Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Ecology of Martens in Southeast Alaska

1 July 1995 -30 June 1996

Rodney W Flynn
Thomas Schumacher

'UMACHER

Grant W-24-4
Study 7.16
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STATE OF ALASKA
Tony Knowles, Governor

DEPARTMENT OF FISH AND GAME
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RESEARCH PROGRESS REPORT

STATE: Alaska **STUDY NO.:** 7.16

COOPERATORS: Ted Schenck, U. S. Forest Service; Jim Faro, ADF&G, Merav Ben-David, UAF

GRANT NO.: W-24-4

STUDY TITLE: Ecology of martens in Southeast Alaska

PERIOD: 1 July 1995-30 June 1996

SUMMARY

During the sixth year of fieldwork on this project, we captured 61martens (*Martes americana*) (42 males and 19 females) on the Salt Lake Bay study area and 16 martens (8 males and 8 females) in Upper Game Creek, northeast Chichagof Island. At Salt Lake Bay, we radiocollared 10 new martens (8 males and 2 females) and only eartagged 36 others. At Game Creek we radiocollared 2 previous captures (2 females) and eartagged 14 others. Altogether, we monitored 38 martens (24 males and 14 females). The high juvenile:adult ratio (1.1) of the animals live trapped in the fall indicated recruitment was relatively high in 1995.

During March 1996, we estimated that about 38 martens, or 0.45 martens/km^2, were on the Salt Lake Bay study area. This abundance estimate was slightly less (16%) than the number of martens estimated in March 1995. Only 3 male martens with active radio collars died during the period. One death appeared from natural causes, and we found 1 marten dead in a trap after the trapping season. One male died of an injury during our live trapping. No one trapped the primary study area at Salt Lake Bay this year.

We recorded habitat use of radiocollared martens at 449 aerial locations during the year. Habitat data were not analyzed for this report. We monitored 8 adult females closely during the late spring to locate den sites. Four of the females showed localized movements, and we found 4 natal dens and 1 maternal den. All dens were in stumps, snags, or logs. Our observations at the den sites indicated that none of these females successfully reared young. Also, we located 13 summer rest sites. Habitat attributes were measured at the den and rest sites to examine microhabitat use.

Our snap-trap index for small mammal numbers showed a decrease (about 27%) from fall 1994. The overall decline resulted from a 55% decline in the catch of deer mice (*Peromyscus keeni*). The catch rate for long-tailed voles (*Microtus longicaudus*) increased 37.5% (8.0 to 11.0 captures/100 trap nights). Because voles are an important food source for martens, the higher snap-trap index for voles may have compensated for the overall decrease in rodents. The lack of females successfully rearing young in spring 1996 indicated that food availability probably decreased over the winter. We expect a decrease in marten recruitment in fall 1996.

Key words: Chichagof Island, demographics, forestry, habitat use, martens, *Martes americana*, modeling, old-growth forests, population biology, Southeast Alaska

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BACKGROUND

We completed a sixth year of ecological research on martens in Southeast Alaska. This report contains a brief summary of information collected from 1 July 1995 to 30 June 1996, the 1995-1996 biological year. We present progress on each of the 10 specific jobs of the study. During this report period, all jobs were active with an emphasis on jobs 1, 4, and 5. Each year, we have periodically live trapped the study area on northeast Chichagof Island to monitor the population and radiocollar a sample of martens. We studied the movements, demography, and habitat use of the radiocollared martens. Additional demographic information on the marten population on northeast Chichagof Island was collected from martens caught by trappers. This study was partially supported by the USDA Forest Service, Chatham Area, through purchase order number 43-0109-9-0749. We also submitted this report to Forest Service personnel to satisfy their reporting requirements. Additional background information on the study can be found in Flynn (1991).

This year, we put more effort into studying the microhabitat use of martens at den and resting sites. In August 1995, Tom Schumacher enrolled at the University of Wyoming to pursue a masters of science degree. His thesis topic is the habitat selection by American martens at den and rest sites. After completing a semester of classes, Tom returned to Southeast Alaska in January to begin fieldwork.

Martens are associated with late-succession and old-growth forests across much of North America (Weckwerth and Hawley 1962, Koehler et al. 1975, Mech and Rogers 1977, Soutiere 1978, Steventon and Major 1982, Spencer et al. 1983, Snyder and Bissonette 1987, Bissonette et al. 1989, Buskirk et al. 1989). Typically, marten populations have declined with the removal of forested habitat, increased human access, and unrestricted trapping (Clark et al. 1987). In Southeast Alaska, martens have been the focus of the fur industry with an average annual harvest of 2770 animals from 1984 and 1988 (ADF&G unpubl. records, Douglas, AK). Because forest management activities were expected to affect population abundance, and marten pelts represented significant economic value to local residents, martens were selected as a management indicator species (MIS) for the revision of the Tongass Land Management Plan (TLMP) (Sidle and Suring 1986, USDA Forest Service 1990). Old-growth forests were identified as a special habitat for martens in Southeast Alaska where the Tongass National Forest encompasses more than 90% of the land area. Although most of the original forested land was old growth, industrial-scale logging has converted about 180,000 ha of old-growth forest habitats into clearcuts and second growth on the Tongass National Forest. The current Tongass National Forest Land Management Plan (TLMP) scheduled an additional 708,000 ha for clearcut logging (USDA Forest Service 1990). The Forest Service's land management plan is currently under revision (USDA Forest Service 1996).

OBJECTIVES

This research was designed to describe the habitat and population ecology of martens on northeast Chichagof Island. The information from this study will be used to evaluate the interagency habitat capability model.

The specific study objectives (Jobs 1-8) are listed below.

1. Determine seasonal habitat use and selection patterns of a sample of martens living in logged and unlogged landscapes at the microsite, stand, and landscape level;

2. Determine the composition of habitats within the northeast Chichagof Island study area;

3. Evaluate the interagency habitat capability model;

4. Determine the demographic characteristics of marten populations on northeast Chichagof Island;

5. Determine marten movement and spatial patterns of martens on northeast Chichagof Island;

6. Determine the relative abundance of small mammal prey within the Chichagof Island study area;

7. Determine the seasonal diets of martens on northeast Chichagof Island; and

8. Evaluate whether the skull size criteria developed by Magoun et al. (1988) correctly classify Southeast martens by sex and age.

STUDY AREA

We chose northeast Chichagof Island for the study because its topography and habitats were typical of northern Southeast Alaska. Also, logging roads provided good access, part of the area had been logged, camp facilities were available at a Forest Service float house, and the area was relatively close to Juneau. We selected the lands adjacent to Salt Lake Bay (58° 56' N, 135° 20' E), located about 90 km (56 miles) west of Juneau and 26 km (16 miles) south of Hoonah, as the primary study area. The Salt Lake Bay study area (125 km^2) was bounded by Port Frederick to the north, Tenakee Inlet to the south, the portage (an narrow strip of land between the large water bodies) on the west, and the Game Creek and Indian River drainages on the east and north (Fig. 1). In 1992, we expanded the study into the upper Game Creek watershed (102 km^2), located north of Salt Lake Bay. Most of the study area was under the jurisdiction of the USDA Forest Service within the Chatham Area, Tongass National Forest. Habitats in the study area are further described in Flynn (1991).

About 7% of the Salt Lake Bay study area was logged from 1984 to 1988, and 27 km of logging roads were constructed. An additional 486 ha were clearcut from 1990 to 1992 (USDA Forest Service 1989). Logging activity began in June 1990 with the construction of about 10 km of logging road. Two units were felled before a court injunction suspended all logging activity at the end of June 1990. The court injunction was lifted during August 1991, and logging resumed September 1991. Logging activity continued until 10 December and about one half of the units were felled. Logging activity was suspended for the winter and resumed again in April 1992. All logging activity in the Salt Lake Bay area was completed 31 October 1992.

The upper Game Creek watershed was the last major unlogged watershed on northeast Chichagof Island. Road building in the upper Game Creek drainage began in April 1992 with the construction of a bridge across the North Fork and 2 bridges across Game Creek. Road building continued at a rapid pace for the remainder of the year, and most of the planned road system was completed by winter. All the low-elevation cutting units were felled during summer and fall. During spring 1993, road building continued into the upper watershed of adjacent Seagull Creek, and the remaining upper-elevation units in Game Creek were felled during 1993 and 1994. All of the logging activity was completed during 1995.

Recreational and subsistence trapping seasons for martens, mink, and weasels on the northeast portion of Chichagof Island were closed for the 1990-1991 regulatory year because of depleted marten populations. The portion of northern Chichagof Island west of Port Frederick remained open with season dates from 1 December to 15 February. The trapping season for both portions of northern Chichagof Island opened on 1 December for the 1991-1992 season. On northeast Chichagof Island, trapping with the use of a motorized land vehicle was prohibited on federal lands by federal subsistence regulation. The trapping seasons for marten, mink, and weasels were closed by emergency order on 24 January 1992 because of concern about the overharvest of martens. During the 1992-1993 season, marten trapping on northern Chichagof Island was allowed only during December. The prohibition of trapping with the use of a motorized land vehicle on federal lands by federal subsistence regulation was extended to cover the west side of Port Frederick. For the remainder of Unit 4, the marten trapping season ran from 1 December to 15 February with no additional restrictions. Marten trapping seasons remained the same in 1993-1994 as the previous year.

For 1994-1995, the recreational and subsistence trapping seasons for martens, mink, and weasels on Chichagof Island were closed on federal lands by the federal subsistence board because of low marten numbers. The state season on nonfederal lands remained the same, a 31-day season on northeast Chichagof Island during December and a 75-day season everywhere else beginning December 1. For 1995-1996, the Federal Subsistence Board established a 31-day trapping season, opening on December 1, for federal lands on Chichagof Island, and prohibited the use of motorized land vehicles for trapping. The state trapping seasons remained the same as the previous year.

METHODS

Most study jobs required the capture and radiocollaring of a sample of martens on the primary study area. Martens were live trapped throughout the year at permanent trap sites systematically located along the logging road system. Trap sites were usually about 500 m apart. Traps (Models 203 and 205, Tomahawk Live Trap Co., Tomahawk, WI) were baited with strawberry jam during summer and sardines or venison scraps during the rest of the year, covered with a green tarp, and placed under a log or the base of a tree at trap sites. We checked the traps at least daily. Captured martens were pressed in the end of the trap using a folded blanket and injected with a mixture of 18.0 mg/kg ketamine hydrochloride (Vetalar) and 1.6 mg/kg xylazine hydrochloride (Rompun) for immobilization. For short-term chemical restraint, we used a dosage of 13.0 mg/kg of ketamine and 1.0 mg/kg xylazine. All captured martens were eartagged (Size 1, Style 1005, National Band and Tag Co., Newport, KY), sexed, weighed, and measured. Two first premolar teeth were pulled for age determination by cementum analysis (Matson's Laboratory, Milltown, MT). We drew a 3.0 cc blood sample from the jugular vein from most captured animals, separated the serum, then froze both portions for future analyses for disease, diet, and pregnancy studies. Some of the captured martens were radiocollared (Telonics, Mesa, AZ). This year, we radiocollared only individuals that had been previously captured on the study area. A 30 g radio collar (MOD-070, expected life of 8 months) was placed on females and a 49 g collar (MOD-080, expected life of 12-18 months) was placed on males. After a marten had recovered from the immobilization, we released it near the capture site. Martens recaptured during a trapping session were released without additional processing. During subsequent trapping sessions, all recaptures were chemically restrained, weighed, and measured. We replaced radiocollars as needed, and the collars on several animals were replaced during the year.

We attempted to capture all resident martens on the study area to determine the minimum number present and the sex and age composition of the resident population. Martens present on a study area throughout the year were considered resident animals. Martens that remained on the study area for less than a month and showed no site fidelity to a home range area were considered transients. Martens more than 1-year-old were classified as adults unless otherwise identified. Young-of-the-year animals, or birth-year martens, were called juveniles.

Job 1. Habitat use. We located radiocollared martens from small aircraft (Mech 1974, Kenward 1987) during daylight hours throughout the year. Mostly, we used a Piper Super Cub aircraft. After an animal was located, we plotted its location on paper copies of high-resolution orthophoto maps (1:31,680 scale) while circling in the aircraft. We also described the habitat at each location while in the aircraft according to USDA Forest Service definitions of timber volume class, stand size class, old-growth forest type, and physiographic location (riparian, upland, beach fringe, estuary fringe, subalpine, or alpine). At the office, we transferred the locations to mylar overlays on color aerial photographs (1:15,840 scale) for a permanent record. We digitized the locations using geographic information system (GIS) software (ArcView) on a personal computer and digital versions of the orthophoto maps. Additional attribute information for each location was recorded from the orthophoto maps including elevation, slope, and aspect.

Habitat selection will be determined by comparing the proportionate use of habitats with their availability (see Job 2) in the study area (Neu et al. 1974, White and Garrott 1990). We considered data collected from September through May to represent habitat use during the fall/winter/spring season. In future analyses, the habitat use of each animal will be compared with the availability of habitats within its home range area and the entire primary study area. A Chi-squared goodness-of-fit test will be used to test the null hypothesis that habitats were used by martens in proportion to their availability. If the null hypothesis is rejected, then each habitat will be evaluated separately for selection using Bonferroni normal statistics (Neu et al. 1974, Byers and Steinhorst 1984, White and Garrott 1990). Manly's measure of preference (Manly et al. 1972, Chesson 1983) will be computed for each habitat category to characterize the degree of selection of a particular habitat.

Job 2. Habitat composition. The composition of the study areas will be determined from US Forest Service GIS databases. We received several GIS data files from US Forest Service staff including timber type, soils, land status, streams, contours, clearcuts, and roads. This information will be further analyzed with GIS software for the final report.

In 1995, US Forest Service staff initiated a pilot study on using LANDSAT TM satellite imagery to map land cover types on northern Southeast Alaska. They extended their pilot study area to include our study areas on northeast Chichagof Island. The US Forest Service hired a consultant for the pilot study, and a report was prepared (Pacific Meridian 1995). We obtained digital copies of the 3 land cover maps - species, size class, and canopy cover - produced by the consultants.

We will consider the proportion of habitats on the study area as a measure of habitat availability. To evaluate landscape-level effects, we will collect additional landscape attributes such as roads, corridors, stand size, and composition.

Job 3. Habitat capability model evaluation. The habitat capability model for martens in Southeast Alaska, developed by an interagency group of biologists (Suring et al. 1992), will be evaluated in 2 ways using the general considerations listed by Schamberger and O'Neil (1986). During model testing, we will compare habitat coefficients values with observed habitat selection indices. Habitat selection indices for fall/winter/spring will be compared with habitat capability coefficients in the marten habitat capability model (Suring et al. 1992). We will compare the estimated density of adult resident martens on the primary study area with values predicted by the model.

Job 4. Population ecology. Each study area was live-trapped intensively during October and March to determine the sex and age composition of the martens occurring there. We recorded the time and location of all known deaths of radiocollared martens. We attempted to retrieve the carcasses of martens that died naturally and examined them for cause of death. We obtained the carcasses of most trapper-caught study animals. These carcasses were processed according to procedures established for the general collection of trapper-caught carcasses.

We surveyed martens on the Salt Lake Bay study area using mark-recapture methods (Seber 1982, White and Garrott 1990). For the survey, we considered captured martens marked with only eartags or wearing failed collars as new individuals. Based on our earlier radiotracking data, we assumed the population was closed (i.e., no emigration or immigration) during the 5-day trapping session and each animal had an equal probability of being captured at least once during the trapping session. The study area was defined by the composite home ranges of resident martens (84 km^2). We computed a Lincoln-Petersen estimate of population number for a closed population, single mark-release experiment for each trapping session. During a trapping session (at least shortly before or after), we located all of the radiocollared martens on the study area to determine the number of marked animals present during the trapping session. In the mark-recapture analysis, we used the number of radiocollared martens on the study area during the trapping session as n_1, the total number of martens captured as n_2, and the number of radiocollared martens recaptured as m_2. We used an Excel spreadsheet, originally developed by Sterling Miller (pers. commun., Alaska Department of Fish and Game, Anchorage), for the numeric analyses, including the population estimate, variance, and

95% confidence intervals using a normal distribution. Also, the minimum number of martens on the study area during the trapping session was determined by adding the number of new captures to the number of previously radiocollared animals present. At this point, we have not determined whether all of the assumptions for a Lincoln-Petersen mark-recapture experiment were met in this situation. We will further evaluate the appropriateness of our methods.

We collected the carcasses of most martens caught by trappers on northern Chichagof Island. Before the opening of the 1 December trapping season, we contacted trappers in Hoonah and Tenakee Springs and offered them $3.00 for each marten carcass delivered to us. Trappers were instructed to record the date and location of each capture and to freeze the carcasses immediately after skinning. Upon receiving the carcasses from the trappers, we kept them frozen until processing. All the carcasses were examined within 2 months of capture.

We weighed each carcass and assigned an index of internal and external fat content, using an ocular estimation procedure developed by Blundell and Flynn (1992, unpubl. report, ADF&G, Douglas, AK). We measured each skull according to Magoun et al. (1988) and classified the animal as juvenile or adult. We heated the skulls in water for 3 hours at 70° C, then extracted a lower canine and premolar 4 teeth. The teeth were stored frozen until sent to Matson's Laboratory (Milltown, MT) for age determination by cementum analysis (Poole et al. 1994). Total, body, and tail lengths of each carcass were measured along with the method of skinning (i.e., feet skinned out or not). We examined the stomachs of each carcass for the presence of parasites, especially *Soboliphyme baturini* worms. We extracted the ovaries from the reproductive organs of females and preserved them in 10% formalin. All ovaries were washed in tap water, then sent to Matson's Laboratory (Milltown, MT) for evaluation for the presence and number of corpora lutea (Strickland and Douglas 1987).

<u>Job 5. Spatial patterns and movements</u>. Radiocollared martens were located from small aircraft, usually a Super Cub, about once every 2 weeks to estimate home ranges of residents (Kenward 1987). Aerial locations were plotted on high resolution orthophoto maps (1:31,680 scale) and digitized as stateplane coordinates using a PC-based GIS computer program. We will model home ranges of resident martens using either the computer program HOME RANGE (Ackerman et al. 1990) or RANGES V (Kenwood and Hooder 1996). Locations were tested for independence (Swihart and Slade 1985) and outliers examined (Samuel et al. 1985). We will calculate the area of home ranges using 90 and 100% convex polygons and adaptive kernel estimates.

Because of the expense, we spent little effort radiotracking transient martens this year. We searched the entire northeastern portion of Chichagof Island periodically (every few months) from aircraft to locate transient martens. We recorded the maximum distance traveled from initial capture sites and the maximum distance between relocations for each transient animal.

<u>Job 6. Small mammal abundance</u>. The abundance of small mammals, excluding red squirrels, was estimated using a snap-trap index (Calhoun 1948). Transects were established in 3 stands: a productive western hemlock old-growth stand; an unproductive, mixed conifer/blueberry old-growth stand; and an 8-year-old clearcut. We established 25 stations

along each transect at 15-m intervals. Two Museum Special snap traps were placed at each station, baited with a mixture of peanut butter and rolled oats, and set for 3 consecutive nights (450 trap nights). We operated the traplines in September when small mammal populations should be at their annual peak. We recorded the number of animals of each species caught per 100 trap nights.

Job 7. Seasonal diets. We collected marten scats at trap sites and opportunistically along roads and trails while working in the field. The scats were labeled and frozen for future analyses. The scats will be examined for the frequency of occurrence of prey items.

Beginning in fall 1992, we drew a 2-3 cc sample of blood from the jugular vein of most captured martens. At camp, the blood was spun at 3,000 rpm in an electric centrifuge, and the serum siphoned into a separate vial. The clotted blood cells were frozen for storage, then sent to Merav Ben-David, University of Alaska Fairbanks, for analysis of the stable isotopes of carbon and nitrogen (Schell et al. 1988). As part of her Ph.D. dissertation, Ben-David compared the stable isotope signatures of the marten blood samples with the signatures of samples collected from potential food items to study marten diets (Ben-David 1996).

Job 8. Evaluation of field sexing and aging technique. We collected marten skulls from trappers operating on northern Chichagof Island to evaluate the field technique for sexing and aging martens proposed by Magoun et al. (1988). We recorded total skull length and length of temporal muscle coalescence for each specimen according to procedures of Magoun et al. (1988). A lower canine tooth and premolar 4 were extracted from each skull for age determination by cementum analysis (Matson's Laboratory, Milltown, MT). We will compare the skull measurements according to Magoun et al. (1988).

RESULTS AND DISCUSSION

During biological year 1995-1996, we captured 61 martens (42 males and 19 females) on the Salt Lake Bay study area 177 times. Because of reduced funding, we radiocollared only 10 of the new martens (8 males and 2 females) (Table 1). Each of the newly radiocollared martens had been captured previously on the study area and eartagged. Thirty six of the captured martens (24 males and 12 females) were not radiocollared. In upper Game Creek, we trapped only in the spring and caught an additional 16 martens (8 males and 8 females) (Table 2). Only 2 of these martens had been handled last year. All captured martens were weighed, measured, and aged by cementum analysis. We did not trap in the drainages of Freshwater Bay or Indian River this year.

Job 1. Habitat use. Radiocollared martens were located 449 times from small aircraft during the year to record habitat use. This information was recorded, plotted on aerial photographs, and entered into a GIS computer file. We did not complete any additional analyses for this report. More information on the selection of habitats will be collected next year and included in the final report.

We spent considerable time trying to locate marten dens in the spring. During March to early May, we live trapped the study area to increase our sample of radiocollared adult females. Eight adult females were radiocollared (6 at Salt Lake Bay and 2 at Game Creek). Unfortunately, the radiocollar on female #56 failed after only 3 weeks, and we were unable to recapture her.

In mid-April, we monitored the movements of radiocollared females about every 5 days from fixed-wing aircraft to locate den sites. If we found a female marten at the same place 3 or more times, we assumed it had localized at a den. We then ground-tracked the female to locate the den structure. Dens were distinguished from rest sites by their repeated use over several days or weeks and the presence of latrines and prey remains. Resting sites were defined as sites occupied by a marten for at least 30 minutes.

We found 4 females that localized their movements, and we located 4 natal and 1 maternal den structures. All dens were in stumps, snags, or logs characteristic of old-growth forest. Marten #184 initiated her natal den on 28 April. The structure, a large cedar snag, was located on 18 May. She was first located at a maternal den under a rotten hemlock stump on 26 May. Apparently, she lost her litter and abandoned the site shortly thereafter. On 6 June, we found her resting about 2.5 km from the maternal den, and she showed no fidelity to any other site.

Females #89, #149, and #161 all localized around 14 May and were ground-tracked to apparent dens. On 26 May and 9 June, #89 was found in a cavity about 6 m high in a rotten cedar snag. However, no evidence of kits was detected, and her radiocollar failed by 21 June. Marten #161 appeared to be pregnant when she was captured on 10 May. From 14 to 22 May, she was located 3 times from the air at a site at the edge of a clearcut. She was ground-tracked to a nearby rotten stump on 28 May. On 4 June she traveled about 3 km west of her den and showed no additional fidelity to the site. We excavated the stump that appeared to be her den, but we found no evidence of kits. On 5 June, female #149 was ground-tracked to a hollow log with 2 large latrines outside and on 10 June she was found under a stump about 30 m away. She had localized her movements here since 10 May, but by 19 June she was traveling more widely. No evidence of kits was found, and she showed no fidelity to any other site. Females #120 and #188 never localized. Female #84 may have localized, but we never successfully tracked her to a den.

Our information indicated only 4 or 5 of the 7 radiocollared adult females attempted to den this spring. Apparently, none of the females successfully reared young. We speculated that a decrease in the availability of prey, particularly long-tailed voles, resulted in the failure to produce young. Diet data from previous years have shown that voles are the primary prey of martens on northeastern Chichagof Island during spring and early summer. Preliminary small mammal trapping work by Jena Hickey indicated vole numbers may be 50 - 75% lower than last summer's population. In addition, all radiocollared martens seemed to be more active than in previous years, indicating more hunting was required to meet their food requirements.

We located 13 summer rest sites used by female martens. All sites were in structures characteristic of old-growth forest. More effort will be expended toward locating resting sites used by all age and sex classes during the remainder of this summer and winter/spring/summer 1997. Habitat attributes at dens and rest sites will be measured to characterize habitats used for denning and resting. Also, the same habitat attributes at random points within 8 habitat strata will be measured to provide a measure of habitat availability within the study areas. We will compare the attributes of den and rest sites with the random points to study habitat selection at the micro-site level. Most of this work will be done during summer 1996 and 1997

Job 2. Habitat composition. We received several GIS data files from US Forest Service staff including land cover, streams, clearcuts, and roads. Next year, we will collect additional landscape attribute information from aerial photos and gather additional US Forest Service data. This information will be further analyzed for the final report with the use of GIS software.

Work was initiated with the US Forest Service on remapping the land cover types on the study area using LANDSAT TM satellite information. Because of problems with the accuracy of the timber-type map, we are hopeful the LANDSAT TM technology will provide an improved land cover map for the habitat analysis. The US Forest Service included the study area into their pilot project. They hired a consultant (Pacific Meridian Resources) to do the pilot study. We attended several meetings to discuss the project and the classification procedures. During July, we spent 2 weeks in the field to sample representative land cover types (training sites) in the Salt Lake Bay area. The consultant completed the initial pilot study in early 1996 (Pacific Meridian 1995). We obtained digital copies of the 3 land cover maps produced - size class, species, and canopy cover.

Additional evaluation work of the land cover maps is scheduled for later in 1996. The new land cover map should be available for our use in 1997.

Job 3. Habitat capability model evaluation. In a previous progress report (Flynn 1991), we compared the habitat selection indices from this study with the habitat capability coefficients in the habitat capability model. Although no additional analyses were completed during this report period, we were asked to develop new model coefficients for use in the Tongass Land Management Plan Revision because of changes in the USFS's GIS database. USFS staff created a new habitat strata by identifying timber-type polygons that also had a hydric soil label. Also, we evaluated a new approach that add a spatial component to the habitat capability model. This new approach will be more completely evaluated and discussed in the next report.

Job 4. Population ecology. We monitored 38 radiocollared martens (24 males and 14 females) at least part of the year. The radiocollared martens were all residents except for 2 juveniles. We were unable to radiocollar all of the resident martens because of an insufficient number of radio collars. Some of the eartagged martens were captured subsequently on the study area, and they were probably residents.

We had 2 good opportunities for mark/recapture trapping session during the year. During October 1995, we estimated that 43 martens (95% CI = ±10) were on the Salt Lake Bay study area for a density of 0.51 martens/km^2 (Figure 2). In contrast, we estimated 45 martens (95% CI = ±12) on the area in March 1995, or a density of 0.54 martens/km^2 (Flynn and Schumacher 1995). Thus, the number of martens on the Salt Lake Bay study area was similar from spring to the following fall. During March 1996, we estimated that 38 martens (95% CI = ±6) were on the Salt Lake Bay study area for a density of 0.45 martens/km^2. Again, the number of martens changed little from the previous fall. Compared to March 1995, the estimated number of martens in March 1996 decreased slightly (45 to 38, or 16%).

Of the martens captured in the fall, 22 individuals were juveniles; 19 were adults, a juvenile:adult ratio of 1.16. The ratio of juveniles:adult females (age 1+) was 3.1. Both ratios indicate recruitment was relatively high last year.

We recorded 4 deaths of radiocollared martens (all males) during the period. Two radiocollared martens were trapped. Marten #107 was caught near Hoonah during the December trapping season. His radio collar had failed previously. We found marten #101 dead in a trap on 26 March along the beach at Salt Lake Bay, apparently in an abandoned trap. An ear-tagged marten was caught near Tenakee Springs during the trapping season. Only 1 marten (male) was believed to have died from natural causes unrelated to human activities.

More trapping effort was expended on northern Chichagof Island this year. About 140 martens were reported taken by 5 trappers. Most of the activity was along the road system on private lands near Hoonah and along the shore near Tenakee Springs. No one reported trapping within the primary study areas. In 1995 we collected 110 marten carcasses from trappers on northern Chichagof Island.

Job 5. Spatial patterns and movements. Radiocollared martens were located from small aircraft 449 times to collect information on movements and spatial use patterns. The data were recorded and entered into a GIS data file. Because of problems converting some of the data to a new coordinate system, we were unable to determine annual home ranges for this report. Next year we will use GIS software to complete a comprehensive analysis of the spatial use data.

Similar to previous years, transient martens of both sexes spent little time on the primary study areas and traveled extensively. Because of the short transmission range of the radio collars, transient martens were difficult and expensive to locate. Because of costs, we spent less effort searching for transient martens and little search effort on the west side of Port Frederick.

Job 6. Small mammal abundance. During September 1995, we captured 38 deer mice and 50 long-tailed voles on 3 transects in 450 trap nights (19.6 captures/100 trap nights). The snap-trap index indicated small mammal numbers decreased about 27% after 2 years of increasing numbers (Fig. 3). Long-tailed vole numbers continued to increase (8.0 to 11.0 captures/100 trap nights), but deer mice declined sharply (55%). Because vole numbers remained relatively constant, the availability of important foods on northeast Chichagof Island for martens may not have changed much during biological year 1995-1996.

Job 7. Seasonal diet. We collected 71 blood samples from live-trapped martens throughout the year for stable isotope analysis. Merav Ben-David analyzed the blood samples at the University of Alaska Fairbanks. In the fall, the mean isotope ratios were -25.13 (carbon) and 4.69 (nitrogen). The winter values were similar -25.2 and 4.5 for carbon and nitrogen. These data indicated the martens during the fall and winter were feeding mostly on terrestrial mammals, probably rodents. These data will be combined with previous results into a scientific publication.

Merav Ben-David successfully completed her Ph.D. thesis in May 1996 (Ben-David 1996). Two chapters of her thesis analyzed marten diets based on data collected during this study. We have submitted a paper on marten diets for publication (Ben-David et al. in press).

Job 8. Evaluation of field sexing and aging technique. We collected another 535 marten skulls from trappers throughout Southeast Alaska including Admiralty, Baranof, Chichagof, and Prince of Wales islands. We also obtained 22 marten carcasses from northern British Columbia. We recorded cementum ages for each animal and measured the skulls. We now have data from a total of 2296 skulls. These data will be analyzed and evaluated for the final report.

Job 9. Scientific meetings. Flynn attended the 2nd Martes Symposium held in Edmonton, Alberta during August and presented 2 papers.

Ben-David, M. and R. Flynn. 1995. Diet selection and reproductive performance in *Martes americana*. Paper presented at 2nd Inter. *Martes* Symposium. Edmonton, Alberta.

Flynn, R. and T. Schumacher. 1995. Age structure and fecundity of martens on Chichagof Island, Southeast Alaska, during a period of variable food availability and trapping effort. Paper presented at 2nd Inter. *Martes* Symposium. Edmonton, Alberta.

Job 10. Reports and scientific papers.

Ben-David, M., R. Flynn, and D. Shell. In press. Annual and seasonal changes in diets of martens: evidence from stable isotope analysis. Oecologia.

ACKNOWLEDGMENTS

Many individuals contributed to the project, and we greatly appreciate their assistance. Jena Hickey, a University of Wyoming graduate student joined the project and assisted in the marten and rodent trapping while working on her thesis project. She was assisted by fellow University of Wyoming undergraduate student Rob Meyers. Rich Lowell assisted with capturing martens. Karen Stone, a graduate student from University of Alaska Fairbanks, assisted with the carcasses evaluations. Merav Ben-David collaborated on the diet analyses. Kimberly Titus provided project review and direction. Mary Hicks edited the report. Our USDA Forest Service cooperators, Ted Schenck, Ellen Campbell, Tom Schmidt, and Mary Willson, provided interagency coordination and arranged for field support. USFS staff at the Hoonah Ranger District provided additional critical logistical support including bunkhouse space and field transport.

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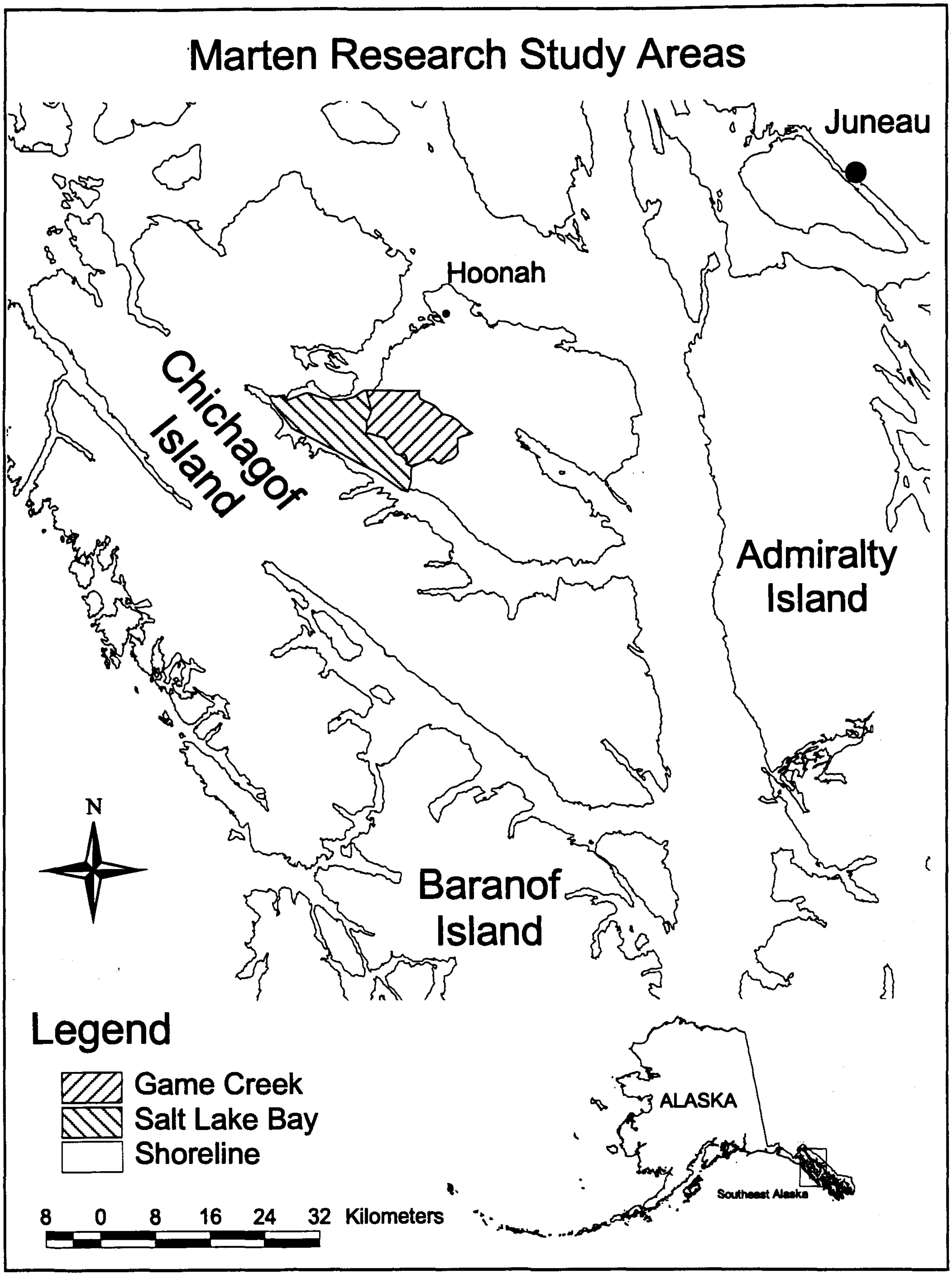


Figure 1 Location map of marten research study areas

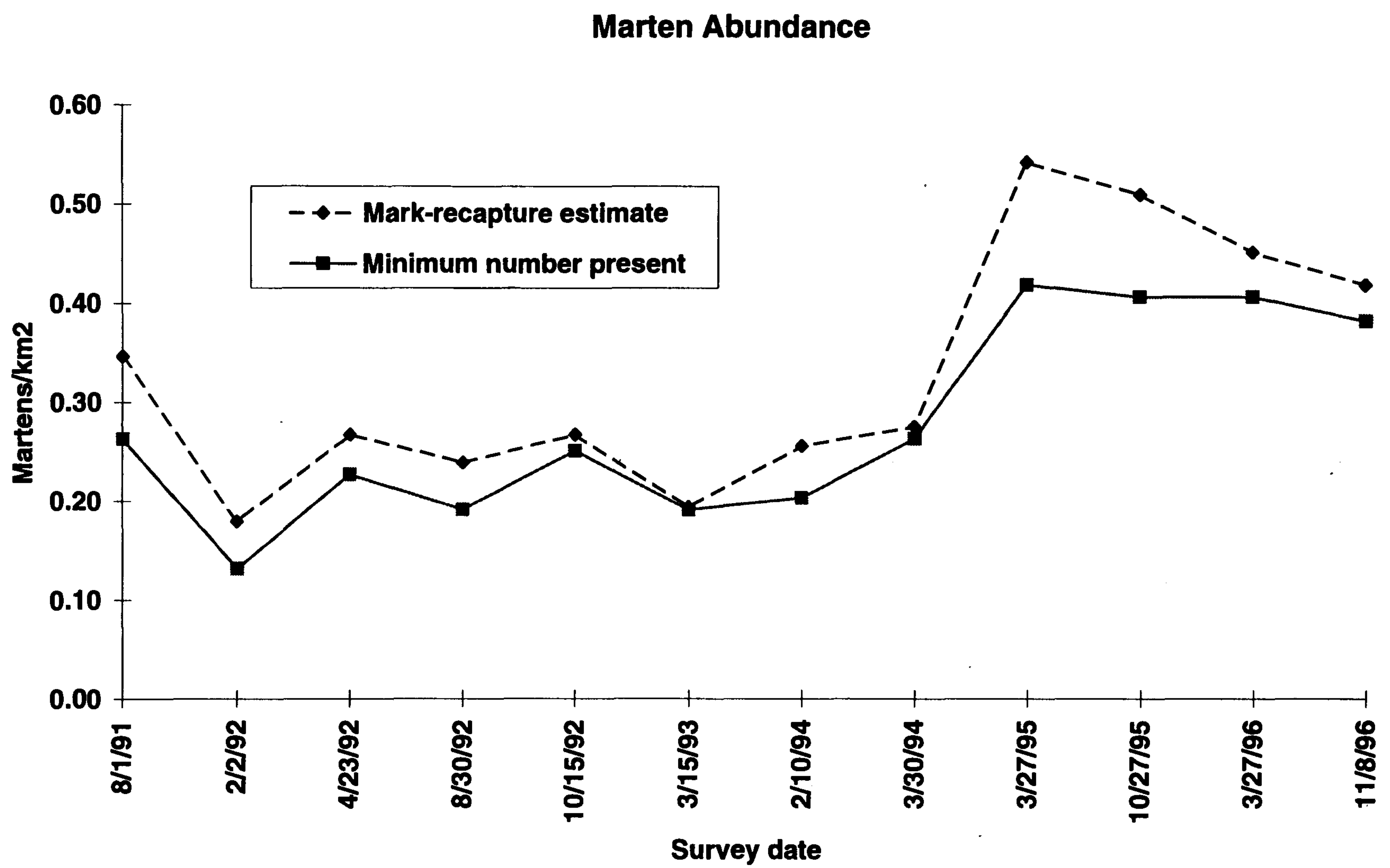


Figure 2 Marten abundance on the Salt Lake Bay study area, northern Chichagof Island, 1991-96

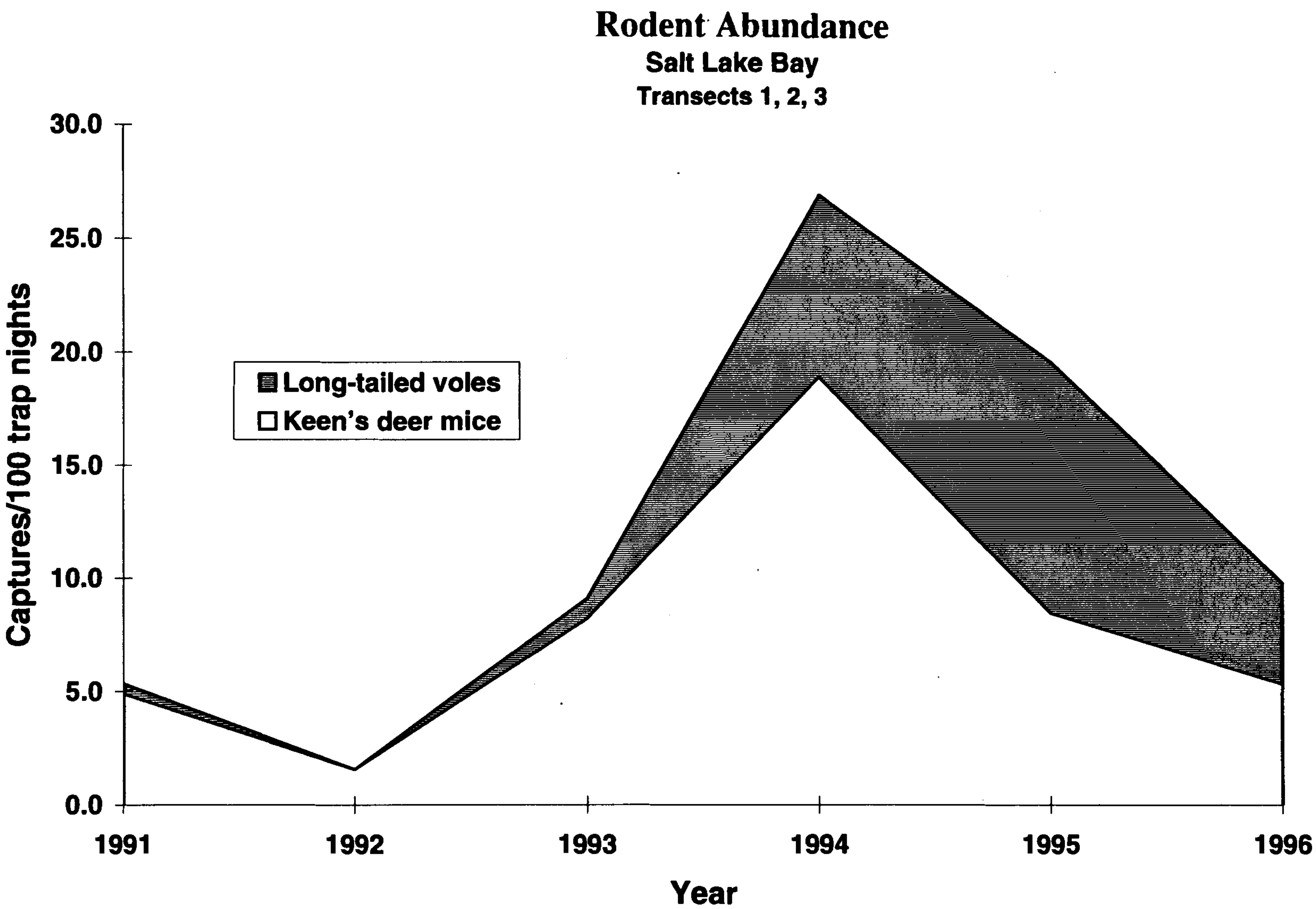


Figure 3 Rodent abundance on northeast Chichagof Island, Southeast Alaska, 1991-1996

Table 1 Age, sex, and status of radiocollared martens monitored on northeast Chichagof Island, 1995-1996

Animal no.	Sex	Age class	Date first radiocollared	No. of captures	Study[a] area	Residency[b] status	Survival status[c]
4	M	6	06/13/90	1	SLB	R	Censored - June
36	M	5	08/02/91	1	SLB	R	Survived
45	M	6	11/16/91	0	SLB	R	Survived
48	F	4	02/02/92	2	SLB	R	Censored - November
52	F	6	03/05/92	0	SLB	R	Censored - August
56	F	6	04/27/92	2	SLB	R	Survived
80	M	6	01/15/93	1	SLB	R	Censored - September
84	F	4	04/27/93	5	SLB	R	Survived
88	M	2	09/26/93	8	SLB	R	Survived
89	F	2	09/26/93	5	SLB	R	Survived
101	M	2	10/29/93	8	GC	R	Trapped - March
107	M	2	11/09/93	1	GC	R	Trapped - December
114	M	3	12/10/93	7	SLB	R	Natural - March
120	F	3	02/15/94	5	SLB	R	Survived
124	M	4	04/02/94	0	SLB	R	Censored - May
128	F	1	10/07/94	2	GC	R	Censored - September
138	F	1	07/19/94	1	FWB	R	Censored - September
140	M		08/30/94	1	FWB	R	Censored - February
149	F	1	09/28/94	2	GC	R	Survived
150	M	1	10/02/94	0	GC	R	Censored - February
151	M	1	10/03/94	0	GC	R	Censored - September
158	F	6	10/05/94	0	GC	R	Censored - September

Table 1 Continued

Animal no.	Sex	Age class	Date first radiocollared	No. of captures	Study[a] area	Residency[b] status	Survival status[c]
161	F	2	10/07/94	1	GC	R	Survived
162	M	1	10/22/94	1	SLB	T	Censored - July
167	M	1	07/21/95	12	SLB	R	Survived
175	F	1	12/11/94	0	SLB	R	Censored - December
179	M	1	12/12/94	2	SLB	R	Censored - May
183	M	2	10/30/95	6	SLB	R	Survived
184	F	2	07/21/95	5	SLB	R	Survived
188	F	1	10/07/95	6	SLB	R	Survived
189	M	1	10/07/95	1	SLB	R	Natural -January
193	M	0	3/23/95	2	SLB	R	Survived
195	M	0	7/21/95	1	SLB	T	Censored - December
199	M	0	10/06/95	4	SLB	R	Survived
200	M	0	10/27/95	4	SLB	R	Survived
202	M	0	10/03/95	11	SLB	R	Survived
207	M	1	10/27/95	10	SLB	R	Survived
213	M	2	10/27/95	1	SLB	R	Survived

[a] SLB = Salt Lake Bay, FWB = Freshwater Bay, and GC = Game Creek.
[b] R = resident or T = transient.
[c] The animal was considered censored for the survival analysis when the radio signal was not found after the month listed.

Table 2 Age and sex of other martens captured on northeast Chichagof Island, 1995-1996. These individuals were only eartagged

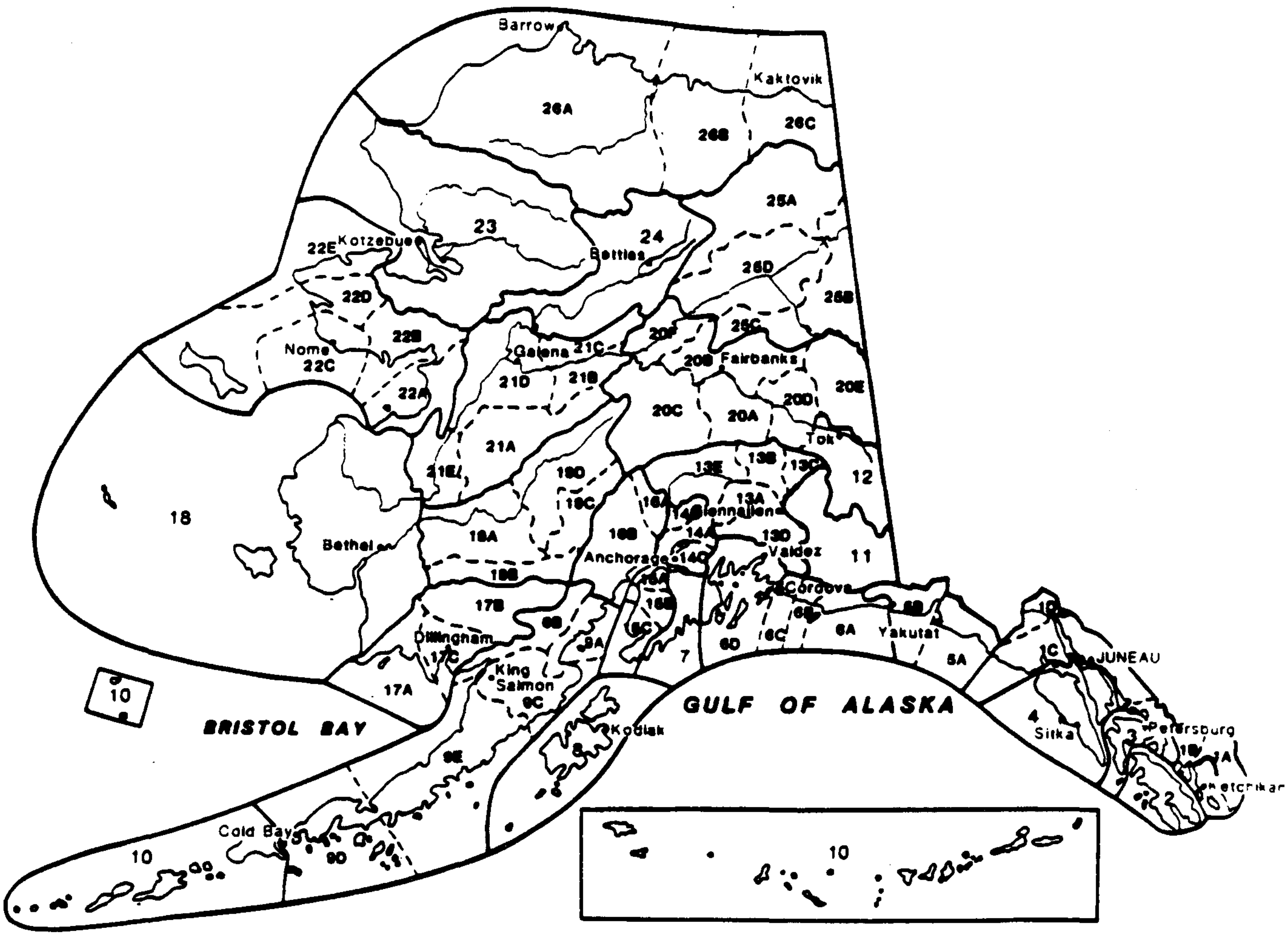
Animal no.	Sex	Age class	Date first captured	No. of captures	Study[a] area	Status
163	F	1	10/24/94	1	SLB	Unknown
191	M	1	3/22/95	1	SLB	Unknown
194	M	0	7/21/95	2	SLB	Handling death[b]
196	M	0	7/22/95	6	SLB	Unknown
197	M	0	7/23/95	3	SLB	Unknown[b]
198	F	0	8/11/95	2	SLB	Unknown[b]
201	M	0	10/01/95	2	SLB	Handling death[b]
203	M	0	10/03/95	1	SLB	Unknown
204	M	0	10/03/95	1	SLB	Trapped - December[b]
205	M	0	10/06/95	6	SLB	Unknown[b]
206	M	0	10/07/95	1	SLB	Unknown
208	M	0	10/07/95	1	SLB	Handling death[b]
209	M	0	10/07/95	8	SLB	Unknown
210	F	0	10/26/95	1	SLB	Unknown
211	M	0	10/26/95	1	SLB	Unknown
212	F	0	10/26/95	1	SLB	Unknown
214	M	0	10/29/95	1	SLB	Unknown
215	M	0	10/29/95	1	SLB	Unknown
216	M	0	10/30/95	2	SLB	Unknown
217	F	0	11/02/95	4	SLB	Unknown
218	F	1	03/09/96	1	SLB	Unknown
219	F	2	03/11/96	1	SLB	Unknown
220	F	2	03/11/96	3	SLB	Unknown
221	F	1	03/12/96	1	SLB	Unknown
222	F	1	03/13/96	1	SLB	Unknown
223	M	2	03/13/96	2	SLB	Unknown
224	F	1	03/14/96	1	SLB	Handling death
225	M	1	03/28/96	2	SLB	Unknown
226	M	1	03/28/96	1	SLB	Unknown
227	M	2	03/29/96	2	SLB	Unknown
228	M	1	03/30/96	3	SLB	Unknown
229	M	2	03/30/96	1	SLB	Unknown
230	M	2	03/30/96	2	SLB	Unknown
231	M	1	03/31/96	2	SLB	Unknown

Table 2 Continued

Animal no.	Sex	Age class	Date captured	No. of captures	Study[a] area	Status
232	M	1	03/31/96	1	SLB	Unknown
233	F	1	04/02/96	2	SLB	Unknown
234	M	1	05/08/96	1	GC	Unknown
235	F	1	05/08/96	1	GC	Unknown
236	M	2	05/08/96	3	GC	Unknown
237	M	1	05/08/96	1	GC	Unknown
238	F	1	05/08/96	1	GC	Unknown
239	M	2	05/09/96	1	GC	Unknown
240	F	1	05/10/96	1	GC	Unknown
241	F	5	05/11/96	1	GC	Unknown
242	M	1	05/11/96	1	GC	Unknown
243	F	1	05/11/96	1	GC	Unknown
244	M	1	05/11/96	1	GC	Unknown
245	F	1	05/12/96	1	GC	Unknown

[a] GC = Game Creek; IR = Indian River; FWB = Freshwater Bay; IR = Indian River

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.

RICHARD BLOOMQUIST