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## Nesting Success and Feeding Habits of Great Blue Herons on the Mississippi River near Cassville, Wisconsin and East Dubuque, Illinois.

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Nesting Great Blue Herons (*Ardea herodias* L.) were studied on Brinkman's Island near Cassville, Wisconsin and on Catfish Island near East Dubuque, Illinois during the breeding seasons of 1978, and 1980-1985. Eggshells and unhatched eggs dropped from nests indicated 94% (n = 1501) of the eggs hatched. Nests near Cassville and East Dubuque contained an average of 2.2 to 2.6 young sufficiently large to be visible from the ground and an average of 1.7 to 2.4 hatchlings survived to fledging, respectively. The larger heronry on Brinkman's Island fledged an average of 1.7 young per nest annually and continued to increase in size. The smaller heronry on catfish island fledged an average on 2.4 young per nest.

Eighty-six fish of 24 species common to the Mississippi River were found beneath nests. Stomach contents of dead young found beneath nests contained crayfish, rodent hair, and fish.

INDEX DESCRIPTORS: Great Blue Herons, Feeding habits, Nest success

The Great Blue Heron is a conspicuous, colonial nesting bird, feeding at the top of the aquatic food chain, and locally dependent upon the environmental conditions of the Mississippi River and its tributaries. As such, it can serve as an indicator species of the aquatic habitat (U.S. Fish and Wildlife Service, 1980). Knowledge of its requirements and tolerance of river development will enable us to make intelligent decisions toward heron management.

The purposes of this study were to: 1) compare fledging success of a large, relatively undisturbed heronry with that of a smaller, more disturbed heronry, 2) determine food habits of Great Blue Herons, and 3) provide baseline data for future reference.

### DESCRIPTION OF SITES STUDIED

The Upper Mississippi River system encompasses an area of 489,507 km<sup>2</sup>, draining major areas of five states. The river system is important from a commercial, recreational, fishery, and wildlife standpoint. The close proximity of urban centers and intensive agricultural activity to the Upper Mississippi River National Wildlife and Fish Refuge has resulted in continuous impacts on bottomland habitats, especially those that are contiguous with shoreline development on privately owned lands. The refuge bottomlands are heavily forested with floodplain species of trees, many of which are mature. Great Blue Herons nest in colonies, scattered at 40-80 km intervals, in the crowns of adjacent tall trees. Large trees contain up to 23 nests.

#### Cassville Area

Brinkman's Island is a large island 2.5 km north of Cassville, Wisconsin, and extends from river mile 608.5 to 613.8. It is nearly 1.6 km wide at its widest point, and is interspersed with many sloughs and channels.

The heronry on Brinkman's Island has been long established. Local fisherman can remember it from the mid 1930's (R. Bauer, per. comm.), and the U.S. Fish and Wildlife Service recorded 50 nests in 1956 (J. Lyons, per. comm.) In 1978 it consisted of 300 nests found in two adjacent areas at river miles 609.25 and 609.75. This heronry had increased to 507 nests in 1983 (J. Lyons pers. comm.), and the two areas have merged into one. This heronry includes approximately 10 Great Egret (*Casmerodius albus*) nests. The most commonly used tree for nesting is silver maple (*Acer saccharinum*).

#### East Dubuque Area

Catfish Island is a wooded island adjacent to the main channel between river miles 575.5 and 576.75, and is approximately 0.4 km

wide at its widest point. It is located 4 km below East Dubuque, Illinois.

Catfish Island has been used as a heronry since approximately 1980, when herons apparently shifted 1.6 km northward from Frentress Lake. The Frentress Lake heronry has decreased from 90 nests in 1981 to 27 nests in 1985 while the Catfish Island heronry has increased from 108 nests in 1982 to 211 nests in 1985.

The Frentress Lake heronry is located in the wooded bottomland between Frentress Lake and the mouth of the Menominee River 14.5 km south of East Dubuque. In the last decade the Frentress Lake heronry moved northward from river mile 574.5 to 575.0 when the elms (*Ulmus* spp.) used for nesting died.

Only Great Blue Herons have been observed in the heronries at Frentress Lake and Catfish Island. Cottonwood (*Populus deltoides*) is used exclusively for nesting on Catfish Island whereas silver maple is the primary nest tree at the Frentress Lake heronry.

### METHODS

Nests were observed on a weekly basis beginning late April or early May with observations continuing until the young fledged from late July to mid August. The majority of the nests were observed from the ground and the young were not visible immediately after hatching. The heronry at Brinkman's Island was observed during the breeding seasons of 1978, 1980 to 1983 and 1985 and heronries at Catfish Island and Frentress Lake were observed from 1982 to 1985. In 1978 we attempted to observe all the nests in the southern portion of the Brinkman's Island heronry. During subsequent years, we sampled 25 to 34 nests per heronry. The number of young in each nest was recorded from the time they were visible from the ground until they fledged. Nests also were observed from blinds adjacent to the heronries in 1983 and from a tower blind at nest level in the Catfish Island heronry in 1982 and 1983.

Eggshells and eggs were collected weekly from beneath the nests of the southern portion of the heronry at Brinkman's Island in 1980. In subsequent years, this island was inundated during hatching. Catfish Island is less susceptible to inundation and eggs and eggshells were gathered weekly in 1982, 1983 and 1985. Eggshells were judged as having hatched when they contained a circular piping pattern around the large end and large blood vessels in the inner membrane. Whole eggs and eggshells containing pieces of the large end were judged as unhatched.

Food habits were investigated by recording the prey dropped beneath nests and the stomach contents of dead young. Most specimens were obtained from the southern portion of the heronry at

**Table 1. Number of eggshells from hatched eggs and whole eggs found beneath the nests.**

Heronry location	Date	Hatched eggs		Unhatched	
		(a)	(b)	(a)	(b)
Brinkman's I.	1980	307	(95%)	6	9
Catfish I.	1982	275	(92%)	1	23
Catfish I.	1983	495	(93%)	2	36
Catfish I.	1985	332	(93%)	2	22
		1409	(94%)	11	81

a - some development of the embryo

b - no embryonic development evident or egg was smashed

Brinkman's Island in 1980 and from Catfish Island in 1982 and 1983. The Great Blue Herons were observed from high bluffs along the Mississippi River flying from the heronry to feed, particularly from Estes Point State Park overlooking the heronry near Cassville. Main channel and backwater areas were checked by boat on a weekly basis for heron feeding locations. Five aerial flights were made between the Cassville and East Dubuque heronries at two week intervals from May to mid July 1984.

**RESULTS**

**Hatching of eggs**

The study period began each year during the hatching period. The earliest breeding seasons observed were in 1981, when nine eggs hatched by 24 April, and 1985, when 169 eggs hatched by 29 April. Ninety percent of the eggs hatched by 22 May 1980 at Brinkman's Island, and by 14 May 1985, 26 May 1983 and 10 June 1982 at Catfish Island. The last eggshells were found 30 May 1980, 17 June 1981, and 24 June 1978 at Brinkman's Island and 29 May 1985, 16 June 1982, and 7 July 1983 at Catfish Island.

A comparison of hatched eggshells to intact eggs and shells of unhatched eggs found beneath the nests indicated 92% to 95% of all eggs hatched. Intact eggs were opened and most lacked observable development (Table 1).

**Production of young**

Most of the 337 nests observed contained 2 or 3 young sufficiently large and active to be counted. A few contained 1 or 4 young, and only 4 nests contained 5 young (Table 2).

Annual nesting success at Brinkman's Island varied from 73% to 94% of young hatched (Table 3). However, the average number of young raised only varied from 1.6 to 2.1 per nest. Herons nesting at Catfish Island raised 90 to 93% of their young to fledging, averaging 0.7 more young per nest than those at Brinkman's Island.

Windstorms caused the most obvious nestling mortality. On Brinkman's Island, windstorms blew down 25 nests containing 52 young in 1978, 5 nests containing 12 young in 1980, 2 nests

**Table 2. Number of nests containing 1 to 5 young sufficiently large to be counted from ground level at Brinkman's Island (1978, 1980-1985) and Catfish Island (1982, 1983, and 1985).**

No. Young/nest	Brinkman's Island	Catfish Island
1	44	1
2	140	29
3	110	26
4	8	11
5	0	4
	302	71

containing 2 young in 1981, and 1 nest with 1 young in 1982. One nest with 3 young was blown down on Catfish Island in 1982.

It was impossible to ascertain the cause of mortality of individual nestlings found hanging in the trees or laying on the ground. Presumably they fell because of storms, siblings pushing them out, and/or initial clumsiness. One young apparently died of a large fish lodged in its throat. Young that survived the fall appeared to be abandoned by the parents and soon died. One exception occurred in 1978 when 5 young no more than two months old were fed on the ground and on a slanted tree and fledged. Brinkman's Island was inundated during the entire fledging period (3 to 30 July) of 1978. Although no young were observed drowning, when observed on their initial flight away from the nest, many struggled as they attempted to land on floating debris.

**Food Habits**

Eighty-six fish of 24 species, 2 crayfish (*Cambarus* spp.), 1 frog (*Rana* spp.), 2 voles (*Microtus* spp.) and a juvenile muskrat (*Ondatra zibethica*) were found beneath heron nests. Most common fish were Centrarchidae and Cyprinidae (Table 4). The stomachs of 38 dead young were examined. Twenty-five had food, of which 23 contained crayfish, 22 fish, 22 rodent hair, and 12 insects. The rodent hair, often found as a fur ball, was *Microtus* spp. Most fish were unidentifiable; identifiable to some degree were 4 suckers (*Moxostoma* spp.), 2 bullheads (*Ictalurus* spp.), 2 bluegills (*Lepomis macrochirus*), 1 drum (*Apoldinotus grunniens*), 1 gar (*Lepisosteus* spp.), and 1 bowfin (*Amia calua*). The insects were aquatic Coleoptera and Hemiptera.

**Feeding locations**

Most Great Blue Herons fed in the backwaters of the Mississippi River. The heronry at Brinkman's Island was observed from Estes Point, a bluff adjacent to the Turkey River. Eighty-one of 100 herons leaving the heronry flew along the Mississippi River; 19 flew inland. Observations of several pairs regularly flying over the same bluff indicated that some pairs may specialize in inland feeding.

**DISCUSSION**

**Nesting Success**

The actual number of eggs were not counted in the nests of the two study areas, nor were the newly hatched young, due to lack of visibility from the ground. However, observations from the tree blinds substantiated that this method was reliable because the activity

**Table 3. Nesting success at Brinkman's Island and Catfish Island.**

Date	No. nests sampled	Ave. no. young hatching/nest	Ave. No. young fledging/nest
Brinkman's Island			
1978	144	2.3	1.7
1980	25	2.5	1.8
1981	63	2.2	1.9
1982	30	2.1	1.9
1983	25	2.1	1.6
1985	14	2.1	2.1
	301	2.2	1.7
Catfish Island			
1982	25	2.8	2.6
1983	25	3.3	3.0
1984	20	2.1	1.9
1985	20	2.3	2.1
	90	2.6	2.4

of young herons kicked the eggs and eggshells from the nest. The dropped eggshells and eggs indicated that egg fertility was very high in both areas. Pratt (1970) observed 84-86% of heron eggs hatching in a California study area, although she suspected minor eggshell thinning caused by DDT. McAloney (1973) observed in a Nova Scotia heronry 75% eggs hatched, 20% failed to hatch, and 5% were lost.

There was a striking difference in productivity between the two study areas. The heronry at Brinkman's Island contained fewer young, and presumably fewer eggs, than those sampled at Catfish Island. Perhaps the large size of the heronry at Brinkman's Island results in greater competition for food and lower clutch size.

The number of young fledged per nesting pair at Brinkman's Island (1.6 to 2.1) was among the lowest recorded in the literature, whereas that at Catfish Island (1.9 to 3.0) was among the highest (Table 5). In spite of this apparently low recruitment, the heronry at Brinkman's Island has increased 169% in the years 1978 to 1983 (J. Lyons pers. comm.). Some of this increase may have been caused by recruitment from a small heronry 20 miles upstream at Glen Lake, which has been abandoned. However, two other heronries adjacent to Brinkman's Island also have increased in population. This would imply that the minimum number of young fledged per nest required to maintain a stable population is less than the 2.8 calculated by Owen (1959-60) or the 1.9 mentioned by Henney and Bethers (1970).

The mortality rates of the nestlings that we observed were similar to the 7% observed by McAloney (1973). Pratt (1970, 1972) recorded nestling mortality rates of 30 and 45% in Central California and 19, to 30, 40, and 45% in San Francisco Bay area. She attributed most mortality to starvation of the youngest nestlings, which failed to compete with siblings during their third to fourth week.

The high mortalities of 1978 and 1980 were attributed to violent thunderstorms during the nesting season. The senior author and a student were present 17 June 1978 when high winds and heavy rainfall brought down numerous nests. Under these conditions, nests

Table 4. Species and number of fish dropped by Great Blue Herons.

Shortnose Gar ( <i>Lepisosteus platostomus</i> )	9
Bowfin ( <i>Amia calva</i> )	2
Gizzard Shad ( <i>Dorosoma cepedianum</i> )	1
Mooneye ( <i>Hiodon tergisus</i> )	5
Pickereel ( <i>Esox americanus vermiculatus</i> )	1
Northern Pike ( <i>Esox lucius</i> )	1
Sucker ( <i>F. Catostomidae</i> )	2
Shorthead Redhorse ( <i>Moxostoma macrolepidotam</i> )	1
River Redhorse ( <i>Moxostoma carinatum</i> )	2
Carp ( <i>Cyprinus carpio</i> )	11
Northern Common Shiner ( <i>Notropis cornutus</i> )	1
Red Shiner ( <i>Notropis lutrensis</i> )	1
Minnnow ( <i>F. Cyprinidae</i> )	2
Channel Catfish ( <i>Ictalurus punctatus</i> )	5
Bullhead ( <i>Ictalurus</i> spp.)	4
White Bass ( <i>Morone chrysops</i> )	3
Smallmouth Bass ( <i>Micropterus dolomieu</i> )	6
Largemouth Bass ( <i>Micropterus salmoides</i> )	1
Bluegill ( <i>Lepomis macrochirus</i> )	6
Rock Bass ( <i>Ambloplites rupestris</i> )	4
White Crappie ( <i>Poxomis annularis</i> )	7
Yellow Perch ( <i>Perca flavescens</i> )	2
Sauger ( <i>Stizostedion canadense</i> )	1
Freshwater Drum ( <i>Aplodinotus grunniens</i> )	8
	86

Table 5. Nestling survival of other Great Blue Heron Colonies.

per nesting pair			
Author	Location	Year	Average no. young fledged per nesting pair
Pratt (1970, 1974)	Central California	1967	1.3
		1968	1.7
		1972	1.7
		1973	1.5
Pratt (1972)	San Francisco Bay	1967	2.2
		1968	2.1
		1969	2.3
		1970	1.9
Henney and Bethers (1970)	Western Oregon	1970	2.0
Vermeer (1969)	Southern Alberta	1967	2.2
		1968	2.3
McAloney (1973)	Nova Scotia	1971	2.8
Quinney (1982)	Nova Scotia	1977	2.6
		1978	3.1

in leafed trees appeared as susceptible as those in the dead elm trees. However, at least part of the higher mortality of 1978 and 1980 was attributable to falling limbs of dead elms. Catastrophic windstorms have been recorded by others (Graber et al. 1978; Pierce 1982). McAloney (1973) noticed that new nests are more likely to blow down than the heavier, older ones.

#### Food habits

Larger prey were more likely to be dropped and found by observers than small items. Smaller items could be overlooked, decompose more quickly, or become lodged within a nest. The young also dropped more large prey in their attempt to swallow it. The prey found in the stomachs of dead young were shorter, on the average, than the prey found on the ground, but the length of eaten prey had to be guessed because of partial digestion.

The herons brought a wide variety of foods to the nests, similar to the variety found in Illinois heronries by Graber et al. (1978). Cyprinid and Centrarchid fishes were important to both groups, but shad (*Dorosoma cepedianum*), a major constituent of the diet of the Illinois herons, were minor in the present study. Most fish captured are

Table 6. Great Blue Heron Nest Counts of Fretress Lake and Catfish Island Heronries.

Date	Fretress Lake Nest Counts	Catfish Island Nest Counts
1974	70 a	
1975	90 a	
1976	40 a, 78 c	
1977	20 a, 44 b	
1978	64 c	
1979	78 c	
1980	125 c	
1981	89 c, 90 d	
1982	29 d	108 d
1983	19 d	159 d, 151 e
1984	18 d	152 d
1985	27 d	211 d

a (Graber et al., 1970), b (Thompson and Landin, 1978), c (J. Lyons, per. comm.), d This study, e (Howe, per. comm.)

characteristic of the shallow backwaters of the Mississippi River. However, some species are as likely to be found in the tributaries, e.g., small-mouth bass (*Micropterus dolomieu*) and shiners. Large mouth bass (*M. salmoides*) and bluegills are also found in farm ponds, and meadow mice are on the adjacent uplands. Shoreline feeding away from the river bottomlands may be critical for herons at certain stages, e.g., gathering smaller food items for juveniles. Feeding in upland aquatic habitats may be more important since the installation of the lock and dam system, which prevents summer drawdown and subsequent concentration of stranded fish. Casual observation indicated greater upland feeding during high water stages of the river. Stream turbidity also clears up more rapidly than the river after severe thunderstorms, permitting prey to be more easily seen. Certain pairs may specialize in feeding in the streams and ponds. The same number of birds flew over the same ridge at approximately the same time on successive days. Although the birds were unmarked, a few did contain the same wing moult pattern.

### CONCLUSIONS

The herons of both study areas had a very high rate of egg fertility. However, Great Blue Herons at the larger heronry at Brinkman's Island laid fewer eggs, and averaged almost one less fledged young per nest, than those at Catfish Island. Nonetheless, both heronries increased in number of nests. Since all larger heronries in pools 9, 10, and 11 have increased in size, we believe that the increase of the population at Brinkman's Island was from its own recruitment. Hence raising slightly less than two young per nest appears sufficient for expansion of the population. The number of young necessary for maintaining a population has probably been overestimated because of the life span of an adult bird probably was underestimated.

Feeding was primarily on fish obtained in backwater areas of the Mississippi River. Herons also made use of upland streams, ponds, and wet meadows, but it was not clear if this was a general behavior pattern while high or turbid river conditions were present or if it only occurred in some birds.

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