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Goshawk Ecology and Habitat Relationships on the Tongass National Forest

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Federal Aid in Wildlife Restoration
1998 Field Season Progress Report
1 January 1998–31 December 1998
Study SE-4-2

Prepared for U.S. Forest Service
U.S. Fish and Wildlife Service

This is a progress report on continuing research. Information may be refined at a later date.

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GOSHAWK ECOLOGY AND HABITAT RELATIONSHIPS ON THE TONGASS NATIONAL FOREST

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STATE: Alaska **STUDY NO.:** SE-4-2

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SUMMARY

During 1998 Alaska Department of Fish and Game (ADF&G) staff continued northern goshawk (*Accipiter gentilis*) surveys across Southeast Alaska in close cooperation with the US Forest Service (FS). The objectives of this multiyear study are to monitor for goshawks and their nest sites while gathering habitat, movement, productivity, and survival data as part of an interagency monitoring program. During the 1998 field season, interagency staff monitored the activity status of known nest areas, searched for new nest sites at locations where goshawk activity had been observed or reported, captured and radiotagged goshawks at active nests, and monitored radiotagged goshawks. A total of 17 active goshawk nests were located in 1998, including 13 located in previously known nest areas and 4 located in new nest areas. One additional nesting area was not included in the total number of active nests because it was located late in the season and although fledglings were present, a nest was not found. The addition of 5 new nest areas in 1998 increased the cumulative total of Southeast Alaska goshawk nest areas documented since 1991 to 55. In 1998, nest searches were conducted at 46 of the 50 nest areas identified before this year, and an active nest was located at 13 (28%) of these areas. These results do not indicate density or population size because our nest searches were nonsystematic and covered only a small portion of the forested lands of the Tongass National Forest. Minimum reoccupancy of a nest area at least once in a consecutive year was documented at 20 (42%) of the 48 nest areas that were identified before 1998 and checked for consecutive year use. In 1998, 17 documented nesting attempts produced 38 young for a mean productivity of 2.2 young/nest (range 0–4). During the 8-year period 1991–98, 88 nesting attempts at 49 nest areas produced 182 young for a mean productivity of 2.1 young/nest (annual mean range 1.5–2.3). These productivity figures are similar to those reported for goshawks in other regions. A total of 37 goshawks, including 21 adults and 16 juveniles, were captured at 12 nest areas in 1998. Twenty-two goshawks, including 18 adults and 4 juveniles, were radiotagged. Time lapse video surveillance of active nests was begun in 1998 as part of a cooperative Boise State University graduate study of the diet of nesting goshawks in Southeast Alaska. A total of 2640 compressed hours of video tape were recorded at 5 nests this year, documenting 759 prey deliveries. Feather and blood samples were collected from captured goshawks and will be used for ongoing stable isotope analyses and future genetic analyses.

Key words: *Accipiter gentilis*, *Accipitridae*, forest management, northern goshawk, raptor, Tongass National Forest

CONTENTS

INTRODUCTION

In 1991 the Alaska Department of Fish and Game (ADF&G) and the USDA Forest Service (USFS) initiated a study of northern goshawk (*Accipiter gentilis*) ecology and habitat relationships on the Tongass National Forest in Southeast Alaska. In 1998 ADF&G and USFS personnel completed the eighth field season of cooperative nest searches and data collection. This report summarizes the results of 1998 field-season activities, including ADF&G and USFS goshawk nest area monitoring on the Tongass National Forest and progress associated with ongoing ecological studies.

The northern goshawk, its population status, and association with forest management continue to be of concern in the western U.S., including Southeast Alaska (e.g., Kennedy 1997). Recent suggestions for information needs focus on demographic, population estimation, habitat relationships, and a meta-analysis to pool data across studies (Kennedy 1997, Crocker-Bedford 1998, DeStefano 1998, Kennedy 1998). This project has shifted focus over the past few years.

PROJECT OBJECTIVES

- monitor goshawk nesting areas for activity in both managed and unmanaged landscapes,

- evaluate inter-year movements of individual goshawks, and
- determine survival of adult goshawks.

These objectives are in keeping with the Tongass Land and Resource Management Plan (Tongass Plan; US Forest Service 1997) that provides direction to coordinate and cooperate with other agencies to develop a better understanding of the northern goshawk. The Tongass Plan also has specific requirements to "manage goshawk foraging habitat (productive old-growth forest) to retain important features of forest stand structure..." using newly designed silvicultural systems in areas where goshawk distribution or occurrence is considered at risk. The current study design will not evaluate the efficacy of these alternative silvicultural systems.

METHODS

ADF&G and USFS staff used standard field methods (Pendleton et al. 1987) for forest raptor studies to collect information about goshawk nesting, survival, and habitat ecology. Raptor survey techniques included searches of known goshawk nest stands and other forested areas where goshawks were or had been observed in previous years (Fuller and Mosher 1987), the use of taped recordings of goshawk calls in attempts to increase detection rates (Kennedy and Stahlecker 1993, Watson et al. 1999), and valley watches for goshawks flying above the canopy (Pentriani 1997). The focus during the 1998 field season was to determine the activity status of known nest areas and search for new nest areas where goshawks or evidence of nesting were observed or reported. Monitoring and nest search activities include inspecting all known nests for signs of recent activity, searching documented or suspected nest stands for nests or signs of occupation by goshawks, broadcasting goshawk "alarm" and "wail" calls in a nonsystematic fashion in attempts to elicit responses, and conducting valley watches for goshawk flight activity in known or suspected nest areas. Some active nests were located by tracking radiotagged adult goshawks to nesting areas different from those of the previous year. This is unlike many other goshawk studies that do not use radiotelemetry and have little likelihood of locating nesting goshawks that may have moved out of an intensively searched study area or moved a long distance to alternate nests.

We captured and radiotagged adult goshawks near their nest site using a non-releasable great horned owl (*Bubo virginainus*) as a lure and dho-gozza nets (Bloom 1987). Adult goshawks were fitted with tail-mount or backpack style radiotransmitters (Kenward 1987), depending on the likelihood of future recapture, remoteness of the site, stage of molt, and sex of bird. Juvenile goshawks were captured and banded, and, depending on the discretion of the biologist in the field, some were fitted with a tail-mount radiotransmitter. Captured goshawks were weighed, standard morphometric measurements were taken, stage of molt was noted, feather samples were collected, and blood was drawn from most individuals. Feather samples were collected for future stable isotope analysis of the diet and trophic relationship of goshawks from Southeast Alaska (Gannes et al. 1997), and the calamus of the pulled feather and blood sample will be archived for future genetic study.

We defined the nest site as the nest tree and a 0.04-ha area surrounding that tree (Titus and Mosher 1981). We define the "nest stand" in an ecological context as the nest site and the associated contiguous forested area where stand structure is relatively homogeneous. The size of

a nest stand may vary from 2 ha to >20 ha, and it may contain ≥1 goshawk nest. We defined the "nest area" as the forested stand of up to a few hundred hectares that may contain ≥1 goshawk nest. Some goshawks may move >1 km between annual nesting attempts, yet these alternate nests are within their normal movement patterns and breeding home range. It was unlikely that many of these alternate nests would have been located without the aid of radiotelemetry. Because of movements between alternate nests and nest stands, it is difficult to draw conclusions about reoccupancy of entire "nest areas," except in the case of some radiotagged goshawks. Thus, we report reoccupancy as minimum values.

RESULTS AND DISCUSSION

NESTING ACTIVITY

A total of 17 active goshawk nests were identified as a result of interagency search efforts in Southeast Alaska in 1998. Of these 17 nests, 13 occurred within previously documented nest areas and 4 occurred within new nest areas located in 1998. One probable new nest area at Madan Bay on the mainland near Wrangell was documented as being active in 1998. Two fledgling goshawks and an adult were observed in this nest area but no nest was found. With the discovery of 5 new nest areas in 1998, the cumulative number of nest areas documented to date in Southeast Alaska increased to 55. Between 1991 and 1998 the highest number of documented active nests occurred in 1994 when 21 active nest areas were located (Fig. 1, Table 1, and Appendix I). (Note: In previous reports the Rio Roberts Creek and Cutthroat Creek–Prince of Wales Island nest areas were considered separate nest areas. These areas were combined in this report to represent a single nest area with 4 widely spaced alternate nest sites, all existing within the territory of the same adult male. As a result, a reduction of 1 nest area in the cumulative total is reported here for 1995–98; these figures differ from those reported previously).

We continue to have difficulty locating active goshawk nests in some portions of Southeast Alaska, especially on islands such as Prince of Wales, Revillagigedo, and the Cleveland Peninsula. While there has been an emphasis on locating goshawk nests in portions of southern Southeast Alaska, our qualitative assessment suggests that few active nests have been found there relative to effort expended. In contrast, we have been consistently able to locate a number of active goshawk nests in the Chatham Area with comparatively less effort than in the southern portions of Southeast Alaska. We believe the number and size of goshawk breeding territories vary across Southeast Alaska, probably in relation to prey distribution and abundance. That goshawks and raptors vary in density across the landscape is well documented in the literature (e.g., Newton 1986). Because our search efforts are not confined to a localized study area or conducted systematically, we are unable to draw quantitative conclusions regarding varying goshawk nesting densities and population size across Southeast Alaska.

In 1998 nest searches ranging from 1 visit lasting several hours to 10 or more visits over the course of the breeding season were conducted at 46 of 50 nest areas identified since 1991; active nests were located at 13 (28%) of these areas. This represents a minimum reoccupancy rate because search effort was variable among areas and some active alternate nests could have gone undetected. In each historical nest area, all known nests were inspected for activity. If all nests were inactive, variable effort was applied to the surrounding area. During the period 1991–98,

consecutive year nest area reoccupancy was documented on at least one occasion at 20 (42%) of the 48 nest areas that were identified prior to 1998 and checked for consecutive year use. In contrast with previous years, however, consecutive year nest area reoccupancy rates in 1998 were relatively high in Southeast Alaska. Eleven of 16 (69%) nest areas known to be active in 1997 also contained an active nest in 1998, though 8 of these 11 nests were located by tracking radiotagged adult females. Goshawk activity (e.g., responses, sightings) was detected at 4 known nest areas where active nests were not found in 1998 (Table 1 and Appendix I). Documented nest area reoccupancy rates for Southeast Alaska are difficult to compare with those reported for other goshawk studies. While our study has the advantage of long-term tracking of some goshawks with radiotelemetry, we lack systematic searches due to difficult logistics and terrain and staffing and funding limitations. Squires and Reynolds (1997) indicate that yearly occupancy rates can be highly variable. They also indicated that determining yearly occupancy of goshawk nest areas is difficult because alternate nests are sometimes widely spaced.

We received information about 1 additional nest area in 1998, and we chose not to include this as a confirmed nest. A probable goshawk nest area was reported from the Bartlett Lake Trail near Gustavus on the Chilkat Peninsula. Fledglings were reported, but searches for an active nest were not conducted.

Of 18 active nest areas located in 1998, 8 (Blueberry, Camp Carl, Fish Creek, Green Cove Margaret Lake, Nugget Creek, Ready Bullion Creek, Roberts/Cutthroat Creek) were found by tracking radiotagged adult females to active nests within previously documented nest areas, 3 (Auke Bay, Elena Bay, Tunehean Creek) were found by tracking radiotagged adult females to new nest areas, 3 (Deer Island, Mud Bay, Timber Knob,) were found by searching previously documented nest areas, 2 (Eagle River, Point Bridget) resulted from observations from members of the public who were engaged in recreation, and 2 (Brown Cove, Madan Bay) were found as a result of goshawk observations during timber presale activities. Of the 55 goshawk nest areas located in Southeast Alaska since 1985, 26 (47%) were located as a result of activities associated with timber sale preparation or harvest, 17 (31%) were located as a result of searches or events unrelated to timber harvest, and 12 (22%) were located by following radiotagged adult females to nesting areas, which differed from those of the previous year (Appendix I).

PRODUCTIVITY

In 1998, 17 documented nesting attempts in Southeast Alaska produced 38 young for a mean productivity of 2.2 young/nest (range 0–4). Two Chatham Area sites each produced 4 fledglings in 1998. One nest failure was documented in 1998 (Roberts–Cutthroat Creek, Prince of Wales Island). This nest failure occurred during the early nestling period. Of 87 total nesting attempts documented since 1991, 5 attempts are known to have failed. Of these 5 nesting failures, 2 occurred during the incubation period, 1 occurred during the nestling period, and 2 occurred during the fledgling dependency period. For the eight year period 1991–1998, 87 documented nesting attempts produced a total of 182 young for a mean productivity of 2.1 young/nest (range of annual means 1.5–2.3; Table 2). These figures are similar to nest productivity figures reported for goshawks in other regions.

ADULT FEMALE BREEDING DISPERSAL

As in previous years, in 1998 some radiotagged adult females moved to new breeding territories. Between 1992 and 1998, 9 adult females moved a total of 11 times to new breeding territories and nested with different mates than in previous years. Mean distance between nests for these 9 radiotagged females was 38.4 km, with a median distance of 24.5 km and a range of 3.2 km to 152 km. In 1997, one radiotagged adult female (96RCAF) moved 152 km between her 1996 nest site at Cutthroat Creek, Prince of Wales Island and a new nest site at Security Bay, Kuiu Island where she paired with a new mate. This represents the largest between-nests movement documented to date. In 1998 this female moved again from Security Bay, Kuiu Island to Tunehean Bay, Kupreanof Island, a distance of 48 km. We have yet to document a radiotagged adult male moving to a new breeding territory ($n = 26$; Table 3).

GOSHAWK CAPTURES

Biologists captured 37 goshawks, including 21 adults and 16 juveniles, at 12 nest sites in Southeast Alaska in 1998. Additionally, the Juneau Raptor Center rehabilitated 2 injured immature goshawks that were banded by ADF&G prior to release. We attached radiotransmitters to 9 goshawks, including 5 adults and 4 juveniles, captured for the first time and attached or replaced transmitters on 13 adults captured on 1 or more previous occasions (Table 4).

Since 1992 we have captured and/or banded 135 goshawks in Southeast Alaska, including 57 adults, 68 juveniles, and 10 immatures (Table 5). Of these, 96 were fitted with radiotransmitters (53 adults, 39 juveniles, 4 immatures), including 90 goshawks (51 adults, 39 juveniles) captured at 34 nest sites and 6 goshawks (2 adults, 4 immatures) captured away from nest sites. The history and status of all adult female and adult male goshawks radiotagged in Southeast Alaska during the period 1992–98 is presented in Tables 6 and 7, respectively.

DIET STUDIES

Stable Isotope Analysis

In 1996 a preliminary analysis of goshawk food webs was conducted by comparing natural abundance of stable isotope ratios (carbon and nitrogen) of goshawk feather samples with tissue samples from known and potential goshawk prey species from across Southeast Alaska (Ben-David 1996). This preliminary examination of 14 goshawk feather samples collected across Southeast Alaska indicated high variability in the composition of goshawk diets during the breeding season. Some individuals apparently consume songbirds and squirrels, while others feed mainly on birds or mammals that feed in intertidal or marine environments. In 1998 additional feather and prey samples collected prior to this year were submitted for analysis. These included 39 goshawk feather samples and 32 tissue samples representing 23 potential prey species from Southeast Alaska. We collected feather samples from an additional 24 goshawks captured in 1998; these will also be used to further assess goshawk diets by extending the 1996 preliminary stable isotope analysis.

Video Surveillance of Active Nests

Peer review of the interagency goshawk project identified a need to develop a better understanding of goshawk diet and prey brought to nests in Southeast Alaska. We currently lack

an assessment of prey brought to nest locations with differing prey availability. In 1997 ADF&G, USFS, and FWS entered into cooperative agreements with Boise State University (BSU) to study the nesting season food habits of the goshawk in Southeast Alaska. The US Forest Service, through the Forestry Sciences Laboratory, also entered into an agreement with BSU for this study.

BSU graduate student Steve Lewis initiated fieldwork associated with the goshawk diet study in the spring of 1998. Initial efforts concentrated on obtaining and field-testing video surveillance systems and locating a sample of active nests suitable for camera deployment. Searches for active nests initially concentrated near Juneau at previously identified nesting areas and other areas where evidence indicates nesting goshawks were likely. A decision was made early on to concentrate initial video-monitoring efforts near Juneau where a comparatively large sample of relatively accessible nest sites had been identified. Furthermore, the presence of an established road system around Juneau reduced logistical considerations and facilitated frequent site visits necessary to operate and maintain video systems at nests. Later, as the field season progressed, nest searches were extended to nest areas elsewhere in Southeast Alaska.

We acquired and field-tested 5 video surveillance systems in early spring before the start of the 1998 field season. The camera systems were later deployed at 4 active goshawk nests near Juneau and 1 active nest on Prince of Wales Island (POW). Camera systems were installed at active nests as soon as possible following hatching with an effort to minimize the chance of nest abandonment. Following deployment, the camera systems were maintained until either the young no longer used the nest (post-fledging), the nest failed, or the surveillance system itself failed. VCRs were programmed to record daily, from sunrise to sunset, and set to maximize the number of frames recorded per second while at the same time minimizing the number of visits required to change videotapes and batteries. Two different video-recorder settings were tested in 1998. At the 4 nests near Juneau, VCRs were programmed to expose videotape at the rate of one frame/0.8 second. At this setting, 1 visit was required every 48 hours to change batteries and videotapes. At the POW nest, the VCR was programmed to expose videotape at the rate of 1 frame every/1.2 second. At this setting 1 in-person visit was required every 72 hours.

Three of the 5 camera systems ran successfully until the early fledgling period, 1 system failed prematurely (1 day post-fledging) due to weather conditions, and 1 nest failed during the mid-nestling period at which time the camera was allowed to cease operating. As a result of these efforts, 63 videotapes comprising 2640 hours of video footage were collected from 5 goshawk nest areas ($\bar{x}$ = 528h/nest; range = 204–811h). During this time, 759 prey deliveries were documented ($\bar{x}$ = 152 deliveries/nest; range = 42–225 deliveries). Mean prey delivery rate for monitored nests was 0.288 deliveries/h (range = 0.2055–0.3107 deliveries/h) (Table 8).

Preliminary analysis of videotapes indicated that several factors can affect the quality of video footage and our ability to identify items delivered to nests. These factors include ambient light conditions at nest sites, size and condition of items brought to nests, where on the nest relative to camera placement items are delivered and consumed, and camera focus. In conjunction with surveillance systems, each of these nest sites were routinely searched for prey remains and pellets which will allow comparison between the video system analysis and more traditional prey and pellet collection analysis.

Goshawk Prey Remains

Between 1991 and 1997, personnel associated with the goshawk project routinely collected prey remains during visits to active nests. During this period prey remains representing 57 nest-years were collected at 33 nest areas in Southeast Alaska. In 1998 prey remains were collected at 13 nest sites located across Southeast Alaska, including 7 sites in the Juneau area. Near Juneau, where frequent visits to active nest sites were more feasible, prey remains were collected weekly. At more remote sites, only 1 or 2 collections were conducted during the course of the field season. A total of 390 samples representing 71 nest-years have been collected from 42 goshawk nest sites across Southeast Alaska. Each sample has been cataloged based on the nest location and the year it was collected.

Efforts to collect and preserve a representative sample of potential prey species indigenous to Southeast Alaska may require an extended visit to a facility where such a collection already exists. Some collecting (salvage) of potential goshawk prey species from Southeast Alaska was initiated in 1998. Current research efforts center on analyzing videotapes and dissecting prey remains and pellets at BSU. Videotape analysis and remains identification will continue until the start of the 1999 field season. Field activities associated with the goshawk food habits study are scheduled to continue through the end of the 1999 field season.

TISSUE SAMPLE COLLECTIONS

In order to archive tissue samples for future analysis of genetic variation in goshawks and to better determine the status of the *A. g. laingi* subspecies, we collected blood samples from an additional 19 goshawks, including 9 adults and 10 juveniles. Since 1992, blood samples from >75 goshawks have been collected for use in future genetic analyses. In addition to blood samples, in 1998 we collected tissue samples from 24 goshawks by plucking a small contour feather from each bird and preserving the tip of the feather shaft along with attached residual tissues in an alcohol solution. These samples are available for future genetics work.

Gavin and May (1996) assayed genetic variation in northern goshawks by examining blood samples collected from 7 geographic regions in North America, including Arizona, California, Michigan, New Mexico, and Southeast Alaska. One objective of their study was to determine whether there is genetic evidence to support the current view that there are 3 subspecies of goshawk in North America, including *A.g.laingi*. Several molecular techniques were used to assay genetic variation, including allozymes, random amplified polymorphic DNA (RAPDs), restriction fragment length polymorphism (RFLPs) of monomorphic RAPD-generated bands, and microsatellites. Blood samples from 59 Southeast Alaska goshawks, including 34 adults and 25 juveniles, were provided to this study in 1994–95; however, no more than ~20 adult samples from this group were used in the various molecular techniques. The results of this study were inconclusive. The authors concluded that *A.gentilis* does not exhibit or does not have as much genetic variation as most other birds studied and that this fact probably complicated their ability to detect genetic variation among the samples examined. No difference was found between the Southeast Alaska goshawk samples. Populations studied are genetically distinct populations; however, because of the low level of genetic variation found in this examination of N.A. goshawk DNA, Gavin and May caution that their conclusions must be viewed as tentative. Further work is needed to examine any genetic variation among N.A. goshawk subspecies and

populations in more detail. This might include advanced molecular techniques such as gene sequencing and examination of nuclear DNA.

RECOMMENDATIONS

This was the eighth full field season of goshawk study in Southeast Alaska. Study objectives were altered slightly in 1996 to focus on surveying and monitoring of nests and adult goshawks in terms of survival and interyear movements. The primary objective of this phase of study is to examine patterns of nest site fidelity and movements by adult goshawks to new nesting areas. Some female goshawks continue to exhibit large movements to new nesting areas between years, so radiotelemetry is a key component of this work.

Monitoring of nests and adult goshawks should continue for 2–3 more years. This would allow us to establish adequate sample sizes to understand the importance of goshawk nesting areas to birds, compare habitat use and home range sizes in managed vs. unmanaged landscapes, document the portion of the adult population moving between nesting areas, and provide survival rate estimates. Understanding long-term patterns of reuse of goshawk nesting areas is important for those implementing the 1997 Tongass Land and Resource Management Plan. That plan has specific management guidelines for protecting goshawk nesting areas. Evaluation of these guidelines will provide useful information for future adaptive management decisions to maintain viable and well-distributed goshawk populations on the Tongass National Forest. For next year we recommend a more thorough data analysis than was included in the goshawk conservation assessment (Iverson et al. 1996). This includes an analysis of existing data on home ranges and landscape characteristics. Various resource–selection statistical procedures should be used to explore the relationships between goshawk home range size and habitat composition. Results from these analyses are of interest to other agencies because they may help clarify how forest management relates to goshawk use of home range and habitat. These analyses require large sample sizes and are confounded by 1) unequal sampling of radiotagged goshawks, 2) differing goshawk prey availability across Southeast Alaska, 3) nonrandom goshawk home range data with respect to managed and unmanaged landscapes, and 4) inaccurate cover maps.

Ideas for additional field study include gathering site-specific habitat data at radiotelemetry locations, perhaps as related to foraging (e.g., Beier and Drennan 1997). Winter habitat use and winter prey availability have also been discussed as possible limiting factors on goshawks in Southeast Alaska. Increasing the effort to study goshawks outside of the nesting season would require additional funding beyond the current monitoring program. Because of anticipated difficulty in acquiring more intensive goshawk radiotelemetry or diet data in the non-nesting season, any winter fieldwork should be undertaken as a pilot study.

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