Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
1996 Field Progress Report
and
Preliminary Stable Isotope Analysis

Goshawk Ecology and Habitat Relationships on the Tongass National Forest

Kim Titus
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Prepared for
US Forest Service
US Fish and Wildlife Service

Study SE-4-2
June 1997

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GOSHAWK ECOLOGY AND HABITAT RELATIONSHIPS ON THE TONGASS NATIONAL FOREST

1996 FIELD SEASON PROGRESS REPORT and PRELIMINARY STABLE ISOTOPE ANALYSIS

Prepared for

USDA FOREST SERVICE
ALASKA REGION
TONGASS NATIONAL FOREST
ORDER NUMBER 43-0109-6-0258

USDA FOREST SERVICE
PACIFIC NORTHWEST FOREST & RANGE EXPERIMENT STATION
JUNEAU FOREST SCIENCES LABORATORY
ORDER NUMBER 43-0109-6-0333
US FISH & WILDLIFE SERVICE
FEDERAL AID IN WILDLIFE RESTORATION
RESEARCH PROGRESS REPORT STUDY SE-4-2 (1 JULY 1996 - 30 JUNE 1997)
AND

US FISH AND WILDLIFE SERVICE
ALASKA REGION
JUNEAU ECOLOGICAL SERVICES

Prepared by

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
DOUGLAS AND KETCHIKAN

JUNE 1997

RESEARCH PROGRESS REPORT

STATE: Alaska **STUDY NO.:** SE-4-2
COOPERATORS: US Fish and Wildlife Service, Alaska Region; US Forest Service, Alaska Region, Tongass National Forest and the Pacific Northwest Forest and Range Experiment Station, Juneau Forest Sciences Laboratory
GRANT NO.: W-24-5
STUDY TITLE: Goshawk Ecology and Habitat Relationships on the Tongass National Forest: 1996 Field Season Progress Report and Preliminary Stable Isotope Analysis
PERIOD: 1 July 1996 - 30 June 1997

SUMMARY

During 1996 Alaska Department of Fish and Game (ADF&G) staff continued northern goshawk (*Accipiter gentilis*) surveys across Southeast Alaska in cooperation with the US Forest Service (FS) and US Fish and Wildlife Service (FWS). The objectives of this multi-year study were to survey goshawks and their nest sites while gathering habitat and survival data as part of an interagency monitoring program. From 1992 through 1995, we documented 42 nesting attempts at 29 nesting areas that were checked for reoccupancy. During the 1996 field season, ADF&G staff monitored the activity status of known nest areas, searched for nest sites in areas where goshawk activity had been observed or reported, captured goshawks at active nest sites, and monitored radiotagged goshawks. A total of 10 active goshawk nests were located across Southeast Alaska in 1996 as a result of interagency efforts. Of the 10 active nests, 4 occurred within previously known nest areas and 6 occurred in new nest areas. One additional nesting area was located in 1996, but it did not meet the specified criteria to be considered active in 1996. Consequently, with the discovery of 7 nest nest areas in 1996, the cumulative number of nest areas documented in Southeast Alaska increased from 36 to 43. A total of 17 goshawks (10 adults, 7 juveniles) were captured in Southeast Alaska during the summer 1996 field season. A total of 10 documented nesting attempts produced 15 young for a mean productivity of 1.5 young/nest (range 0-3). Two nest failures occurred in 1996, resulting in the lowest documented productivity (number of young per active nest) recorded in 6 field seasons of goshawk study. We cooperated in a preliminary analysis of goshawk feathers in 1996 with M. Ben-David of the University of Alaska-Fairbanks. The objective was to determine the potential for using stable isotope analysis of tissue samples as a method for assessing goshawk diet. Preliminary results indicate that goshawk diet during the breeding season was variable among individuals, with some goshawks feeding on songbirds and squirrels, while others fed mainly on intertidal or marine sources, probably birds that feed in this environment.

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

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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 1996, ADF&G, USFS, and US Fish and Wildlife Service (FWS) personnel completed the sixth field season of cooperative nest searches. This report summarizes the results of 1996 field season activities, including ADF&G goshawk surveys and nest area monitoring on the Tongass National Forest, as well as other progress associated with ongoing ecological studies.

Despite years of cooperative effort by ADF&G, USFS, and FWS biologists to locate goshawks and their nests, the number of nesting areas identified to date in Southeast Alaska remains relatively low. After 6 field seasons of searching, 43 goshawk nest areas have been identified. Given the high level of search effort, the relatively low number of documented nesting areas tends to support speculation that goshawk breeding densities in Southeast Alaska are lower than those reported elsewhere within the species' range.

Schempf et. al. (1996) used broadcast conspecific vocalizations during the 1995 breeding season to conduct random systematic surveys for goshawks and their nests in wilderness and roadless areas in Southeast Alaska. These researchers estimated the density of active nest sites within the survey area was 1.49 nests per 100 km^2. Furthermore, they found no evidence to support speculation that wilderness and roadless areas of the Tongass National Forest support a significant reservoir of undocumented goshawk breeding territories that could buffer loss of nesting habitat elsewhere in Southeast Alaska.

Documented goshawk nest site and nest area reoccupancy rates in Southeast Alaska are also low, compared to those reported for the species elsewhere. Between 1992-1995, we documented 42 nesting attempts at 29 nest areas which were checked for reoccupancy. Based on our search efforts, only 13 (31%) of 42 attempts represented nest area reoccupancies (ADF&G, June 1997).

DISCUSSION

NESTING ACTIVITY

Due in part to interagency cooperation, goshawk surveys and nest search efforts increased annually on the Tongass between 1991 and 1994. During 1995 and 1996, reduced funding, personnel limitations, and the completion of timber harvest pre-sale work in some project areas resulted in an overall decrease in goshawk survey effort. During the 1996 field season ADF&G staff associated with the goshawk project focused monitoring the activity status of known nest areas, searching for nest sites in areas where goshawk activity had been observed or reported, capturing goshawks at active nests, and monitoring radiotagged goshawks. Survey efforts included nest searches in proposed timber harvest units as part of pre-sale goshawk inventories, searches at previously identified nest areas, and searches at new locations where goshawks or evidence of nesting were observed or reported. Still other nests were located by tracking radiotagged adult goshawks to nesting areas that differed from that of the previous year.

In 1996, a total of 10 "active" goshawk nests were identified as a result of interagency search efforts in Southeast Alaska. Of the 10 active nests, 4 occurred within previously documented nest areas and 6 occurred within new nest areas located in spring 1996. In addition, 1 newly located but "inactive" nest site was found in southern Southeast (Twelvemile Arm, Prince of Wales Is.). With the discovery of 7 new nest areas in 1996, the cumulative number of nest areas documented in Southeast Alaska increased from 36 to 43. Table 1 provides a site by site summary of the 43 documented nest areas in Southeast Alaska. The total number of active nests and cumulative number of nest areas documented each year in Southeast Alaska from 1991-1996 are presented in Figure 1. The highest number of documented active nests occurred in 1994 when a total of 21 active nest areas were located.

In 1996, as in previous years, nest area reoccupancy rates remained relatively low in Southeast Alaska. Just 4 of 10 nest areas known to be active in 1995 also contained an active nest in 1996. Nest searches ranging from 1 visit lasting several hours, to 10 or more visits over the course of the breeding season were conducted at 26 of the 36 nest areas identified between 1991 and 1995. Based on interagency search efforts only 4 of the 26 nest areas searched contained active nests. Goshawk activity (e.g., responses, sightings) was also detected at 4 known nest areas where active nests were not found. A freshly constructed, but apparently inactive, nest was located at Cat Creek, Cape Fanshaw, indicating this territory was occupied in 1996. The activity status of the 43 documented nest areas in Southeast Alaska are presented in Table 2.

In 1996, 2 radiotagged adult females changed mates and moved to new breeding territories, resulting in the discovery of 2 new nest areas. The distances between sequential year nests for these 2 females were 11.5 and 17.5 miles. To date, 7 adult females have selected new mates and moved to new breeding territories (Table 3). The mean distance between nests for these 7 females was 13.7 miles (range: 2.0 mi. to 26.9 mi.). Although 1 male (Rio Roberts Creek, Prince of Wales Island) moved 1.8 miles to a new nest site, the largest documented move between nests for a male, the alternate nest was still within the male's previously documented breeding territory. We have yet to document an adult male moving to a new breeding territory.

Of 10 active nest areas located in 1996, 4 were found by searching known nest areas, 3 were found by tracking radiotagged adult goshawks to new nest sites which differed from that of the previous year, 2 were found as a result of activities related to timber sale preparation, and 1 was found as a result of forest research activities unrelated to the goshawk project. Of the 43 goshawk nest areas located on the Tongass National Forest since 1991, 22 (51%) were located during activities associated with timber sale preparation or harvest and 21 (49%) were located as a result of searches or events unrelated to timber harvest. The method of detection for the 43 documented nest areas in Southeast Alaska is presented in Table 2.

PRODUCTIVITY

In 1996, a total of 10 documented nesting attempts produced 15 young for a mean productivity of 1.5 young/nest (range 0-3). Two nest failures in 1996 (Game Creek, Chichagof Island, and Kadake Bay, Kuiu Island), resulted in the lowest documented productivity (number of young per active nest) recorded in 6 field seasons of goshawk research. Both nest failures occurred during the late-nestling/early-fledgling dependency period. Prior to 1996, only 1 nest failure had been documented in 46 nesting attempts. For the six year period 1991-1996, 56 documented nesting attempts produced a total of 112 young for a mean productivity of 2.0 young/nest (range: 1.5 - 2.3) (Table 4).

GOSHAWK CAPTURES

In 1996, ADF&G personnel captured a total of 17 goshawks (10 adults, 7 juveniles) at 6 nest sites in Southeast Alaska (Table 5). Radiotransmitters were attached to 11 goshawks (7 adults, 4 juveniles) captured for the first time and replaced on 3 adults captured on one or more previous occasions. In addition to the 17 goshawks captured at nest sites, 1 injured immature male (Auk Bay, Juneau) was rehabilitated, banded, and radiotagged before its release.

Since 1992, ADF&G biologists have captured and/or banded a total of 86 goshawks (41 adults, 39 juveniles, 6 immature) in Southeast Alaska (Table 6). Of these, 77 were fitted with radiotransmitters (41 adults, 32 juveniles, 4 immature), including 70 goshawks (39 adults, 31 juveniles) captured at nest sites and 7 goshawks (2 adults, 1 juvenile, 4 immature) captured away from nest sites.

An immature male goshawk (band # 1807-41976), originally captured 12/30/93 while raiding domestic fowl near Juneau, was recaptured in 1996 as a breeding adult. Following its initial capture at Sunny Point near Juneau, the bird was radiotagged, and released 21.5 miles north of Juneau. Five weeks later, the bird had returned to the vicinity of the Mendenhall Wetlands. It was relocated 8 times between 2/6/94 and 5/18/94 at which time the transmitter signal from the bird was lost. While 7 of 8 relocations were near the Mendenhall Wetlands, on 4/18/94 this bird was relocated as far north as Berners Bay 43.5 miles north of Juneau. On 7/2/96 this goshawk was recaptured as a breeding adult at a nest site on Douglas Island after replacing another radiomarked adult male which died the preceding fall.

Diet Analysis

In 1996, feather samples were collected from 8 captured goshawks and will be used to analyze goshawk food webs by comparing natural abundance of stable isotope ratios (carbon and nitrogen) of goshawk feather samples with tissue samples collected from prey species. A preliminary examination of 15 goshawk feather samples from across Southeast Alaska indicates a high variability in the composition of goshawk diets during the breeding season. It is during this period that goshawks are molting and developing new feathers. Some individuals apparently rely on song birds and squirrels, while others feed mainly on birds or mammals that feed in intertidal or marine environments (Appendix).

Genetic Samples

A previous analysis compared 49 genetic samples from Southeast Alaska goshawks with 336 samples from elsewhere in the United States but failed to provide conclusive results about the subspecific status of *A. g. laingi* (Gavin 1995). Nonetheless, staff biologists have continued to collect blood samples from captured goshawks. In 1996, blood was collected from a sample of captured goshawks. Since 1992, > 60 goshawk blood samples have been collected and are being preserved for future genetic analyses.

Goshawk Conservation Assessment

ADF&G staff associated with the goshawk project were extensively involved in the development and publication of the *Conservation Assessment for the Northern Goshawk in Southeast Alaska,* which is incorporated in the Tongass Land Management Plan Revision for the Tongass National Forest (Iverson et al. 1996). Activities included the compilation, analysis, and summarization of radiotelemetry and other ecological data, development of a strategy for maintaining viable populations of goshawks on the Tongass National Forest, and final editing of the document for publication. Development of the goshawk conservation assessment occupied considerable staff time during 1996 and early 1997.

RECOMMENDATIONS

1996 was the sixth full field season of goshawk study in Southeast Alaska. Study objectives were altered in 1996 to focus on survey and monitoring of nests and adult

goshawks in terms of survival and inter-year 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.

This monitoring work should continue for a few more years to establish adequate sample sizes to understand the importance of goshawk nest sites to the birds, document the portion of the adult population moving between nesting areas, and perhaps estimate survival rates.

One well-identified gap in our knowledge of goshawk ecology in Southeast Alaska is diet and feeding ecology. Analysis of stable isotope tissue samples suggests this technique should be pursued further to better our understanding of goshawk diet.

ACKNOWLEDGMENTS

Field studies and data management associated with ongoing ecological studies occurred with significant interagency cooperation by ADF&G, USFS and FWS. The Forest Service's regional office, the Ketchikan, Stikine, and Chatham area offices, and especially the Thorne Bay, Craig, Misty Fjords, Petersburg, Juneau, Hoonah, and Sitka ranger districts provided important logistical, technical and staff support. Chris Iverson's administrative support, ecological insights, and assistance with practical decisions on study direction were instrumental in making this difficult study a reality. Gene DeGayner and Gary Fisher provided valuable GIS support. LaVern Beier and Tom Schumacher assisted with radiotelemetry data collection. Peter Walsh assisted with field data collection and data management. Other persons deserving special recognition are Cole Crocker-Bedford, Stewart Bentley, Joachim Bilancio, Mike Brown, Kerry Burns, Galia Ely, Cheri Ford, Vince Franke, Byron Gardner, Melissa Green, Kelly Gruber, John Haddox, Moira Ingle, Ken Jouppi, Don Martin, Kurt Merg, Matt Meyers, Susan Patla, Amy Russell, Phil Schempf, Terri Shaw, Terry Suminski, Kris Sundeen, Ernie Hillman (Sealaska Corporation), Noele Weemes (Juneau Raptor Center) and Kim Middleton (Sitka Raptor Center).

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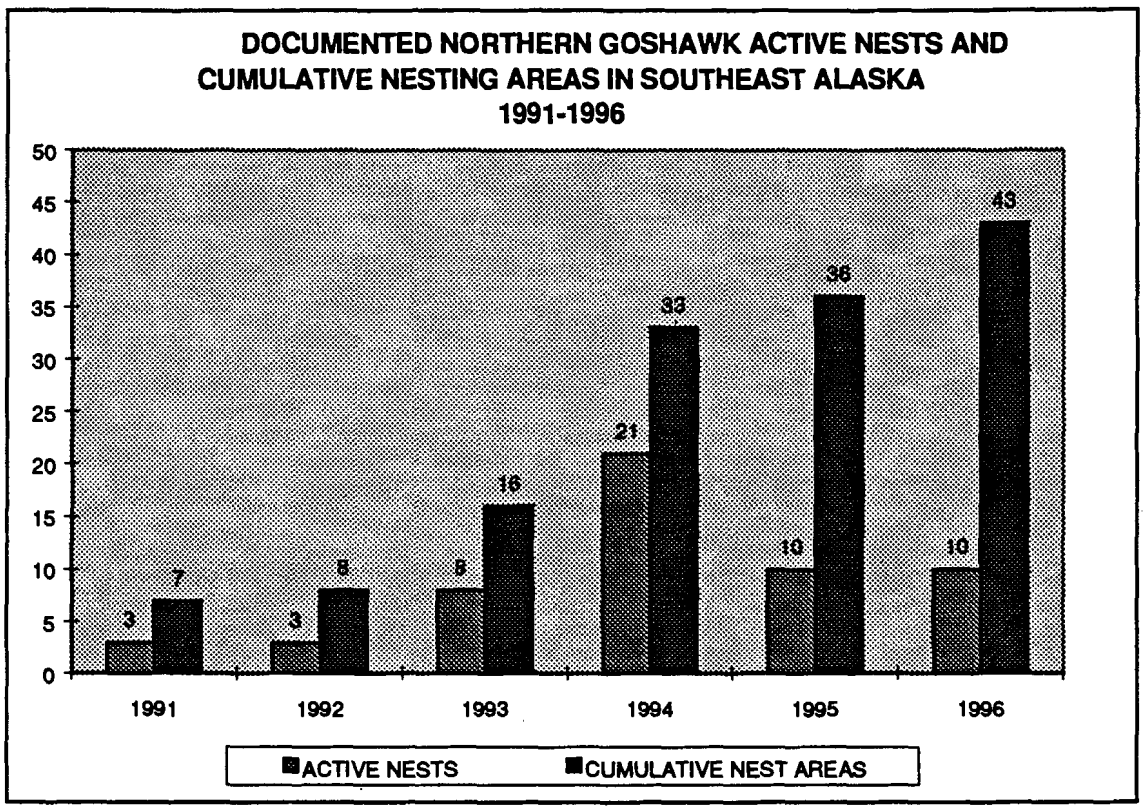

Figure 1 Documented Goshawk active nests and cumulative nesting areas in Southeast Alaska, 1991-1996

Table 1 Goshawk nest site summary, Southeast Alaska, 1996.

A. Ketchikan Area

Nest Area	Status
Butterball Lake, Heceta Island	Site active in 1994. Remains of tagged 1994 adult female recovered in 3/95. Last signal for tagged 1994 adult male in 8/94. No activity observed in 1995 or 1996.
Cutthroat Creek, Prince of Wales Island	New site located in 1996 by tracking 1995 Rio Roberts adult male. Adult male and female captured and tagged on 6/25/96. Single juvenile male captured and tagged on 8/8/96.
Convenient Cove, Hassler Island	Site active in 1994. Adult goshawks observed at site in 4/95 and 5/96 but nest not located.
Logjam Creek, Prince of Wales Island	Site active in 1993. Site checked but no activity observed 1994-96.
Margaret Lake, Revillagigedo Island	Site active in 1994. Goshawks observed in 1995 but nest not located. Active nest found on 4/24/96 in alternate nest first located in 1994. Adult female and male captured and tagged on 6/25/96. Single juvenile male captured and tagged on 8/5/96.
Port Refugio, Suemez Island	Site active in 1989 and 1994. No activity observed in 1995. Adult goshawks observed 1992, 1993, and 1996 but active nest not found.
Rio Roberts Creek, Prince of Wales Island	Site active in 1995. Mortality location of adult female tagged in 1995 confirmed on 3/27/96 near Sweetwater Lake, Prince of Wales Island. Adult male tagged in 1995 tracked to new nest site in 1996 ~1.75 mile to NNE (Cutthroat Creek). 1995 nest inactive.
Sarheen Creek, Prince of Wales Island	Site active in 1991. Goshawk observations reported in vicinity 1993-95 but no nesting activity observed. No activity observed in 1996.
Sarkar Lake, Price of Wales Island	Site active in 1992. No activity observed 1993 or 1994. Adult male responded to playback calls in adjacent stand in 1995. No activity observed in 1996.
Traitors Creek, Revillagigedo Island	Site active in 1994 and 1995. No activity observed in 1996. Transmitter of adult female tagged in 1995 located in creek on 5/1/96; bird presumed dead. Adult male tagged in 1995 last relocated on 1/23/96.
Timber Knob, Heceta Island	New site in 1996. Two fledglings observed and nest located on 7/13/96.
Twelevemile Arm, Prince of Wales Island	Inactive nest located in 1996. Goshawk feathers and prey remains collected on 8/20/96.

Table 1 Continued

B. Stikine Area

Nest Area	Status
Big John Creek, Kupreanof Island	Site active in 1992 and 1993. No activity observed in 1994 or 1995. Site not checked in 1996.
Cat Creek, Cape Fanshaw	Site active in 1994. Adult female tagged in 1994 last relocated in 8/94. No activity observed in 1995. Freshly constructed nest located on 6/6/96 but no additional indication of nesting activity observed.
Duncan Creek, Kupreanof Island	Site active in 1994. No activity observed in 1995. Site checked on 7/18/96. Hairy woodpecker pluck at base of nest tree. No other activity observed.
East Bay of Pillars, Kuiu Island	Site active in 1994 and 1995. Not checked in 1996. 1995 adult female residing in vicinity of Duncan Canal, Kupreanof Island during spring and summer of 1996 but not nesting. Adult male's transmitter recovered 7/10/96 at Rowan Bay, Kuiu Island.. Bird presumed dead.
Irish Lake, Kupreanof Island	New site located in 1996. Two fledglings observed on 7/25/96. Nest located on 7/28/96.
Kadake Bay, Kuiu Island	New site located on 7/15/96 by tracking 1995 West Bay of Pillars adult female to new breeding territory. Remains of single pre-fledge nestling found on ground ~50m from nest tree.
Mitchell Creek, Kupreanof Island	Site active in 1994 and 1995. Checked on 7/17/96. No activity observed. Adult female not tagged in 1995. Remains of adult male tagged in 1995 recovered on north Zarembo Island on 4/1896.
Mossman Inlet, Etolin Island	1986 nest inactive in 1992 and 1993. Site not checked in 1994-96.
Mountain Point, Kupreanof Island	Site active in 1994. Adult female radiotagged in 1994 recovered dead on 5/9/95. Transmitter of adult male tagged in 1994 failed 12/94. No activity observed at site in 1995. Site not checked in 1996.
Nergo Creek, Cape Fanshaw	Site active in 1994. Site occupied by adults in 1995 but active nest not located. Site checked on (6/6/96). No activity observed..
Rowan Creek, Kuiu Island	Site active in 1993. No activity observed in 1994. Unbanded adult male observed at nest site on 7/18/95. Site checked on 7/11/96. No activity observed.
Sanborn Canal, Cape Fanshaw	Site active in 1994. No activity observed in 1995. Site checked on (6/7/96). No activity observed.
Starfish, Etolin Island	Site active in 1991. No activity observed 1992-95. Site not checked in 1996.
Totem Camp, Kupreanof Island	Site active in 1994. No activity observed in 1995. Site not checked in 1996.
Upper Totem Creek, Kupreanof Island	Two inactive nests located in 1993. No activity observed in 1994 or 1995. Site not checked in 1996.
West Bay of Pillars, Kuiu Island	Site active in 1994 and 1995. Not checked in 1996. 1995 radiotagged adult female nested ~3 miles north of Kadake Bay, Kuiu Island with different male in 1996. Remains of adult male tagged in 1995 recovered on (5/6/96) at Rowan Bay, Kuiu Island.

Table 1 Continued

C. Chatham Area

Nest Areas	Status
Blueberry Hill, Douglas Island	Site active in 93, 94, and 95. Not active in 1996. Radiotagged adult female relocated to nest site at Green Cove, Admiralty Island in 96. Radiotagged adult male remains on territory but apparently non-nesting in 96.
Dewey Lake Trail, Mainland	Site active in 85. Not checked 91-96.
Distin Lake, Admiralty Island	Site active in 94. Not checked in 96.
Duffield Peninsula, Barinof Island	Site active in 94, 95, 96. Unmarked pair occupied the same nest all 3 years.
Eagle Creek, Douglas Island	Site active in 93. Adult female relocated to Fish Creek nest site in 94. Radiotagged adult male's transmitter failed in 94. No nesting activity documented in 94, 95 or 96.
Fish Creek, Douglas Island	Site active in 94, 95, and 96. Same adult female all 3 years. Adult male tagged in 94 died 10/95 and was replaced by a 2 year old male originally banded as an immature bird at Sunny Point during 12/94. Site fledged 2 young in 96 one of which was radiotagged.
Florence Bay, Chichagof Island	New site located in 96 by FSL crew doing forest research. Nest stand partially harvested ~ 60-80 years ago. Both adults captured and radiotagged. Fledged 2 juveniles. Old prey remains suggest site was also active in 95.
Green Cove, Admiralty Island	New site located in 96 by following radiotagged Blueberry Hill adult female to new breeding territory. Adult female recaptured and adult male captured and radiotagged in 96. Site fledged 2 juveniles. Prey remains suggest site was also active in 95.
Lace River, Mainland	Site active in 94. Radiotagged adult female disappeared during 10/94. Radiotagged adult male went off the air in 10/95. No nesting activity documented in 95 or 96.
Mud Bay River, Chichagof Island	Site active in 93 and 94. No documented nesting activity in 95. Site not checked in 96.
Nugget Creek, Mainland	Site active in 93 and 94. Radiotagged adult female died during 2/95. Radiotagged adult male remained on territory but presumed to be non-nesting in 95. Adult male went off the air in 10/95. No documented nesting activity in 96.
Pavlof River, Chichagof Island	Site active in 95. Radiotagged adult female non-nesting in 96. No documented nesting activity in 96.
Point Bridget, Mainland	Site active in 92 and 93. Adult male and female radiotagged in 93. Adult female relocated to Lace River in 94. Adult male went off the air in 3/94. Despite repeated goshawk sightings and responses in 94, 95, and 96, no documented breeding activity.
Ready Bullion, Douglas Island	Site active in 91 and 92. Adult female radiotagged in 92 presumed to have died in 9/92. Adult male radiotagged in 92 disappeared during 9/92. Alternate nest, possibly active in 93 or 94, located in 96. No documented nesting activity in 96.
Game Creek, Chichagof Island	Site active in 95 and 96. Radiotagged adult female which went off the air in 10/95 confirmed alive and nesting in 96. Site failed in 96 during fledgling dependency period.

Table 2 Activity status of goshawk nest areas, Southeast Alaska 1986-96*

Nest Area	Found by	80s	90	91	92	93	94	95	96
Ketchikan Area									
Butterball Lake, Heceta Island	radiotag						NAR	O	O
Cutthroat Creek, P.O.W. Island	radiotag								NAR
Convenient Cove, Hassler Island	other						NA	G	G
Logjam Creek, P.O.W. Island	timber					NAR	O	O	O
Margret Lake, Revillagigedo Island	other						NA	G	AR
Port Refugio, Suemez Island (1989)	timber	NA	O	O	G	G	A	G	G
Rio Roberts Creek, P.O.W. Island	other							NAR	O
Sarheen Creek, P.O.W. Island	timber			NA	G	G	O	O	O
Sarkar Lake, P.O.W. Island	other				NAR	O	O	G	O
Timber Knob, Heceta Island	timber								NA
Traitors Creek, Revillagigedo Island	timber						NAR	AR	O
Twelvemile Arm, P.O.W. Island	timber								NO
Stikine Area									
Big John Creek, Kupreanof Island	timber				NA	AR	O	O	O
Cat Creek, Cape Fanshaw	timber						NAR	O	O
Duncan Creek, Kupreanof Island	timber						NA	O	O
East Bay of Pillars, Kuiu Island	radiotag						NAR	AR	X
Irish Lake, Kupreanof Island	timber								NA
Kadake Bay, Kuiu Island	radiotag								NAR
Mitchell Creek, Kupreanof Island	timber						NAR	A	O
Mossman Inlet, Etolin Island (1986)	timber	NA	X	X	O	O	X	X	X
Mountain Point, Kupreanof Island	timber						NAR	O	X
Negro Creek, Port Houghton	timber						NA	G	O
Rowan Creek, Kuiu Island	timber					NAR	O	G	O
Sanborn Canal, Port Houghton	timber						NA	O	O
Starfish, Etolin Island	timber			NA	O	O	O	O	X
Totem Camp, Kupreanof Island	timber						NA	O	X
Upper Totem, Kupreanof Island	timber					NO	O	O	X
West Bay of Pillars, Kuiu Island	radiotag						NAR	AR	X
Chatham Area									
Blueberry Hill, Douglas Island	other					NAR	AR	AR	GR
Dewey Lk., Admiralty Is. (1985, 1987)	other	NA	X	X	X	X	X	X	X
Distin Lake Trail, Admiralty Island	other						NA	X	X
Eagle Creek, Douglas Island	other					NAR	O	O	O
Fish Creek, Douglas Island	radiotag						NAR	AR	AR
Green Cove, Admiralty Island	radiotag								NAR
Florence Bay, Chichagof Island	other								NAR
Lace River, Berners Bay	radiotag						NAR	O	O
Mud Bay River, Chichagof Island	timber					NA	A	G	X
Nugget Creek, Mendenhall Glacier	radiotag					NAR	AR	O	G
Pavlof River, Chichagof Island	timber							NAR	O
Point Bridget, Echo Cove	other				NA	AR	O	G	G
Ready Bullion, Douglas Island	other			NA	AR	O	O	O	O
Duffield Peninsula, Baranof Island	timber						NA	A	A
Game Creek, Chichagof Island	other							NAR	AR

***radiotag** = nest found by tracking radiotagged goshawk.
timber = nest found during timber sale preperation or harvest.
other = nest found during nest search, recreation, or other activity.

N = nest area first located
A = active nest found
G = active nest not found, goshawk activity observed
O = active nest not found, no activity observed
R = adult(s) radiotagged and/or present
X = nest area not checked

Table 3 Distances between nests for adult female goshawks which moved to new breeding territories

Ad. Female	Nest Area Movement	Distance
SLF1	Sarkar Lake, P.O.W. Island to Butterball Lake, Heceta Is.	16.8 mi
BJF1	Big John Lake, Kupreanof Is. to west Bay of Pillars, Kuiu Is.	26.9 mi
RNF1	Rowan Creek, Kuiu Is. to east Bay of Pillars, Kuiu Is.	6.1 mi
ECF1	Eagle Creek, Douglas Is. to Fish Creek, Douglas Is.	2.0 mi
PBF1	Point Bridget, mainland to Lace River, mainland	15.2 mi
BBF1	Blueberry Hill, Douglas Is. to Green Cove, Admiralty Is.	11.5 mi
WPF1	West Bay of Pillars, Kuiu Is. to Kadake Bay, Kuiu Is.	17.5 mi
	mean distance moved	**13.7 mi**

Table 4 Productivity of goshawk nest sites in Southeast Alaska 1991-96[a, b]

Nest Site	# Young Observed						
	1991	1992	1993	1994	1995	1996	Total 1991-96
Ketchikan Area							
Butterball Lake, Heceta Island				3			3
Cutthroat Creek, P.O.W. Island						1	1
Convenient Cove, Hassler Island				2			2
Logjam Creek, P.O.W. Island			1				1
Margret Lake,Revillagigedo				2		1	3
Port Refugio, Suemez Island				0			0
Rio Roberts Creek, P.O.W.					2		2
Sarheen Creek, P.O.W. Island	2						2
Sarkar Lake, P.O.W. Island		2					2
Timber Knob, Heceta Island						2	2
Traitors Creek, Revillagigedo				3	2		5
Twelvemile Arm, P.O.W. Island							0
Stikine Area							
Big John Creek, Kupreanof		2	1				3
Cat Creek, Cape Fanshaw				2			2
Duncan Creek, Kupreanof Island				3			3
East Bay of Pillars, Kuiu Island				3	3		6
Irish Lake, Kupreanof Island						2	2
Kadake Bay, Kuiu Island						0	0
Mitchell Creek, Kupreanof Island				3	1		4
Mountain Point, Kupreanof				2			2
Negro Creek, Port Houghton				3			3
Rowan Creek, Kuiu Island			2				2
Sanborn Canal, Port Houghton				2			2
Starfish, Etolin Island	2						2
Totem Camp, Kupreanof Island				2			2
Upper Totem, Kupreanof Island							0
West Bay of Pillars, Kuiu Island				2	1		3
Chatham Area							
Blueberry Hill, Douglas Island			2	2	2		6
Distin Lake Trail, Admiralty				2			2
Eagle Creek, Douglas Island			2				2
Fish Creek, Douglas Island				3	1	2	6
Green Cove, Admiralty Island						2	2
Florence Bay, Chichagof Island						2	2
Lace River, Berners Bay				1			1
Mud Bay River, Chichagof Island			3	2			5
Nugget Creek, Mendenhall			3	3			6
Pavlof River, Chichagof Island					3		3
Point Bridget, Echo Cove		2	2				4
Ready Bullion, Douglas Island	2	1					3
Duffield Peninsula, Baranof				3	2	3	8
Game Creek, Chichagof Island					3	0	3
TOTAL # of young observed	**6**	**7**	**16**	**48**	**20**	**15**	**112**
TOTAL # of active nests	**3**	**4**	**8**	**21**	**10**	**10**	**56**
MEAN # young/nest	**2.0**	**1.8**	**2.0**	**2.3**	**2.0**	**1.5**	**2.0**

[a] Productivity = number of fledglings when observed, otherwise = number of nestlings.

[b] Excludes 3 nest areas reported active prior to initiation of ADF&G study in 1991.

Table 5 Northern goshawks captured in Southeast Alaska in 1996

Nest Site	Age	Sex	Date	USF&WS Band #/Leg	Previously Banded/Tagged?
KETCHIKAN AREA					
Cutthroat Creek, P.O.W. Island	adult	female	7/1/96	1387-84710 right	no
Cutthroat Creek, P.O.W. Island	adult	male	7/1/96	1807-41984 left	yes Rio Roberts, 6/95
Cutthroat Creek, P.O.W. Island	juvenile	male	8/8/96	1807-41991 left	no
Margaret Lake, Revilla. Island	adult	female	6/25/96	1387-84709 right	no
Margaret Lake, Revilla. Island	adult	male	6/25/96	1807-41988 left	no
Margaret Lake, Revilla. Island	juvenile	male	8/5/96	1807-41990 left	no
CHATHAM AREA					
Duffield Peninsula, Barinof Island	Juvenile	Female	7/24/96	1387-84720 right	no
Duffield Peninsula, Barinof Island	Juvenile	Male	7/24/96	1807-41979 left	no
Duffield Peninsula, Barinof Island	Juvenile	Female	7/25/96	1387-84722 right	no
Fish Creek, Douglas Island	Adult	Female	7/02/96	1387-64182 left	Eagle Creek 7/93 Fish Creek 6/94, 7/95
Fish Creek, Douglas Island	Adult	Male	7/2/96	1807-41976 right	Sunny Point 12/94
Fish Creek, Douglas Island	Juvenile	Male	8/7/96	1807-41980 left	no
Florence Bay, Chichagof Island	Adult	Female	7/16/96	1387-84721 right	no
Florence Bay, Chichagof Island	Adult	Male	7/15/96	1807-41978 left	no
Florence Bay, Chichagof Island	Juvenile	Female	7/25/96	1387-84723 right	no
Green Cove, Admiralty Island	Adult	Female	7/7/96	1387-64177 left	Blueberry Hill 6/93, 6/94, 6/95
Green Cove, Admiralty Island	Adult	Male	7/11/96	1807-41977 left	no

STIKINE AREA

No goshawks were captured or radiotagged on the Stikine Area during the 1996; however, two previously tagged goshawks are being monitored: 1.) the 1995 West Bay of Pillars, Kuiu Island adult female (band # 1387-64206) was tracked to a nest site ~3 miles north of Kadake Bay, Kuiu Island on 7/15/96. This site apparently failed in the late nestling phase due to predation; 2.) the 1995 East Bay of Pillars, Kuiu Island adult female (band # 1387-64183) resided near Duncan Canal, Kupreanof Island during the spring and summer of 1996 and, based on telemetry relocations, appears not to have nested.

Table 6 Goshawks banded in Southeast Alaska, 1992-96

#	DATE	LOCATION	AGE	SEX	BAND #	LEG	STAT	RECAP	TAG?
1	2/10/92	Sunny Point, Juneau	adult	female	1387-02003	left	dead	93, 94	Y
2	3/10/92	Sunny Point, Juneau	immature	female	1387-02004	?	ukn		N
3	6/10/92	Sarkar Lake, P.O.W. Island	adult	female	1387-64171	right	dead	94	Y
4	6/10/92	Sarkar Lake, P.O.W. Island	adult	male	1807-41951	left	dead		Y
5	6/29/92	Sarkar Lake, P.O.W. Island	juvenile	male	1807-41952	right	unk		Y
6	7/2/92	Ready Bullion Cr., Douglas Is.	juvenile	female	1387-64172	right	dead		Y
7	7/2/92	Ready Bullion Cr., Douglas Is.	adult	female	1387-64173	right	dead		Y
8	7/2/92	Ready Bullion Cr., Douglas Is.	adult	male	1807-41953	right	unk		Y
9	7/28/92	Sarkar Lake, P.O.W. Island	juvenile	male	1807-41954	left	unk		Y
10	8/12/92	Big John Cr., Kupreanof Is.	juvenile	female	1387-64174	right	unk		N
11	8/12/92	Big John Cr., Kupreanof Is.	juvenile	female	1387-64175	left	unk		N
12	8/14/92	Falls Cr., Mitkof Island	juvenile	male	1807-41955	left	unk		N
13	9/8/92	Hungary Point, Mitkof Island	immature	female	1807-41961	right	dead		Y
14	6/29/93	Blueberry Hill, Douglas Is.	adult	female	1387-64177	left	alive	94,95,96	Y
15	6/29/93	Blueberry Hill, Douglas Island	adult	male	1807-41956	right	alive	94, 95	Y
16	7/1/93	Nugget Cr. Juneau	adult	male	1807-41957	right	unk	94	Y
17	7/6/93	Point Bridget, Juneau	adult	female	1387-64178	right	unk	94	Y
18	7/6/93	Point Bridget, Juneau	adult	male	1387-64179	left	unk		Y
19	7/13/93	Big John Cr., Kupreanof Is.	adult	female	1387-64181	left	unk	94	Y
20	7/13/93	Big John Cr., Kupreanof Is.	juvenile	male	1807-41958	left	dead		Y
21	7/13/93	Big John Cr., Kupreanof Is.	adult	male	1807-41962	right	unk		Y
22	7/23/93	Eagle Cr., Douglas Is.	adult	female	1387-64182	left	alive	94,95,96	Y
23	7/23/93	Eagle Cr., Douglas Island	adult	male	1807-41963	right	unk		Y
24	7/28/93	Rowan Cr., Kuiu Island	adult	female	1387-64183	left	alive	95	Y
25	7/28/93	Rowan Cr., Kuiu Island	adult	male	1807-41964	right	dead		Y
26	8/4/93	Logjam Cr., P.O.W. Island	adult	male	1807-41965	right	dead		Y
27	8/4/93	Logjam Cr., P.O.W. Island	juvenile	male	1807-41966	left	unk		Y
28	8/9/93	Nugget Cr. Juneau	juvenile	female	1387-64196	left	unk		Y
29	8/9/93	Nugget Cr. Juneau	juvenile	female	1387-64197	right	unk		Y
30	8/13/93	Blueberry Hill, Douglas Is.	juvenile	female	1387-64198	right	unk		Y
31	8/13/93	Eagle Cr., Douglas Island	juvenile	male	1807-41967	right	unk		Y
32	8/13/93	Eagle Cr., Douglas Island	juvenile	male	1807-41968	left	unk		Y
33	8/16/93	Rowan Cr., Kuiu Island	juvenile	female	1387-64184	right	dead		Y
34	8/16/93	Point Bridget, Juneau	juvenile	male	1807-41959	left	unk		Y
35	8/16/93	Point Bridget, Juneau	juvenile	male	1807-41960	right	dead		Y
36	8/17/93	Rowan Cr., Kuiu Island	juvenile	female	1387-64185	left	unk		Y
37	8/19/93	Big John Cr., Kupreanof Is.	juvenile	female	1387-64180	right	dead		Y
38	12/28/93	Petersburg, Mitkof Island	adult	male	1807-41969	left	unk		Y
39	6/17/94	Butterball Lake, Heceta Is.	adult	male	1807-41970	left	dead		Y
40	6/24/94	Fish Cr., Douglas Island	adult	male	1807-41971	right	dead	95	Y
41	6/27/94	Lace River, Juneau Mainland	adult	male	1807-41972	left	unk		Y
42	7/1/94	East Bay of Pillars	adult	male	1807-41973	right	dead	95	Y
43	7/8/94	Mitchell Cr., Kupreanof Is.	adult	female	1387-64192	right	unk		Y

Table 6 Continued

#	DATE	LOCATION	AGE	SEX	BAND #	LEG	STAT	RECAP	TAG?
44	7/8/94	Mitchell Cr., Kupreanof Is.	juvenile	female	1387-64194	right	unk		N
45	7/10/94	Mountain Point, Kupreanof Is.	adult	female	1387-64193	right	dead		Y
46	7/10/94	Mountain Point, Kupreanof Is.	adult	male	1807-41974	left	unk		Y
47	7/13/94	Cat Cr., Cape Fanshaw	adult	female	1387-64195	right	unk		Y
48	7/21/94	Traitors Cr., Revillagigedo Is.	adult	female	1387-64200	right	dead	95	Y
49	7/27/94	Convenient Cove, Hassler Is.	juvenile	female	1387-64201	left	unk		Y
50	8/1/94	Butterball Lake, Heceta Is.	juvenile	female	1387-64202	right	unk		Y
51	8/2/94	Fish Cr., Douglas Island	juvenile	female	1387-64186	right	unk		Y
52	8/2/94	Fish Cr., Douglas Island	juvenile	female	1387-64187	right	unk		Y
53	8/10/94	Mountain Point, Kupreanof Is.	juvenile	female	1387-64199	right	dead		Y
54	8/11/94	Duncan Cr., Kupreanof Is.	juvenile	female	1387-64203	right	dead		Y
55	8/17/94	West Bay of Pillars, Kuiu Is.	juvenile	female	1387-64189	right	unk		Y
56	11/9/94	Sunny Point, Juneau	immature	female	1387-64190	right	dead		Y
57	12/31/94	Sunny Point, Juneau	immature	male	1807-41976	right	alive	96	Y
58	2/3/95	Vallenar Point, Gravina Is.	immature	female	1807-41989	right	unk		N
59	6/27/95	Traitors Cr., Revillagigedo Is.	adult	male	1807-41975	left	unk		Y
60	6/29/95	Rio Roberts Cr., P.O.W. Is.	adult	female	1387-64205	right	dead		Y
61	6/29/95	Rio Roberts Cr., P.O.W. Is.	adult	male	1807-41984	left	alive	96	Y
62	7/7/95	West Bay of Pillars, Kuiu Is.	adult	female	1387-64206	right	alive		Y
63	7/7/95	West Bay of Pillars, Kuiu Is.	adult	male	1807-41985	left	dead		Y
64	7/9/95	Mitchell Cr., Kupreanof Is.	adult	male	1807-41986	left	dead		Y
65	7/27/95	Pavlof River, Chichagof Is.	juvenile	female	1387-64191	right	unk		Y
66	7/28/95	Pavlof River, Chichagof Is.	adult	female	1387-84716	right	alive		Y
67	8/1/95	Fish Cr., Douglas Island	juvenile	female	1387-84717	right	unk		Y
68	8/4/95	Game Cr., Chichagof Is.	juvenile	female	1387-84718	right	unk		Y
69	8/8/95	Rio Roberts Cr., P.O.W. Is.	juvenile	female	1387-84701	left	unk		Y
70	8/8/95	Rio Roberts Cr., P.O.W. Is.	juvenile	male	1807-41987	right	unk		Y
71	8/11/95	Traitors Cr., Revillagigedo Is.	juvenile	female	1807-57801	right	unk		Y
72	8/16/95	Game Cr., Chichagof Is.	adult	female	1387-84719	right	alive		Y
73	6/25/96	Margaret Lake, Revilla. Is.	adult	female	1387-84709	right	alive		Y
74	6/25/96	Margaret Lake, Revilla. Is.	adult	male	1807-41988	left	alive		Y
75	7/1/96	Cutthroat Creek, P.O.W. Is.	adult	female	1387-84710	right	alive		Y
76	7/11/96	Green Cove, Admiralty Island	adult	male	1807-41977	left	alive		Y
77	7/15/96	Florence Bay, Chichagof Is.	adult	male	1807-41978	left	alive		Y
78	7/16/96	Florence Bay, Chichagof Is.	adult	female	1387-84721	right	alive		Y
79	7/24/96	Duffield Peninsula, Barinof Is.	juvenile	female	1387-84720	right	unk		N
80	7/24/96	Duffield Peninsula, Barinof Is.	juvenile	male	1807-41979	left	unk		N
81	7/25/96	Duffield Peninsula, Barinof Is.	juvenile	female	1387-84722	right	unk		Y
82	7/25/96	Florence Bay, Chichagof Is.	juvenile	female	1387-84723	right	unk		N
83	8/5/96	Margaret Lake, Revilla. Is.	juvenile	male	1807-41990	left	alive		Y
84	8/8/96	Cutthroat Creek, P.O.W. Is.	juvenile	male	1807-41991	left	alive		Y
85	8/7/96	Fish Creek, Douglas Island	juvenile	male	1807-41980	left	unk		Y
86	12/7/96	Auk Bay, Juneau mainland	immature	male	1807-41981	left	alive		Y

APPENDIX

DIET ANALYSIS OF NORTHERN GOSHAWKS USING STABLE ISOTOPE RATIOS

Preliminary Progress Report

MERAV BEN-DAVID
UNIVERSITY OF ALASKA FAIRBANKS
August 1996

APPENDIX DIET ANALYSIS OF NORTHERN GOSHAWKS USING STABLE ISOTOPE RATIOS

Preliminary Progress Report

MERAV BEN-DAVID
UNIVERSITY OF ALASKA FAIRBANKS
August, 1996 in cooperation with interagency goshawk project

INTRODUCTION

I used stable isotope ratios to indicate diets of Northern Goshawks. In nature carbon and nitrogen each occur as two stable isotopes: ^{12}C and ^{13}C ;^{14}N and ^{15}N. Ratios of the 2 isotopes as compared with standards are noted as $\delta^{13}C$ for carbon and $\delta^{15}N$ for nitrogen, and are measured in parts per thousand (‰; Ehleringer and Rundel, 1988). The analysis of food webs using natural abundance of stable isotope ratios compares the $\delta^{13}C$ and $\delta^{15}N$ values of tissues from predator and prey. Values of $\delta^{13}C$ differ between terrestrial and marine food sources due to differential assimilation of ^{13}C by primary producers in these ecosystems, and enable tracing food webs (Fry and Sherr, 1988; Tieszen and Button, 1988). Values of $\delta^{15}N$ increase with transfer between trophic levels and therefore reflect both diet and trophic levels (DeNiro and Epstein, 1981). The specific combination of values of $\delta^{13}C$ and $\delta^{15}N$ result from the dietary interaction of species or individuals (Ambrose and DeNiro, 1986; Gearing, 1991; Hobson, 1991; Schell et al., 1988; Schoninger and DeNiro, 1984). Applying this technique to tissues, such as blood or feathers, allows repeated sampling of known individuals in different seasons or years (Hobson, 1991).

METHODS

Sampling - Goshawk feathers were collected during summer from nests in the coastal rain forests of the Pacific northwest. 1 feather from each nest site was selected at random for the stable isotope analysis.

Stable Isotope Ratio Analysis - a sub-sample from the tip of each feather (1-1.5 mg) was cut and placed in a miniature tin cup (4 by 6 mm) for combustion. I used a Europa C/N continuous flow mass-spectrometer to obtain the stable isotope ratios. Each sample was analyzed in duplicate and results were accepted only if the variance between the duplicates did not exceed that of the peptone standard. Stable Isotope values for possible prey were adopted from Ben-David (1996). I selected values of salmon and intertidal fish to represent marine birds such as fish crows, shorebirds, marbled murrelets, and pigeon guillemots, because no data were available for these birds.

I determined the diet source for each goshawk based on the combined values of $\delta^{13}C$ and $\delta^{15}N$. I used a dual-isotope, multiple-source mixing model, (Ben-David, 1996; Kline et

al., 1993), to estimate of the contribution of each prey item to the diet of the predator. This model uses the mean $\delta^{13}C$ and $\delta^{15}N$ value of each type of prey. This mean value (*A*, *B*, *C*, etc.) is then corrected for the enrichment in predator ratios compared with its diet (i.e., fractionation values; *A'*, *B'*, *C'*, etc.; Ben-David, 1996; DeNiro and Epstein, 1981; Kline et al., 1993; Tieszen and Button, 1988). Euclidean distance between the corrected isotopic values of prey and each individual predator (i.e. the length of the line connecting *A'* and *P*, *B'* and *P*, etc.) is then calculated by $z = \sqrt{x^2 + y^2}$. The contribution of each prey to the diet of the predator is inversely related to the distance between the corrected signature of the prey and the predator (i.e., the shorter the distance the greater the contribution). Because of this inverse relationship, the relative contribution of each prey is calculated by:

$$\% X \text{ in diet} = (PX'^{-1} / PA'^{-1} + PB'^{-1} + PC'^{-1}) \times 100,$$

where *X'* is *A'*, *B'* or *C'*.

The mixing model requires that isotopic values of all prey be significantly different from each other. This model assumes that each individual predator consumes all possible types of prey. Therefore this model will tend to overestimate the proportion of food items that are rarely consumed and underestimate the proportion of commonly used prey. Consequently, I used the model as an index of prey consumption rather than as actual proportions in the diet.

I used fractionation values of 2 ‰ for carbon when mammalian prey, and avian prey, were consumed, and 1 ‰ when salmon was consumed (Ben-David, 1996; Hobson, 1991; S. Farley and C. Robbins, pers. comm.). Also, I used fractionation values of 3 ‰ for nitrogen when mammalian prey, and avian prey, were consumed and 2 ‰ when salmon was consumed (Ben-David, 1996; Hobson, 1991).

RESULTS AND DISCUSSION

Diets of goshawks during the breeding season showed high variability in composition (Figure1). Some individuals relied on songbirds and squirrels, while others fed mainly on intertidal or marine sources probably birds that feed in this environment (Figure 1). Using the multi-source mixing model, I determined the percentage of the different prey items in the diet of each individual Goshawk (Table 1). The diet of nine individuals was largely composed of squirrels (> 40% of diet). It is possible, however, that grouse will have the same stable isotope signatures as squirrels, in which case grouse will comprise a large part of the goshawk diet. Four of the goshawks had stable isotope values characteristic of marine derived diet (Table 1), probably shorebirds, fish crows, marbled murrelets, and pigeon guillemots. Obtaining tissues from grouse as well as marine birds will be crucial to further understand the importance of these prey to goshawks in the coastal environment of the Pacific Northwest. It is important that assumptions be understood and tested about the variety of prey before making final interpretations of the data (Gannes et al. 1997). The pattern arising from the stable isotope values suggests that although goshawks can be considered opportunistic feeders on the population level, individuals show specialization in

their diet. This merits further investigation, and data on age, location of home range on the landscape and prey availability will be useful for understanding and explaining the variation in individual goshawk diets.

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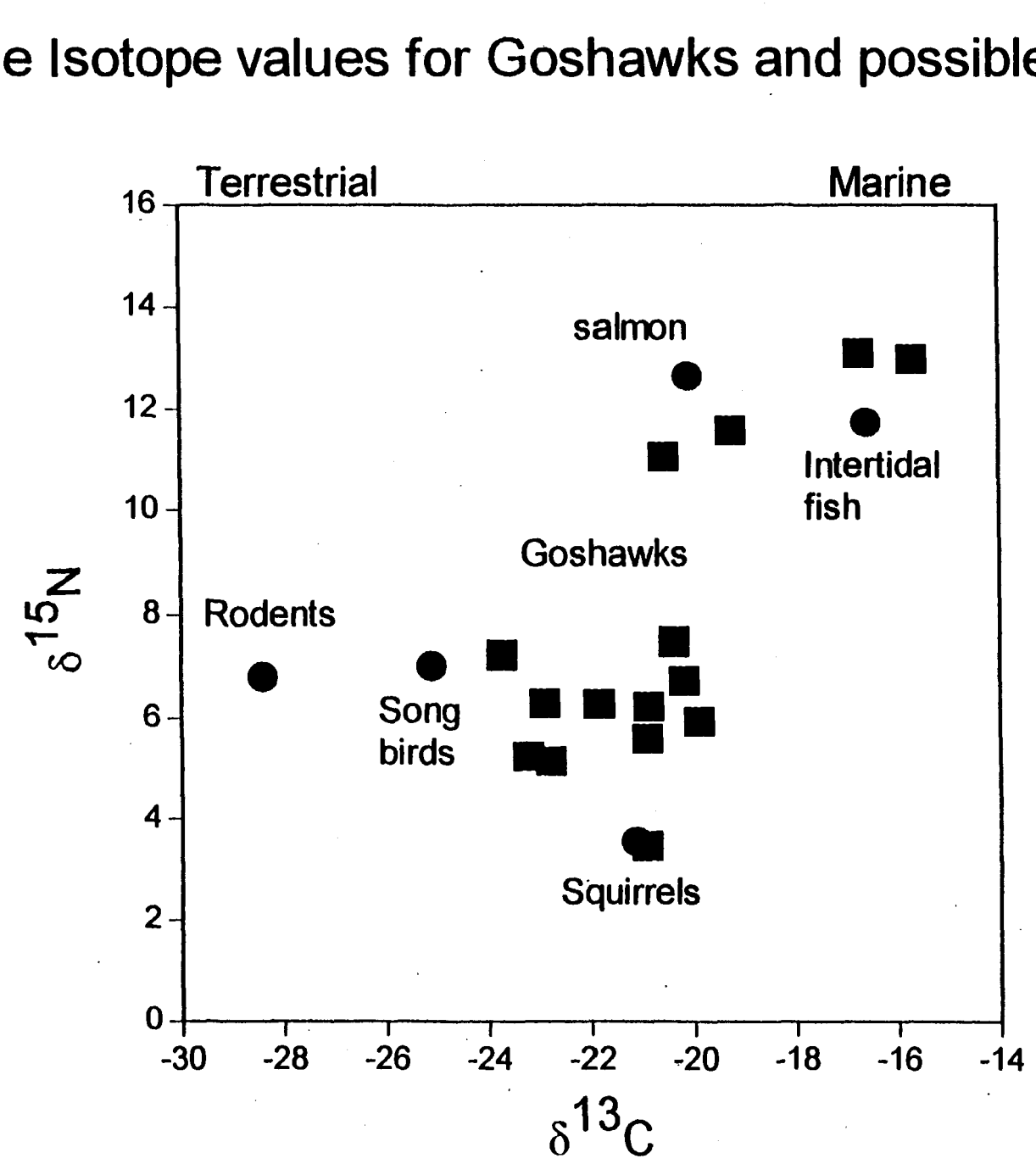
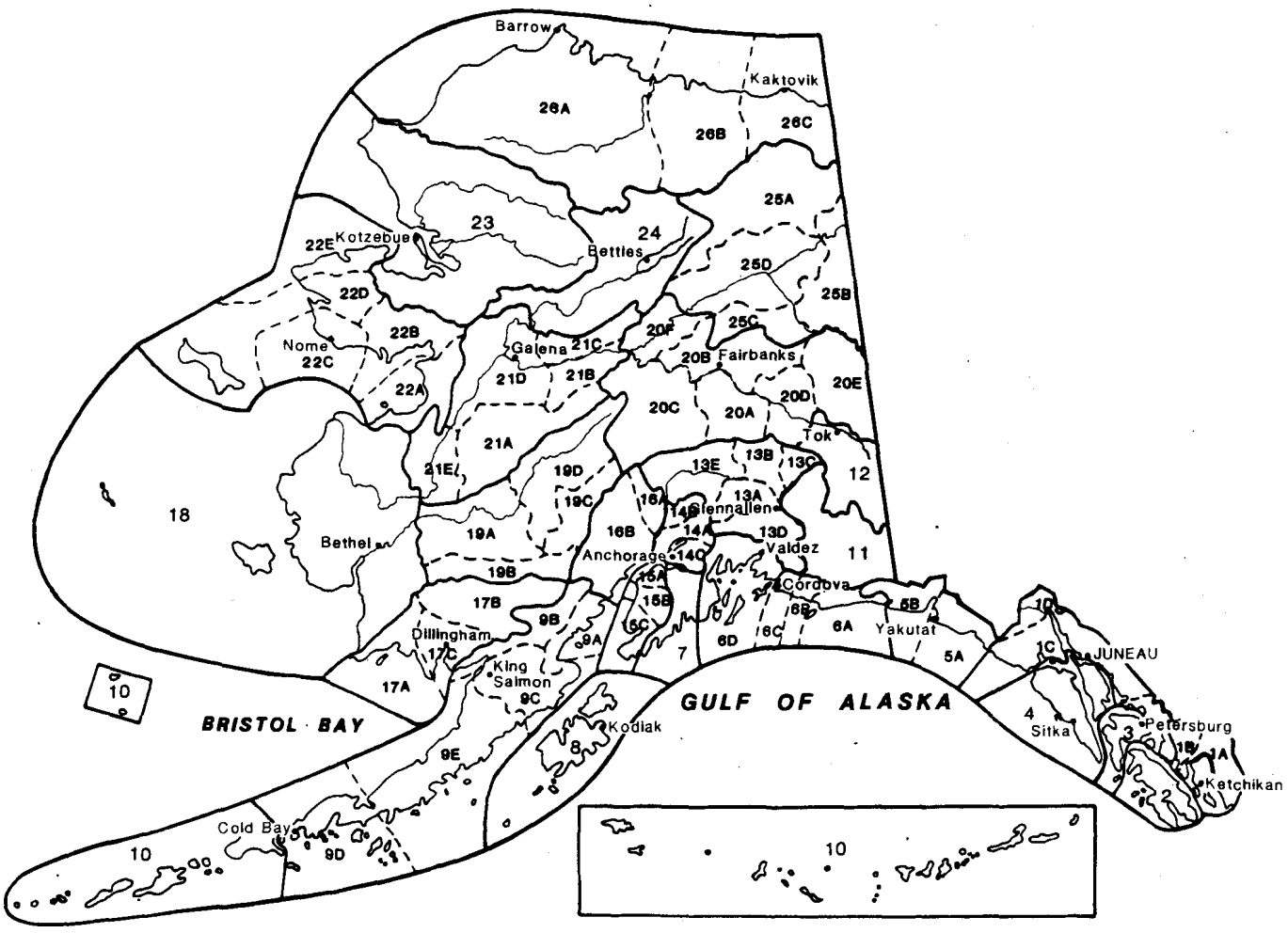


Figure 1 Stable isotope values for Goshawks and possible prey

Table 1 Stable isotope ratios, and percent of prey in diet of Northern Goshawks, established from feathers collected in the Pacific Northwest

Sample ID	Date	Age	Location	Sex	Feather	C	N	% Salmon	% Birds	% Squirrel	% tidal
NGH1	1995	Adult	Fish Creek Douglas Is.	M	secondary	-23.24	5.19	13.1	35.7	40.1	11.1
NGH2	1/14/94	Adult	Stikine River Mitkoff Is.	M	deck	-21.86	6.23	10.1	29.8	51.6	8.5
NGH3	1993	Adult	Logjam Creek, POWI	?	primary	-20.57	11	27.1	32.4	23.4	17.1
NGH4	1995	Adult	Pavlof River, Chichagof Is.	F	contour	-20.93	5.53	8.6	19.7	64.2	7.5
NGH5	1993	Adult	Rowan Creek, Kuiu Is.	F?	primary	-20.9	6.17	6.8	16.4	71.1	5.8
NGH6	1995	Adult	Nugget Creek, Juneau	F	primary	-19.91	5.87	5.9	11.7	77.1	5.3
NGH7	1992	Adult	Sarkar Lake, POWI	?	primary	-19.26	11.53	34.4	22.9	20.7	22.0
NGH8	1993	Adult	Eagle Creek, Douglas Is	?	contour	-22.9	6.24	11.7	39.5	39.0	9.6
NGH9	1993	adult	Mud Bay River, Chichagof Is	?	primary	-16.75	13.05	31.6	11.7	12.0	44.7
NGH10	1993	Adult	Blueberry Hill, Douglas Is	?	secondary	-20.19	6.67	2.0	4.3	91.9	1.7
NGH11	1992	Adult	Ready Bullion, Douglas Is	F	primary	-23.74	7.18	11.3	52.5	27.2	9.0
NGH12	Jul-93	Adult	Big John River, Kupernof Is	?	secondary	-20.4	7.43	8.5	19.9	64.4	7.1
NGH13	1992	Adult	Point Bridgit, Juneau	?	secondary	-22.8	5.09	12.7	33.4	43.1	10.8
NGH14	1990	Adult	Suemez Is. Alaska	F?	primary	-15.72	12.94	24.4	11.0	11.8	52.8
NGH15	late 1980s	Juv.	Olympic Pen. Washington	?	secondary	-20.94	3.41	13.6	25.8	48.3	12.3

Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

Craig J Flatten