ILLINOIS

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

PRODUCTION NOTE

University of Illinois at
Urbana-Champaign Library
Large-scale Digitization Project, 2007.

ILLINOIS NATURAL HISTORY SURVEY

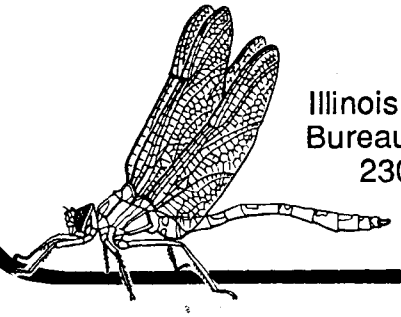
AN ASSESSMENT OF THE USE OF ARTIFICIAL PERCHES BY WINTERING BALD EAGLES AT THE MISSISSIPPI RIVER BRIDGE (U. S. ROUTE 136) AT HAMILTON, HANCOCK COUNTY, ILLINOIS (FAP 53).

FINAL REPORT
October 1988

Section of Faunistic Surveys and Insect Identification Technical Report

by

Patti L. Malmborg
Glendy C. Vanderah



For

Illinois Department of Transportation
Bureau of Location and Environment
2300 South Dirksen Parkway
Springfield, IL 62764

Section of Faunistic Surveys and Insect Identification
Technical Report 1987 (3)

TABLE OF CONTENTS

(Table Of Contents Concluded On Next Page)

(Table Of Contents Concluded)

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

In 1984, the Illinois Department of Transportation (IDOT) completed construction of a four-lane bridge spanning the Mississippi River between Hamilton, Illinois, and Keokuk, Iowa. Relocation of the bridge and re-routing of U.S. Route 136 necessitated removal of bald eagle diurnal perch-trees in the floodplain forest on the Illinois side of the Mississippi River. One of the mitigation measures agreed upon by the Illinois Department of Conservation and the IDOT was the construction of artificial perch-trees on the Illinois shoreline downstream from the new bridge. Over a period of two years five artificial perch-trees were embedded in concrete on the riverbank and one existing snag was modified. The two traditional pole-design perch-trees and the snag were constructed and modified (respectively) in 1984, but their use by bald eagles was disappointing as has been similarly reported by many researchers during the first year of artificial perch experiments. One adult bald eagle used one perch for less than 15 minutes over the course of the winter season (Mike Sweet, Missouri Department of Conservation, unpublished data). In 1985, three additional natural design perch-trees were erected and the two pole-design perch-trees were modified with cottonwood trunks and branches (Dunstan and Ives 1985). Large branches also were added to a live silver maple tree adjacent to and downstream from the artificial perch-trees. This silver maple was toppled by flood waters during the 1986 autumn flooding of the Mississippi River shoreline. Figure 1 shows the six artificial perch-trees as they appeared during this study.

The success of artificial perch-trees erected in recent years in other states has been questionable (Steenhof 1978), suggesting that artificial perch designs and their usefulness to bald eagles needed further study. As requested by the IDOT, the Illinois Natural History Survey monitored bald eagle use of the six artificial perch-trees during the 1986-87 winter season.

The objectives of this study were as follows:

1. To determine bald eagle use of artificial perch-trees versus naturally occurring perch-trees within the study area.

2. To determine bald eagle preferences for specific artificial perch-trees or perch-tree designs.

3. To evaluate artificial perch-trees as a substitute for natural perch-trees in order to provide information useful to future mitigations for similar projects.

STUDY AREA

The study area consists of approximately 0.8 km of shoreline immediately downstream of the Illinois Route 136 bridge on the Illinois side of the Mississippi River (Figure 2). A strip of floodplain forest approximately 15 to 25 m wide and dominated by eastern

Figure 1. The six artificial perch-trees located downstream of the U.S. Route 136 bridge at Hamilton, Hancock County, Illinois.

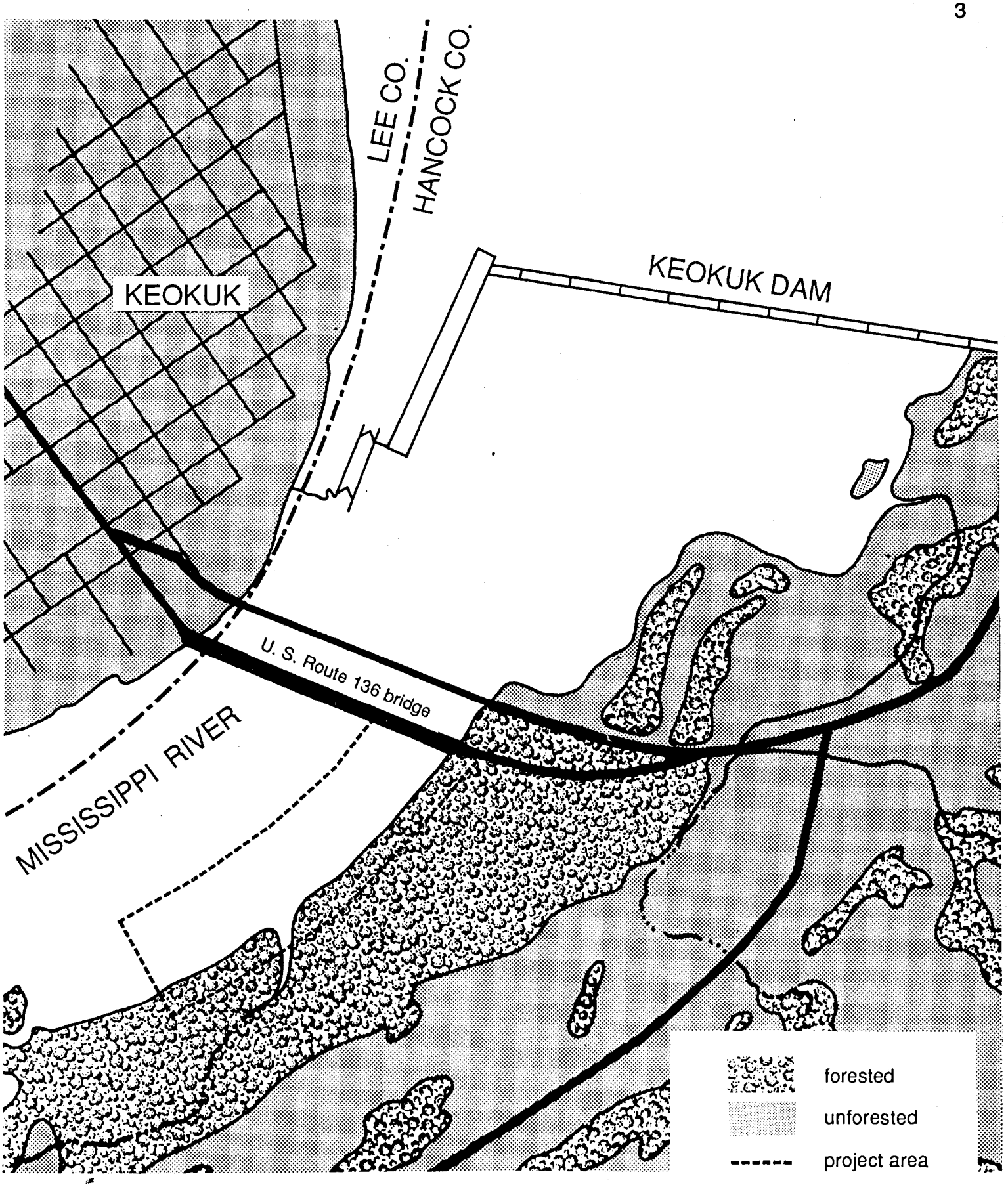


Figure 2. The study area located downstream of the U.S. Route 136 bridge at Hamilton, Hancock County, Illinois.

METHODS

Perching activities of bald eagles were monitored from November 15, 1986, through March 1, 1987. Observations were performed weekly during successive one-hour afternoon (between 1200 and 1500 hrs), evening (between 1600 hrs and dusk) and morning (between dawn and 1000 hrs) periods over two consecutive days by two individuals using binoculars and a spotting scope. The limits of the formal study area were determined at the onset of the investigation (see Figure 2).

The study area was observed from the new Illinois Route 136 bridge, which afforded the best view of the shoreline. This observation point was approximately 100 m from the artificial perch-trees. Bald eagles that were perched near the bridge never flushed as observers approached. Eagle activities did not appear to be disturbed throughout observation periods. It is possible that eagles in the area become tolerant of pedestrians as well as vehicles, since the bridge maintains a large amount of pedestrian traffic throughout the year. Also, it is suspected that the constant flow of vehicular traffic on the bridge concealed the observers' movements to and from the observation point. During the course of this study, several eagles were disturbed by human activity on only two occasions, each resulting from the encroachment into their foraging area by fishermen in boats. These eagles remained agitated throughout the duration of the fishermen's stay.

Three diurnal activities of eagles perching within the study area on both natural and artificial perches were recorded. Specific activities were determined by observing an eagle's movement and behavior. For example, foraging eagles actively scanned the water from a perch on the shoreline or while flying over the water; loafing eagles either were preening or showed minimal head movements. Age-class of eagles was recorded; white head and tail signified an adult; dark or mottled appearance signified an immature. Tree height, perch height, and dbh for both natural and artificial perch-trees also were recorded. In this study, a 'perch-tree' refers to either an artificial or natural structure used for perching, and 'perch' refers to a particular branch of a structure.

The period during which an eagle remained on a particular perch was considered one independent observation. However, totally independent observations could not be assured because individual eagles were not marked and could not be distinguished during different observation periods. This source of bias was unavoidable. Statistical analyses, including contingency table analysis, chi-square goodness-of-fit test, and the log-likelihood ratio (G), were performed on the data in order to determine differences in use between artificial versus natural perch-trees.

Originally, three designs were proposed for the artificial perch-trees, *i. e.* , natural, modified-pole, and modified existing. In this study, the "modified existing structure" could not be assessed as a third perch design. The modified snag and large silver maple (see introduction) were examples of the third category. The modified silver maple was toppled by flood waters, and the remaining modified existing structure (snag) was the shortest of the artificial perch-trees. Throughout this study, the snag was used least of all the artificial perch-trees. This design category would not have been so poorly represented had the large silver maple survived. The modified snag

was determined to be an inadequate representative of a third and separate perch-design; therefore, it was included in the natural-design category, since the two designs shared many characteristics.

The availability of suitable perches within the study area was determined by two independent observers. For statistical purposes it was assumed that all branches which would support the weight of one bald eagle had an equal chance of being used by an eagle, regardless of other factors, and hence was available. Therefore, all branches assumed capable of supporting at least one bald eagle were counted. Judgements were made through experience gained by observing eagles on various perches. A 5% error factor was added to the total of natural perches because individual branches were sometimes difficult to distinguish from a distance. The number of natural perches remains conservative; however, a greater proportion of available natural perches would produce more robust differences in the analyses.

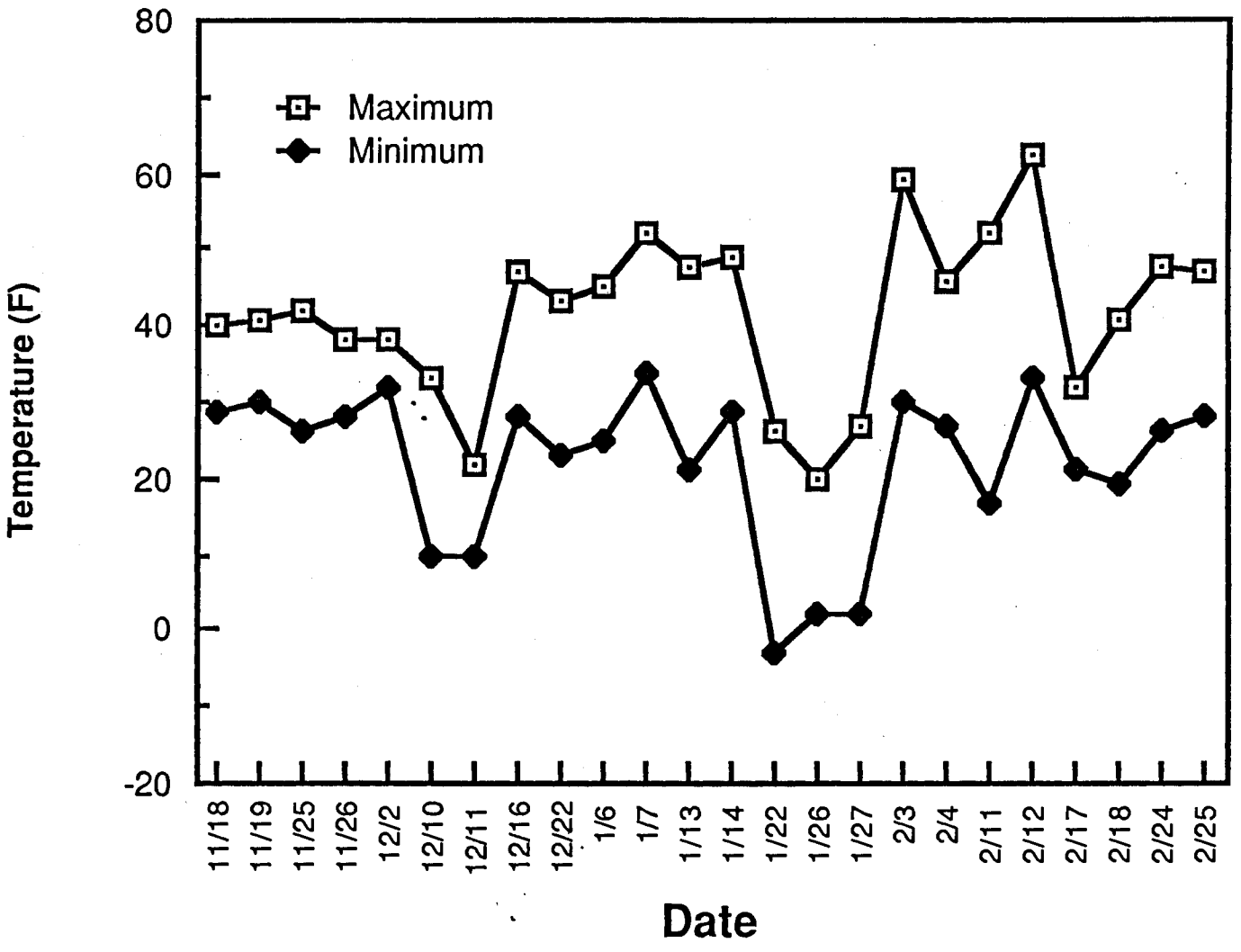
RESULTS

Average temperatures for the winter of 1986-87 were relatively mild (Figure 3), allowing open water to persist on the river throughout this investigation. Therefore, foraging areas were not limited, because open water enabled eagles to disperse along the river independently of locks and dams, power plants, etc., which maintain open water during freezing conditions. Low eagle numbers were considered to be an advantage. Individual eagles were easier to follow due to a lack of confusion when many eagles are flying simultaneously . However, the statistical results obtained from this study would have been strengthened by an increase in total eagle numbers.

TEMPERATURE INFLUENCES

Bald eagle counts within the study area indicated a slight inverse relationship between temperature and bald eagle numbers (Figures 3 and 4). When temperatures decreased sharply, bald eagle numbers began to increase. If temperatures remained mild, bald eagle numbers were low. This trend is fairly typical of bald eagle/ temperature relationships (Southern 1963; Jonen 1973). Bald eagle numbers remained comparatively low within the study area during the entire 1986-87 winter season. In the previous year at Keokuk, Iowa, the maximum count for wintering bald eagles observed in one day was 327 (Dunstan *et al.* 1985), while the maximum day count during this investigation within this study area was only 33.

Figure 3. Maximum and minimum temperatures during the 1986-87 winter season * for Hancock County, Illinois.



* Data obtained from USCOE Rock Island District

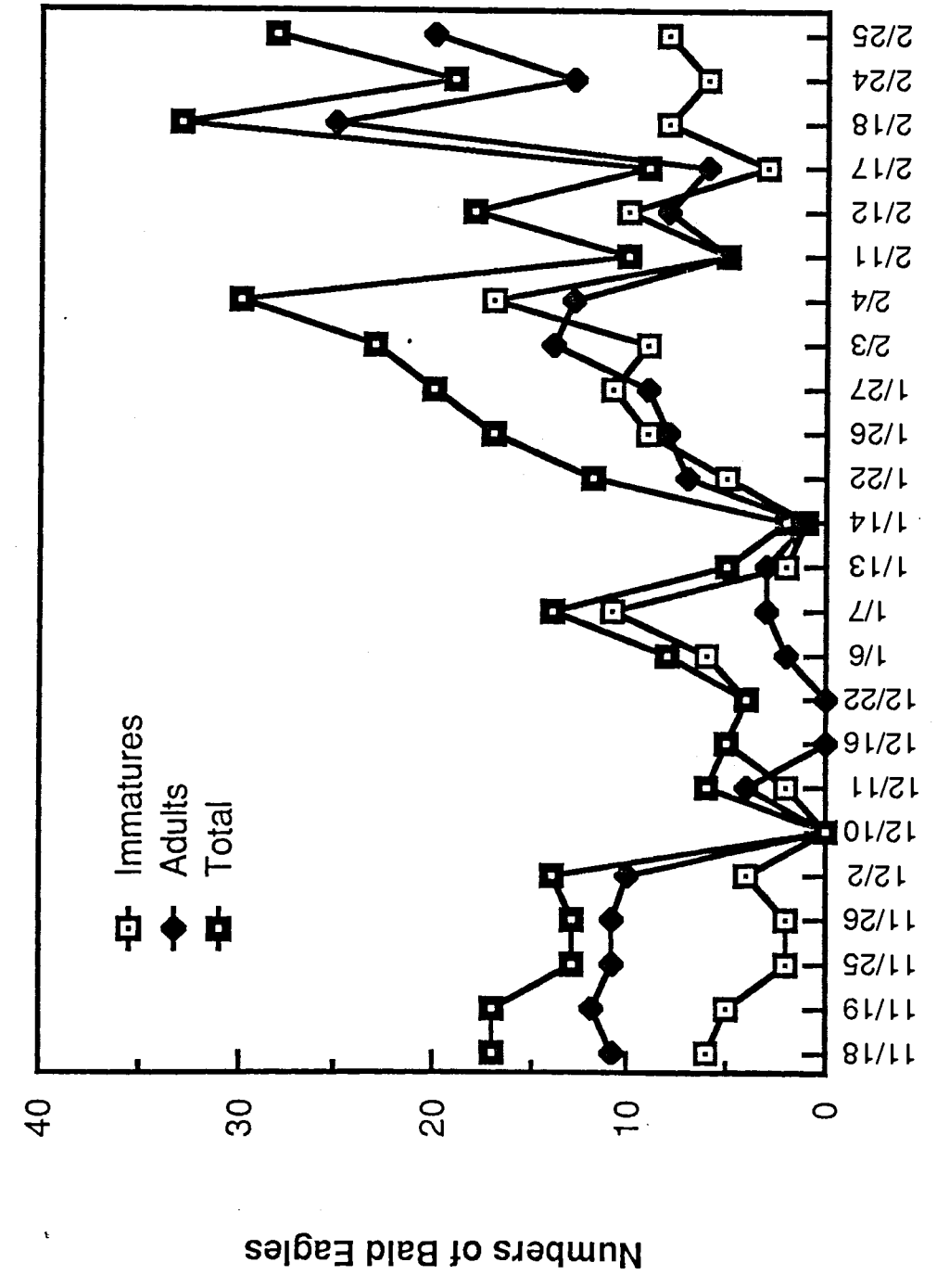


Figure 4. Immature, adult, and total numbers of bald eagles observed during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

BALD EAGLE NUMBERS AND PERCH USE

During this study the maximum eagle count for one day was 33, the minimum count was two (when eagles were present), and the mean count was 14 (Table 1). Five hundred twenty-eight bald eagle perching observations were recorded. Figure 5 identifies the location and frequency of bald eagle perchings within the study area. Of these 528 perching observations, 80% (421) occurred on natural perches and 20% (107) on artificial perches (Table 2). Activities observed during eagle perchings were as follows: loafing, 73%; foraging, 22%; and eating, 5%; Table 3 contains these data separated by age classes. Figure 6 identifies locations and frequencies of perchings separated into three activities.

At the initiation of the study immature eagles perched on artificial trees more often than did adult eagles, even though adults outnumbered immatures within the study area at that time (Figures 7 and 8). Artificial perch use increased during the second half of the study, possibly due to the greater number of eagles present. Although both age-classes were present in similar numbers, adult bald eagles used artificial perch-trees consistently more often than did immatures during this period (Figures 7 and 8). After February 17, when adults once again outnumbered immatures, natural perches were used much more often by immatures than by adults (Figure 9). Intraspecific competition, temperature, or some phenological difference between age-classes may have accounted for these observations. Artificial perch use may be density-related, even in years of low bald eagle numbers when intraspecific competition may be minimal. During this study, different age-classes appeared to use the artificial perch-trees at different times and with varying intensity.

Three aspects of bald eagle perch use were compared : (1) artificial vs. natural perch-trees; (2) individual artificial perch-tree selection; and (3) natural vs. modified-pole artificial perch-tree designs. In Section I, results are analyzed in relation to perch availability within the study area; in Section II results are examined in relation to perches that actually were used. Direct comparisons were made between types of perch-trees, and among individual artificial perch-trees, as used by all bald eagles, by each age-class, and for all three diurnal activities.

Table 1. Numbers of bald eagles observed during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

Date		Immatures	Adults	Total
1986	11/18	6	11	17
	11/19	5	12	17
	11/25	2	11	13
	11/26	2	11	13
	12/2	4	10	14
	12/10	0	0	0
	12/11	2	4	6
	12/16	5	0	5
	12/22	4	0	4
1987	1/6	6	2	8
	1/7	11	3	14
	1/13	2	3	5
	1/14	1	1	2
	1/22	5	7	12
	1/26	9	8	17
	1/27	11	9	20
	2/3	9	14	23
	2/4	17	13	30
	2/11	5	5	10
	2/12	10	8	18
	2/17	3	6	9
	2/18	8	25	33
	2/24	6	13	19
	2/25	8	20	28

Table 2. Bald eagle use of artificial and natural perch-trees during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

Date *	Adult		Immature		Total	
	Artificial	Natural	Artificial	Natural	Artificial	Natural
1986						
11/18-19	-	3	10	15	10	18
11/25-26	-	5	2	38	2	43
12/1-2	1	2	3	6	4	8
12/10-11	-	2	-	4	-	6
12/16-17	-	2	-	-	-	2
12/22	-	6	-	-	-	6
1987						
1/6-7	2	10	-	4	2	14
1/13-14	-	4	-	3	-	7
1/22-23	-	3	-	-	-	3
1/26-27	7	18	4	16	11	34
2/3-4	20	38	8	68	28	106
2/11-12	1	25	3	20	4	45
2/17-18	-	3	-	13	-	16
2/24-25	9	11	2	37	11	48
3/3-4	19	18	16	47	35	65
Total	59	150	48	271	107	421

* Dates represent one complete observation period (includes one afternoon, 1200 to 1500 hrs; evening, 1600 hrs to dusk; and morning, dawn to 1000 hrs, session) on two consecutive days.

Table 3. Bald eagle activities on artificial perch-trees separated by age-class during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

Activity	Artificial Perch -Tree 1	2	3	4	5	6	Total
ADULT							
loafing	21	10	1	0	0	0	32
foraging	14	7	1	0	1	0	23
eating	4	0	0	0	0	0	4
IMMATURE							
loafing	6	3	2	13	0	12	36
foraging	2	2	0	3	2	1	10
eating	0	1	0	1	0	0	2
TOTAL	47	23	4	17	3	13	107

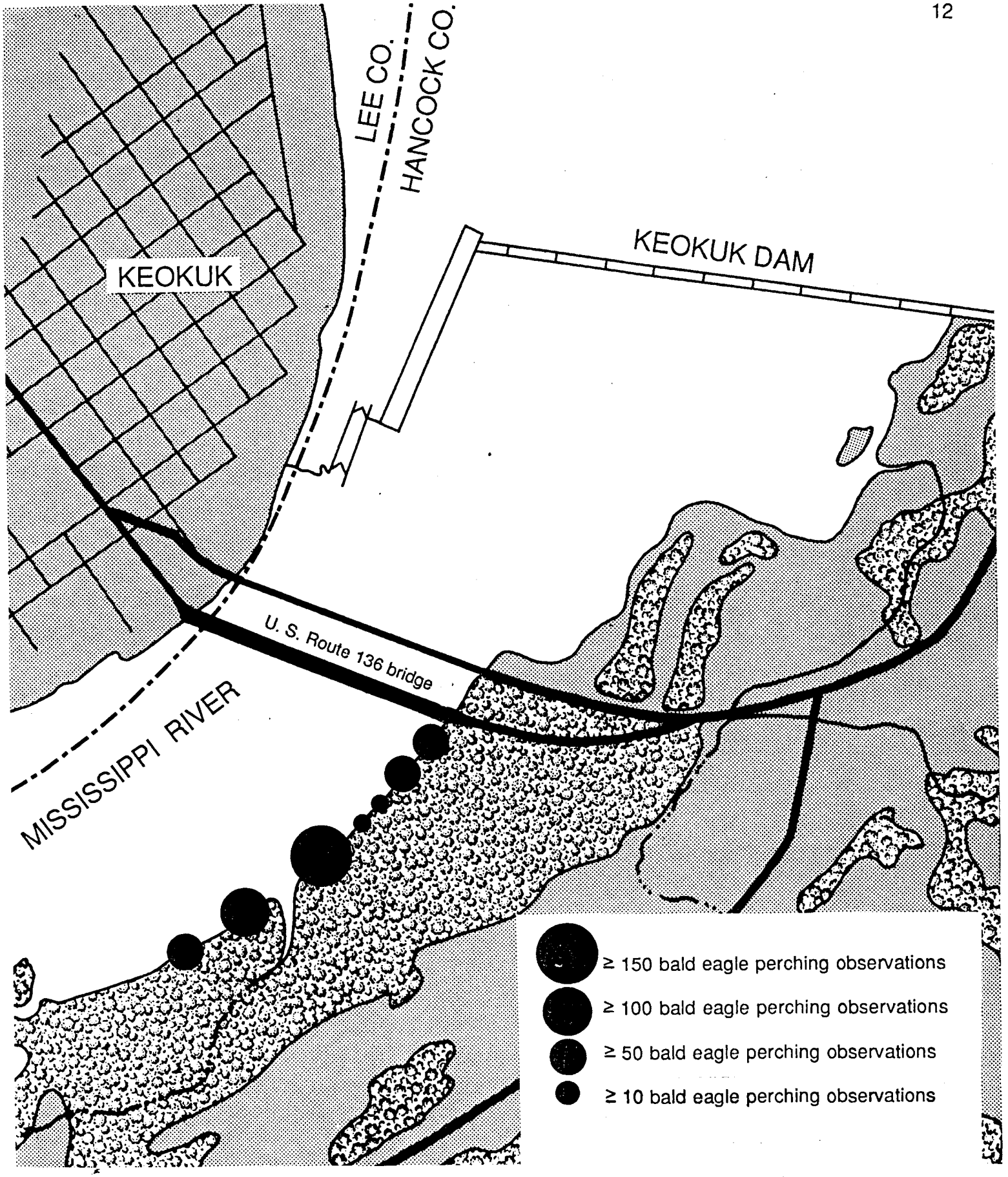


Figure 5. Location and frequency of bald eagle perching observations recorded during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

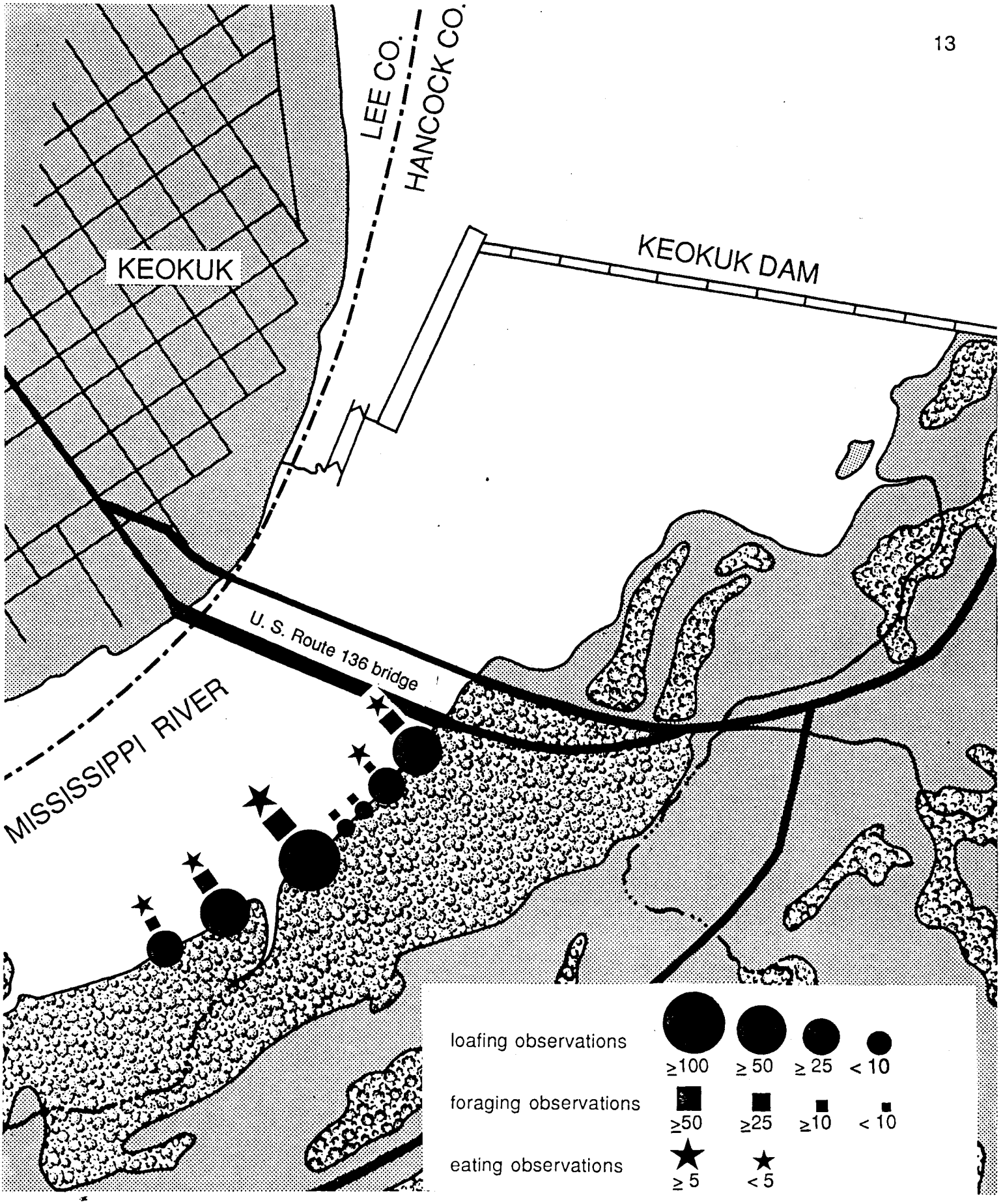


Figure 6. Location and frequency of three bald eagle perching activities recorded during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

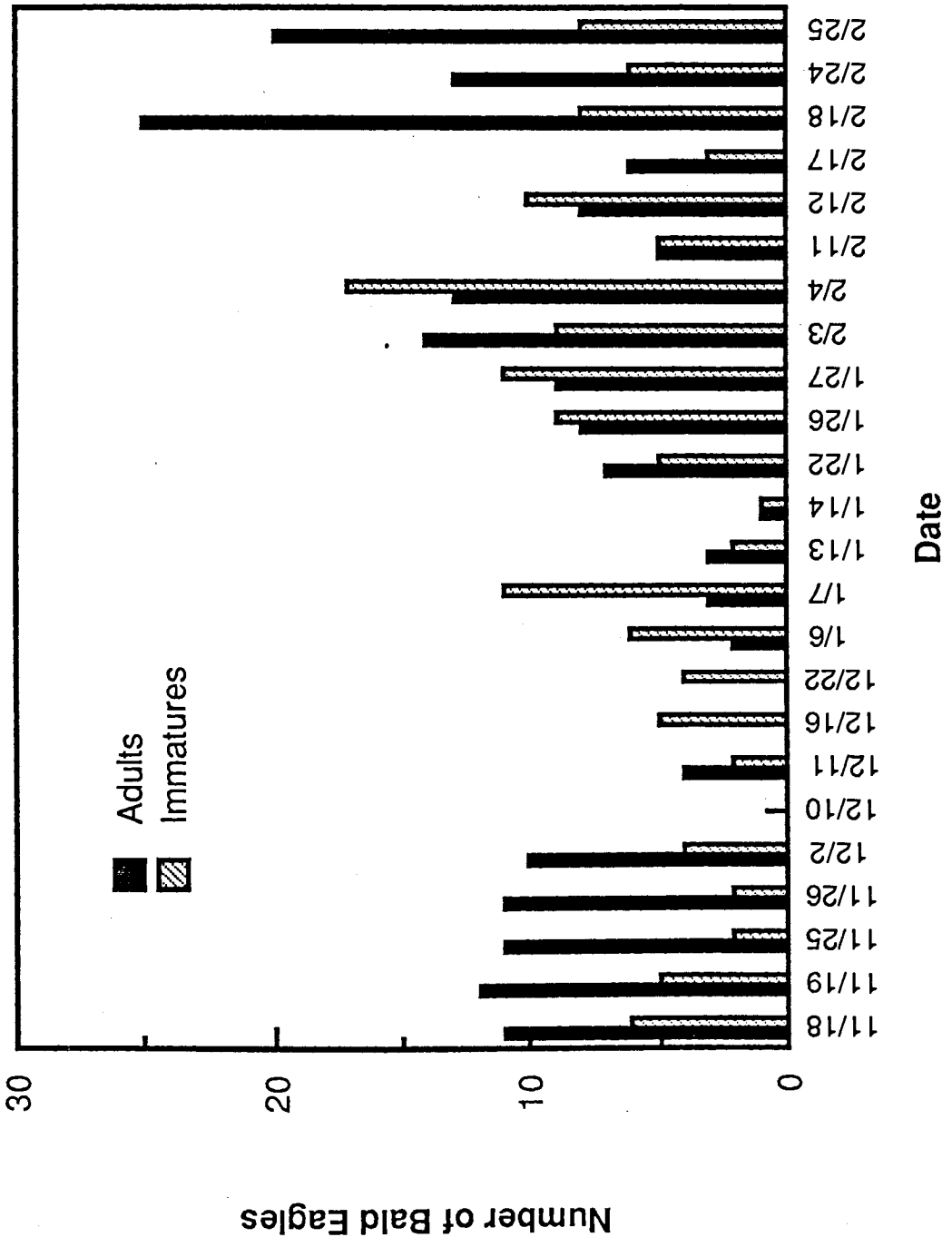


Figure 7. Numbers of immature and adult bald eagles observed during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

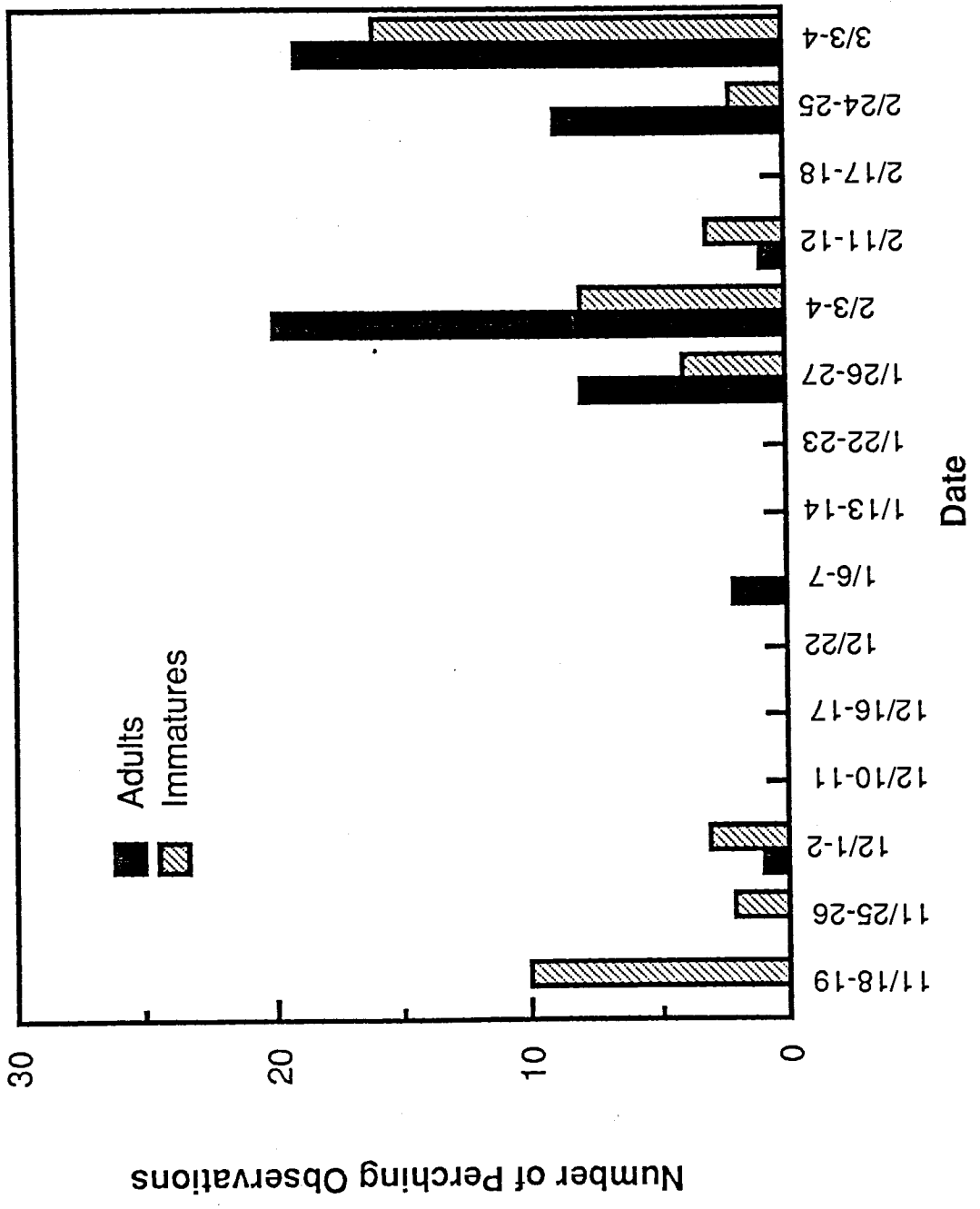


Figure 8. Bald eagle perching observations on artificial perch-trees recorded during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

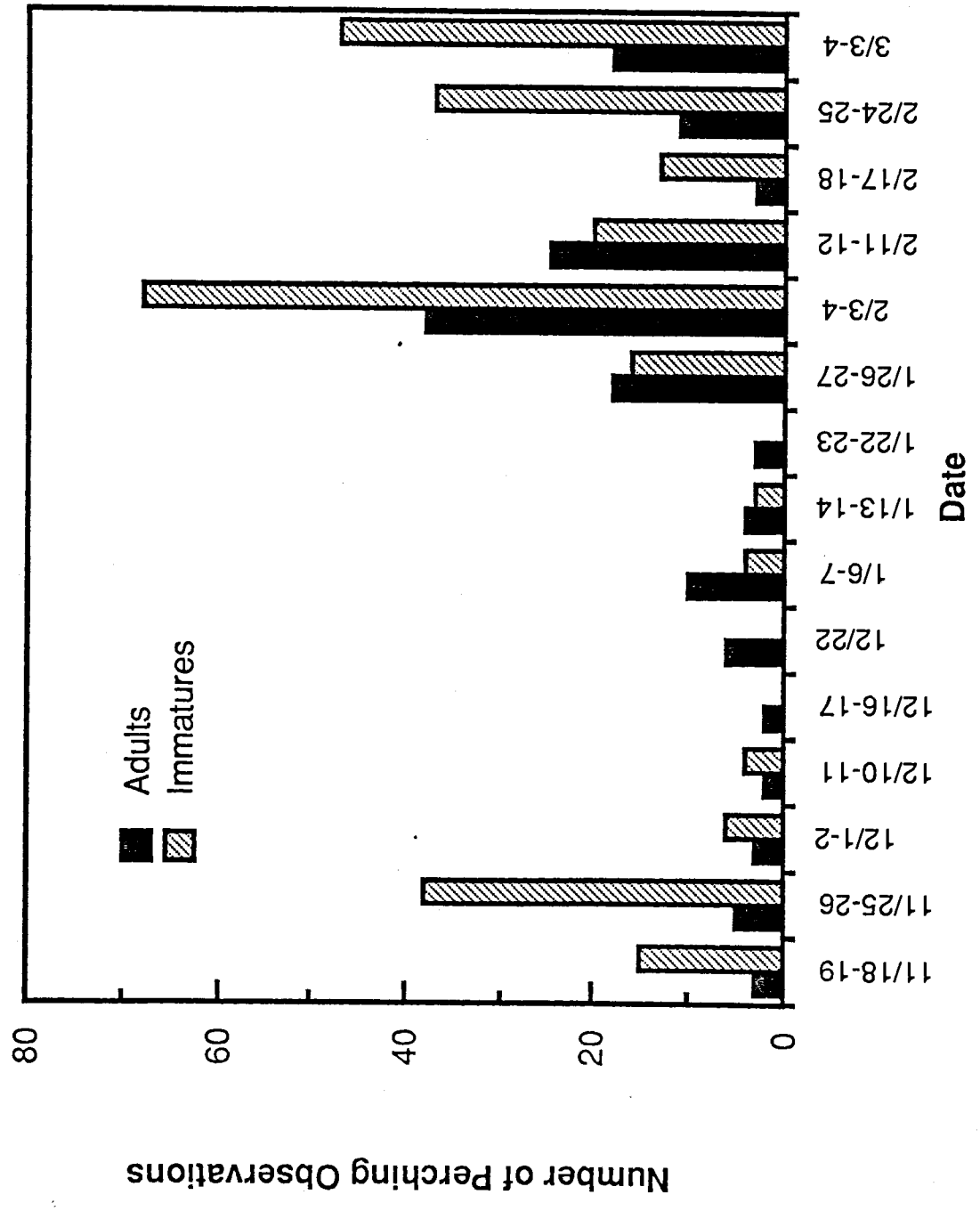


Figure 9. Bald eagle perching observations on natural perch-trees recorded during the 1986-87 winter season in the study area at Hamilton, Hancock County, Illinois.

SECTION I

BALD EAGLE USE OF NATURAL VS. ARTIFICIAL PERCH-TREES RELATIVE TO PERCH AVAILABILITY

If bald eagles treated all available diurnal perches (capable of supporting the weight of at least one bald eagle) indiscriminately, the use of artificial perches could be predicted by the proportion of their occurrence. A total of 325 suitable natural perches and 53 suitable artificial perches were counted in this study area. Therefore, 86% of bald eagle perching activities would have been expected to occur on natural perch-trees and 14% on artificial perch-trees.

Bald eagles used artificial perch-trees significantly more often than expected relative to perch availability within the study area ($x^2 = 16.56$, 1 df, $p < 0.001$). This indicates that the number of eagle perchings recorded on artificial perches was greater than would be predicted from the proportion of artificial to natural perches occurring within the study area, suggesting that eagles were not using all available perches indiscriminately.

Analyses of perch use by the two age-classes show conflicting results. Adult bald eagles used artificial perches more than expected relative to perch availability within the study area ($x^2 = 33.20$, 1 df, $p < 0.001$). There was no significant difference, however, between the use of artificial and natural perches by immature eagles relative to perch availability ($x^2 = 0.22$, 1 df, $p > 0.90$). Adults, therefore, appeared to be selective when choosing perches; immatures appeared to use whatever was available.

The relationship between diurnal activities (loafing, foraging, and eating) and perch availability was also examined. Bald eagles used artificial and natural perches in proportion to their occurrence for loafing and eating activities. Foraging activities from artificial perches occurred significantly more than expected ($x^2 = 18.57$, 1 df, $p < 0.001$). Therefore, eagles foraged more often from artificial perches than would be predicted from the proportion of artificial to natural perches occurring within the study area. This suggests that bald eagles may have been more selective toward their foraging perches than toward loafing or eating perches.

Adult bald eagle activities differed from those of immatures on perch-trees relative to perch availability. Adults foraged and loafed on artificial perches significantly more than expected ($x^2 = 25.52$, 1 df, $p < 0.001$; $x^2 = 9.71$, 1 df, $p < 0.005$, respectively). Eating by adults, and all activities of immature eagles, were conducted equally on artificial and natural perches (in proportion to their occurrence within the study area). Results suggest that adults may prefer certain perch characteristics and were more selective than immatures regarding perches used for foraging and loafing within the study area.

BALD EAGLE USE OF ARTIFICIAL PERCH-TREES 1 THROUGH 6 RELATIVE TO PERCH AVAILABILITY

Bald eagle use of the six artificial perch-trees varied significantly relative to perch availability (x^2= 32.82, 4 df, $p < 0.001$). The use of artificial perch-tree 1 (Figure 10) contributed 65% of this result (Table 3). Testing only artificial perch-trees 2 through 6, a non-significant result was obtained. Therefore, perch-trees 2 through 6 were used in proportion to the number of suitable perches they possess.

Diurnal activities of bald eagles varied significantly among the six artificial perch-trees relative to perch availability (G= 56.54, 4 df, $p < 0.001$; Table 3). Loafing occurred more than expected on perch-tree 1 and less than expected on perch-tree 5. Bald eagles foraged more than expected from perch-tree 1 and less than expected from all other perch-trees (G= 78.21, 4 df, $p < 0.001$). Eating activities also were observed more frequently than expected at perch-tree 1 (G= 11.70, 4 df, $p < 0.05$). Therefore, bald eagles did not use the artificial perch-trees in proportion to perch number. Results suggest that artificial perch-tree 1 may have been more attractive to bald eagles than perch-trees 2 through 6.

Adult activities varied significantly among artificial perch-trees relative to perch availability. Both loafing and foraging occurred more than expected from perch-trees 1 and 2 (G= 99.26, 4 df, $p < 0.001$; G= 55.08, 4 df, $p < 0.001$, respectively). Immatures used the artificial perch-trees differently for loafing activities (G= 35.85, 4 df, $p < 0.001$). Perch-trees 4 and 6 were used more than would be expected from the number of available perches present. Foraging activities of immatures occurred in proportion to perch number. Eating activities of adults and immatures were not testable due to small sample sizes.

BALD EAGLE USE OF NATURAL VS. MODIFIED-POLE ARTIFICIAL PERCH-TREE DESIGNS RELATIVE TO PERCH AVAILABILITY

Results indicate that bald eagles used perch-tree designs as would be expected from the number of perches present on each perch-tree. However, adult and immature age-classes used the two designs very differently. All adult observations were recorded on the natural perch-tree design (x^2= 31.06, 1 df, $p < 0.011$). Immature eagles used the modified-pole perch-tree design significantly more than expected (x^2= 14.02, 1 df, $p < 0.001$) relative to the availability of perches.

Activities of all bald eagles also varied between artificial perch-tree designs when tested relative to perch availability. Loafing and eating occurred as expected, but foraging was observed to occur significantly more often from the natural perch-tree design (x^2=6.93, 1 df, $p < 0.01$). This suggests that certain perches were selected for foraging, while loafing and eating occurred on any available perch.

Figure 10. Artificial perch-tree 1 located downstream of the U.S. Route 136 bridge at Hamilton, Hancock County, Illinois.

Adults using artificial perch-trees conducted 100% of their diurnal activities on the natural perch-tree design; however, immature activities varied between artificial perch-tree designs. Immature eagles loafed more on the modified-pole perch-trees than would be expected from available perches (x^2= 16.56, 1 df, $p < 0.001$). Immature foraging activities occurred in proportion to available perches. This suggests that immatures may have been choosing certain perch qualities for loafing, but would use any suitable perch for foraging. Intraspecific competition with adults, however, could influence perch choice.

SECTION II

The assumption that bald eagles would use all available perches was necessary to establish whether or not bald eagles used the artificial perch-trees more than would be expected from perch availability alone. However, bald eagles do not use all available perches. Studies have documented that certain perch characteristics are preferred by bald eagles (see Steenhof 1978; Stalmaster and Newman 1979). This fact, in conjunction with the results of this study, suggests that the artificial perch-trees possess some characteristic(s) that bald eagles choose.

BALD EAGLE USE OF ARTIFICIAL VS. NATURAL PERCH-TYPES

Artificial perches were compared to only those natural perches chosen and used by bald eagles within the study area. If bald eagles used the artificial perches similarly to natural perches that were chosen for some preferred characteristic(s), then it would appear that the artificial perch-trees were accepted readily as diurnal perches.

All bald eagles treated artificial and natural perches equally when foraging, loafing, and eating ($G = 5.78$, 2 df, $p < 0.10$). However, age-classes used artificial and natural perches differently for diurnal activities ($G = 26.11$, 5 df, $p < 0.001$). Adult bald eagles used artificial and natural perch-trees similarly for loafing activities, but immatures loafed more frequently on natural perches. Adults foraged more frequently from artificial perches while immatures foraged similarly from artificial and natural perch-trees. Eating activities are not discussed here due to small sample size. These results suggest that intraspecific competition between age-classes could have effected perch choice or that adults and immatures preferred different perch characteristics.

BALD EAGLE USE OF ARTIFICIAL PERCH-TREES 1 THROUGH 6

From previous results it was determined that wintering bald eagles did not use the six artificial perch-trees as would have been expected from perch availability. For this analysis, use of the six artificial perch-trees was compared, focusing only on perches actually used by bald eagles. Additional differences emerged when age-classes and diurnal activities were tested. Hence, some artificial perch-trees may be preferred for certain activities and by age-class.

A significant difference was found between use of the six perch-trees by adults and immatures ($G=34.27$, 5 df, $p< 0.001$). Also, activities of adults on artificial perch-trees were significantly different from those of immatures ($G= 68.55$, 5 df, $p < 0.001$). Sixty-six percent of observations of adult loafing were recorded on artificial perch-tree 1 and 31% occurred on perch-tree 2 (97% of total observations; Table 3). Sixty-one and 30% of foraging activities by adults occurred from artificial perch-trees 1 and 2, respectively (91% of total observations). All eating activities of adults were recorded on artificial perch-tree 1. Only three adult perching observations were recorded from artificial perch-trees 3 through 6 during this investigation.

While adult bald eagles concentrated most of their diurnal activities on artificial perch-trees 1 and 2, immature eagles used all six of the perch-trees. The majority of loafing by immatures occurred on artificial perch-trees 4 (36%) and 6 (33%). Foraging activities were recorded on all artificial perch-trees with the exception of perch-tree 3. Only two eating observations of immatures were recorded on artificial perch-trees (one observation each on perch-trees 2 and 4).

These results suggest that adult bald eagles showed a preference for artificial perch-trees 1 and 2 for all activities. This phenomenon may have been due to perch-design, perch-tree height, perch-tree location, or a combination of these factors. Immature eagles appeared to be less selective; however, they may have been responding to competition from adults.

BALD EAGLE USE OF NATURAL VS. MODIFIED-POLE ARTIFICIAL PERCH-TREE DESIGNS

It was determined from results stated above, that bald eagles, in general, used the two artificial perch-tree designs, as would be expected from perch availability. This result indicates that bald eagles did not show a preference for either of the two designs. However, the two designs were used differently by both age-classes and for diurnal activities.

Bald eagle activities on the two perch-tree designs were compared. Bald eagles used the two perch designs differently ($x^2= 7.08$, 2 df, $p < 0.05$). Loafing occurred slightly more than expected on the modified-pole perch-tree design, while foraging occurred more than expected from the natural perch-tree design.

When comparing perches chosen and used by both age-classes, adults used the two perch-tree designs differently than did immatures ($x^2= 49.22$, 1 df, $p < 0.001$). One hundred percent of adult activities occurred on the natural design. Immatures, however, treated the two designs similarly ($x^2= 0.91$, 1 df, $p > 0.90$). Therefore, adults appeared to be very selective in choosing appropriate perches. In this study, adult perch choice could have been based upon several factors: perch-tree location, perch-tree height, or perch-tree design. The effects of these factors can not be separated due to the scope of this study. During this investigation, immature bald eagles appeared to be less selective than adults when choosing perches. However, this tendency could have been in response to intraspecific competition with adults.

DISCUSSION

Bald eagles, in general, used artificial perch-trees significantly more than expected relative to perch availability within the study area. Factors that may have contributed to this phenomenon include both the location and design of the artificial perch-trees. Artificial perch-trees are situated closer to Lock and Dam 19 than are the majority of natural perch-trees within the study area. Fish are known to become dazed and disoriented when passing through a dam, thus providing an easily obtainable food source for bald eagles. It has been documented that proximity to a food source is probably the most important factor in diurnal perch selection by eagles (Steenhof 1978). Hence, bald eagles may have found it more profitable to forage from the artificial perch-trees within the study area. Also, bald eagle perch requirements or preferences have influenced the design of these artificial perch-trees. Optimal perch-trees are typically tall with an 'open' growth structure, have an open edge-exposure (*e.g.* a shoreline, forest-edge, etc.), and are near water (Steenhof 1978; Stalmaster and Newman 1979). Within the study area, artificial perch-trees are more suitable in terms of these characteristics than are many of the available natural perch-trees. Thus, bald eagles could be assured of better visibility and accessibility when conducting their activities.

During this study, bald eagles were observed using the six artificial perch-trees differently relative to perch availability. Artificial perch-tree 1 was used significantly more frequently than expected for all eagle activities. Artificial perch-tree 1 was rated the best of the natural design perch-trees relative to eagle perching requirements prior to this study (Dunstan and Ives 1985). It is the most proximal to Lock and Dam 19, is the tallest artificial perch-tree, and is of the natural perch-tree design. These factors may have contributed to its attractiveness to bald eagles. Though artificial perch-tree 1 is located closest to Lock and Dam 19, it also is closer to the bridge and highway. It appears, however, that moving vehicular traffic, as on a highway, has little or no effect on foraging eagles (Ingram 1982). Perch-trees 2 through 6 were used indiscriminately by eagles relative to perch availability. Thus, these trees were acceptable but none was preferred.

Differences in the use of the artificial perch-trees do occur between age-classes (Table 3). Adult eagles used artificial perch-trees 1 and 2 almost exclusively and conducted 100% of their activities from the natural perch-tree design. Immatures appeared less selective and used all six artificial perch-trees. Loafing by immatures was concentrated mainly on the two modified-pole perch-trees, while foraging occurred from all perch-trees. Perch-use results suggest that competition between adult and immature bald eagles for 'preferred' loafing and foraging perches may have influenced perch choice.

Griffin (1981) found that immature bald eagles tended to avoid aggressive interactions with adults and that adult eagles dominated younger birds. Stalmaster and Gessaman (1984) supported this conclusion. If immature eagles were avoiding aggressive interactions with adults during this study, one could expect that immatures would use different perches or perch-trees.

Age-class segregation was observed to occur primarily during loafing activities. Though adults and immatures may have been in close proximity, they were usually on a different perch or in a different perch-tree. One might expect segregation to be greatest during feeding activities when adult dominance is highest (Erskine 1968; Stalmaster and Gessaman 1984). It is known, however, that younger eagles are less effective at feeding than adults and may benefit by being near dominants to learn the location of a food source (Murton *et al.*1971; Stalmaster and Gessaman 1984).

Bald eagles, as a whole, used the two perch-tree designs equally relative to perch availability. Therefore, no preference was shown for a particular design. However, bald eagles appeared to prefer certain perch characteristics for certain activities. Foraging was conducted mainly from natural perch-tree designs, while loafing was conducted on the modified-pole perch design. If this result is analyzed further, it can be seen that adult eagles are responsible for the majority of foraging observations on the natural design and immatures are largely responsible for loafing observations on the modified-pole design.

Results of this study indicate that both the natural and modified-pole perch-tree designs were suitable and successful. Bald eagles, as a whole, showed no preference for either design. Use by age-class and for specific diurnal activities may depend on perch-tree height, location, relation to other trees or perch-trees, and design. The dominant adult eagles could use one, all, or a combination of factors in choosing specific perch-trees. Immatures may have been influenced by competition with adults in their perch-tree choice.

In summary, bald eagles used artificial perch-trees more than would be expected from occurrence alone. This indicates that bald eagles were choosing some characteristic(s) of the artificial perch-trees over natural perch-trees. Bald eagles, as a whole, treated the artificial and natural perches actually used similarly. As these general results were broken down systematically, it was discovered that differences occurred between age-classes and among diurnal activities. Typically, adult eagles appeared more selective in their perch choices than did immatures. Immature eagles may have been influenced in their perch or perch-tree choices by adult aggression.

It is clear that bald eagles accept and use these two artificial perch-tree designs. However, due to the limited scope of this study, it is unclear as to what subtle characteristics determine the choices of adults and immatures among perch-trees and between designs.

MANAGEMENT IMPLICATIONS

The artificial perch-trees within the study area had replaced natural perch-trees that were used primarily for foraging (Dunstan and Fischer 1981). During this investigation, the artificial perch-trees were used significantly more than expected for bald eagle foraging activities, relative to perch availability within the study area. Results of this study indicate that this mitigation action was a success, and that artificial perch-trees may be an effective tool in the future as both a mitigation measure and a

management strategy. Natural and modified perch-tree designs may be a solution to the 'first year avoidance' syndrome experienced in other artificial perch endeavors.

However, artificial perch-trees as a long-term management solution may not be practical. Predictions estimate a fifteen-year life expectancy for artificial perch-trees exposed to the elements and use (George Rose, IDOT, pers. comm.). On several occasions branches on artificial perch-trees snapped under the weight of a bald eagle. Maintaining artificial perch-trees could prove to be expensive. Planting cottonwood, sycamore, or silver maple seedlings in the artificial perch area would provide a natural stand of trees after the artificial perches are no longer useful, and, therefore, would be a longer term solution.

As of August 1988, the artificial perch-trees sustained a large amount of damage to their branches. Artificial perch-tree 1 has lost all of it's limbs and is now shorter than the surrounding vegetation. Out of the six artificial perch-trees, those of the 'natural-design' (1, 2, and 3) experienced the most damage. Branches added to modify the existing pole-perches also have broken, however the original pole-perches remain undamaged. The procedure of cutting down and re-erecting existing cottonwoods, for the natural-design perch-trees, may have badly stressed the tree limbs causing them to weaken and eventually break (George Rose, IDOT, pers. comm.). The situation is being evaluated at the present time.

Therefore, the unknown fate of natural-design perch-trees may suggest that the modified pole-perch design, at this time, may be the most cost efficient and successful of the four perch-tree designs (pole-perch, modified pole-perch, modified existing, and natural) mentioned in this report. The addition of natural branches may be more attractive to bald eagles the first year that artificial perch-trees are erected (reducing first year avoidance of perch-trees), and if the natural branches break, the pole structure (which eagles have become familiar with) will remain to be used in subsequent years.

ACKNOWLEDGEMENTS

We would like to thank Mark J. Wetzel, Joyce E. Hofmann and Elizabeth A. Cook for assisting in data collection and constructively commenting on this technical report. Drs. Lawrence M. Page and Wallace E. LaBerge made additional comments.

LITERATURE CITED

Bellrose, F. C. 1944. Bald eagles nesting in Illinois. Auk 61(3):467-468.

Bohlen, H. D. 1978. An annotated check-list of the birds of Illinois. Illinois St . Mus. Pop. Sci. Ser. Vol. 9. viii + 156 pp.

Bowles, M., and R. H. Thom. 1981. Endangered and threatened birds. Pp. 34-58 *In* Natural Land Institute. Endangered and threatened vertebrate animals and vascular plants of Illinois. Illinois Dept. Conserv., Springfield.

Brown, L., and D. Amadon. 1968. Eagles, hawks, and falcons of the world, Vols. I & II. McGraw-Hill Book Co., New York. 945 pp. + 15 pls.

Cory, C. B. 1909. The birds of Illinois and Wisconsin. Field Mus. Nat. Hist. Zool. Ser. 9(131):1-766.

Collins, F., J. Duyvejonck, and K. Bahus. 1984. Collection of behavioral data on wintering bald eagles within the Rock Island District of the U.S. Army Corps of Engineers Mississippi River Locks and Dams 11-22. Pp.130-136 *In* W. Southern and M. Sweet, eds. 1984. Proc. Midwest Workshop Bald Eagle Research and Management. 142 pp.

Dunstan, T. C. and D. L. Fischer. 1980. Feeding behavior and habitat use by bald eagles, Haliaeetus leucocephalus, at Lock and Dam 19, Mississippi River. Howard, Needles, Tammen, and Bergendoff Research Report, Addendum 7. 63pp.

Dunstan, T. C. and J. D. Ives. 1985. Artificial perch tree project. Technical report submitted to Illinois Department of Transportation, Springfield, IL. 13 pp.

Dunstan, T. C., R. G. Harper, and C. D. Hammond-Beyer. 1985. Feeding behavior and habitat use by bald eagles, *Haliaeetus leucocephalus*, at Lock and Dam 19, Mississippi River: Phase II, construction. Technical report submitted to Illinois Department of Transportation, Springfield, IL. 25 pp.

Erskine, A. J. 1968. Encounters between bald eagles and other birds in winter. Auk 85:681-683.

Griffin, C. R. 1981. Interactive behavior among bald eagles wintering in North-Central Missouri. Wilson Bull. 93:259-264.

Griffin, C. R., T. S. Baskett, and R. D. Sparrowe. 1982. Ecology of bald eagles wintering near a waterfowl concentration. U. S. Fish Wildl. Serv. Spec. Sci. Rept. Wildl. No. 247. 12 pp.

Havera, S. P., R. D. Crompton, and F. C. Bellrose. 1984. Aerial inventories of bald eagles in Illinois, 1957-1974. Pp. 90-104 *In* W. Southern and M. Sweet, eds. 1984. Proc. Midwest Workshop on Bald Eagle Research and Management. 142 pp.

Herrick, F. H. 1932. Daily life of the American Eagle: early phase. Auk 49(3):307-323.

Ingram, T. N. 1982. Management guidelines for bald eagles wintering along the Upper Mississippi River and associated river systems. Eagle Valley Environ. Tech. Rept. BEM 82. 21 pp.

Jonen, J. R. 1973. The winter ecology of the bald eagle in west-central Illinois. Unpubl. M.S. thesis, Western Illinois Univ., Macomb. 84 pp.

Kleen, V. M. 1978. Breeding season: seasonal report no. 18. Illinois Dept. Conserv. Springfield. 6 pp.

Kleen, V. M. 1980. Breeding season: seasonal report no. 26. Illinois Dept. Conserv., Springfield. 12 pp.

Kleen, V. M. 1981. Breeding season: seasonal report no. 30. Illinois Dept. Conserv., Springfield. 16 pp.

Kleen, V. M. 1982. Breeding season: seasonal report no. 34. Illinois Dept. Conserv., Springfield. 14 pp.

Kleen, V. M. 1983. Breeding season: seasonal report no. 38. Illinois Dept. Conserv., Springfield. 14 pp.

Kleen, V. M. 1984. Field notes: the breeding season. Illinois birds and birding. Pp. 14-20. Illinois Dept. Conserv., Springfield, IL.

Lehman, R. N. 1979. A survey of selected habitat features of 95 bald eagle eagle nest sites in California. California Dept. Fish Game Wildl. Manage. Br. Admin. Rept. 79-1. 23 pp.

Murton, R. K., A. J. Isaacson, and N.J. Westwood. 1971. The significance of gregarious feeding behavior and adrenal stress in a population of wood-pigeons *Columba palumbus.* J. Zool. (London) 165:53-84.

Ridgway, R. 1913. The ornithology of Illinois. Vol. I. Illinois State Lab. Nat. Hist. H. W. Rokker, Springfield, Illinois. viii + 520 pp.

Snow, C. 1973. Southern bald eagle *Haliaeetus leucocephalus leucocephalus* and northern bald eagle *Haliaeetus leucocephalus alascanus* . Habitat Mange. Ser. Endangered Species Tech. Note. U. S. Bur. Land Manage. Rept. No. 5. 57 pp.

Southern, W. E. 1963. Winter populations, behavior, and seasonal dispersal of bald eagles in northwestern Illinois. Wilson Bull. 75(1):42-55.

Stalmaster, M. V., and J. A. Gessaman. 1984. Ecological energetics and foraging behavior of overwintering bald eagles. Ecol. Monog. 54:407-428.

Stalmaster, M. V., and J. R. Newman. 1979. Behavioral responses of wintering bald eagles to human activity. J. Wildl. Manage. 42(3):506-513.

Steenhof, L. 1978. Management of wintering bald eagles. U. S. Fish and Wildlife Service. FWS/OBS 78/79. 59 pp.

Steenhof, K., S. S. Berlinger, and L. H. Fredrickson. 1980. Habitat use by wintering bald eagles in South Dakota. J. Wildl. Manag. 44(4):798-805.

APPENDIX

SPECIES ACCOUNT

Haliaeetus leucocephalus (Linnaeus) - Bald eagle

The range of the bald eagle extends south to Florida and Baja California, and north to Alaska and northern Canada (Brown and Amadon 1968). Part of the Canadian and north-central United States population (*H. l. alascanus* Townsend) winters in the Mississippi and Illinois River valleys. Cory (1909) and Ridgway (1913) indicated that, historically, the bald eagle in Illinois occurred along the major rivers and unsettled areas, was present year-round, and bred throughout its range. Current distribution in Illinois continues to be strongly associated with major waterways (Bowles and Thom 1981; Havera *et al.* 1984).

Breeding bald eagles no longer are common in Illinois. In 1978, two young eagles were fledged in Alexander county (Kleen 1978). Prior to this, eagles had not been reported nesting in Illinois since the 1940's (Bellrose 1944). A breeding pair has nested successfully, every year since 1980, at the Crab Orchard National Wildlife Refuge in Williamson County (Kleen 1980, 1981, 1982, 1983, 1984). Other (unsuccessful) nesting attempts in recent years have occurred in Union and Jo Daviess counties (Bowles and Thom 1981). In 1986, a bald eagle nest was discovered in Pike County (Sue Lauzon, pers. comm.). Bald eagles begin nest construction in January and lay eggs in March. Young hatch April or May. Adults tend to use the same nesting site every year (Herrick 1932).

Bald eagle use of the Mississippi River valley during winter has increased greatly as a result of alteration of the river by man (Steenhof 1978). Eagles congregate around dams, which are sources of open water and thus provide a plentiful supply of food. Steenhof (1978) believed that food may be the most important requirement of wintering bald eagles, but that distribution also is influenced by the location of preferred perches. Southern (1963) and Jonen (1973) found that eagles on the Mississippi River in northwestern Illinois fed primarily upon fish (usually *Dorosoma cepedianum*). Because eagles also feed on crippled or dead ducks and geese, they are associated with areas of high waterfowl concentration (Griffin *et al.* 1982). Wintering eagles are found in Illinois from late September to early April (Bohlen 1978).

Bald eagles prefer large, tall trees (average 42 to 62 cm dbh) near rivers reservoirs (1 to 10 km) for roosting and nesting (Jonen 1973; Steenhof 1978; Lehman 1979; Steenhof *et al.* 1980). The tallest trees in an area are usually preferred, especially large dead or dying trees (Jonen 1973; Snow 1973; Steenhof 1978; Steenhof *et al.* 1980). Also, trees which have one or two open edges are favored (e. g. riverbank, cropland) because they allow easy surveillance for food and accessibility (Snow 1973; Steenhof 1978; Steenhof *et al.* 1980). Eagles require a buffer zone from human disturbance around their nest sites and feeding perches (Snow 1973; Stalmaster and

Newman 1979). During poor weather and winter nights, eagles move to more protected sites such as conifers or floodplains surrounded by riverbluffs (Jonen 1973; Steenhof *et al.* 1980).

In response to its significant decline in the continental United States, the bald eagle has been declared endangered and placed on the federal list of endangered and threatened species. This decline has been attributed to dwindling habitat, illegal shooting, and the adverse effects of pesticides on egg viability (Snow 1973; Stalmaster and Newman 1979; Bowles and Thom 1981).

In 1972 the Illinois Department of Conservation permanently incorporated the bald eagle into its autumn, winter, and spring waterfowl counts. Researchers from the Illinois Natural History Survey-Havana Laboratory conduct annual aerial surveys along the Illinois and Mississippi rivers, including floodplain lakes, wildlife refuges, nature preserves, and cooling reservoirs adjacent to the rivers (Havera, INHS Havana Laboratory, pers. comm.; Havera *et al.* 1984).