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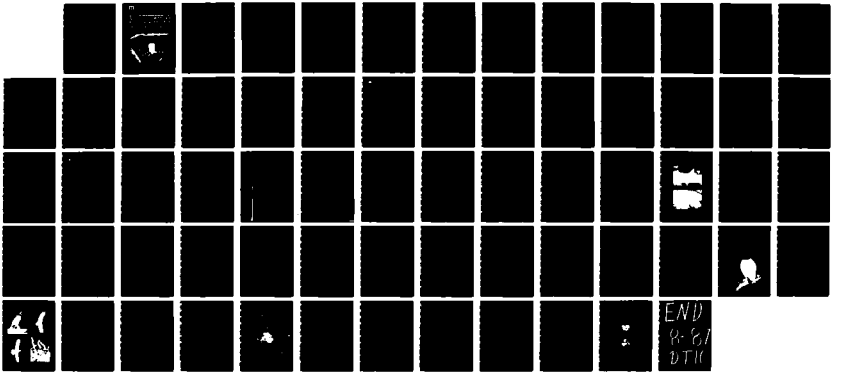

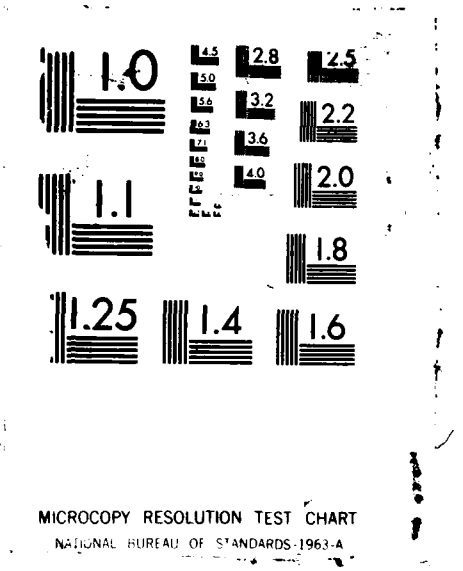

US Army Corps
of Engineers
Nashville District

American Bald Eagle Restoration Plan For Dale Hollow Lake

June 1987

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The U.S. Army Corps of Engineers is considering a hacking program in an effort to reestablish nesting populations of the American Bald Eagle (Haliaeetus leucocephalus) in the Upper Cumberland Region. Dale Hollow Lake was chosen as a potential site for this project due to its proximity to other reservoirs which are also likely to offer suitable eagle nesting habitat.

The issue addressed herein is whether Dale Hollow provides a sufficient food supply to support a successful project. The report also proposes recommendations for implementing such an endeavor.

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AMERICAN BALD EAGLE RESTORATION PLAN

FOR DALE HOLLOW LAKE

O. Ray Jordan

Department of Biology

Tennessee Technological University

Cookeville, TN 38505

Final Report

Contract # DACW 62-86-M-0818

AMERICAN BALD EAGLE RESTORATION PLAN

FOR DALE HOLLOW LAKE

O. Ray Jordan
Department of Biology
Tennessee Technological University
Cookeville, TN 38505

INTRODUCTION:

Breeding populations of American bald eagles (Haliaeetus leucocephalus) have disappeared from most of their historic nesting areas in the conterminous 48 United States, causing this species to become federally listed as endangered. This disappearance has been generally attributed to DDT and related chemicals concentrated in the food chains of the adult breeders. These chemicals caused weakening of the egg shells with concomitant death of the embryos. Mature eagles usually return to the locality where they were fledged (reared) to reproduce. Successive failures to fledge young in various areas, in addition to loss of resident nesting adults due to death from normal causes, have terminated all reproduction by eagles in a majority of areas that were formerly productive. A lesser but serious cause of the dramatic decline in eagle production has also been loss or degradation of suitable undisturbed nesting sites.

In the past decade, federal law has forbidden the general use of DDT. This action seems to be mitigating the egg shell problem, but many former nesting sites now lack parent breeding stock imprinted to return to these sites.

With the construction of large impoundments (e.g., Center Hill, Cordell Hull, and Dale Hollow Lakes) in Middle Tennessee and elsewhere, excellent potential habitats for bald eagles and osprey (Pandion haliaetus) have been created. Although occasional sightings were reported in years past, neither of these fish-eating species could be supported in substantial numbers along the preimpounded streams. The introduction of a breeding populations of these raptors to the mid-state area appears to be suitable at this time, due to the availability of adequate habitat, potential hacking facilities, and interested personnel.

To re-establish breeding populations of bald eagles at former nesting sites and to establish them at new sites, young eagles must be fledged ("hacked" or reared) at a site as soon as possible after hatching. This activity entails placing an artificial nest on a platform raised 35-50 feet above the ground, sometimes in a tree or, perhaps more suitably, on a constructed tower. An additional platform on a nearby tree, or on a second tower, has been used by some researchers to transmit food and water via a system of pulleys to the caged eaglets atop the nest platform. Rearing of eaglets in this manner appears to imprint the young to return to the general area of the hacking site when they reach sexual maturity, usually at four or five years of age. This method reportedly has been successful and appears to be the most practical method presently known for establishing breeding populations of bald eagles and other raptor species in suitable habitat, either historic or newly established.

Dale Hollow Lake, a U. S. Army Corps of Engineers project has a maximum flood control pool area of 30,990 acres (48.28 square miles) encompassed by a sloping, deeply indented forested shoreline (with adequate openings) of 620 miles and a pool length of 61 old river miles. This lake lies along the Kentucky-Tennessee border approximately halfway between the east-west limits of both states, with the large majority of surface in Tennessee. The congressionally authorized purposes of Dale Hollow Lake are flood control and hydroelectric power generation with fish and wildlife and recreation also important features.

Dale Hollow Lake has supported a substantial wintering bald eagle population for many years (see attachment). This seems to indicate a possible suitable summer food supply for nesting adults and their young. The surrounding forests contain adequate mature trees for nesting, and many of these trees are located where security from human disturbance could be maintained during hacking, and hopefully, natural nesting. Biologists from the Tennessee Valley Authority, the U. S. Fish and Wildlife Service, the Tennessee Conservation League, and other experts on eagle hacking have expressed enthusiasm about Dale Hollow Lake as an area having suitable required habitat and, therefore, worthy of extended endeavors to establish new nesting bald eagle populations.

Should hacking efforts at Dale Hollow offer some measure of success, the location of this lake may potentially contribute to establishing new bald eagle nesting populations in surrounding regions of Kentucky and Tennessee. Other locations within the

Dale Hollow Lake area that likely offer suitable eagle nesting habitat include:

	Approx. Air Distance from Dale Hollow--Miles
1. Lake Cumberland (Kentucky)	24
2. Cordell Hull Lake (Tennessee) . .	10
3. Center Hill Lake (Tennessee) . . .	46
4. East Tennessee Lake Complex (Norris, Cherokee, Douglas Lakes, etc.)	107
5. Southeast Tennessee Lakes	72
6. The Big South Fork National River and Recreation Area (Kentucky and Tennessee)	37

On the following pages are annual counts (1979-1987) of wintering populations of bald eagles at Dale Hollow Lake, from data supplied by the U. S. Army Corps of Engineers (USACE).

Dale Hollow Lake receives, beside wintering bald eagles from the northern USA, bald eagle visitors during the summer from south of Tennessee, probably from Florida. Dale Hollow attracts a segment of the public who are interested in eagles, usually in winter. The hacking sites tentatively selected at this lake can be viewed by the public without causing alarm to the eaglets being fledged. Those persons coming to view hacking towers and associated activities and, hopefully, free roaming eagles later will contribute to the economy of the Dale Hollow Lake vicinity. In addition, the USACE efforts to re-establish this endangered species would be fulfilling their responsibilities under the

Endangered Species Act to promote the well being of the United States' national symbol.

WINTERING POPULATIONS OF BALD EAGLES AT DALE HOLLOW LAKE 1979-1987*

Year	No. Mature**	No. Immature	Totals
1979	12	29	41
1980	24	16	40
1981	23	22	45
1982	29	18	47
1983	34	21	55
1984	35	36	71
1985	44	4	48
1986	45	16	61
1987	45	16***	61
Totals (9 yrs.)	291	178	469
Means	32.3	19.8	52.1

* Data from Dale Hollow USACE personnel.

** Eagles are sexually mature 4-5 years of age.

*** One bird (age unconfirmed) included in this number.

FEASIBILITY STUDY

PREFACE:

During late summer and fall of 1986, an attempt was made to evaluate the available literature, tentative site selection and appropriate habitat relative to a bald eagle hacking project at Dale Hollow Lake. In addition, visits were made to active eagle hacking facilities at the Tennessee Wildlife Resources Agency's (TWRA) Reelfoot Lake site, Tennessee Valley Authority's (TVA), Land Between the Lakes operation in Kentucky, and the Alabama Game and Fish's Mud Creek hacking project. These trips were made in an attempt to observe, first-hand, the differences and similarities of hacking endeavors of three separate agencies, all of which were being conducted under somewhat unlike physiographic situations.

THE DALE HOLLOW LAKE SITE:

Dale Hollow Lake appears to be, when compared to the three sites visited, worthy of serious consideration as a possible location for the introduction of a resident population of American bald eagles (Haliaeetus leucocephalus). There is, and has been for at least the past nine years, a sizable wintering population of the birds on the lake. Although the availability of a winter food supply does not insure the same in summer, there is a high probability that this is true.

POTENTIAL FOOD SUPPLY:

Fish appear to be the chief dietary item of bald eagles over much of their range. These may be caught by the birds themselves

or stolen from other picivorous species (e.g., ospreys). They may also eat carrion, small mammals (rodents, rabbits, opossums), reptiles (snakes and turtles) as well as waterfowl and shorebirds. Obviously, the birds are opportunistic feeders, and their specific diet will vary with their home region and seasonal availability of specific prey species.

Some believe the wintering eagles at Dale Hollow Lake feed chiefly on coots (Fulica americana), which are largely absent during the summer months and therefore unavailable to newly hacked birds. In addition to the opportunistic feeding habits of bald eagles, two facts appear to negate such a stance. First, newly fledged eagles at other hacking facilities return to the holding towers for several days (or even weeks) to be fed (food is placed on top of the towers and is taken by the young birds). Second, the recent introduction of the alewife (Alosa pseudoharenyus) into Dale Hollow, with the long established threadfin (Dorosoma petenense) and gizzard shad (D. cepedianum) populations affords ample opportunity for "surface fishing" by the birds. This is in addition to various other fish occasionally available to the birds in the shallows. TWRA cove samples, done in August 1983 and 1984 (*See appendix*), substantiate the presence of fish populations which would provide adequate food for a small group of young eagles in the summer. Other terrestrial and aquatic vertebrates would undoubtedly supplement the diet.

CURRENT HABITAT:

During the summer of 1986 and the spring of 1987, two potential hacking tower sites were examined -- one at Irons Creek (Tennessee) and Casey's Branch (Kentucky). Both appear to be adequate for such an operation, with the Irons Creek location somewhat more suitable. Both are located on shallow coves which could easily be closed to the public or posted and both are rather isolated from the general public use areas of the lake. Likewise, in both situations, the shallow water areas would afford easy access to fish by newly hacked eagles and ample perch sites are in the area. A relatively wide band of deciduous forest surrounds these proposed sites, as well as most of Dale Hollow Lake, providing additional cover for the birds. This forest cover also serves to limit terrestial access to the sites by the public.

Additional studies to determine more definitely the adequacy of fish availability during the summer months; to examine the abundance of potential roost trees; and the potential nest sites in the area of each cove are suggested. The current study, in the limited time available, did not address these questions in detail.

OTHER HACKING SITES:

During this investigation, three active hacking sites were visited: (1) Reelfoot Lake (Tennessee), (2) Land Between the Lakes (Kentucky), and (3) Mud Creek (Alabama). These facilities were examined to determine their similarities and differences.

Each was in a different physical environment, and each was constructed somewhat differently. Some of the differences are hereby noted:

(1) **Reelfoot Lake** -- The towers here are constructed in live cypress trees at a height of some 20-25 feet over shallow water. Access to the tower is provided via a boardwalk and an inclined walkway. The tower itself is one unit, encompassing both the observation area and hacking cages. The observation area is equipped with one-way glass for recording data on the eagles.

(2) **Land Between the Lakes** - This facility, one of the earliest in the region, consists of two separate towers. One of these is the observation tower and the other houses the hacking cages. They are separated by a line of trees along a fence row, with the cages being located nearer the water. One tower is 30' high and the other is 40' high. Both are mounted on telephone poles with access being gained only by climbing the poles. Observations are made via binoculars and a spotting scope.

(3) **Mud Creek** - The Mud Creek facility is also divided into two separate structures. The actual hacking tower is constructed of metal scaffolding anchored in a concrete slab. It is further secured by metal cables running up one side, over the top, and down the opposite side. Wooden cages are mounted on top with access to them via metal stairs.

The observation building is located some distance away across a small water-filled embayment. Observation is accomplished with spotting scopes and binoculars through a large glass window.

Each of the above facilities have cages measuring 8' x 8' and approximately 5' high. All cages are provided with artificial nests (approximately 5' in diameter) constructed of limbs and other vegetation. Each is provided with watering and food trays. Both the observation towers and observation areas are protected by ample lightening rods. The number of hacking cages varies from location to location. An 8' x 8' cage can accommodate up to three birds each. Birds of differing ages are separated, however.

HACKING PROPOSAL SUMMARY:

Based upon the preliminary information presented, it appears feasible to attempt a bald eagle hacking program on Dale Hollow Lake at an early date. Techniques and materials utilized would be modified to the terrain of the Upper Cumberland area after those employed by TVA at their Land Between the Lakes hacking site, as well as those at Reelfoot Lake and Mud Creek, Alabama. It is suggested that the program be instituted in the summer 1987, and carried out over a period of five consecutive breeding seasons. It is further suggested, because of time constraints, that the 1987 season be used in site selection; tower (or other suitable nesting structure) construction; visiting other successful similar operations to refine techniques; personnel

selection; public relations; and making arrangements for hatchlings to be used the following season or late in the summer of 1987. During the following seasons, young birds would be reared, tagged and released according to the plan formulated in 1986-87. Some measurement of project success should be evidenced by the return of mature (or nearly so) eagles in 4-5 years.

BASIC RECOMMENDATIONS -- DALE HOLLOW:

1. A bald eagle hacking program be instituted at Dale Hollow Lake during the summer of 1987 and continued a minimum of four successive summers. It is further recommended that this be initiated on a small scale (2-3 birds maximum) for the first summer and expanded during the following years. Note the 50 releases projected by the Tennessee Wildlife Resources Agency (Appendix - May 11, 1987 letter from Gary Myers).

2. The hacking site be located on the Tennessee side of Dale Hollow Lake at Irons Creek, because TWRA has all the necessary Federal permits and has indicated they will provide assistance to the Corps.

3. The selected site be cleared of vegetation in a somewhat triangular fashion from the hacking tower to the shoreline. The hacking tower would then be constructed near the apex of the triangular clearing. This would give the eaglets full view of the water as well as a direct and unobstructed flight pathway for their initial release. Such a clearing pattern would also maximize concealment of the site from most lake traffic.

4. The site be posted in an appropriate manner (signs along USACE terrestrial boundaries and buoys in the cove).

5. A hacking tower be constructed following these general guidelines:

A. Tower be mounted on 4-6 cresosote-treated poles with the bottom of the supporting platform located 25 to 30 feet from the ground. Some have suggested metal supports to avoid possible vandalism by burning.

B. Two cages, measuring 8 ft. x 8 ft. x 6 ft. high be mounted atop the above structure (Three birds of the same age can be housed in each.) Three sides and the top of these cages should consist of a wooden frame securing round steel conduit bars. Approximately one-half of the top should also be fitted with a protective cover (probably plywood) to afford shade and protection from heavy rain. The side nearest the water of each cage will be equipped with a release door. Four to five foot perch poles also will be mounted on the lake side of the cages. Each cage will be provided with an artificial nest (5' diameter), feeding tray or platform and watering device. A catwalk around the cages is necessary for worker access and cage maintenance. Specific construction details will be formulated in consultation with the Resource Manager of Dale Hollow.

C. The observation/care area be constructed on the same tower behind (forested side) the hacking cages. The exact size would be determined but should accommodate 3-4 workers comfortably. It is suggested that the doors to each cage open from this area as well as the food/water access. The wall separating the observation booth from the cages should be constructed of a material which will minimize noise. This will

avoid the problem of eaglets becoming associated with the presence of humans. This wall should also be provided with one-way glass for observation of the birds.

D. Each cage and the observation area must be protected with lightening rods, and metal predator guards must be installed on the tower supports.

E. Access to the tower/observation area from the ground is yet to be determined. A ladder or narrow stairway would perhaps be best. An enclined ramp is used at Reelfoot; metal stairs at Mud Creek; and metal climbing spikes are in one of the poles at LBL. The latter is inconvenient and also requires the attachment of safety lines for the workers.

6. Provision would have to be made for housing the worker/observer(s) within a reasonable distance from the tower. Since the nearest dock (Willow Grove) is some 2.5-3 mi. distant, it has been suggested that the worker(s) be located on the Irons Creek site at all times for security of the eagles. If it is decided that this is necessary, then a small trailer or perhaps a houseboat will be required.

7. A public relations program (aimed at local residents, dock and resort operators, as well as visitors) be developed and implemented at an early date. A pride of "local ownership" of the eagles will likely go far in eliminating a concern for security of the site and successfully fledged birds.

8. The program be funded at approximately the same level, minus tower construction and site preparation, for a minimum of four successive summers (See attached tentative budget for 1987).

PERSONNEL:

Project Director: O. R. Jordan, Assistant Professor, Department of Biology, Tennessee Technological University.

Consultant: B. L. Ridley, Professor Emeritus, Department of Biology, Tennessee Technological University.

Student Workers: Three full time at $5/hr. for 12 hr./day ($60.00 day), 60 days.

USACE Personnel: Responsible for tower construction, assistance with site security, and some observation.

Volunteers: Tennessee Ornithological Society Members in the area.

TWRA Personnel: Consultants, advisors, and assistance by local TWRA Wildlife Officer (as time permits).

APPENDIX

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

May 11, 1987

Mr. James W. Pulliam, Jr.
Regional Director
U.S. Fish and Wildlife Service
75 Spring Street
Atlanta, GA 30303-3376

re: Amendment for Bald Eagle Translocation
Dale Hollow Lake, Tennessee

Dear Mr. Pulliam:

This is an amendment to my enclosed letters of February 17, 1983 and January 20, 1987. We are not increasing our request for "up to 36 eaglets" for hacking in Tennessee during 1987. However, we are proposing to add a Bald Eagle hack site on Dale Hollow Lake in Clay County, Tennessee. This project is to be fully funded by the U.S. Corps of Engineers, who are imminently constructing a two-cage hack tower under our guidelines. Faculty and students of the Tennessee Technological University are to provide most daily feeding, care and monitoring under our guidance.

The Dale Hollow hacking project could begin by June 15, 1987, provided eaglets are available beyond minimum needs at Reelfoot Lake and Land-Between-the-Lakes.

In accordance with USFWS' Bald Eagle Translocation Policy, the following information is provided for Dale Hollow Lake.

1. Evaluation of Past, Present and Future Ownership and Management of the Area

   Dale Hollow Lake is located astride the Tennessee-Kentucky line in north-central Tennessee about 75 miles NE of Nashville and 86 miles NW of Knoxville, Tennessee. This Obey River impoundment is part of 52,542 acres of land and water under the administrative control of the U.S. Corps of Engineers. The normal summer pool consists of 27,700 acres of water, surrounded by 24,842 acres of public lands of which 98 percent is vegetated with central hardwood forests.

The land has been in U.S. governmental ownership since shortly before the dam was complted in 1943, and is anticipated to remain in public ownership in perpetuity.

2. Evaluation of Prior Bald Eagle Use and Nesting

Dale Hollow Lake usually ranks second only to Reelfoot Lake in support of wintering Bald Eagles in Tennessee. There were at least 58 Bald Eagles during the January, 1987 mid-winter count, with 32 of them in Tennessee. The total lake count for 1983 through 1987 ranges from 48 to 71 and averages 59 Bald Eagles.

There are no documented records of Bald Eagle nests on Dale Hollow Lake, except that the Tennessee Ornithological Society has published historical unsubstantiated observation by local residents concerning five Bald Eagle nests on Dale Hollow Lake during the 1940's and 1950's (Hassler and Hassler, 1972). One eagle nest apparently fledged one young in 1986 on the Corps' 12,000-acre Cordell Hull Lake about 25 miles SW of Dale Hollow Lake. The Cordell Hull Lake nest hatched two eaglets by April 29, 1987.

3. Prey Base and Eagle Foraging Areas

The wintering Bald Eagle populations are believed to feed primarily on the American Coot (Fulica americana), which migrates northward each spring. During the spring and summer, the Bald Eagles would need to feed an estimated 85 to 90 percent on fish from the lake, as well as on a variety of terrestrial wildlife, such as eastern cottontail rabbits (Sylvilagus floridanus) and woodchucks (Marmota monax). These terrestrial populations should be increased by planned small openings in the forest.

Dale Hollow Lake has a relatively low fishery productivity. However, TWRA's Regional fishery biologists advise that there are usually floating, freshly dead gizzard shad (Dorosome cepedianum), threadfin shad (Dorosoma petenense), and alewife (Alosa pseudoharengus). These shallow dwelling species would probably also be the most vulnerable to live taking by eagles.

4. Availability and Suitability of Nest and Perch Sites

The Corps' approximately 24,000 acres of forest land has not been cut since completion of the Dale Hollow Dam in 1943. The Corps' proposed operational plan for the lake proposes a forest management program that will retain all trees within line of sight of the lake from

300 feet to 0.5 mile from shoreline. A 90-year cutting rotation is proposed for cutting timber in small (average of 10-12 acres) compartments, in 6,000 of the 24,000-acres of forest land, except where mature timber needs to be retained for eagles and other wildlife. Bald Eagles are important manifestations of this plan. See the attached Corps' map - "Dale Hollow Lake Forest Management Prescription" and "Operational Management Plan - Part One - Dale Hollow Lake", Chapter 9, pages 76-78, as related to eagle management.

5. Potential Public Disturbances

The Corps of Engineers is prepared to close terrestrial accessibility into areas supporting nesting eagle populations, and where such need is indicated for potential nesting.

6. Limiting Factors Contributing to Previous Decline

The primary limiting factor causing the previous regional and national decline of Bald Eagles is believed to be DDT. After it was banned nationally in 1972, and since there are more Tennessee large impoundments than in historic times, these are improved opportunities for restoring nesting of the species by the transplantation process.

7. Local Public Sentiment Toward Reintroduction

There are good indications of public support of Bald Eagle restoration on Dale Hollow Lake. When the Corps first proposed their Dale Hollow operational plan in 1983, local citizen and environmental groups were quick to question adequate consideration for the Bald Eagle. The Corps have since accepted the revisions as developed by a multi-disciplinary team.

8. Tennessee's Long Term Goals and Objectives

According to the Southeastern Bald Eagle Recovery Plan, Tennessee's recovery goal is twenty occupied breeding areas, with greater than 0.9 young per occupied nest, greater than 1.5 young per successful nest, and at least 50 percent success in nesting, all on a 3-year average.

During 1986, Tennessee had eight known breeding territories, of which four successful nests fledged seven young.

Based on the attached, "Computer Model Projections for Bald Eagle Hacking in Tennessee", we believe that Tennessee's Bald Eagle hacking program can result in

fifty (50) successful nests within 75 miles of our hack sites (including adjacent states) by about the year 2005, provided adequate eagles are available for hacking.

We propose to extend our hacking operations to Chickamauga Reservoir in SE Tennessee by about 1989, or when hacking efforts at Reelfoot Lake have been essentially completed.

9. Funding and Personnel Requirements

Estimated costs for construction and operations of the Dale Hollow Lake site during 1987 is between $20,000 and $25,000. The Corps of Engineers has agreed to fund all related costs for 1987 and until approximately 50 eagles can be hacked at that site.

Key personnel to be involved in the Dale Hollow hacking are:

Robert M. Hatcher - M.S., Auburn University, 1961. TWRA Coordinator of Nongame and Endangered Species since 1978. Has coordinated Tennessee's statewide eagle and osprey hacing programs since 1980 and peregrine falcon hacking since 1984. Is to provide overall technical guidance for Dale Hollow eagle hacking project.

O. Ray Jordan - M.S., University of Arkansas, 1962. Tennessee Technological University, Cookeville, TN. Assistant Professor of Biology since 1968. All Ph.D. requirements completed except dissertation at Mississippi State in Zoology (animal behavior). At TTU, teaches ornithology, herpetology, comparative vertebrate anatomy, nature study and general zoology. Past President of Tennessee Ornithological Society. To coordinate daily feedings and monitoring of hacked birds, utilizing TTU wildlife students, volunteers from Tennessee Ornithological Society, the Clay County Wildlife Officers, and Corps' Biologists/ Rangers.

Frank Massa - B.S., Agricultural Sciences, Tennessee Technological University, 1966. Corps of Engineers since 1966. Dale Hollow Lake Resources Manager since 1985. To be responsible for construction of hack site facilities, in consultation with TWRA and Ray Jordan. To also assist in expediting total eagle program at Dale Hollow in every way feasible. Was a Director of Tennessee Conservation League for seven years.

Bruce Anderson - M.S. in Wildlife Management from University of Tennessee, 1975. TWRA Regional Nongame/ Endangered Species Coordinator since 1982. Has coordinated regional osprey hacking since 1982. Significant experience with raptor rehabilitation.

Patty Coffey - B.S. in Wildlife/Fisheries, University of Tennessee, 1984. Wildlife Biologist, Corps of Engineers, Nashville Office. 5-year Corps Veteran. Assisting with on-site planning, contracts and other documentation.

Please provide any needed permit amendments to us for authorization of Bald Eagle hacking at Dale Hollow Lake, as described above.

Please refer to our "Bald Eagle Restoration" federal aid project description for more details of Tennessee's overall project.

Please advise if further information is needed.

Sincerely,

TENNESSEE WILDLIFE RESOURCES AGENCY

Gary T. Myers
Executive Director

GTM/bjs
Enclosures
cc: Mr. Larry Marcum
Mr. Bruce Anderson
Mr. Phil Neil
Mr. Ray Jordan
Mr. Frank Massa
Ms. Patty Coffey
Mr. Bob Hatcher

GUIDELINES FOR BALD EAGLE HABITAT AREAS IN TENNESSEE

Tennessee Wildlife Resources Agency
January 10, 1986

A. HABITAT EVALUATION FOR POTENTIAL BALD EAGLE HACKING AND/OR NATURAL NESTING

1. How much historical nesting has occurred in the area?

2. Do good wintering populations use the area?

3. Is the primary winter food supply also available during the the nesting season (e.g. coots as a primary winter food on Dale Hollow Lake)?

4. Is there good fish productivity in available waters?

5. Is there normally a good supply of dead and dying fish during the nesting season?

6. Are there other available food sources: deer carrion, open foraging areas for mammals and birds, small turtles, etc.?

7. Are there areas where relative isolation from human disturbance can be provided?

8. Are there adequate potential nesting trees, as described in Section C?

9. Are landowner(s) and residents interested in promoting eagle populations?

B. RECOMMENDATIONS FOR PRESERVING BALD EAGLE COMMUNAL ROOST AREAS

1. Identify all areas of lake commonly used for eagle communal roosting, which usually occurs along or near water edges.

2. No large trees should be removed within 1/4-mile of areas commonly used for communal roosting. Such large trees should be the largest in the stands, especially those with open crowns and stout lateral limbs; aerially accessible by eagles. Dead or dying large trees are commonly used as perches.

3. Develop landowner cooperative agreements with each affected landowner, concerning specific needs.

4. In areas commonly used for communal roosting, limit tree cutting, if any, to selective thinning.

C. RECOMMENDATIONS FOR IMPROVING POTENTIAL EAGLE NESTING HABITAT

1. Identify potential nest trees of the following characteristics:

(a) Sufficiently taller than adjacent trees so as to permit eagle accessibility (with 6 to 7 foot wing span) into the upper 1/4 of the tree; may be a single dominant tree or stands of dominant trees.

(b) Top of tree often having dead or dying open and sparse branching, with a major branch that partially shades the potential nest area, which tends to be the first available major branch below the crown and next to the tree trunk. A dead branch from this or nearby tree is often used as a perch.

(c) Typically located on the edge of an opening in the forest canopy.

(d) In the study of 292 Minnesota nests, nests were usually located between the shoreline and 1/4 mile distance, averaging less than 300 yards (with longer distances expected where human exposure is greater); nests normally less than one mile from water. NOTE: Tennessee eagle nests during 1984 were one mile and two miles from water at Dover/Westvaco and LBL, respectively.

(e) Preferably in areas relatively isolated from human exposure, and away from such obstacles (especially to inexperienced fledglings) as power lines.

(f) Providing a commanding view of the surrounding area, and normally in sight of water.

(g) Having good sources of food, including: fish, coots, ducks, geese, small mammals, carrion, painted turtles , and small birds.

(h) Examples of tree species favored for eagle nesting: cypress at Reelfoot Lake, oaks at Dover/Westvaco and LBL, and conifers regularly used in other states.

2. Silvicultural Recommendations:

(a) Preserve all or most potential eagle nest trees, as described above, in areas identified as having good potential for bald eagle nesting.

(b) Conduct silvicultural practices to insure the development of potential nest trees. Always maintain several tracts of mature timber of over 18-inch DBH. The tree age should normally be over approximately 50 years for pine and over 80 years for hardwoods.

(c) Enhance eagle aerial accessibility to potential nest trees, where needed, by leaving a few dominant trees, and by removal of adjacent obstructing tree(s).

(d) Retain dead and dying trees where needed for perch trees, and for the many other snag-dependent species.

(e) Provide open areas in order to: improve aerial accessibility of eagles to potential nests, increase the terrestrial prey base, and improve survivability of grounded young eagles.

(f) Within 1/4 mile of any active eagle nest, conduct silvicultural practices only outside the nesting season. Conduct such practices outside the period of December 1 to March 31 when wintering communal eagle roosts are involved.

3. Develop landowner cooperative agreements for detailed measures concerning protection of specific active eagle nests, and where feasible, for good potential nest sites.

4. TWRA cooperatively participate, where feasible, in detailed silvicultural plans for each compartment, as related to eagle habitat management.

5. TWRA urge the lead agency to thoroughly orient field personnel concerning proper implementation of such plans and to closely supervise such activities.

6. Control off-road vehicles for minimizing bald eagle disturbance.

7. To the extent feasible, utilize MANAGEMENT GUIDELINES FOR THE BALD EAGLE IN THE SOUTHEAST REGION, as provided by the U. S. Fish & Wildlife Service.

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RMH: 10/84; 12/19/84; 1/30/85, 1/10/86

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

August 18, 1986

Dr. Ray Jordan
Biology Department
Tennessee Technological University
Cookeville, TN 37205

Dear Ray:

In accordance with our telephone conversation of July 15, I am enclosing minutes of the Kentucky-Tennessee Eagle Management Team Meeting of April 7, 1986. Please note Item 10, where the Corps' Ranger, Frank Huff, is quoted concerning the bald eagles' heavy dependence on coots for their winter food supply on Dale Hollow Lake. Just prior to Frank's transfer to a Corps Reservoir in Kentucky, I had him write a letter concerning these observations, but am not able to locate it at this time.

The question that we have is, "After the coots migrate north each spring, is the fishery food base at Dale Hollow of sufficient quantity and/or availability, to sustain nesting bald eagles during the spring and summer months?"

Sincerely,

Robert M. Hatcher, Coordinator
Nongame/Endangered Species

RMH/bjs

Kentucky-Tennessee Eagle Mgt. Team
Dale Hollow Lake
4/7/82

Attendance:

Ben Chapman - Corps
Jim Durell - Ky. Game & Fish
Wendell Crews - USFWS
Sam Barton - USFWS
Jim Cox - Reelfoot Park
Brian Anderson - Ky. Nature Preserves
Ed Ray - LBL
Leon Rhodes - USFWS
Bob Hatcher - TWRA
Frank Huff - Corps, Dale Hollow
Mike Elkins - ~~Corps Dale Hollow~~ USFWS, Cross Cr.
Tom Peak - Corps, Laurel Lake
Jim Hunter - Corps
Jim Whittington - Reelfoot Refuge
Mike Elkins - USFWS
Laura Ellenwood - LBL Intern

1. Tennessee National Refuge - Peaked at 42 eagles; fewer goldens.
2. Cross Creeks - Report by Sam Barton, normal year.
3. LBL - Ed Ray: no golden, 29 adults and 45 immatures (total of 74) bald eagles on February 19, 1982, largest concentration ever recorded at LBL.
4. Reelfoot Lake - Peak of 188 eagles in February, down from 22 in 1981 for Lake and 2 Miss. River sections. Only 102 and 92 eagles on Lake for January and February respectively; both times lake had just thawed out, too early for full return.
5. Dale Hollow - Peaked with 47 eagles on January 6, 1982. Had 46 on February 17, 1982. One eagle had orange wing marker that apparently had been applied in Minnesota in 1979.
6. Reelfoot State Park - Had 8,832 visitors during 1981-82, down from 11,363 in 1980-81. This is due primarily to about 3 weeks of frozen lake in January and February, 1982, and lesser number of daytime programs.
7. LBL Visitation - Attendance was up during 1981-82. Have continuous raptor education program at Interpretative Center. Have 173 programs with 5,712 students. Had 13 field tours with 318 people. Had 300 people for Eagle Weekend. Averaged seeing about 20 eagles for each group. Eagle hacking tape shown to 2,203 people on 194 times. Also, show films. LBL sponsoring a bald eagle tee shirt design contest, with slogan. Tee shirt to be developed from two winning designs.
8. Dale Hollow had a one day eagle watch for third time in February, 1982. Conduct tours by barge from Dale Hollow State Park, Kentucky, with 40 to 50 people. Also, had about 200 people at another site.
9. Next Kentucky-Tennessee Eagle Team Meeting scheduled for Sept. 8, 1982 at TWRA Building in Nashville at 10:00 a.m.
10. Corps reports that all observed eagle feeding at Dale Hollow Lake has been on coots, except two on dead fish. They will fly into a flock, identify weaker coots, and pick them off. The eagle also observe coots diving and pick them off when the coots surface.

Notes by: Robert M. Hatcher

RMH:ss

cc: Don Miller
John Quillen
Bill Yambert

Table 49. Fish standing crop values derived from a cove-rotenone sample (2.81 acres) on Dale Hollow Lake (Jinks Cove) in August 1983.

Group/Species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
GAME FISHES										
Largemouth bass	3	0.04	2	0.81	2	2.48	7	3.33	0.2	2.0
Smallmouth bass	28	0.16	6	1.95	3	4.31	37	6.42	1.0	3.9
Spotted bass	25	0.09	3	0.95			28	1.04	0.8	0.6
Black crappie					2	0.57	2	0.57	0.1	0.3
White crappie					1	0.07	1	0.07		
TOTAL	56	0.29	11	3.71	8	7.43	75	11.43	2.0	6.9
FOOD FISHES										
Channel catfish	11	0.05	1	0.11	1	0.13	13	0.29	0.4	0.2
Flathead catfish	2	0.01	1	0.07	1	5.02	4	5.10	0.1	3.1
TOTAL	13	0.06	2	0.18	2	5.15	17	5.39	0.5	3.3
PISCIVOROUS TOTAL	69	0.35	13	3.89	10	12.58	92	16.82	2.5	10.2
PANFISHES										
Bluegill	632	1.23	225	10.58	69	13.24	926	25.05	25.3	15.1
Green sunfish	1	0.01	1	0.01			2	0.02	0.1	t
Longear sunfish	1,172	2.56	303	9.21	6	1.18	1,481	12.95	40.4	7.8
Redear sunfish					1	0.48	1	0.48	t	0.3
Warmouth	9	0.01	28	1.06	1	0.36	38	1.43	1.0	0.9
TOTAL	1,814	3.81	557	20.86	77	15.26	2,447	39.93	66.8	24.1
COMMERCIAL FISHES										
Redhorse					1	0.77	1	0.77	t	0.5
Carp					3	25.09	3	25.09	0.1	15.1
Yellow bullhead			3	0.37	1	0.33	4	0.70	0.1	0.4
Drum					25	28.56	25	28.56	0.7	17.2
TOTAL			3	0.37	30	53.98	33	54.35	0.9	32.8
FORAGE FISHES										
Steelcolor shiner	2	0.01					2	0.01	0.1	t
Gizzard shad			6	0.46	179	47.77	185	48.23	5.1	29.1
Alewife	699	4.11	33	0.82			732	4.93	20.0	3.0

Gizzard shad										
Alewife	699	4.11	33	0.82						

Group/Species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Emerald shiner	2	0.03	1	0.01			3	0.04	0.1	
Bluntnose minnow	105	0.20					105	0.20	2.9	0.1
Madtom	1	t					1	t		
Misc. shiners			1	0.01			1	0.01		
Darter	2	t					2	t	0.1	t
Logperch			3	0.26			3	0.26	0.1	0.2
Brook silverside	9	0.02					9	0.02	0.2	t
Notropis sp.	48	0.14					48	0.14	1.3	0.1
Total	866	4.51	44	1.56	179	47.77	1,091	53.84	29.8	32.5
NON-PISCIVOROUS TOTAL	2,680	8.32	604	22.79	286	111.01	3,571	148.12	97.5	89.4
GRAND TOTAL	2,749	8.67	617	26.68	296	130.36	3,663	165.71	100.0	199.5

Table 56. Fish standing crop values derived from a cove rotenone sample (2.81 acres) on Dale Hollow Lake (Jinks Cove) in August 1984.

Group/Species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
GAME FISHES										
Largemouth bass	2	0.04	6	1.72	2	2.57	10	4.33	0.2	2.5
Smallmouth bass	5	0.04	4	0.63	0	0.28	9	0.95	0.2	0.6
Spotted bass	41	0.20	11	1.25	0	0.34	52	1.79	1.1	1.0
Black crappie			1	0.26	1	0.83	2	1.09		0.6
White crappie	1	0.03	5	0.68	1	0.32	7	1.03	0.1	0.6
Total	49	0.31	27	4.54	4	4.34	80	9.19	1.6	5.3
FOOD FISHES										
Channel catfish	9	0.03	0	0.04	1	0.52	10	0.59	0.2	0.3
Flathead catfish	5	0.02			1	4.32	6	4.34	0.1	2.5
Total	14	0.05	0	0.04	2	4.84	16	4.93	0.3	2.8
PREDATORY FISHES										
Longnose gar			0	0.06	1	5.41	1	5.47	t	3.2
Total			0	0.06	1	5.41	1	5.47	t	3.2
PISCIVOROUS TOTAL	63	0.36	27	4.64	7	14.59	97	19.59	1.9	11.3
PANFISHES										
Rockbass	0	t	0	0.01	0	0.05	0	0.06	t	t
Bluegill	1,249	2.71	436	11.31	42	6.69	1,727	20.71	35.4	12.1
Longear sunfish	579	1.98	223	6.32	5	0.96	807	9.26	16.6	5.4
Redear sunfish					1	0.36	1	0.36	t	0.2
Warmouth	9	0.03	15	0.36	4	0.68	28	1.07	0.6	0.6
Total	1,837	4.72	674	18.00	52	8.74	2,564	31.46	52.6	18.3
COMMERCIAL FISHES										
River redhorse					2	5.66	2	5.66	t	3.3
Carp					5	39.68	5	39.68	0.1	23.1
Yellow bullhead			2	0.26			2	0.26	t	0.2
Drum					24	31.03	24	31.03	0.5	18.1
Total			2	0.26	31	76.37	33	76.63	0.6	44.7

Table 56 continued.

Group/Species	Fingerling size (per acre)		Intermediate size (per acre)		Harvestable size (per acre)		Total (per acre)		Percent of total population	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
FORAGE FISHES										
Gizzard shad			13	1.42	112	30.35	125	31.77	2.6	18.5
Shiners	395	1.31					395	1.31	8.1	0.8
Logperch			0	0.03			0	0.03	t	t
Flathead minnow	59	0.33					59	0.33	1.2	0.2
Brook silverside	52	0.54					52	0.54	1.1	0.3
Alewife	1,548	9.77					1,548	9.77	31.8	5.7
Total	2,054	11.95	13	1.45	112	30.35	2,179	43.75	44.8	25.5
NON-PISCIVOROUS TOTAL	3,891	16.67	689	19.71	195	115.46	4,776	151.84	98.0	88.6
GRAND TOTAL	3,954	17.03	716	24.35	202	130.05	4,873	171.43	99.9	99.9

t $\geq$ 0.005 lb/a, and 0.05%.

Restoration of Bald Eagle Populations in the Midsouth

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Abstract: A Bald Eagle (*Haliaeetus leucocephalus*) reintroduction program was initiated at the Tennessee Valley Authority's (TVA) Land Between The Lakes (LBL) during the summer of 1980. This program was a cooperative effort between TVA and the Tennessee Wildlife Resources Agency to establish the Bald Eagle as a breeding species in Tennessee by a falconry "hacking" technique which has been successful in New York.

Two 8-week old Bald Eagles were removed from separate wild nests in northern Wisconsin and transferred to the Tennessee portion of LBL. Placed in a manmade nest atop a 13 m tower, the young eaglets were fed and monitored from a nearby observation tower without direct human contact until released into the wild at 14 weeks of age. Each bird was fitted with a battery-powered and a solar-powered radio transmitter to allow monitoring of post-release behavior and movements. Both eagles became self-supporting, remained in the region over winter, and 1 was present a year after release.

The Bald Eagle (*Haliaeetus leucocephalus*) formerly nested along the major river systems in Tennessee and Kentucky and to a limited extent in the Cumberland Mountains and Great Smoky Mountains of eastern Kentucky and Tennessee. Although suitable breeding habitat has been substantially increased by reservoir construction beginning in the late 1930's, the nesting Bald Eagle population declined through the 1950's. The last known regional nest was located at Lake Isom National Wildlife Refuge (NWR) in Lake County, Tennessee, in 1961. Since that time pairs of adult Bald Eagles have initiated nests at the Tennessee Valley Authority's (TVA) Land Between The Lakes (LBL), Lake Isom NWR, Reelfoot NWR, and Ballard County, Kentucky.

Eggs were not laid in any instance and the eagles soon left the areas. Alsop (1979) has summarized the available information on historical and current Bald Eagle activities in Tennessee.

Major factors in the decline of Bald Eagle populations were shooting and the widespread use of persistent pesticides (Wiemeyer, pers. comm., Reichel *et al.* 1969, Mulhern *et al.* 1970). Since both impacts have been dramatically altered within the last 10 years and an abundance of suitable nesting habitat is present (Robards and King 1966, McEwan and Hirth 1979), we believed that this region would support a viable breeding population of Bald Eagles (Snow 1973, Fraser 1981). Therefore, we proposed to release immature Bald Eagles obtained from other regions into suitable nesting habitat using "hacking" techniques developed in New York, and used in Georgia and Ohio to restore the nesting population of Bald Eagles in this region.

STUDY AREA AND METHODS

Site Selection

Although potential nesting habitat along the 18,000 km of reservoir shorelines in the Tennessee Valley is abundant, preliminary nesting attempts and the predominance of historical nest sites indicated that western Kentucky and Tennessee were optimal areas. Consequently, we reviewed various potential sites along the Mississippi River, on the Tennessee and Cumberland Rivers, and at Reelfoot Lake. Site selection criteria (Nye 1979, J. Ruos pers. comm.) in order of importance included: (1) nesting habitat in the immediate area and adjacent regions to provide for future expansion, (2) available food supplies, (3) water quality and pesticide contamination of prey items, (4) security and public access control, (5) migrant and wintering Bald Eagle populations, (6) capabilities and commitments of cooperating agencies, and (7) compatibility with ongoing natural resource programs. Potential site review by personnel from the U.S. Fish and Wildlife Service (USFWS), Tennessee Wildlife Resources Agency (TWRA), Kentucky Department of Fish and Wildlife Resources (KDFWR), and the TVA narrowed the selection to 3 areas, Reelfoot Lake, and portions of Kentucky Lake. LBL was selected as the first site because funds, personnel, and facilities would not be available for the other sites in 1980.

Study Area

LBL is a national demonstration area for outdoor recreation, environmental energy education, and multiple-use natural resource management (Fig. 1). The peninsula consists of a series of narrow ridges with moderate to steep slopes separated by narrow valleys oriented perpendicular to the long axis. Soils are mostly gravelly, infertile, and generally not well suited for farm crops. Forests occupy about 61,000 ha (85%) and oak-hickory hardwoods make up 88% of the forest lands. Open areas consisting of cropland

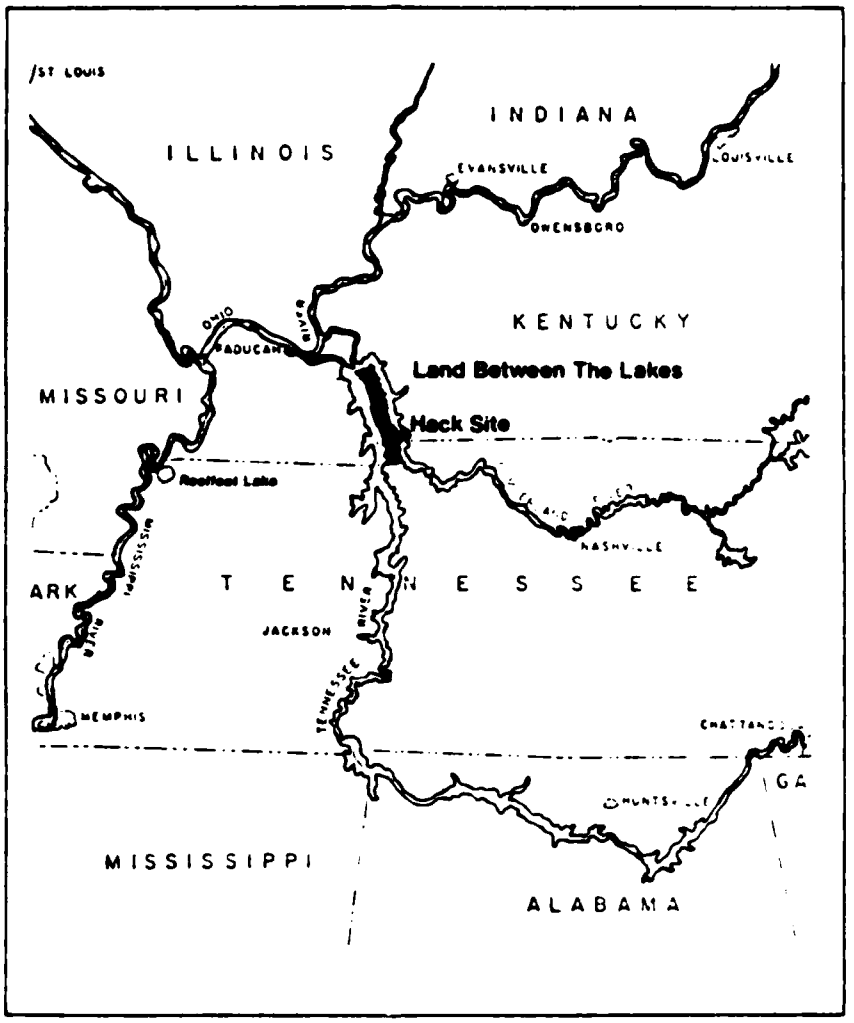

FIGURE 1 Location of the Bald Eagle project in the midsouth

meadow, and reverting fields occupy 10,000 ha located in long, narrow valleys. Of primary importance to this project is the 500 km of undeveloped shoreline on Kentucky and Barkley Lakes, as well as numerous islands and extensive shallow water areas. Three subimpoundments of Lake Barkley, 2 small interior lakes, and over 300 ponds provide 400 ha of water surface within LBL. Year-round free-flowing streams are rare.

Another basic resource of LBL is its wide variety of wildlife, including resident and migrant waterfowl (Anatidae) and a peak wintering population of 70 Bald and Golden (*Aquila chrysaetos*) Eagles. The 2 large lakes with their many bays and inlets, combined with an abundance of fish and wintering waterfowl, make LBL ideal for wintering eagles.

To provide added protection for wintering eagles and waterfowl, LBL and KDFWR have established a seasonal waterfowl refuge on 10 km (river miles 51.0-57.3) of Lake Barkley and an eagle sanctuary in Duncan Bay on Kentucky Lake. Hunting, fishing, and boating are prohibited in the waterfowl refuge between 1 November and 15 February, and between 1 October and 31 March at Duncan Bay. Wintering eagle use in these refuges ranges from 30 to 40 Bald Eagles and a communal eagle roost has been located in the Lake Barkley waterfowl refuge.

Hacking Site Location

Aerial and ground searches of the Tennessee portion of LBL were conducted to select the actual hacking site. Selection criteria included (1) proximity to large shallow water areas for fledgling fishing or scavenging, (2) large trees along the surrounding shoreline areas as perching and roosting sites, (3) access for construction equipment, (4) public access control for security and to reduce disturbance while the eagles were in the area, and (5) low-level vegetation at the release site to facilitate eaglet retrieval if first flights were unsuccessful. Pryor Bay on Lake Barkley in the southeastern portion of LBL was chosen for the hacking site since it fulfulled all of the above requirements.

Project Security

The hacking area (400 ha) was closed to the public to prevent human disturbance by establishing barricades and warning signs around the perimeter of the area. At least 1 project observer was onsite at all times while the eagles were on the hack tower. Public safety officers added the hack site to routine patrols and project observers had radio contact with the Public Safety Office.

Source of Eaglets

Although a few historical nests along the lower Mississippi River had eggs or young in the nests in November and December (southern Bald Eagles, *H*

FIGURE 2 Hacking and observation towers including food delivery system

l. leucocephalus), the majority in this region nested later with young fledging in June or July (northern Bald Eagles, *H. l. alascanus*). In addition, a recent nest (1976) in Alexander County, Illinois, was chronologically representative of northern populations. Bands and color-mark observations of 7 wintering Bald Eagles on LBL from 1976 to the present were applied as follows: Chippewa National Forest, Minnesota–4; Crandon, Wisconsin–2; and the Province of Saskatchewan–1. Therefore, we believed that young eagles from the Lake States' Bald Eagle population would be appropriate for release in this area (J. Ruos pers. comm., S. Wiemeyer pers. comm.).

Eaglet Collection

Good production in 1980 and the cooperative philosophy of the Wisconsin Department of Natural Resources resulted in permission to obtain 2 eaglets. The 8.5-week-old eaglets were collected from nests with 3 young and 2 young in Sawyer and Douglas Counties, Wisconsin, and identified as "male" (FWS band number 629-08324) and "female" (FWS band number 629-08307) from body and foot size (C. Sindelar and D. Evans pers. comm.). Nesting survey records, size, and feather development suggested that the birds were 8.5 weeks old at the time of their removal from the nests.

Release Methods

The Bald Eagle hacking technique was a modification of a successful Peregrine Falcon (*Falco peregrinus*) release program at Cornell University (Sherrod and Cade 1978). Hacking refers to the release of a captively held raptor into the wild to sharpen its hunting skills with subsequent recapture by the falconer. The New York Department of Environmental Conservation pioneered Bald Eagle hacking in 1976 and has continued the program each year. Young eagles are fed and monitored with minimal human contact until released into the wild at the time of fledging. New York has successfully released 22 young eagles with only 1 postfledging mortality. A pair of fledglings, hacked in 1976, returned to build a nest in 1979 and successfully raised 2 offspring in 1980 (Nye 1980). New York's results confirmed the suitability of hacking young eagles to reestablish breeding eagles in non-utilized portions of historic breeding ranges.

Construction of Nest and Observation Towers

The nesting (hacking) tower was located approximately 200 m west of the water's edge of Pryor Bay of Lake Barkley in a mowed field 350 m from mature timber to the north and south.

Tower construction specifications generally followed designs of New York (Milburn 1979), Georgia (R. Odum, pers. comm.), and Ohio (H. Overton, pers. comm.) in earlier hacking projects with some site-specific modifications. One major difference was positioning the observation platform on a

separate tower 23 m distant and behind a treeline from the hacking tower rather than on the same tower (Fig. 2).

The hacking tower consisted of 4 12.7 m creosote-treated poles with predator guards supporting a 2.7 m^2 platform enclosed with a conduit pipe and plywood cage to prevent predation and premature flight attempts. The 4 sides and top of the platform were enclosed with wooden frames (1.5 × 2.4 m) holding round steel conduit bars spaced 13 cm apart (on center), and the floor was of 5 × 10 cm boards with 1.25 cm spacing. Poultry wire (2.54 cm mesh) was added around the exterior of the cage after the eaglets were observed squeezing between the conduit bars. Sheet plywood covering the west side and one half of the top of the enclosure provided shade and protection from inclement weather. A sliding access door was incorporated in the west side, and the side facing the observation tower had an opening (12 × 50 cm) for the food tray delivery system. A low catwalk provided safe observer access to all sides of the platform.

The observation platform (2.7 m^2) was elevated 0.5 m higher than the hacking platform and had a solid plywood side facing the hacking tower with small observation ports and the food delivery system door. It also included a roof and partial panel sides with guardrails on the remaining sides. One pole on each tower had pole climbing steps and a lightning protection system. Camouflage netting screened the access path to the observation tower.

The nest base consisted of interlocked hardwood branches from 2.5 to 5.0 cm in diameter and 1.5 to 2.0 m long with a nest cup in the center lined with willow branches, leaves, and down. Overall size was approximately 1.5 m^2 and 0.5 m high.

Food and Food Delivery

The eaglets were provided food items in a metal tray via a trolley system between the 2 towers. The sheet metal feeding tray (46 × 92 cm) was attached to a trolley on a cable between the towers, and a continuous rope on pulleys at both towers moved the feeding tray between the towers. A counterweight (41 kg) below the feeding tray provided balance and a sheet metal ramp guided the tray into position in the hacking tower (Fig.2).

A major objective of the hacking program was to rear the eaglets as naturally as possible, given the fact that neither parent bird was present (Milburn 1979). Even though the eagles were probably already imprinted on the parents, it was important to minimize direct human contact to prevent acclimatization to human activities. The possibility of eagles associating humans with food and subsequent misplaced imprinting represented a critical aspect of the hacking project. Consequently, food was placed on the tray in the observation tower and the door was opened only to move the tray outside the platform and closed while the tray was moved across to the hacking platform. Fish, obtained by electroshocking, hand netting, and from commercial fishermen,

was the principal food source supplemented with fresh road-killed mammals. Food was frozen and kept on ice until fed to the birds.

Major types of fish included: Shad (*Dorosoma cepedianum*), Carp (*Cyprinus carpio*), Catfish (*Ictalurus punctatus*) and crappie (*Pomoxis* spp.). In addition, eaglets were fed parts of the following mammals: Fox (*Sciurus niger*) and Gray (*S. carolinensis*) Squirrels, White-tailed Deer (*Odoceileus virginianus*), and Woodchucks (*Marmota monax*). To encourage feeding, larger fish and mammals were cut open to expose the flesh and internal organs.

Fresh food was presented several times each day. Moisture content of the food was a concern since no other water was available to replenish body water lost through heat dissipation mechanisms. Consequently, dehydrated fish were replaced, a hypodermic syringe was used to inject water into body cavities of small fish, and larger fish were dipped in water before feeding. Attempts to directly provide water failed because the feeding tray was unstable.

Monitoring System: Prefledging

The birds were observed almost continuously during daylight hours with a 15x to 60x spotting scope, 7x binoculars, or with the naked eye through a 5 cm opening in the observation blind. Major movements and behavioral elements were recorded throughout each day.

A Kodak Analyst 8mm time-lapse camera and timer in the observation blind exposed 1 frame per minute during daylight hours except for the last 3 days when exposure frequency was increased to 1 frame per 30 seconds. Supplementary records were obtained with 35mm still cameras.

A closed-circuit video camera in the observation blind with a monitor screen in a camping trailer provided remote observation capability during poor weather or at meal time and taped records for future review. Design of the voltage and phase converter portion of the system was inadequate and only limited information was obtained.

Monitoring System: Post-Fledging

Studies at natural nests (Dunstan *et al.* 1975, Milburn 1979, Fraser 1981) have indicated that fledgling eagles often land on the ground and Kussman (1977) showed that parent birds feed young eagles until they have well-developed flight capability. Locating the hacked birds after fledging was essential and monitoring behavior, movements, and feeding later was highly desirable to evaluate project results. Although each bird was banded, radio telemetry was selected as the principal monitoring system to obtain data during 3 critical periods: (1) at and for 2 to 3 weeks after release, (2) during the first winter, and (3) at sexual maturity 4 to 5 years later. After literature review and discussion with researchers experienced with eagle telemetry and

equipment manufacturers, we selected 2 independent microtransmitters for attachment to each bird. The primary unit was a solar-powered, capacitor-assisted transmitter (15 g) with a design lifetime of 5 to 6 years and air-to-ground range of 65-80 km. It was centered on the birds' backs with a double-looped harness of Teflon elastic strap material, and the whip antenna extended to the base of the tailfeathers. Since the solar unit lacked a battery, might fail to operate if shaded from the sun, and was a relatively new design, we also attached a conventional unit to each bird. The mercury-battery transmitter (7 g) with a design life of 180 days and an air-to-ground range of 5-8 km was sewn to the proximal portion of 2 central rectrices (Dunstan 1973).

Transmitters, the Falcon Five receiver, and a 3-element yagi antenna were purchased from Wildlife Materials, Inc., Carbondale, Illinois. Thomas Dunstan, under TVA contract, attached the transmitters the day before the eaglets were released.

After release, the birds were monitored during daylight hours on an hourly basis for the first weeks, twice a day for the second and third weeks, and at least 3 times during following weeks from motor vehicles and boats. Descriptive literature was distributed to solicit eagle reports from the LBL staff and the public.

RESULTS AND DISCUSSION

Arrival and Initial Reactions

The 2 8-week old eaglets were transported in standard USFWS wooden crates by light aircraft and air-conditioned car from Hayward, Wisconsin, to the hack site on 28 June 1980. Upon arrival, each was transferred to a light wooden box, hoisted to the hack platform, and released in the hack cage.

Defensive-threat postures and vocalizations were exhibited by both eaglets whenever handlers approached throughout the transfer. Sumner (1929) and Ellis (1979) have reported similar behavior with young Golden Eagles. Both birds were alert and active but soiled and disarranged plumage reflected confinement and travel conditions.

The birds remained on the platform for 3 h before moving onto the artificial nest. Neither left the nest during the remainder of the first day. Activity consisted of preening and gazing on the side of the nest away from the observation tower. No feeding was observed.

Pre-fledging Feeding Patterns

Neither eaglet fed from the tray during the first 2 days in the hack cage nor did they leave the nest for any other purpose. The third morning we tossed small fish into the nest while hidden behind the opaque panel and sliding door. The female eagerly ate 4 fish, swallowing them whole, but the male still did not eat. Direct feeding was repeated on the fourth day and both eaglets ate small quantities. By the fifth day both male and female were feeding

on fish scraps on nest and platform. The male ate fish from the food tray on day 7 but the female did not feed out of the tray until the ninth day.

After initial feedings of Shad, the eaglets ate fleshier fish such as Carp and Catfish and left small fish in the tray. A preference for mammals was noted, but the birds readily ate all food types. Intestines and other viscera were commonly consumed first and fleshy portions later. Heads of large fish were not eaten and were tossed and strewn about the platform and nest, as were cleaned mammal skins and bones.

At 10 weeks the male first used his feet to assist feeding by striking at a fish lying on the platform, grasping it with talons, and tearing away flesh. Forward thrusting and clutching with foot and talons (foot-stab behavior) is a significant developmental step of raptorial birds learning to strike, capture, and subdue prey (Ellis 1979). Both birds exhibited foot-stab or prey-attack behavior on food by 11 weeks of age and also on nest branches, dried food remains, and toward each other.

As strength and muscle coordination developed, portions of food were commonly foot-stabbed and carried about the nest and platform in the bill or talons. By 12 weeks the pair was carrying food items onto the nest before eating.

Ad libitum feeding virtually eliminated competition for food, although normal sibling dominance at feeding times was observed. On 3 occasions, food stealing threats elicited food shielding with a mantling position by the threatened eaglet. The male was dominant during the first 2 weeks, feeding before the female, chasing her from the tray until he had eaten or occasionally chasing the female until she dropped food that he consumed.

At 10 weeks feeding dominance reversed and the female wing-slapped the male to drive him away from food. After the 10th week the male made an attempt to secure food and submitted to the aggresive response of the female by lowering his head and turning his back. Female aggression at times forced the male to the farthest corner from food but the male consumed similar and occasionally greater amounts of food by feeding after the female or while she was resting.

Major feeding sessions (15 to 30 minutes) usually occurred just after sunrise, at midmorning and occasionally in late afternoon. Brief feeding sessions frequently occurred throughout the day.

Total daily food consumption varied from 400 g to almost 1,300 g per bird, varying with air temperatures and wind velocities. Less food was consumed on hot, calm days than on cooler, windy days. During hot weather they peered at the food in the tray or picked at dried carcasses without consuming observable amounts. Although there was a decrease in feeding and activity on hot days, both birds were alert and defecated regularly.

Intraspecific Interactions

Very little aggression was noted during the first 2 weeks. The eaglets stood or sat close together in the nest observing their surroundings and occasionally "social nibbling" that may promote pair bonding (Ellis 1979). Later behavior was predominantly nonaggressive, although physical contact often elicited bill-stabbing or wing-slapping that progressed into mock fighting without actual contact (Milburn 1979). Periods of aggression, while common at feeding, were unpredictable at other times. In a few instances the female abruptly, and with no apparent provocation, bill-stabbed and/or wing-slapped the male. He usually retreated in a submissive posture but occasionally wing-slapped in defense. By the age of 12 weeks, the female appeared totally dominant and often jumped from the top of the nest directly on the male when he attempted to feed. By 14 weeks of age the male began returning her billstabs and wingslaps and crouched over food instead of retreating. He refused to relinquish food and initiated offensive behavior during the last 3 days in the hack cage.

Aggressive actions represented a small portion of the total behavior on the tower. Other interactions typical of nestlings – tossing or carrying sticks, mutual preening, and tug-of-war with dried food or mammal bones – occurred rarely during the early weeks but more frequently as the birds approached fledging (Milburn 1979).

Interspecific Interactions and Human Disturbances

Sources of external stimuli consisted of movements and sounds of other animals, aircraft overhead, vehicles on a road 400 m away, and a fishing boat within 200 m of the tower. The eaglets watched movements of numerous White-Tailed Deer and Woodchucks but were most interested in other birds, especially larger ones, ie. Crows (*Corvus brachyrhynchos*), Great Blue Herons (*Ardea herodias*), and Canada Geese (*Branta canadensis*). On 1 occasion an Eastern Kingbird (*Tyrannus tyrannus*) flew through the hack cage and the eaglets watched closely, but did not move from their nest perch.

Humans were partially or fully in view when we: (1) tossed fish directly into the hack cage to encourage feeding, (2) placed chicken wire around the enclosure to prevent escape, (3) attached radio transmitters to each bird, and (4) removed a side panel to release the birds. On each occasion, the eaglets attempted to escape by moving to the far corner of the enclosure and facing away. As individuals approached closer or entered the enclosure, the birds began jumping against the bars and thrashing with their wings. When we entered the enclosure to attach transmitters, the female flew to the cage roof, grasped the bars, and attempted to forcibly escape. Raising hackles, wing arching, bill opening, and clucking vocalizations in response to human approach were also representative of normal eaglet behavior (Bent 1961). A small fishing boat nearby was watched for a minute or so without any other reaction.

Vocalizations and Preening

Excepting human disturbance, only the female vocalized while on the tower and always in conjunction with aggression toward the male. A series of rapid high-pitched clucks (rattle-chip) first occurred at 10 weeks of age (Ellis 1979) and she later emitted a gutteral "honk" after forcing the submissive male into a corner. Also, the female gave a high, shrill "eenk" as she jumped on the male's back and foot-stabbed him in mock-prey attack behavior. After release a high pitched "hee-ah" was often emitted by both birds, apparently to locate each other.

Preening to relieve discomfort from parasites, oil feathers, and remove soil or other debris (Ellis 1979) was frequent throughout the captivity period. During the first weeks, preening efforts concentrated on emerging and unsheathing new feathers and down was pulled from the plumage throughout the day. Up to 4 h of continuous preening and vigorous shaking occurred after a rain.

Response to Weather

Record high air temperatures during the project produced characteristic responses from the eaglets. Both sought shade provided by the roof and side panel. Periods of heavy panting with open mouth and extended, elevated tongues (Ellis 1979), and wing-drooping to increase radiation and heat convection from the torso (Kahl 1971) were common during the hottest periods of the day. With extreme heat and humidity, both birds, but more commonly the male, laid on the platform floor near the edge, resting their heads on a side panel or out between the bars. Much less feeding or wing-flapping activity occurred on hot days or at midday compared to cooler days or early morning hours.

The eaglets did not seek protection from rainfall, although the cage was partially roofed. Moderate or high winds, especially during cool periods, elicited various wing-flapping behaviors.

Wing-flapping exercises were classified into 5 categories for descriptive purposes: walk-flapping, hop-flapping, jump-flapping, stationary wing-flapping, and free wing-flapping. The first 3 were used primarily in movement about the nest and platform; the latter 2 were strenuous exercises that promote development of the flight muscles and familiarity with wind currents (Bent 1961, Ellis 1979). The first 3 categories are self-explanatory. Free wing-flapping differed from the stationary wing-flap in that the eaglet did not grasp any object and occasionally lifted off the substrate upward or slightly forward occasionally striking the roof of the enclosure.

Most wing-flapping exercise was in response to and oriented toward a steady breeze regardless of time of day. In calm air, wing-flapping without specific orientation was noted immediately after feeding and during cool morning hours. Duration varied from a few seconds to over 0.5 h with longer

sessions involving different types of wing-flapping interspersed with brief rest periods. The frequency of longer, more intensive exercise periods increased during the last 2 weeks prior to release similar to eaglets in natural nests (Bent 1961). In a typical sequence of wing-flapping, an eaglet hop-flapped to the nest edge for 15 seconds of stationary wing-flapping, released the nest stick for a short period of free wing-flapping, landed on the nest, and jump-flapped to the far edge.

Prefledging Behavior

Movements within the cage, wing-flapping and attempts to escape gradually increased during the last 3 weeks of captivity. The female first attempted to escape on 19 July by jump-flapping against the bars, extending her legs through the bars and wing-flapping for a short period. She dropped to the platform, walked back and forth peering outside, and then walked directly into the bars putting her head and one leg out while attempting to walk-flap through the bars. Similar attempts occurred during the following weeks but the male did not attempt to escape until 29 July, after which we added chicken wire around the enclosure.

General restlessness, characterized by frequent head jerking movements, almost continual movement about the enclosure, and escape attempts during the last 2 to 3 weeks, contrasted dramatically with the limited activity observed earlier.

Feeding rates decreased, probably due to daily temperatures near or exceeding 38°C, even though other activity substantially increased during the 2 weeks of captivity beyond the normal fledging time (Bent 1961).

Post-Release Behavior and Movements

One side of the hacking tower enclosure was removed at 0630 (CDT) on 10 August and the male jump-flapped from the nest to a large limb on the platform railing. The female flew directly from the nest across the field (about 175 m) with alternate gliding and flapping and landed out of sight. The male flew slightly farther and gained altitude approaching a perch tree, but missed the target limb and fell 3 m before landing on a lower limb. By late afternoon the female flew to a low-level tree perch and the male changed perches several times by short flights to nearby trees.

Improved flight capability was evident, but landings were still poorly coordinated during the second day. Neither bird returned to the tower to feed; instead they had located and fed upon fish placed along the shoreline during the third day.

Flights at the end of the first week were short, low altitude (50 m) and generally in the back of the bay. Most flights were between perches on the north shore and feeding areas on the west shore. On a few occasions both

birds circled the bay with considerable flapping, gliding, and banking in wide arcs; overwater flight was low and wing tips often impacted the surface.

Preferred perch sites were located in a group of 10 to 20 m high snags along the northwest shoreline of the bay and in a single windfall with several large limbs protruding above the water, 250 and 150 m from the hacking tower.

Tower feeding was continued with fish and a White-tailed Deer fawn placed on the shoreline after dark during the first and second weeks. Neither eaglet fed at the tower and extent of other fish use was undetermined, but the deer carcass was fed upon for the following week. Two weeks after release, the female struck at but failed to capture a live fish.

The solar-powered transmitter functioned only during flight or when the eagle's back was directed to the sun, forcing us to rely on the weak signal of the battery-powered transmitter for most location information. The signal from the solar-powered transmitter could be detected at 5-6 km after exposure to direct sunlight.

Flight distances and duration increased and the birds moved onto the main lake 3 weeks after release. As experience increased, both spent more time in the air performing strong flights that included soaring, gliding, banking, and "parachuting" (Ellis 1979). The eagles moved along the lakeshore up to 3 km distant with infrequent return trips to the hack site, and only once did either bird perch on the tower. Strong flight and alert condition of the birds indicated success in finding dead fish along the shoreline and/or catching live prey as food.

By the end of the third week monitoring was reduced to 2 or 3 observations of less than 1 h per week and our data are incomplete. Flight ability was well developed and the eagles soared for continuous periods of several minutes, but soaring was at low altitude (150 m) and the eagles rarely exceeded 10 m elevation while escaping from observers. Low-level flight characterized the remainder of the period when the eagles were under observation.

The eagles gradually moved northward to the Fords Bay-Donaldson Creek area of Lake Barkley 8-10 km from the Pryor Bay hacking site during the fourth and fifth weeks. Movement from this area was minimal (2 km) during the next 6 weeks, after which the female eagle could not be located. The male remained an additional 2 weeks (total of 13 weeks after release) in this vicinity before also disappearing.

Hunting behavior was observed on only 1 occasion at 5 weeks after release. In flight, the female saw an injured shad flipping on the surface and glided to the shoreline. After watching the fish a few feet offshore, she walked into the belly-deep water, captured the fish, returned to the shore, and ate it. After searching the area for additional fish, the eagle flew to and remained on a nearby perch tree until the observers departed.

On 3 other occasions, the eagles were observed eating while perched on

snags or stumps just above the waterline but the food source – live catch or scavenging – was undetermined. Two searches after the eagles left revealed fresh fish scales on the snag but no food items were located on the third search. Hunting and scavenging behaviors at 7-8 weeks after release were similar to observations of the eagles hacked in New York (Milburn 1979).

Dispersal

The eagles were 14.5 weeks at release and the female was 27 weeks and the male 29 weeks old when each left the Fords Bay-Donaldson Creek area in November. Despite 3 boat searches of Lake Barkley, neither transmitter signal was detected and eagle sightings were unreliable due to the arrival of migrant and wintering Bald Eagles. Two aerial searches of the LBL area in December and January failed to locate either bird.

Dispersal ages for juvenile eagles vary widely. At Chippewa National Forest, Minnesota, juveniles dispersed at 7 to 17 weeks after first flight (Kussman 1977, Fraser 1981). Five hacked eagles at Montezuma remained in the vicinity for 3.5 to 14.0 weeks after fledging (Milburn 1979). Dispersal of the LBL hacked eagles at 13 and 15 weeks was similar to reports of both wild and hacked eagles.

An extensive aerial search on 4-5 February 1981 located the male on Tennessee NWR approximately 80 km south of the release site and the female in Honker Bay 23 km north of the hack site. The male was observed soaring, perching, and feeding with 2 other immature Bald Eagles, and the female was perched with an immature Bald Eagle in an area that receives considerable roosting use by migrant and wintering eagles. Although the female was not located again, personnel of the Tennessee NWR frequently observed the male with other immatures until mid-March. After the migrants departed, he remained in the area through May, disappeared for a month and reappeared in mid-July and September 1981. Though we lack precise information, unverified reports suggest that the female may be located on the north end of Lake Barkley.

SUMMARY AND RECOMMENDATIONS

Transfer, rearing, and release of young Bald Eagles to initiate restoration of nesting populations using the hacking technique developed in New York (Nye 1980) was used to fledge 2 Bald Eagles in Tennessee in 1980. Although final evaluation of this restoration project must await eagle maturation and successful nesting, this effort established 2 independent, self-supporting Bald Eagles in the region.

Although both eagles associated with migrant and wintering eagles, we do not believe that either left the region with migrants. The male was self-sustaining at Tennessee NWR over 1 year after release.

Successful adjustment of Lakes States eaglets to this region suggests that

this population's gene pool encompasses the phenotypic characteristics required for survival in the current environments of this region.

Eaglet transport by light aircraft and air-conditioned car was expeditious (3-h flight) and cool despite near record high air temperatures in Wisconsin and Tennessee. Standard eagle crates, designed for air carrier transport, should have additional ventilation incorporated for future use in hot summer weather.

Although more costly, locating the observation platform on a separate tower with screened access eliminated auditory as well as visual stimuli from movements of project staff. Steel conduit bars should be spaced 10 cm apart or less to avoid needing mesh wire. Extensive successful implementation of hacking in many areas of the United States has provided adequate testing of this experimental technique. Adoption of the procedures as a management practice will necessitate the design of less costly hacking and observation towers. Successful experience with hacking Osprey from less elaborate, inexpensive towers suggests that large, elaborate platforms currently used for eagles may be substantially modified in the future (Hammer and Hatcher 1982).

The continuous rope-pulley mechanism to transport the feeding tray prevented association of food with project staff, provided for removal of uneaten food and supplemented with feeding observations, facilitated estimation of food consumption. The tray was not capable of transporting water. We have since incorporated a hand-powered pump, tubing, and water pan to provide water for cooling during hot weather. Although the diet of wild eaglets is largely fish (Bent 1961), our eaglets preferred mammals, and future projects should incorporate mammal and bird food items as well as fish.

Since both eaglets had been hand-fed to capacity for a few days before transfer, failure to eat for the first few days on the tower did not jeopardize their health or development. Trauma of removal from the natural nest, handling, transfer, and adjustment to an artificial nest may also have affected feeding behavior. Placing fish directly in the nest encouraged the female to eat on the third day and the male on the fifth day, suggesting that failure to eat immediately reflected unfamiliarity with food in a feeding tray external to the nest and/or unwillingness to leave the nest to obtain food. Future projects should plan to place food directly in the nest for the first few days.

General behavior of the eaglets, interactions between eaglets, and reactions to other birds and mammals were similar to reports from other hacking projects and wild nests.

Marking for individual identification and location are critical at 3 periods for the success and evaluation of hacking projects. Project staff must have the ability to locate and perhaps retrieve a fledging in jeopardy for at least the first 3 weeks after release. Later dispersal, migration, and association with other Bald Eagles during the first winter is important in evaluating movements, survival, and adaptive ability of hacked eagles. Thirdly, identification

of mature eagles upon nest initiation in the hack region is essential for final evaluation of project results.

After receiving numerous negative comments on patagial tags, short jesses, and other markers from many researchers, we selected a long-range, extended life, telemetry unit as the primary tagging device. The solar-powered units did not have a battery in the circuitry and theoretically should have unlimited longevity. However, since the capacitor-assisted technology was relatively new, and because the solar units would not function without continuous solar energy, we also attached small battery-powered units to provide redundancy. The battery units provided requisite information during phase 1) the post-fledging period—including the early portions of phase 2) fall and early winter. Thereafter, only very limited information was obtained via the solar-powered units due to design and/or mounting flaws that rendered these transmitters inoperable except when the eagle was flying or perched with its back toward full sunlight. In addition, it appears doubtful that the polymer embedding material will prevent moisture ingress for the desired 4- to 5-year period. Obviously a critical need exists for the development of satisfactory color-marking techniques.

The eaglets were not released until 14.5 weeks old, 2 to 3 weeks beyond natural fledging ages, to ensure maturation of retrices before transmitter attachment. Wing-flapping exercises peaked at 11 to 12 weeks, then declined slightly, and restless escape behavior increased during the next 2 weeks. Behavior at release, flight strength and flight manoeuverability suggested that extended captivity enhanced development of flight capability enabling both fledglings to use elevated perches within hours of release and begin searching for food in a day or two.

Although food was available on the hack tower after release, only the fish and deer carcass placed along the shoreline were used. Placing fish directly in shallow water will reduce rates of decay and may facilitate the development of appropriate hunting and searching behavior patterns.

Although both eaglets left the hack site relatively early and associated at other locations with migrant and wintering Bald Eagles during the winter, these movements appeared to represent gradual exploration of the adjacent environs rather than dispersal. Furthermore, the male's movement southward 65 to 80 km during the winter could not be considered migration.

Presence of the male, and possibly also the female, in the region at least 1 year after release confirms our hypothesis that regional environments are suitable for Bald Eagles and substantiates the validity of hacking as a release technique. Though our results to date and recent successful nesting of 2 hacked eagles in New York (Nye 1980) are encouraging, validation must be delayed until successful reproduction has been demonstrated from hacked eagles

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MANAGEMENT GUIDELINES FOR THE BALD EAGLE IN THE SOUTHEAST REGION

BALD EAGLE MANAGEMENT GUIDELINES

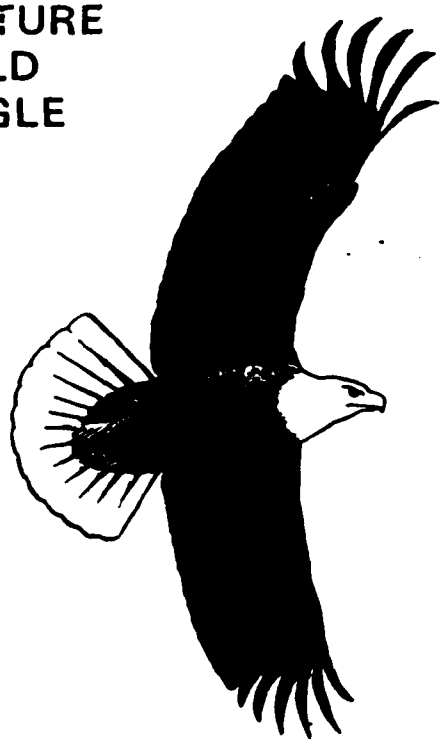
GENERAL: The purpose of these guidelines is to maintain and improve environmental conditions that are required for the survival and well-being of bald eagles. The emphasis is to prevent human disturbance to eagles, particularly during the nesting season, and to preserve and enhance present populations.

Some eagles will tolerate human presence or disturbance until they reach a critical point or threshold level. The effects of human presence and activities on bald eagles are still being argued. These birds exhibit considerable variation in response to human activities depending on the type, frequency, and duration of activity, modification of the physical environment, time in reproductive cycle, and an individual bird's accommodation to disturbance.

Certain human activities are likely to disturb eagles and are specified in the following sections as recommended restrictions. Although these guidelines are based on available ecological information, one cannot predict with certainty the effects of a given amount of disturbance on a particular pair of eagles. We recognize the unclear relationship between human activities and their impacts on a particular pair of eagles. However, we do not know what the long-term effects of human activities will have on the population. Generally, it is thought that what is good for a pair of eagles is also good for the population. This can be determined only over a long period of time. Therefore, even strict adherence to these guidelines will not guarantee continued eagle use of an area. Whoever makes land use decisions will need to take into consideration variations in topography and the behavior of individual eagles so that these general management guidelines can be tailored to suit local conditions.

For management purposes, the following guidelines are divided into sections on Nesting, Feeding, Roosting, Legal Considerations, and Compliance.

MATURE
BALD
EAGLE



IMMATURE
BALD
EAGLE

I. NESTING: Human activities, both short-term and long-term, and alteration of habitat may affect the reproductive success of nesting eagles. The impact of short-term disturbance is largely dependent upon the nature of the activity, its time of occurrence in the nesting cycle and the past exposure of the nesting pair to similar activities. In the Southeast, the nesting period of most eagle pairs will fall between October 1 and May 15. Eagles are most vulnerable to disturbance during courtship, nest building, egg laying, incubation and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity (including aircraft operation) near a nest late in the nesting cycle may cause flightless birds to jump from the nest tree, thus lessening their chance of survival.

Bald eagles often use alternate nests in different years. These nests are located in the same general vicinity. The following guidelines apply equally to all nests used by any particular pair of eagles even though a nest may not have been used for raising young for 1 or more years. Eagle nesting territories are here divided into primary and secondary management zones, within each of which certain human activities have been found to disturb the nesting process. Such disturbance is defined by the restrictions recommended for each zone.

A. Primary Zone: This is the most critical area immediately around the nest, and must be maintained to promote optimum conditions for eagles.

1. Size: Except under unusual circumstances (e.g., where a particular pair of eagles is known to be tolerant of closer human activity), the boundary of the primary zone shall not be less than a 1,500-foot radius (457 meters) from the nest tree, except in Florida where it will be from 350-750 feet (107-229 meters). This exception is due to the large number of nests and birds throughout the State of Florida in comparison to other areas in the Southeast. The size of the primary zone in Florida will be modified and reviewed on an individual basis. In general, the size of the primary zone should be adjusted by the actual use of the area around the nest tree to include frequently used perch trees.

2. Recommended Restrictions:

a. We recommend that there be no activity in the primary zone. The following human activities are likely to cause disturbance to eagles and, therefore, should not occur within the primary nesting zone at any time:

(1.) Land use changes - logging, commercial and industrial development, construction, and mining.

(2.) Use of toxic chemicals - persistent organochlorine pesticides, PCB, mercury, and lead.

(3.) Human entry during the nesting period (except authorized eagle research and management activities with appropriate permits). Human entry during the non-nesting period should be restricted to camping, hiking, picnicking, bird watching, hunting, fishing and use of firearms.

(4.) Low level aircraft operation - Operation of aircraft within 500 feet vertical distance or 1,000 feet horizontal distance from an eagle nest.

b. Other activities that should be restricted in the primary zone during the nesting period.

(1.) Essential research and management activities. Only those activities that are necessary for the protection or continued survival of the bald eagle and its habitat should be allowed and they should be closely supervised and coordinated.

(2.) No expanded human activity should occur in an area already receiving human use where a pair of eagles chooses to establish a new nest. The human activities occurring at that time may continue except for the use of toxic chemicals.

B. Secondary (Buffer) Zone: The purpose of this zone is to minimize disturbance that might weaken the integrity of the primary zone, protect important areas outside of the primary protection zone, and encompass lands that may provide suitable habitat in the future.

1. Size: The size of the secondary zone will be determined by local topography and the resulting visibility from the nest. This secondary zone should be arranged to be contiguous with feeding areas and provide a protected access between nests and the food source. It shall lie

outside the primary zone and be approximately circular, with a minimum boundary of 1 mile (1,609 meters) from the nest tree, except in Florida where it will have a minimum boundary of 1,500 feet (457 meters). This exception is due to the large number of nests and birds throughout the State of Florida in comparison to other areas in the Southeast.

2. Recommended Restrictions:

a. Certain human activities of a permanent nature are likely to disturb eagles and should be limited within the secondary zone. Their impacts increase with the proximity to an eagle nest. The activities include but are not limited to:

(1.) The development of new commercial and industrial sites.

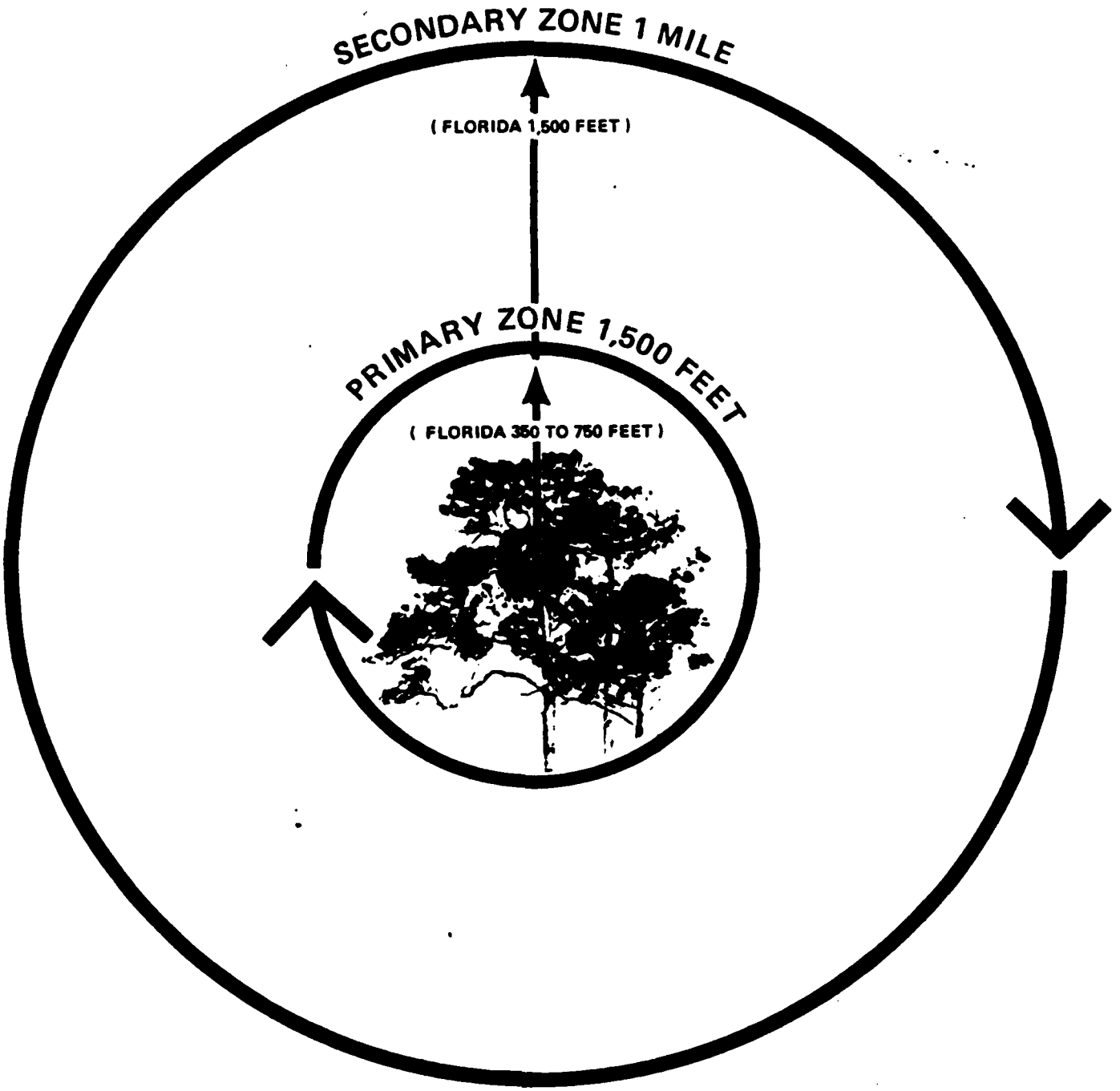
(2.) The building of multi-story buildings and housing developments.

(3.) The building of new roads, trails, and canals facilitating access to the nest.

(4.) The use of toxic chemicals - persistent organochlorine pesticides, PCB, mercury, and lead.

b. In general, no major activities should occur in this zone during the nesting period. Even intermittent use or activities of short duration are likely to provide such a disturbance. Examples are logging (including selective cutting), seismographic activities employing explosives, mining, oil well drilling, low level aircraft operations. Acceptable minor activities the birds will tolerate if restricted to the secondary zone include hiking, birdwatching, fishing, camping, picnicking, hunting, use of firearms, and recreational off-road vehicle use.

These primary and secondary management zone delineations will not vary except under unusual circumstances which will be reviewed on an individual basis and modified to fit specific local conditions and needs. In general, the closer the proposed action would be to the nest, the more restrictive would be the recommendations.



C. Nest Sites: A small yet significant percentage of a bald eagle population nests in new habitat every year. Therefore, to satisfy future nesting needs, it is essential to preserve and protect suitable nesting habitat in addition to that which is presently used. These trees may either be in the secondary management zone or outside of it. Most eagles select nesting sites that include a dominant tree or stand of trees relatively close to a body of water and prefer tall mature trees in an open stand (in an area free of human disturbance) with a clear flight path to the water.

1. Existing Nests: Any bald eagle nest should be brought to the attention of the Fish and Wildlife Service or State wildlife agency so they may provide the necessary protection. Bald eagles often use alternate nests in different years. Existing nests are often rebuilt and occupied after years of inactivity and, therefore, cannot be removed or destroyed even though they have been seemingly abandoned. Legally as long as the nest still possesses those characteristics which make it suitable for occupation, it cannot be disturbed. Non-nest trees in the surrounding primary zone should also be protected until the nest tree is destroyed by the elements.

2. Movement of Nests: Movement of eagle nests is not in the best interest of the birds. In addition, the moving or destroying of an eagle nest is illegal under the Bald Eagle Protection Act (BEPA) (16 U.S.C. 668-668c) and the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-711).

II. FEEDING: This section pertains to an eagle's access to and use of feeding areas in the vicinity of both wintering and nesting habitats. These guidelines will enhance such feeding areas and eliminate or minimize human disturbance.

A. Eliminate the use of toxic chemicals in the watersheds of lakes and rivers where eagles feed. These include persistent organochlorine pesticides, PCB, mercury, and lead.

B. Discourage the construction of buildings along shorelines where eagles feed.

C. Manage fish populations or other primary food supplies to sustain eagles.

D. Limit fishing, boating, and other human disturbances adversely affecting eagles.

E. Prohibit the clear-cut and high-grade logging along the shoreline of feeding waters. This will prevent the removal of large trees preferred by eagles for hunting, roosting, and loafing perches.

F. If possible, prevent or reduce shoreline erosion to protect roost or perch trees. These trees also help to prevent siltation.

III. ROOSTING: The following guidelines are provided to help preserve present roosting sites and provide future habitat for bald eagles.

A. Roosts within the nesting territory

Within the primary management zone, no large trees should be removed. Within the secondary management zone, a minimum of three to five large trees should be saved for potential roost and perch trees. Characteristically, these should be the largest trees in the timber stand which provide safety from any threat from the ground. Trees with open crowns and stout lateral limbs are preferable. This provides for maneuverability and aids in easy entry and exit.

B. Communal Roosts

1. There should be no logging within a communal roosting area.

2. There should be no other human activity during the period of eagle use until specific management recommendations have been made.

3. If possible, prevent or reduce shoreline erosion to protect roost or perch trees.

4. Any eagle roosting concentration should be brought to the attention of the Fish and Wildlife Service or State wildlife agency so that a public or private conservation agency may consider preservation of the roost by purchase, easement, or land exchange [subject to the availability of funds].

IV. Legal Considerations: The following are those Acts that provide legal protection to the bald eagle.

Legal constraints are set forth in the BEPA (16 U.S.C. 668-668d) and the regulations that have been derived there-from (50 CFR 22). The BEPA states in part that no person "shall take ... any bald eagle ... or any golden eagle, alive or dead, or any part, nest, or egg thereof ...." (16 U.S.C. 668). The BEPA further states that "take" includes "pursue,

shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb ...." (16 U.S.C. 668c). Whoever violates any part of the BEPA may be fined from $5,000 to $10,000 or imprisoned from 1 to 2 years or both.

Under Section 9 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531), as amended, it is unlawful to take any listed species. The ESA states that "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." For any person who violates any provision of the ESA, the penalties are civil or criminal prosecution with fines from $5,000 to $20,000 or imprisonment from 6 months to 1 year or both.

All Federal agencies must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any Threatened or Endangered species or result in the destruction or adverse modification of their Critical Habitat as provided for under Section 7 of ESA.

Under the MBTA (16 U.S.C. 703-711) it is unlawful "to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, ... offer for sale, sell, ... , any migratory bird, any part, nest or eggs of any such bird ...." Anyone violating these regulations may be fined from $500 to $2,000 or imprisoned from 6 months to 2 years or both.

V. Compliance: These guidelines, prepared by the Fish and Wildlife Service (FWS), are advisory in nature.

COMPLIANCE WITH OR DISREGARD FOR THESE GUIDELINES DOES NOT, OF ITSELF, SHOW COMPLIANCE WITH OR VIOLATION OF THESE ACTS OR DERIVED REGULATIONS. IT IS ADVISABLE THAT THE APPROPRIATE STATE WILDLIFE AGENCY OR AREA MANAGER, FWS, BE CONTACTED IF THERE ARE ANY QUESTIONS ABOUT AN ACTIVITY TO BE CONDUCTED IN THE VICINITY OF AN EAGLE NEST OR THE NEST OF ANY OTHER LARGE BIRD.

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