NESTING OF GREAT BLUE HERONS AT THE COLD SPRING HERON COLONY

Max L. Partch
Professor Emeritus
Department of Biological Sciences
St. Cloud State University
St. Cloud, MN 56301
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Abstract

A Great Blue Heron colony was closely monitored for 30 years. The nine species of trees used for nesting, their diameters, exact location in the colony, the number of heron nests in each, the first and last year of use, and/or the year the tree fell down were recorded.

The number of nests varied from 386 in 1954 to 1,585 in 1974. Although some trees lasted for 30 years, the three most-used trees, American elm, basswood and black ash, had a combined average nest-support life of just over 13 years. The average for 62 paper birches used for nesting was just over four years.

Most trees begin and end their nest-support years with one nest whereas well over 90% begin and end with four or fewer nests.

The maximum number of nests a tree supports depends on the species, its size, and its location in the colony. The latter, especially, may affect the number of years before a tree supports its maximum number. Over half of all trees had more than three nests although one elm had thirty.

Key Words

Ardea herodias, Great Blue Heron, Minnesota, nesting habitat, nest tree longevity, nest tree species, population change.

Nesting of Great Blue Herons at the Cold Spring Heron Colony

Introduction

The Cold Spring Heron Colony is located along the Sauk River between Cold Spring and Rockville in Stearns County, Minnesota. Glacial activity produced an abundance of basins for lakes, ponds and marshes. The Mississippi River is within twelve miles. The property was acquired by The Nature Conservancy in 1968.

This paper traces the nesting history of Great Blue Herons *(Ardea herodias)* in that colony for the 30-year period 1954-1983. The main emphasis is on the relationship between the nests and the nest trees. A damaging storm in September 1983 changed, but did not totally destroy, the colony site. Colony, as used here, has two meanings: the population of great blue herons using this site; the site itself, i.e. the land with the physical environment and the vegetation growing there. The nesting area is essentially an old forested river levee separating a peat bog forest to the north from a partly wooded flood plain to the south. The flood plain trees have been used for nesting only since the 1983 storm.

Methods

A grid with 100' x 100' square quadrats was established in 1954 and expanded over the years as the colony population and the colony site increased (Fig. 1). Site expansion was restricted on all sides: by cultivated fields on the east and west; by smaller trees and later a cultivated field on the north; and by the flood plain on the south.

Field maps of each quadrat were used to record all nest trees by species, exact location, size, number of nests and year last used and/or down.

Not all Great Blue Heron nests are alike due primarily to the stage of construction. Four stages or types were recognized; "complete" type of nest; "plus" (+) type nests; "thin" nests; and "very thin" nests.

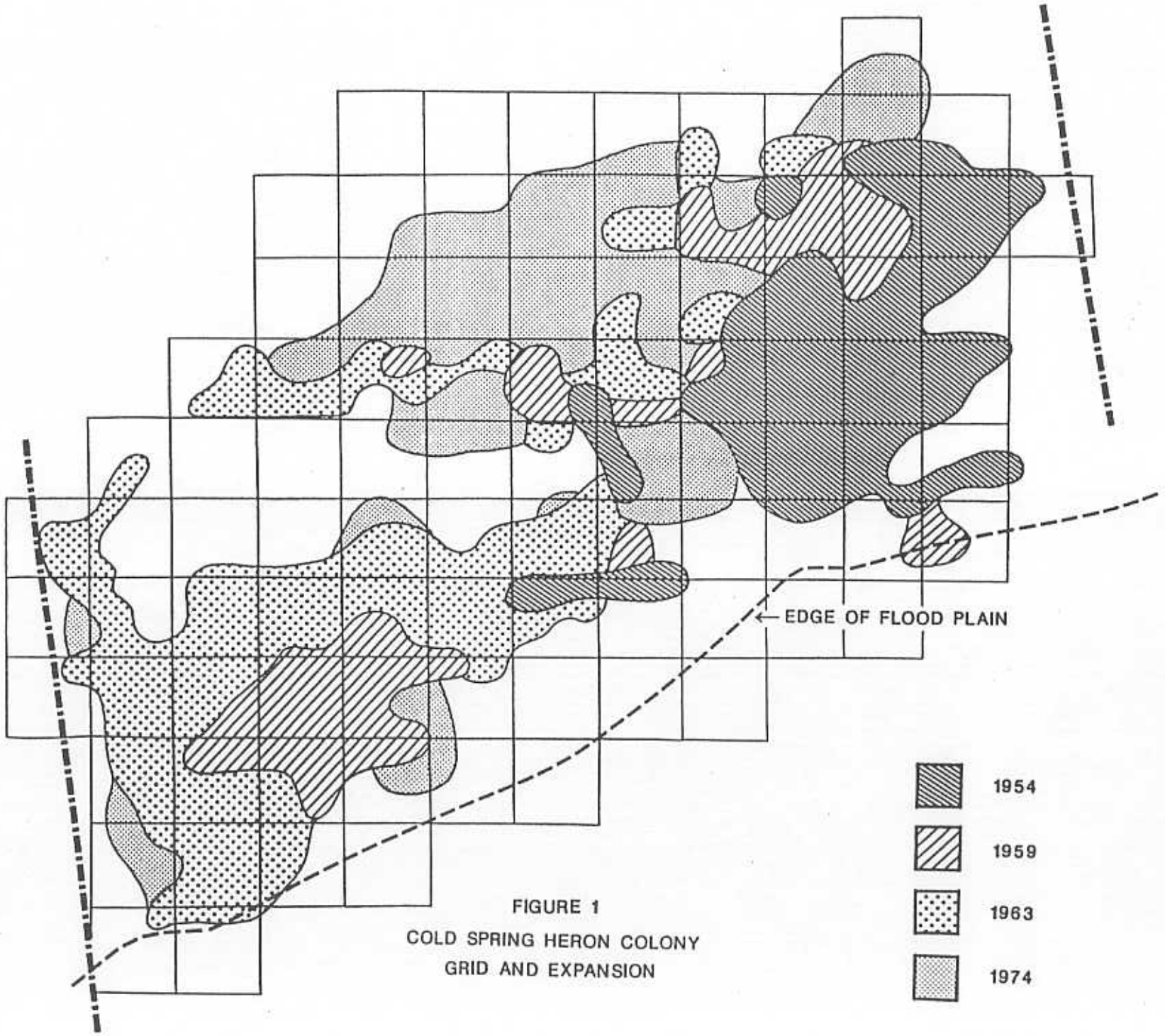

FIGURE 1
COLD SPRING HERON COLONY
GRID AND EXPANSION

The "complete" nests are those that have a thick enough base so that no opening, or light, can be seen from below. The "plus" nests are those with a slightly looser, and perhaps newer, base so that openings may be seen from below. The openings are not large enough to permit an egg to drop through. Incubating birds were frequently seen on such nests so this type has been included with the "usable" nests. A typical entry at the proper tree on a field sheet might be "5+1" which would mean five "complete" nests and one "plus" nest. Although these latter designations have been used in Tables 1 and 2, the numbers of nests in other tables refer to "usable" nests.

Those platforms which would not hold an egg were recorded as "thin," whereas just a few random sticks that did not yet even suggest a platform were recorded as "very thin."

Results and Discussion of the Following Phases of the Study

Colony Expansion

Figure 1 shows the limits of colony expansion as of four significant years. In 1954, when the study began, the colony was mostly restricted to the east side of the woods with a hint of future expansion. A major expansion occurred to the SW in 1959. By 1963 the colony had reached the west fence. At the height of the colony population in 1974 new areas in the colony were used extending the nesting area especially to the north.

Using the total quarter-quadrats (50' x 50') for the calculation of the area actually used for nesting, the colony occupied 1.1 hectares in 1954. In 1974 the colony occupied 4.4 hectares at which time it extended for one forth mile along the levee. The 100 nest trees used in 1954 increased to 447 in 1974.

The total cumulative number of each of four types of nests, over the first 30 years of this study, 1954-1983, is shown in Table 1.

Table 1. The Cumulative Number of Four Nest Types for 30 Years

Type of Nest	# of Nests	% of Total	
"Complete"	28,906	97.04	
"Plus" (+)	694	2.34	99.4%
"Thin"	133	0.44	usable
"Very Thin"	53	0.17	
	29,786		

One annual nest count was made in April, but the most accurate counts were made the first week of May. An earlier count resulted in more "plus" and other incomplete nests because nests were still being made. A count later in May was difficult or impossible because of the density of the canopy foliage. An early May nest count is perhaps 99.4% accurate (Table 1). There were several instances of "complete" and "plus" nests recorded in fall counts that were not evident in the spring. Even in May, the number of nests in one tree has been known to change from seven to nine between the 4th and 9th of the month. Nests recorded as "thin" in late April have become "complete" in May.

Other nests recorded on the field sheets as "old" were either compact masses of sticks with no new sticks projecting, and obviously not used, or were nests that had fallen lower in the tree, usually in a lower crotch where they would not be used. Over the years there were about 165 of these "old" nests still in the trees. No doubt others had fallen from the trees and went unrecorded. Adding these "old" nests to the total would bring the cumulative number to 29,951. The "old" nests were 0.55% of this total.

The greatest number of "plus" nests occurred in the central quadrats of the colony. This indicates that the herons preferred the central locations and will compete to nest there even if it means later nesting. In contrast, the north central colony area, with fewer nest trees, showed higher percentages of both "plus" and "thin" nests. This area is less desirable than the levee area adjacent to the flood plain because of smaller trees.

30-year Population Change

Table 2 shows the number of usable nests in the colony from 1954-1983. This is the best index to the heron population over the 30 years.

The curve in Fig. 2 shows a mostly steady, four and one half fold, increase in the number of nests from 354 in 1955 to the peak 1,585 nests in 1974. The decrease in the number of nests that followed was probably due to less population pressure by the herons not the lack of nest sites. After 1979 the number of nests again showed a steady, though moderate, increase.

The percent change column in Table 2 indicates that there was an increase in 21 and a decrease in 8 of the years. Except for 1969, there is an apparent general downward trend in the percentages of increase over the 30 years.

Although there were decreases in 1955, 1965, and 1975 I would hesitate to suggest that this indicates some cyclic behavior. The apparent decrease in 1955 might be due to the earlier survey date in April of that year, when the percent of "plus" nests was 15%, the highest ever recorded. Another period of relatively high percent of "plus" nests was from 1968 through 1970 when the population was increasing rapidly.

Table 2. Changes in the Number of Usable Nests

Year	Usable Total	Percent "Plus"	Number Change	Percent Change
1954	386	0.8	--	--
1955	354	15.0	- 32	- 8.3
1956	420	1.4	+ 66	+ 18.6
1957	460	0.2	+ 40	+ 9.5
1958	516	0.4	+ 56	+ 12.2
1959	633	0.9	+ 117	+ 22.7
1960	650	2.9	+ 17	+ 2.7
1961	706	1.4	+ 56	+ 8.6
1962	808	1.4	+ 102	+ 14.4
1963	857	2.0	+ 49	+ 6.1
1964	792	2.3	- 65	- 7.6
1965	755	2.8	- 37	- 4.7
1966	830	2.6	+ 75	+ 9.9
1967	930	2.8	+ 100	+ 12.0
1968	956	4.5	+ 26	+ 2.8
1969	1,228	4.1	+ 272	+ 28.4
1970	1,270	4.5	+ 42	+ 3.5
1971	1,408	1.0	+ 138	+ 10.9
1972	1,504	3.6	+ 96	+ 6.8
1973	1,455	1.3	- 49	- 3.2
1974	1,585	1.4	+ 130	+ 8.9
1975	1,256	2.1	- 329	- 20.8
1976	1,382	2.1	+ 126	+ 10.0
1977	1,271	1.4	- 111	- 8.1
1978	1,151	1.5	- 120	- 9.4
1979	1,130	1.6	- 21	- 1.8
1980	1,191	0.9	+ 61	+ 5.4
1981	1,205	2.6	+ 14	+ 1.2
1982	1,252	1.9	+ 47	+ 3.9
1983	1,259	3.6	+ 7	+ 0.6
	29,600			

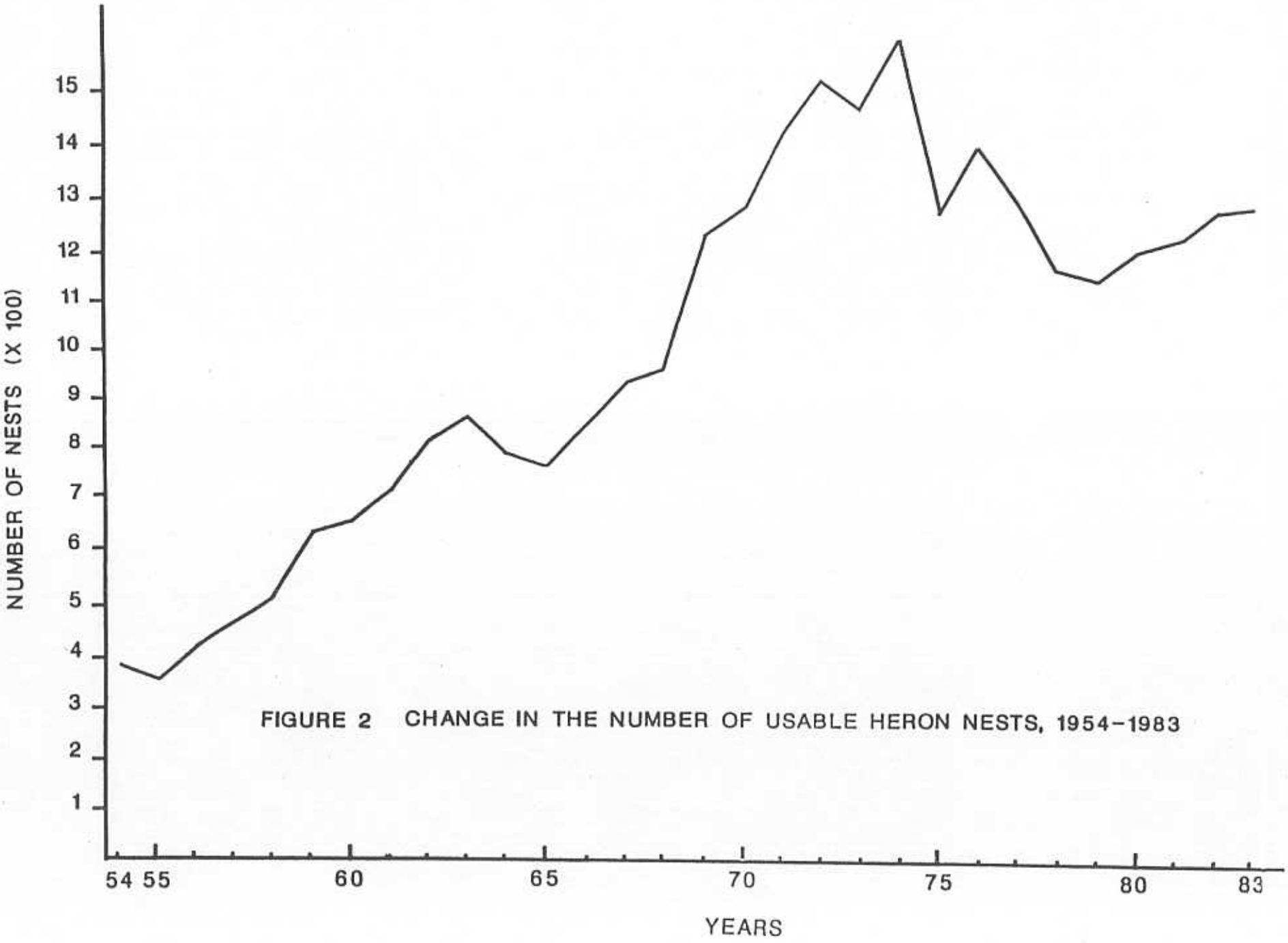

FIGURE 2 CHANGE IN THE NUMBER OF USABLE HERON NESTS, 1954–1983

Seasonal Changes in Number of Nests

Heron nests may fall or be blown out of the trees at any time of the year. During the 30-year period, nest counts were made at irregular intervals from October to April in addition to the "official" May count. If the rate of nest fall were constant through the year, i.e. the same every month, one would expect the lowest percent decrease in the number of nests, compared to the May maximum, to be found in late summer or fall, then increasing during the winter months and reaching the highest percent of loss, compared to the previous May, just before the herons return to repair and/or rebuild nests. But, due to the vagaries of weather and dead trees, this is not always the case (Table 3).

In 1967 there was a 37% loss of nests between May and November, the greatest decrease registered during the 30-year period reported here (this excludes the 88.7% nest loss by wind in September 1983).

In 1963 the loss between May and December was 7.9% and between May 1963 and March 1964 still only 8.6%, thus a 0.7% loss from December to March. Between May of 1982 and April 1983 the decrease was 12%. These are the lowest losses determined during the study. The 8.6% decrease to March 1964, ten months after the original May count, represents a nest loss of less than 1% per month. The 37% loss as of November 1967, or six months after the May count, represents a nest loss of just over 6% per month. The average decrease of all thirteen "off-season" nest counts is just over 2% per month. The evidence suggests that most nest loss occurs in summer and early fall and is not constant throughout the year.

Because of the dense foliage it would be difficult to determine when the absolute maximum number of nests for the year normally occurs. This could be mid or late May or early in June. The main reasons for supporting early May are: 1) the percent of "plus" and "thin" nests is low at that time signifying that nest building is practically complete, and 2) most nests contain young by early May.

Table 3. Percent Decrease in the Number of Nests Following the May Count

May to Recount Year		Re-count Month after May count						
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1957	1957		14.6					
1963	1963			7.9				
1963	1964						8.6	
1964	1965					14.5		
1967	1967		37.0					
1970	1971							28.0
1971	1971			15.3				
1972	1973						15.6	
1974	1974	26.8*						
1974	1975					24.8		
1975	1976						13.1	
1979	1979			12.6				
1982	1983							12.0
		26.8	25.9	11.9	----	19.8	12.4	20.0

*limited sample

The Nest-life of an Occupied Tree

How many years can one tree support the nests of Great Blue Herons? Because of the chemical nature of the droppings and other events, every nest tree eventually dies and falls to the ground. Herons, however, are not the only cause of tree mortality. Wind is an ever-present threat and recently Dutch Elm Disease has taken a significant toll.

There were 732 nest trees used during the 30 years. One hundred of these were already in use in 1954 and are labeled the "early" years group in Table 4. Three-fourths of these were either elm or ash. The "later" years group of 315 nest trees, first used after 1954, were still in use in 1983. Basswood had replaced ash as the second most important nest tree. The "middle" years group included 316 trees which began and ended their nest-supporting life-spans between 1954 and 1983. Birch was used mostly during the middle years, but was not selected during the early years of the colony when other, more favorable, species were available. When birch was finally used the individual trees did not long survive.

Table 4. Number of Nest Trees, by species*, used during three time periods.

Species	Early Years	Middle Years	Later Years	Total #	% of Total	Cumulative %
Elm	36	114	175	325	44.4	44.4
Ba	13	74	98	185	25.2	69.6
Ash	37	46	33	116	16.2	85.8
Bi	3	59	-	62	8.4	94.2
H	11	12	7	30	4.1	98.3
YBi	-	9	-	9	1.2	
Pop	-	1	1	2	0.3	
Tam	-	1	-	1	0.1	
BO	-	-	1	1	0.1	
Total	100	316	315	731	100.0%	

*Abbreviations for tree species:

Elm = American Elm	*Ulmus americana* L.
Ba = Basswood	*Tilia americana* L.
Ash = Black Ash	*Fraxinus nigra* Marsh.
Bi = Paper Birch	*Betula papyrifera* Marsh.
H = Hackberry	*Celtis occidentalis* L.
YBi = Yellow Birch	*Betula lutea* Michx.
Pop = Trembling Aspen	*Populus tremuloides* Michx.
Tam = Tamarack	*Larix laricina* (DuRoi) K. Koch
BO = Bur Oak	*Quercus macrocarpa* Michx.

Table 4 shows the number of trees in all three groups. Five species accounted for over 98% of the total, with elm the most abundant. Except for the one bur oak and the hackberries, which occurred on the levee, the other species are typical of lowland and bog forests in central Minnesota.

Sixteen of the orginal hundred trees were still in use in 1983 having lasted at least 30 years. The remainder, of those in use in 1954, are known to have been in use from 1-29 years as seen in Table 5, and, for an undetermined number of additional years before 1954. Except for the birches which lasted 9 years or less, and the basswoods which lasted 10 or more years, the other species had a random number of years of use.

The average number of years that the trees of various species in the three groups were used for nesting are shown in Table 6. For the most used species, elm, basswood, ash, birch and hackberry, the averages for the number of years occupied ranged from 4.1 years for birch in the "middle" years to 18.3 years for basswood in the "early" years (or 20.1 years if the two 30-year basswoods are included).

Table 5. Years used by species in the "early" years group

Years of Use	Elm	Ash	Ba	H	Bi
1	3	1		1	1
2	2				
3		1			
4					
5	1	1		1	
6	1				
7	1	1			
8		1			1
9	3	3		1	1
10	1	3	1		
11	1				
12	1	3			
13		1			
14	2	4	1	1	
15					
16		2	3		
17	2	1			
18				1	
19		3			
20	1		1		
21	2	2	2	2	
22	1	1		2	
23	1	2	1	1	
24	2		1		
25					
26					
27	3	2			
28					
29			1		
30	8	5	2	1	/=16
Total	36	37	13	11	3 /=100

Table 6. Average Nest-Supporting Life-Span of Trees

Species	Early Years	With 30-year trees	Middle Years	Later Years	Average of all Years
Elm	13.7	17.3	9.9	14.9	13.5
Ba	18.3	20.1	10.8	16.3	14.4
Ash	14.2	16.5	7.7	15.8	11.8
H	15.6	16.9	12.8	18.0	15.5
Bi	6.0	-	4.1	-	4.2
YBi	-	-	4.7	-	4.7
BO*	-	-	-	15.0	15.0
Pop	-	-	1	14.0**	7.5
Tam	-	-	2	-	2.0

* Only one bur oak used.
** An abberation. This aspen was used only the first and the last years of the 14-year spread.

The averages for the number of years used in the "early" and "later" years groups were higher than in the "middle" years group. These averages would be even higher if the actual years of use were known.

The averages for the "middle" years in Table 6 do not convey the full scope of tree longevity. The reason is partly because there are more trees that were used for only 1-5 years (Table 7). Of the five main species of trees listed for the "middle" years group by far the greatest percent of birches (27.1%) were used for only one year, whereas 71.2% of birches were used for five years or less. Over 68% of the ashes were used for five years or less, as were over 25% of the basswoods and 33% of the elms. About 43% of all the trees listed were used for five years or less.

The highest percents for elm, basswood, and hackberry, were in the 11-20 year column. Although the average nesting life-span for elm is 9.9 years in the "middle" years group, there were 34.2% of the elms used for 11-20 years and almost 8% with nesting life-spans of 21-27 years.

The high percentages of 1-5 year trees in the "middle" years group may be interpreted as the temporary experimental occupation of trees which were less desirable either because of size, species, or location in the colony. The low frequency use did not occur with hackberry because they were the right size for continued use and were in a favorable location in the colony on the levee.

Table 7. Percent of Years Used by 5 Species of the Middle Years Group

Species	Years of Use				
	1 Year Only	1-5	6-10	11-20	21-29
Elm	14.0	33.3	24.6	34.2	7.9
Ba	9.3	26.7	24.0	41.3	8.0
Ash	13.7	68.6	7.9	15.7	7.8
Bi	27.1	71.2	23.7	5.1	-.-
H	-.-	16.7	16.7	58.3	8.3
	Average.	43.3	19.4	30.9	6.4

Nest Use In Individual Trees

No two trees have exactly the same pattern of nest use. Some trees are used for consecutive years, some intermittantly, some for only one year, and some for 30 years or more. There is a wide range of maximum number (Max #) of nests that a tree will support and the year when the Max # is reached. Every year some tree(s) are used for the first and/or last time.

Trees may be used intermittantly because of species, size, or location in the colony. Such trees affect the calculation of the number of years to reach the Max # of nests. Also affected would be the possible number of heron pairs to use a tree which may be different than the Max # in that tree (Table 8).

One elm with a 61" circumference (49.3 cm d.b.h.) located in the NW 1/4 of the NE 1/4 of Quadrat 10 is used as an illustration. Significantly, Quadrat 10 is peripheral in the colony.

Table 8. Number of nests in one elm tree

Years	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
E61 NE-A	1	1	2	2	-	-	-	2	3	1	-	1	4	4	4

In Table 8 a logical, but hypothetical, interpretation could be that one pair nested in 1971 and 1972. "Pair" as used here does not mean to imply that the same male and female are bonded year after year. A second pair also used the tree in 1973 and 1974. These two pairs abandoned the tree in 1975, 1976, and 1977. For any number of reasons they "disappeared."

Two new pairs, #3 and #4, occupied the tree in 1978 and they shared the tree with pair #5 in 1979. One pair continued in 1980. These latter three pairs "disappeared" in 1981. Pair #6 occupied the tree in 1982 along with pair #7, #8, and #9 in 1983. Nine pairs could have used this tree in 13 years even though the Max # was never more than four.

(This tree also supported four nests in 1984 and 1985 but was reduced to a stub in 1986 with no nests thereafter.)

This tree could be interpreted as taking 2 or 13 years to reach the Max # of four.

Fluctuations in nest numbers seem to be normal in the vast majority of the colony trees even when the numbers do not drop to zero. It may be possible to calculate an average number of years that one pair would use a tree from such nest data.

It should be kept in mind that all live trees are continuously growing, therefore a tree that may be able to support only one or two nests intermittantly for several years may then reach a size which can support more nests. Also, as the colony grows, a tree may not continue to be peripheral.

Now, after 30 years, it is probable that most, if not all, of the nests in the colony are on branches that did not even exist in 1954.

A Hypothetical Nest Tree Population Curve

Typically one might expect a tree to be occupied by one or a few nests for the first year that it is used. Then if the tree is large enough to support more nests the numbers would increase over the years, gradually or rapidly, thus resulting in different Rates of Increase. At some point a Max # of nests would be reached which that tree, depending on the size and species, could support. The Max # may be maintained for one or more years. Then, as the tree begins to die, branches are gradually lost, crotches for nest placement disappear and the number of nests decreases over the years (Rate of Decrease), possibly to one lone surviving nest clinging precariously to what is little more than a tall dead stub before it, too, falls to the ground or can no longer support a nest.

Nest Numbers During the First Year of Tree Use

A tree first used for nesting is occupied by just one nest about 78% of the time. The 636 trees included in part of Table 9 are those that were first used after 1954. Almost 91% of all the trees start with one or two nests, 95% start with no more than three nests, and 98% of all trees have no more than four nests when first used. The average number of nests during the first year is 1.4. Thus it follows that Great Blue Herons, although colony nesters, do not ordinarily invade a new nest tree as a group but as pairs. Great Blue Heron migration and foraging are also essentially solitary activities.

Ten nests were found in each of three trees during their first year of use. The elm trees that were occupied the first year by from 5 to 10 nests were larger than average for the species, (68.1 cm d.b.h. vs. an average of 45.7 cm d.b.h. for all elms used for nesting). Comparable figures for basswood are 65.0 cm vs. 42.2 cm and for ash 50.5 cm vs. 38.4 cm. Nine of these trees were first used in the years 1959 to 1963 when the big colony expansion to the southwest quadrats occurred (Fig. 1). Three coincide with colony expansion to the north.

Table 9. The Number and Percent of Trees That Supported Various Numbers of Nests During the First and Last Years of Use

First Year of Use				Last Year of Use		
# of Nests	# of Trees	% of Trees	Cum. %	# of Elms	% of Elms	Cum. %
1	494	77.7		243	66.8	
2	84	13.2	90.9	58	15.9	82.7
3	26	4.1	95.0	27	7.4	90.1
4	19	3.0	98.0	13	3.6	93.7
5	5	0.8		6	1.6	
6	2	0.3		4	1.1	
7	2	0.3		5	1.4	
8	1	0.1		4	1.1	
9	-	-.-		2	0.5	
10	3	0.5				
13	-	-.-		1	0.3	
18	-	-.-		1	0.3	
Total	636			364		

Rate of Increase of Nests in Individual Trees

The Rate of Increase was calculated for each tree by counting the number of years, starting from the first year of occupancy, to the year when that tree supported various numbers of nests. An example is given in Table 10. Similar data are presented in Table 11.

Table 11 shows the average % frequencies of Rates of Increase in various year classes. Of the 300 trees used to calculate the average number of years to reach two nests, 71.3% of these were in the 1-5 year category. For one tree it took 22 years before the usual one nest was increased to two. Whereas the percentages in the 1-5 year column tend to decrease with an increase in the number of nests, the mode, or high point, of the percentages in the other columns coincide with progressively higher nest numbers (underlined). Almost 40% of the Rate of Increase data for eight nests was in the 11-15 year group. Eight trees happened to reach eight nests in five or less years (16.7%) whereas it took one tree 26 years to reach eight nests (2.1% of this group of 48 trees).

Table 10. Method Used to Determine the Rate of Increase for E40 SE-B Quadrat 6

The years when this tree was used.

Year	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83

The actual nest count for each year.
Successively higher nest numbers underlined.

# Nests	1	2	1	2	3	3	3	3	4	6	7	6	5	4	6	6	7	6	7	8	11	10

NOTE: It took four years for an increase from three to four nests, but only one year for an increase from eight to eleven nests.

The number of years to reach each successively higher nest number.

# Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Thus it took five years to reach three nests and 21 years to reach the Max # of 11.

Table 11. % Frequencies of Trees to reach various nest numbers and Average Number of Years to reach various numbers of nests per tree.

# of Nests	# of Trees	Year Classes = years to reach a certain nest number. 1-5	6-10	11-15	16-20	21-25	26-30	Avg.
2	300	71.3%*	22.0	5.7	0.7	0.3		4.4
3	240	52.1%	32.9	14.6	0.4			6.0
4	175	34.3%	34.3%	22.8	6.8	1.7		8.2
5	135	32.6	35.6%	23.7	7.4	0.7		8.4
6	80	31.2%	30.0	28.8	8.8	1.2		9.4
7	65	18.5	36.9%	30.8	7.7	4.6	1.5	10.3
8	48	16.7	25.0	39.6%	14.6	2.1	2.1	11.4
9	37	24.3	29.7%	29.7%	16.2			10.2
10	22	18.2	27.3%	27.3%	13.6	13.6		11.4
11	12	0.0	25.0	33.3	41.7%			14.0
12	17	11.8	23.5	29.4%	29.4%	5.9		12.7

*Underlined is highest % for each nest number.

The characteristics of the trees that seemed to take an abnormal amount of time to reach a certain nest number are of interest. No birch trees ever lived long enough to be considered as taking an abnormal amount of time to reach any nest number. The average diameters of those trees that took 20 or more years to reach certain nest numbers were smaller, except for hackberry, than the average for all nest trees for the species involved. The slow Rate of Increase for one hackberry is due to its location. In 1960, when it first had one nest, it was at the edge of a new part of the colony site which seems to be less favorable than an interior location. Further, this tree supported only one nest for each of its first years and then contained no nests for the next four. By 1969, when five new trees in the quadrat were being used, this hackberry was in a more interior position and it supported three nests. There was then an increase to seven nests in 1982 and 1983.

The Maximum Number (Max #) of Nests per Tree

Table 12 shows the number of trees of each species to reach Max # of nests. For example, 24 elms reached a Max # of five nests and four birches reached a Max # of five which was also the highest Max # for any birch. Eighty-five percent of birch trees had a Max # of only 1 or 2. Individual birch trees have the lowest average life expectancy as nest trees of the five most used species in the colony. The highest maximums occurred in elms, the most abundant species. The highest maximum of 30 nests was in a large, 100.6 cm d.b.h. elm.

Table 12. The Number of Trees of Each Species to Reach Various Max # of Nests

Max # Nests	Elm	Ash	Ba	H	Bi	YBi	Pop	BO	Tam	Total	Cum. %
+1*	4	1			3					8	
+2*	1									1	
1	65	33	36	6	36	6	2		1	185	26.4
2	41	16	39	5	14	2				117	42.5
3	37	18	27	4	5	1				92	55.1
4	41	9	26	3						79	
5	24	17	19	4	4					68	
6	19	5	13	2						39	
7	21	5	9	2						37	
8	15	4	7							26	
9	14	2	4	1				1		22	
10	7	3	2	2						14	
11	5		2							7	
12	5	1	1							7	
13	6	1								7	
14	4									4	
15	2	1								3	
16	2									2	
17	4	1								5	
18	1			1						2	
19	3									3	
20										-	
21	1									1	
22										-	
23	1									1	
24										-	
25										-	
26	1									1	
27										-	
28										-	
29										-	
30	1									1	
TOTAL	325	117	185	30	62	9	2	1	1	732	
Avg. Max #	5.2	3.8	3.7	4.4	1.7	1.5	1.0	9.0	1.0		

* Some trees had Max # of "plus" nests only.

Decreasing Max # of nests, following elm, were in hackberry, ash, basswood, bur oak (one tree only), paper birch and yellow birch. The bur oak probably had not reached its potential Max # before being blown down. The hackberry average seems high but this is due to the relatively low frequency of one- and two-nest maximums. Fifty-five percent of all of the trees had maximums of three or less nests.

Table 13 lists the average diameters at the same time when the Max # of nests was reached. Several diameters were extrapolated from actual measurements or were calculated from known growth rates following actual measurements.

As noted in Table 13, basswood average diameters are lower than elm measurements, for comparable Max # of nests. Therefore, basswood trees support more nests than elms of comparable size. The average diameters for ash are consistantly lower, for corresponding Max # of nests, than either elm or basswood. Ash may be considered the most efficient provider of nesting locations in this colony. This is due to the form of the tree and to the size and rigidity of the twigs and branches.

Some measurements for hackberry (Table 13) might suggest that, compared to other species, they should support higher maximums. The two hackberries with a Max # of 10 averaged 64.0 cm d.b.h. One ash of smaller size supported 17 nests and one elm of the same size had a maximum of 21 nests. The elm tree shape presents more canopy surface "open to the sky." However, the small sample provided by one elm and one hackberry, each with a Max # of 18, favors the hackberry.

Years that Trees are Used After Max

The number of years that elms were used after the last Max year are shown in Table 14. The table includes those which were last used prior to 1983, and those still in use in 1983 but having the Max # occur before 1983.

The average number of years that elms supported nests after the last Max year increased with increased diameter. Larger trees provide nest locations longer than smaller trees in the years of decreasing use. The average for elm is 4.4 years.

Table 13. Average Diameter (cm) of Trees when the Max # of nests was reached

Max # Nests	Elm	Ash	BA	H	Bi	YBi	Pop	BO	Tam	Avg.
+1	43.7	49.0			35.1					42.7
+2	34.8									34.8
1	39.6	34.8	38.9	45.2	32.5	35.1	46.2		33.5	37.3
2	42.7	40.1	41.4	41.1	31.8	31.2				40.4
3	47.2	38.9	42.9	47.8	34.0	39.6				43.7
4	47.0	38.9	45.5	49.5						45.5
5	47.8	43.2	45.0	46.5	40.1					45.2
6	51.6	45.7	54.4*	55.6						52.1
7	52.1	46.2	47.0	55.9						50.3
8	59.7	43.2	54.9							55.6
9	58.9	46.2	55.1	53.1						54.4
10	63.0	47.5	58.7	64.0				63.5		59.2
11	55.9		71.1*							60.2
12	66.0	47.8	70.7							63.2
13	61.7	45.7								53.8
14	57.4									57.4
15	67.1	51.1								61.7
16	84.1									84.1
17	68.8	60.2								67.1
18	73.9**			63.1						73.9
19	77.7									77.7
20										
21	64.0**									64.0
22										
23	79.2**									79.2
24										
25										
26	68.8**									68.8
27										
28										
29										
30	100.6**									100.6

* Only two basswood averages are larger than comparable elms.
** One tree.

Of those elms which were still in use in 1983, but with the Max # occurring before 1983 (Column 2), the average length of use after the last Max year was 5.9 years. Eight of the averages in column two are higher than the corresponding averages in column one of Table 14, signifying that smaller elms in this group are supporting nests longer.

Most nest trees that started after the peak year of 1974 were probably not at the Max # in 1983. Nest use in them was increasing. The averages for the larger elms would no doubt be much higher, i.e. the # of years of use following the Max # would be greater, if this phase of the study had not been terminated in 1983. The beneficial effect of larger tree size could not take place.

Table 14. Average # of Years Elms are Used After Max #

	1		2	
Diameter	# Trees	Ended Before 1983	# Trees	If Used in 1983
12"	3	1.3	3	4.7
13"	1	3	1	5
14"	6	3	9	7.1
15"	7	3.7	8	6.2
16"	6	4.3	15	4
17"	4	5.5	12	5.3
18"	8	4.4	6	5.8
19"	5	6.4	3	9.3
20"	4	2	4	6.8
21"	2	1	6	4.3
22"-25"	9	6.3	4	5.2
26"-30"	7	6.1	4	5.8
31"+	2	10.5	3	7
Total	64		78	
Average		4.4		5.9

The Number of Nests Used During the Last Year of Tree Occupancy

As hypothesized, the typical life history of a nest tree should begin occupation by one or a few nests, then over the years the number of nests should increase to a Max # depending on the size, and perhaps location of the tree in the colony. Then, as the tree inevitably begins to die because of the herons, or other causes, the number of nests in the tree will decrease over the years, presumably to one nest, until the tree is totally unacceptable, i.e. will no longer furnish places for nests. Wind, sometimes aided by a defective tree, can foreshorten or truncate this hypothetical curve.

As seen in Table 9, all trees do not decrease to just one nest by their last year of occupation. Maybe the surprising thing is that 2/3 of all of the elms used for the calculation, not those in use in 1983, did support only one nest during the last year.

Ninety percent of all of the elms recorded for the last year of use in Table 9 ended their nest support life with three or less nests. Whereas, 77.7% of all trees started with one nest, "only" 66.8% of the elms ended with one nest. All of the other percents in the Last Year of Use column in Table 9 are higher than for corresponding percents in the first year column.

Summary

In the Cold Spring Heron Colony 732 different nest trees were used during 30 years by Great Blue Herons. Forty-four percent of these were American Elm, 25% basswood, 16% black ash, with other species of lesser importance. The number of nests increased from less than 400 in 1954 to over 1,500 in the early 1970's.

Nest building is practically complete by the first week of May, incubation has begun, and with the tree canopy still open that is the optimum time for a nest survey.

Most nest loss (the structures not the herons) occurs in summer and early fall.

Although each nest tree may have its own unique life history of occupancy, basic similarities occur. Almost 78% of all trees are occupied by only one nest during the first year of use. Ninety-eight percent of the trees have four or less nests during the first year.

The species of tree, its size and the location of the tree in the colony all help to determine whether or not a tree will increase in nest use, the Max # of nests that the tree will support, and the number of years to reach that Max #.

The Max # of nests never exceeded three in over half of all trees although counts in four trees exceeded 20 nests. The Max # was 30 in one elm.

Larger trees support higher Max # and also continue in use longer after the Max # is reached.

Trees also end their nesting life history with low numbers of nests. Exceptions are usually due to catastrophic windfall or otherwise defective tree.

Herons generally start with one nest per tree. The number of nests in a tree for the first year is more dependent on the behavioral choice of the herons. Herons do not always have a chance to end with just one nest per tree. They probably use a tree as long as it has any possibilities at all. The number of nests in a tree for the last year is more dependent on the limitations of the tree. The end of the tree is more likely determined by factors beyond the control of either the tree or the herons.

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