A Study of a Heron Nesting Colony

Linden J. Leatham

Utah State University

Follow this and additional works at: https://digitalcommons.usu.edu/etd

Part of the Zoology Commons

Recommended Citation
https://digitalcommons.usu.edu/etd/1189

This Thesis is brought to you for free and open access by the Graduate Studies at DigitalCommons@USU. It has been accepted for inclusion in All Graduate Theses and Dissertations by an authorized administrator of DigitalCommons@USU. For more information, please contact dylan.burns@usu.edu.
A STUDY OF A HERON NESTING COLONY

LINDEN J. LEATHAM
A STUDY OF A HERON NESTING COLONY

by

Linden J. Leatham

THESIS

Submitted in Partial Fulfillment of the Requirement for the Degree of

MASTER OF SCIENCE

in

Zoology

in

THE GRADUATE SCHOOL

of the

UTAH STATE AGRICULTURAL COLLEGE

1947

Approved:

____________________
Major Professor

____________________
Head of Department

____________________
Dean of the Graduate School

Deposited in College Library __________________ Date __________________ Librarian
ACKNOWLEDGMENTS

Grateful acknowledgment is extended to:

Dr. J. S. Stanford, for his stimulating instruction and congenial companionship in the field

Dr. D. M. Hammond, for his patient teaching and kind assistance and supervision during the writing of the thesis

Mr. Allan McIntosh of the Zoological Division, Bureau of Animal Industry, for identifying the parasites submitted to him
TABLE OF CONTENTS

Introduction .............................................. 1
Description of the Colony ............................. 5
Migration .................................................. 13
Social Life ................................................ 21
Food Habits ............................................. 33
Economic Status ....................................... 46
Limiting Environmental Factors ...................... 48
History of the Colony ................................ 55
Relationships to Other Animals ....................... 59
Summary ................................................... 67
Bibliography ............................................ 69
ILLUSTRATIONS

Figures

1. Aerial photograph of the territory surrounding the Wellsville heronry ............................................. 12
2. Chart of the horizontal and vertical distribution of nests in a small community of herons (Community "A") .... 29
3. Chart of the horizontal and vertical distribution of nests in a small community of herons (Community "B") .... 30
4. Map of southern Cache Valley showing important heron feeding areas .................................................. 39

Graphs

1. Mean daily temperatures for a five-months period, December to April, for 1937-38, 1938-39 and 1939-40 ............ 14

Tables

1. Spring migration of herons to the Wellsville heronry ............ 17
2. Returns from herons banded in northern Utah ...................... 20
3. A tabulation of the food of three species of herons ............. 41
4. Identifications of parasites from herons .......................... 53

Plates

1. Brewster's Egret (photograph of mounted specimen) ............ 6
2. The Black Crowned Night Heron and its nest ....................... 7
3. Black Crowned Night Heron (adult and juvenile) ................. 8
4. The Treganza Heron .................................................. 9
5. Nests of the Treganza Heron ........................................... 25
6. Nest of Snowy Heron ................................................... 26
7. Nest of Black Crowned Night Heron ................................. 26
8. Nests of the Black Crowned Night Heron and the Snowy Heron ... 27
INTRODUCTION

Herons are well known because of their gregarious nesting habits. Like many others of the lower orders of birds they nest together in pure or mixed colonies of many different combinations and under diverse living conditions. The population of different colonies may vary from a few pairs to many thousands of pairs depending upon the nature and extent of the breeding area, the food supply available and the protection afforded either by natural or artificial means.

In Utah and adjacent areas of bordering states, many types of heron associations have been studied and reported by ornithological workers. Breeding colonies of Treganza Herons, Black Crowned Night Herons and Snowy Herons in pure species associations and mixed communities have been recorded. The tendency of herons to associate with other unrelated orders of birds in nesting situations has also been noted. Such colonies as the Gull-Pelican-Heron associations of the Great Salt Lake Islands and the Heron-Cormorant communities of Cache Valley and Bass Pond Reservoir support this observation. At least eight different communal associations involving herons in the nesting season are known in Utah. These are listed as follows:

1. **Treganza Heron** (pure species association) colonies are found near Bear Lake in Southern Idaho and in the Bear River Marshes near Corinne, Utah.

2. Pure species colonies of the **Black Crowned Night Heron** are known in various marshes of the State.

3. Pure species colonies of **Brewster's Egret** (Snowy Heron) occur in the tules of the Bear River Marshes near Corinne, Utah.

4. **Black Crowned Night Heron** and **Brewster's Egret** colonies have been observed in southern central and northern Cache Valley, Bear Lake region in southeastern Idaho and in the Bear River Marshes.
(5) The Treganza Heron, Black Crowned Night Heron and Brewster's Egret nest together in Cache Valley, Utah, in two different colonies.\textsuperscript{35}

(6) Colonies of the Treganza Heron and Double Crested Cormorant are known from Cache Valley\textsuperscript{35}, Great Salt Lake Islands\textsuperscript{36} and Bass Pond Reservoir.\textsuperscript{29}

(7) Brewster's Egret and the White Faced Glossy Ibis have been seen nesting together in the tules of the Bear River Marshes.\textsuperscript{29}

(8) The California Gull, White Pelican and Treganza Heron nest together in colonies on the islands of the Great Salt Lake.\textsuperscript{24, 36}

Published accounts of heron colonies and associations involving nesting herons in Utah have dealt largely with the location and history of the colonies, the numbers of individuals present, nests and general food habits. Other species of animals have been noted about the nesting area in only a few instances, and the relationships of these animals to the nesting birds have not been worked out. There is a lack of knowledge concerning the part played by mammals, reptiles, insects and other types of animal life in the welfare of the bird communities.

The question of the economic status of herons has long been debated among ornithologists and those engaged in the propagation of wild life, especially fish culture. The fish eating propensities of herons are known all over the world. In some regions the birds are condemned as a menace by the sportsman and in other areas they are considered to be his benefactors. Adequate studies have not been published to definitely establish the economic status of this group of birds.

It is the purpose of this thesis to contribute to the knowledge of Ornithology by a presentation of the writer's observations and findings on a colony of nesting herons, noting, especially, certain factors influencing the behavior of the birds, their relationships to other animals of the community, economic importance and development of the colony.
Method of Study. The observations and conclusions of the thesis are based almost entirely upon original studies of the writer in the field and laboratory. The heron colony on which the study is based has been observed over a period of sixteen years, 1931 to 1946, inclusive. The writer visited the heronry at least once each year during the years 1931 to 1937. It was during these visits that an interest in the problem was developed. In 1938 the writer decided to undertake the study of the heron colony as a problem for graduate research. Intensive field work on the problem was begun in the Spring of that same year. Visits to the colony were made at least once each week and often several times each week throughout the nesting season. The trips were often made under difficult circumstances since during the months of April and May it was often necessary to wear hip boots and wade through high water which covered the flood plain of the Little Bear River. This intensive study was continued in the 1939 season and again in 1946. During the years 1940 to 1945 only casual visits were made to the colony since the writer was disabled part of this time and during the rest of the period was living in another area.

Most of the observing was done in the heronry from concealed positions beneath the dense canopy of foliage. Sometimes the writer climbed to the tops of tall hawthorne trees to observe conditions that were not evident from below the nests. 8X binoculars were often used, even at close range, to help reveal the activities of the birds more accurately. Observations on the time of arrival, behavior, feeding habits, relationships to other animals and nesting activities were carefully recorded in field notes.

Observations on the feeding habits of the herons were made in the heronry, in the feeding areas at some distance from the colony and in the laboratory. A number of specimens were collected at the heronry for purposes of stomach examinations. The stomachs were removed and preserved
in 10% formalin. Careful examinations of the stomachs were made later in the laboratory and the material was identified to species, where possible. Field observations of the herons in their feeding areas were made at various periods of the day including early morning, daytime and evening hours.

Parasites were collected from the digestive tracts of the birds that were taken for food studies. In many cases the parasites were removed soon after the birds died. Some, however, were obtained from the preserved stomachs. Nematode parasites were preserved in 10% formalin. The tape-worms were fixed in hot Schaudinn's fluid and later transferred to 50% alcohol. These parasites were identified by the Zoological Division, United States Bureau of Animal Industry, Washington, D. C.

Photographs were taken from vantage points in the tops of trees in the heronry. Mounted specimens were used to illustrate the different species because it was not possible to get close enough to the living birds to photograph them. A blind was erected in one portion of the heronry to facilitate the photographic studies but the venture proved to be a failure because the herons would not nest near the structure.

Some heron studies were carried on in other nesting areas. The writer, with Dr. J. S. Stanford, visited the heron and cormorant colony of Central Cache Valley and gained some valuable information on the habits of the Treganza Heron. At another time, in the company of Miss Charlotte Dancey, then Physiology Instructor at U. S. A. C., the writer visited a colony of herons located near Franklin, Idaho. This colony was quite similar to the colony near Wellsville, Utah and proved to be very interesting for comparison. Other observations have been made at the Bear River Migratory Bird Refuge near Corinne, Utah, while the writer took part in various field trips to that area.
Species. The heron nesting colony upon which this study is based is a mixed community of the Black Crowned Night Heron (*Nycticorax nycticorax hoactli*, (Gmelin), Brewster's Egret (*Egretta thula brewsteri*, Thayer and Bangs), also known as the Snowy Heron, and the Treganza Heron (*Ardea herodias treganza*, Court). These three species occur commonly in Utah, especially in the central and northern portions. Their gregariousness during the nesting season is very pronounced and under favorable conditions they return year after year to reuse the same nesting site, even building on to the old nests used during the previous years. For reasons discussed later in the thesis the herons have changed the location of the nesting area twice since 1932. Since all three of the nesting sites are similar in their features, the heronry occupied from 1933 to 1936 will be described, thereby becoming a type example.

Location. The heronry is located on the Little Bear River approximately two miles north of Wellsville, Utah. It is reached by following U. S. Highway 91 north from Wellsville about two miles then turning West at Wyatts' lane and continuing in a westerly direction along the winding course of the lane to the ranch of Mr. Heber Bankhead. The heronry lies almost due west of Mr. Bankhead's milking corral and may almost at once be located by the presence of the white Snowy Herons which perch in the treetops of the nesting area and are seen flying about the territory. The location is more accurately given as Range 1 W.; T. 11 N.; Sec. 23 (S.W. ¼); Salt Lake Meridian. The heronry is partly encircled by the Little Bear River and lies about ½ mile S. E. of "The Island". These directions are given from the topographic map, (Fig. 1).

Description of Nesting Territory. The heronry is comprised of a dense hawthorne thicket approximately 1.7 acres in extent. In places
Plate 1. BREWSTER'S EGRET (Snowy Heron), Egretta thula brewsteri
glyphograph of a specimen in the South Cache High School
Museum at Hyrum, Utah)
The Black Crowned Night Heron (*Nycticorax nycticorax hoactli*). (The white plumes arising from the crown have been found to be very important in the social life and courtship of the night heron. 26)
Plate 3. The Black Crowned Night Heron (*Nycticorax nycticorax hoactli*)
Plate 4. The Treganza Heron (Ardea herodias treganzai)
Photograph of male and female specimens in the South Cache High School Museum, Hyrum, Utah
the hawthorne canopy is so dense that one can make his way about on the
tops of the trees by stepping from limb to limb and holding to protruding
branches for additional support. Viewed from one of the higher trees cer-
tain portions of the heronry appear as a dense green carpet of foliage.
The herons seem to favor the young growth, apparently because of its greater
density.

**Natural Protection.** The course of the Little Bear River completely
surrounds the nesting colony on one side and in flood time overflows its
banks inundating most of the ground area. At such times it is practically
impossible to reach the heronry. A boat would be the only means of reaching
the colony, and a poor means, at that, since it would be necessary to
go far upstream and follow the tortuous course of the river until the
heronry is reached. Wading to the colony is impracticable because of the
numerous "oxbow lake" channels which pervade the area and which are filled
with streams of water. The element of isolation by water seems to be an
important factor in the choice of a nesting site by the herons. The heron
associations on the islands of the Great Salt Lake, in the Bear River Marshes,
in the marshes of the Bear Lake area and the colonies in Cache Valley are
all found to be surrounded by water, at least at the time the colony is
re-established following the Spring migration period. It has been found
that herons will abandon a nesting site when it becomes too exposed. This
is probably due to attacks by enemies, including man, which naturally
occur when the heronry becomes easily accessible.

A dense belt of willow and rose thickets, one eighth to one fourth
mile in width, surrounds the heronry and lines the banks of the oxbows.
These thickets are in most places passable to man only with great inconven-
ience. Entanglements of vines and patches of nettle and Canada thistle
make the passage even more unpleasant. The writer has followed the cattle
Fig. 1. Aerial photograph of the territory surrounding the Wellesville heronry on the Little Bear River. (Note the tortuous course of the river, the numerous "oxbow lakes" and the limited extent of dense hawthorne growth suitable for natural cover for the nesting herons. Pond in the upper right section is "Andersons' Pond", an important source of food during the nesting season. Photograph was copied from a Soil Conservation Department map.)
trails that wind about through the thickets as a means of getting through the dense entanglement. Here, again, the factor of isolation seems to be a predominant feature of the chosen nesting area. The aerial map (fig. 1) shows the dense entanglement of foliage and the numerous flood channels which protect the colony.

MIGRATION

Controlling Influence of Weather. Herons are thought to be of tropical or sub-tropical origin since the greatest number of species and individuals is found living in such environments. In the United States the most flourishing colonies of herons are found in such regions as Florida and the warm Gulf States, especially Mississippi and Louisiana. Therefore, it is reasonable to assume that herons react most favorably to a uniform climatic condition. They are especially sensitive to cold extremes of temperature. Conditions of unusual heat are not detrimental to this family of birds. Indeed, they are lovers of sunlight and the fledgeling young are often found basking in full exposure to the sun's rays during the hottest days of the nidification period without exhibiting any signs of discomfort.

While migration of birds is supposedly due to physiological changes within the avian organism the effects of climate or weather as an influencing factor cannot be overlooked. The period of Spring migration of herons in this region, at least, varies from year to year. An explanation is found in an analysis of weather data during the migration period. Not all the factors concerned with the determination of average weather conditions have been considered in this study but an analysis of temperature trends is compared with the progress of Spring migration and the relationships are noted. Daily maximum-minimum temperatures
Graph 1. Mean daily temperatures for a five months period, December to April, incl., for the years 1937-38, 1938-39 and 1939-40, at Logan, Cache County, Utah.

**KEY**
- ~~~~ = 1937-38 curve
- ~~~~ = 1938-39 curve
- ~~~~ = 1939-40 curve
for a three-year period, 1938, 1939 and 1940, covering the months December to April, inclusive, were obtained from the U. S. A. C. weather station. From these the mean daily temperatures were computed by taking the average between the maximum and the minimum. The mean daily temperatures were plotted on a curve and readily show the trend for each year. These curves, when compared with the dates of arrival, show some interesting relationships between temperature and migration. It is assumed, in making these comparisons, that the migration of herons is influenced by temperatures farther south but that the seasonal trends for Cache Valley are indicative of the temperature trends elsewhere.

An analysis of the temperature graph (Graph 1) for the winter of 1937-38 shows that season to have been relatively mild and uniform, the average daily temperature being approximately 31° Fahrenheit. The lowest temperature indicated is 23° and the highest, 63°, giving a range of 40 degrees, which is comparatively narrow. During that season early arrival of the birds was noticeable. The actual dates of migration are shown in Table 1.

The 1938-39 season shows marked temperature fluctuations indicating alternating cold and warm periods of several days duration each. The average temperature was 30°. The lowest temperature was 11° and the highest, 63°, giving a range of 52°. Lateness of Spring weather conditions was noticeable and field crops were unusually late in their development that year. The curve shows a rapid climb in the later part of March and in early April. Migration was correspondingly late in the Spring of 1939 and nesting was delayed considerably.

The 1939-40 season was marked by wide fluctuations of temperature with cold extremes in the early winter months. Rather moderate and uniform conditions prevailed in the later months, February, March and April. The average daily temperature was approximately 35°, lowest,
8° and the highest, 64°, giving a range of 56 degrees. Migration was late but not extremely so.

The height of migration (period of greatest influx) in the nesting area is given in Table 1 for each of the three years and is seen to be the same in 1940 as in 1938, even though the first arrivals came at an earlier part of the season in 1938. The temperature curve for 1940 shows definite uniformity and mildness of temperature after January 25th, while the graph for 1938 shows uniformity and mildness throughout most of the season with cold extremes in the latter part of March. It is apparent that even though migration began at an early date in the 1938 season its progress was slowed by cold temperatures in late March. Conversely, migration in the 1940 season was delayed at the start by the existence of extreme low temperatures in the early part of the season but was accelerated, once under way, because of the ideal conditions in the later months.

Some generalizations as to the relationship of temperature to Spring migration, based on the data presented above, are made here.

(1) Fluctuating temperatures with cold extremes during the Winter and early Spring months are conducive to late migration.

(2) Uniform, mild temperatures are conducive to early migration.

(3) The starting point of Spring migration is influenced by the temperature conditions in early and mid-winter.

(4) The progress of migration is influenced by temperature conditions of late Winter and early Spring.
### Table 1. Spring migration of herons to the Wellsville heron colony during the years 1938, 1939 and 1940

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DATE OF FIRST ARRIVAL BY SPECIES</th>
<th>HEIGHT OF MIGRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treganza Heron</td>
<td>Night Heron</td>
</tr>
<tr>
<td>1938</td>
<td>March 16</td>
<td>April 1</td>
</tr>
<tr>
<td>1939</td>
<td>March 26</td>
<td>April 8</td>
</tr>
<tr>
<td>1940</td>
<td>March 25</td>
<td>April 6</td>
</tr>
</tbody>
</table>
Banding. During June, 1939, approximately fifty young Night Herons and as many Snowy Herons were banded with the regular aluminum bands provided by the United States Bureau of Biological Survey (now the Fish and Wildlife Service, Division of Bird Banding). In addition to the metal bands some birds were tagged on the left leg with colored celluloid bands for purposes of identification while in the immediate area. The young birds were captured while they were in the nests or in the home tree and the aluminum bands were attached with pliers. The results of these banding operations have been disappointing. Only four returns have been received and these have not all been distant recoveries. However, the few returns that have come in are worthy of consideration. These returns are listed in Table 2.

The colored bands have been found to be of no good use since they are difficult to see in the field or even at close range under crowded conditions such as are encountered in the breeding colony. It has been found by other banders that celluloid bands are sometimes removed by the birds themselves, especially by those possessing strong bills. It was hoped that the colored bands would reveal the extent to which the young birds return to the home colony in subsequent years. None of the birds with colored bands attached to their legs have been seen about the heronry or elsewhere since the time of banding.

One interesting fact revealed by the returns listed in Table 2 is that the young Snowy Heron makes a short northward migration late in the Summer, probably as soon as a state of independence is reached after the nesting season. Whether or not this habit is characteristic only of young birds is not known since only the young birds were banded. In each case the northern recoveries were made in the same year that the banding was done. Other observers and banders have noticed this same migration habit in the Black Crowned Night Heron. 23
After their northward journey these two species make their way southward to New Mexico where they follow the Rio Grande River Valley, apparently feeding as they go, to the Gulf of Mexico.
Table 2. Returns from herons banded in northern Utah

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>NUMBER</th>
<th>DATE BANDED</th>
<th>LOCALITY</th>
<th>DATE RETRIEVED</th>
<th>LOCALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Heron</td>
<td>664709</td>
<td>6/24/39</td>
<td>Wellsville, Utah</td>
<td>?</td>
<td>Monterey, Mexico</td>
</tr>
<tr>
<td>Night Heron</td>
<td>672005</td>
<td>5/15/40</td>
<td>Wellsville, Utah</td>
<td>9/10/40</td>
<td>Lordsburg, New Mexico</td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>529218</td>
<td>6/24/39</td>
<td>Wellsville, Utah</td>
<td>July, 1939</td>
<td>Wellsville, Utah</td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>529020</td>
<td>6/1/46</td>
<td>Wellsville, Utah</td>
<td>8/18/46</td>
<td>Blackfoot, Idaho</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>313448</td>
<td>7/15/25</td>
<td>Salt Lake County</td>
<td>8/24/25</td>
<td>Pocatello, Idaho</td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>313353</td>
<td>7/27/25</td>
<td>Salt Lake County</td>
<td>11/16/25</td>
<td>El Paso, Texas</td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>313379</td>
<td>7/27/25</td>
<td>Salt Lake County</td>
<td>9/20/25</td>
<td>El Paso, Texas</td>
</tr>
<tr>
<td>Snowy Heron</td>
<td>3615</td>
<td>7/3/16</td>
<td>Bear River Marshes</td>
<td>1/20/23</td>
<td>Escumapa, Salina, Mexico</td>
</tr>
</tbody>
</table>

* The second section of the table represents returns from herons banded by Bailey.³
SOCIAL LIFE

Communal Association. It was noted in the introduction that the herons are an exceedingly gregarious family of birds. Their love for communal association appears to be especially intense during the breeding season. It is not clearly known why the birds congregate thus during the nesting period, but is supposed by many observers to be due to an instinct for mutual protection. Herons are very seldom found nesting in single pairs. The writer has not observed any such occurrence. In one instance a pair of Treganza Herons which had established a nest in the central colony area deserted the nest with three eggs when the other herons failed to settle in that area. Birds which nested in the outer, less populous areas of the colony were found to be more fearsome and wary than those in the more crowded portions. This would seem to indicate either that the herons gain a sense of safety and protection through close association or that those on the outer edges of the colony had been exposed to frequent dangers or molestations. The latter possibility is not very probable because of the natural protection afforded the entire area by the flood waters and the dense thickets surrounding them.

Gross,\(^{18}\) in writing of the Black Crowned Night Heron, states that colonies of this species may vary from two or three pairs to several thousand individuals. Hayward\(^{20}\) reports having counted several hundred nests in a colony of Treganza Herons north of Bear Lake in Southern Idaho. Cameron\(^{11}\), Pearson\(^{29}\), Shadle\(^{32}\), Pericles\(^{30}\) and many others have given accounts of large numbers of individuals in various heronries.
The Wellsville heronry, though perhaps not one of the largest colonies in Utah, is, nevertheless, one of the most important. On April 23, 1938, the writer attempted to count the number of birds present in the colony. It was possible to roughly estimate the visible birds by hiding in a tall tree and using binoculars. Some difficulties were encountered in making the count since occasional changes in the bird's positions occurred and some of the birds were leaving the area while others were coming in from the feeding areas. It has been estimated that approximately 40 to 50 percent of the birds leave the heronry in search of food during the daytime. Taking this factor into consideration, it is estimated that the colony consisted of approximately 200 Black Crowned Night Herons, 200 Snowy Herons and 15 Treganza Herons or about 412 birds in all. These birds were confined within a nesting area less than one acre in extent.

**Territory Selection.** Where such large numbers of individuals are concentrated in a small area there is naturally competition for living space. With most birds this living space must include sufficient territory to insure an adequate food supply as well as to exclude interference with the courtship procedures and nesting activities. With the herons, however, food supply does not enter in to the contest for individual positions since their food is obtained from distant areas in the marshes, ponds, streams and pastures.

When the first arrivals reach the heronry, usually in late March and early April, they may be seen perched in conspicuous places about the colony. As other arrivals move in, there are frequent and sometimes violent encounters, supposedly due to territory disputes. The birds sit quietly for a long time. Then suddenly a commotion will start when one bird encroaches on the territory of another.
When an encroachment is made fighting usually develops immediately. The encounters are frequently vicious and feathers may be seen flying as the birds thrust violently at each other with their sharp, spear-like bills until one of the opponents leaves the territory. The victor then becomes owner and defender of the immediate territory.

As a result of such contests, enmity finally ensues and each pair of herons seems to settle upon a particular location. In some instances the territorial claim may not include more than a radial distance of three feet. Even after the nesting is begun there may be occasional skirmishes when a strange bird enters the wrong territory. Usually the invader is driven off in such cases.

**Method of Fighting.** Fighting among the herons is a rather scenic affair. These birds are well adorned with beautiful plumes. This is particularly true of the Snowy Heron. In combat procedure the plumes are raised so as to appear as effective as possible. Opponent birds then brace themselves securely and thrust fiercely at each other with their strong bills, emitting loud squawks. Since the necks of herons are quite long they can reach out to a considerable distance. A direct blow from one of the birds is often sufficient to completely dislodge an opponent and send feathers flying as well as inflicting a serious wound. Fighting is usually of short duration and the beaten contestant will either leave the scene or retire to a less exposed position where he is generally left unmolested by the victor. Strife occurs mostly between the Black Crowned Night Herons and the Snowy Herons. Each of these species also fight among themselves. The Treganza Heron lives rather peaceably with the others, a fact which is no doubt due to his preponderance of size and scarcity of numbers. Occasionally, however, the Treganza Heron fights with other members of the same species. On several occasions the writer has observed a
Treganza Heron invade the territory of another Treganza Heron only to be driven away by fierce blows from the sharp bill of the defending bird.

Adjustment of Nest Levels and Dominance. As a result of the settlement of territorial disputes the herons seem to resign themselves to a scale of dominance so that the best fighters and the largest birds gain the most favored nesting positions. Definite nest levels are established according to the dominance of the birds. Thus, where a pair of Treganza Herons and a pair of Black Crowned Night Herons nest in the same tree, the night herons are found nesting at a lower level. When the Black Crowned Night Heron and the Snowy Heron nest in close proximity to each other, the Snowy Heron establishes its nest at a decidedly lower level. Although the Snowy Herons are found nesting at higher levels than the Black Crowned Night Herons in some instances, it is found in these instances that they maintain a considerable distance from the latter species and that the nest is in a less favorable position than the nest of the dominant bird.

Observations on the interactions of the three species of herons show that the Treganza Heron is master while the Black Crowned Night Heron exhibits a dominance over the Snowy Heron. Accordingly, the nests of the Treganza Herons are found in the topmost limbs and in the most favorably exposed parts of the heronry. The Black Crowned Night Herons maintain a higher average nest level than the Snowy Herons. This scale of dominance and order of choice of nesting sites corresponds, also, with the order of arrival in the Spring migration since the Treganza Heron appears first, followed by the Black Crowned Night Heron and later the Snowy Heron. This fact may have something to do with the choice of territory, the situation being one of "first come, first served". This is a factor of secondary importance, however, since many Snowy Herons arrive at the heronry ahead of late stragglers of the Black Crowned Night Heron species and yet the dominance of the
Plate 5. Nests of the Treganza Heron (*Ardea herodias treganzai*)
(Four eggs are usually laid but it is not uncommon to find five and, in rare instances, seven eggs.)
Plate 6. Nest of Snowy Heron in hawthorne tree

Plate 7. Nest of Black Crowned Night Heron in hawthorne tree. (Nests are frequently quite flat like the one shown here.)
Plate 8. Nests of the Black Crowned Night Heron (upper left) and the Snowy Heron (lower). (This picture shows the usual dominant position of the Night Heron over the Snowy Heron where the two species nest in close proximity.)
night herons is expressed in the final settlement of territorial disputes.

In order to substantiate general observations on the establishment of dominance and nest levels, the writer choose two random communities and made accurate measurements of heights and horizontal distribution of the nests. The results have been drawn to scale and appear in the accompanying diagram, Figures 2 and 3. Community "A" (Fig. 1) represents an association where crowding does not exist. Seven nests were found in an area of 50 square yards. This gives an average of about 7 square yards to each pair of birds. Of course, some of the birds utilize more than that amount of territory and some utilize less. In this community it is apparent that the Treganza Heron is dominant, its nest being decidedly higher than those in those in close proximity to it. In the one case where the Black Crowned Night Heron and the Snowy Heron come into close association the night heron nest is seen to be two feet higher than the nest of the other species. One Snowy Heron nest is found at a height equal to nest levels of the Black Crowned Night Herons in this community but is found to be well spaced horizontally from the nest of the dominant species.

Community "B" represents a crowded association of Black Crowned Night Herons and Snowy Herons. The dominance of the night herons is apparent.

Once the territorial disputes are adjusted and the nesting activities are begun, the herons live in comparative peace with each other. Occasional quarrels develop when one bird encroaches on another's territory, either intentionally or by mistake. These skirmishes are quickly settled, usually with the invader being repelled.
Fig. 2. Chart of the horizontal and vertical distribution of nests in a small community of herons, (Community "A")

Code:  - Treganza heron nest  - Night Heron nest  - Snowy Heron nest

Scale: (Horizontal) 1" = 4 ft.; (Vertical) 1" = 2 ft. Height of nests is computed from the base line (red) which represents a level of 14 feet from the ground.
Fig. 3. Chart of the horizontal and vertical distribution of nests in a small community of herons at the Wellsville heron colony, 1938 (Community "B")

Key:  
- Night Heron nest;  
- Snowy Heron nest

Scale: (horizontal) 1 inch = 4 feet; (vertical) 1 inch = 1 foot
Height of each nest is computed from the base line (red) which represents a level of 13 feet from the ground.
Social Life of Young. Most of the young herons are hatched in late May and early June, the exact dates depending upon the type of season and the species involved. As a rule, the Snowy Herons are latest in development. They are fed in the nest for a period of 15 to 20 days. During this period the social problems are not pronounced except that each bird strives hard to get all the food it is possible to get. The full clutch of eggs is usually laid before incubation is begun. Consequently the young of any one family are nearly all of the same size.

In some instances, young of different sizes have been found in the same nest. This usually results in the smallest members of the family being crowded out, sometimes to the extent that they perish for want of food. The smallest birds are sometimes trampled to death while they are very young and helpless. Dead birds are often found flattened and dried on the nest platform or perhaps hanging from the sides of the nest.

After 15 or 20 days of rapid growth the young begin to climb about on nearby twigs and limbs. As their ability to climb increases, they begin to clamor for favorite positions and compete for space. Fighting among the young occurs frequently at this stage and an order of dominance or pecking order is created. Thus, five young members of one Night Heron family might be found perched at various levels in the home tree, the topmost one being dominant and so on down to the weakest, which is found in the least favorable position. The dominant birds are in the best position to receive food from the parent birds and can easily maintain their superior status by reason of their greater vigor.
**Dispersal from the Colony.** Within forty days after hatching the young birds acquire sufficient flying ability to move from one tree to another. During this stage of the young birds' growth, the parent birds encourage them to take short flights by offering the food from a position away from the home tree. The young then fly to the new position to obtain the nourishment. At evening the birds return to the home tree to roost. At such times the heronry is very crowded and very noisy, since there are many private quarrels and demonstrations among the birds as they adjust their positions in the colony. The population of the colony at such times increases four fold or so, including both young and adults. This figure is based upon a 1946 estimate when the actual nesting territory included approximately .5 acre of group space. These figures afford the reader some idea of the crowded condition that exists.

During the last days of July and the first part of August the young are found perched in the willows surrounding the oxbows and the slow streams of the surrounding area. It is during this time that the young become semi-independent, being fed in part by the parent birds and obtaining for themselves small forms of animal life which they obtain from the immediate area. The writer visited the heronry on August 1, 1941 and at this time the birds were perched in trees bordering the Little Bear River. From the top of a tall hawthorne tree the writer could follow the course of the river by the winding trail of white birds perched in the willow trees along its banks. During this period of dispersal from the nest the young are often encouraged by their parent, by calling while circling above the home tree, to go on short flights in order to strengthen the wings and acquaint themselves with the surrounding territory. This period of training helps
greatly in reducing the mortality rate, since the time at which young birds leave the nest is considered to be the most critical period in their life history.

By mid-August, the young have nearly all left the vicinity of the heronry and become totally independent. As the banding returns indicate (Table 2) some of them may have made their way far northward. The communal association of the nesting season thus seems to have been completely dispersed.

FOOD HABITS

Feeding Habits. The herons are naturally equipped with special adaptations for obtaining an adequate supply of food for growth and carrying on other life processes. Their long, naked legs with spreading toes (Plate 4) enable them to be at home in marsh, mudflat or in shallow water where an abundance of small vertebrate and invertebrate life abounds. Their strong, sharp beaks and long, snake-like necks afford them ability to seize quickly moving forms such as insects, fish, amphibians and rodents.

Although the herons exhibit a decided social propensity in their nesting activities, they are nearly always found to be solitary in their feeding habits. The Tregenza Heron is found patiently waiting at the edge of some quiet pond or stream for some luckless fish or frog to chance by or he is seen in the shallow water of the bay or marsh pond, wading slowly, with almost imperceptible motions, disturbing the water as little as possible and intently stalking his prey. Often he is found stalking flooded pastures in search of rodents forced out of their burrows by the water.
The Snowy Heron is found most often in the marshes, oxbows, or at the edges of mudflats in the shallow water wading stealthily about and selecting various forms of aquatic animal life that abound in these places such as insects, crayfish, spiders, snails, small fish and earthworms. The pure white color and graceful ways of the Snowy Heron make him a pleasant subject to observe in these feeding situations.

The feeding habits of the Black Crowned Night Heron differ somewhat from those of the other two species. Seldom seen in the daytime, this bird is more often observed feeding during the early daylight and twilight hours. Hence, the name "Night Heron". His food preferences and methods of hunting take him most often to the edges of ponds and streams where fish can be captured. Sometimes the Night Heron is found searching for rodents in the flooded pastures during the bright daylight hours. These occurrences are not common, however. This bird is found to be quite active on cloudy days and periods of stormy weather.

Food Preferences. The heron appetite includes a wide variety of animal life ranging from snails, worms, insects and crustaceans to various kinds of vertebrates. No vegetable matter is eaten except as it may be accidentally swallowed with the animal food. The Tregenza Heron and Night Heron exhibit a decided preference for fish and probably most of their diet consists of this item. However, they eat crayfish and rodents extensively. The Snowy Heron feeds chiefly on aquatic insects, crustaceans and small fish. A large portion of the food of the young, at least, in this species appears to be composed of aquatic insects such as dragonfly nymphs and diving beetles. Frogs are
occasionally eaten. The fish eaten by the Snowy Heron are usually small sized, 1 to 2½ inches in length.

Methods of Feeding Young. The size of food and method of feeding is determined by the age of the young herons. For a period of four to six days, the young are fed small bits of food which may consist of animal forms such as insects and worms or partially digested fish. The parent bird usually regurgitates the food from the gullet. During the first few days the food is offered with the tip of the bill. As the young become older and more active, larger sizes of food are offered and the material is placed on the edge of the nest for the nestlings to reach. As the young birds acquire climbing ability, the food is placed on the nest or the parent bird feeds them individually from different positions in the tree. The type of food to be offered determines the method by which the young birds are fed. A single fish or other vertebrate is offered individually to the young bird, while a mass of pulped insects, fish and other material is usually regurgitated on the edge of the nest. In the latter case the young birds often fight over the offering. When the young birds learn to take short flights, (usually within 15 to 20 days) the parent bird lights on a conspicuous perch in the vicinity of the home tree and gives the food call which nearly always brings a hearty response from the family. Oftentimes the young of other broods are attracted and are fed by mistake. The young of neighboring nests may encroach and steal food when it is placed on the nest. Later in their development, the young are taught to seek food for themselves.

Food Capacity. The food capacity of a heron, like that of a pelican,
is amazingly large. A young night heron can swallow a fish which weighs more than half as much as the bird's own weight. It is not uncommon to see a young heron with the caudal fin of a large fish protruding from its mouth. The bird remains contentedly in this position until the lower portions of the fish are digested, allowing room for the undigested portion to enter the digestive tract. The gullet is very expandable and will hold almost unbelievable amounts of food material.

**Regurgitation.** Regurgitation of food by the young birds appears to be a reflex act stimulated by fear. When the young birds are approached they often yield up the food stored in their gullets. In this process the bird most often faces the intruder and offers the food in his direction. When one approaches from below he is likely to be showered with partly digested fish and other food particles of an offensive, foul smelling nature. In one instance, when the writer was approaching a nest, a young Treganza Heron regurgitated a large sucker estimated to be between 13 and 14 inches in length. As the fish fell to the ground it struck the rim of the writer's hat. A young Black Crowned Night Heron regurgitated a full grown ground squirrel (*Citellus armatus*). This bird was captured and, in the writer's estimation, seemed to weigh less than the squirrel it had regurgitated.

It is supposed that the habit of regurgitation is useful to the herons for protection, being used either to drive away the enemy by reason of the foul smell of the partially digested food or, perhaps, to offer a secondary source of food to some predator. Again, the process is useful to the young bird to help reduce weight so that it can more actively attempt to escape. The latter statement seems more evidently truthful when the climbing and jumping activities of young herons are considered. The toes of herons are equipped with long claws which have exceptional endurance for holding on to a secured limb or twig. Their long legs and necks adapt them well for
reaching and grasping the branches about them. Thus they make easy work of climbing through the dense foliage of the hawthorne trees. When a young heron chances to fall, which, indeed, is a rare occurrence, he is generally able to quickly secure a new hold on a twig nearby. The writer has observed instances where a young bird has fallen into a seemingly clear space and in the course of the fall has regained a perch. In one of these instances a young night heron was falling to the ground and caught hold of a small protruding branch with a single claw of one foot. After clawing frantically at the air with the free foot the bird finally secured a second hold on another twig. Suspended upside down between two branches, the bird reached up with its long neck and grasped a third twig in its bill. After considerable maneuvering in the manner of a trapeze acrobat, interspersed with short resting periods while it simply hung quietly, the bird finally righted itself and made its way to the top of the tree. A young Snowy Heron was observed to behave in much the same manner when it fell from a branch and succeeded in grasping a new perch while in mid-air. Each of these situations occurred when the bird was trying to escape. It is thus likely that the young birds are aided in their escape activities by getting rid of excess weight caused by a full gullet.

The habit of regurgitation is present among all three species of herons but it is most pronounced in the Black Crowned Night Heron. The writer has gained much valuable data on the food of the young herons by observing the nature of regurgitated material.
Source of Food. The location of various heronries throughout Utah suggests that these nesting sites are chosen not only with respect to natural protection but also with respect to the available food supply. It has been shown how this particular colony is well isolated by flood waters and thickets. A study of the maps, Fig.'s 1 and 4 reveals that the colony is also situated in the midst of abundant sources of food. The numerous oxbow lakes, streams, ponds and marshes formed by the flood plain of the Little Bear River support large quantities of animal life which serve as food for the adults and young. Of particular importance are the large ponds in the vicinity, such as "Andersons' Pond" and "The Pelicans". Mr. Orval Anderson states that the herons come in the early morning and the evening hours to the pond located on his property to feed. Often there may be as many as six Treganza Herons and a dozen Night Herons and Snowy Herons feeding about the pond at one time. Snowy Herons and, occasionally, Night Herons are flushed from the oxbow lakes where they feed in the shallow water or about the edges of the pool. It is not known how far the parent birds travel to obtain food for their young, but apparently a large part of it is obtained from the immediate area, probably within a six mile radius, since the birds are seen feeding there very frequently, especially during the morning and early evening hours.

Food Study - Method of Analysis. Because of the existing controversy over the economic status of herons, the writer has attempted to assemble sufficient information on their food habits to help determine their position with regard to man's welfare. It was not deemed advisable to collect the adult birds during the nesting season, therefore the analyses have been made mostly from the nestlings. However,
Fig. 4. Map of Southern Cache Valley, Utah, showing important heron feeding territory and important individual sources of food. (Taken from topographic map, Logan Quadrangle)
this method provides a good estimate of the status of the birds since the largest part of the food consumed annually by herons in this region is consumed during the nesting season when the demands for food by the young are great. The actual needs of the adult birds for food are inconsequential when compared to the quantities of food consumed by the young.

Four methods of acquiring data on the food of herons were employed in the study:

(1) Some birds were collected; stomachs were preserved and later examined in the laboratory.

(2) Regurgitated material was either analyzed in the field or preserved and later examined in the laboratory.

(3) Food lying on the nests and about the heronry was examined and field notes were made.

(4) Observations on the feeding habits of the birds about the feeding territory were recorded.

Laboratory analyses were made with considerable care. When necessary the stomach contents and regurgitated material were examined under the binocular microscope. Careful identifications of the individual items of food were made. Some insects that were difficult to classify were taken to the Entomology Laboratory where advanced students assisted in the identifications. The food data are listed in Table 3.

Observations of Other Workers on Food of Herons. Knowlton records the food of one Brewster’s Egret (Snowy Heron) taken in the meadows west of Logan, Utah on September 6, 1940. The stomach of this bird contained 12 warior grasshoppers (Camnula pellucida).

Baynard lists the food of fifty young Night Herons as follows:
60 crayfish, 610 small catfish, 31 small pickerel and 79 dragonflies.

Although Baynard's observations were made in the Eastern United States, the type of food indicated for his birds is much the same as that for local species in Cache Valley.

Table 3. A tabulation of the food of three species of herons in Cache Valley, Utah as determined through stomach analysis, examination of regurgitated material and general observations.

<table>
<thead>
<tr>
<th>Species</th>
<th>Food Elements*</th>
<th>Method of determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Heron</td>
<td>1 entire ground squirrel (Citellus armatus) sub-adult</td>
<td>Regurgitated material (field analysis)</td>
</tr>
<tr>
<td>(immature)</td>
<td>1 crayfish (medium size)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 fish (Bass) containing larval nematodes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Furry pellets beneath nest</td>
<td></td>
</tr>
<tr>
<td>Night Heron</td>
<td>Fragments and remains of several crayfish</td>
<td>Regurgitated material (field analysis)</td>
</tr>
<tr>
<td>(imm.)</td>
<td>Furry pellets beneath nest</td>
<td></td>
</tr>
<tr>
<td>Night Heron</td>
<td>12 or more small fish about 3&quot; long; 1 trout species, 1 carp and the balance</td>
<td>Regurgitated material (field analysis)</td>
</tr>
<tr>
<td>(imm.)</td>
<td>suckers and chub.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 large sucker 11 to 12&quot; long</td>
<td></td>
</tr>
<tr>
<td>Night Heron</td>
<td>4 large earthworms</td>
<td>Regurgitated material (field analysis)</td>
</tr>
<tr>
<td>Night Heron</td>
<td>Remains of a large sucker</td>
<td>Found in nest</td>
</tr>
<tr>
<td>Night Heron</td>
<td>1 large ground squirrel (Citellus armatus)</td>
<td>Regurgitated material (field analysis)</td>
</tr>
<tr>
<td>(imm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night Heron</td>
<td>28 Nematode worms (parasitic)Stomach remains of fish</td>
<td>Laboratory analysis</td>
</tr>
<tr>
<td>(imm. male)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Nematode worms listed here are parasitic forms and are not to be considered as food items.
<table>
<thead>
<tr>
<th>Species</th>
<th>Food Elements</th>
<th>Method of determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Heron (imm., female)</td>
<td>32 Nematode Worms (parasitic) of fish</td>
<td>Stomach (Lab. analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>20 Nematode Worms (parasitic) Many elytra and heads of aquatic beetles, many of the genus Tropisternus and Haliplus</td>
<td>Stomach (Lab. analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>1 medium sized fish (10 to 12&quot; long) partly digested 1 head of small fish (Chub) many fish scales</td>
<td>Stomach (Lab. analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>Remains of fish (mostly digested) 1 fragment of aquatic beetle, probably Dytiscus</td>
<td>Stomach (Lab. analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>1 large sucker, approximately 12&quot; long</td>
<td>Stomach (field analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>1 large fish, 10&quot; long, probably Bass sp. scales of fish</td>
<td>Stomach (field analysis)</td>
</tr>
<tr>
<td>Night Heron (imm.)</td>
<td>1 sunfish 3/4 to 4&quot; long pellets on the ground beneath the nest contained: sand grains, labrum of dragonfly, nymph (Aeschnidae) mandibles and elytra of aquatic beetles, Chara moss, other moss, piece of reed (bulrush) and rodent fur (appeared to be from Citellus armatus)</td>
<td>Regurgitated material and pellets (Lab. analysis)</td>
</tr>
<tr>
<td>Species</td>
<td>Food Elements</td>
<td>Method of determination</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Night Heron</td>
<td>Elytra and heads of aquatic beetles, Tropisternalus, Haliplus, Dytiscus and others.</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(imm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>4 dragonfly Nymphs (Fam. Aeschnidae)</td>
<td>Regurgitated Lab. analysis</td>
</tr>
<tr>
<td>(imm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>11 suckers, 2 to 3½&quot; long&lt;br&gt;1 trout sp. 2&quot; long&lt;br&gt;1 unidentified fish (fragments)&lt;br&gt;insect remains, about 3% of total, mostly elytra from aquatic beetles</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(imm. female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>Fragments of aquatic beetles, (elytra, mandibles, legs and indigestible parts. 50 mandibles were counted)</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(adult female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>1 medium sized crayfish &lt;br&gt;several Amphipods (Gammarus) &lt;br&gt;1 large grasshopper (Dissosteira) &lt;br&gt;Remains of aquatic insects &lt;br&gt;3 small stones, probably concretions of Calcium Carbonate (the stones had definite round shape and seemed to be formed in concentric layers)</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(adult male)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>Mandibles and elytra of aquatic beetles, including several Hydrophilus and Dytiscus &lt;br&gt;1 Annelid worm (Haemopsis or Horse leech) &lt;br&gt;Remains of fish (scales and fragments &lt;br&gt;Some leaf fragments</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(imm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egret</td>
<td>50% small fish, 2 to 3&quot; long&lt;br&gt;6 Suckers&lt;br&gt;4 Chub&lt;br&gt;50% insects&lt;br&gt;1 Locust, Melanoplus femur- rubrum&lt;br&gt;3 Locust, Dissosteira Carolina&lt;br&gt;remains of aquatic insects, mostly beetle adults and larvae.</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td>(imm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Food Elements</td>
<td>Method of determination</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
</tbody>
</table>
| Egret (imm. male) | 45 sunfish, range in size from 1 to 2½"  
2 large adult dragonflies, Aeschna  
2 Damsel Fly sp., adult forms  
9 Aquatic Bugs, Notonecta sp.  
1 Dragonfly Nymph, Anax sp.  
1 Aquatic Beetle, Tropisternus sp.  
1 Fragment of large aquatic beetle, Hydrus triangularis, adult form | Lab. analysis |
| Egret (imm.) | 81 larvae of aquatic beetle, Tropisternus sp.  
10 larvae of aquatic beetle, Dytiscus sp.  
2 larvae of large aquatic beetle, Hydrus triangularis  
1 water spider  
36 Mayfly nymphs, mixed species  
1 Damsel fly nymph  
1 Damsel fly adult  
1 adult aquatic beetle, Tropisternus sp.  
13 small fish, ½ to 1½" long, species undetermined | Regurgitated Lab. analysis |
| Egret (imm.) | 37 small fish, 1 to 2 ¾" long, appeared to be sunfish  
1 small fish, 4" long, determined to be sunfish sp.  
5 small fish, probably suckers  
1 large adult dragonfly, Aeschna sp.  
2 adult Damsel fly  
1 water spider  
3 aquatic bugs, Notonecta sp.  
4 large flies, fam. Syrphidae  
1 Aquatic beetle, Dytiscus sp.  
10 large earthworms  
1 annelid worm, sp.  
14 larval nematode worms, parasitic | Stomach Lab. analysis |

Remains of aquatic insects including the large beetle Hydrus triangularis and other small beetles such as Tropisternus sp., Dytiscus sp. and Haliplus sp.
<table>
<thead>
<tr>
<th>Species</th>
<th>Food Elements</th>
<th>Method of determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egret (imm. female)</td>
<td>76 sunfish, range in size from 1½&quot; to 2½&quot;</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td></td>
<td>1 adult sunbass, 4½&quot; long</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 aquatic bugs, Notonecta sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>parts of small aquatic beetles, such as Hamiplius sp., Tropisternus sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and Dytiscus sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mandibles of large aquatic beetles, Hydrous triangularis, larval form</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fragments of fish, partially digested</td>
<td></td>
</tr>
<tr>
<td>Egret (imm.)</td>
<td>1 Giant Water Bug (?)</td>
<td>Stomach Lab. analysis</td>
</tr>
<tr>
<td></td>
<td>7 Leopard Frogs, (4 small, 3 medium)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(one frog stomach contained a large locust, Dissosteira carolina)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 small carp, 2&quot; long</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 large dragonfly nymphs, Fam. Aeshnidae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 large dragonfly adult, just emerged Aeshna sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 larvae of water beetle, Hydrous triangularis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14 meadow Grasshoppers, Conocephalus vaginus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 small dragonfly, adult</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 grasshopper heads, Trimerotopus sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Miscellaneous fragments of aquatic insects and grasshoppers.</td>
<td></td>
</tr>
<tr>
<td>Tregenza Heron</td>
<td>1 Trout sp. (German Brown) was found on edge of nest.</td>
<td>Field Observation</td>
</tr>
<tr>
<td>Tregenza Heron (imm.)</td>
<td>Remains of the Ground Squirrel, Citellus armatus, were found in the nests and were regurgitated by the young birds in the summer of 1933. This occurrence was common during frequent visits to the heronry. Large fish, usually suckers, were often deposited on the nests or were dropped to the ground when the birds were passing over and became alarmed.</td>
<td>Field Observation</td>
</tr>
<tr>
<td>Tregenza Heron (imm.)</td>
<td>On Aug. 1, 1946 a parent bird was seen to deposit a large sucker, 14&quot; long on the nest, presumably for the young.</td>
<td>Field Observation</td>
</tr>
<tr>
<td>Tregenza Heron (imm.)</td>
<td>In the summer of 1935 the writer found ground squirrels, Citellus armatus, Pocket Gophers, Thomomys sp. and the Field Mouse, Microtus sp. very commonly on and under the nests of these birds.</td>
<td>Field Observation</td>
</tr>
</tbody>
</table>
The economic status of herons of this region has long been a controversial issue. Prejudices are widely held against these birds and seem to have been founded upon the idle talk of sportsmen or on circumstantial evidence. A local sportsmans' club was at one time determined to annihilate the heron colony at Wellsville because a single Treganza Heron was making regular visits to the Wellsville Irrigation Reservoir and was feeding on the newly planted game fish. These regular visits by the heron gave some of the sportsmen the impression that many birds were visiting the pond and hence the whole race of birds was blamed for the depredations of a single individual. When the bird was shot the visits of herons were observed to come to an end.

The Night Heron, similarly, has fallen into disrepute among fish and game management personnel. These birds cause some damage at the fish hatcheries throughout the state. They visit the rearing ponds in the early morning and evening hours, lighting on the edge or descending to the surface of the water, to feed upon the abundant game fish found there. In 1938, the writer sought protection for the colony at Wellsville while research was being done. A letter was written to the State Fish and Game Department asking for assistance in protecting the birds. In reply the Fish and Game Commissioner stated that, "If the birds are of the night heron species this department would not be in favor of their protection."

It is conceded by some hatchery managers, however, that local control measures are sufficient to stop these depredations. Often a single bird is responsible for the raids and if this bird is shot, trapped or otherwise disposed of the raids will cease. When several birds make appearances they can be discouraged by the erection of a series of parallel wires at intervals of two feet apart above the rearing ponds. This prevents the birds from lighting. The wire control method was used at the U. S. Government Hatchery in Springville, Utah and was considered by the manager to have been an
Control of Trash Fish. Careful consideration of food data (Table 3) shows that herons do not often feed upon game fish. Most of the fish taken are of such varieties as suckers, carp, chub and sunfish which are commonly known as "trash fish" and are deemed detrimental to the interests of game fish culture since they multiply rapidly and crowd out the desirable species.

Crayfish form an important part of the diet of herons, especially of the Black Crowned Night Heron. Baynard has emphasized the fact that crayfish are known to destroy the spawn of fishes and that herons actually help to make fish more abundant by destroying the crayfish. The crayfish eating habits thus work to the herons' own interests.

Control of undesirable Water Life. Herons give indirect aid to man by feeding upon snails in the pasture lands. This activity helps to control the infestation of flukes in cattle and sheep, since the snail is known to be an intermediate host for the parasites.

Control of Rodents. It is a very common occurrence to find large ground squirrels and field mice in the nests of the Treganza Heron and the Black Crowned Night Heron. The young have been seen to regurgitate ground squirrels on many occasions. Remains of rodents are frequently found on the ground beneath the nests in the heronry. The writer has seen adult Treganza Herons and night herons catching rodents in flooded pastures. Farmers in the vicinity who are aware of these feeding habits appreciate the presence of the birds in their territory. Many of the mice are probably obtained in the marshy meadows by chance seizure as the birds are searching for other forms of animal life also. The control of rodents is seen, therefore, to be a very important factor in the economic importance of the heron family.

Aesthetic Interest. Aside from the good or bad feeding habits one must consider the aesthetic values derived from this family of beautiful birds. Their cooperation and devotion to duty is a moral lesson to mankind. Their
natural beauty and the graceful ways they employ as they pursue their court-
ship and other activities are exciting to the appreciative observer, at least.
The view of hundreds of Snowy Herons perched in the tops of the hawthornes
at sunset is a delightful experience. Such organisms fill a definite place
in the world of nature and mankind is benefitted by their existence.

LIMITING ENVIRONMENTAL FACTORS

Predators. For several years the writer has carefully noted the presence
of any dead herons in the colony, particularly if these birds have exhibited
signs of having been killed by a predator. In all cases where predation was
apparent an effort was made to determine the predatory species involved.
Two species were definitely found to be predatory.

Magpies, although harmless to the adult birds, were found to prey on the
young herons. In two separate instances the writer has watched a magpie
take a young Snowy Heron from its nest and carry it away. It was also seen
that the magpie did not molest the nests containing advanced young.

During the 1958 nesting season the remains of nine Snowy Herons and two
Black Crowned Night Herons, all adult birds, were found in various parts of
the heronry. These kills were traceable to the activities of a Western
Horned Owl which nested in a tall hawthorne tree in the center of the heronry
and raised a brood of three young. Nearly all of the kills bore the same
features. The heads, feet and wings were left among a tangle of feathers
while the fleshy parts of the carcass were torn away. In a few cases the
feathers and parts of the wings were scattered about the immediate area of
the kill. Feet of Snowy Herons were found in the owl’s nest and on the
ground immediately beneath the nest. The writer did not observe any predation
during the daytime, but this fact might be attributable to the nocturnal
habits of the owl. It was also observed that when the owl flew up from its
nest or from a perch within the heronry the herons became very much alarmed and scattered to the outer portions of the area. Their fear of the owl was very apparent and indicated that molestation had taken place.

One pair of Long Eared Owls nested in the heronry in 1939. The remains of one night heron were found in the vicinity of the owl nest but no evidence could be found that would prove that this pair were predatory.

The mischievous magpie is one of the chief natural enemies of the heron family. In its search for food this bird takes a considerable toll of heron eggs. It is aided in its depredations by the presence of other heron enemies such as the Western Horned Owl and, especially, man. Herons are wary and in the presence of danger they leave their nests in an unguarded condition. In this kind of situation the magpie finds it advantageous to sneak about and feed on the eggs in the exposed nests. It seldom invades territory where a heron is standing guard. In one instance the writer watched a magpie as it lit on one of the nests and attempted to pick one of the eggs. It did not notice that the owner of the nest was standing guard only two feet away. The heron suddenly thrust with its bill and completely dislodged the magpie from its perch, sending black and white feathers flying about the area. In the process of taking the eggs the magpie first pecks a hole in the shell, then either eats out the inner contents or takes hold of the broken edge of the shell and carries the egg away in his bill.

Magpies begin their nesting activities at an earlier date than the herons. Consequently they are supporting young at the time the herons are laying their eggs or incubating. This seems to be advantageous to the magpie since the heron eggs are available at the time when the young magpies are growing fastest and their food requirements are large. Again, the herons guard their nests less closely during the egg laying period.

No mammal predators were observed to molest the herons.
Parasites and disease. The possibilities for spread of parasitism and contagious diseases among the herons are great. This is due to the colony nesting activities and consequent crowded conditions. Close intermingling of the young and adult birds is the rule in the heronry. Often, too, the nests are arranged such that some are placed directly over others and the droppings of an infected bird may easily contaminate nests and perches occupied by other birds. After the nesting season is well advanced almost the entire foliage of the heronry is seen to take on a whitewashed appearance due to the coatings of calcareous excreta from the hundreds of young and adult birds. The habits of feeding the young, involving regurgitation of the food from the gullets of the parents, is an unsanitary process and it is easily possible that many young birds are infected with parasites from the adults. The writer has often observed young birds devour food material regurgitated by other nestlings. These occurrences make it possible to spread parasites from one young bird to another.

No comprehensive study was made of the diseases of these birds. Many parasites were collected from the internal organs of the birds taken for dissection or preservation and general observations were made on the condition and vigor of the colony. In the Summer of 1939 the writer observed several sick birds on the ground beneath the heronry. Individuals of each of the three species were seen. They showed the following symptoms; the wings drooped, the head wobbled from apparent weakness and the birds made no attempt to escape when approached. The eyes were of dull lustre suggesting a diseased condition. (Wounded birds do not show the latter characteristic unless a bad infection has developed) Similar cases were noticed in 1934. Unfortunately the writer was not prepared to determine the cause of the condition but it was apparent that the birds were victims of some form of contagion or parasitism since none of them showed any signs of external injuries.
A distinct loss of vitality was noticed in two adult night herons in the 1938 season. These two birds did not participate in the normal activity of the heronry and did not show signs of alarm at the presence of danger, which is an unusual condition. The birds were collected and examined. In each case the proventriculus and gizzard were completely filled with parasitic nematode worms. Nearly all of the night herons and Treganza Herons and many of the Snowy Herons that were collected yielded these parasites from the alimentary tract. In some cases the worms were even found clinging to the mucous lining of the gullet. Infestations are frequently very heavy. Whether or not the helminth parasites are toxic to the herons is not definitely known but the evidence above seems to show that the vitality of the birds is affected by the presence of the worms.

*Tapeworms* (Cestoda) and *spiny headed worms* (Acanthocephala) are also commonly found in the intestinal tracts of herons but infestations of these two types of parasites are usually light or moderate in degree. The two latter groups of parasites are usually found in the small intestine. The nematodes are found in the gizzard, proventriculus and gullet, as indicated above.

**Identifications.** Many parasites were collected from the alimentary tracts of various specimens and preserved for identification purposes. The identifications were made by the Zoological Division, United States Bureau of Animal Industry, Washington, D. C. and are listed in Table 4.

The nematode, *Contracaecum sp.*, is the most common form of parasite infesting the birds. This worm is commonly found in its larval form in the tissues of native fishes. It undoubtedly gets into the alimentary tract of the heron when infested fish are eaten by the bird. The fish probably become infested with the parasite when the water in which they live is contaminated with droppings of the birds. Further evidence of this cycle is seen in the fact that other types of birds, such as cormorants and pelicans, which feed
exclusively upon fish, are abundantly and unfailingly infested with these same nematodes. A previous study of the helminth parasites of Utah birds shows that the frequency of infestation with nematodes is almost 100% for piscivorous varieties. The data shown in Table 3 indicate that all Night Heron stomachs that were examined contained nematode worms. In one case the parasites in a larval state were found in the food material, including fish, that was regurgitated by a young Night Heron. It is seen, also, that the Snowy Heron, which feeds to a lesser extent on fish, is least parasitized by nematodes. On the other hand, the Snowy Heron is most infested with cestode and acanthocephalid worms which are known to be transmitted through small arthropod hosts, such as insects. (See Table 4)

Some flukes (Trematoda) were obtained from the intestines of herons but were not identified. Protozoan forms, notably Coccidia, were found in fecal smears from intestinal contents of the herons but no pathological effects could be determined through general inspection.

**External Parasites.** An attempt has been made to discover the degree to which herons are affected by biting lice (Mallophaga). Many specimens were searched for this kind of parasite but few insects were found on them. Most wild birds are heavily infested with various species of lice. The scarcity of such parasites on herons is a surprising fact since the colony nesting habits of the birds would seem to favor the development of insect parasites. The existence of a pectinate claw on the inner margin of the middle toe is characteristic of all true herons, (Ardeidae), and this fact might explain the absence of lice on the birds. The writer has observed the Tregenza Heron at close range in the act of "combing" the neck and head plumage with the middle toe of one foot. It is suggested by the writer that the pectinate claw is possibly used as a "de-lousing" instrument to rid the heron of external parasites.
Table 4. Identification of some helminth parasites of herons in the Cache Valley area.

<table>
<thead>
<tr>
<th>SPECIMEN</th>
<th>SPECIES</th>
<th>COLLECTED</th>
<th>PARASITES*</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Treganza Heron</td>
<td>Wellsville, Ut., 6/25/37</td>
<td>Nematode, Contracaecum sp.</td>
</tr>
<tr>
<td>22</td>
<td>Night Heron</td>
<td>Wellsville, Utah, 5/15/37</td>
<td>Nematode, Contracaecum sp., (probably C. spiculigerum)</td>
</tr>
<tr>
<td>24</td>
<td>Night Heron</td>
<td>Wellsville, Ut., 5/21/38</td>
<td>Nematode, Contracaecum sp. (probably C. microcephalum)</td>
</tr>
<tr>
<td>28</td>
<td>Snowy Heron</td>
<td>Wellsville, Ut., 5/7/38</td>
<td>Nematode, Contracaecum sp.</td>
</tr>
<tr>
<td>30</td>
<td>American Bitter</td>
<td>Logan, Utah, 5/6/38</td>
<td>Acanthocephalid, Synhimantus sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nematode, Contracaecum sp. (probably C. microcephalum)</td>
</tr>
<tr>
<td>44</td>
<td>Night Heron</td>
<td>Wellsville, Ut., 5/15/37</td>
<td>Nematode, Contracaecum sp.</td>
</tr>
<tr>
<td>51</td>
<td>Snowy Heron</td>
<td>Wellsville, Ut., 5/15/37</td>
<td>Cestode, Raillietina sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Acanthocephalid, Arhythmarhynchus sp.</td>
</tr>
</tbody>
</table>

* Identifications were made by the Zoological Division, United States Bureau of Animal Industry, Washington, D. C.
Mosquitoes are frequently seen withdrawing blood from the young birds. These insects are especially numerous about the heronry and they undoubtedly cause considerable irritation to the young birds.

In some seasons plant lice, (aphids), are especially numerous on the foliage of the hawthornes and they cause irritation to the young herons. This was particularly true in May and June, 1940, when the writer observed that many trees containing nests and young had lost ninety percent of their leaves through the actions of the aphids and that myriads of these insects were crawling about on the young birds causing them to be restless and uncomfortable. Thus these pests reduce the vigor of the young herons and interfere with their natural growth.

**Interference by Man.** Man's influence constitutes by far the most important limiting factor in the welfare of this community of herons. Whether intentional or indirect, his acts have at times jeopardized the existence of the colony and at other times have seriously curtailed its development. The practice of "shooting out" the heronry, popular with prejudiced sportmen, is especially severe on the birds of the colony. The writer has noted the occurrence of these raids many times during the years 1930 to 1934. At such times the raiding parties have been guilty of wholesale cruelty, having shot the parent birds from the tops of the trees, thus leaving the fledgeling young to starve and in some instances having shot the young from the nests in large numbers. The raiders have often excused their actions on the basis of the economic harm the herons supposedly do. Such logic is obviously not founded upon facts but upon prejudice or hearsay since studies of the feeding habits of herons in this area have definitely established them as beneficial to the interests of mankind.

During the period 1937 to 1946 no raids were observed on this colony and the birds have obviously increased in numbers. The colony is well
protected from attacks during the early part of the nesting season by the flood waters of the Little Bear River which inundate the surrounding area, but later the waters subside to the normal channel flow and the heronry is then exposed to attack. It is seen that the colony is then in need of protection for the nests are filled with young and the parent birds are less cautious and self protecting.

Reclamation of land by the local farmers often creates grave dangers for the heron community. In order to clear the dense thickets of willows, wild rose, hawthorne and other foliage it is often necessary to set fire to the brushy areas. Often the fires reach the heronry and burn portions of it. One such fire was set in the early summer of 1932. The fire completely enveloped the nesting area and destroyed hundreds of young birds and eggs in the nests. The adult birds escaped and built a new colony in a dense growth of hawthornes about one half mile south of the original home. However, high mortality rates and disturbances brought about poor breeding conditions and few young were actually reared to maturity in that season. The occurrence of smaller brush fires in and about the heronry has been observed many times since 1932. This factor is seen as a very serious threat to the welfare of the colony.

HISTORY OF THE COLONY

The writer first learned of this bird colony in 1930. It was then located near "The Island" on the Little Bear River. (see Fig. 5). Mr. Orval Anderson, on whose property the colony was located, states that the colony has been there since the land was first tilled. It is probable that this heronry has been established in the area for a very long time for these birds are not likely to change the location of their colony.
Fig. 5. Aerial photograph of the territory supporting the Wellsville heron colony showing the change in location of the colony from 1931 until the present (1947).

Red indicates the original colony occupied until 1933.

Yellow indicates the location of the colony from 1932 to 1939.

Blue indicates the scattered colony of 1940.

Ochre indicates the location of the colony from 1941 until the present time (1947). (Note how this colony is exposed on the East side.)
without serious provocation. It is noted above, however, that the original site of the heronry was destroyed by fire in 1932 and that the herons were forced to select a new location. The heronry was then established in a growth of hawthornes surrounded by a large "hairpin" bend in the river and barricaded on the east side by a dense, wide thicket of willows, rose, entangling vines, nettles and canadian thistle. This new home seemed to have suitable characteristics and the birds nested there for eight consecutive years, 1932 to 1939. The population of the colony increased from year to year, which is a testimony to the natural cover and protection of the location. However, the birds abandoned this heronry in 1940 after a few stragglers had attempted to settle in the area. The reasons for the change are not at all apparent since the abandoned site is the best protected part of the vicinity. In the 1940 season the herons nested in scattered clumps of hawthorne around the immediate vicinity of the original home that had been destroyed by fire in 1932. This act is probably an expression of an instinctive devotion the herons have for the original home colony. Other observers have noted this same characteristic in herons. The birds were unsuccessful in 1940 and in the 1941 season were found nesting in an entirely new situation. The new colony was established in a dense, young growth of hawthornes one half mile to the south on the property of Mr. Heber Bankhead. Here the birds have nested, apparently without molestation, until the present time and their numbers have increased remarkably.

The possibilities for future development of the heron colony are not promising. The natural breeding territory of the herons is constantly diminishing as a result of the agricultural pursuits of man. The aerial map (Fig.1) shows clearly the limited extent of the dense hawthorne-willow association where the herons breed. There are other such favorable
areas in northern Cache Valley but these locations, too, are becoming reduced in size and more easily accessible to man. As land becomes more valuable and machinery for tilling the soil becomes more efficient it is probable that much of the remaining cover will be destroyed and the herons will be forced to seek other nesting sites, perhaps less favorable to their development.

RELATIONSHIPS TO OTHER ANIMALS

The heronry and its immediate surroundings are utilized by many other animals besides the herons. The species that have been observed are listed below and their relationships are explained.

MAILARD (Anas platyrhynchos)
CINNAMON TEAL (Querquedula cyanoptera)
PINTAIL (Pajula acuta)
REDHEAD (Aythya americana)

These birds are found on the river surrounding the heronry and in the oxbow channels. To a slight extent they compete with the herons for food. A nest of the Pintail containing six eggs was found in the heronry on April 16, 1938; the nest was later destroyed by flood waters which inundated the area.

AMERICAN BITTERN (Botaurus lentiginosus)

The bittern inhabits the cat-tail swamps about the region of the heronry and is undoubtedly an important competitor for food since its feeding habits and diet are very much the same as those of the herons.

SWAINSON HAWK (Buteo swainsoni)

One pair nested in a tall boxelder tree one fourth mile south of the heronry in 1937, 1938 and 1939. One pair (thought to be the same pair) nested in a tall hawthorne tree in the middle of the heronry in 1940.
The hawks built their nest on an old Treganza Heron nest and raised four young. A pair of Night Herons raised a brood of young ones no more than five feet away. No signs that would indicate predation on the herons could be found. Most of the food signs about the nest were remains of rodents.

**AMERICAN ROUGH LEGGED HAWK (** *Buteo lagopus* sancti-johannis **)

Two individuals roosted in the heronry in late winter, 1938. Pellets found beneath the roosts contained fur and bones of the field mouse, *Microtus* sp.

**RING NECKED PHEASANT (** *Phasianus colchicus torquatus **)

These birds are common in the weed patches and thickets surrounding the heronry.

**SORA RAIL (** *Porzana carolina **)

Common in the marshes; compete for food with the herons.

**AMERICAN COOT (** *Fulica americana **)

They nest in the oxbow channels and ponds about the region of the heronry and in other regions where the herons seek food. This bird is an important competitor for food.

**KILDERER (** *Oxychus vociferus **)
**SPOTTED SANDPIPER (** *Actitis macularia **)
**WESTERN WILLET (** *Catoptrophorus semipalmatus inornatus **)
**CALIFORNIA GULL (** *Larus californicus **)

These birds are commonly associated with the herons in the irrigated pastures as well as on the mud flats. They are important competitors for food.

**MOURNING DOVE (** *Zenaida macroura marginella **)

Mourning doves nest in the heronry and in the surrounding thickets. Sometimes they utilize old heron nests as platforms on which to build their nests.
WESTERN HORNED OWL (Bubo virginianus pallecens)

One pair nested in the heronry in 1938 and raised a brood of four young ones. This bird is a very important predatory species. It is known to have killed at least twelve adult herons during the 1938 season. Its predatory actions have been described elsewhere in the thesis. (p.48)

LONG EARED OWL (Asio wilsonianus)

A pair of long eared owls nested in the heronry in 1939 and are suspected of predation upon the herons. Remains of an adult Night Heron were found in the vicinity of the owl nest. This species has been seen roosting in the heronry many times.

SHORT EARED OWL (Asio flammeus)

A pair of Short Eared Owls were thought to be nesting somewhere in the heronry during the 1940 season. They were seen in the heronry each time the writer visited the area and they were seen in the surrounding area, feeding at dusk. They apparently do not prey on the herons.

TRAILL'S FLYCATCHER (Empidonax trailli brewsteri)

Common in the thickets surrounding the heronry.

BANK SWALLOW (Riparia riparia riparia)
VIOLET GREEN SWALLOW (Tachycineta thalissima lepida)
ROUGH WINGED SWALLOW (Stelgidopteryx ruficollis)
BARN SWALLOW (Hirundo erythrogaster)
CLIFF SWALLOW (Petrochelidon albifrons)

These swallows are frequently skimming over the ponds of the area during the high water period.

AMERICAN MAGPIE (Pica pica hudsonica)

The magpies are numerous in the heronry and in the surrounding thickets. Six pairs were nesting in the heronry in 1938, eleven pairs in 1939 and ten pairs in 1940. They are important enemies of the herons because they take the eggs and small young herons from the nest. They frequently take fish and other food remains that fall to the ground from
the heron nests.

CROW ( *Corvus brachyrhynchos hesperis* )

Flocks of crows visit and roost in the heronry in late winter as a general rule. Occasionally a pair may be seen about the heronry in the springtime. They are very scarce in late Spring and early Summer which is fortunate for the herons since the crow is known in other areas to be an important enemy to herons through its depredations on the eggs.

LONG-TAILED CHICKADEE ( *Penthestes atricapillus septentrionalis* )

This bird is common in the heronry throughout the year. In the Spring months small flocks are seen picking minute insects from the bark of the trees.

CATBIRD ( *Dumetella carolinensis* )

The Catbird is a common visitor about the heronry. It nests in the surrounding thickets.

ROBIN ( *Turdus migratorius propinquis* )

They are common in the heronry in Spring, Summer and Fall. Some pairs nest within the heronry. One nest was found placed on an old, abandoned Treganza Heron nest. Robins are especially numerous about the heronry in late Summer and early Fall when they feed on the ripened hawthorne berries, prior to migration.

WILLLOW THRUSH ( *Hylocichla fuscescens salicicola* )

Common throughout the heronry, probably nesting in the vicinity. They are often heard singing in the thickets but are seldom seen on account of their extreme shyness.

SCHUFELEDT'S JUNCO ( *Junco oreganus schufeldti* )

Flocks of these Juncos are seen about the heronry in the Winter. They feed on the numerous weed seeds in the clearings among the thickets.
YELLOW WARBLER (Dendroica aestival marcomi)

Common in the trees and thickets of the area. A nest containing four eggs was found in a rose thicket at the south border of the heronry in 1938.

WESTERN YELLOWTHROAT (Geothlypis trichas occidentalis)

This bird is common in the marshes about the area of the heronry.

LONG TAILED CHAT (Icteria virens longicauda)

Nests in the thickets; visits the heronry to feed and sing; adds much color to the environment.

REDWING BLACKBIRD (Agelaius phoeniceus fortis)

Many males are heard singing in and about the heronry in the Spring.

BULLOCK'S ORIOLE (Icteria bullocki)

They were numerous about the heronry in 1940; seemed to be feeding on the aphids. A few pairs nest in the boxelder trees scattered here and there about the area.

LAZULI BUNTING (Passerina amoena)

They are common in the heronry; nest in the thickets.

PINE SISKIN (Spinus pinus pinus)

Commonly seen in the hawthornes in Spring and Summer.

PALE GOLDFINCH (Spinus tristus pallidus)

Small flocks are seen in the thickets and trees in late Winter, Spring and early Summer. They feed in the weed patches among the clearings.

FOX SPARROW (Passerella iliaca ssp.)

SONG SPARROW (Melospiza melodia ssp.)

These two species are common in the heronry. They feed in the undergrowth and on the ground. Both species were numerous in the Spring of 1940. Singing was extensive.
PORCUPINE (Erethizon dorsatum)

One individual was seen in the heronry throughout the Fall, Winter and Spring of 1937-38 season. Two individuals were present in 1939 and early 1940. Their work of "de-barking" the trees was very much in evidence. Nearly every hawthorne tree in the entire heronry had been visited and the upper twigs were stripped. Porcupine dung was found on the ground throughout the heronry.

An interesting relationship developed between the porcupines and the herons. The herons benefitted by the presence of the porcupine by using the clean stripped twigs in building the nests. On the other hand, the porcupine was able to utilize to advantage the abandoned heron nests for resting platforms. Many old nests of herons were found covered with a mat of porcupine dung and two porcupines that were shot during the Spring of 1940 were found lying on old heron nests. The herons and porcupines seem to live peaceably together in the heronry.

GROUND SQUIRREL (Citellus armatus)

This mammal is very numerous in the pastures and alfalfa fields surrounding the heronry. It is a common food item for the Tegananza Heron and the Night Heron. Upon three occasions the writer has seen a Night Heron young with a whole, adult ground squirrel in the gullet. Undevoured ground squirrels are commonly found lying on the nests of the Tegananza Heron. Many of the squirrels are caught as they are drowned out of their burrows by irrigation waters in the pastures.

FIELD MOUSE (Microtus sp.) (probably Microtus montanus nanus)

This mouse is very numerous in the fields and marshes about the heronry. It is commonly eaten by the Tegananza Heron and the Night Heron. It is probably eaten by the Snowy Heron, also. The mice are obtained
under conditions similar to those described above for the ground squirrel or by chance seizure at the edges of marshes and ponds where the herons feed.

POCKET Gopher (Thomomys sp.)

Pocket gopher diggings are numerous in the pastures surrounding the heronry. The Treganza Heron and Black Crowned Night Heron feed extensively on gophers. (Specimens of pocket gophers have been found in the nests of the Treganza Heron and in the crops of young Night Herons.) Many of the gophers, like the ground squirrels and field mice, are taken in the flooded pastures during irrigation periods.

Marmot (Marmota sp.)

One marmot was seen in the heronry in 1939. It is improbable that this mammal has any important relation to the birds unless the larger herons might feed upon the young marmots as they do on the adult ground squirrels and pocket gophers.

Cottontail Rabbit (Sylvilagus nuttallii grangeri)

The cottontail or "brush rabbit" is common throughout the lower regions of the valley wherever thickets or brushy areas might be found. Many individuals have been seen about the region of the heronry. Some have been collected. No direct relation between the rabbits and the herons is seen. The Swainson Hawks which nested in the midst of the heron colony in 1939 preyed upon the cottontail rabbit as evidenced by the fact that one partly devoured specimen was found on the hawk's nest and other remains of rabbits and ground squirrels were present.

Mule Deer (Odocoileus hemionus)

Small herds of mule deer have been seen in the brushy areas and pastures surrounding the heronry. They seem to have no direct effect on the herons but are known to use the dense hawthorne growth for shelter.
General Relationships. Herons are apparently socially repugnant to the smaller-sized song birds. Observations have indicated that nesting songbirds are always scarce in the heronry while they are especially numerous in the surrounding thickets. It has been noticed, also, that the undergrowth and the tree foliage of the heronry is kept subdued by the coating of calcareous excreta from the young birds. At times the whole of the area seems to have been completely "whitewashed" and the effects of retarding the growth of the foliage are very apparent. Other writers have observed this condition in various other heronries and in some instances the trees are actually found to be dead as a result of the action of the limy excretions. On a visit to the heronry site one year after its abandonment by the herons in 1940 the writer was very much impressed by the remarkable change in the foliage of the area. The herbaceous plants and shrubs, as well as the hawthorne canopy, had made vigorous growth and there was a remarkable increase in the numbers of nesting song birds present. Chats, orioles, catbirds, song sparrows, goldfinches, warblers, robins, mourning doves, willow thrushes and chickadees were present and were singing profusely. Except for a few remaining effects caused by the herons and the aphids, the old heronry had become a veritable song bird paradise.
SUMMARY

1. The Wellsville heron colony is a mixed community of three species, the **Black Crowned Night Heron**, **Snowy Heron** (Brewster's Egret) and the **Treganza Heron**. Approximately 400 to 500 of these birds are found nesting in a dense growth of hawthorne trees on the Little Bear River about two miles north of Wellsville, Utah. Isolation by Spring flood waters and dense thickets is an important feature of this chosen breeding territory.

2. Weather factors are found to influence the migration of herons in the Spring. Uniform, mild temperatures stimulate early arrival of the birds while cold extremes retard the progress of migration. The results of banding young herons are shown in tabular form.

3. The social life of herons is discussed. These birds are found to be gregarious in nesting habits but solitary in feeding habits and certain migration activities. Crowded conditions in the heronry create competition for space. A scale of social dominance is developed among the three species and among individuals of each separate species. Spatial relationships, both horizontal and vertical, are established whereby the strongest birds dominate the most favorable nesting positions.

4. Feeding habits are explained. The herons locate the colony in the midst of abundant food. Fish are found to constitute a large percent of the food of the Treganza Heron and Black Crowned Night Heron. These two species also eat small mammals, amphibians and arthropods in large quantities. The Snowy Heron lives chiefly on arthropods and small vertebrates. The food of 13 Night Herons, 11 Snowy Herons and 4 Treganza Herons is tabulated.

5. The **economic status** of herons is discussed and it is shown that they are of definite benefit to mankind since they destroy untold quantities of undesirable water life. The destruction of game fish by herons was proved inconsequential compared with the good deeds the birds perform.
6. Limiting environmental conditions have been considered. The herons have been preyed upon by the Western Horned Owl. The Magpie is an important enemy because it destroys the eggs of the herons. Parasites and disease seriously affect the birds. The roundworm, *Contracaecum* sp., is the most abundant parasite found. The herons were found to obtain the latter parasite by eating fish infected with the larval form of the worm. The activities of mankind constitute the greatest limiting factor in the welfare of the heron community. Destruction of the natural cover through reclamation projects and raids by prejudiced sportsmen have, at times, threatened the existence of the colony.

7. The Wellsville heronry is found to be an old colony, having been in existence at least as long as man has been in the area and probably much longer. Due to the interference of man the birds have changed the location of their nesting site three times since 1932. In each instance the new location has been in the immediate vicinity of the original colony, thus reflecting the instinctive love of the herons for their traditional home. The colony is in danger of eventual annihilation as a result of the encroachment of man, in his agricultural pursuits, on the natural breeding territory.

8. Forty seven species of animals are found to be related to the herons in the ecological community. Some species are shown to be detrimental to the herons. Others are beneficial or neutral in their effects on the welfare of the colony.
1. Allee, W. C.
   1932
   Animal Life and Social Growth -- Baltimore, The
   Williams & Wilkins Co. and Associates, 1932, 159 pp.

2. Allee, W. C.
   1926
   Some Interesting Animal Communities of Northern
   Utah. Sci. M'thly., 23 :481-95

3. Bailey, Alfred M.
   1926
   A Study of the Snowy Herons of the United States.
   Auk, 45 (4) : 430-440

4. Bailey, Alfred M.
   1938
   Brewster's Egret Nesting in Colorado. Condor,
   40 (1) : 44

5. Bailey, Samuel Waldo
   1915
   The Plum Island Night Herons. Auk, 32 (4) : 424-41

6. Baynard, Oscar E.
   1912
   Food of Herons and Ibises. Wilson Bul. 24 (81) :
   167-69

7. Behle, William H.
   1935
   A History of the Bird Colonies of the Great Salt
   Lake. Condor, 37 : 24-35

8. Bennett, Logan J. and Kate E. LaMar

   A Marsh Nesting Colony of Black Crowned Night
   Herons. Iowa Bird Life, 7 : 44-46

9. Bent, A. C.
   1926
   Life Histories of North American Marsh Birds.
   Bul. U. S. Nat. Mus., 135 : 211

10. Bretherton, Wilford A.
    1891
    The Great Blue Heron. Ornith. and Ool., 16 : 90-91

11. Cameron, Ewen Somerled
    1906
    Nesting of the Great Blue Heron in Montana. Auk,
    23 : 252-62
12. Carriger, Henry Ward and John Ray Pemberton
1908
Some Notes on the Great Blue Heron. Condor, 10 : 78-81

13. Christy, Bayard H.
1928
A Wading Rookery. Auk, 45 (4) : 423-29

14. Cooke, Wells Woodbridge
1897

15. Court, Edward J.
1908
Treganza Blue Heron. Auk, 25 : 291-96

16. Dawson, William Leon
1915
The Breeding of the Snowy Egret in California.
Condor, 17 : 97-98

17. Finley, William Lovell
1906
Herons at Home. Condor, 8 : 35-40

18. Gross, Albert O.
1923
The Black Crowned Night Herons of Sandy Neck.
Auk, 40 (1) : 1-30 ; (2) 191-214

19. Hammond, Datus M. and Linden J. Leatham
1938
Some Helminth Parasites of Utah Birds. Ut. Acad.
Sci. 15 : 131-32

20. Hayward, C. Lynn
1932
Important Heron Rookeries of Southeastern Idaho.
Auk, 51 (1) : 39-42

1943
Grasshoppers and Crickets Eaten by Utah Birds.
Auk, 60 (4) : 589-90

22. Lincoln, Frederick C.
1923
1268 : 1-56

23. Lincoln, Frederick C.
1927
1927 : 331-54
   1942  
   Birds of the Great Salt Lake Islands. Auk, 59 (1) : 35-46

25. Newton, Alexander  
   A Dictionary of Birds. London, A. and C. Black,  

   1938  
   Social Behavior of the Black Crowned Night Heron.  
   Auk 55 (1) : 7-40

27. Noble, G. K. and M. Wurm  
   1942  
   Further Analyses of the Social Behavior of the Black  
   Crowned Night Heron. Auk, 59 (2) : 205-224

28. Northrup, Edwin F.  
   1893  
   A Visit to a Heronry. Ornith. and Ool., 10 (1) :  
   11-13

29. Pearson, Thomas Gilbert  
   1927  
   A Birding in Utah. Bird Lore, 29 (5) : 379-383

30. Pericles, Eugene  
   1895  
   Nesting of the Great Blue Heron. Oologist, 12 :  
   179-81

31. Rockwell, Robert Blanchard  
   1910  
   Some Colorado Night Heron Notes. Condor, 12 :  
   113-21

32. Shadle, Albert R.  
   1931  
   A Grand Island, New York, Heronry. Auk, 48 (4) :  
   567-70

33. Stanford, J. S.  
   1937  
   Cormorant and Heron Colonies in Cache Valley, Utah.  

34. Taivner, P. A.  
   1922  
   An Aquatic Habitat of the Great Blue Heron. Canad.  
   Field Nat., 36 : 59-60
35. Treganza, Antivenet and Owen Albert  
1914  
A Forty-Five Year History of the Snowy Heron in Utah.  
Condor, 16 : 245-50

36. Woodbury, A. M. and William H. Behle  
1933  
The Bird Rookeries of the Islands of Great Salt Lake.  
Ut. Acad. Sc., 10 : 165