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CHARACTERISTICS OF WHITE-TAILED SEA EAGLE NEST SITES IN HOKKAIDO, JAPAN[1]

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Abstract. I studied the characteristics of 26 White-tailed Sea Eagle (*Haliaeetus albicilla*) nest trees and 24 nesting forests in Hokkaido, Japan. Nest trees were an average of 7.9 m taller and an average of 45.6 cm larger in dbh than the surrounding forest, and many of them were near the forest edge. Eagles preferred Glehn's Spruce (*Picea glehnii*) and Japanese Alder (*Alnus japonica*) as nest tree species, though not exclusively. Nests were an average of 2.8 m higher than the average height of surrounding trees, and all nests had canopy openings above them. Openings above nests in the forest interior were an average of about 110° wider than those above nests near forest edges, because the nests were built on emergent trees. Eagle nesting habitat in Hokkaido requires trees large enough to support the nest, and a surrounding structure which allows accessibility and good visibility.

Key words: Nest site selection; nest tree; nesting forest; vegetation structure; Haliaeetus albicilla.

INTRODUCTION

The White-tailed Sea Eagle (*Haliaeetus albicilla*) is distributed widely, but locally, in the northern Palearctic, Greenland and the Aleutian Islands (King 1981, Tobish and Balch 1987), and its status is considered vulnerable (King 1981). In Japan, this species breeds only in Hokkaido, the southernmost breeding area in far east Asia (The Ornithological Society of Japan 1974). The breeding population was recently estimated as 39 pairs (Shiraki 1992). White-tailed Sea Eagles have been designated as a natural monument by the Japanese Cultural Agency since 1970, and listed as an endangered species in the Japanese Red Data Book (Japan Environmental Agency 1992).

Haga first observed nesting in Hokkaido in Abashiri (1955) and two nestings in Nemuro Peninsula (1956). Mori (1980) surveyed breeding ecology of the eagle and the nesting habitat in eastern Hokkaido. Recently, Nakagawa et al. (1991) reported the breeding status of this species in Hokkaido, and stated that the nesting habitat has been greatly changed by logging and development in the past 20–30 years. Globally, Fischer (1970) and Love (1983) reviewed nest site features of this species and Labzyuk (1975) described coastal nest sites on the Gulf of Olga. These studies described some nesting habitat characteristics and measurements of some nests and nest trees. However, no prior study has analyzed quantitatively the White-tailed Sea Eagles' nest sites. The object of this paper is to describe quantitatively White-tailed Sea Eagle's nest trees and surrounding forest conditions to facilitate development of conservation policy for this eagle's breeding areas in Hokkaido.

STUDY AREA AND METHODS

This study was conducted in Hokkaido, the most northern main island of Japan (Fig. 1). The climate of surveyed areas is humid-subarctic (Köppen in Saito and Okitsu 1987). Average yearly temperatures range from 5°C to 8°C in low areas, and average annual precipitation is higher in the west than in the east, ranging from 600 mm to 1,600 mm (Aono and Otogawa 1981). Vegetation is characterized by pan-mixed forest, a mosaic mixture of boreal forest consisting of Yezo Spruce (*Picea jezoensis*), White Fir (*Abies sachalinensis*) and Glehn's Spruce (*Picea glehnii*), and temperate deciduous areas consisting of a variety of species (Tatewaki 1958).

Surveys on nest trees and their surrounding vegetation were conducted at 24 nest sites (Fig. 1), two of which had two nests each. I classified 19 of 24 nest sites and 21 of 26 nests as active. I considered occupation by breeding pairs (sites) and incubation or successful breeding (nests) during at least one year between 1988 and 1993

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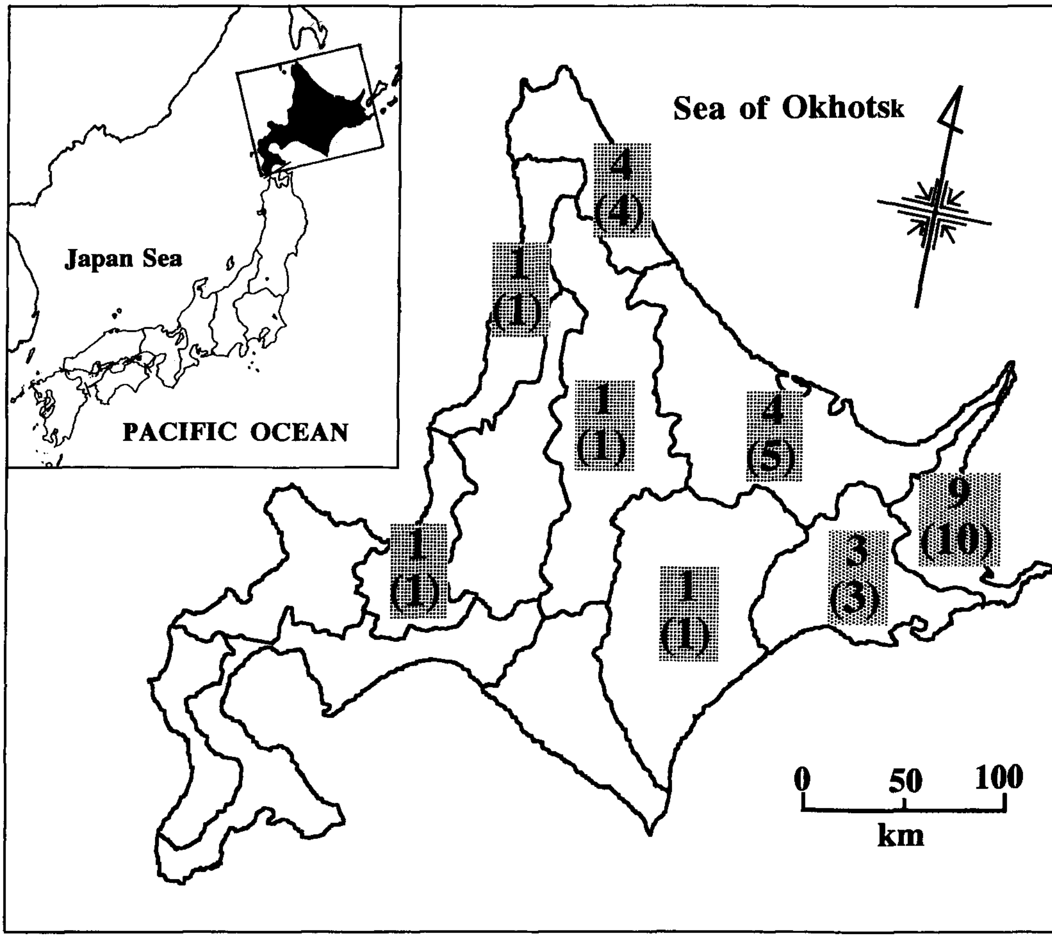

FIGURE 1. Distribution of surveyed White-tailed Sea Eagle nest sites and nests by political division in Hokkaido, 1991–1992. Upper figures indicate number of nest sites and ( ) indicate number of nests.

(Shiraki, unpubl. data, pers. comm., Wild Bird Society of Japan) as active.

Nest site vegetation was measured during July–September in 1990–1991, post-fledging. I recorded tree species, tree condition (live, dead-topped live, dead), trunk diameter at breast height (dbh), and tree height for three levels of vegetation: the nest tree, the nest site and the surrounding forest stand. The nest site vegetation was all trees ≥7.5 cm dbh (quadrant trees) within a 15 m × 15 m quadrant centered on the nest tree. The surrounding forest stand was surveyed using the point-centered-quarter method (Cottam et al. 1953). I sampled a total of 40 trees dbh ≥7.5 cm in 10 sampling points, excluding quadrant trees, established at regular intervals in each forest stand. I defined nesting forests as deciduous (≥70% dominance in deciduous trees), coniferous (≥70% dominance by conifers) or mixed. To examine whether use of nest tree species was frequency dependent, I compared frequencies of the 13 nest tree species with expected values. Expected values were calculated from the frequencies of trees >35 cm dbh and ≥7 m height in the forest stands, the minimum size trees used for nests in the study area. In addition, I measured the height of each nest's upper edge (nest height) and made crown projection diagrams for each quadrant. From these diagrams, I measured the degree of open space (canopy opening) above the height of the nest, and within a 7.5 m radius circle centered on the nest tree trunk. For all measurements of height, I used a Wize hypsometer.

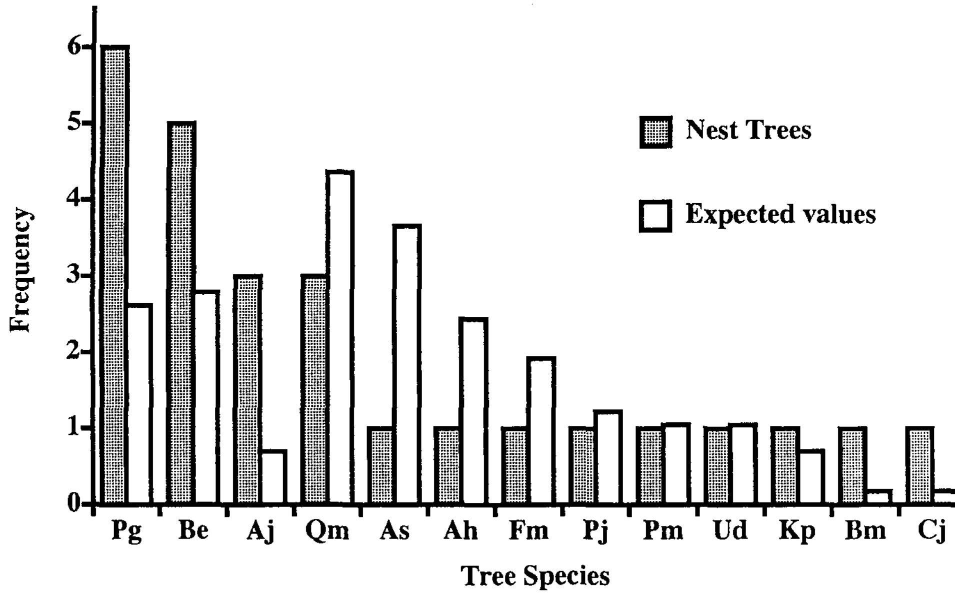

FIGURE 2. Frequency distribution of 26 White-tailed Sea Eagle nest tree species in Hokkaido, 1991–1992. Expected values are the frequencies of each tree species that would be expected when 26 trees are chosen randomly from the nesting forest stands. Tree species: Pg, *Picea glehnii*; Be, *Betula ermanii*; Aj, *Alnus japonica*; Qm, *Quercus mongolica* var. *grosseserrata*; As, *Abies sachalinensis*; Ah, *Alnus hirsuta*; Fm, *Fraxinus mandshurica* var. *japonica*; Pj, *Picea Jezoensis*; Pm. *Populus maimowiczii*; Ud, *Ulmus davidiana* var. *japonica*; Kp, Kalopanax pictus; Bm, *Betula maximowiczia*; Cj, *Cercidiphyllum japonicum.*

Distance of nest tree from the nearest forest edge was measured directly at each nest site when the distance was ≤50 m, but when distance was >50 m this value was measured off of 1/25,000 or 1/50,000 topographic maps prepared by National Geographical Survey Institute in Japan. I defined the locations of two nest trees on steep slopes >15° as 0 m from the forest edge.

RESULTS

Eighteen of 24 (70.8%) nesting forests were deciduous dominated, four (16.7%) were mixed and three (12.5%) were conifer-dominated forests. Thirteen (50.0%) of 26 nest trees were on level ground, 11 (42.3%) were on slopes or ridges, and two (7.7%) were on valley floors. The 21 active nest trees were: one (4.8%) dead, five (23.8%) dead-topped live, and 15 (71.4%) live trees.

Nest trees at active nest sites were wider and taller than the average of both quadrant trees and forest stands (Wilcoxson's signed rank test, $P = 0.0001$) (Table 1). Nests were also located higher than average tree heights within each quadrant (Wilcoxson's signed rank test, $P = 0.017$) (Table 1). However, the differences between nest heights and average tree heights in each forest stand were not significant (Wilcoxson's signed rank test, $P = 0.32$) (Table 1).

The 26 nest trees were of 13 species (Fig. 2). Nest tree species selected by eagles differed from those selected at random, Glehn's Spruce ($P = 0.041$) and Japanese Alder (*Alnus japonica*) ($P =$

TABLE 1. Characteristics of active nest trees, quadrat trees and forest stands in Hokkaido, 1991–1992. Two of 19 forest stands have two nests and quadrats each.

	Nest tree ($n = 21$)		Quadrat ($n = 21$)		Forest stand ($n = 19$)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Tree height (m)	20.2	5.3	11.2	3.3	12.3	3.3
Dbh (cm)	68.8	26.0	22.1	7.6	23.2	7.0
Nest height (m)	14.0	5.0	—	—	—	—

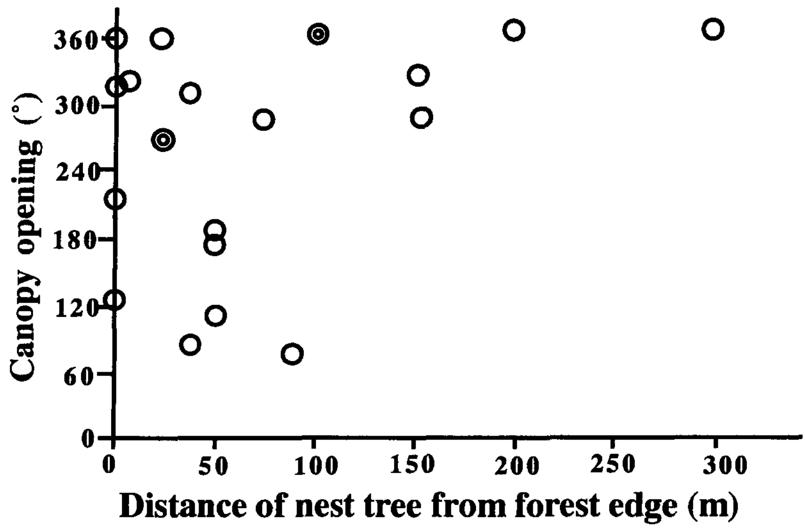

FIGURE 3. Relationship between distance of nest tree from forest edge and degrees of canopy opening. Double circles indicate duplication of two equivalent data points.

0.032) were used more frequently than expected (Binomial test).

White-tailed Sea Eagles tended to nest near forest edge and have canopy openings above nests (Fig. 3). Thirteen of 21 nest trees (61.9%) were within 50 m of the forest edge and 17 of 21 nest sites (81.0%) were at canopy openings of 180° or more, and the minimum of all nests was 75° (Fig. 3). Sites further than 100 m from the forest edge (forest interior) had wider canopy openings than those within 100 m of the forest edge (Mann-Whitney's U test, $P = 0.0074$) (Table 2). To examine why canopy openings were larger at forest interior nests, I compared the height of nests relative to the height of average quadrant trees and the density of quadrant trees (trees/m^2) between the two categories of nest sites (Table 2). Canopy openings above forest interior nests were larger due to the nest height being an average of 7.58 m higher than the average height of quadrant trees (Mann-Whitney's U test, $P = 0.0024$). The large canopy openings above nests were not a result of the nests being built in areas of lower tree density because the difference between densities was insignificant (Mann-Whitney's U test, $P = 0.70$).

DISCUSSION

All White-tailed Sea Eagle nests in Hokkaido were in trees. Although in some areas of its range this species nests on ledges (Labzyuk 1975; Tobish and Balch 1987; Love 1983, 1988) and, rarely, on the ground (Cramp and Simmons 1980, Love 1983). Northeastern Hokkaido has ledges available (Mori 1980), but they have not been used for nesting, possibly because eagles prefer to nest in trees when available (Cramp and Simmons 1980, Mori 1980).

In this study, nest trees were greater in dbh and taller than the average height of quadrant trees and forest stands. Nest height was also significantly higher than average quadrant trees, but

TABLE 2. Canopy opening, difference between nest height and the average height of quadrat trees (height difference) and quadrat trees density for 21 active nest sites of White-tailed Sea Eagle categorized as near or far from forest edge, Hokkaido, 1991–1992.

Distance from forest edge	Canopy opening (°)		Height difference (m)		Density (trees/m^2)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
<100 m ($n = 15$)	232.00	97.19	0.92	4.14	0.048	0.027
≥100 m ($n = 6$)	343.34	28.75	7.58	5.36	0.059	0.040
P	0.0074		0.0024		0.70	

the difference between nest height and average tree height of the forest stand was not significant. Nest height may be less important than the height of the nest relative to the surrounding canopy. This interpretation is supported by reports of nests on ledges and the ground in open areas. The explanation for the large dbh in preferred nest trees is that large trees are required to support the massive nests. A nest I measured in Nemuro in 1993 weighed over 210 kg. A nest reported by Brown and Amadon (1968) was 240 kg.

Certain nest tree species were preferred. Palmer (1988) reported that Spruce (*Picea*) were often used for nest trees of White-tailed Sea Eagles. In this survey, I found that Glehn's spruce was often used for nest trees. More research is needed to determine degree of preference.

Mori (1980) mentioned good visibility as a characteristic of White-tailed Sea Eagle nest sites in Hokkaido. Brown and Amadon's (1968) previously described nest was in a situation allowing free flight into and out of the nest. Love (1983) cited both of these conditions as requirements to be fulfilled for nesting. Many studies on nesting habitat of Bald Eagles (*Haliaeetus leucocephalus*), a closely related species, have also suggested this view (Wood et al. 1989, Gerrard and Bortolotti 1988, Andrew and Mosher 1982, McEwan and Hirth 1979). Many nest trees examined in this study were near the forest edge, and five (28.6%) of them were dead or dead-topped trees. These factors provide easy nest access and good visibility. Further, I found that canopy openings were wider above forest interior nests than nests near the forest edge, suggesting that at forest interior nests, eagles require more open canopy to compensate for the lack of visibility provided by nesting at the forest edge. The structure of emergent trees (projecting from surrounding canopies) may attract eagles to nest in forest interior areas.

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