Alaska Department of Fish and Game
Division of Wildlife Conservation
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Technical assistance, analysis and dissemination of results from an interagency northern goshawk study on the Tongass National Forest

16 May 2001–30 September 2002

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Kim Titus
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Final Research Performance Report
Endangered Species Conservation Fund
Federal Aid Grant E-1-1, Project 2.0

Please note: This final report describes work accomplished on ongoing goshawk research using funds from this grant. Information taken from this federal aid report should be cited with credit given to authors and the Alaska Department of Fish and Game.

FEDERAL AID
FINAL RESEARCH PERFORMANCE REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 25526
Juneau, AK 99802-5526

PROJECT TITLE: Technical assistance, analysis, and dissemination of results from interagency northern goshawk study on the Tongass National Forest

PRINCIPAL INVESTIGATORS: Craig Flatten, Kim Titus, Steve Lewis

COOPERATOR: USDA Forest Service

FEDERAL AID GRANT PROGRAM: Endangered Species Section 6

GRANT AND SEGMENT NR.: E-1-1

PROJECT NR.: 2.0

WORK LOCATION: Douglas and Ketchikan

STATE: Alaska

PERIOD: 16 May 2001 – 30 September 2002

I. PROGRESS ON PROJECT OBJECTIVES

OBJECTIVE 1: Continue analysis of 1991 – 2001 data, report preparation and manuscript development.

A number of analyses were completed of the 9 – 10 years of goshawk data. Specifically, we conducted analysis of a) morphometric measurements of Queen Charlotte goshawks handled during capture as part of our long-term studies. We had the opportunity to cooperate with Ms.E. McClaren of the Ministry of Water, Land, and Air Protection, Nanaimo, British Columbia, to analyze goshawk morphology data from Vancouver Island as part of the same analysis. This additional data made for an improved morphometric analysis of the subspecies over a broader portion of the birds' range. Progress has been completed on most aspects of the analysis of size and color variation in northern goshawks from Southeast Alaska and Vancouver Island. Significant progress was also made on analyzing the nest site habitat data. We estimated adult goshawk survival rates.

OBJECTIVE 2: Acquire a more complete sample of habitat data at goshawk nest sites.

We obtained information at 37 goshawk nest trees within 22 nest areas during this period. Broader sampling of nest plot data were collected at 30 sites within 21 nest areas. We believe that this sample is representative of the population of known goshawk nest areas in Southeast Alaska. Some goshawk nest sites in remote locations were sampled during this period.

II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD

JOB A: Analysis of goshawk morphology as related to the status of the "Queen Charlotte" subspecies – *Accipiter gentilis laingi*

During this period, Federal Aid funds were used in support of staff time to analyze mensural data from northern goshawks previously captured in Southeast Alaska and Vancouver Island, British Columbia. Adult and recently fledged juvenile goshawks were captured at 85 nesting areas across both regions during 1991-1999. We used univariate and multivariate statistical analyses to compare measurement data within and among regions, and across the North American range of the northern goshawk. Adult male goshawks from Vancouver Island were significantly smaller than males from Southeast Alaska across all measurements. Adult female goshawks were also significantly smaller from Vancouver Island, but the pattern was not as strong across all measurements. Examination of geographic size variation by latitude suggested weak but significant correlations between nest site latitude and individual size for males from Southeast Alaska and Vancouver Island, but not for females. Wing chord length was analyzed across many regions and it serves as a useful metric to examine bird size across regions. Mean adult male wing chord was significantly smaller in Vancouver Island than in Southeast Alaska, central interior British Columbia, and Yukon Territory to the north, and the Olympic Peninsula of Washington, northeast Oregon, and northern Arizona to the south of this location. Adult male wing chord was also significantly smaller in Southeast Alaska than all other locations compared except Vancouver Island. Mean adult female wing chord was significantly smaller in Vancouver Island than central interior British Columbia and Yukon Territory to the north, and northeast Oregon and northern Arizona to the south. These and other results from the analysis of goshawk size suggest that clinal variation occurs within the range of the *laingi* subspecies, especially for males. Across western North America, our analyses suggest that *laingi* goshawks are smaller than those examined from other regions. *A. g. laingi* is described as being a smaller and darker goshawk. Results from examination of key plumage characteristics indicated considerable overlap among phenotypes possible between *laingi* and *attricapillus*. Assignment of 45 adult goshawks by phenotype from Southeast Alaska was 40% *laingi,* 33% *atricapillus*, and 27% *laingi* or *atricapillus*. Assignment of 21 adult goshawks by phenotype from Vancouver Island Alaska was 38% *laingi,* 19% *atricapillus*, and 43% *laingi* or *atricapillus*. These results are based on much larger sample sizes than were used to originally describe the *laingi* subspecies. These results support the original descriptions of the subspecies noting population variability in plumage color.

JOB B: Description of nest site habitat data

During this period, Federal Aid funds were used to sample goshawk nest site habitat, perform data entry, and analyze habitat data at multiple scales. The job was accomplished as planned and included the sampling of some goshawk nests in remote locations. We measured nest and nest tree characteristics at 37 nest trees in 22 nesting areas and measured habitat characteristics at 30 nest sites and nest stands from 21 nesting areas. Goshawks appeared to be selecting the location of their nests at different spatial scales. At the stand scale, goshawks nested in large volume, western hemlock (*Tsuga heterophylla*) dominated

forests with relatively dense canopy and shrub layer. Within those stands (mean basal area of stands = 48.5 m^2/ha), nest sites occurred in predominately western hemlock forest patches containing larger trees on average and an overall higher basal area (mean basal area of nest sites = 60.8 m^2/ha). Nest trees were either Sitka spruce (*Picea sitchensis;* 54% of nest trees) or western hemlock (41% of nest trees). Mean dbh (diameter breast height; 68.7 cm; SE = 3.7) of nest trees was significantly larger than the mean dbh of nest site trees (51.7 cm; SE = 1.2). Nest trees were either dominant or codominant in the forest canopy. These results are useful to forest managers in southeast Alaska who can ensure that goshawks have nesting habitat into the future by conserving high volume timber stands with large trees and relatively dense canopy.

JOB C: Estimation of adult goshawk survival rates based on radiotagged birds

During this period we used Federal Aid funds to prepare and analyze radiotelemetry data for the survival rate estimates. During 1991 – 1999 there were 41 nesting areas where adult goshawks were radiotagged. A total of 31 males and 32 females were radiotagged and survival rates were determined for each sex separately. For each month over this period the fate of each bird was determined and placed in one of three categories: alive – known to be alive using radiotelemetry, censored - unable to determine status, and dead – remains recovered (n = 18) or static signals (n = 2). Program MARK was used to estimate monthly survival rates and calculate standard errors. For males, 12 of 31 were recaptured and retagged and 9 died during our study period. Mean annual survival for adult males was 0.59 (SE = 0.10, 95% CI 0.38 – 0.77). Survival was not constant across months, with most male mortality occurring in late winter. For females, 21 of 32 were recaptured and retagged and 11 died during our study period. Some of our females moved (termed 'movers') between nesting areas and exhibited breeding dispersal, while other females were resident (termed 'residents') among years. In cases where females were not tracked for at least 2 nesting seasons, we could not determine whether they were 'movers' or 'residents' hence they were termed 'first'. We hypothesized that movement status would effect survival, and we tested this hypothesis using program MARK. Results indicated that survival was not constant across months or groups. Like males, most adult female mortality occurred in late winter. Mean annual survival for all adult females was 0.74 (SE = 0.06, 95% CI 0.59 – 0.85). Separating the three groups, we found that adult females that 'moved' between years had the highest annual survival rate of 0.96 (SE = 0.03, 95% CI 0.84 – 0.99), followed by 'first' with an annual survival rate of 0.81 (SE = 0.08, 95% CI 0.60 – 0.92), and 'residents' having the lowest annual survival rate of 0.57 (SE = 0.12, 95% CI 0.34 – 0.78). The estimated survival rate for adult males was among the lowest estimated for this species. Our results were accomplished as planned, yet the low survival rate estimate for males suggests the need to carefully examine our data, analysis and results prior to peer review.

III. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

We cooperated with Forest Service staff in disseminating information on our findings and provided expertise on suspected goshawk nests located by agency personnel. In one situation we provided written findings to the Forest Service because of the sensitivity of the location related to proposed logging/thinning. We also conducted some monitoring of goshawk nest sites when Forest Service staff were not available.

IV. PUBLICATIONS

Papers presented directly related to this performance report.

LEWIS, S-B, K TITUS AND C FLATTEN. 2002. Northern goshawk nesting area characteristics in Southeast Alaska. Poster Paper. 3rd North American Ornithological Conference. New Orleans, La.

TITUS K, C FLATTEN, G PENDLETON, R LOWELL, AND S LEWIS. 2002. Northern goshawk survival rates – Tongass National Forest, Alaska. Poster Paper. 3rd North American Ornithological Conference. New Orleans, La.

V. RECOMMENDATIONS FOR THIS PROJECT

We recommend continued data analysis and report writing. Aspects of interest to agencies include

a) submission of the goshawk size (morphology) and color variation manuscript to peer review. These results are of interest to the US Fish and Wildlife Service because of their role in determining the status of the subspecies under the Endangered Species Act.

b) further analysis of the nest site habitat data as related to forest inventory and timber databases for the Tongass. Further comparative analyses will allow better predictions about the number of goshawk nest areas that are of similar size and forest structure as forest stands desired for timber harvest.

c) final analysis of the goshawk survival rate analysis. Initial analysis using program MARK suggests that male goshawks have very low survival rates and that adult female survival rates differ depending on the inter-year movement status of the female. Both results are unusual and require additional data-checking and analyses to verify the findings.

VI. APPENDIX

See copies of poster papers attached.

VII. PROJECT COSTS FOR THIS SEGMENT PERIOD

FEDERAL SHARE $ 39,999.50 + STATE SHARE $ 13,332.50 = TOTAL $53,332

VIII. PREPARED BY:

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SUBMITTED BY:

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Tom Paul
Federal Aid Coordinator
Division of Wildlife Conservation

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Wayne L Regelin, Director
Division of Wildlife Conservation

APPROVAL DATE: _____

Northern Goshawk Survival Rates ~~Tongass National Forest, Alaska

Kim Titus, Craig Flatten, Grey Pendleton, Rich Lowell, Steve Lewis
Alaska Department of Fish & Game, Division of Wildlife Conservation, Douglas & Ketchikan

Introduction

Few studies have estimated northern goshawk survival rates (*Accipiter gentilis*). For goshawks, there are two methods to estimate these rates. Birds can be marked and resighted in subsequent years, typically using color bands (e.g., Reynolds and Joy 1998; Arizona). Alternatively, birds can be radiotagged and followed to determine their fate (e.g., Kenward et al. 1999; Sweden). We used radiotelemetry to estimate goshawk survival rates by following adults from 1992 – 2000. We worked with the Queen Charlotte goshawk (*A. g. laingi*).

Study Area

Tongass National Forest – Southeast Alaska 77,000km^2

- Coastal temperate rainforest (125 – 500 cm rain per year)
- 1,000+ islands; 16,600 km coastline
- 90% of Southeast Alaska is public land
- 2,000,000 ha of pristine old growth rainforest
- Sitka spruce, western hemlock dominant trees
- 405,000 ha of old growth forest harvested by clearcut logging

Field Methods

- 61 Total nesting areas
- 41 Nesting areas where adults were tagged
- All adults trapped at nest sites
- 31 Males radiotagged
- 32 Females radiotagged
- Aerial radiotracking used to locate birds
- About 2,500 telemetry locations

Statistical Methods

Estimated survival by MONTH and used 3 fate categories

- *ALIVE – known to be alive (using radiotelemetry)*
- *CENSORED – unable to determine status*
- *DEAD – remains recovered (n = 18) or static signals (n = 2)*

Used program MARK (known fates model) to estimate monthly survival rates and standard errors. Separate models for males and females. Started with general models that allowed survival to differ by group by month (movers, residents, first encounter of bird). Subsequently fit reduced models constraining survival rates among months and/or groups. Selected appropriate model based on AICc (small sample correction factor. Developed separate estimates by month.

Acknowledgments

Funding for our long-term studies of the Queen Charlotte goshawk have been provided by the USDA Forest Service, Alaska Department of Fish & Game, and the US Fish and Wildlife Service.

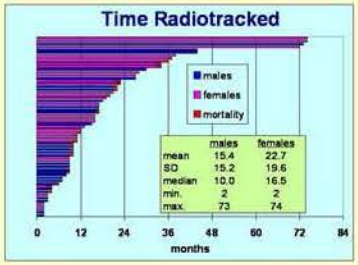
Results – Length of Tracking

Males

- 12 of 31 were recaptured and retagged
- 9 died

Females

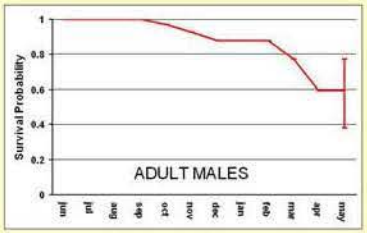
- 21 of 32 were recaptured and retagged
- 11 died

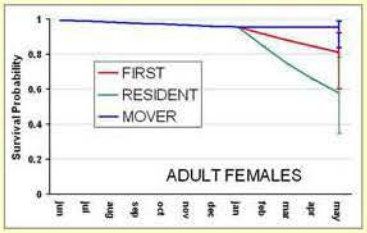


Results – Survival Estimation

Males – Mean annual survival was 0.59 (SE = 0.10; 95% CI 0.38 – 0.77). Because all of our males were residents on their breeding home range, did not test between residents versus movers. Survival was not constant across months, with most male mortality occurring in late winter.

Females – Mean annual survival was not constant across months or groups. Resident female goshawks had lower survival probabilities than movers and the 95% confidence intervals did not overlap (see figures below).





Discussion

MALES – Survival rate estimates are among the lowest reported for the species. We currently have no clear explanation for this result. Possible explanations include transmitter impacts and types of transmitters (tailmounts and 1 – year backpacks on males versus mostly 2 – year backpacks on females).

FEMALES – The model that separated movers, residents and first year tagged birds suggests differences among groups. Females that exhibit breeding dispersal among years had much higher survival than females that remained in the same home across years. Part of this analysis is confounded by differing prey on some islands. Five of 8 resident females that died were on the southern portion of the Tongass and Prince of Wales and other islands that have no red squirrels and no blue grouse; important goshawk prey species.

Northern Goshawk Nesting Area Characteristics in Southeast Alaska

Stephen B. Lewis and Kim Titus, Alaska Department of Fish and Game, Douglas, AK;
Craig Flatten, Alaska Department of Fish and Game, Ketchikan, AK

Introduction

A cooperative study of northern goshawk (*Accipiter gentilis*) ecology in the Alexander Archipelago of southeast Alaska began in 1991. During 1995 and 2000, we collected data to systematically describe and quantify goshawk nesting area characteristics at multiple spatial scales. The object of this research was to complement our knowledge of goshawk breeding ecology in Southeast Alaska.

Methods

Study Area

Figure 1. Southeast Alaska; dots show nests at which vegetation data was collected during 1995 and 2000.

Vegetation Sampling

3 spatial scales (Figure 2):

Nest Tree (n = 44 trees from 24 nesting areas):

- measured species, DBH, nest aspect, nest and tree height.

Nest Site (n = 37 sites from 22 nesting areas):

- nest site: 0.05 ha (r = 12.8 m) circle centered on nest (Figure 2).
- measured species, DBH, site aspect, and canopy closure.

Nest Stand (n = 37 stands from 22 nesting areas):

- nest stand: one circular, fixed-radius plot centered 50 m from the nest tree in each cardinal direction (Figure 2).
- measured species, DBH, site aspect, and canopy closure.

Analysis:

1. We used DBH as a metric for comparisons among spatial scales within the nesting area:
   a. Compared Nest Tree DBH with that from all other trees in the Nest Site using a mixed effects model (Proc MIXED, SAS).
   b. Compared DBH of Nest Site trees with that from trees in the 4 Nest Stand plots using a mixed effects model.

Figure 2. Schematic drawing of sampling design for data collected at goshawk nesting areas in Southeast Alaska, 1995 and 2000.

2. Calculated basal area for Nest Site and Nest Stand; compared basal area of Nest Sites with that of Nest Stand plots.

Acknowledgments

Funding was provided by Alaska Department of Fish and Game, USDA Forest Service, and USDI Fish and Wildlife Service. Rich Lowell (ADF&G), Glen Ith, Kurt Aluzas, and Peg Robertson (USFS) assisted with logistics during data collection. Grey Pendleton (ADF&G) provided statistical assistance. Michelle Kissling helped with poster development.

Results

	Nest Tree	Nest Site	Nest Stand
Tree Species:	54% *Picea sitchensis* 41% *Tsuga heterophylla* 5% *Thuja plicata*	58% *Tsuga heterophylla* 23% *Picea sitchensis* 19% other species	56% *Tsuga heterophylla* 22% *Picea sitchensis* 22% other species
DBH ($\bar{x} \pm s_{\bar{x}}$; cm):	68.7 ± 3.7	51.7 ± 1.2	44.9 ± 0.6
Basal Area (m^2/ha):	N/A	70.1 ± 4.9	55.8 ± 3.2
Canopy Closure (%):	N/A	69 ± 3	60 ± 2
Aspect (°)	147	171	N/A
Height (m):	Nest = 15.5 ± 0.7 Tree = 32.0 ± 1.5	N/A	N/A

1. Nest trees were predominately Sitka spruce while the surrounding forest at both the site and stand scale were dominated by western hemlock (see Tree Species above).

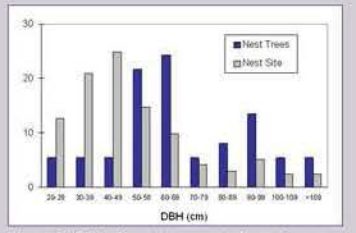


Figure 3. DBH of nest trees and all trees in nest site plots in southeast Alaska.

2. DBH of Nest Trees was larger than that of trees in Nest Site plots (t =21.08, df = 119, $p < 0.0001$) (Figure 3).

3. DBH of trees in Nest Site plots was larger than that of trees in Nest Stand plots (t = 17.86, df = 32, $p < 0.0001$) (Figure 4).

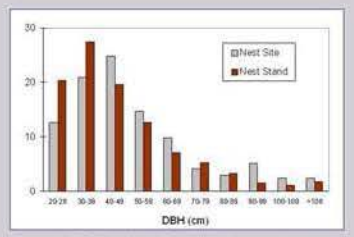


Figure 4. DBH of trees in nest site and nest stand plots in southeast Alaska.

4. Nest Site plots had higher basal area than surrounding Nest Stand plots (F = $9.41_{1,119}$, p = 0.0027) (Figure 5).

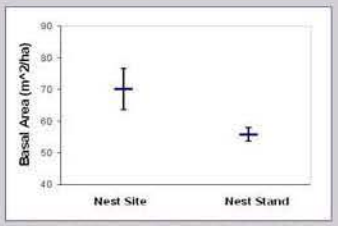


Figure 5. Mean basal area (± SE) of nest site plots and nest stand plots from northern goshawk nesting areas in southeast Alaska.

Summary

Northern goshawks in southeast Alaska appear to be selecting the location of their nests at different spatial scales:

1. At the stand scale, goshawks nests in relatively large volume, western hemlock-dominated forests.
2. Within those stands, nest sites occurs in the larger trees, again predominately western hemlock.
3. The nest tree is one of the largest trees in the site and is often Sitka spruce.

Building on these results, we will perform a principal components analysis to determine which characteristics are most important to goshawks nesting in Southeast Alaska.

Finally, we will compare forest characteristics around goshawk nests to a set of random points (n=884) generated from the Forest Service's Permanent Plot Database.