SUSITNA
HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

UPDATE AND REFINEMENT OF BALD AND GOLDEN EAGLES IMPACT ASSESSMENTS AND MITIGATION PLANS

LGL
Alaska Research Associates

UNDER CONTRACT TO

HARZA-EBASCO
SUSITNA JOINT VENTURE

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Report by
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Under Contract to
Harza-Ebasco Susitna Joint Venture

Prepared for
Alaska Power Authority

Final Report
October 1984

NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING THIS REPORT SHOULD BE DIRECTED TO THE ALASKA POWER AUTHORITY SUSITNA PROJECT OFFICE

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OCTOBER 1984

The attached enclosures provide updated baseline information on bald and golden eagles in the Susitna project area, a refined assessment of impacts to these species, and more detailed descriptions of proposed mitigation measures. Enclosure No. 1 (with two accompanying maps) indicates the numbers of eagles of both species in the middle Susitna River basin and the numbers that would be unavoidably lost as a result of flooding by the proposed reservoirs or otherwise impacted by the project. (For a more detailed discussion see the Summary Statement on Nest Losses and Conflicts for Bald Eagles and Golden Eagles in the Susitna Hydroelectric Project Area that is included in this transmittal). Enclosure No. 2 provides information on the mitigation measures that would be implemented to reduce impacts of the project on nesting eagles. (These measures do not include the possible use of artificial nesting locations or nest sites as a mitigative measure.) Enclosure No. 3 reviews available information on the successful use of artificial nests and nest structures for raptors. Enclosure No. 4 describes in detail a method for constructing an artificial bald eagle nest, and Enclosure No. 5 provides detailed methods for building and placing artificial nesting structures for bald eagles (on which artificial nests would be placed -- a key element that has been omitted from some past attempts to attract bald eagles for nesting). Enclosure No. 6 briefly outlines methods that could be used for constructing artificial nest ledges and nest structures for golden eagles. Enclosure No. 7 outlines a preliminary design for an experimental program in the middle Susitna basin. Enclosure No. 8 provides a general overview of information on bald eagle nesting habitat in Alaska and in the middle Susitna basin, and Enclosure No. 9 lists references used in Enclosures 1-8.

ENCLOSURE 1

Nesting Locations and Impacts to Them

Nesting Locations and Impacts to Them

The license application provided information on 53 raptor/raven nesting locations that had been discovered in the middle basin of the Susitna River drainage during raptor surveys conducted in 1974 (White 1974) and in 1980-1981 (Kessel et al. 1982), and during field work on other avian species in 1982 (B. Kessel, pers. comm.). Ten active nesting locations of eagles were found in 1980 -- 6 golden eagle and 4 bald eagle. Eleven active nesting locations of eagles were found in 1981 -- 6 golden eagle and 5 bald eagle. The license application also reported that, on the basis of the 1980-1981 surveys, at least two of the 1974 nesting locations (GE-6 and GE-12) did not appear to be present at the positions indicated for them, and that these locations probably corresponded to two of the remaining locations.

The middle basin was resurveyed by helicopter on 29-30 May 1984. Reported positions of nesting locations GE-6 and GE-12 were reevaluated during these surveys, and seven additional eagle nesting locations were found, including five in outlying areas not previously surveyed (four golden eagle and one bald eagle) and two in previously surveyed areas along the river course (one golden eagle and one recently-constructed bald eagle nest). A brief summary of information on eagle nesting locations found in the middle basin is provided below. A brief summary of nesting locations that may be affected by project actions, including those that will be lost as a result of reservoir filling and those that will be subjected to disturbance, is also provided below.

Nesting Locations

Thirty-three eagle nesting locations are now known to occur in the vicinity of the project area in the middle basin of the Susitna River drainage. Nesting locations GE-6 and GE-12 are included in this total. Nesting location GE-6 was included as a separate nesting location because a small cliff does occur at the position indicated by White (1974). Although a previous evaluation of this cliff suggested that it was not especially suited to golden eagles, reevaluation in 1984 found the cliff comparable to a few other locations where golden eagles have occasionally nested in Alaska (D. G. Roseneau, unpubl. data). Nesting location GE-12 was also included because, although exposed rock does not exist at the approximate location indicated by White (1974), two golden eagle nests and another suitable nest ledge were found on a high-quality cliff only 0.75 miles to the northeast in a small side canyon. (The side canyon was suspected to represent the actual nesting location during surveys in 1981; however, the presence of nests was never confirmed.)

Twenty-three locations are known to have been used by golden eagles and ten by bald eagles (see maps for nesting golden eagles and bald eagles). It is also likely that at least one of the golden eagle locations has been used by gyrfalcons in previous years; White (1974) saw a gyrfalcon near GE-22 in 1974, and observations made in 1984 suggest that the nesting location has ideal nesting sites for gyrfalcons. (This location has also been identified as GYR-6.) In 1984, four of the 23 golden eagle nesting locations were active and seven of the ten bald eagle nesting locations were active.

Impacts at Nesting Locations

Twelve golden eagle and seven bald eagle nesting locations are associated with the Watana project area. Eleven golden eagle and three bald eagle nesting locations are associated with the Devil Canyon project area.

Five golden eagle and three bald eagle nesting locations will be completely inundated during filling of the Watana reservoir (assuming a maximum operating level of 2,185 ft and a maximum flood level of 2,202 ft). The loss of these nesting locations may represent the loss of 2-3 nesting pairs of golden eagles and 2-3 nesting pairs of bald eagles. One additional golden eagle nesting location will be partially inundated; however, two of the three nest sites at it will remain about 115 ft above maximum operating level and 100 ft above maximum flood level. The base of the nest tree at an additional bald eagle nesting location will probably be flooded to a depth of a few feet if the Watana reservoir reaches maximum flood level. One additional golden eagle nesting location will probably be inundated during filling of the Devil Canyon reservoir and another golden eagle nesting location will be partially inundated. About 90-100 ft of cliff will escape inundation at the location that will be partially flooded, however, and the current nest site will remain about 55 ft above maximum operating level and 45 ft above maximum flood level (assuming a maximum operating level of 1,455 ft and a maximum flood level of 1,465 ft).

Two bald eagle locations that will not be inundated are located near proposed access corridors -- one (BE-6) about 0.5 mile from the Denali-to-Watana access road, and one (BE-8) about 0.25 mile from the Devil Canyon-to-Gold Creek railroad link. One golden eagle location (GE-18) that will not be inundated is located about 0.6 mile from the Devil Canyon damsite, about 0.25 mile from the Watana-to-Devil Canyon access road, about 0.5 mile from the access road bridge, and about 0.5 mile from the transmission corridor. Two additional golden eagle nesting locations (GE-11 and GE-23) that will not be inundated are located within several hundred feet of proposed borrow site zones.

ENCLOSURE 2

Mitigation Measures for Eagles (Other than Artificial Nests)

Mitigation Measures for Eagles (Other than Artificial Nests)

A number of mitigative measures are proposed in the license application (Alaska Power Authority 1983) in order to minimize disturbance at eagle nests; to ensure that eagles are not electrocuted on power lines; to avoid where possible the loss of eagle nests; to delay unavoidable nest losses until they must occur; and to compensate for the unavoidable loss of nests.

General Disturbance Restrictions

Measures to prevent disturbance to nests of bald eagles and golden eagles (as well as gyrfalcons and peregrine falcons) were adapted from guidelines established by the Alaska Department of Fish and Game (ADF&G) and the U. S. Fish and Wildlife Service (USFWS) for the proposed Alaska Natural Gas Transportation System (Behlke 1980; Roseneau et al. 1981; Alaska Power Authority 1983, Table E.3.168). Changes were made in the sensitive time periods for which these guidelines will apply in order to reflect the nesting phenology of raptors in the Susitna basin. For convenience, Table E.3.168 is repeated here.

These mitigative measures will automatically apply to all known nesting locations of bald and golden eagles during 15 March - 1 June each year. Monitoring of nest sites will be conducted each year (during the construction phase and into the operation phase) to determine which locations are active (Alaska Power Authority 1983, p. E-3-525). Monitoring must occur on or after 1 June, and if monitoring shows that a nesting location is inactive during a particular year, the restrictions on aircraft activity and on major and minor ground activity will be withdrawn after 1 June (Alaska Power Authority 1983, p. E-3-532). However, we anticipate recommending that the restriction on permanent facility siting should remain in force, as it would be difficult or impossible to apply the restrictions there in future years if the nesting location should

TABLE E.3.168: STATE OF ALASKA TEMPORAL AND SPATIAL PROTECTION CRITERIA FOR NESTING RAPTORS[1]

Species	Sensitive Time Period[2]	Aerial Activity[3]	Minor Ground Activity	Major Ground Activity	Facility Siting	Habitat Disturbance
Peregrine falcon	April 15- August 31	1 mi h or 1500 ft v	1 mi	2 mi	2 mi	2 mi
Gyrfalcon	February 15- August 15	1/4 mi h or 1000 ft v	1/4 mi	1/4 mi	1/2 mi	-
Golden eagle[4]	March 15- August 31	1/2 mi h or 1000 ft v	1/4 mi	1/2 mi	1/2 mi	-
Bald eagle[4]	March 15- August 31	1/4 mi h or 1000 ft	1/8 mi	1/4 mi	1/2 mi	1/8 mi

Explanatory Notes

Raptor nest sites are assumed occupied until June 1 each year. After that date, protection measures for a specific nest site can be withdrawn for the remainder of the year if the nest is documented to be non-active.

It should be noted that any activity, disturbance, or habitat alteration that may affect historic or currently active peregrine falcon nest sites must be reviewed by the U.S. Fish and Wildlife Service, Office of Endangered Species, to evaluate the potential for detrimental impacts to the welfare of this endangered species.

Restrictions - The restriction columns provide temporal and spatial protection measures necessary to minimize disturbance to sensitive wildlife areas from aerial activity, minor ground activity, major ground activity, and the siting and operation of facilities.

Aerial activities include the potential disturbance effects from both fixed-wing aircraft and helicopters. The disturbance and "startling" impacts of low-level aircraft activity are of particular concern during raptor nesting.

Minor ground activity is characterized by limited, short-term, reconnaissance and exploration-type programs that do not involve significant amounts of personnel, equipment, surface disturbance, or noise. Examples of minor ground activity include foot reconnaissance, field inventories, topographic surveys, resistivity surveys, and some borehole/test pit exploration activities.

Major ground activity is characterized by extensive construction-related disturbance involving significant amounts of personnel, equipment, surface disturbance, noise, or vehicular activity. The duration of this disturbance may be either short-term or long-term, but the magnitude of overall activity is such that sensitive wildlife areas could be adversely affected. Typical major ground activities include clearing, pad construction, blasting, ditching, pipe laying, materials site development, and facility construction.

Facility Siting - The concerns of facility siting in proximity to sensitive wildlife areas include the long-term impacts of facility operation during duration of the project and the effects of habitat alteration on the integrity of wildlife use areas. Continuously occupied or operating facilities may generate noise or activity disturbance that could preclude wildlife occupation of a sensitive use area for the duration of the project. Alteration of adjacent habitats beyond the boundary of a defined wildlife use area may also discourage or preclude continued use of a sensitive area by wildlife.

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1 Derived from "Sensitive Wildlife Areas of the Northwest Alaskan Gas Pipeline Corridor," C. E. Behlke, State Pipeline Coordinator, letter to E. A. Kuhn, NWA, July 15, 1980 (see footnote 4 below). Protection criteria are accepted guidelines followed by the Alaska Dept. of Fish and Game and the U.S. Fish and Wildlife Service.

2 Sensitive time periods listed here differ somewhat from broader phenological periods listed in Table E.3.129, but are specifically designed to encompass the great majority of nesting pairs during what are considered to be the most critical portions of the breeding season.

3 h = horizontal; v = vertical.

4 Sensitive time period dates were modified to reflect earlier nesting by some golden eagles that may winter in the Alaska Range in the milder years (Roseneau, unpubl. data) to allow for later fledging of some bald eagle nestlings (see Table E.3.129).

again become active. All restrictions will remain in effect until 31 August at all nesting locations that are active (Alaska Power Authority 1983, Table E.3.168). (We anticipate recommending [in the mitigation plan] that a nest should be considered active if either a pair or a single bird demonstrates an affinity for the nesting location at any time during the nesting season [Roseneau et al. 1981].)

The mitigative measures that apply to project aircraft will restrict aircraft to a minimum altitude of 1000 ft above ground level (agl) for overflights of bald and golden eagle nesting locations. These altitude restrictions will apply within specified horizontal distances of the nesting locations--1/4 mile for bald eagles and 1/2 mile for golden eagles (Alaska Power Authority 1983, Table E.3.168). These restrictions will also prohibit landings within these distances from nesting locations (Alaska Power Authority 1983, p. E-3-531). However, when weather conditions or special flying needs require lower altitudes, maintaining the horizontal distance restrictions from nest locations will limit disturbance to these sites. All aircraft restrictions and schedules will be provided to pilots in a concise manual (Alaska Power Authority 1983, p. E-3-531).

Minor ground activity (limited, short-term activity that does not involve significant amounts of personnel, equipment, surface disturbance or noise) will be prohibited within 1/8 mile of bald eagle nesting locations and within 1/4 mile of golden eagle nesting locations (Alaska Power Authority 1983, Table E.3.168). Major ground activity (which involves significant amounts of personnel, equipment, surface disturbance or noise, and which includes clearing, road and facility construction, and materials site operations) will be prohibited within 1/4 mile of bald eagle nesting locations and within 1/2 mile of golden eagle nesting locations (Alaska Power Authority 1983, p. E-3-533, Table E.3.168). Permanent facilities will not be sited within 1/2 mile of bald and golden eagle nesting locations (Alaska Power Authority 1983, Table E.3.168). The concern with permanent facilities is the impact from noise and from disturbance by human activities throughout the operation of the project. The types of facilities included in this restriction have not been listed (Behlke 1980; Alaska Power Authority 1983, Table E.3.168), but we have interpreted the restriction to include the access road, the bridge and the railroad.

Specific Applications of Disturbance Restrictions

The measures for ground activity and facility siting have been stated as general restrictions. When they are applied to the known eagle nesting locations in the Susitna basin and the project plans, there are only a few known locations where these restrictions will be needed.

Bald eagle nest BE-6 is located on the original centerline of the Denali-to-Watana access road along Deadman Creek, and would have been lost in the road's construction. The access road has been realigned northwestward and westward to remain 1/2 mile from the nesting location (Alaska Power Authority 1983, p. E-3-537, Figure E.3.81). No restrictions are required to limit disturbance from ground activities at this distance from the nest.

Bald eagle nest BE-8 is located 1/4 mile from the railroad access route, which cannot be realigned (Alaska Power Authority 1983, p. E-3-533). No restrictions are required to limit disturbance from ground activities at this distance, because it is the outer limit of the area within which major ground activity would be prohibited during the sensitive period. However, the railroad route is in conflict with the restriction on permanent facilities. The nest is on the opposite side of the river from the railroad; this will provide additional protection from disturbance. Nevertheless, it should be noted that all of the bald eagle nests in the lower Susitna basin are at least 1/2 mile from the railroad. Because the railroad route cannot be realigned, there are no further measures that could be applied to protect against disturbance at that nest site. If the eagles do not tolerate this disturbance, the only possible mitigation would be to provide artificial nest sites in an attempt to move the eagles farther from the railroad.

Golden eagle nest GE-18 is located 0.6 mile downstream from the Devil Canyon damsite, and 1/2 mile from the transmission line. These distances will not require any restrictions on ground activities, provided the activities do not encroach on the 1/2 mile distance. However, the location of the bridge, currently proposed at a location 1/2 mile downstream of the nesting location, has not been fixed, and it is possible that engineering constraints will require repositioning of the bridge to some point 1/10 mile or more in either direction from the currently proposed site (Harza-Ebasco Susitna Joint Venture 1984, memo 4.3.3.2 of 24 September 1984 from C.L. Elliott to R.G.B. Sener). Furthermore, the access road will pass 1/4 mile from this nesting location, and it cannot be realigned (Alaska Power Authority 1983, p. E-3-533). Compliance with the restrictions in Table E.3.168 will require that no major ground activity (including construction of the bridge) occur within 1/2 mile of the nesting location (and no minor ground activity within 1/4 mile) between 15 March and 31 August of all years, with the exception of the 1 June - 31 August periods of those years in which the nest is shown to be inactive. We anticipate recommending this compliance with Table E.3.168. (The statement in the text of the license application [Alaska Power Authority 1983, p. E-3-533] is less restrictive in regard to the access road.) In addition, once the bridge and the road have been constructed, no activities will be permitted east (upstream) of the bridge, or south of the road or along the cliff top within 1/2 mile of the nesting location (Alaska Power Authority 1983, p. E-3-533). However, if the bridge is relocated upstream and closer to the nest for engineering purposes, it will be in conflict with the restriction on major ground activity and with the restriction on permanent facilities, and the access road routing will still be in conflict with the restriction on permanent facilities. Because the final location of the bridge is dependent on engineering constraints, and because the road cannot be realigned, there are no further mitigative measures that can be applied to protect the nesting location against disturbance from these two facilities. It is noted that disturbance can be partially controlled by strictly preventing activities east (upstream) of the bridge and south of the road (we recommend that this measure be taken). It is also noted that the road will be behind the cliff top from, and out of sight of, the nest, and this will provide an additional buffer against disturbance. However, golden eagles are quite sensitive to disturbance (Roseneau et al. 1981), and with disturbance on three sides of the nest (dam, road and bridge) the nest quite likely will be abandoned in spite of the mitigative measures. In this event, the only possible mitigation would be the provision of artificial nest sites in nearby areas where disturbance would not be a problem.

Golden eagle nesting location GE-11 was thought to have been partially located within borrow site E (Alaska Power Authority 1983, p. E-3-537). The nesting location consists of three nest sites that are several hundred feet upstream from the borrow area and at least 100 ft higher than the probable maximum elevation of borrow operations. Compliance with the restrictions in Table E.3.168 will require that no quarrying or other major ground activity occur within 1/2 mile of the nesting location (and no minor ground activity within 1/4 mile) between 15 March and 31 August of all years, with the exception of the 1 June - 31 August periods of those years in which the nest is shown to be inactive. We anticipate recommending this compliance with Table E.3.168. (The statement in the text of the license application [Alaska Power Authority 1983, p. E-3-537] is less restrictive.) We further anticipate recommending that no mining activity occur within 1/8 mile of this nesting location. (The nesting location is considered to be the area encompassed by the three nest sites.)

However, it is noted that borrow site E will be a major source of material (Harza-Ebasco Susitna Joint Venture 1984, memo 4.3.3.2 from C.L. Elliott to R.G.B. Sener). Furthermore, its boundaries are not likely to be fixed until detailed drilling tests are made, and detailed schedules for removing material from it are not likely to be developed until engineering designs are finalized. Because of these factors, it cannot be confidently stated that mining activities will not occur within 1/2 mile of the nesting location during the sensitive period. If mining activities encroach on the 1/2 mile distance during the sensitive period, the nest quite likely will be abandoned for the duration of the activities. If mining activities encroach on the 1/2 mile distance only during the nonsensitive period, the nesting location will remain usable.

Golden eagle nesting location GE-23 (discovered in 1984) is located along the east side of Fog Creek and about 1200-1300 feet east of borrow site H's eastern boundary. Compliance with the restrictions in Table E.3.168 will require that no quarrying or other major ground activity occur within 1/2 mile of the nesting location (and no minor ground activity within 1/4 mile) between 15 March and 31 August of all years, with the exception of the 1 June - 31 August periods of those years in which the nest is shown to be inactive. We anticipate recommending this compliance with Table E.3.168. We further anticipate recommending that no mining activity occur within 1/8 mile of this nesting location. It is noted that borrow site H is a low priority materials site, and probably will not be used during project construction (Harza-Ebasco Susitna Joint Venture 1984, memo 4.3.3.2 of 24 September 1984 from C.L. Elliott to R.G.B. Sener). However, it is also noted that the possibility of borrow site H's being used cannot be entirely ruled out. Furthermore, its boundaries are not likely to be fixed until drilling tests are made, and detailed schedules for removing material from it are not likely to be developed until engineering designs are finalzed. Because of these factors, it cannot be confidently stated that mining activities will not occur within 1/2 mile of the nesting location during the sensitive period. If mining activities encroach on the 1/2 mile distance during the sensitive period, the nest quite likely will be abandoned for the duration of the activities. If mining activities encroach within 1/2 or 1/8 mile during only the nonsensitive period, the nesting location will probably remain usable.

Electrocution

The configuration that has been selected for the transmission line and towers is such that eagles are very unlikely to be electrocuted on the line (Alaska Power Authority 1983,p. E-3-497). However, the possibility of electrocution exists along the temporary 34 kV transmission line from Cantwell to Watana. Protective measures have been successfully implemented in other parts of North America to avoid this problem (Olendorff et al. 1981), and these methods will be employed in the Susitna development (Alaska Power Authority 1983, p. E-3-539). These measures include the use of particular pole/line configurations, and the possible use of perch guards or elevated perches if these latter methods are found to be needed.

Loss of Nesting Locations

One nesting location (BE-6) would have been lost under the original project plans because of conflicts with the access road. As was discussed above, project plans have been changed to prevent the loss of the nesting location.

A number of known nesting locations will be unavoidably lost due to the impoundments if the project proceeds. Under the Bald Eagle Protection Act (as subsequently amended), bald eagle nests can only be "taken" (including lost) for scientific or exhibition purposes. No provision is made for taking nests that interfere with resource development. A similar situation existed for golden eagles under the Act, but the Act has recently been amended to permit the Secretary of the Interior to authorize the taking of golden eagle nests that interfere with resource development. The taking of any eagle nests as a result of the Susitna development will require consultation with and the approval of the Alaska Regional Director of USFWS (Alaska Power Authority 1983, p. E-3-451).

Of the nests that will be unavoidably lost, some are cliff nests (1 bald eagle and all the golden eagle nests), and the rest are tree nests. The tree nests will actually be lost during the clearing operation prior to impoundment flooding. (Other golden eagle cliff nests will be on the edge of the impoundments but above the water level; they may, however, be affected by the clearing operations.) Clearing of the impoundments will not begin until two or three years prior to flooding (Alaska Power Authority 1983, p. E-3-537). Clearing operations will be subject to the major ground activity restrictions concerning disturbance near nest sites; clearing will not occur within the specified distances from nesting locations (1/2 mile for golden eagles, 1/4 mile for bald eagles) during the sensitive periods of each year, with the exception at individual nests of the periods after 1 June of those years in which the nest is shown to inactive (Alaska Power Authority 1983, p. E-3-537 [Table E.3.168]).

Clearing operations will also be conducted to leave protected "islands" of trees around tree nests (Alaska Power Authority 1983, p. E-3-537). We anticipate recommending that such "islands" be left for a radius of 1/8 mile around bald eagle nests. Grier et al. (1983), in their preliminary draft of the Northern States Bald Eagle Recovery Plan, recommend 1/8 mile as the distance within which bald eagle nests should be protected from activities such as clearcutting. No buffer zone "island" of trees is needed around the cliff nests of golden eagles, which nest high above the forest cover and are unlikely to be affected by the removal of the forest cover during the nonsensitive period.

Although clearing of the nest tree "islands" and the nest trees should be postponed as long as possible, the timing of this clearing should be such that the nest is not flooded while birds are in the process of nesting. If the flooding schedule would have a nest flooded during the period 15 March - 31 August, that nest and "island" should be cleared during the previous fall or winter. There may also be a problem if cliff nests are to be flooded during the sensitive period when birds are nesting. Steps might be needed early in the nesting period to discourage birds from nesting at the site (e.g., removal of nests and nesting ledges).

The loss of some eagle nests due to the flooding of the impoundments cannot be avoided if the project proceeds. The only possible mitigation measure is to compensate for this loss by the construction of artificial nesting locations and nest sites and by habitat manipulation to create more suitable nesting habitat.

ENCLOSURE 3

Background Information on Artificial Raptor Nests

Background Information on Artificial Raptor Nests

The concept of modifying cliff-nesting and tree-nesting habitat to provide new nesting locations and nest sites for raptors appears to offer an effective and feasible means of compensating for losses of eagle nesting habitat as a result of resource development projects, such as construction and operation of the Susitna Hydroelectric Project. A major advantage of this type of compensation is that it allows actual mitigation of losses in the same area where they have occurred, rather than on distant lands, or by some form of out-of-kind compensation. The concept relies on the fact that raptors are one of the few groups of birds that are often limited by availability of nesting locations and nest sites, rather than by food (see Newton 1979). Several methods and techniques have proven successful, and additional techniques and methods are being refined and tested (e.g., Olendorff et al. 1980). Examples of successful applications for several raptor species are listed below.

Artificial Cliff-Nests

1. "Pot-hole" type nest sites have been successfully provided for prairie falcons (*Falco mexicanus*) in cliffs that lacked natural cavities in Alberta (Fyfe and Armbruster 1977, also see Olendorff et al. 1980). Originally, some holes were blasted out of the rock, but it became more effective to locate soft spots and dig them by hand. The program, which was initiated in 1970, had provided about 200 new nesting cavities by 1975. During 1971-1975, about 25% of the holes were occupied by nesting prairie falcons, some Canada geese (*Branta canadensis*), and occasional peregrine falcons (*Falco peregrinus*) (White 1974). The number of prairie falcons that nested in several drainages in Alberta increased as a result of the program (U. Banasch, pers. comm.).

2. A ledge was excavated in December 1979 on a cliff in California that was rated as a potential peregrine falcon nesting location, but had no history of previous use. Four months later, early in the 1980 nesting season, a female peregrine occupied it. She laid eggs on the new ledge and was observed incubating them (see Olendorff et al. 1980).

3. Because nest sites at some peregrine falcon nesting cliffs in the Massif Central of Europe were accessible to predators (genets), a new artificial, but natural-appearing, ledge was constructed in a rock face near the top of one of the nesting cliffs. It was readily accepted by a pair of peregrines (Cugnasse 1980).

4. The nesting ledge fell off an abandoned peregrine falcon nesting cliff in California. A steel and lightweight metal ledge was fabricated, artistically modified to look relatively natural, and installed on the rock face. The following year a pair of prairie falcons accepted the ledge and fledged young from it (Boyce et al. 1980.)

5. A nest site designed for gyrfalcons (Falco rusticolus) was constructed on a cliff in northern Europe. It was used by gyrfalcons the following year (see Olendorff et al. 1980).

6. A cliff used by gyrfalcons was found on the Seward Peninsula, Alaska. The cliff had only one usable ledge on it, although an excellent potential pot-hole site was also present. The pot-hole site was unusable because the floor lacked detritus and soil for scraping in, and because it sloped steeply to the rear of the cavity. Two years later (1970) the original ledge had become unstable and was in danger of falling off the cliff. At the completion of the 1970 breeding

season, about 100 lb of material (sand, dirt and fine gravel) was placed in the pot-hole cavity to level the floor. A rim was constructed of sticks that were wired together and in turn wired to the rock. (The rim simulated the remains of a rough-legged hawk [Buteo lagopus] nest; such nests are often used by gyrfalcons.) The falcons scraped in the new site the following year (1971), but still used the old, unstable ledge (D. G. Roseneau and W. Walker II, unpubl. data). In later years however, when the original ledge had become so dilapidated that it would no longer be used, the modified pot-hole was found to contain evidence indicating it had been used by gyrfalcons (W. R. Tilton, pers. comm.).

Bare Artificial Platforms in Trees

1. A bald eagle tree-nest collapsed in California prior to 1979. The nest tree showed signs of black beetle infestation and decay. A natural-appearing nest platform was constructed from pruned branches in a nearby tree in 1979. Bald eagles built a nest on the artificial platform and produced two young in 1981 (Bertram 1981).

Artificial Tree-Nests

1. A golden eagle (Aquila chrysaetos) tree-nest was blown down. The nesting location was not occupied by eagles the following year and later that summer an artificial nest was built. Golden eagles nested in it the next year (Craig and Anderson cited in Call 1979).

2. A golden eagle nest in a tree in Wyoming was located on lands that were to be strip-mined for coal. Through a series of manipulations

involving first providing and then destroying several artificial platforms and nests, moving a nestling after it was capable of thermoregulation, and moving a nest constructed by the eagles, the nesting pair was successfully relocated over the course of two breeding seasons to a new nesting location outside the coal development area and 2.5 km from the original nesting location (Postovit et al. 1982).

3. An active bald eagle (Haliaeetus leucocephalus) nest in Minnesota was blown down. It was reconstructed, and the two nestlings were successfully fledged from it (Dunstan and Borth 1970).

4. An active bald eagle nest in Michigan was blown down in 1969. An artificial wooden platform was erected, nesting material was placed on it, and the one surviving nestling was placed in it. The nestling successfully fledged. The following year, eagles built a new nest about 150 m away, and fledged 10 young from it during 1970-1973 and 1975-1976. In 1974, the eagles had attempted to nest at the artificial site, but the nesting attempt was unsuccessful. However, eagles reoccupied the artificial site in 1977 and successfully reared three young at it (Pinkowski 1977, Postupalsky 1977). The artificial site was also reoccupied in 1978 and 1979; however, logs were being sawed about 100 m away and the nesting attempts failed during the incubation and brooding stages, respectively (Olendorff, pers. comm.).

5. During 1971-1975, 37 nest baskets containing artificial nests designed for buteos (primarily ferruginous hawks [Buteo regalis] and Swainson's hawks [Buteo swainsoni]) were erected in Alberta in former raptor territories and in other grassland areas judged suitable for these raptors. Sixteen of the artificial nests were occupied by buteos. Most were in areas where pairs had formerly nested, but several were

in areas where pairs were previously unable to nest because of a lack of suitable nest sites (Fyfe and Armbruster 1977).

6. In Europe, artificial nests (including the basket-type) have been erected and successfully used by a variety of tree-nesting northern raptors, including goshawks (Accipiter gentilus) and great gray owls (Strix nebulosa) (see Olendorff et al. 1980).

7. Great horned owls (Bubo virginianus) readily accepted artificial nest baskets erected to attract them in central Minnesota (see Olendorff et al. 1980).

Artificial Structures without Artificial Nests

1. Six artificial platforms were erected on Bonneville Power Administration/Idaho Power Company transmission towers carrying 720,000 volt lines. Golden eagles, red-tailed hawks (Buteo jamaicensis) and ospreys (Pandion haliaetus) successfully nested on three of them, and another pair of ospreys and a pair of bald eagles unsuccessfully attempted to nest at two others (Nelson and Nelson 1977; Nelson 1978).

Artificial Structures with Artificial Nests

1. A tripod-type structure with platform and artificial nest was erected in Michigan, and ospreys nested on it during 1970-1972. The site was unoccupied during 1973 and 1974. Bald eagles attempted to nest at the site in 1975 and 1976, but the nesting attempts failed. (Failure was probably due to the age of the pair -- the female was a young adult.)

The pair returned to the artificial structure in 1977 and successfully fledged two young (Pinkowski 1977, Postupalsky 1977). The pair also returned to the artificial structure in 1978 and produced two eggs, but the eggs failed to hatch for unknown reasons (Olendorff, pers. comm.). The pair built a nest in a nearby tree in 1979, but the outcome of the nesting attempt is unknown (Olendorff, pers. comm.).

2. An active bald eagle nest containing two viable eggs fell down. An artificial aluminum tripod-type structure with artificial nest and perches was erected nearby. The eagles quickly accepted the artificial structure and nest, perching and roosting on it the next year. The pair laid two eggs in the nest the following year. The nesting attempt failed, but only because the thin-shelled eggs broke before they could hatch (Grubb 1980).

Nest Boxes

1. Nest boxes have been built and erected to attract a variety of cavity-nesting raptors, including American kestrels (Falco sparverius) and several species of small owls. In most instances, the nest boxes have been accepted readily, and in several instances large nesting populations of these species have become established in areas where nesting did not previously occur because of a lack of nest sites (see Olendorff et al. 1980).

2. In two separate instances, several nest boxes were erected specifically for boreal owls (Aegolius funereus) near Fairbanks, Alaska. In both cases several pairs of boreal owls readily accepted them, and in

one instance a pair of hawk owls (Surnia ulula) also used one of the boxes (D. G. Roseneau and W. R. Tilton, pers. comm.).

3. Several nest boxes were also erected near Fairbanks, Alaska, to attract cavity-nesting waterfowl. Boreal owls were discovered nesting in one of the boxes in 1984 (D. D. Gibson, pers. comm.).

Failure of Artificial Platforms without Artificial Nests

Attempts to provide artificial nesting structures and platforms have not worked in some cases for some species. In most of these cases, no attempt was made to provide the last necessary ingredient -- artificial, but natural-appearing nests. Several early attempts aimed at bald eagles, for example, involved erecting bare platforms similar to those that had proven very successful for ospreys (a species that often readily accepts and builds nests on bare platforms [e.g., Olendorff et al. 1980]). Bald eagles are not as prone to build nests on man-made structures as are ospreys, and only a few pairs have built nests on bare platforms erected on artificial nest structures (e.g., Olendorff et al. 1980). In contrast, in two instances where artificial nest structures (tripods) were tried in conjunction with artificial nests, bald eagles were attracted to and accepted them (Pinkowski 1977; Postupalsky 1977; Grubb 1980). Several nesting attempts failed at these two structures; however, these failures were not related to structure design.

ENCLOSURE 4

A Recommended Design for Artificial Bald Eagle Nest Sites in Trees

A Recommended Design for Artificial Bald Eagle Nest Sites in Trees

Artificial bald eagle nest sites are defined as man-made nests constructed to closely resemble natural nests on appropriate, natural substrates in appropriate, natural settings (see Olendorff et al. 1980). The following design and methods for constructing these artificial bald eagle nest sites in trees are derived from a basic design provided by Lamb and Barager (1978), and from details on the construction of an artificial nest site built in a ponderosa pine along the Pit River, California in 1983 (G. Hunt and R. Jackman, pers. comm. 1984). The basic design was selected for its superior stability and strength and its capability to remain in place over a period of many years. It has been modified where appropriate to provide additional strength, stability, and ease of construction, and to increase the natural appearance of the final product. Details of the modified design and discussion of its construction and placement are provided below.

Substrates

The artificial nest is designed to be mounted in medium to large, living deciduous or coniferous trees. In the Susitna project area it would be mounted in balsam poplar (cottonwood) or white spruce trees, which are favored by bald eagles nesting in interior and south-central Alaska.

Platform Base and Support Bracket Construction

Construction of the basic platform and support brackets is shown in Figures a-d. The support brackets are constructed from 1.5 x 2.5 inch (on a side) solid steel angle iron stock, or from perforated Right Angle RA-225 galvanized steel angle iron stock.

Lamb and Barager (1978) recommended use of a 5 ft length of 0.75 inch round steel conduit bent at right angles at a point 2 ft from one end. Each end was flattened for 2 inches to allow drilling two 0.25 inch holes to accept 0.25 x 4 inch lag bolts. Hunt and Jackman (pers. comm). used 1.5 x 1.5 inch (on a side) solid steel angle iron stock cut and welded at right angles with limbs of the same length as Lamb and Barager (1978). A short steel rod was also welded between the angle iron limbs near their juncture to provide increased strength. Several 0.5 inch holes were drilled in each limb of the angle iron bracket. The 2 ft side of the completed bracket was attached to the tree with two 0.5 x 6 inch lag bolts.

Use of Right Angle RA 225 1.5 x 2.5 inch (on a side) perforated steel stock for construction of the support brackets has several advantages over solid steel conduit or angle iron stock. It is stronger than 0.75 inch round conduit, and as strong as, but lighter than most 1.5 x 1.5 inch solid angle iron stock. It is galvanized and pre-marked in increments of 0.75 inch, 1.5 inch, and 3 inch lengths, and pre-drilled to accept 0.25 inch and 0.5 inch bolts about every 0.75 inches. The extensive pattern of alternating round and oval holes (in two continuous columns on the 1.5 inch side) allows for "erector-set" construction in the field (including bolting on of the corner support braces in a variety of configurations).

At least two 2 x 3 ft support brackets are required for each nest platform (see Figures b, c). In some instances, one or two additional brackets of different sizes may be required. The bracket limbs are cut from solid angle iron or RA-225 stock and either welded or bolted together at angles of not less than 95° (see Figure a). Triangular steel plates are welded into the corners of the brackets, if they are made from solid steel stock. Bolted cross braces cut from RA-225 stock are substituted for the triangular support plates, if the brackets are made from RA-225 stock. After assembly, the brackets are spray-painted in a camouflage pattern of flat gray, tan, brown, and charcoal tones (using high quality weather-resistant paints). If galvanized RA-225 stock is used, the brackets must be thoroughly washed with a strong vinegar solution and allowed to dry before painting. (Paint does not bond well to untreated galvanized metal -- the vinegar treatment 'etches' the zinc-coated surface, minimizing this problem.)

In some cases, it may be necessary to modify the recommended 95° angle between the support bracket limbs to compensate for the angle of growth of trees selected to receive nest platforms (brackets made from RA-225 stock can be adjusted quickly and easily at the field site by trimming the ends of the corner pieces with a hacksaw and/or repositioning the bolts). Regardless of the angle necessary to compensate for trees that are off 'plumb', the 3 ft limbs of the mounted brackets should always extend slightly upwards away from the tree trunks so that the mounted platforms tilt toward the trunks (i.e., at a slope of about 5°). This modification in design improves drainage and encourages nesting material to settle against the tree trunks, instead of slumping in directions that may eventually cause it to slump off of the platform base.

Hexagonal or oval platform bases are cut from 4 x 10 ft sheets of 1.0 inch thick marine grade plywood (see Figures b, c). The 1.0 inch marine grade stock is stronger and more durable than the 0.75 inch AC (exterior) grade material recommended by Lamb and Barager (1978). Hexagonal platforms recommended by Lamb and Barager (1978) are easier to fashion than oval platforms; however, oval platforms more closely approximate the shape of the nest core-rings, and may provide more uniform support around their edges, if they are carefully matched to the platforms. The steps for prefabricating platforms of either shape are the following:

1. Cut the hexagonal or oval platform blank as shown in Figures b, c.

2. Drill about 40 0.75 inch diameter holes through the platform blank in an evenly-spaced pattern.

3. Cut 20 pegs 5-6 inches long from 0.75 inch diameter hardwood dowel stock, and 14 pegs 24 inches long from 1.0 inch diameter hardwood dowel stock.

4. Saw all hardwood pegs across the center of one end to a depth of about 1 inch.

5. Cut 14 4 x 4 inch blocks from 1.0 inch plywood stock.

6. Align the plywood blocks around the edge of the platform's upper surface in an evenly-spaced pattern, and glue and nail them in place flush with the platform edge (but not along the edge that will rest against the tree).

7. Drill 1.0 inch diameter holes at 45° angles toward the center of the platform through each of the 14 plywood blocks and the underlying platform base (Figure d).

8. Spray-paint the platform base and all finished pegs in a camouflage pattern of flat gray, tan and charcoal tones (leaving about 1 inch of the sawed end of each short peg, and about 3.0 inches of the sawed end of each long peg unpainted).

Field Assembly

The prefabricated platform bases, support brackets, and accessories (including the loose 5-6 inch and 24 inch pegs, wood shims for driving into the pre-cut slots in the ends of each peg, water-proof marine quality glue, 0.5 x 1.5 inch bolts with washers and lock-nuts, and 0.5 x 6-8 inch lag bolts) are transported to the field location for final assembly. Tools required at the field site include a hammer, assorted galvanized or aluminum nails, keyhole saw with extra blades, small hand or battery-operated drill with extra bits, florist's wire, block and tackle, assorted rope, several heavy duty mesh bags for hauling materials aloft, and climbing gear. A 4 x 4 ft sheet of heavy cardboard is also required to serve as a template. (The cardboard may be folded for transport, and can be used at least four times.)

A minimum of two support brackets are bolted to the tree trunk with a minimum of three 6-8 x 0.5 inch lag bolts each (Figure d). A cardboard template is made by cutting a shallow arc where it rests against the tree trunk. The template is also marked to show the positions of the holes in the support bracket limbs. The template is dropped to the ground and used as a guide to cut a shallow arc from the side of the platform base that will butt against the tree, and to drill bolt holes that correspond to the holes in the support bracket limbs. Glue is applied to the unpainted ends of the short pegs (5-6 inch dowels), and they are driven into alternating holes in the platform base and shimmed. The platform base is hoisted aloft and bolted onto the support brackets.

Nest Construction

Several days in advance of visiting the location where the nest will be built, nest core rings are loosely woven from supple, about 0.5-0.75 inch diameter, unpeeled green willow (Salix sp.) (see Figure e). The outside diameter of the completed core rings is about 6 ft, and the cross-section diameter is about 18-24 inches. (In certain cases it may be more efficient to construct the core rings on site, provided that sufficient willow of appropriated size is known to be available.) The nest core rings are to be transported to the field site along with the platform material, or separately, after the platforms have been erected. The core rings should be reinforced with a wrapping of wire for transport.

The basic steps taken to construct nests on pre-mounted platforms are listed below:

1. Insert glue in the holes in the platform's edge blocks.

2. Temporarily wire the nest core ring in place on the platform. (Wire used to reinforce the rings for transport may be removed and reused for this purpose.)

3. Drive the long pegs (24 inch dowels) through the loose weave of the core ring into the holes and shim them (see Figure f). Permanently wire the core ring to the platform base where appropriate with heavy-gauge coated florist's wire. (Drill 0.25 inch holes as needed with a brace and bit, or yankee-type hand drill.)

4. Individually wedge sticks among the platform's upright, short pegs (5-6 inch dowels) until the pegs are completely covered.

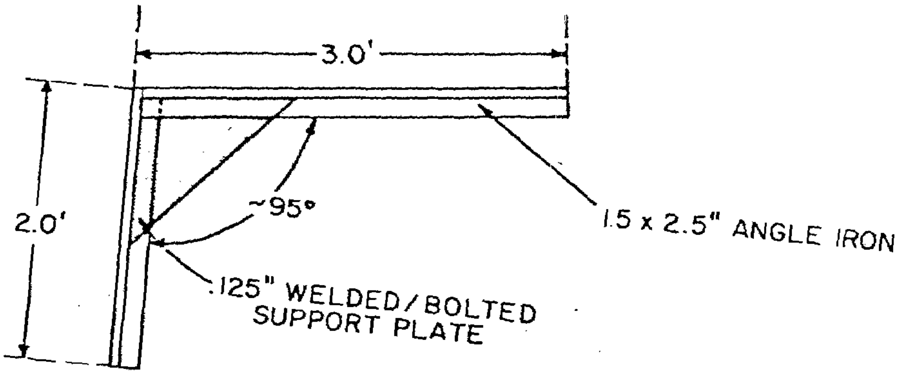
5. Line the floor of the nest with smaller diameter sticks to a depth about two-thirds the height of the core ring.

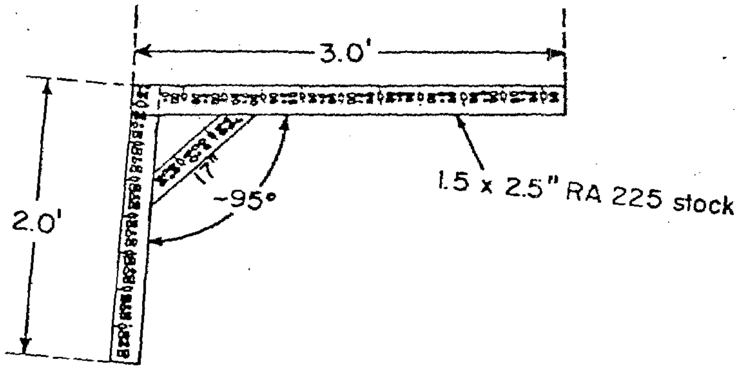
6. Line the floor of the nest with dried grass and smaller twigs to complete the natural appearance of the nest cup.

7. Gather sheets of bark or weathered wood and nail the material over the support bracket limbs where they are bolted to the nest tree. (The bark serves as primary, although somewhat temporary camouflage; the paint applied earlier to the support brackets serves as backup, long-term camouflage.)

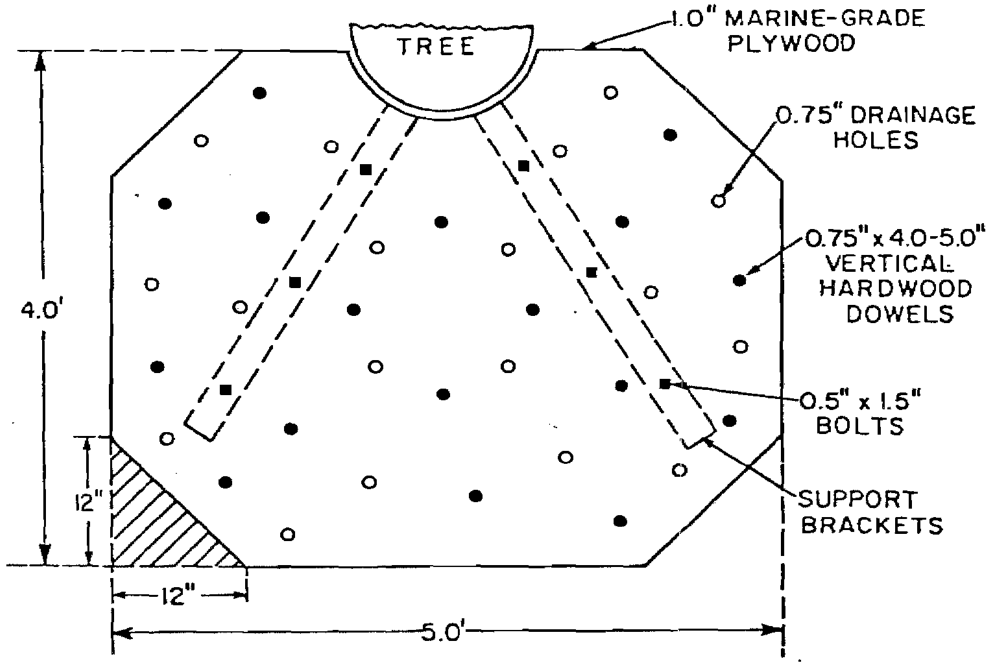
8. Finally, prune appropriate limbs of the tree to provide perches, and to open the canopy of the tree around the nest site to provide adequate access for adult eagles (see Figures g, h). During this operation, care should be taken to leave some live canopy above and to the sides of the nest site to provide shade. (Some pruning of limbs may be required during platform construction, but any such initial pruning of limbs should be kept to a minimum, so that final "sculpting" of the canopy surrounding the nest site is not compromised.) Final touches also include pruning several nearby trees (if present) to provide additional perching places. Perches should be higher than the nest site and should offer clear views of it.

a) Nest Support Bracket

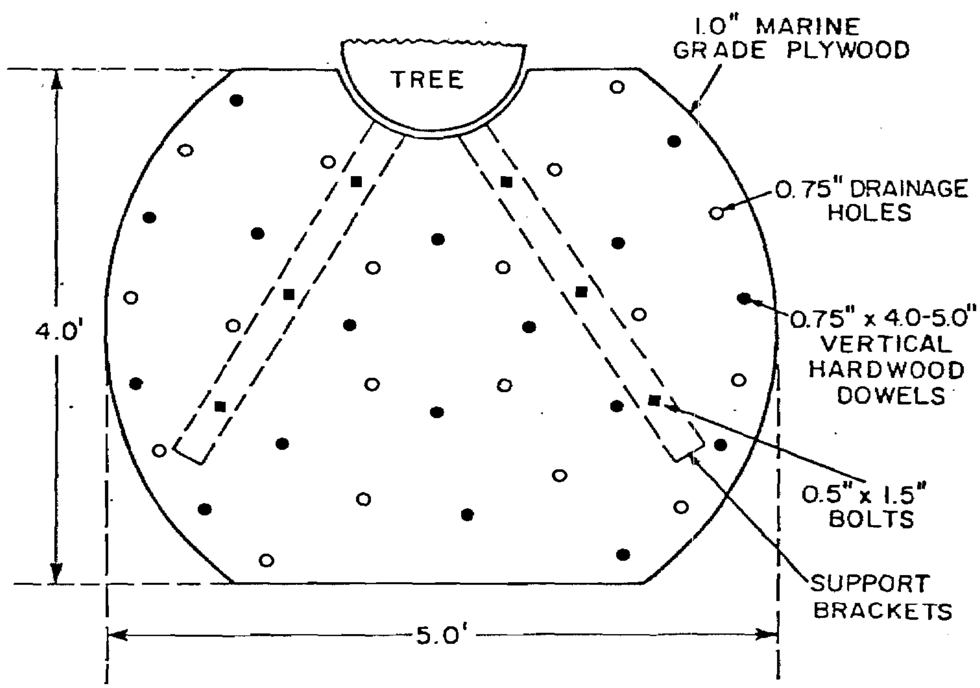




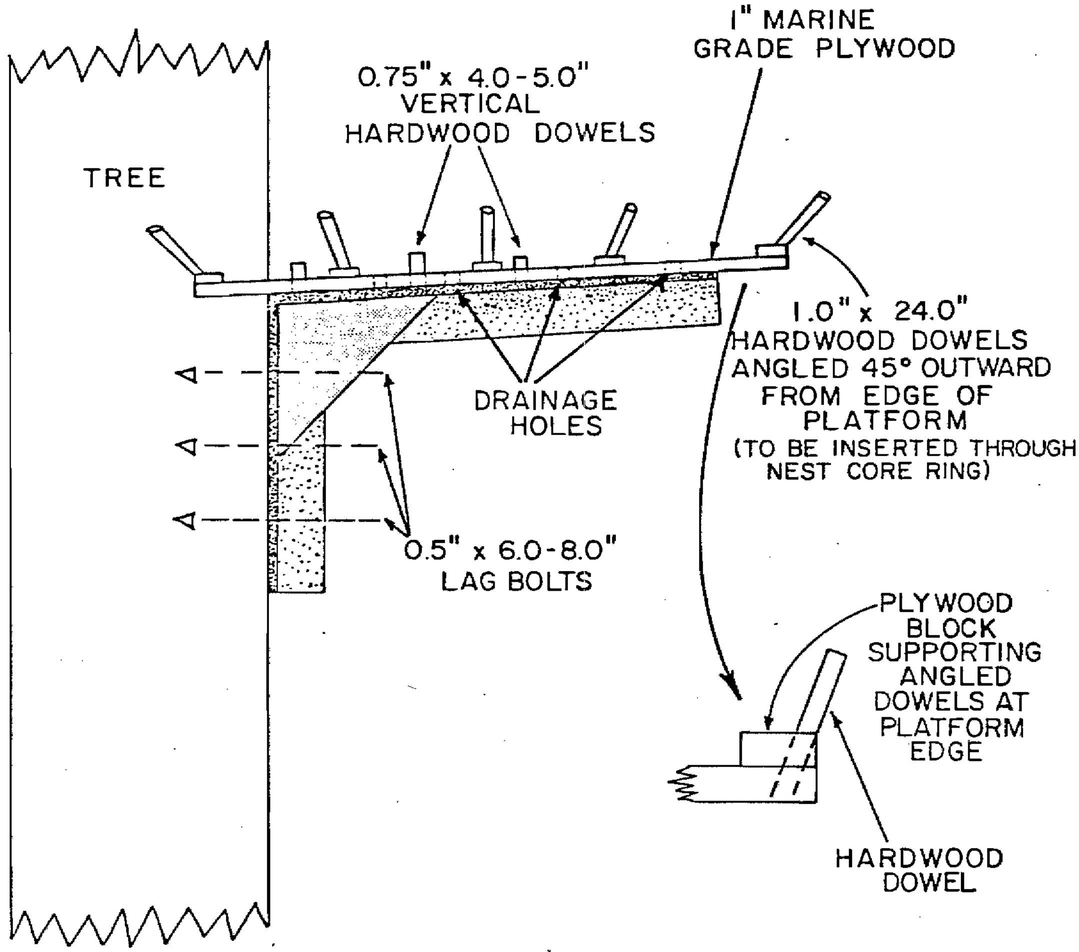
b) Overhead View of Attached Platform



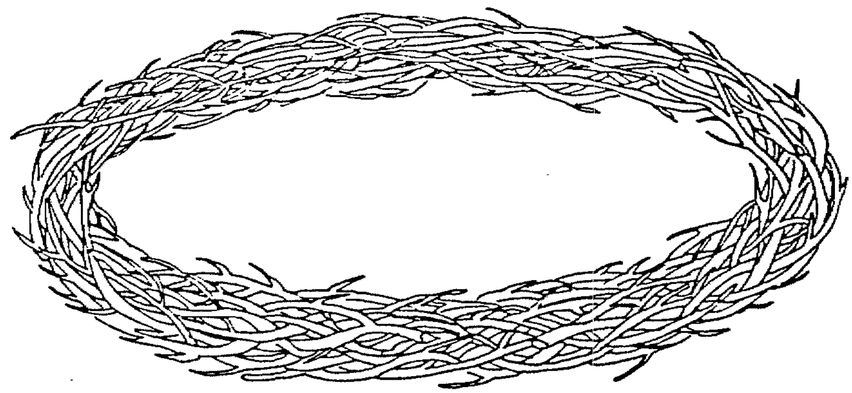
c) Overhead View of Attached Oval Platform



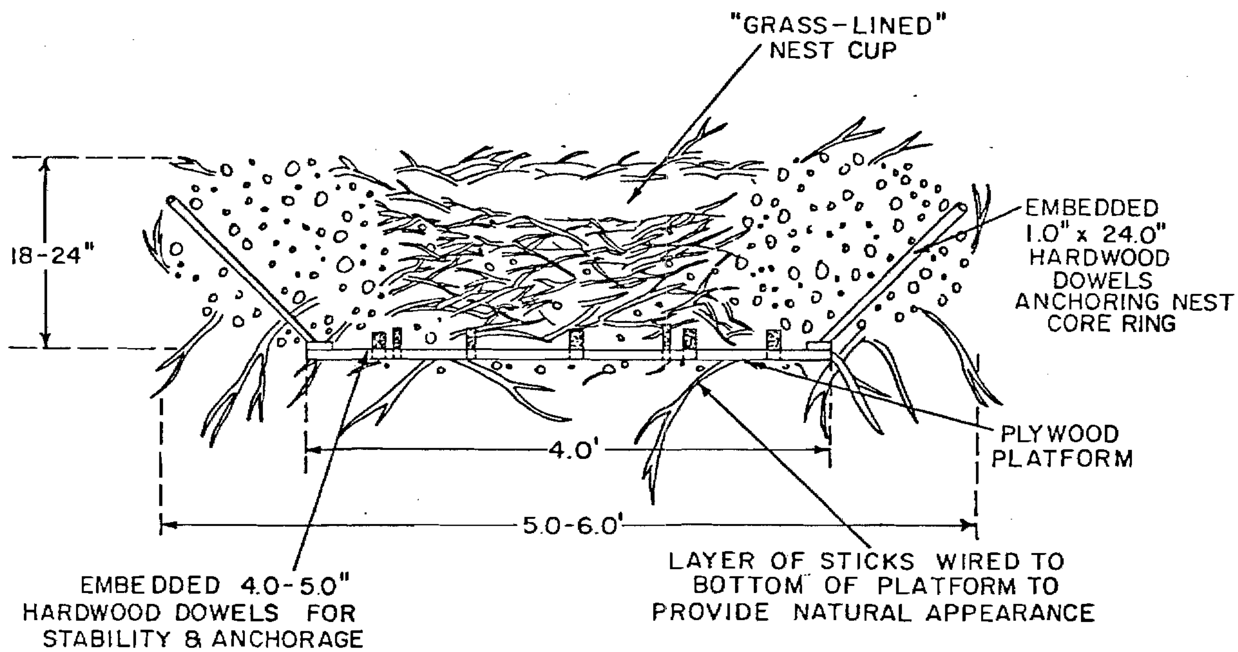
d) Side View of Attached Platform



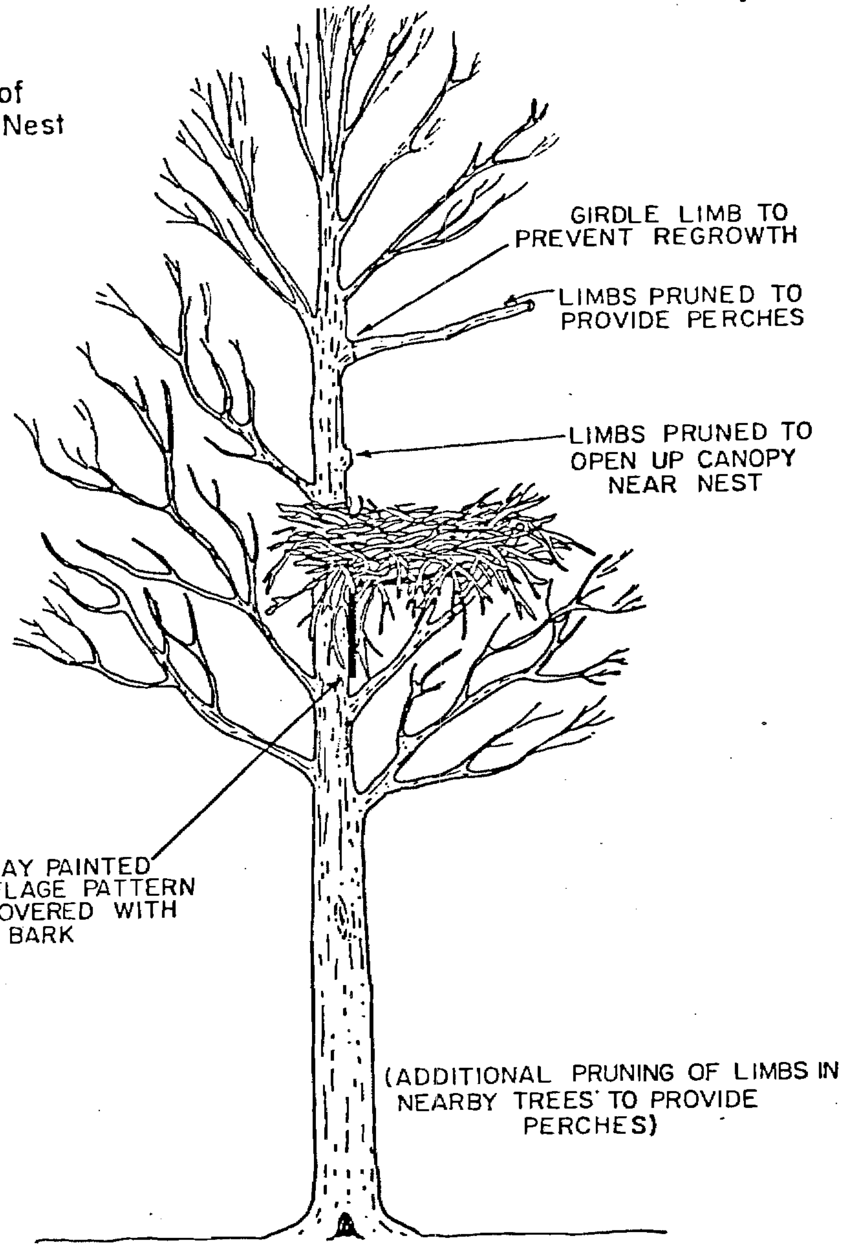
e) Nest "Core Ring": Prefabricated from loosely woven, supple green willow (*Salix* sp.)



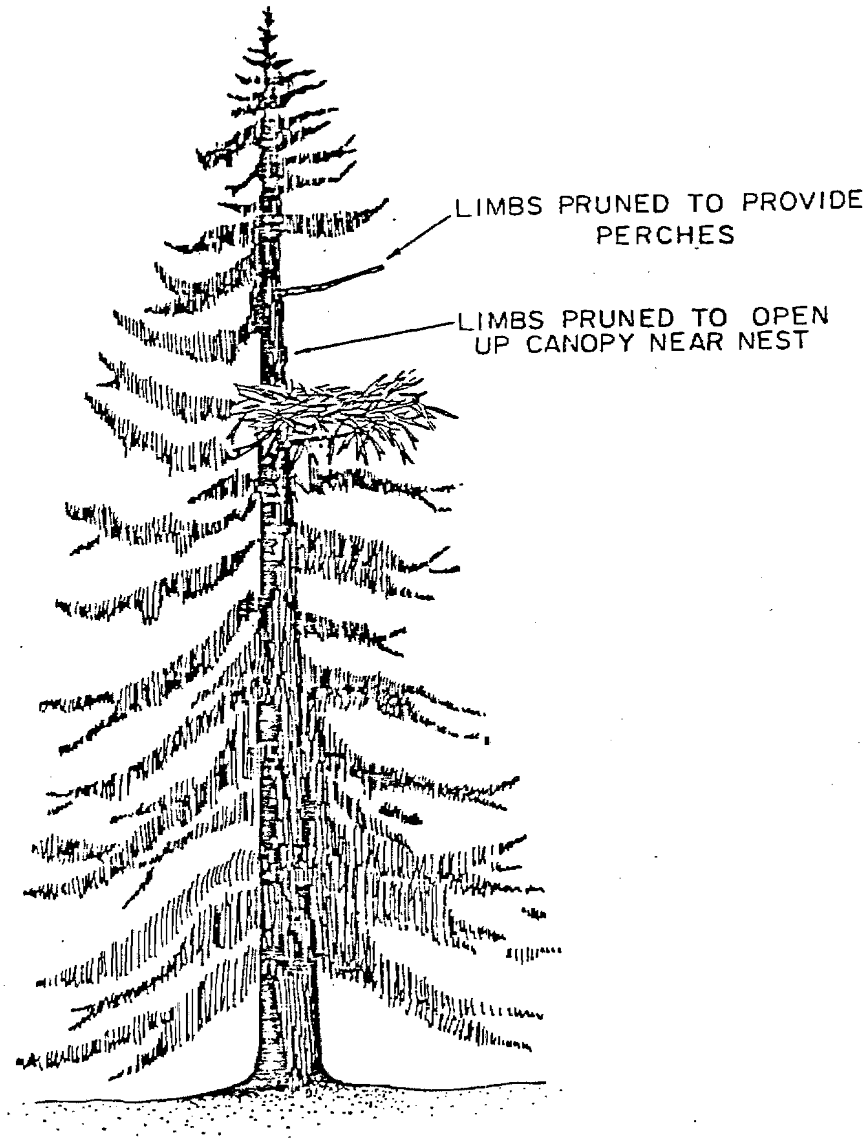
f) Cross-section of Completed Nest



g) Side View of Completed Nest



h) Completed Nest in Spruce Tree



ENCLOSURE 5

A Recommended Design for Artificial Bald Eagle Nesting Structures

A Recommended Design for Artificial Bald Eagle Nesting Structures

Artificial bald eagle nesting structures are man-made structures designed to serve in place of natural nesting substrates such as trees or cliffs (see Olendorff et al. 1980). Artificial structures generally consist of wooden or metal towers with attached nesting platforms or baskets. Artificial nests may also be provided, or the birds may build a nest on the artificial structure. One of the following designs for these structures is taken from Grubb (1980). Grubb's design, which incorporates a tripod structure, has been successfully used by nesting bald eagles. A second design, which uses a monopod structure, is also described. Artificial nests are key elements common to both designs. Advantages of the tripod design include inherent stability and minimal requirements for construction of subsurface anchor points. Advantages of the monopod design include greater initial resemblance to natural nesting substrates (e.g. trees, dead snags). The monopod design also lends itself well to additional modifications that can increase the resemblance of the finished structure to natural substrates (e.g., attachment of dead branches to provide perches and greater resemblance to dead trees). Details of both designs and discussion of their construction and placement are provided below.

Substrates

Tripod or monopod structures are intended for use in areas that lack bald eagle nesting habitat, but contain suitable foraging habitat. Typical areas where placement of these structures may be appropriate include expanses of wetlands that support fish and waterfowl populations, but that have little or no coniferous or deciduous tree cover (e.g., areas where high moisture content or climate may prevent or stunt the growth of trees of a size large enough to support artificial platforms and nests).

Tripod Structures

The basic tripod structure, as shown by Grubb (1980), is illustrated in Figures a, b, c. Each tripod leg was made from one 6.7 ft and two 20 ft sections of 4.0 inch diameter aluminum pipe. Leg joints were made from 40 inch sections of 3.5 inch diameter aluminum pipe. The sections of aluminum pipe were pre-drilled to accept hinge bolts, leg joint bolts, and footing bolts. Footings are pre-cut and pre-drilled from 1 x 1 x 8 ft wooden beams. A cross-perch of appropriate size was also pre-cut from wood stock. Components, including an artificial stick nest assembled in a wire basket, were transported to the field site for final assembly. After assembly, the tripod was raised into place with the aid of a helicopter and bolted securely to the footings which were pre-sunk about 6 feet into the ground in a triangular pattern 40 ft on a side.

Several modifications to the basic structure are recommended below:

1. The cross-perch should be fashioned from an appropriate length of solid dead spruce about 3-4 inches in diameter. Well-cured, solid spruce poles from old burned-over areas are ideal for this purpose. The perch is bolted in place between any two of the upper sections of the tripod.

2. Steel pipe in the order of 4-6 inches in diameter and coated with an appropriate preservative may be substituted for the buried wooden footings. (Strength and longevity are not compromised, and transportation is considerably easier.)

3. Appropriate pad-type above-ground footings may be substituted for other designs in permafrost areas.

4. Tripod height may be reduced to a size that places the finished nest about 20 ft above ground level in appropriate situations. (Some bald eagles are known to construct nests at very low heights in trees in tundra situations in Alaska.)

5. All aluminum parts should be painted in flat neutral tones (e.g., grays and browns) with appropriate long-lasting, weather-resistant paint to protect the metal and help blend the structure into its surroundings.

Monopod Structures

A basic monopod structure is shown in Figure d. The structure consists of a 40 ft pressure-treated wooden telephone pole with attached artificial platform and nest (see Enclosure 4). The pole is pre-drilled to accept a variety of natural, dead branches that provide perches and help simulate a dead snag. Basic construction steps are briefly outlined below:

1. Coat about 10 ft of the butt end of the pole with an appropriate preservative.

2. Pre-drill the upper end of the pole to accept at least two artificial nest platform support brackets. The holes should be positioned about 8-10 ft below the top of the pole.

3. Pre-drill several large-diameter holes in the upper 8-10 ft section of the pole, and in a 10 ft section of the pole immediately below the

attachment point for the artificial nest platform. (Avoid placing any holes for several feet immediately above the attachment point for the artificial nest platform -- access to the nesting platform must not be inadvertently blocked by branches when they are inserted in the holes.)

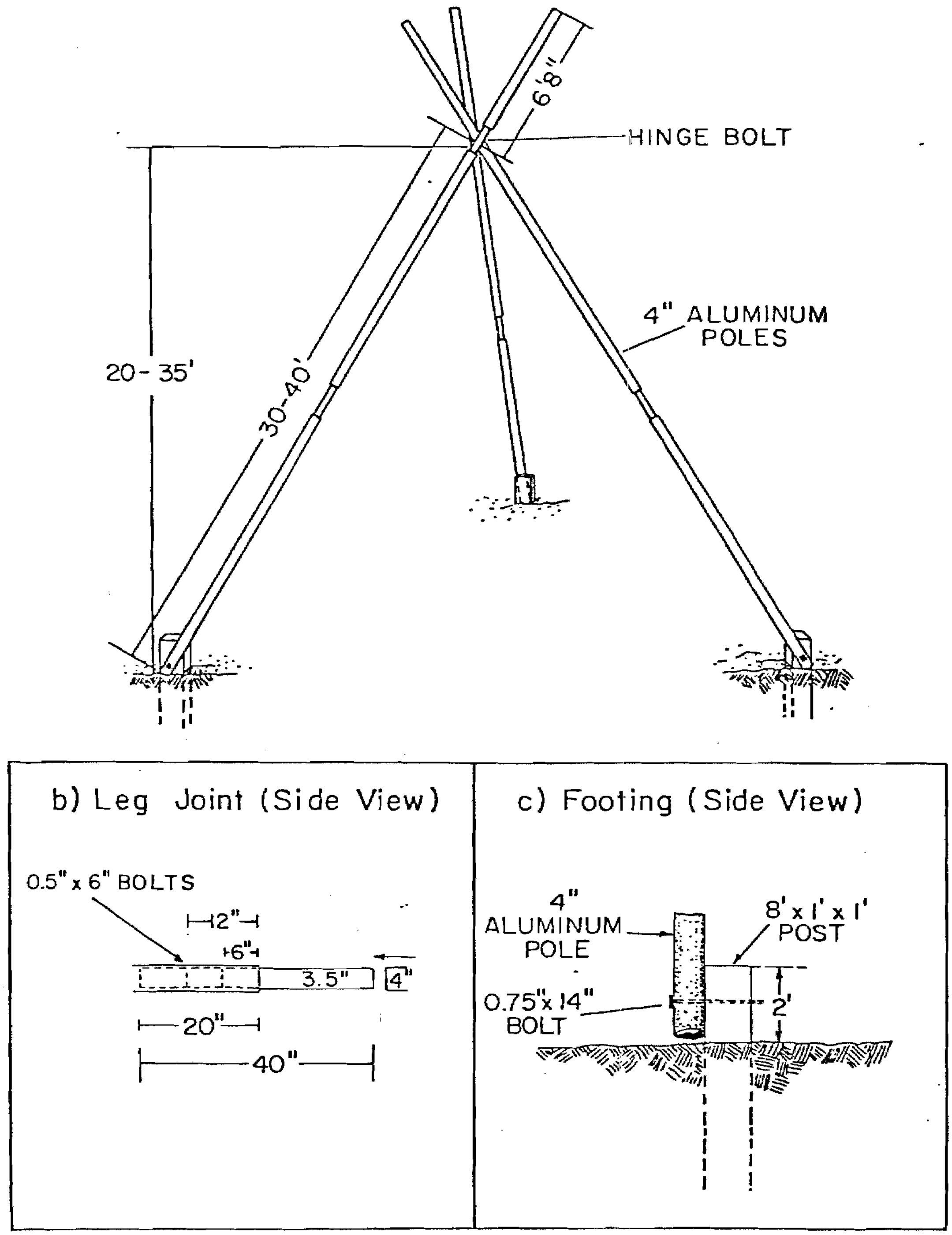
4. Attach the platform assembly, artificial stick nest, and upper perches to the pole at the field site. (Perches may be fabricated from dead, well-cured spruce poles. Before setting them in the holes, thoroughly coat the butt-ends with high quality, water-proof glue.)

5. Raise the pole into a prepared 7-8 ft hole with the aid of a helicopter and guy lines, and firmly back-fill the hole.

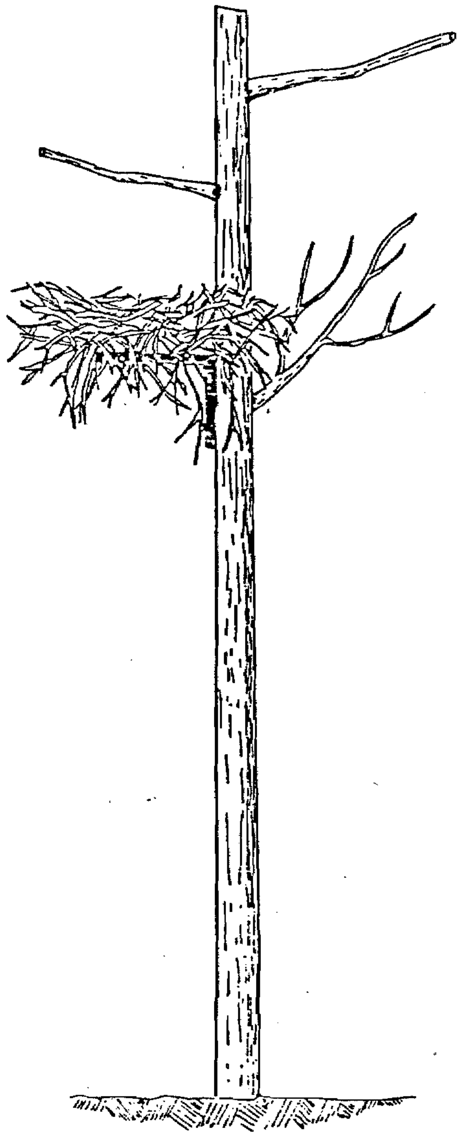
6. Under certain circumstances, the bare pole may be hoisted to about 100 ft by the helicopter and released. This method of "planting" the poles requires sharpening of the butt-ends, and temporary attachment of plywood fins at the top-ends. Nesting platforms are attached after the pole is in place. The method only works if soil conditions are right (e.g., relatively soft, swampy ground) and permafrost is not present.

7. Climb the pole, make final adjustments to the artificial stick nest, including nesting cup, and insert and secure the remaining perches and other branches below the nesting platform.

a) From Grubb 1980--Artificial Nest Structure (Tripod Design)



(d) Artificial Nest Structure (Single Pole Design)



Enclosure 6

Artificial Nest Sites and Nesting Structures for Golden Eagles

Artificial Nest Sites and Nesting Structures for Golden Eagles

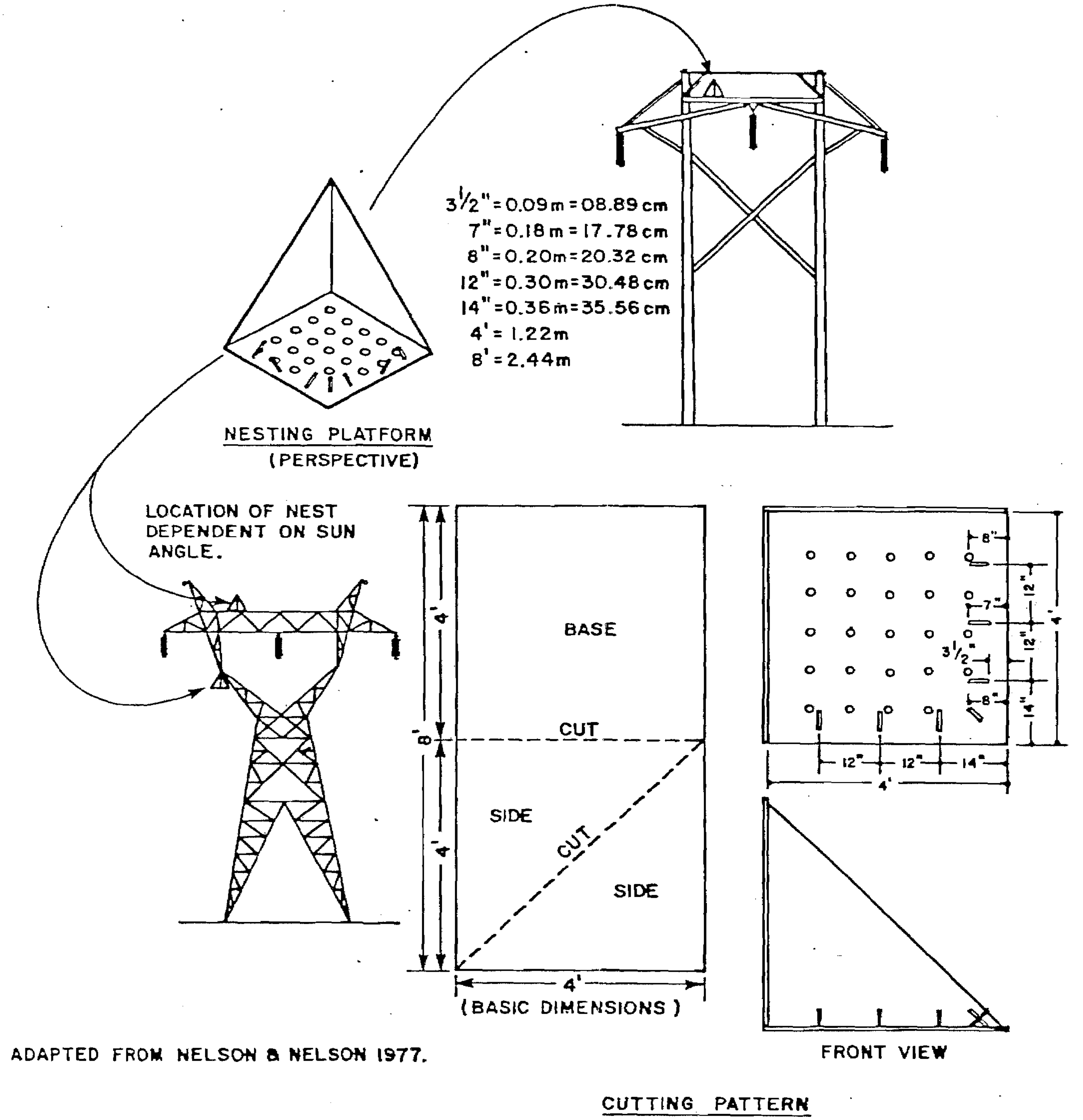
There are four methods of creating artificial nest sites and/or nesting structures for golden eagles. The methods have been briefly discussed in the license application (Alaska Power Authority 1983, p. E-538, 539) and are reiterated here. They will be developed more fully in the refinements to the mitigation plan, which is currently in progress.

1. Former nest ledges that are no longer suitable for nesting may be improved to provide ledges capable of supporting nests. An artificial stick nest may then be placed on the ledge.

2. New nest ledges may be constructed on existing cliffs that lack appropriate nest ledges. These nest ledges could be blasted (using small shaped explosive charges) or dug out with hand tools from the cliff faces. (In some cases, metal and masonry nest ledges may be attached to cliff faces.) Artificial stick nests may then be placed on nest ledges. New nest ledges would be created where possible at higher elevations on cliffs where the original nests would be inundated; repositioned ledges would be constructed at least 50 ft above maximum water level.

3. New nesting cliffs may be constructed in the course of quarry operations. Quarrying may be done in such a way as to leave a suitable cliff for nesting with appropriate nest ledges. The ledges could be further augmented with artificial stick nests.

4. In the event that insufficient cliffs are available for a full program to artificially encourage nesting on cliffs by the above methods, nesting platforms may be built for golden eagles on the tops of transmission towers when these towers are built (see Figure E.3.118 from license application). These platforms would contain artificial stick nests.



EAGLE NESTING PLATFORMS TO BE PROVIDED ON TRANSMISSION TOWERS

Enclosure 7

Experimental Design

Experimental Design

The experimental program as outlined in this section is preliminary in nature. It will be developed in greater detail in conjunction with the refinement of the mitigation plan for the Susitna Hydroelectric Project. The experimental program will only be undertaken if a scientific permit to conduct it is issued by USFWS, and further, if the Federal Energy Regulatory Commission approves the Susitna Hydroelectric Project's license application and that project goes ahead.

In most instances, the experiments and successful applications of techniques to provide nesting habitat for raptors have involved only a few pairs of some species. The limited numbers of experiments and successful applications are primarily a result of a lack of opportunity and support, rather than a lack of sufficient knowledge, methods, and techniques. Successful applications and experiments involving a variety of raptor species clearly suggest that the chances of success of such measures in the middle basin of the Susitna River drainage are high for the species involved, especially if proper planning, and appropriate designs and expertise are employed. The chances of success and the ultimate overall effectiveness of these measures can be increased further by modifying more of a variety of potential nesting locations (currently unused) than are lost, including locations along edges of the impoundments above maximum reservoir flood level, others in the nearby vicinity of the project, and locations that may occur in more distant areas of the middle and upper basins of the Susitna River drainage. Breeding raptors would be provided with a good variety of choices by the provision of about three modified locations for each location that is lost as a result of project actions and by providing several variations in artificial nest design. Once appropriate numbers of pairs of targeted species have accepted and established themselves at the artificially modified locations, excess locations can be removed or remodified to prevent their use and to thereby stabilize the populations at levels that are compatible with the project's mitigation goals.

Methods and techniques used to provide compensatory raptor nesting locations and nest sites will be individually tailored to each targeted species and may vary slightly as each particular situation dictates. State-of-the-art techniques and designs that produce natural-appearing nesting locations and nest sites will be stressed to ensure the certainty of success. The following basic methods will be employed: (1) modifying trees and tree canopy-cover in selected areas of appropriate habitat for tree nesting bald eagles; (2) supplying natural-appearing artificial nests (and sometimes nest structures) for bald eagles; and (3) modifying the microrelief of existing, but currently unusable, cliffs and rock outcroppings at appropriate elevations and suitable areas, and providing natural-appearing artificial nests for cliff-nesters, especially golden eagles. Artificial platforms with artificial nests that can be installed on selected transmission towers may also be experimented with (especially for golden eagles). One method that will be tested for both bald and golden eagles would be patterned after Postovit et al. (1982), who successfully moved a nesting pair of golden eagles several miles in a series of steps that included building artificial nests, moving a nestling capable of thermoregulation, and removing the original nest tree (see Enclosure 3). Basic designs for each species will take into account such factors as slope, aspect, height, 'overlook', distance to alternate nesting locations and overall distribution of nesting locations, accessibility to predators, drainage, prevailing wind directions, shade, and the vegetation types and sizes to be used in construction of nests (as applicable to each targeted species).

Commencement

The experimental program will commence as soon as it receives a scientific permit to do so from USFWS and the Susitna Hydroelectric Project receives approval to proceed. More experimental planning will be undertaken during FY85 as a part of the refinement of the mitigation plan for the Susitna project.

Duration

The experimental program will continue at an intensive level for at least five years -- two years to establish nests and at least three years to determine their initial success. It will then continue at a lower level of involvement throughout the life of the project to ensure that as much information as possible is gathered from the experiment and that complete compensation has been achieved for the nests lost.

Number of Artificial Nests

About three artificial nests (and possibly artificial nesting structures) will be provided for each eagle nesting location that is lost. In cases where attempts are made to move eagles from existing locations to unaffected locations in a series of incremental steps, several nests may be progressively provided and then removed to encourage eagles to complete each step.

Locations

In the course of conducting raptor surveys in the middle Susitna basin in 1984, a number of potential locations for artificial nests and/or site enhancement were noted. These will be documented in the report for that survey. Enclosure 8 provides information on the nesting and hunting habitats of bald eagles; this information was used in noting potential areas for artificial bald eagle nests.

Monitoring

The experimental program will require a detailed program of annual monitoring in order (1) to determine the success of the site enhancement measures and the artificial nests and structures, and (2) to use these results to continue to improve the artificial nests and structures. The Alaska Power Authority has already shown their commitment to conducting such a monitoring program (Alaska Power Authority 1983, p. E-3-525). Detailed accounts of methods, techniques and results will be kept and reported to ensure that the results are available for scientific evaluation and future use.

Hacking

The site enhancement measures and the provision of artificial nests and nesting structures may not prove to be fully successful (at least to the extent of providing complete compensation for nests lost due to the Susitna project). In this event (which we consider unlikely), a further technique, that of hacking, is available. In this technique nestling raptors would be released at artificial nest sites. They would be fed at these sites (in a manner that would preclude imprinting on humans) until they had fledged, had learned to hunt, and had become independent of the nest site. It is anticipated that such birds would, when mature, return to nest in the area, and quite possibly would do so at an artificial nest site.

Hacking has been used very successfully at a number of locations for releasing young peregrine falcons into the wild. Many of these birds have become successful breeding adults. Hacking has also been used successfully for a number of other large raptors, and the results from preliminary experiments indicate that the technique may be especially successful for bald eagles. Cade (1983), in reviewing programs to restore bald eagles in New York, stated that:

> "The rate at which hacked eagles have become established as breeders in the wild is well nigh unbelievable. Of the seven eagles hacked by Tina Milburn and The Peregrine Fund, Inc. in 1976 and 1977, three are now breeders, and at least one other is probably still alive after four years. These figures auger well for the establishment of additional pairs from the total 20 eaglets released at Montezuma under the State's endangered species program through 1980."

Detailed plans for a hacking program will be developed during detailed program development as a fallback position to be used if the artificial nests and structures are not as successful as is anticipated. These plans will incorporate information from more recent experiments that are currently underway in New York. (These experiments involve the hacking of about 20 bald eaglets that were taken from southeastern Alaska for this purpose.)

Enclosure 8

Bald Eagle Nesting and Hunting Habitat

Bald Eagle Nesting and Hunting Habitat

Bald eagles are capable of exploiting a variety of nesting habitats and successfully using a variety of nesting substrates. The majority of bald eagles inhabiting southeastern Alaska and the eastern Gulf of Alaska are found along the coast, where they construct their nests almost exclusively in large, living coniferous trees (especially Sitka spruce, but also western hemlock and cedar), and much less frequently in dead spruce, hemlock and cedar (e.g., Robards and Hodges 1977). In treeless portions of the western Gulf of Alaska, Aleutian Islands, and southern Bristol Bay regions, bald eagles regularly construct their nests on coastal cliffs and bluffs, sea stacks, and the ridge tops connecting sea stacks with larger islands (e.g., Sherrod et al. 1976; White et al. 1977). Throughout the remainder of Alaska, including the interior and south-central regions, the majority of nesting pairs are closely associated with riparian habitats along river and large stream courses, sloughs, lake shores, and other wetlands that are interspersed with smaller streams and ponds. They usually construct their nests in large, live balsam poplar (cottonwood) and white spruce, but they occasionally nest in live aspen or black spruce or in dead snags, and rarely on cliffs or on the ground (e.g., Hensel and Troyer 1964; Roseneau et al. 1981; Ritchie 1982; Byrne et al. 1983a,b).

In regions where bald eagles typically nest in trees, only certain trees are suitable as structures on which the large stick nests can be built. The most frequently used trees are large, live mature trees that are dominant members of a stand (e.g., Ritchie 1982), and that have tops (1) that are deformed or broken, (2) that are unusually bushy (a particularly important feature of the white spruce trees that are used in the interior and south-central regions), or (3) that have lost sufficient limbs to have partially opened the canopy cover (a particularly important feature of the balsam poplar trees that are used in the interior and south-central regions) (e.g., Robards and Hodges 1977; Roseneau et al. 1981). The conformation of the tree tops is a particularly important feature because the eagles require not only solid platforms of sufficient size to build on, but also openings of sufficient size to allow unobstructed flight during approaches to and departures from their nests.

Stands of mature balsam poplar (cottonwood) and white spruce that contain trees of suitable size and conformation for bald eagle nests become increasingly scarce in the Susitna River drainage as one proceeds upstream from the Indian River. Consequently, the vast majority of the bald eagle nests in the Susitna River dainage are found downstream from the Indian River in the lower river floodplain.

Bald eagles nesting in inland regions of Alaska, including most of the Susitna River drainage, hunt in wetland areas, especially along river and stream courses, and at lakes and ponds. Their food in these habitats includes (1) fish caught at the surface of deep waters or in shallow waters (including dead and dying salmon); (2) birds caught on the water or in flight over waterbodies or other open areas; (3) small mammals caught when swimming or on the ground in areas relatively free of escape cover; and (4) carrion scavenged from surface waters (e.g., floating carcasses of fish and birds) or from shoreline or other open terrain (e.g., washed up carcasses of fish, birds, and mammals, including large mammals). Most hunting probably occurs within relatively short distances of the nesting sites (e.g., 1-2 miles or less), especially at nesting sites that are conveniently located near food supplies. However, some hunting may occur at greater distances from certain nest sites. For example, an adult that nested on a hillside overlooking Quartz Lake, near Big Delta, was seen flying over the back side of the hill toward the Tanana River at a minimum distance of 2 miles from the nest (Roseneau, pers. obs.). In another example, hunting bald eagles have been seen as far as 5 miles from an active nesting location in an area of Washington state where no other pairs are known to nest (Anderson 1984, pers. comm.).

The following areas within or near the middle basin of the Susitna River drainage provide examples of typical hunting habitat for bald eagles: (1) the river floodplain; (2) the wetlands on the north side of the river between Portage Creek and the Indian River; (3) the upper Talkeetna River drainage, including the Prairie Creek drainage and the wetlands surrounding Stephan Lake; (4) the Portage Creek drainage; (5) the Fog Lakes wetlands; (6) the Oshetna and Tyone river wetlands; and (7) portions of the wetlands adjacent to the river upstream from the Tyone River. Bald eagles are not known to nest in several of these areas, including the wetlands between the Indian River and Portage Creek, the Portage Creek drainage, and the Fog Lakes wetlands. The absence of nesting pairs appears to correspond to an absence of suitable nesting trees, rather than the lack of a suitable prey base. The Portage Creek drainage provides an excellent example. Portage Creek contains several species of fish, including salmon; waterfowl are found in nearby lakes and ponds west of the creek; and nearby clearwater streams and beaver ponds contain grayling. Portage Creek also contains stands of balsam poplar of a size adequate to support bald eagle nests, but the tops of these trees tend to be uniform and closed, and dominant trees with partially open tops of the appropriate configuration appear to be lacking.

The hunting areas and ranges of the bald eagles that currently nest in the middle basin of the Susitna River are unknown. However, a review of the available wetlands, waterbird populations and fisheries resources strongly suggest that it may be incorrect to assume that pairs of bald eagles nesting along the river between Vee Canyon and Devil Canyon necessarily hunt only along the river within the confines of the Susitna valley. The river waters upstream from Devil Canyon are swift and highly turbid during much of the nesting season. Although bald eagles nesting along the river may take some waterfowl (e.g., mergansers), other birds, small mammals, and carrion on the valley floor, fish resources appear to be somewhat limited, with the best fishing opportunities in the river occurring at the mouths of clearwater tributaries. Several clearwater tributaries on the north side of the river flow through narrow constricted gorges that terminate in waterfalls. The lower canyons and mouths of those tributaries appear to provide little fishing habitat for bald eagles. Better fishing opportunities (and larger concentrations of waterbirds) are available in nearby wetlands above and to either side of the river, where grayling, round whitefish and Dolly Varden are common (Moulton 1984, pers. comm.). It seems unlikely that resident bald eagles nesting within a few miles of these resources would fail to exploit them.

Enclosure 9

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Literature Cited

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