicated that sounds from a passing boat or airplane were the stimulus for movement of the head. Later these sounds received little attention. Blinking during this period of relaxation occurred quite frequently in the perched position, but lessened when the neck was retracted. Blinking did not seem to involve the eyelid, only the nictitating membrane. The nictitating membrane covered the eye for one or two seconds at a time. The average number of blinks was sixteen per minute. These were obtained by observing ten herons on separate occasions.

Maintenance activities concerning perching, alert position, scratching, shaking, bill wiping, care of the feet, stretching and throat pulsation in this colony were described previously by Parker and Maxwell (1969).

FEEDING BEHAVIOR

Adult feeding. — Three methods of securing food by adult Great Blue Herons were observed in this study. Bent (1926) stated that two methods, still hunting and stalking, were employed in deep-knee fishing areas. The third method, alighting on deep water, is considered a rare observation by most authors. Still hunting (1) was observed on exposed shoals and among cattails in a marsh. In this method, the body assumed a position upright with the head and neck fully extended at a 45 degree angle. Sometimes the body was crouched in a horizontal position with the bill almost touching the water. This position was noted prior to striking the prey. The heron struck quickly into the water with his bill, grasping the prey between the mandibles. Larger prey was positioned for swallowing and done so immediately. The stalking method (2) was very similar to walking. The body may be erect or low and horizontal. Compared to still hunting, the neck was carried lower and more forward. The heron appeared to be trying to locate prey rather than waiting for it to come to him. Meyerriecks (1960) mentioned a modification of stalking where the Great Blue Heron flicked the wing two or three times in rapid succession in order to startle prey. This type of behavior was not observed in this study. Alighting on the water (3) was seen on two occasions. A heron was flying toward the heronry when it made a circular swing and landed as a duck would in deep water. The heron was in the water but a few seconds when it took off without obtaining the prey. The movement was very slow as the wing tips hit the water before becoming airborne. Upon investigation, a small perch was found swimming on the surface where the heron had landed. The other observation was made after strong winds had stirred the water causing large quantities of material to float on top of the water. A heron flying about ten feet above the water surface suddenly dropped and made contact with the water for a few seconds.

Palmer (1962) described similar swimming, stalking and still hunting for the Black-crowned Night Heron and Meyerriecks (1960) for the

Green Heron. Drinkwater (1958) mentioned the use of bill motion by the Black-crowned Night Heron to catch prey. Meyerriecks (1959, 1966) and Hoyt (1961) cite several instances where the Green Heron stirred the water with the foot to disturb fish. Neither type of feeding behavior was observed of the Great Blue Heron in this study.

Hedeen (1967) observed two variations of deep water fishing. Either the heron was flying toward the heronry when it began searching, or it came off a perch from which it had spotted the prey.

Feeding grounds. — Several areas along the St. Lawrence River, in a radius of three miles from Ironsides Island, were explored as possible feeding grounds. Four areas were observed as frequented feeding grounds: (1) shallow water inlets, (2) a small stream running through a marsh, (3) shallow water around islands, and (4) shoals (See Fig. 1). There was usually at least one heron in a particular area which indicated a feeding ground, but it was difficult to determine whether the same herons returned each time.

Feeding of the young. — First observations of the adult Great Blue Heron feeding the young were at one week of age. At this age, in one nest observed over a five hour period, the adult was seen feeding at the nest almost once each hour. Each young nestling appeared to be fed individually at every feeding and showed very little aggression in obtaining food.

More aggression and participation began at about three weeks of age. As the adult approached the nest the young herons appeared to sense their parent by displaying an action resembling bobbing and making constant vocal sounds which increased in volume. These sounds tended to be like those of the Grey Heron "which might be written as yek-yek-yek-yek-yek, are entirely vocal and produced with the mandibles parted, yet of such a quality as to suggest bill clapping." (Lowe, 1954:86). Once the adult landed feeding might be immediate or several minutes later. The feeding procedure as described by Parker and Maxwell (1969) is in agreement with our observations.

The Great Blue Heron may regurgitate several particles of food at a feeding. In the very young nestlings the food was small and appeared to be semi-digested, but as the young matured whole organisms such as fish and frogs were observed being regurgitated by the adult. Mature young herons would jump or walk back, from nearby branches, to the nest when the adult approached. The adult then regurgitated the food directly into the nest, and the young would pick up food from the bottom of the nest. Only two feedings a day were seen at this time; one in early morning, and the other ranging from late afternoon until dusk.

Sampling of food fed to the young was attempted by causing regurgitation (Kirkpatrick, 1940). This method proved unsuccessful. The few specimens obtained were dropped by the young herons during feeding

as they picked the food from the bottom of the nest and shook it in order to align the specimen for swallowing. Although the results were insignificant the main type of food observed was fish. Specimens found included three alewives (*Alosa pseudoharengus*), three rockbass (*Ambloplites repestris*), one perch (*Perca flavescens*), one bluegill sunfish (*Lepomis macrochirus*), and one pickerrel frog (*Rana palustris*).

SUMMARY

A field study involving the locomotion, feeding and maintenance behavior of the Great Blue Heron was conducted on Ironsides Island, Jefferson County, New York, in the summer of 1969. Descriptions of the behavior patterns associated with locomotion included walking, flight, take-off, and landing; those of body maintenance included the alert position, preening, scratching, shaking, bill cleaning, stretching, sun bathing, defecation, sleeping, yawning, and relaxation. Descriptions of feeding behavior included adult feeding, feeding grounds, and feeding of the young.

Specific comparisons were made between the Great Blue Heron, the Black-crowned Night Heron, and the Green Heron where merited. A summary of these comparisons is presented in Table 3.

TABLE 3
COMPARATIVE BEHAVIOR CHART

The following chart compares the Great Blue Heron (*Ardea herodias herodias* L.) behaviors with those of the Black-crowned Night Heron (*Nycticorax nycticorax hoactl* L.) and the Green Heron (*Butorides virescens virescens* L.). A question mark (?) signifies that information is unavailable or that descriptions in the literature are not detailed enough for comparative purposes. Literature sources have been cited in this paper. The following abbreviations are used for the herons:

GBH — Great Blue Heron

BCNH — Black-crowned Night Heron

GH — Green Heron

Behavior	GBH	BCNH ^a	GH ^b
LOCOMOTION			
Walking	erect	crouched	crouched
Flight	neck retracted, except short flights	shortened	retracted
gliding	during landing and sustained flights	similar	upon landing

Take-off	feathers sleek with the body lowered as the head and neck extend upon lift-off then are withdrawn	similar with slight variation	similar with slight variation
intention movement	side turn and extension of wing	head rotation	tail flipping
Landing	glides to perch with extended head and neck, upon landing assumes the perched position	similar	similar plus crest erection

MAINTENANCE

Perching	legs bent or straight with head and neck S-shaped	similar with head and neck withdrawn	similar with head and neck withdrawn
Alert position	head and neck extended vertically with body	similar	similar
Preening	entire body reached by bill except head and upper neck	similar	similar except pulling out of feathers and finishing with oiling bill
Scratching	head and neck scratched by direct method	similar	similar
Shaking	erects feathers and moves wings in and out	similar	similar but usually just prior to flight
Bill wiping	bill rubbed against an object to remove material	similar	similar
Bill cleaning	use of the foot to remove material from bill	?	similar
Care of feet	little attention	little attention	peck at feet during preening
Stretching	during preening or isolated incident	similar	similar
one wing	neck in perched position	similar	head and neck extended
both wings	neck extended with wings above back	?	similar
Sun bathing	erect with head and neck fully extended facing sun	?	similar but head and neck not as fully extended

^a Maxwell and Putnam, 1968.

^b Meyerriecks, 1960.

Table 3. Continued

Behavior	GBH	BCNH ^a	GHB ^b
Defecation	occurred in perched position and in flight	similar	seldom defecated upon take-off
Sleeping	head rested on retracted neck	similar	similar
Yawning	bill opened wide with eyes bulged	similar	similar
Relaxation	in the perched position with movement of nictitating membrane	?	similar
Throat pulsation	rapid in and out movement in the gular region	similar	?
FEEDING			
Adult	still	similar	similar
	stalking	similar	similar
	alighting on water	similar	?
Young	grasp the adult bill and withdraw food	similar	?

^a Maxwell and Putnam, 1968.

^b Meyerriecks, 1960.

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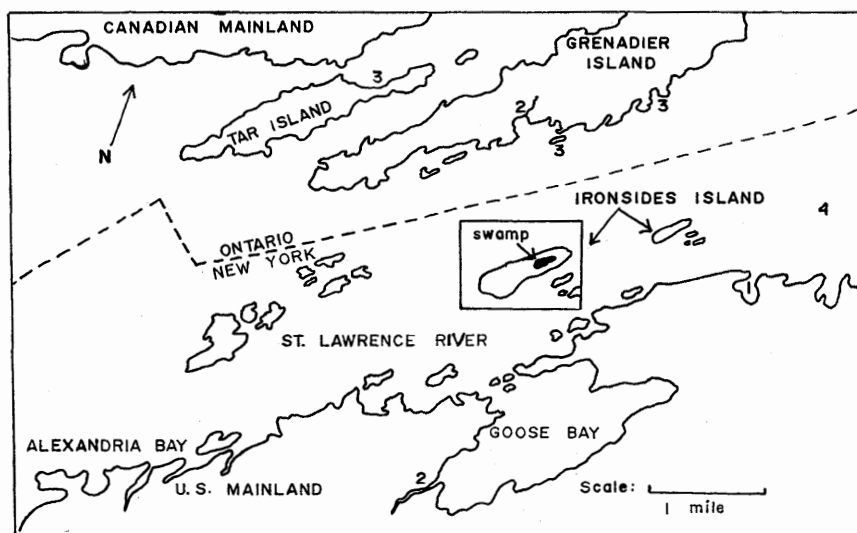


Fig. 1. Location of Ironsides Island, Jefferson County, New York. Numbers on map indicate feeding grounds for the Ironsides Island Great Blue Heron colony.

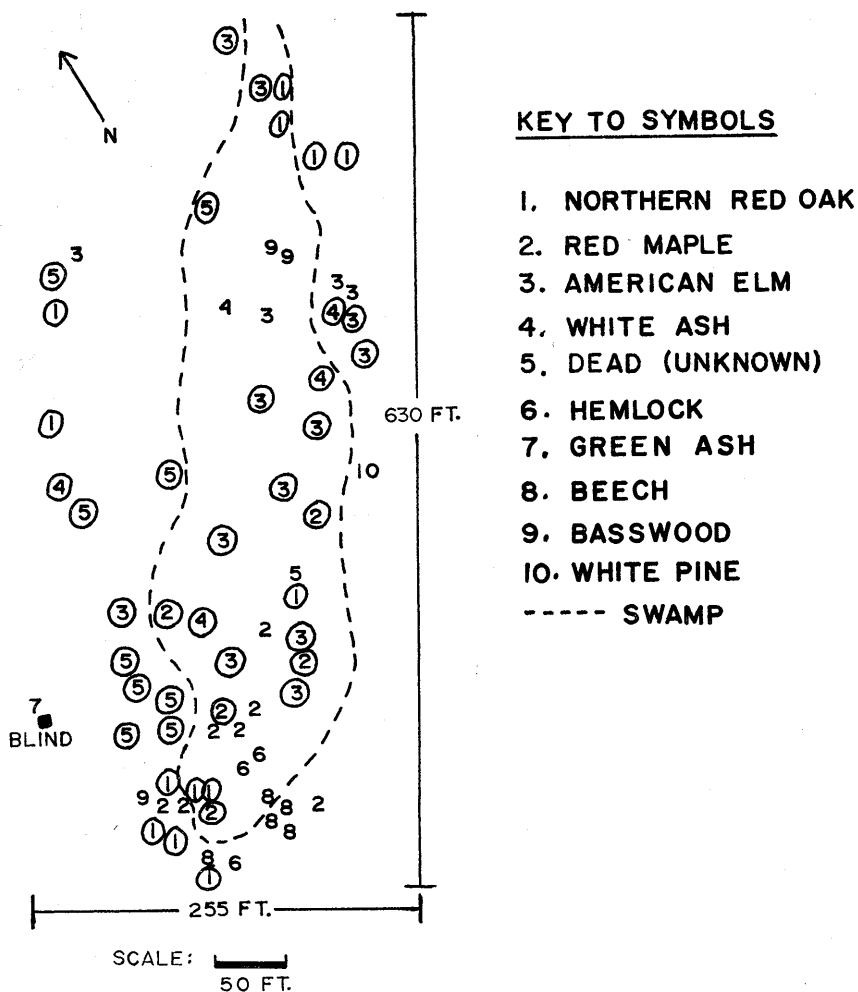


Fig. 2. Location of canopy trees in the Great Blue Heron colony on Ironsides Island, New York. Circled numbers indicate trees with nest or nests.



Fig. 3. Preening Primaries



Fig. 4. Neck Preening



Fig. 5 Scratching



Fig. 6. Shaking

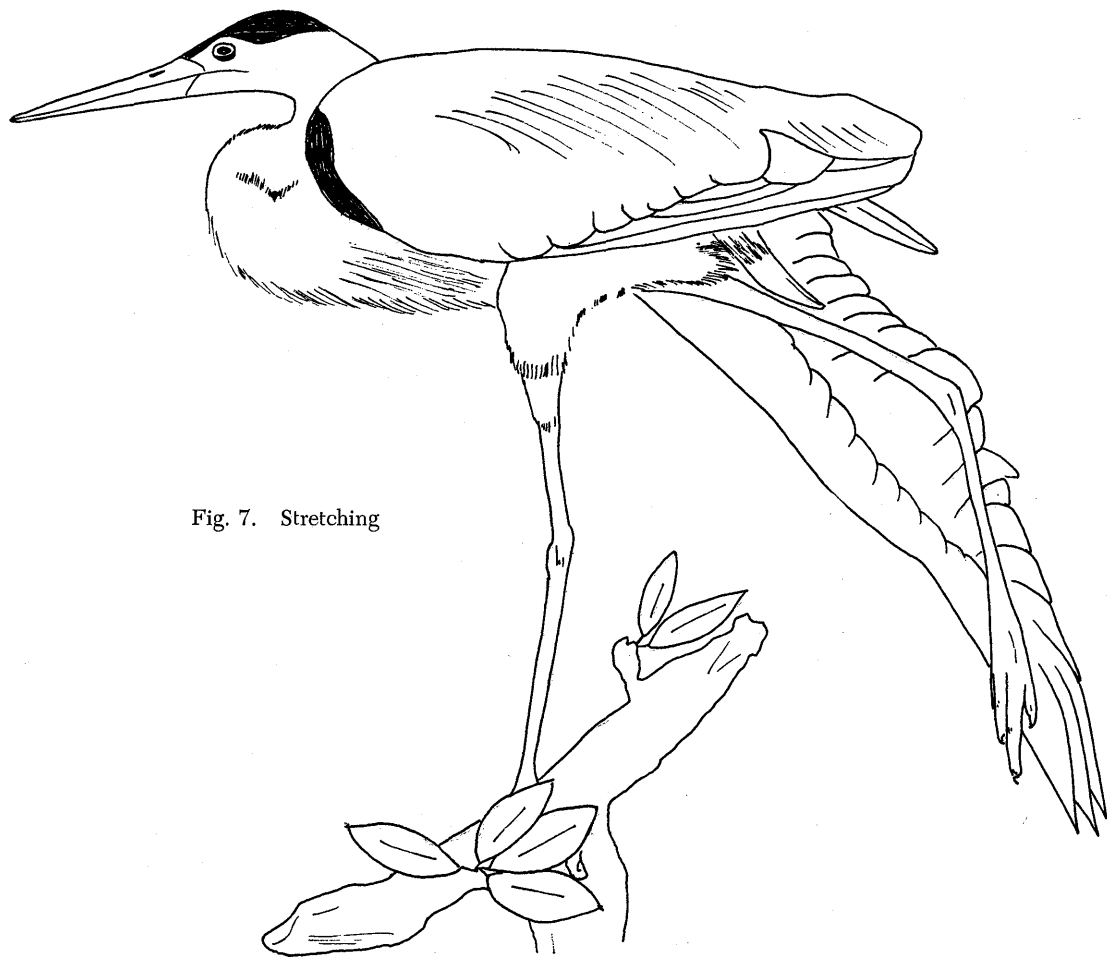


Fig. 7. Stretching

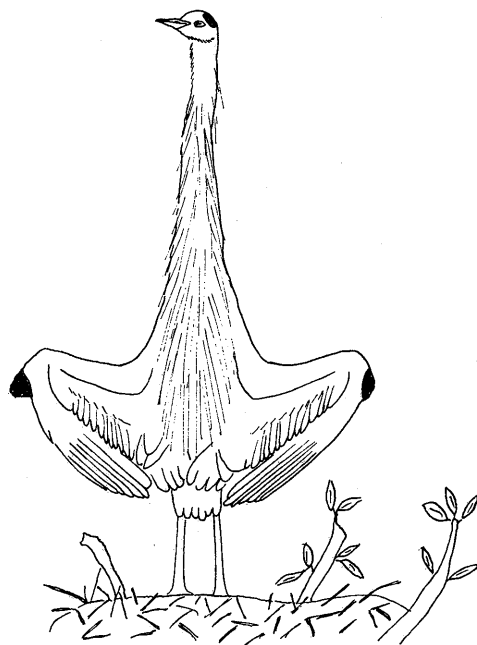


Fig. 8. Sunning