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GAME BIRD REPORT

By

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Volume XIII
Project Progress Report
Federal Aid in Wildlife Restoration
Projects W-17-4 (2nd half) and W-17-5 (1st half), Job 10.6R

(Printed May, 1973)

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Jerry D. McGowan

Project Nos.: W-17-4 & W-17-5 Project Title: Small Game Investigations

Job No.: 10.6R Job Title: Distribution, Density and Productivity of Goshawks in Interior Alaska

Period Covered: January 1, 1972 to December 31, 1972

SUMMARY

Aerial surveys in 1971 and 1972 have proved effective in locating 25 potential goshawk nesting sites. Approximately half of these sites were used by goshawks in 1972, and 64 percent of those active in 1971 were used in 1972. Birch woodlands seemed to be preferred nesting habitat, and 70 percent of 30 nests studied since 1970 were in birch trees. Aspen and balsam poplar were also selected for nesting. Various physical and biological aspects of nest sites are discussed. Most active nests had other stick nests of similar size within a few hundred yards, and such areas are considered traditional goshawk nesting areas. Times of nest building, egg laying, hatching, and fledging are discussed for 1971 and 1972. Breeding density, reproductive success, and the proportion of nesting yearlings showed a decrease from 1971. Nest failures prior to hatching, lowered hatching success, and poor chick survival all contributed to the decrease in production. Fall trapping success and age ratios of captured goshawks further suggested lowered production in 1972. Observed productivity declines may be related to declines in prey abundance.

CONTENTS

BACKGROUND

The goshawk (*Accipiter gentilis*) is an important predator throughout the year in wooded regions of Alaska. Goshawks are known to prey on snowshoe hares (*Lepus americanus*) and upland game birds. On the Kenai Peninsula the major cause of winter mortality among spruce grouse (*Canachites canadensis*) was predation by raptors, particularly goshawks (Ellison, 1972). In Minnesota goshawk predation is the major cause of ruffed grouse (*Bonasa umbellus*) mortality during spring and fall (Eng and Gullion, 1962). Studies in Finland indicate that grouse are preferred prey of goshawks even when other birds are available (Sulkava, 1964). Presently, there is serious concern for the well-being of raptor populations in many regions because of decreased productivity resulting from contamination by chlorinated hydrocarbons. Declines of peregrine falcons (*Falco peregrinus*) have been discussed by Hickey (1969), Cade et al. (1968), and others. Because goshawks, as well as gyrfalcons (*Falco rusticolus*), are permanent residents of Alaska, pesticide contaminations are probably not reducing productivity of these species to the extent recorded for migratory raptors. Goshawks have long been recognized as excellent birds for falconry, and the demand for raptors to be used for this purpose is increasing. In view of the recent decrease in productivity of peregrine falcons and other birds of prey, goshawks and gyrfalcons may be the only species we are justified in using to satisfy this increasing demand. We have good general knowledge of gyrfalcon populations on the Seward Peninsula (Roseneau 1969, 1970, and 1971); however, little information on Alaskan goshawks has been reported. A literature review revealed few references to this species from elsewhere in North America,

and no information concerning population densities or productivity was found. Initial studies on Alaskan goshawks were reported by McGowan (1971, 1972). This report summarizes findings of goshawk studies conducted during 1972.

OBJECTIVES

To estimate the nesting population of goshawks in the general vicinity of Fairbanks, Alaska, and to determine yearly density, productivity and movements of goshawks in this area.

PROCEDURES

Nest Surveys

Intensive nest surveys in all birch (*Betula papyrifera*) and aspen (*Populus tremuloides*) stands within the 144 mi^2 (372 km^2) study area (Fig. 1) were conducted using a Piper "Supercub" on April 6 and 7, 1972. This amounted to five hours of actual survey time. Particular attention was given to hardwood stands which generally occur on south and west facing slopes, while little time was spent surveying white spruce (*Picea glauca*) stands. Most pure spruce stands on the study area are composed of trees too small to support goshawk nests, hence, these stands are considered unsuitable nesting habitat. Consequently, spring nesting surveys were not conducted at random, but were based on physiographic and vegetative conditions.

Stick nests were easily observed from the air when snow was on the ground and the trees devoid of leaves. Surveys were conducted by flying approximately 200 feet (60 m) above the tree tops with an observer systematically searching all suitable habitat. Stick nests observed were plotted on maps and visited on the ground as soon as possible to determine activity. Attempts were made to locate all stick nests on the 144 mi^2 (372 km^2) study area but some nests possibly were overlooked. The effectiveness of the aerial survey technique has not been evaluated, hence, the extent to which nests may have gone undetected is unknown. Several nests located off the study area were found, and data from these nests are used to augment productivity information.

Nesting Studies

Once active nests were located, visits were scheduled in order to determine the following: laying dates, clutch sizes, incubation times, hatching dates, hatching success, period of time spent in nests by chicks, fledging dates, and fledging success. In most cases about five visits were made to each nest. During these visits attempts were made to minimize disturbance, and whenever possible, a tree other than the nest tree was selected for climbing. At each nest site the following physical and biological data were collected: nest size, height of nest above ground, position of nest in tree, position of nest tree on slope, aspect of slope, altitude, presence of other stick nests nearby, species

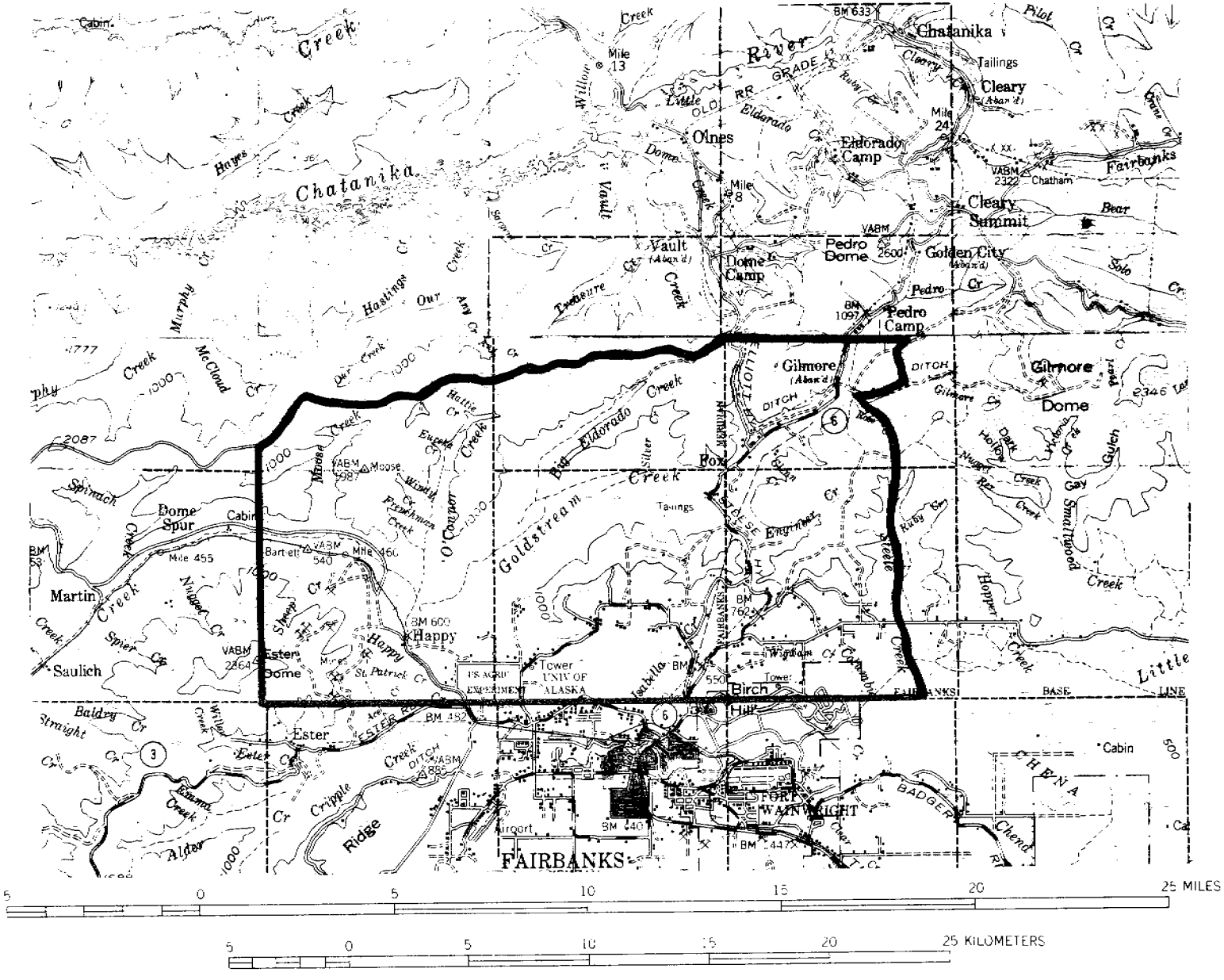


Fig. 1. Goshawk study area 144 mi^2 (372 km^2).

of nest tree, and general description of stand in which nest is located. Note was also made of plumage (including wing and tail molt) and behavior of adults.

Pole climbing irons and a lineman's belt were used for climbing. It was necessary to wear a hard hat and heavy leather jacket for protection from defensive adults.

Trapping and Banding

During the period October 1 through December 15 seven Swedish goshawk traps, baited with three or more feral pigeons (*Columba livia*), were operated. The traps were similar to those described by Beebe and Webster (1964, p. 301) and Meng (1971). Trapping was restricted to the study area, but trapping effort was distributed over the entire area. Clearings surrounded by deciduous woodlands were selected as trapping sites. Three trap locations were used throughout both the 1971 and 1972 trapping seasons in order to yield comparative information for the two years. Other traps were moved as many as three times between October and December in order to capture as many hawks as possible.

Trapped hawks were banded with size 7B U. S. Fish and Wildlife Service bands. In the past, color bands had also been used. Their use was discontinued because: 1) they did not prove adequate for positive identification of individuals under field conditions, and 2) a significant number of hawks lost their plastic color bands even though all seams were bonded with acetone.

It is generally felt that male goshawks are approximately one-third smaller than females (Mueller and Berger, 1968; Storer, 1966). When hawks were trapped their sex was initially judged by general body and foot size; however, all hawks captured were weighed and subjected to the following measurements as described by Pettingill (1939, pp. 323-325): length, wing chord length, length of the first, fourth, and fifth primary (numbering 1-10 proximately), and length of center rectrix. In the past, extent and bill lengths were taken, but these measurements were deleted from banding procedures in 1972. Measurements of primaries were the lengths of flattened feathers.

Trapped hawks were placed in three age categories as described by Mueller and Berger (1968). Juveniles (birds less than 1 year of age) are typified by a brownish, streaked breast, while adults I (birds 1 but less than 2 years of age) display a mixture of gray, adult and some brownish juvenile plumage. Adult II (birds 2 or more years of age) have grey, adult plumage with no brown. General observations on eye color, condition, molted feathers and presence of shock marks were also made. All trapped birds were released at the same location as trapped. Similar measurements were obtained from dead goshawks and, in these cases, it was possible to confirm sex by internal examination.

Food Habits

After the young had fledged, castings and skeletal remains were

collected both from the nest and the base of the nest tree. Castings were dried and later analyzed to reveal food habits. Errington (1932) and Glading et al. (1943) concluded that casting analysis reflects food habits of hawks qualitatively and not quantitatively. It is not possible to differentiate between castings deposited by nesting females and chicks; consequently, food habits information presented is intended merely as a qualitative listing of summer prey species and their relative frequencies of occurrence.

FINDINGS

Traditional Nesting Sites

Knowledge of all stick nests on the study area is important in order to facilitate location of active sites in the future. Aerial surveys coupled with intensive ground searching revealed stick nests to be distributed over the entire study area (Fig. 2). I feel certain that these nests were built by goshawks in most cases. Other common birds in interior Alaska utilizing large arboreal stick nests include great horned owls (*Bubo virginianus*), great gray owls (*Strix nebulosa*), ravens (*Corvus corax*) and Harlan's or red-tailed hawks (*Buteo jamaicensis*). It is generally agreed that great horned and great gray owls rarely build their own nests (Bent, 1937a). In fact, I have recorded two instances of great horned owls utilizing nests that had been occupied by goshawks the previous year. In both cases, goshawks did not nest in the area when owls were present, but it is not known whether the hawks were displaced or replaced. Because ravens and red-tailed hawks have rarely been found nesting on the study area, they probably are responsible for few, if any, of the stick nests located. In most cases, several nests were situated relatively close together (Fig. 2). At 21 sites where stick nests were observed from the air, intensive ground searches revealed that only four contained a single nest. Such areas, with two or more nests clumped within an area 0.5 mi (0.8 km) in diameter, are considered to be traditional goshawk nesting sites.

Not all areas containing stick nests have been used by goshawks during the study. For example, approximately half the sites considered as potential nesting areas were active in 1972. Most active sites studied since 1971 were classified as traditional, and all three instances where this was not the case (active sites containing a single nest) the breeding female was a yearling. In one such case an adult female built and used a nearby nest the subsequent year. This was probably a traditional site being established, possibly by the same female. However, yearling females have also nested at sites containing several old nests. First-year females are probably not successful in competition with adults for nesting areas, and only occupy vacated traditional sites. Twenty-one active nesting areas have been located since 1970, and a high proportion of sites are utilized yearly (Fig. 3). Both sites known to be active in 1970 remained active through 1972, and of 11 active sites in 1971, 64 percent were active in 1972.

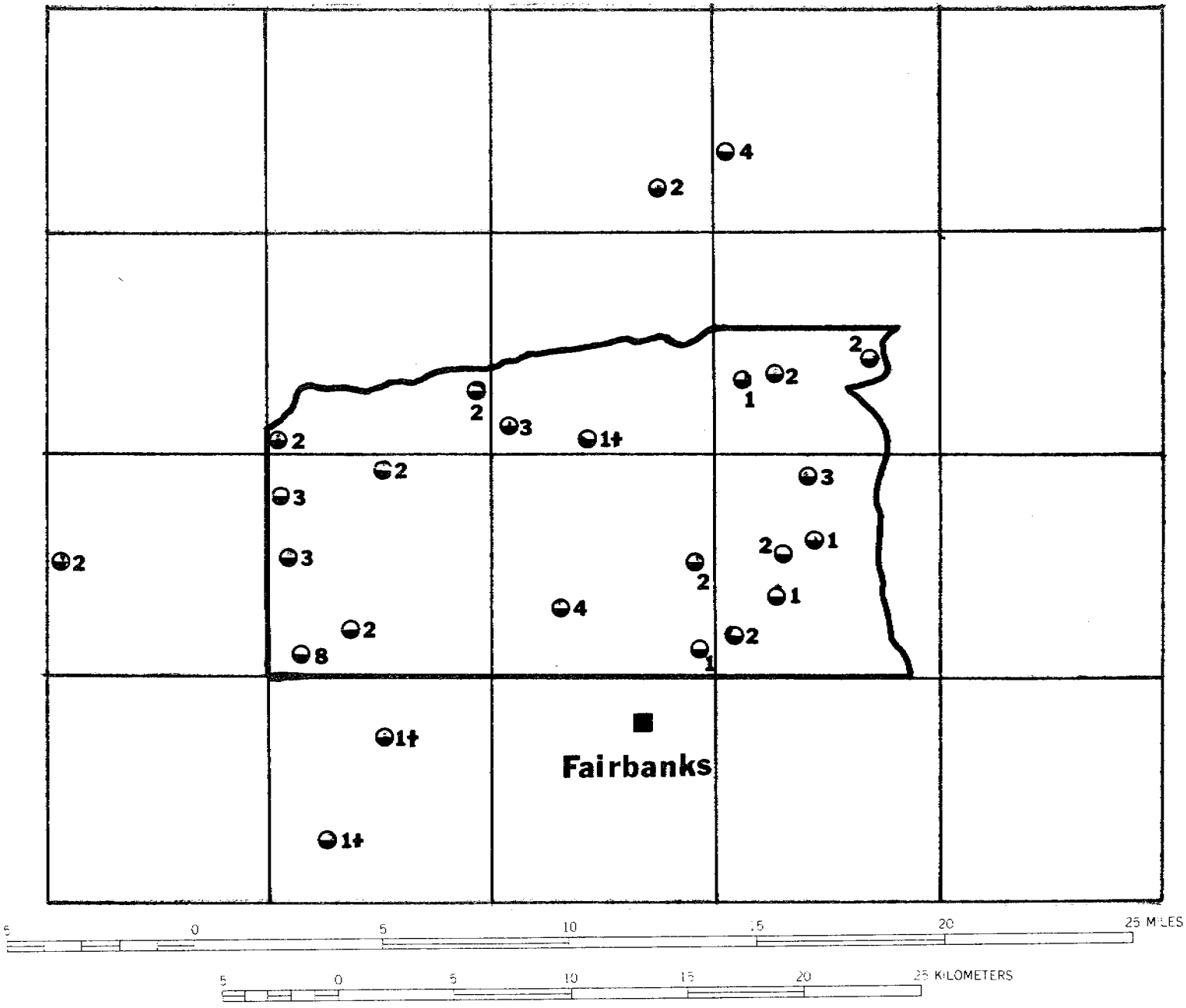
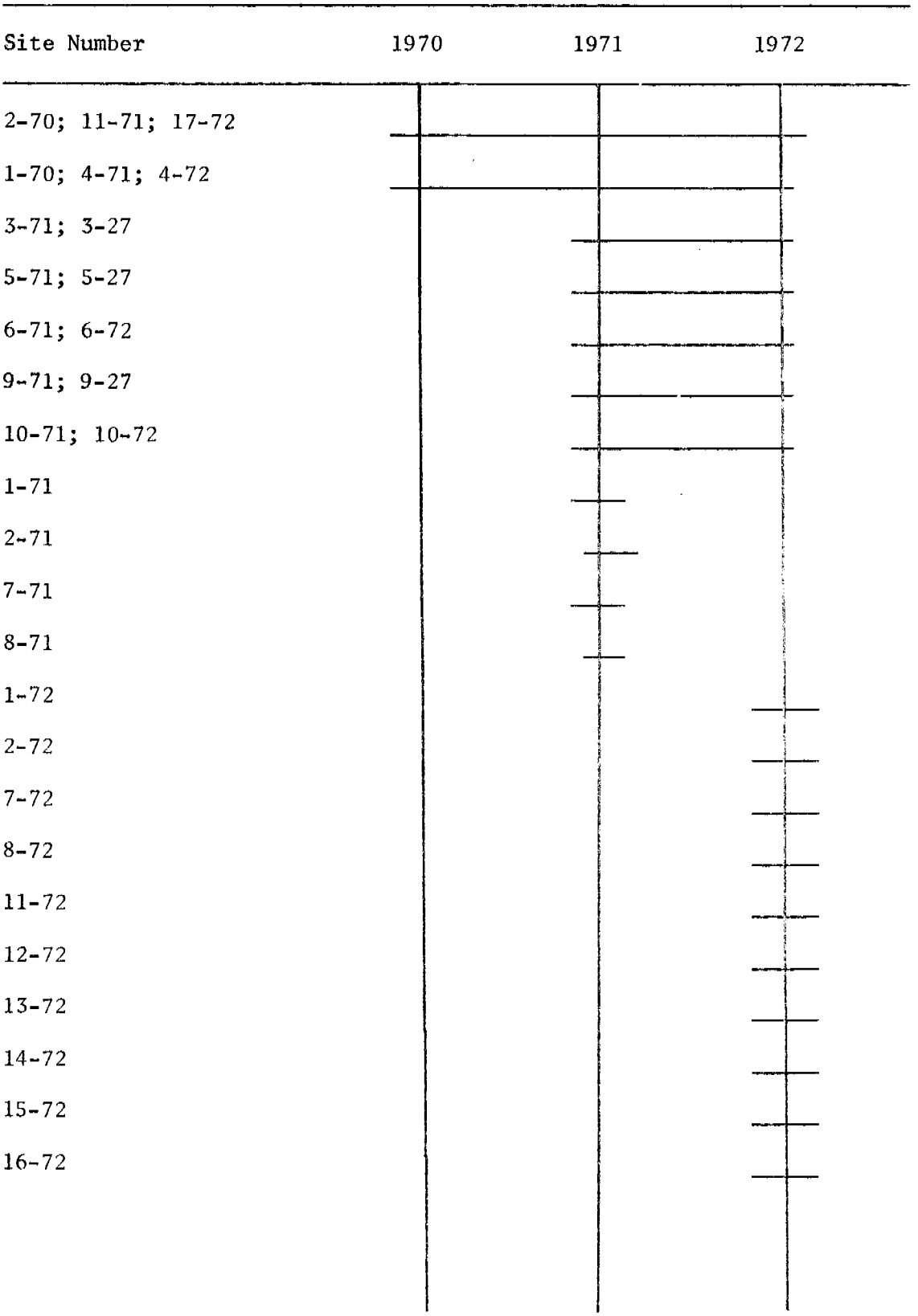


Fig. 2. Potential goshawk nesting sites showing the number of stick nests at each site.

Figure 3. Patterns of use at 21 goshawk nesting sites, 1970-1972.



There is little doubt that goshawks, like most raptors, are highly traditional in nest site selection. They may 1) repeatedly use the same nest, 2) alternate yearly between existing nests or 3) build a new nest in the same area. All of these patterns have been observed in this study. Unfortunately, we have not attempted to mark nesting birds in order to allow identification of specific individuals in relation to specific nest sites. The risk of undue disturbance at the nest is, in my opinion, too great. Consequently, it is not certain whether traditional sites are occupied yearly by either or both members of a pair during the nesting season throughout their lives, or whether such areas are highly preferred and yearly attract birds at random.

Description of Active Nesting Sites

Specific physical and biological data for each of the 16 nests studied in 1972 are presented in Appendix A. Comparable data for other years are presented by McGowan (1971, 1972). Paper birch forests appear to offer preferred nesting situations (Table 1). Seventy-five percent of the active nests studied since 1971 were in woodlands containing significant amounts of paper birch, while aspen was an important species in only 21 percent of the nesting areas. Furthermore, 39 percent of the nests were in pure birch stands, and only 21 percent in homogenous aspen forests. Of the ten instances where goshawks nested in mixed forest situations (birch-aspen and birch-spruce), the nest tree selected was paper birch in all but one case. Of 30 nests studied since 1970, 21 (70 percent) were in birch trees, six (20 percent) in aspen, and three (10 percent) in cottonwood (*Populus balsamifera*).

Mature birch trees may be preferred because of their tendency, unlike aspen, to have several large branches or forks required for nest foundations. The diameter (DBH) of nest trees varied between 7.3" (18.5 cm) and 14.0" (35.6 cm), averaging 11.0" (27.9 cm). The mean DBH for birch nest trees was 11.8" (30.0 cm) while aspen trees averaged smaller (9.0" or 22.9 cm). Sixty-three and 37 percent of the nests were located in the upper or middle portions of trees, respectively; however, there was no significant difference in nest placement with respect to species of nest tree. The height above the ground of nests ranged from 15' (4.5 m) - 50' (15.0 m), averaging 29.3' (8.8 m). The average height of nests did not vary significantly with respect to species of nest tree. Approximate nest size (diameter x depth) averaged 36" x 21" (91.4 cm x 53.3 cm), with no significant differences between nests in the various species of trees. In all cases, eggs were laid in cup-shaped depressions, but as chicks matured, trampling reduced cup depth to a point where the nest resembled a platform.

Since 1970 all but seven of 30 nests studied were situated on hillside situations. Those nests in flat terrain were located along stream courses near the town of Central in the Birch Creek Flats. In this area, timber of suitable size for nesting goshawks is restricted to narrow bands along water courses. In hillside situations 48 percent of the nests occupied the middle portion of the slope, 35 percent were on the lower portion, and 17 on the upper portion. Nest sites ranged in elevation from 650' (195 m) to 1,800' (480 m). Sixty-one percent of the

Table 1. Number of active goshawk nests in various timber types, 1971 and 1972.

Timber Stand Type	1971	1972	Total
Birch	4	7	11
Birch-Aspen	1	5	6
Aspen	4	1	5
Birch-Spruce	1	3	4
Cottonwood-Spruce	1	1	2
Total	11	17	28

nests occupied slopes of southerly exposure, and 39 percent were on northerly slopes.

The majority of nests were lined. Lining materials consisted of deciduous twigs and green leaves, coniferous twigs with needles, and bark. Sometimes only one type of lining was used, while in other cases, several types were used. Lining material was added as the nesting season progressed.

Nesting Chronology

Data reflecting times of territory establishment, breeding, nest building, and egg laying are limited. Few visits were made to nesting areas early in the season in order to minimize chances of desertion. Goshawks have been observed at nest sites as early as April 18. In one case (April 19) when nests still contained several inches of snow, fresh sticks were being added to a nest which later proved to be active. Two other nests in the immediate area showed no signs of use in mid-April. Both in 1971 and 1972 incubation time was estimated at approximately 29 days. This is in general agreement with Craighead and Craighead (1956) and Bent (1937b). In summary, goshawks in interior Alaska are on territories, and associated with a specific nest by mid-April. Egg laying probably occurs during the last week of April, and most clutches are complete and incubation underway by May 5. Cade (1970) found that spring weather affected the onset of reproduction in Alaskan gyrfalcons, consequently these generalizations may not hold true in years when unusual climatic conditions persist. Craighead and Craighead (1956) found that in Wyoming selection of nesting territories occurs in early April and egg laying can start as early as May 6. In interior Alaska nesting activities appear to be initiated earlier than in southern latitudes and more in phase with the nesting schedule observed in northern Norway (69°10'N lat.) (Myrberget, 1970).

Summaries of hatching and fledging dates and number of days chicks were in nests are presented in Table 2. In both years there was one nest hatching unusually late. Whether or not these were cases of renesting is unknown. Despite unusually cool spring temperatures and persistent snow cover in 1972, hatching dates did not differ greatly. A fledged chick was observed at a nest on June 22, 1972. The exact hatching date, in this case, was not determined, however, this is the earliest instance of fledging we have observed. Assuming the chick spent the usual number of days in the nest, hatching would have occurred on approximately May 13. The latest hatching date we have recorded is June 25. These dates probably represent extremes in hatching dates for goshawks during most years in the Interior, with the peak occurring between May 27 and June 5. Exact fledging dates are difficult to determine. Chicks probably frequent the nest and nest tree for at least a week after they have made their first flight. By the third week of July most of the broods will not be found at the nest tree, but they may still be in the general nesting area. Craighead and Craighead (1956) found the period between hatching and fledging to be about one week shorter than indicated in Table 2.

Table 2. Known goshawk hatching dates, fledging dates, and number of days chicks were in nests, 1971 and 1972.

	Hatching		Fledging		Mean No. Days Chicks in Nest (N)
	Range	Mean* (N)	Range	Mean (N)	
1971	May 30 - June 23	June 5 (8)	July 5 - July 28	July 12 (8)	37 (8)
1972	May 25 - June 25	June 2 (12)	June 22 - July 15	July 8 (4)	42 (3)

*Mean hatching date disregarding unusually late nests May 23 (1971) and June 25 (1972).

During visits to nests females openly attacked and often struck observers. Adult females were more aggressive than juveniles. Defense displays consisted of loud calling and numerous low "passes" at intruders. In some cases males joined in defense displays but they usually stayed further away, and rarely struck the observers. In general, nesting birds were far more aggressive after hatching than in earlier stages of the nesting season, and the females remained highly protective for some time after the young had left the nest.

Age of Breeding Birds

All females nesting in 1972 were in adult plumage. In 1971, thirty-six percent of the breeding hens were first-year birds. Males have been observed at only 37 percent of the nests studied, and in all cases they were in adult plumage. This supports the findings of Haukioja and Haukioja (1970) and Hoglund (1964) who found that yearling males rarely bred. Males have never been observed in nesting areas occupied by yearling females.

The significance of the decline in number of yearling females found nesting is unclear. Interpretation of age ratio changes among nesting goshawks must await assessment of potential bias of field techniques plus knowledge concerning fidelity of specific individuals to specific nest sites and relative success in competition for nest sites between age groups.

Breeding Density

Seventeen active goshawk nests were located in 1972. The distribution of 13 active nests located on or near the study area in 1972 is shown in Fig. 4. Nine of the nests were on the study area for a minimal known density of one nesting pair per 16.0 mi^2 (41.5 km^2). Minimal nesting density recorded in 1971 was slightly lower, one pair per 18.8 mi^2 (48.6 km^2). It is not known that all active nests on the study area were located; hence, actual nesting densities may have been greater in both years. Active nests were located 1.5 miles (2.4 km) apart in 1971 and 1.9 miles (3.1 km) apart in 1972, further evidence that under certain conditions relatively high nesting densities can be attained. In Finland density of one pair of goshawks per approximately six mi^2 (15 km^2) has been recorded (Hakala, 1969).

Production

Clutch size, hatching success and fledging success for nests studied in 1972 are summarized in Table 3. In 1971, 11 clutches averaged 3.1 eggs, and 82 percent of the nests started were successful. Among successful nests, 96 percent of the eggs hatched, and 100 percent of the young survived through fledging age. Consequently, 11 nests contributed 27 young (mean 2.4 per nest started) to the fall population (Table 4). In 1972, 16 clutches averaged 2.9 eggs, and only 75 percent of the nests started produced chicks. Among nests producing young, hatching success was 79 percent, and 88 percent of the chicks survived through fledging age. In 1972, 13 nests, where full production data were obtained, added

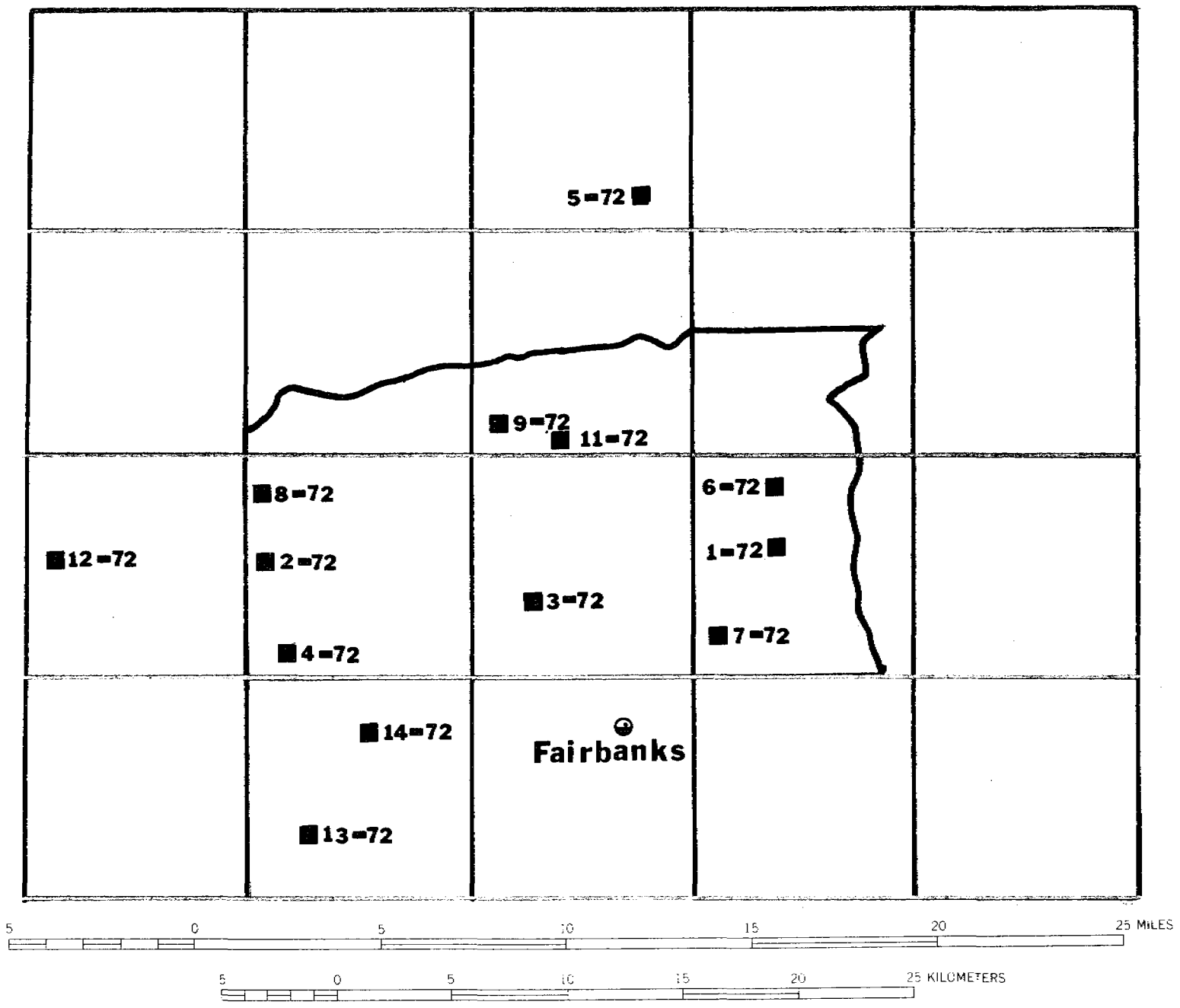


Fig. 4. Active goshawk nests, 1972.

Table 3. Goshawk clutch size, hatching success, and fledging success for 15 goshawk nests, 1972.

Nest No.	Clutch Size	Number of Eggs Hatched	Number of Chicks Fledged*
1-72	3	0	0
2-72	3	2	-
3-72	4	4	2
4-72	4	3	3
5-72	2	2	2
6-72	4	4	4
7-72	3	3	3
8-72	3	2	2
9-72	3	1	0
10-72	3	0	0
11-72	3	2	2
12-72	2	1	-
13-72	3	3	-
14-72	3	3	3
15-72	3	0	0
16-72	1	0	0
Total	47	30	21
Mean	2.9	1.9	1.6**

* Absence of dead chicks in nest or general nest vicinity was assumed to indicate absence of pre-fledging mortality.

**Mean computed for 13 nests where fledging data were obtained.

Table 4. Goshawk production data 1971 and 1972.

Year	Clutch Size Range	Clutch Size Mean (n)	Percent of Nests Successful	Percent Hatching Success	Percent Chick Survival	Mean Production Per Nest Started
1971	1-4	3.1 (11)	82	96	100	2.4
1972	1-4	2.9 (16)	75	79	88	1.6

21 young (mean 1.6 per nest started) to the fall population (Table 4). Assuming no summer mortality of nesting hawks, the summer gain was 2.2 and 1.8 for 1971 and 1972, respectively.

Cause for production failures in 1971 were desertion or death of the female in two cases (both first-year breeders), and failure of one egg to hatch. In 1972 nesting failure prior to hatching coupled with decreases in both hatching success and chick survival were responsible for lower productivity. The slight decrease in clutch size is not considered a significant factor contributing to relatively low reproductive success in 1972. In three cases, visits to nests at the estimated hatching time revealed no adults nor eggs. The nests showed no signs of disturbance, and the cause of such failures remains unknown. The possibility that the adults ate the eggs should be mentioned, though there was no evidence this occurred. Eating of eggs and desertion has been recorded for other species of raptors, and is associated with birds carrying high levels of pesticide residues. A nest observed to have one small chick on June 23, was later found to have neither chick nor adult, and no signs of disturbance were detected. Frounce (*Trichomonas* sp.) was responsible for the death of two chicks, while two others from the same nest survived to leave the nest in an apparently healthy condition. Eggs that do not hatch are apparently removed from the nest by the adults, and as a result, we rarely determine whether or not hatching failures were due to infertility. Most of the decimating factors recorded in 1972 were not apparent the previous year. Production in 1971 was unusually high, and 1972 data may more nearly reflect the rate of production in most years.

Data on goshawk production from other regions are scarce. Hakala (1969) found an average of 3.4 eggs per nest (n=22) in Finland, and 1.5 fledged young per nesting pair. In the same country, earlier findings by Hoglund (1964) showed clutches to average 3.5 with 2.7 juveniles fledged per nest. While clutch sizes for Alaskan goshawks have been lower and more variable, production rates have been within the range recorded in Finland. These limited data suggest that chick survival may be higher in Alaska than Finland during some years.

The abundance and production of numerous species of raptors has been related to prey abundance. This has been shown to be true for Finnish goshawks (Sulkava, 1964). Lowered production of Alaskan goshawks in 1972 cannot, at this time, be explained by drastic fluctuations in prey abundance. It should be mentioned, however, that snowshoe hares, which have been the major prey species, occurred at moderate but decreasing densities throughout the study. Grouse numbers have been low in both years, however, no information on red squirrel (*Tamiasciurus hudsonicus*) and passerine abundance is available. Goshawk production should be monitored until hare populations reach a low. Hare populations in interior Alaska are expected to decline further during the next few years, and this coupled with a concurrent low in grouse numbers provides an excellent opportunity to investigate goshawk production in relation to prey abundance.

Fall Abundance

Goshawks handled in 1972 are listed in Appendix B. With the exception of 24 chicks banded as nestlings, all hawks were captured in Swedish goshawk traps. Intensive trapping occurred between October and mid-December, and during this period 364 trap days yielded 12 different individuals (one capture/30 trap days). Trapping success for the same period in 1971 was considerably higher (one capture/9 trap days). Trapping success in 1972 was highest in October (one capture/16 trap days). One capture per 55 trap days was recorded for both November and December and the most successful trap site averaged a capture every 13 trap days. In 1972 traps were purposely left at two sites regardless of their success in order to obtain comparable information. In one case success was greater than in 1971 and above the overall 1972 average, but the reverse was true at the other sites. These findings, plus the observed inefficiency of the Swedish goshawk trap, pose problems in using only captures per unit of trapping effort as an index of abundance.

Age and sex information for birds trapped in 1971 and 1972 are presented in Table 5. In 1971 the overall sex ratio of captured goshawks was 50:50, however, in 1972 only 18 percent of the birds captured were males. The low proportion of males captured in 1972 may simply reflect small sample size. The juvenile to adult (Ad I and II) ratio in 1972 (1.0:1.0) was much lower than that for the comparable trapping period in 1971 (4.8:1.0). Juvenile goshawks are more mobile, and possibly less trap wary, than adults, consequently, juveniles are more apt to be captured than birds of older age classes. Nevertheless, the relatively low proportion of juveniles captured in 1972 suggests a significant decline in production from 1971. No absolute figures of fall abundance are available, but the observed reproductive success and age ratios of captured hawks indicate fewer goshawks on the study area in the autumn of 1972 than the previous fall. This decrease may have been in the neighborhood of 30 percent.

Of 124 goshawks banded since 1970, only 10 (8 percent) have yielded return information. This low recovery rate precludes population estimates based on band returns. While fall trapping is essential for collecting morphological and other data, its value in population enumeration is seriously questioned. Nevertheless, age ratio data from trapped birds supplement those from production studies, hence they aid assessment of relative abundance. Fall trapping should be continued as long as productivity data are collected in order to evaluate trapping as a technique for monitoring population trends.

Movements

The overall return of 108 goshawks banded prior to the 1972 trapping season was 9 percent. Goshawks banded as adults showed the highest return (23 percent), while birds banded as nestlings or juveniles in their first fall of life yielded a 7 percent return. The average distance moved for five juvenile goshawks was 12.0 miles (19.3 km), while that for 10 adults averaged only 1.8 miles (2.9 km). These findings suggest higher fall mobility among juveniles than older goshawks, and

Table 5. Summary of goshawk trapping data, 1971 and 1972.

Age Class	1971		1972*		Total
	Male	Female	Male	Female	
Juvenile	20	23	2	4	49
Adult I	7	2	0	4	13
Adult II	1	3	0	1	5
Total	28	28	2	9	67

*One additional bird in adult plumage but of unknown age or sex captured in 1972 but not included in this compilation.

agree with the findings of Haukioja and Haukioja (1970) and Mueller and Berger (1967). Data available are insufficient to test differences in mobility between sexes.

Several instances of three or more recaptures at the same location during different seasons have been recorded for adults. One male goshawk banded as an adult in 1967 was subsequently captured in the same area three times (April 1971, July 1971, and February 1973). This bird was at least 7 years of age in 1973, and definitely a local resident. Multiple recaptures have not occurred among juveniles with one exception. In one instance a female banded as a nestling in 1971 was captured in September 1972 as an adult I, 13.5 miles (21.7 km) from the nest. This bird was later captured twice during the winter of 1972, and had probably taken up residence (at least during winter) in the vicinity of the trap site. The majority of adults probably winter in the vicinity of their nesting territory, while juveniles are thought to wander significantly during their first fall and winter. Therefore, fall trapping probably samples from: 1) the resident adult population, and 2) a highly mobile population of juveniles that have not yet settled on territories.

Food Habits

Castings (regurgitated pellets) were collected at successful nests in 1971 and 1972. Fewer castings were found at nests in 1972, probably because of lowered chick production that year. Collections from each nest were considered a single sampling unit. The frequencies of various food items are summarized in Table 6. During the nesting season snowshoe hares composed the major food of goshawks in both years. Red squirrels and birds, probably passerines in most cases, were also taken commonly. Nesting goshawks have been observed to take nestling robins (*Turdus migratorius*) and microtines. A large proportion of the hares taken during the summer are probably young animals. In 1971 hares gave birth to their young first litters just prior to the goshawk nesting period, and second litters were born a few days before the majority of chicks fledged.

It is of interest that few grouse remains have occurred in castings in view of findings from Norway where grouse comprise the major food item (Hoglund, 1964). Grouse populations have been low throughout the study, and while snowshoe hares have been abundant, the population declined moderately between 1971 and 1972 (Ernest, in press). Food habits of goshawks in Finland vary widely with respect to prey abundance (Sulkava, 1964). Grouse may assume higher importance as a food in Alaska during other years. Red squirrels were found to be an important food source for nesting goshawks in the northeastern United States (Meng, 1959), and this may be especially true in Alaska during years of simultaneous lows in grouse and hare populations.

Miscellaneous Activities

Morphological data were collected from all hawks banded, and from dead goshawks brought into the office by fur trappers. Carcasses of the latter were donated to the University of Alaska for parasite and

Table 6. Food item frequencies for castings analyzed from goshawk nests, 1971 and 1972.

Food Items	Frequencies		
	1971*	1972*	1971-72
Snowshoe hare	100	100	100
Unidentified feathers	100	67	83
Red squirrel	67	44	56
Rodents	0	33	33
Passerines	44	22	33
Grouse	33	11	22
Mammals	100	100	100
Birds	100	89	95

*Castings collected from nine nests in both 1971 and 1972.

pesticide studies. A summary of morphological and parasite data will appear in a later report.

A radio transmitter was placed on an adult female goshawk in February, 1973 by Dr. J. Schnell and Terrence Bendock of the University of Alaska. The bird will be located every 24 hours as long as the transmitter is functional. A summary of these findings will also appear in a future report.

ACKNOWLEDGMENTS

Phil Connor, Division of Wildlife Protection and Rudd Thabes, Game Division, were pilots during aerial surveys. Terrence Bendock, working as a Game Technician, assisted in nesting studies. Mr. and Mrs. Robert Larson, Mrs. Lawrence Mayo, and Mr. Roger Bolstad aided in trapping operations. Other members of the Department contributing to the study were K. Alt, R. Bishop, J. Burns, W. Heimer, S. Linderman, D. Simpson, A. Smith, and M. Vierthaler.

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Appendix A. Data collected at 16 goshawk sites, 1972.

Nest No.	Nest Size* cm. (in.)	Ht. of Nest Above Ground m. (ft.)	Position in Tree	Species of Nest Tree	DBH of Nest Tree cm. (in.)	Timber Type	Position on Slope	Aspect of Slope	Elevation of Nest Site m. (ft.)	No. of Other Stick Nests Nearby	Plumage of Adults
1-72	76x40 (30x16)	9.0 (30)	Mid 1/3	Birch	33 (13)	Birch-Aspen	Mid 1/3	S.E.	334 (1,100)	1	- ♂ Ad ♀
2-72	117x76 (41x30)	13.5 (45)	Upper 1/3	Birch	25 (10)	Birch-Spruce	Lower 1/3	N.E.	258 (850)	2	- ♂ Ad ♀
3-72	112x30 (44x12)	13.2 (44)	Upper 1/3	Birch	48 (19)	Birch	Mid 1/3	N.E.	258 (850)	3	Ad ♂ Ad ♀
4-72	102x38 (40x15)	6.6 (22)	Mid 1/3	Birch	36 (14)	Birch	Mid 1/3.	N.E.	383 (1,260)	7	Ad ♂ Ad ♀
5-72	76x46 (30x18)	67.5 (25)	Mid 1/3	Aspen	23 (9)	Aspen	Mid 1/3	S.W.	304 (1,000)	1	- ♂ Ad ♀
6-72	99x46 (38x18)	10.5 (35)	Upper 1/3	Aspen	25 (10)	Birch-Aspen	Upper 1/3	S.	350 (1,150)	2	Ad ♂ Ad ♀
7-72	122x46 (48x18)	7.5 (25)	Upper 1/3	Birch	23 (9)	Birch	Mid 1/3	N.W.	249 (820)	1	Ad ♂ Ad ♀
8-72	116x46 (46x18)	12.0 (40)	Upper 1/3	Birch	36 (14)	Aspen-Birch	Lower 1/3	S.E.	304 (1,000)	2	- ♂ Ad ♀
9-72	46x30 (18x12)	10.5 (35)	Upper 1/3	Birch	36 (14)	Aspen-Birch	Lower 1/3	S.W.	304 (1,000)	2	Ad ♂ Ad ♀
10-72	91x71 (36x28)	4.5 (15)	Mid 1/3	Birch	18 (7)	Birch-Spruce	Flat	Flat	292 (960)	1	- ♂ Ad ♀

Appendix A. Continued.

Nest No.	Nest Size* cm. (in.)	Ht. of Nest Above Ground m. (ft.)	Position in Tree	Species of Nest Tree	DBH of Nest Tree cm. (in.)	Timber Type	Position on Slope	Aspect of Slope	Elevation of Nest Site m. (ft.)	No. of Other Stick Nests Nearby	Plumage of Adults
11-72	102x38 (40x15)	7.5 (25)	Mid 1/3	Birch	33 (13)	Birch-Aspen	Mid 1/3	S.	255 (840)	-	♂ - ♀ Ad
12-72	102x46 (40x18)	9.0 (30)	Upper 1/3	Birch	28 (11)	Birch	Lower 1/3	S.W.	274 (900)	1	♂ - ♀ Ad
13-72	102x30 (40x12)	9.0 (30)	Upper 1/3	Birch	36 (14)	Birch	Upper 1/3	N.E.	292 (960)	-	♂ Ad ♀ Ad
14-72	102x41 (40x16)	7.5 (25)	Mid 1/3	Birch	25 (10)	Birch	Upper 1/3	S.E.	195 (640)	-	♂ - ♀ Ad
15-72	102x102 (40x40)	9.0 (30)	Upper 1/3	Birch	23 (9)	Birch-Spruce	Flat	Flat	334 (1,100)	-	♂ - ♀ Ad
16-72	76x76 (30x30)	9.0 (30)	Mid 1/3	Birch	25 (10)	Birch	Flat	Flat	274 (900)	2	♂ - ♀ Ad

*Nest Size = diameter x depth.

Appendix B. Goshawks handled in 1972, interior Alaska.

Band #	Color Band	Date	Location	Sex	Plumage
877-10083	Blue Rt. #1	6-15-72	St. Pat. Cr.	-	Downy Chick
877-10084	Blue Rt. #2	6-15-72	St. Pat. Cr.	-	Downy Chick
877-10085	Blue Rt. #3	6-15-72	St. Pat. Cr.	-	Downy Chick
877-10086	Blue Rt. #4	6-16-72	Isabella Cr.	-	Downy Chick
877-10087	Blue Rt. #5	6-16-72	Isabella Cr.	-	Downy Chick
877-10088	Blue Rt. #6	6-16-72	Isabella Cr.	-	Downy Chick
877-10089	Blue Rt. #7	6-19-72	Grenac Rd.	-	Downy Chick
877-10090	Blue Rt. #8	6-19-72	Grenac Rd.	-	Downy Chick
877-10091	Blue Rt. #9	6-19-72	Goldstream Cr.	-	Downy Chick
877-10092	Blue Rt. #10	6-19-72	Goldstream Cr.	-	Downy Chick
877-10093	Blue Rt. #11	6-20-72	Goldstream Cr.	-	Downy Chick
877-10094	Blue Rt. #12	6-20-72	Goldstream Cr.	-	Downy Chick
877-10095	Blue Rt. #13	6-21-72	Vault Cr.	-	Downy Chick
877-10096	Blue Rt. #14	6-21-72	Vault Cr.	-	Downy Chick
877-10097	Blue Rt. #15	6-21-72	Engineer Cr.	-	Downy Chick
877-10098	Blue Rt. #16	6-21-72	Engineer Cr.	-	Downy Chick
877-10099	Blue Rt. #17	6-21-72	Engineer Cr.	-	Downy Chick
877-10100	Blue Rt. #18	6-21-72	Engineer Cr.	-	Downy Chick
877-14201	Blue Rt. #19	6-22-72	Goldstream Cr.	-	Downy Chick
877-14202	Blue Rt. #20	6-22-72	Goldstream Cr.	-	Downy Chick
877-14203	Blue Rt. #21	6-22-72	Cripple Cr.	-	Downy Chick
877-14204	Blue Rt. #22	6-22-72	Cripple Cr.	-	Downy Chick
877-14205	Blue Rt. #23	6-22-72	Cripple Cr.	-	Downy Chick
877-14207	Blue Rt.	6-23-72	Goldstream Cr.	-	Downy Chick

Appendix B. Continued.

Band #	Color Band	Date	Location	Sex	Plumage
Not banded	-	10-4-72	Yankovich Rd.	♀	Ad I
877-14206	None	10-8-72	French Gulch	♀	Ad I
*877-10010	None	10-9-72	Yankovich Rd.	♀	Ad I
877-14208	None	10-11-72	O'Connor Cr.	♀	Ad I
877-14209	None	10-14-72	Gilmore Tr.	♂	Juvenile
Not banded	-	10-15-72	O'Connor Cr.	♂	Juvenile
877-14210	None	10-17-72	O'Connor Cr.	♀	Juvenile
877-14211	None	10-21-72	O'Connor Cr.	♀	Juvenile
Not banded	-	10-22-72	Goldstream Cr.	-	Ad ?
877-14212	None	11-5-72	Gilmore Tr.	♀	Juvenile
877-14213	None	11-9-72	Goldstream Cr.	♀	Juvenile
877-14214	None	11-16-72	Goldstream Cr.	♀	Ad II
*877-10010	None	12-7-72	Goldstream Cr.	♀	Ad I

*Bird originally banded as nestling in 1971.