KETCHIKAN FOREST RAPTOR STUDY
FINAL REPORT

A SUMMARY OF SURVEY, RADIO-TELEMETRY, AND OTHER RESULTS REGARDING GOSHAWK FIELD STUDIES IN SOUTHEAST ALASKA

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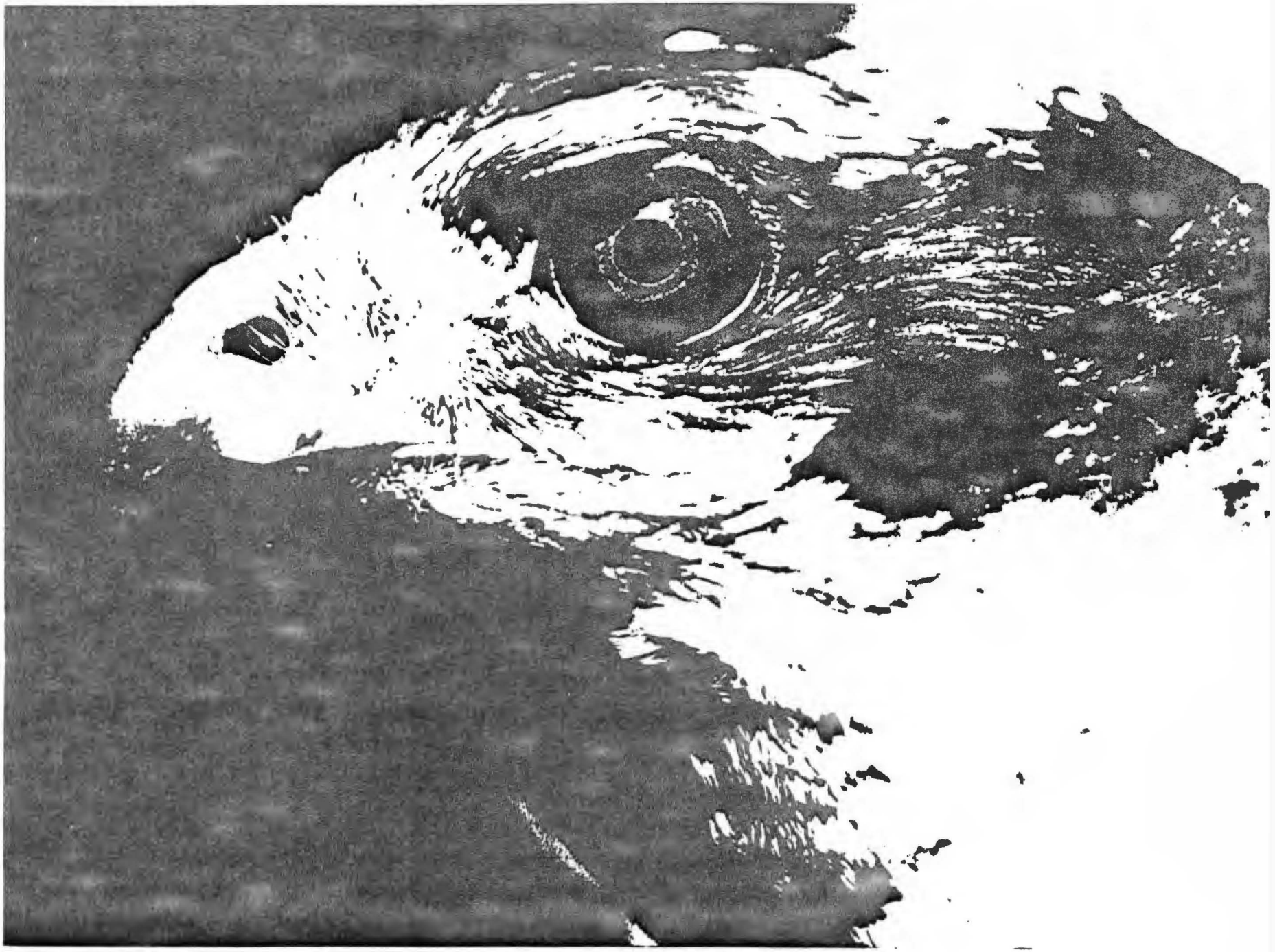

Adult Male Goshawk, Douglas Island, July 2, 1992. Photo by Craig Flatten.

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Abstract: During 1991 and 1992 studies were initiated in Southeast Alaska to locate and inventory goshawks (*Accipiter gentilis*) and assess their habitat associations on the Tongass National Forest (ADF&G 1992). Sampling through the use of acoustical luring was conducted to increase goshawk detecitons and locate nests. Although goshawks were observed in 11 different general locations during the period of courtship to juvenile dispersal, observations in seven of these locations were aided by previously documented goshawk activity. Only one confirmed active nest site and one probable nesting stand were located as a result of two summers of field surveys utilizing acoustical luring through the broadcast of conspecific calls. A total of 10 goshawks, four adults and six juveniles, were captured. Seven of ten captured goshawks were fitted with radio transmitters to determine home ranges, juvenile dispersal, survival rates, winter residency, and habitat use.

A total of 51 adult male and 45 adult female independent telemetry relocations were collected from a pair of goshawks which nested on Prince of Wales Island (POWI). A preliminary analysis of telemetry data from this adult pair of goshawks was accomplished using the Forest Service geographical information system (GIS). The combined minimum convex polygon nesting home range of the adult male and female was 101,596 ac. (158.7 mi^2), of which 50,798 ac (79.4 mi^2) was land. The combined minimum convex polygon total home range of the adult male and female was 390,042 ac (609.4 mi^2), of which 195,021 ac. (304.7 mi^2) was land. The male's and female's home ranges contained relatively little overlap during all periods, and the amount of overlap was 4.4% and 5.9% for the nesting and total home ranges, respectively.

A preliminary Forest Service-Ketchikan Area GIS analysis of forest volume class use vs. availability showed that the POWI adult goshawks selected mature forests of greater than 8,000 board feet/acre and avoided unforested habitat and forest stands of less than 8,000 board feet/acre.

At the Douglas Island site, a total of 13 adult male and 12 adult female relocations were collected. A total of 5 post-dispersal relocations were collected for the single juvenile.

None of the 3 goshawks (2 adults and 1 juvenile) successfully tracked through the fall and winter migrated from Southeast Alaska. The maximum distance any of these radio-tagged goshawks were relocated from its nest site was approximately 34 miles (54 km), indicating regional year-round residency. The one juvenile goshawk successfully tracked after dispersing from the Douglas Island nest site was found dead 9 miles (14 km) from the nest on March 26, 1993. The two radio-tagged POWI juveniles could not be relocated following their presumed dispersal from the nest site.

Prey remains at nest sites were also collected and identified.

INTRODUCTION

For approximately 100 years ornithologists have recognized the presence of northern goshawks (*Accipter gentilis*, hereafter goshawks) in southeastern Alaska, and have long suspected the occurrence of a breeding population. The earliest recorded indications of summertime goshawk residency are from specimens collected from Baranof Island on August 5, 1896, and August 25, 1907 (Webster 1988). What was probably a family group consisting of an adult pair and three fledged juveniles was recorded on August 12, 1944 (Gabrielson and Lincoln 1959). It was not until 1990, however, that biologists began a concerted effort to learn more. This resulted in recent documentation of both past and present nesting activities, the collection of prey-item remains at nest sites, the acquisition of home range data from several radio-tagged goshawks, and the identification of a sample of habitat associations utilized by goshawks in Southeast Alaska.

Goshawk nomenclature in Southeast Alaska was discussed and established by several authors, and has received no recent study. The Queen Charlotte goshawk (*Accipiter gentilis laingi*) was originally described by Taverner (1940) as a mostly non-migratory subspecies found along coastal British Columbia. The type-specimen was collected from the Queen Charlotte Islands, located ~30 miles across Dixon Entrance from southeastern Alaska. The American Ornithologists' Union adopted Taverner's classification in 1957 (AOU 1957). Following the examination of goshawk specimens collected in Southeast Alaska, Webster (1988) wrote that the range of *Accipiter gentilis laingi* extended north from the Queen Charlotte Islands as far as Baranof Island and Taku Inlet. The U.S. Department of Interior's Habitat Management Series for Unique or Endangered Species Report No. 17 (Jones 1981) also recognizes *Accipiter gentilis laingi* as a distinct subspecies, but shows its range extending north to Prince William Sound. Palmer (1988) suggests that a redefinition of *laingi* might include more size variation and greater sexual size-dimorphism than so far reported. Beebe (1974) indicates that the goshawks on Vancouver Island may be different from both the *laingi* and *atricapillus* subspecies, and could be an undescribed subspecies. Additionally, Beebe's (1974) physical description of *A. g. laingi* emphasizes that in the adults of this subspecies; 1) the black of the head extends nearly to the mid-point of the back before lightening to a dark leaden grey, and 2) the close barring of the underside is darker and coarser than that of continental birds, with the shaftline marks wider and black, not grey.

STUDY AREA, GOALS AND OBJECTIVES

The study area, objectives, and goals were originally defined and described in detail in the study plan, which was finalized in April, 1992 (ADF&G 1992). In addition to pre-sale inventories, the intent of this study was to begin to assemble the ecological information necessary to gain a better understanding of goshawks in Southeast Alaska. This enhances agency management capabilities

pursuant to directives such as the National Forest Management Act of 1976. Goshawk populations are thought to be effected by forest management practices, and they are often associated with mature forests in the Pacific northwest (Reynolds (1989).

The study was initially limited to the Ketchikan area of the Tongass National Forest during the 1991 field season. It was later expanded by the Forest Service to include other parts of the Tongass as well. In addition to the Forest Service's intent to increase the scope of inventory work, it also became a priority to collect basic biological data at active goshawk nest sites as new opportunities became available throughout Southeast Alaska.

As little local quantitative information regarding goshawks was available in 1990, the scope, goals and objectives of this study were broad. Goshawks appear to be rare or uncommon in the Tongass National Forest (Crocker-Bedford 1990, 1992), and are especially difficult to inventory or study in the rugged terrain of Southeast Alaska. Agency staff recognized that the study would need to be extended to better evaluate habitat use and spatial distribution of this species as specified in the following goals and objectives:

Goals

- Provide goshawk survey results in timber sale assessment areas.
- Determine goshawk habitat associations on selected portions of the Tongass National Forest.
- Prepare management recommendations for maintaining healthy goshawk populations on the Tongass National Forest.

Objectives

- Develop and evaluate goshawk survey methods that are applicable in the coastal rainforest of Southeast Alaska.
- Survey for detecting goshawks in relation to landscape habitat features and land cover types.
- Determine home range, patch size, and habitat associations of the goshawk.
- Determine short-term dispersal distances and survival rates of juvenile goshawks.
- Assist with the coordination and development of raptor survey methods on the Tongass National Forest.

METHODS

Two approaches were taken during this portion of the study to meet the intended objectives. The first approach involved sampling to detect individual goshawks and nesting areas with an intent for eventually improving the design, testing, and implementation of surveys for enhancing goshawk detections. The second approach involved determining home ranges and habitat associations of goshawks based upon radio-telemetry relocation data. Forest raptor studies are difficult to conduct (Fuller and Mosher 1987), and it was also our desire to qualitatively evaluate methods that could be applied to the field conditions existing in Southeast Alaska.

A variety of field and analytical methods were used. The most pertinent methods were described in detail in the other reports submitted for this project; the 1991 Progress Report (ADF&G 1991), the 1992 field season Progress Report (ADF&G 1993b), and the radio-telemetry Progress Report (ADF&G 1993a).

Goshawk surveys were conducted in a variety of forested landscapes, including unmanaged old growth stands in wilderness areas and managed forest lands representative of the various stages of seral development (ADF&G 1991 and 1993b). While some sampling occurred in Congressionally designated Wilderness Areas and other landscapes without timber harvest plans, most sampling and inventory work occurred within lands that may be harvested in the future. The initial emphasis was to sample timber sale assessment areas. This accommodated the Forest Service's objective of considering the potential effects of timber harvests on forest raptors for the purpose of including this information in several environmental planning documents. A relevant aspect of this study involves comparing reproductive success, movements, and habitat use patterns before and after timber harvest. If goshawks are also studied in timber harvested and non-harvested landscapes, both temporal and spatial considerations are addressed in terms of an optimal environmental design (Green 1979). Although it may be several years before such comparisons can be made, these types of field data are important for appropriate forest planning and management. The following jobs were assigned by the original study plan (ADF&G 1992) in its discussion of methods. Each job was designed to assist with project goals and meet a specific objective(s):

- Survey for the presence of goshawks in relation to landscape habitat features and land cover types.
- Develop and evaluate raptor survey methods that are applicable in the coastal rainforests of Southeast Alaska.
- Analyze habitat and cover types associated with previous nesting areas and sightings of goshawks.
- Capture and radio-tag goshawks.
- Determine home range, patch size, and habitat associations of goshawks.

- Determine short-term dispersal distances and survival rates of juvenile goshawks.

- Coordinate and advise on raptor inventories and habitat management.

- Analyze data, prepare annual and final reports, prepare and publish semi-technical and technical articles/reports.

As previously mentioned, a more detailed explanation of the specific methods applicable to each of these jobs is available in the previous citations applicable to this study.

RESULTS AND DISCUSSION

Observations of Goshawks as a Result of Surveys

1991 Field Season:

The use of broadcast tape-recorded goshawk food-begging vocalizations during the 1991 field season showed some promise as a survey or sampling technique for locating goshawks in Southeast Alaska. The broadcast of tape-recorded goshawk alarm calls also elicited some response, but was thought to be less effective than the use of food begging calls played between late-June to mid or late-August.

During approximately 112 person-days in the field, goshawk sightings were documented in only four separate locations over a land base of about 72,950 acres [(114 mi^2), Table 1]. All four sighting locations were places where confirmed goshawk sightings had previously been reported in the past by individuals not associated with this project. Approximately 57.5 person-days of surveys were conducted in locales where goshawks had previously been observed. Surveys in these areas resulted in a total of seven sightings over the 36,150 acres (56.5 mi^2) surveyed. Four of the seven sightings, however, occurred in the same location. One inactive nest site was also found within approximately one mile of the location of the multiple goshawk sightings.

In other locales, where goshawks were not known to have been previously reported, 54.5 person-days of surveys were conducted on approximately 36,800 acres (57.5 mi^2) of what was potentially suitable habitat. No goshawks were detected in these areas, and no nests were discovered.

Timber sales are currently planned in three of the four areas where goshawk sightings were documented in 1991. The fourth sighting, an adult female observed on July 24, occurred within a drainage system protected from timber harvest.

Radio transmitters, necessary for initiating home range and habitat use studies, were not received until after the juvenile goshawks had already dispersed at the end of the 1991 field season.

Consequently, this aspect of the project was not started until 1992. A complete description of the 1991 field activities is provided in the "Ketchikan Area Raptor Survey 1991 Progress Report" (ADF&G 1991).

1992 Field Season:

Between March 1, and August 31, 1992, a total of 139,730 acres were sampled for goshawks utilizing a variety of goshawk survey techniques with varying levels of intensity:

- The broadcast of tape-recorded conspecific calls during foot, vehicle, and boat surveys.

- Observations from vantage points overlooking forested habitat, and during vehicle travel on roads.

- Searches conducted on foot in forested areas.

Using the above techniques approximately 123,090 acres were sampled in the Ketchikan area and 16,640 acres in the Stikine area. A total of 1300 person-hours were accumulated in this effort (Table 2). Additionally, ADF&G staff visited two active goshawk nest sites in the Juneau area where no survey activities were conducted. ADF&G survey efforts in 1992 resulted in a total of 15 independent goshawk detections, including 12 confirmed goshawk detections and three probable detections. Of the 15 total detections, six were responses to conspecific calls and nine were sightings during observation periods. Detailed information about these detections was presented in the 1992 Progress Report for this study (ADF&G 1993b). One primary objective was to locate nests where goshawks could be captured, so surveys were not conducted using a systematic pattern of randomly selected habitats.

Of the 12 confirmed goshawk detections (four responses and eight observations), eight were at places where confirmed goshawk sightings had been reported in previous years, and four were detections at locations without previously documented goshawk activity. Thus, only four sightings or responses in 1992 were the direct result of searches not aided by previously documented goshawk activity. These detections were made at three locations: Sarkar Lakes on Prince of Wales Island, Anita Bay on Etolin Island, and Falls Creek on Mitkof Island.

A total of four confirmed active nests and one probable active nest area were identified in Southeast Alaska in 1992. One confirmed active nest on Prince of Wales Island and one probable nest site on Mitkof Island were located as a direct result of ADF&G's 1992 survey efforts. The three other confirmed active nest sites in Southeast Alaska were visited by ADF&G staff during the 1992 field season; one on Douglas Island, one on the Juneau area mainland, and one on Kupreanof Island. Two of these nests were located and reported in 1992 by Forest Service biologists; one was discovered during timber sale lay-out and the other during off-duty recreational pursuits.

ADF&G biologists completed the 1992 field season with a total of 10 separate localities with confirmed goshawk observations (Table 3). Eight of these localities are either currently scheduled for logging or have the potential to be scheduled at some future date. Two of the localities with confirmed observations occur in areas protected from timber harvest.

Acoustical Luring Chronology:

Although acoustical luring utilizing broadcast conspecific vocalizations is perhaps the most promising technique currently available for locating individual birds, its limitations should be recognized. Acoustical luring is very labor intensive and only a few detections may occur during an entire field season (e.g., Devaul 1990). To be most effective, this technique should be systemically applied along survey transects that are separated by a distance of only 260 m. (Kennedy and Stahlecker 1993). During a study conducted by the Pacific Northwest Forestry Sciences Lab of Olympia, Wa., in a similar type of habitat in western Washington in 1987, only two responses were obtained during surveys conducted by four full-time raptor specialists that sampled 1,153 randomly selected points (Table 4, Flatten and Swingle 1989). The timing of surveys, type of call broadcast, and distance calls are broadcast from an active nest are also critical factors (Kennedy and Stahlecker 1993). This is evidenced by the fact that of 11 sampling attempts with playback recordings conducted at 0.6 km (0.4 mi.) from an active nest site in 1992, only two resulted in detectable responses (Table 5). Based upon the field observations made during 1991 and 1992, the optimal goshawk survey chronology in this region using taped calls appears to be as follows:

- Pre-nesting and courtship period (mid-March to mid-April). Adult distress call and observations for courtship flights.

- Post-hatching until fledgling (mid-May to mid or late-June). Adult distress call and adult female food-begging call.

- Fledgling dependency period (late-June to mid or late-August). Adult female and juvenile food begging call.

One disadvantage of sampling during the post-hatching and fledgling dependency periods is that only successful nesting attempts are part of the sampling universe.

A Compilation of Known, Probable, and Possible Nest Sites

Documentation exists for only ten current or formerly active goshawk nest sites in Southeast Alaska. One of these nests sites was reportedly cut in 1980 as a result of timber harvest activities (unpubl. rep.), and another active nest was known to have been cut in 1989 (Alaska Raptor Rehabilitation Center 1989). Five more of the known nest sites are located within planned timber sales and are currently being managed under the Forest Service's "Interim Habitat Management Recommendations for the Northern Goshawk" (USDA-FS 1992b). One nest site which is located outside of the Tongass

National Forest could potentially be scheduled for harvest at some date in the future, and the remaining two nest sites are in areas currently designated for recreational use (Table 6).

Additionally, there are ten areas in Southeast Alaska where probable goshawk nest sites are likely to exist, or have existed (Table 7). Two of these locations are in drainages protected from logging.

Ten additional areas in Southeast Alaska have been identified as possible goshawk nesting territories (Table 8). In these areas historical or summertime observations have implied breeding activity, although specific stands have not been identified as actual nesting sites. Some of these areas are likely to experience future timber harvest.

Prey Remains

Prey remains collected in the immediate vicinity of goshawk nest sites in Southeast Alaska contained the following species: Franklin's grouse (*Dendragapus canadensis franklinii*), blue grouse (*Dendragapus obscurus*), Steller's jay (*Cyanocitta stelleri*), varied thrush (*Ixoreus naevius*), northwestern crow (*Corvis caurinus*), belted kingfisher (*Ceryle alcyon*), greater yellowlegs (*Tringa melanoleuca*), sharp-shinned hawk (*Accipiter striatus*), red-breasted sapsucker (*Sphyrapicus ruber*), woodpecker sp., *Alcid* sp., waterfowl sp., shorebird sp., unidentified birds, red squirrel (*Tamiasciurus hudsonicus*), and unidentified mammals (Table 9). These prey remains could be biased towards large prey items (Reynolds and Meslow 1984, Bielfeldt et al. 1992).

We did not quantify the relative abundance of prey species which were captured by goshawks in Southeast Alaska. It is difficult to accurately quantify the importance of prey species within a goshawk's diet based strictly upon prey remains collected at nest sites. Beebe (1974), however, found that on the Queen Charlotte Islands goshawks specialize on the northwestern crow, while on Vancouver Island they concentrate on the Steller's jay and varied thrush. Reynolds and Meslow identified the Stellar's jay as a common goshawk prey item in Oregon as was the case in Southeast Alaska. Analysis of prey killed and not brought to the nest (e.g., Kenward et al. 1981) is not feasible in Southeast Alaska.

Prey remains also may not provide information pertinent to determining the specific locations or habitat types where goshawks actually captured prey items. For example, one cannot assume that a greater yellowlegs was taken from a shoreline or muskeg, because greater yellowlegs have also been observed in old growth spruce/hemlock during their breeding season (Suring et al. 1985). Additionally, some waterfowl such as goldeneye (*Bucephala sp.*) and bufflehead (*Bucephala albeola*) nest in tree cavities (Gabrielson and Lincoln 1959, Campbell 1990), although these species of ducks are not otherwise normally associated with forests. Consequently, even though numerous Franklin's grouse carinate sternums were found at the Suemez Island nest site, and although Steller's jay feathers

were found at all nest sites, it is premature to generalize about goshawk food habits in Southeast Alaska.

It is also important to consider that in comparison to other areas in the United States, prey densities for goshawks in Southeast Alaska appear to be quite low, especially during the winter months. One reason for this could be due to the apparent lower diversity of important prey species thought to occur in Southeast Alaska. For example, certain common mammalian prey species which are widespread elsewhere, and heavily utilized by goshawks (Reynolds et al. 1992), are absent from most of Southeast Alaska. Species such as snowshoe hare (*Lepus americanus;* important to goshawks throughout northern boreal forests), the mantled ground squirrel (*Citellus lateralis;* important in all goshawk diet studies in the continental western United States), chipmunks (*Tamias* sp; also very widespread), and cottontail rabbits (*Sylvilagus* sp.; a generally ubiquitous species throughout much of the goshawk's range) are unavailable in Southeast Alaska.

Another reason for a presumed low winter-time goshawk prey density in Southeast Alaska could involve the trans-continental migrations exhibited by certain non-resident avian species (e.g., varied thrush, greater yellowlegs, sharp-shinned hawk). These prey species would be unavailable to resident goshawks during the winter. Additionally, resident prey species which utilize the forest primarily only during their nesting season (e.g. *Alcid* sp., cavity nesting ducks, etc.) may be unavailable to goshawks during the winter. Table 9 indicates some of the prey species which are likely to be available to goshawks during the winter.

One avian prey genera collected at five of six nest sites was *Dendragapus*. This could be an especially important genera in goshawk diets in Southeast Alaska because, unlike some other prey species, the non-migratory behavior of *Dendragapus* makes it available during the winter. Johnsgard (1990) cites gallinaceous birds, such as grouse, as typically the most important avian prey for goshawks. Grouse have also been identified by other authors as being very important in goshawk diets (Beebe 1974, McGowan 1975, Reynolds et al. 1992). However, the relationships between Franklin's grouse, blue grouse, and other prey species to goshawk productivity in Southeast Alaska are not known.

Capture of Goshawks

A variety of capture techniques were used during attempts to trap and radio-tag goshawks (ADF&G 1993a). The type of trap used varied according to a number of factors, such as the time of year, location of capture attempt, phase of nesting period, and age of the targeted goshawk. In some instances multiple traps or different trap types were set simultaneously in order to increase the likelihood of successful capture.

Efforts to capture and radio-tag goshawks were initiated during January and February of 1992 with the placement and monitoring of Swedish goshawk traps (Bloom 1987) at selected locations. Winter

trapping efforts were conducted in several areas on the Cleveland Peninsula and Prince of Wales Island. As many as six traps, placed a minimum of 0.25 miles (0.40 km.) apart, were set in selected trapping areas and visually checked every 3-5 hours. To maximize the visual detectability of traps by goshawks, traps were generally placed in open locations along shorelines, in estuaries, and in muskegs. A total of 738.5 winter trap hours were accumulated using Swedish goshawk traps, resulting in no goshawk captures. Additionally, a total of 176 spring trap hours were accumulated using Swedish goshawk traps, also resulting in no goshawk captures.

Adult goshawks were captured at active nest sites utilizing the dho-gazza technique. This involved setting a break-away mist net near a live great-horned owl (*Bubo virginianus*) decoy (Bloom 1987). A total of four adult goshawks, including two males and two females, were captured at two active goshawk nest sites using this method.

Two nestling juvenile goshawks, including one at each of two sites, were banded and radio-tagged with temporary leg mount transmitters. This was done by ascending the nest tree with climbing spurs, removing and processing the birds, and then returning them to the nest. After their rectrices completed growth these juveniles were recaptured and leg-mounted transmitters were replaced with longer-lived tail-mounted transmitters.

Several trap types were used in efforts to capture fledged juveniles for banding and radio-tagging. These included the bal-chatri, noose carpets, and harnessed lure birds (Bloom 1987). A total of six fledgling goshawks were captured, including five at three known nest sites and one at a probable nest site. Three fledglings were captured using bal-chatri traps containing live pigeons and three were captured using noose carpet traps placed over bait. No goshawks were captured using harnessed lure-birds.

Radio-Telemetry Results

Of the ten goshawks captured and banded at nest sites, seven were fitted with radio transmitters. These seven goshawks represent two family groups at Sarkar Lake on Prince of Wales Island and Douglas Island near Juneau. A combined total of 138 radio-telemetry relocation points were recorded between June 17, 1992 and March 10, 1993 from the seven goshawks radio-tagged at these two sites (Table 10). This total does not include juvenile relocation points prior to post-fledging dispersal.

Sarkar Lake, Prince of Wales Island:

Four goshawks were captured and radio-tagged at the Sarkar Lake nest site. These four birds comprised one family group including the paired adults, juvenile male, and juvenile female. The juveniles fledged successfully in early July, 1992.

Adult Home Range Size: An independently sampled relocation point is generally described as one that is separated in time from other

relocation points by at least the amount of time necessary for a tagged animal to cross its range (Swihart and Slade 1985, in: Kenward 1987). For analysis of radio telemetry data, a minimum sampling interval of one hour was selected. This amount of time was considered a conservative estimate of the time necessary for a goshawk to cross its home range.

A total of 108 individual goshawk relocation points, including 60 adult male and 48 adult female, were recorded for the Sarkar Lake pair between June 17, 1992 and March 10, 1993. Of these 108 relocations, 96 relocations, including 51 male and 45 female, satisfied the independent sample criterion for inclusion in the home range data set analysis. For the male, 32 nesting and 19 post-nesting independent relocations were used. For the female, 24 nesting and 21 post-nesting independent relocations were used.

Two separate minimum convex home range polygons were constructed for each adult. One home range polygon consisted of relocation points collected during the nesting period only, while the second polygon included all points collected during the nesting and post-nesting periods (Figure 1). Polygons were constructed and their areas calculated by the Forest Service's Ketchikan Area GIS. Polygon areas were described by total area (including all land, salt and fresh water) and by total land area (including land area only) (Tables 11, 12, and 13).

At the Sarkar Lake site, initial relocations were made on June 17 during the mid-nestling period. Nesting period polygons for the adult male and adult female were constructed using all independent relocations collected between this date and 10 August. This latter date coincides with the first known date on which both of the juveniles had dispersed from the nest site, and is considered the end of the fledgling dependency period and nesting cycle. Relocations used to construct the total home range polygons for the adult male and adult female included all independent relocation points collected between June 17, 1992 and March 10, 1993, the last date of field data used in this report.

A minimum convex polygon constructed using adult male relocation points collected during the nesting period, describes a nesting home range containing 46,736 ac (73.0 mi^2) of land and water. When fresh and salt water are eliminated from this polygon, the male's breeding home range contains 26,541 ac (41.5 mi^2) of land (Table 11 and Figure 1, polygon C).

A minimum convex polygon constructed using all independent adult male relocations collected between June 17, 1992 and March 10, 1993 describes a total home range containing 169,153 ac (264.3 mi^2) of land and water. With fresh and salt water are eliminated from this polygon, the male's total home range contains 75,734 ac (118.3 mi^2) of land (Table 11 and Figure 1, polygon A).

The minimum convex polygon constructed using adult female relocation points collected during the nesting period describes a nesting home range containing 59,309 ac (97.2 mi^2) of land and

water. When fresh and salt water are eliminated from this polygon, the female's nesting home range contains 25,737 ac (40.2 mi^2) of land (Table 12 and Figure 1, polygon D).

A minimum convex polygon constructed using all independent adult female relocations collected between June 17, 1992 and March 10, 1993 describes a total home range containing 243,783 ac (380.9 mi^2) of land and water. When fresh and salt water are eliminated from this polygon, the female's total home range contains 174,675 ac (272.9 mi^2) of land (Table 12 and Figure 1, polygon B).

When the adult male and female nesting home range polygons are combined, the resulting area contains a total of 101,596 ac (158.7mi^2) of land and water. With fresh and salt water eliminated, the combined breeding home range of this pair contains an estimated 50,798 ac (79.4 mi^2) of land (Table 13 and Figure 1, polygons C and D).

When the adult male and female total home range polygons are combined, the resulting area contains 390,042 ac (609.4 mi^2) of land and water. When fresh and salt water are eliminated from these polygons, the combined total home range of this pair for the period June 17, 1992 to March 10, 1993 contains an estimated 195,021 ac (304.7 mi^2) of land (Table 13 and Figure 1, polygons A and B).

The adult male and adult female home ranges contained relatively little overlap during both the nesting and post-nesting periods. For the nesting and total home range polygons, overlap was 4.4% and 5.9%, respectively (Figure 1). During the nesting season the area of overlap contained 4,449 ac (7.0 mi^2) of land and water. In Figure 1, this area is represented by polygon F. The nest was located in the southern portion of this polygon. When fresh and salt water are eliminated from this area, the nesting home range overlap contains an estimated 2,225 ac (3.5 mi^2) of land (Figure 1, polygon F).

The area of overlap between the total home ranges of this pair for the period June 17, 1992 to March 10, 1993 contains 22,893 ac (35.8 mi^2) of land and water. When fresh and salt water are eliminated, the total home range overlap contains an estimated 11,447 ac (17.9mi^2) of land (Figure 1, polygon E).

Volume Class Use: Of the 108 relocations recorded for the Sarkar Lake adult goshawks, 94 relocations, including 50 male and 44 female, were used in analyses of volume class selection. Relocations not used in these analyses included 12 which did not meet the independent sample criterion (see: a. Adult Home Range), and 2 which could not be placed confidently in only one specific habitat type. The Sarkar Lake juvenile male and female could not be relocated following their dispersal from the nest site and, therefore, no volume class selection information is available for these birds.

Both tables and figures were developed to depict comparisons between telemetry relocations and habitat availability within the

home ranges of the pair of the adult goshawks nesting on POWI. The terrestrial home ranges and telemetry relocations are compared by forest volume class for the adult male and female in Tables 14 and 15, respectively. All adult male relocations and 91% of the adult female relocations occurred in mature forests of greater than 8,000 board feet/acre ($\geq$ volume class 4). The total land area of the male's and female's home ranges contained only 54.6% and 40.2%, respectively, of forest cover with greater than 8,000 board feet/acre. As analyzed by the Forest Service GIS, a disproportionate number of telemetry relocations occurred in volume class 5 (20,000 - 30,000 board ft./acre). Although only 21% of the land area of the adult male goshawk's total home range was volume class 5, 56% of the relocations for this bird occurred in this volume class. Similarly, although only 13% of the land area of the adult female goshawk's total home range was volume class 5, 52% of the relocations for this bird occurred in this volume class. Relocation data analyzed by the GIS also showed that these birds generally avoided unforested habitat, forest stands of less than 8,000 board feet/acre, clearcuts, and young second growth (Figures 2 and 3).

Juvenile Dispersal: The two radio-tagged Sarkar Lake juveniles could not be relocated following their presumed dispersal from the nest site despite extensive aerial searches. Dispersal and survival information are, therefore, not available for these birds.

Signals were last detected from the juvenile male and juvenile female in the vicinity of the nest on August 4 and August 10, respectively. Subsequent aerial searches conducted through 30 September covered more than 20,000 mi^2 without detection of either bird's transmitter signal. It is not known if the juveniles dispersed outside of the searched area, if the unlikely event of failure of both radio transmitters occurred, or if some other factor(s) (e.g., search patterns, topography, mortality) prevented signal reception. Despite continued scanning of the juveniles' transmitter frequencies during all telemetry flights after September 30, no radio signals were detected from these birds.

Douglas Island, Juneau:

Three goshawks were captured and radio-tagged at the Douglas Island nest site. These three birds comprised one family group including an adult male, adult female, and juvenile female. The juvenile female fledged successfully from this nest in late July, 1992.

In an effort to conserve available funding, an attempt was made to "piggy-back" Juneau area goshawk telemetry flights on existing brown bear (*Ursus arctos*), mountain goat (*Oreamnos americanus*), and marten (*Martes americana*) radio-tracking flights. While this proved financially beneficial, it resulted in reduced relocation effort for goshawks radio-tagged near Juneau, and an inability to accurately estimate home range sizes. Kenward (1987) recommends that a minimum of 30 independent locations per individual be used for home range analysis.

Adult Home Range: A total of 25 adult goshawk relocation points were recorded at the Douglas Island site between July 10, 1992 and September 23, 1992, including 13 adult male relocations and 12 adult female relocations. These include 9 nesting and 4 post-nesting locations for the adult male, and 9 nesting and 3 post-nesting locations for the adult female. Relocation of the Douglas Island female's radio-transmitter occurred at the same location since September 23, 1992, indicating that this bird either perished or dropped the radio package. The high elevation and deep snow cover at this location prevented recovery of the transmitter prior to its failure. Additionally, no relocations of the Douglas Island male's radio-transmitter occurred after September 23, 1992.

Douglas Island goshawk telemetry relocation data was entered into the Forest Service's GIS, but it has not been analyzed. Though too few relocation points were collected to construct reliable nesting home range and total home range polygons, this data will be useful in examining other attributes important to understanding goshawk ecology on the Tongass National Forest, including movements and habitat use. Because of variation in both sampling effort and size of relocation data sets for the Douglas Island and Sarkar Lake goshawks, home range and other telemetry data analyses cannot be accurately compared between these sites. Home range estimates are a function of the number of locations used to generate the estimates and two estimates are not comparable if the sampling effort is not equal (White and Garrott, 1990).

Volume Class Use: Volume class data may not be available for all of the data points because some relocations occurred on non-Forest Service lands.

Juvenile Dispersal: A total of 5 post-dispersal relocation points were recorded between August 26, 1992 and February 10, 1993 for the single juvenile female reared at the Douglas Island nest site. The juvenile's first documented significant movement (>0.5 mi.) away from the nest site occurred on August 28, when it was located 2.8 miles (4.5 km) from the nest. This bird's greatest recorded distance from the nest was 11 miles (17.6 km) on September 23, 1992. On February 10, 1993, this goshawk was located 9.0 miles (14.4 km) from the nest. On March 26, 1993 the transmitter and remains of this bird were recovered at the same location following ground-based radio tracking. The cause of death was not determined.

Movements:

The Sarkar Lake adult female's nesting home range, including land and water, was calculated to be 27% larger than the nesting home range of the adult male at this site (Tables 11 and 12). The greater size of the female's nesting home range may be accounted for, in part, by the fact that she began movements to the northern portion of her range during this period (Figure 1, polygon D) as soon as the nestlings fledged in early July, while the male did not begin similar movement to the southern portion of his nesting home

range until after juvenile dispersal in early August (Figure 1, polygon C). Yet, the total land area of the male's and female's nesting home ranges differed by only 3%.

The adult male's continued foraging for the juveniles through their dispersal may account for his later movement away from the nest site. Food deliveries to the juveniles by the male during this period are implied by repeated relocations of the male in the proximity of the nest site and by direct observation. In contrast, after her first recorded movement away from the nest site on July 13, 1992, the female was relocated again at the nest site only three times through March 10, 1993; July 14, July 16, and February 11. Based on these observations, it is believed that the adult female did little or no foraging for the juveniles after July 16. This contrasts with theories concerning the concept of the post-fledging area, which appear to have been developed using the assumption that the young followed the adult female during the post-fledging period (Kennedy 1989, USDA-Forest Service 1991).

A general range expansion was recorded for both the Sarkar Lake adult male and adult female after the nesting period (Figure 1, Tables 11 and 12). This increase in home range area between the end of the nesting period (August 10, 1992) and the end of the recorded post-nesting/winter residency period (March 10, 1993) was 362% for the adult male and 411% for the adult female. These increases reflect distant movements away from the vicinity of the nest site by both the male and female. The greatest distance from the nest recorded during this period was 19 miles (30.4 km) for the male on October 13, 1992, and 34 miles (54.4 km) for the female on December 3, 1992.

The radio-tagged adult goshawks at the POWI site were relocated through the fall and winter within 34 miles (54 km) of their nests, documenting their winter residency in Southeast Alaska. The juvenile at the Douglas Island site, prior to its death, also failed to exhibit movements indicative of migratory behavior. Relocations of the radio-tagged Douglas Island adult female goshawk occurred at the same location since September 23, 1992, indicating that this bird either perished or dropped the radio package prior to winter. Additionally, due to unknown reasons, no relocations of the Douglas Island male's radio-transmitter occurred after September 23, 1992. As noted, the juveniles at the POWI nest site could not be relocated after dispersal and, therefore, no information regarding their post-dispersal or survival was collected.

Other interesting observations regarding movements were made during field activities. One noteworthy example occurred at the Sarkar Lake site on July 16, 1992, during the fledgling dependency period. In this instance, two separate radio-telemetry relocations showed that the adult female moved 13 miles back to the nest site within the two hour time period between the telemetry relocations.

Through the use of radio-telemetry we were also able to document movements back to the vicinity of the nest site by both the Sarkar

Lake adult male and female goshawks during the winter. For example, the Sarkar Lake male was relocated within one mile or less of the nest site on November 27, December 3, and December 16. During December the Sarkar Lakes adult female also returned from her more wide-ranging movements of the late-summer and fall. On December 16 this adult female was relocated 6.5 miles from the previous summer's nest site and was within one-third mile of the nest on February 11, 1993.

Discussion of Radio-Telemetry Results:

Goshawk home range sizes were based on a preliminary analysis of data collected from a single pair of birds at Sarkar Lake on Prince of Wales Island during the nine month period between June 17, 1992 and March 10, 1993. Home range estimates were calculated by the Forest Service's Ketchikan Area GIS and based on the area of minimum convex polygons.

A full year of relocation data is desirable to accurately determine total home range size for radio-tagged goshawks and could increase the total home range estimates. The preliminary analysis of nine months of relocation data given in this report does, however, provide a good indication of nesting home range and total home range size for this pair. In fact, to our knowledge, only Widen (1985), in Sweden, radio-tracked goshawks beyond summer.

The land area of the nesting home range for the Sarkar Lake pair was calculated to be 50,798 ac.(79.4 mi^2). This area is more than eight times the 6,000 ac (9.4 mi^2) foraging area which must be managed for a known goshawk pair as specified in the USDA Forest Service's "Management Recommendations for the Northern Goshawk in the Southwest United States" (Reynolds et al. 1992). Although these standards were developed in the southwestern U.S., they are currently being implemented on the Tongass National Forest (USDA-Forest Service 1992b). Within this 6,000 ac. foraging area, 20 percent (1200 ac), must remain in stands which meet the most important or moderately important habitat structure utilized by young and adult goshawks.

The land area of the total home range of the Sarkar Lake goshawk pair was calculated to be 195,021 ac. (304.7 mi^2) and is 39 times larger than the assumptions used by the "Interagency Viable Population Committee" (Suring et al. 1993). This committee, when developing a strategy for maintaining viable wildlife populations on the Tongass National Forest, proposed establishing 40,000 acre Habitat Conservation Areas (HCAs) to provide and maintain habitat for 8 pairs of goshawks. However, much of the rest of the data and information obtained through this study are consistent with the literature review, observations, and assumptions regarding habitat selection, prey items, dispersal, and winter residency of goshawks as presented in Suring et al. (1993). Kennedy (1989) noted high variability in home ranges of *Accipiters* she studied with radio telemetry in northern New Mexico. Harmonic mean home range estimates for female goshawks was 1,406 ac (n = 5) and males was 5204 ac (n = 3).

We were unable to locate and radio-tag adjacent nesting pairs of goshawks to determine if spatial overlap occurred. It was noted, however, that the Sarkar Lake pair was not found to be traveling in or utilizing the Sarheen Creek drainage to the north which, based upon previous nesting activity and current observations, was suspected to contain a an adjacent goshawk home range. We provide no evidence to support the theory that 8 pairs of breeding goshawks could be maintained in a 40,000 acre HCA in southern Southeast Alaska.

Although no rigorous tests have been conducted to evaluate the accuracy of telemetry relocations used in home range and habitat analyses, sightings of radio-tagged goshawks during radio-tracking flights and the recovery of the Sarkar Lake adult male's transmitter approximately 20 yards (18 m) from its estimated position, suggest that these locations have an acceptable margin of error. Prior to any final analyses of telemetry data, however, accuracy tests will be conducted to establish actual margins of error.

During forest volume class typing of relocation points by the GIS, it was found in some instances that points did not appear to be accurately typed when compared with volume class information from aerial photos and field notes. Consequently, although we agree with others that there appears to be some inaccuracies in the TLMP volume class maps resident in the Forest Services GIS (Brickell 1989), a more thorough analysis of relocation data may be done by using the greater resolution of aerial photographs. Relocation point volume class, stand volume class, timber-type, and slope, for example, may be determined in finer detail on aerial photos than is currently possible using the existing GIS data base. For the purpose of this report, however, only the results of preliminary GIS-based analyses were presented (Tables 11, 12, 13, and Figures 1, 2, 3).

Mortalities

Two mortalities of radio-tagged goshawks were recorded and a third was probable. The Sarkar Lake adult male's transmitter, along with a number of feathers, were recovered at Shipley Creek on Kosciusko Island on March 10, 1993. Little evidence was present to enable a determination of the cause of death, however, the location and appearance of the collected remains indicate that this bird may have been killed here by another raptor between March 2 and 10.

The juvenile female radio-tagged at the Douglas Island nest site was found dead 9 miles (14.4 km) from the nest on March 26, 1993. The remains of this bird were in a decomposed state and cause of death could not be determined.

The Douglas Island female's radio-transmitter has been relocated at the same place on Douglas Island since September 23, 1992. This location remained inaccessible throughout the winter due to high elevation snow cover. It is probable that this bird has died.

A juvenile female goshawk originally recovered in an emaciated condition near Petersburg on August 18, was released near the same location on September 8. Although not included as part of the telemetry data set, this rehabilitated bird was radio-tagged to track its progress after release. On October 14, 36 days after its release, this bird was found dead by Forest Service personnel on Sasby Island at Petersburg. When located, the corpse of this bird had a full crop and weighed 875 g. This weight is approximately 265 g less than the bird's weight when it was released. The loss of weight and the obviously thinner condition of the bird indicate that successful foraging was not regular. Cause of death was not determined. This bird was excluded from mortality figures because it was originally found in an emaciated condition and would have perished earlier without human intervention.

Winter Residency

Until the winter of 1992-93, no information existed to document that goshawks breeding and rearing young in the Tongass National Forest were also residing in Southeast Alaska during the winter. As a result of the radio-telemetry work accomplished, however, it is now known that the nesting Sarkar Lake adult goshawks captured and radio-tagged during the summer of 1992 did not migrate. Additionally, the one juvenile which was monitored through the fall also did not exhibit migratory behavior. These observations are consistent with Taverner's (1940) belief that the goshawks of the nearby Queen Charlotte Islands and the British Columbia coast are probably resident. Other ornithologists have also thought that goshawks found in Southeast Alaska could be residents (Gabrielson and Lincoln 1959). Additionally, Beebe (1974) has stated that the goshawks of western British Columbia do not migrate, but that those breeding in the boreal forests of Canada east of the coastal mountains are migratory.

Central Prince of Wales Planning Area

One goal of this contract was to begin to provide the Forest Service with survey and radio-telemetry results in timber sale assessment areas (ADF&G 1992). Although the project is only in the preliminary stages of being able to accomplish this goal, some initial observations are possible regarding the Central Prince of Wales planning area in relation to the goshawk home range which overlaps a portion of this planning area.

The recent Draft Environmental Impact Statement (DEIS) for Central Prince of Wales (CPOW) (USDA-Forest Service 1992a) proposes timber harvest in approximately 22 units located within the Sarkar adult male's home range. Radio telemetry locations were recorded within the boundaries of three of these units. The CPOW DEIS also proposed to harvest up to approximately 75 logging units found within the adult female's home range. This pool of units may last for several years, after which more units are planned for future decades. Cumulatively, within the approximately 321,866 acre CPOW planning area, about 6% of the commercial forest lands (12,415 acres) are reserved from timber harvest (USDA-Forest Service

1992a). Because radio-telemetry relocations provide only a small sample of the total habitat use, we cannot currently identify all areas utilized by radio-tagged goshawks or the relative importance of these areas during the short or long term. Our study provides no information about goshawk habitat use outside this home range and for the remainder of the planning area.

CONCLUSION

The initial phase of this study may be viewed as a determination of the feasibility of collecting data regarding goshawks in Southeast Alaska. This effort has yielded valuable and previously unknown information about nests, prey, home range size, habitat associations, and winter residency of goshawks in this region. As such, the data and other pertinent findings provide managers with a stronger base of knowledge than has been previously available. The home range size of the one pair of goshawks regularly monitored in this study differs from the allowances made by the Interim Management Guidelines currently being implemented on the Tongass National Forest (USDA- Forest Service 1992b). We also found selection by this pair for mature forests of greater than 8,000 board feet/acre. Habitats are sufficiently varied in Southeast Alaska and analysis suggests that knowledge of this species' relative abundance and habitat associations from other portions of its range may not apply to the coastal rainforest environment. The continuation of research to acquire more data on the goshawk in Southeast Alaska is desirable and appropriate to aid future management decisions.

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Table 1. Confirmed Goshawk Observations. ADF&G/FS Survey Participants. June - August 1991.

LOCATION	DATE	WERE SIGHTINGS PREVIOUSLY REPORTED?	TIMBER SALE NAME	ACTIVE NEST SITE LOCATED	REMARKS
Suemez Island	July 16	Yes	Santa Cruz	No	A nest suspected as active in 1991 was found in 1992.
Grant Creek	July 24	Yes	Not applicable	No	Response to recording, adult ♀
Vixen Lk/Crk	July 26	Yes	Vixen Inlet	No	Response to recording
Sarheen	Aug. 1, 6, & 13	Yes	89-94 LTS	No	Two juveniles 1 mile from old nests
Douglas Island*	June 22	Yes	Not scheduled	Yes	Two juveniles fledged

* Although staff confirmed a goshawk nest at this location, it was not in a place surveyed and was outside of the 1991 study area.

Table 2. ADF&G - USDA Forest Service Goshawk Study. Southeast Alaska, 1992.

AREA SURVEYED[a]	PERSON HOURS	DETECTIONS	GOSHAWKS OBSERVED[b]	NESTS LOCATED[c]
139,730 ac.	1300	4	8	1

[a] Area surveyed by conspecific playback recordings, point observations, and foot searches.

[b] Goshawks observed during survey efforts other than playback recordings.

[c] Includes only nests located by field survey effort.

Table 3. Confirmed Goshawk Observations. ADF&G/FS Survey Participants. March - August 1992

LOCATION	DATE	WERE SIGHTINGS PREVIOUSLY REPORTED?	TIMBER SALE NAME	ACTIVE NEST SITE LOCATED	REMARKS
Sarkar	3/30 et al.	No	CPOWI	Yes	Two juveniles fledged/banded
Grant Creek	4/7-9	Yes	Not applicable	No	Adult ♂ (3 observations)
Sarheen	4/22, 7/1	Yes	89-94 LTS	No	Two observations/ in-flight
Anita Bay	4/24	Yes	Starfish	No	Adult ♂
Pan Creek	4/29	Yes	Potential MHT sale	No	♂, age unknown
Suemez Is.	6/24 & 26	Yes	Santa Cruz	No	Old nests inactive
Douglas Island*	7/2 et al.	Yes	Not scheduled	Yes	One juvenile fledged/banded
Big John Creek	8/12	Yes	North Irish	Yes	Two juvenile fledged/banded
Falls Creek	8/14	No	Not scheduled	No	One juvenile fledged/banded
Pt. Bridget*	8/14 & 19	Yes	Not applicable	Yes	Two juveniles fledged

* Although staff confirmed goshawks at these locations, sampling activities were not actually conducted in these areas.

Table 4. USDA Forest Service Northern Goshawk Study, Western Washington, 1988[a]

POINTS SAMPLED[b]	RESPONSES	GOSHAWKS OBSERVED[c]	NESTS LOCATED
1,153	2	6	0

[a] Surveys conducted by 4 full-time raptor specialists.

[b] Points sampled with conspecific playback recordings at 0.5 mile intervals along segments of road and trail randomly selected in three forest type strata.

[c] Goshawks observed during survey from selected vantage points and by chance during travel on roads.

Table 5. Detections using Conspecific Playback Recordings. Sarkar Lakes Goshawk Nest Site, 1992[a]

DATE	SAMPLING ATTEMPTS	DETECTIONS
30 March	1	1
14 April	4	0
15 April	3	0
17 April	1	0
21 April	2	1

[a] Nest located on 16 May 0.4 mile (0.6 km) from sample point.

Table 6. Known Goshawk Nest Sites[a] in Southeast Alaska

SITE NAME	LOCATION	PAST OR FUTURE HARVEST AREA	OTHER REMARKS
KETCHIKAN AREA			
Port Refugio	Suemez Island	Yes[b]	Active in 1989, Adjacent alternate nest apparently used in 1991.
Sarheen	Prince of Wales	Yes[b]	Two foodbegging juveniles Aug. 1-13, 1991; old nests found < 1 mi. away.
Sarkar Lakes	Prince of Wales	Yes[c]	Two young fledged in 1992.
STIKINE AREA			
Kake Tribal	N.W. Kupreanof Island	Yes[b]	Two young & unhatched egg (6/23/89); nest cut.
Starfish Sale	Etolin Island	Yes[b]	Two young fledged in 1991.
Big John Creek	Kupreanof Island	Yes[b]	Two young fledged in 1992, banded.
Cabin Creek	Mitkof Island	Yes[b]	Nest in Unit 14, 1980. Later harvested. Adjacent nest unharvested.
CHATHAM AREA			
Douglas	Douglas Island	Yes[c]	Two juveniles in 1991, one juvenile in 1992.
Pt. Bridget	Juneau Mainland	No[c]	Two juveniles in 1992; previous attacks reported
Mendenhall	Juneau Mainland	No[c]	Active in 1992.

[a] Confirmed nest sites as of May 1993.
[b] Site located during timber lay-out or harvest activities.
[c] Site located during activities other than timber lay-out or harvest (e.g., recreation, wildlife survey).

Table 7. Probable Goshawk Nest Sites[a] In Southeast Alaska.

SITE NAME	LOCALE	PAST OR FUTURE HARVEST	REMARKS
KETCHIKAN AREA			
Chickamin River	Misty Fjords National Monument	No[c]	Observations of juveniles Aug. 2-5, 1973; adult, 4/25/74.
Cannery Creek[d]	Cleveland Peninsula	Yes[c]	Attacks in summers of 1986 and 1987
Niblack Anchorage	Prince of Wales	Yes[c]	Observation of juvenile, ~ Aug. 15-17, 1992.
Tonowek Creek	Heceta Island	Yes[b]	Unconfirmed nest report (1982); cut in mid-1980's.
STIKINE AREA			
Falls Creek	Mitkof Island	Yes[c]	Fledgling male captured & banded 8/14/92; adult feather nearby
Mossman Inlet[d]	Etolin Island	Yes[b]	Forester attacked in 1986, old nest found in 1992.
Pan Creek	Mitkof Island	Yes[c]	Fledged juvenile 7/23/90; adult 4/4/90 and 4/29/92.
Salamander Creek	Wrangell Island	Yes	Foodbegging juvenile 8/10/91.
CHATHAM AREA			
Dewey Lake Trail[d]	Skagway	Yes[c]	Attacks in 1985 and 1987; nest reported but unconfirmed.
Thayer Lake[d]	Admiralty Island	No[c]	Attacks/observations in summer 1986, 1987, 1988; plucking sites.

[a] Sites where nests have not been located or confirmed by biologists, but adult goshawk behavior or the presence of juvenile goshawks indicate a probable nesting location.
[b] Site located during timber lay-out or harvest activities.
[c] Site located during activities other than timber lay-out or harvest (e.g., recreation, wildlife survey).
[d] Places with defensive behavior displayed by adults have the highest probability of being within close proximity to an active nest.

Table 8. Possible Goshawk Nesting Areas[a] In Southeast Alaska.

SITE NAME	LOCALE	PAST OR FUTURE HARVEST	REMARKS
KETCHIKAN AREA			
Grant Creek	Misty Fjords National Monument	No[c]	Adults observed 7/24/91, and 4/7-9/92.
Vixen Lake	Cleveland	Yes[c]	Observations, July 1990 & 1991.
Hatchery Lake	Honker Divide (POW)	Yes[c]	Potential nest cut in 1990, observations in 1991.
Thorne River	Honker Divide (POW)	Yes[c]	Response 3/26/92; unconfirmed historical sightings
Ketchikan Lakes	Revilla Island	No[c]	Observations in March 1992.
Naha/Leask	SW Central Revilla	--[c]	Loring specimen (1992); multiple observations, unconfirmed nest report.
North Revilla	Hassler Pass	Yes[c]	Unconfirmed historical 7/07/92.
STIKINE AREA			
Nemo Road	Wrangell Island	Yes	Unconfirmed historical nesting reports; recent habitat loss
CHATHAM AREA			
Shelter Island	Shelter Island		July-Aug. 1986, adult with food begging young (unconfirmed).
Eagle Glacier	Juneau Mainland		Observations, two different years.

[a] Documentation for the existence of an actual nest site is weak. However, observations, especially those from March-August, indicate potential nesting activity.
[b] Observations or evidence from timber lay-out or harvest activities.
[c] Observations or evidence from activities other than timber lay-out or harvest (e.g., recreation, wildlife survey).

Table 9. Prey Remains Collected at six Goshawk Nests in Southeast Alaska, 1990-92.

PREY SPECIES	P.O.W. ISLAND	SUEMEZ ISLAND	ETOLIN ISLAND	KUPREANOF ISLAND	DOUGLAS ISLAND	POINT BRIDGET
Alcid sp.				X		
Waterfowl sp.	X					
G. Yellowlegs		X				
Shorebird sp.					X	
Franklin's Grouse*	X	X				
Blue Grouse*				X	X	X
Sharp-shinned Hawk	X					X
Belted Kingfisher	X					
R.b. Sapsucker	X					
Woodpecker sp.*	X			X		
Northwestern Crow*	X					
Steller's Jay*	X	X	X	X	X	X
Varied Thrush	X	X		X		
Unidentified Bird	X	X	X	X	X	X
Red Squirrel*			X			
Unidentified Mammal	X	X	X	X	X	X

* Indicates prey items which are likely to be available in the winter.

Table 10. ADF&G - USDA Forest Service Goshawk Study In Southeast Alaska, 1992.

ACTIVE NESTS LOCATED	GOSHAWKS TRAPPED AND BANDED	GOSHAWKS RADIO-TAGGED	RADIO RELOCATIONS
5*	10	7	138**

* Includes four confirmed nests and one probable nest site.

** Sarkar Lakes and Douglas Island sites, June-March.

Table 11. Sarkar Lake Adult Male Goshawk: Area of Total Home Range and Nesting Home Range.[1]

	Total Home Range[2]	Nesting Home Range[3]
Polygon area with water	169,153 ac.(A)[4]	46,736 ac.(C)[5]
Polygon area without water	75,734 ac.	26,541 ac.

[1] Area of minimum convex polygon calculated by USFS Ketchikan Area GIS.
[2] June 17, 1992 - March 10, 1993. n = 51 telemetry relocations.
[3] June 17 - August 10, 1992. n = 32 telemetry relocations.
[4] Figure 1, polygon A.
[5] Figure 1, polygon C.

Table 12. Sarkar Lake Adult Female Goshawk: Area of Total Home Range and Nesting Home Range.[1]

	Total Home Range[2]	Nesting Home Range[3]
Polygon Area with water	243,783 ac. (B)[4]	59,309 ac. (D)[5]
Polygon Area without water	174,675 ac.	25,737 ac.

1 Area of minimum convex polygon calculated by USFS Ketchikan Area GIS.
2 June 17, 1992 - March 10, 1993. n = 45 telemetry relocations.
3 June 17 - August 10, 1992. n = 24 telemetry relocations.
4 Figure 1, polygon B.
5 Figure 1, polygon D.

Table 13. Sarkar Lake Adult Male and Female Goshawks: Area of Pair Total Home Range and Nesting Home Range.[1]

	Total Home Range[2]	Nesting Home Range[3]
Polygon area with water	390,042 ac. (A+B)[4]	101,596 ac. (C+D)[5]
Polygon area without water	195,021 ac.	50,798 ac.

1 Area of minimum convex polygon calculated by USFS Ketchikan Area GIS.
2 June 17, 1992 - March 10, 1993. n = 96 telemetry relocations.
3 June 17 - August, 1992. n = 56 telemetry locations.
4 Figure 1, polygons A and B combined.
5 Figure 1, polygons C and D combined.

Table 14. Sarkar Lake Adult Male Goshawk: Home Range Land Area and Telemetry Relocations by Forest Volume Class.[1,2]

Volume Class[3]	Area (ac.)	% of Home Range Total Land Area	# Telemetry Relocations	% Telemetry Relocations
<3	12,283	16.2	0	0
3	22,112	29.2	0	0
4	9,607	12.7	9	18.0
5	16,232	21.4	28	56.0
6	10,126	13.4	11	22.0
7	5,373	7.1	2	4.0
Total	75,733[4]	100.0	50	100.0

Table 15. Sarkar Lake Adult Female Goshawk: Home Range Land Area and Telemetry Relocations by Forest Volume Class.[1,2]

Volume Class[3]	Area (ac.)	% of Home Range Total Land Area	# Telemetry Relocations	% Telemetry Relocations
<3	90,127	51.6	1	2.3
3	14,335	8.2	3	6.8
4	40,239	23.0	13	29.6
5	22,285	12.8	23	52.3
6	4,923	2.8	2	4.5
7	2,766	1.6	2	4.5
Total	174,675[4]	100.0	44	100.0

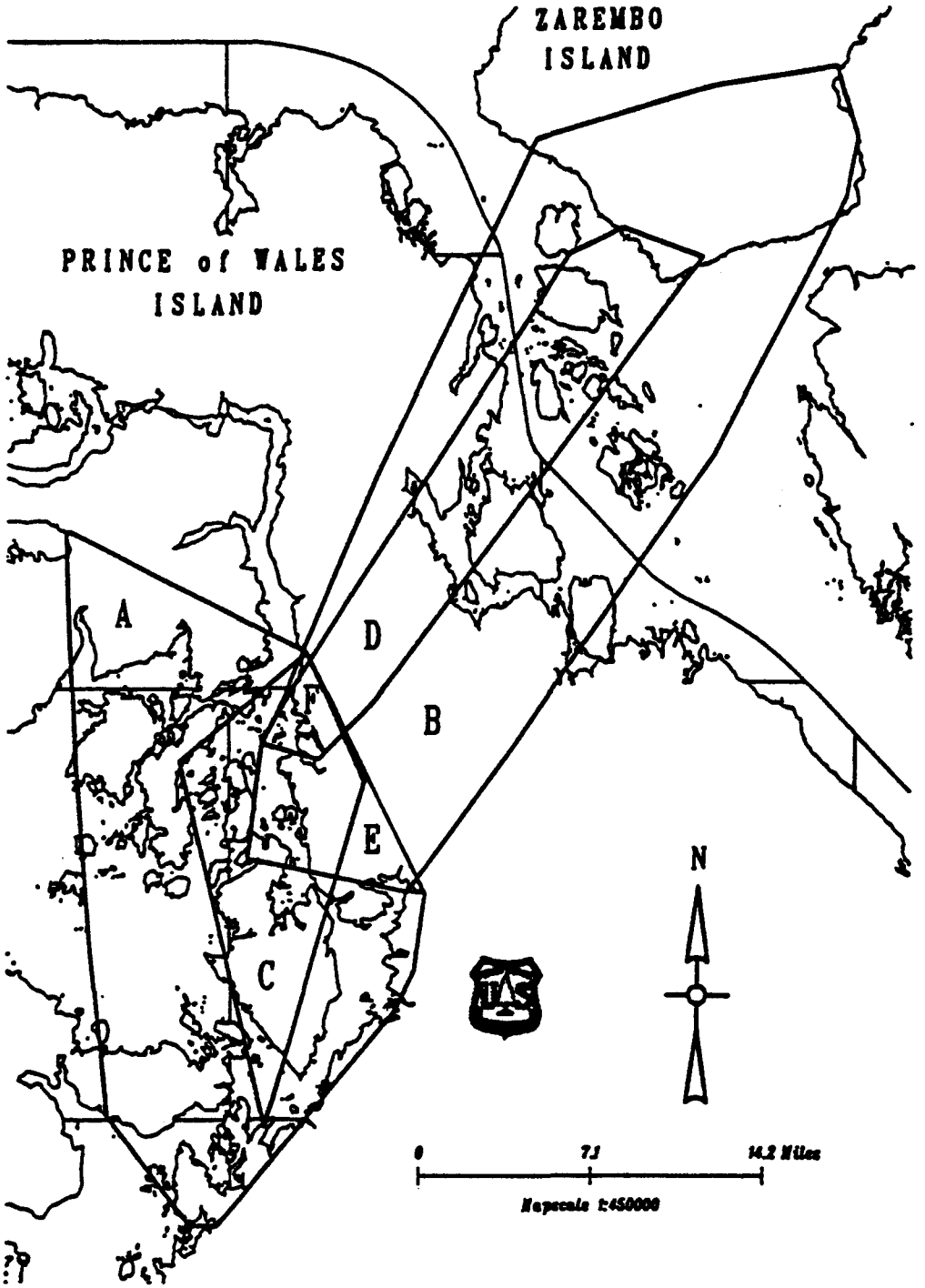
1 Home range area and forest volume classifications by USDA Forest Service, Ketchikan Area GIS.

2 Telemetry relocation data collected June 17, 1992 - March 10, 1993.

3 <3 = low productivity forest and non-forest cover types.
3 = 0-8,000 bf/ac.; clearcuts and second growth.
4 = 8,000 - 20,000 bf/ac of old growth.
5 = 20,000 - 30,000 bf/ac of old growth.
6 = 30,000 - 50,000 bf/ac of old growth.
7 = 50,000+ bf/ac of old growth.

4 Equals total land area of home range polygon. For adult male, see Figure 1 polygon A and Table 3. For adult female, see Figure 1, polygon B and Table 4.

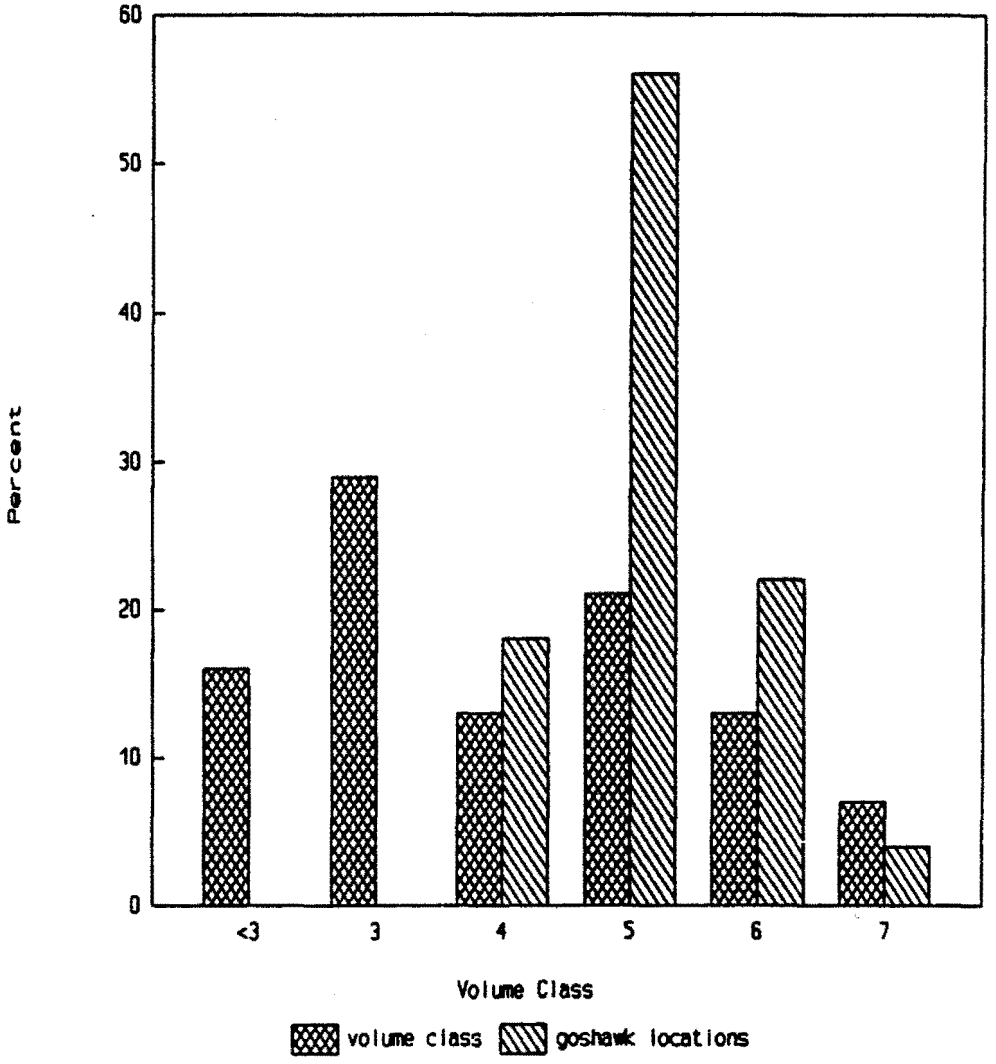
Figure 1. Sarkar Lake Adult Male and Female Goshawk Home Range Polygons. June,1992-March,1993.*



A = Adult male total home range. June 17,1992-March 10,1993.
B = Adult female total home range. June 17,1992-March 10,1993.
C = Adult male nesting home range. June 17,1992-August 10,1992.
D = Adult female nesting home range. June 17,1992-August 10,1992.
E = Adult male and female total home range overlap.
F = Adult male and female nesting home range overlap.

* See text and Tables 3,4 and 5 for description of polygons.

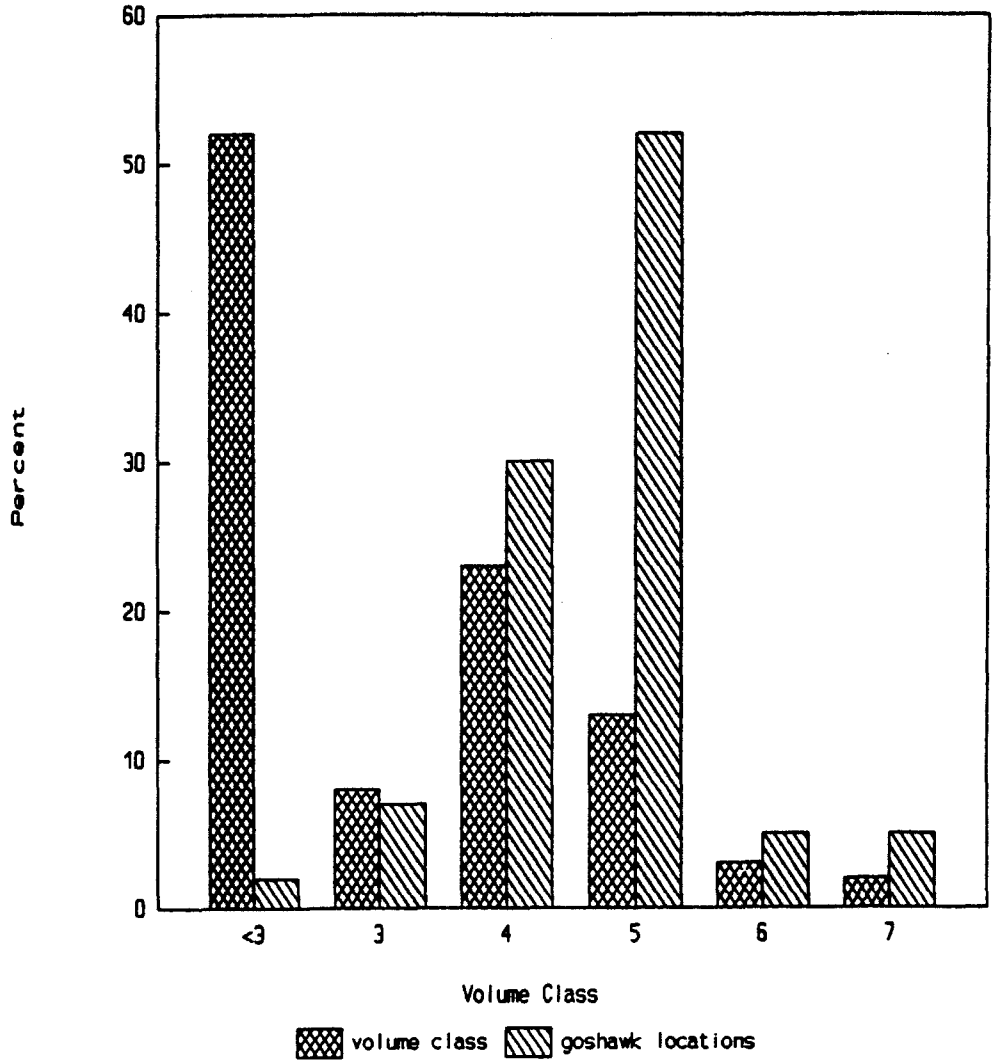
Figure 2. Sarkar Lake Adult Male Goshawk: Home Range[1] Forest Volume Class Availability and Use[2]



[1] Home range telemetry data collected June 17, 1992 - March 10, 1993. n = 50 relocations.

[2] Home range area and forest volume classifications by USDA Forest Service, Ketchikan Area GIS. Availability of each volume class represented as percent of home range total land area. Volume class use represented as percent of total relocations. See Table 14.

Figure 3. Sarkar Lake Adult Female Goshawk: Home Range[1] Forest Volume Class Availability and Use[2]



[1] Home range telemetry data collected June 17, 1992 - March 10, 1993. n = 45 relocations.

[2] Home range area and forest volume classifications by USDA Forest Service, Ketchikan Area GIS. Availability of each volume class represented as percent of home range total land area. Volume class use represented as percent of total relocations. See Table 15.