Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Ecology of Martens in Southeast Alaska

by

Rodney W. Flynn

Project W-24-1
Study 7.16
December 1993

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PROGRESS REPORT (RESEARCH)

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SUMMARY

During the third year of field work on this project, 28 martens (*Martes americana*) (17 males and 11 females) were captured 71 times on the Salt Lake Bay study area and 15 martens (9 males and 6 females) were captured 25 times in Upper Game Creek, northeast Chichagof Island. At Salt Lake Bay, I radio collared 12 new martens (10 males and 2 females) for the first time. All 15 martens captured at Game Creek were uncollared. Altogether, I monitored 48 martens (29 males and 19 females) during at least part of the year.

I recorded habitat use of the radio-collared martens at 778 aerial locations during the fall/winter/spring season. Habitat selection data were not analyzed for this report.

The estimated density of martens on the Salt Lake Bay study area decreased about 30% from October to March. During March 1993, I estimated that 16 martens, or 0.19 martens/km^2, were on the Salt Lake Bay study area. The decrease in numbers resulted from resident animals leaving the area, resident animals being trapped on or near the study area, and all transient martens leaving the study area. Also, only three new animals established residency on the study area during the period, and no additional transient martens were captured after December.

Fifteen martens with active radio collars (13 males and 2 females) died during the period. I estimated annual survival of radio-collared martens at 0.57. Two deaths (1 male and 1 female) resulted from natural causes, and 13 martens (12 males and 1 female) were killed by humans during the trapping season. Another male marten with a failed collar was also trapped. Only one party trapped the primary study area at Salt Lake Bay, and they caught one resident male along the Tenakee Inlet beach. The remainder of the radio-collared martens that died were transients (87%). Nine trapped martens were caught on private lands near Hoonah with the use of a motorized land vehicle.

Median home range size (95% convex polygons) of males was 7.5 km^2, an increase from 5.5 km^2 in 1991-92. The median home range size of females increased from 2.7 in 1991-92 to 6.3 km^2 in 1992-93. In each year, median home range sizes of males have been larger than females.

The snap-trap index for small mammal numbers decreased 82% from last year and long-tailed voles were completely absent. Because small mammals are an important food source for martens, the lower snap-trap index indicated a reduction in food availability. This trend has continued for two years.

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

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BACKGROUND

I have completed a third year of ecological research on martens in southeast Alaska. This report contains a brief presentation of information collected during the past year. Each year, the study area has been periodically live trapped, and the movements, demography, and habitat use of the captured martens have been studied. In order to provide additional demographic data, marten carcasses have been collected for the past two years from trappers operating on northern Chichagof Island. This year, I expanded the collection of trapper-caught carcasses to the remainder of Chichagof Island and northern Baranof Island.

Although designed as a broad ecological study, the project has been divided into 10 specific jobs. I present progress on each job separately. During this report period, all jobs were active, but jobs 1, 4, and 5 were emphasized. Some aspects of this study were partially supported by the USDA Forest Service, Alaska Region, through contract 43-0109-9-0749. I also submitted this report to the Forest Service to satisfy its reporting requirements.

Martens have been 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 2,770 animals from 1984 and 1988 (ADF&G unpubl. records, Douglas). 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 the species in southeast Alaska where the Tongass National Forest encompasses more than 90% of the land area. Although most of the original forested land was in an old-growth condition, industrial-scale logging has converted large areas of old-growth forest habitat into clearcuts and second growth. About 162,000 ha of old-growth habitat have already been logged on the Tongass National Forest, and the current Tongass National Forest Land Management Plan (TLMP) schedules an additional 708,000 ha for clearcut logging (USDA Forest Service 1990). Additional background information on the study can be found in Flynn (1991).

OBJECTIVES

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

The specific study objectives (jobs 1-8) are to:

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

I chose northeast Chichagof Island for study because the topography and habitats there are typical of northern southeast Alaska including a substantial amount of logged and unlogged areas. Also, a logging road system provided access to portions of the area, lodging facilities were available through the USDA Forest Service, and the area was relatively close to Juneau. The area adjacent to Salt Lake Bay (58° 56'N, 135° 20'E), 56 miles west of Juneau and 16 miles south of Hoonah, was selected as the primary study area. The upper Game Creek watershed was added as a second primary study during 1992-93. Because several martens moved off the primary study areas after capture, the entire northern portion of Chichagof Island was treated as a secondary study area.

The Salt Lake Bay study area included about 130 km^2 in USDA Forest Service Value Comparison Units (VCUs) 202, 222, and 223 on the Hoonah and Sitka ranger districts on the Chatham Area of the Tongass National Forest. The study area was bounded by Port Frederick to the north, Tenakee Inlet to the south, a narrow portage between the large water bodies on the west, and the Game Creek and Indian River drainages on the east and north (Fig. 1). The upper Game Creek study area included about 102 km^2 in VCUs 203 and 204 on the Hoonah Ranger District. Most habitats typical of northern southeast Alaska occur on the study areas including a range of physiographic types from beach fringe to alpine. Habitats in the study area are further described in Flynn (1991).

About 7% of the Salt Lake Bay study area was logged during 1984 to 1988, and 27 km of logging roads were constructed. Under the current timber operating plan (USDA Forest Service 1989), an additional 486 ha were scheduled for clearcut logging during 1990-92. Logging activity began in June 1990 with the construction of about 10 km of new 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 during 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 by 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 two bridges across Game Creek. The road building continued at a rapid pace for the remainder of the year. 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.

Recreational and subsistence trapping seasons for martens, mink, and weasels on the northeast portion of Chichagof Island were closed during 1990-91 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. During 1991-92, the trapping season for both portions of northern Chichagof Island opened on 1 December. 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 1992-93, the marten trapping season on northern Chichagof Island lasted 30 days beginning 1 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.

METHODS

Most study jobs required the capture and radio collaring of a sample of martens on the primary study area. Martens were live trapped throughout the year at 64 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 the rest of the year, covered with a green tarp, and placed under a log or the base of a tree at trap sites. I checked the traps at least daily. Captured martens were run into a holding cone and immobilized with a mixture of 18.0 mg/kg ketamine hydrochloride (Vetalar) and 1.6 mg/kg xylazine hydrochloride (Rompun). For short-term chemical restraint, I used a dosage of 13.0 mg/kg of ketamine and 1.0 mg/kg xylazine. All captured martens were ear tagged (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). I 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. All captured martens were radio collared (Telonics, Mesa, AZ). A 30 g radio collar (MOD-070, expected life of eight 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, I released it near the capture site. Martens recaptured during a trapping session were released without additional processing. During a subsequent trapping session, all recaptures were chemically restrained, weighed, and measured. I replaced radio collars as needed, and the collars on several animals were replaced during the year.

I 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. Temporary residents were present on a study area for less than a year. 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 considered adults unless otherwise identified. Young-of-the-year animals, or birth-year martens were called juveniles.

Job 1. Habitat use. I located radio-collared martens from small aircraft (Mech 1974, Kenward 1987) during daylight hours throughout the year. Mostly, I used a Piper Super cub aircraft. Each located marten was assigned to a relatively homogenous stand, and the location of the stand was plotted on high resolution orthophotoquad maps (1:31,680 scale) while circling in the aircraft above the location. The forest-stand type for each location was described using 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). After returning to the office, I transferred the locations to mylar overlays on color aerial photographs (1:15,840 scale) of the study area for future photo interpretation work. Universal Transverse Mercator (UTM) coordinates were determined for each location using a digitizer with the orthophotoquad maps. I recorded additional stand-level habitat attributes from the orthophotoquad maps including elevation and aspect.

Habitat selection will be determined by comparing the proportionate use of habitats with the their availability (see Job 2) in the study area (Neu et al. 1974, White and Garrott 1990). I 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). Ivlev's index of electivity (E_t) (Ivlev 1961), scaled to vary from 0.00 to 1.00, and 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. Habitat capability indices (HCIs), based on each selection index, will be computed by dividing the selection index for each habitat by the maximum value for that index (e.g., $HCI_i = E_{t\ i}/E_{t\ max}$).

<u>Job 2. Habitat composition</u>. The composition of habitats, described by timber volume class and physiographic type, for the stand-level analysis was generated by Forest Service staff from their geographic information system (GIS) "points" database for VCUs 202, 222, and 223. Information on the abundance of old-growth forest types as described by Boughton et al. (1992) was unavailable from this database. The GIS "points" database was created especially for the TLMP Revision project by systematic computerized sampling of the timber volume class maps with the elevation contours and physiographic types identified. Each point sample represented the midpoint of a 8.1-ha hexagon.

I will consider the proportion of habitats on the study area as a measure of habitat availability. To evaluate landscape-level effects, I will collect additional landscape attributes such as roads, corridors, stand size, and composition of adjacent stands. In future analyses, these effects will be evaluated.

<u>Job 3. Habitat capability model evaluation</u>. The habitat capability model for martens in southeast Alaska, developed by an interagency group of biologists (Suring et al. 1992), will be evaluated in two ways using the general considerations listed by Schamberger and O'Neil (1986). Model testing will emphasize the assumptions used and variable values instead of overall outputs. Habitat selection indices for fall/winter/spring will be compared with habitat capability coefficients in the marten habitat capability model (Suring et al. 1992). Also, I will compare the estimated density of adult resident martens on the primary study area with assumptions in the model.

Job 4. Population ecology. Each study area was trapped intensively several times during the year to determine the sex and age composition of martens present there. I recorded the time and location of all known deaths of radio-collared martens. I attempted to retrieve the carcasses of several martens that died naturally and examined them for cause of death. The carcasses of most trapper-caught study animals were retrieved. These carcasses were processed according to procedures established for the general collection of trapper-caught carcasses.

The density of martens on the primary study area at several time periods was estimated by a series of capture-recapture trapping sessions. A Lincoln-Petersen estimate of population number for a closed population, single mark-release experiment (Seber 1982, White and Garrott 1990) was computed for each trapping session. During a trapping session (at least shortly before or after), I located all of the collared martens on the study area to determine the number present. The size of the study area was defined by the collective home range areas of the resident collared martens. In the mark-recapture analysis, I used the number of radio-collared 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 collared martens recaptured as m_2. I used an Excel spreadsheet, originally developed by Sterling Miller (pers. comm.), 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 radio-collared animals that were present. Because the entire Salt Lake Bay study area was not trapped each session, I split the study area into eastern and western portions. Each portion was about the same size. At this point, I have not determined whether all of the assumptions for a Lincoln-Petersen mark-recapture experiment were met in this situation. Further evaluation of the appropriateness of the methods used in this application will be completed in the next report period.

I estimated the survival rate of radio-collared martens using the Kaplan-Meier product limit estimator as described by Pollock et al. (1989) for the staggered-entry design. I converted a Lotus spreadsheet obtained from Pollock et al. (1989) to Excel for the numeric analyses. A monthly time step was used to develop annual survival functions. Animals not located for more than one month were considered as censored observations and eliminated from the analysis at the next time step. Marginal survival functions were constructed for trapping and nontrapping causes by treating deaths from causes other than the group being examined as censored observations (Pollock et al. 1989).

I attempted to collect the carcasses from all the martens trapped on northern Chichagof Island. Before the opening of the 1 December trapping season, a letter was sent to everyone who had trapped on northern Chichagof Island during the past three years. Trappers were offered $3.00 for each carcass received and instructed to record the date and location of capture and to freeze the carcasses immediately after skinning. Upon receiving the carcasses from the trappers, I kept them frozen until processing. All the carcasses were examined within 2 months of capture.

During 1992-93, the carcass examination job was expanded to included southern Chichagof Island and northern Baranof Island. Because this portion of the project was done under a new USDA Forest Service contract, a separate report on the methods and results was prepared (Appendix A).

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

Job 5. Spatial patterns and movements. I estimated home ranges of resident martens from radio-telemetry locations (Kenward 1987). Radio-collared martens were located from small aircraft, usually a Supercub, about once a week depending on weather conditions. Although I obtained a substantial number of locations from the ground, these data were not analyzed during this report period. Aerial locations were plotted on high resolution orthophotoquad maps (1:31,680 scale) and recorded as Universal Transverse Mercator (UTM) coordinates. I modeled marten home ranges using the computer program HOME RANGE (Ackerman et al. 1990). Locations were tested for independence (Swihart and Slade 1985) and outliers examined (Samuel et al. 1985). I evaluated several methods of delineating home range including the harmonic mean method (Dixon and Chapman 1980) and 75%, 95%, and 100% convex polygons (Ackerman et al. 1990). Core areas within home ranges were examined (Samuel et al. 1985b), but most animals had too few relocations for reliable estimates. Harmonic centers of activity were plotted (Ackerman et al. 1990).

In order to locate transient martens, the entire northern portion of Chichagof Island was searched monthly from aircraft. I recorded the maximum distance traveled from initial capture sites and the maximum distance between relocations for each transient animal. I compared the mean distance traveled by males and females. Transient martens were difficult and expensive to locate because of their extensive travels and the limited range of the radio transmitters.

Job 6. Small mammal abundance. The abundance of small mammals, excluding red squirrels, was estimated using a snap-trap index (Calhoun 1948). Transects were established in three stands: a productive, western hemlock, old-growth stand; an unproductive, mixed conifer/blueberry, old-growth stand; and a 6-year-old clearcut. I 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 three consecutive nights. I operated traplines in September when small mammal populations should be at their annual peak. I recorded the number of animals of each species caught per transect and per 100 trap nights.

Job 7. Seasonal diets. Marten scats were collected at trap sites and opportunistically along roads and trails. The scats were labeled and frozen for future analyses. Stomach contents from martens caught by trappers operating near the study area were collected and frozen for future analyses.

Beginning in fall 1992, blood samples were drawn from the jugular vein of captured martens and sent to Merav Ben-David, University of Alaska Fairbanks, for analysis of stable isotopes of carbon, nitrogen, and sulfur (Schell et al. 1988). As part of her Ph.D. dissertation, Ben-David will compare the stable isotope signatures of the marten blood samples with the signatures of samples collected from potential food items to infer marten diet composition (Ben-David 1992).

Job 8. Evaluation of field sexing and aging technique. I 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). I 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). I will compare the skull measurements according to Magoun et al. (1988).

RESULTS AND DISCUSSION

During 1992-93, 28 martens (17 males and 11 females) were captured 80 times on the Salt Lake Bay study area (Table 1.). Additionally, 15 martens (9 males and 6 females) were caught in upper Game Creek (Table 2). Twelve martens (10 males and 2 females) captured at Salt Lake Bay were handled for the first time. All captured martens were radio collared, weighed, and aged by cementum analysis (Table 3).

Job 1. Habitat use. Radio-collared martens were located 778 times from small aircraft during the fall/winter/spring season to determine habitat use. This information was recorded, plotted on aerial photographs, and stored on a computer file, but not analyzed for this report. More information on the selection of habitats will be collected next year and included in the final report.

Job 2. Habitat composition. I cooperated with the Hoonah Ranger District staff on a habitat assessment project. Vegetative data were collected at several plots along 6 transects during summer. This project will be inactive next year. Additional data were not collected this report period. Next year, I will collect additional landscape attributes from aerial photos such as roads, corridors, and stand size to evaluate landscape-level effects. This data will be further analyzed for the final report with the use of geographic information system software.

Job 3. Habitat capability model evaluation. A comparison of the habitat capability coefficients in the habitat capability model with the habitat selection indices from this study was reported in the previous progress report (Flynn 1991). No additional analyses were completed during this report period.

Job 4. Population ecology. Of the 48 martens monitored during at least part of the year, 29 were males and 19 were females. I classified 16 martens (8 males and 8 females) as residents on the Salt Lake Bay study area, and 3 male martens were considered temporary residents there (Table 2). Eight martens (7 males and 1 female) captured at Salt Lake Bay were transients and spent little time there. In upper Game Creek, 6 martens (2 males and 4 females) were classified as residents, and 8 martens (3 males and 5 females) were considered transients. I could not determine the status of an additional 6 animals (5 males and 1 female) because they were trapped shortly after tagging. Most resident martens on the Salt Lake Bay study area had probably been captured because of the high recapture rates (up to 80%) during trapping sessions.

During August 1992, I estimated that 20 martens (95% CI = +/-7.3) were on the Salt Lake Bay study area for a density of 0.24 martens/km^2 (Fig. 2). Because of the low recapture rate (28.6%), this estimate had a large variance. In October 1992, 22 martens (95% CI = +/-3.0), or 0.27 martens/km^2 were estimated to be on the study area. During this trapping session, the recapture rate was high

(80%) and provided a better estimate of the fall population. By March 1993, the population estimate decreased to 16 martens (95% CI = +/-1.0), or a density of 0.19 martens/km^2. The estimated density of martens on the Salt Lake Bay study area decreased about 30% from October to March. The population decrease resulted from resident animals leaving the area, resident animals being trapped on or near the study area, and all transient martens leaving the study area. Also, only three new animals established residency on the study area during the period and no additional transient martens were captured after December.

Mean body weight of male martens captured during fall was lower than winter/spring 1993. For male martens, mean body weight has been lowest during fall each year (Fig. 3). Also, mean body weight for females was lowest during fall. This pattern had not been observed during previous years (Fig. 4). Body weight appears to be a useful measure of a marten's body condition. This relationship will be investigated further during the next year.

At Salt Lake Bay, the mean age of monitored martens increased from 1.80 to 2.02. The juvenile:100 adults ratio was 25:100 versus 13:100 in 1991-92 and 57:100 in 1990-91. The older age structure reflected poor recruitment since 1990-91. The age structure of martens collared at Upper Game Creek was somewhat younger because more dispersing juveniles were captured there (Fig. 5). At Game Creek, the juvenile:100 adults was 41:100.

Sixteen tagged martens (14 males and 2 females) died during the period. Fifteen animals had operating collars at death, and one trapped male (#30) had a failed collar. Two deaths (1 male and 1 female) resulted from natural causes. The decomposed carcass of the female (#50) was found wrapped over a limb located about 20 m up in a small hemlock tree. A resident of Tenakee Springs reported finding the decomposed carcass of a male marten (#64) along the beach in front of his house. Because neither carcass was recovered promptly after death, I was unable to determine the actual cause of death.

Although only one party trapped within the primary study areas, humans still killed 14 radio-collared martens (13 males and 1 female) during the open trapping season (Fig. 6). This year, most trapping activity was focused on private lands near Hoonah because the restriction on the use of motorized land vehicles did not apply there. Three trappers operating along the Hoonah road system caught nine tagged martens (8 males and 1 female) including a male marten (#30) with a failed collar. Two collared martens (#63, #75; all males) were trapped at the Eight-fathom logging camp during the opening week of the trapping season by a worker living there. I found male #9 dead in a trap near the Eight-fathom logging camp on 19 December, apparently caught in an abandoned trap. One male marten (#5) was captured along Tenakee Inlet within its home range, and one transient male (#71) was trapped at a cabin in Idaho Inlet.

I estimated annual survival radio-collared martens for 1992-93 at 0.57 (95% CI = 0.42-0.72) (Fig. 7). With only two natural deaths, trapping was the major reason for failure to survive. Likewise, most of the mortality occurred during the December trapping season. In contrast, the annual survival rate of radio-collared martens was estimated at 0.88 (95% CI = 0.76-1.00) for 1990-91 and 0.25 (95% CI = 0.16-0.34) for 1991-92.

The age structure of the marten catch for 1992-93 on Chichagof and Baranof islands and estimated maximum fecundity based on counts of corpora lutea in the ovaries were presented in Appendix A.

Job 5. Spatial patterns and movements. Radio-collared martens were aerially located 778 times to obtain information on movements and spatial use patterns. Annual home ranges were modeled for resident martens with an adequate number of relocations using the peeled convex polygon method. Although convex polygons using 75%, 95%, and 100% contours were presented, 95% convex polygons best represented home range areas. All additional discussion of home range areas refers to 95% convex polygons. A comprehensive analysis spatial use data will be done next year using geographic information system software.

Median home range size of 10 adult males (7.5 km^2) was larger than 10 adult females (6.3 km^2) (Wilcoxon 2-sample test, $P < 0.05$). In each year, median home range sizes of males have been larger than females (Flynn 1991, Flynn and Blundell 1992). In 1992-93, male and female martens showed an increase in home range size compared with last year. Median home size of males increased 36% this year from 5.5 km^2 in 1991-92 (Wilcoxon 2-sample test, $P < 0.05$). Female median home range size increased 133% from 2.7 km^2 last year.

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 the costs involved, less effort was made this year to locate transient martens and little search effort was made on the west side of Port Frederick. At least five transients (5 males) were located on the west side of Port Frederick; all of these animals died.

Job 6. Small mammal abundance. During September 1992, 7 Sitka mice were captured on 3 transects in 450 trap nights (1.6 captures/100 trap nights). Transects were located in a 4-year-old clearcut at 150 m elevation; a western hemlock/well-drained, old-growth stand at 90 m elevation; and a mixed conifer, old-growth stand at 60 m. Captures were highest on the old-growth forest transects (1.3 and 2.7 captures/100 trap nights versus 0.7 captures/100 trap nights). Only Sitka mice were captured this year. In 1990, long-tailed voles were the most abundant small mammal in the area, but their numbers appear to be greatly diminished.

Based on the snap-trap index, small mammal numbers on the primary study area decreased again, about 82% from last year (Fig. 8). Long-tailed voles showed the greatest reduction in numbers with no captures last year. I observed a reduction in small mammal numbers on old-growth forest and clearcut areas, with the greatest reduction on the clearcut transect (-89% versus -72%). Although no information has been analyzed on marten food habits in the study area, small mammals, especially voles, usually comprise a large proportion of the martens' diet. The reduction in small mammal numbers indicated that the availability of preferred foods on northeast Chichagof Island for martens was greatly reduced during 1992-93.

Job 7. Seasonal diet. I collected 30 marten scats in the primary study area and froze them for future analyses. The contents from 120 stomachs of trapper-caught martens were collected for future analyses. Fifteen blood samples were obtained from collared martens for stable isotope analysis. These samples will be analyzed by Merav Ben-David and discussed in the final report.

Job 8. Evaluation of field sexing and aging technique. I collected skulls from 250 trapper-caught martens from Chichagof Island and northern Baranof Island. The skulls of these martens were measured, and cementum ages obtained. These data will be analyzed and evaluated for the final report.

Job 9. Scientific meetings and workshops. I presented a paper titled "Marten demographics on northern Chichagof Island, southeast Alaska: implications for population management" at the Seventh Northern Furbearer Conference held at Whitehorse, Yukon.

Job 10. Reports and scientific papers. Besides completing this progress report, I continued to participate in the publication of a manuscript titled "A strategy for maintaining well-distributed, viable populations of wildlife associated with old-growth forests in southeast Alaska" including a chapter titled "A strategy for maintaining well-distributed, viable marten populations in southeast Alaska". Currently, staff of the Pacific Northwest Experimental Station, USDA Forest Service, are reviewing this manuscript.

ACKNOWLEDGMENTS

Many individuals contributed to the project, and their assistance was appreciated greatly. Gail Blundell worked on the project as field technician for the second year and did most of the aerial radio tracking and capture work. Loyal Johnson collected and processed marten carcasses from the Sitka area. Several volunteers contributed to the field work including Pancho Winters, John Maniscalco, Monte Lewis, and Charles Gibilisco. Merav Ben-David collaborated in the field and contributed to the diet analyses. Trooper David Jones, Fish and Wildlife Protection, greatly facilitated the field work by providing logistical support and office space in Hoonah. Brent Kennedy, Lynn Bennett, Mike Dinkins, and Cinimon Vongehr piloted the aerial surveys. Lowell Suring, Kimberly Titus, E. L. Young, and Matt Kirchhoff contributed many useful ideas to improve the study. David Anderson provided project review and direction. Susan Abbott edited the report. The assistance of USDA Forest Service cooperators, Ellen Campbell, Ted Schenck, Paul Alaback, and Kris Rutledge, made the study possible along with the additional field support provided by the staff of the Hoonah Ranger District. The cooperation of the local trappers who provided carcasses - G. Coutlee, N. Gallagher, J. Carter, A. Strong, and B. Shepard - was appreciated.

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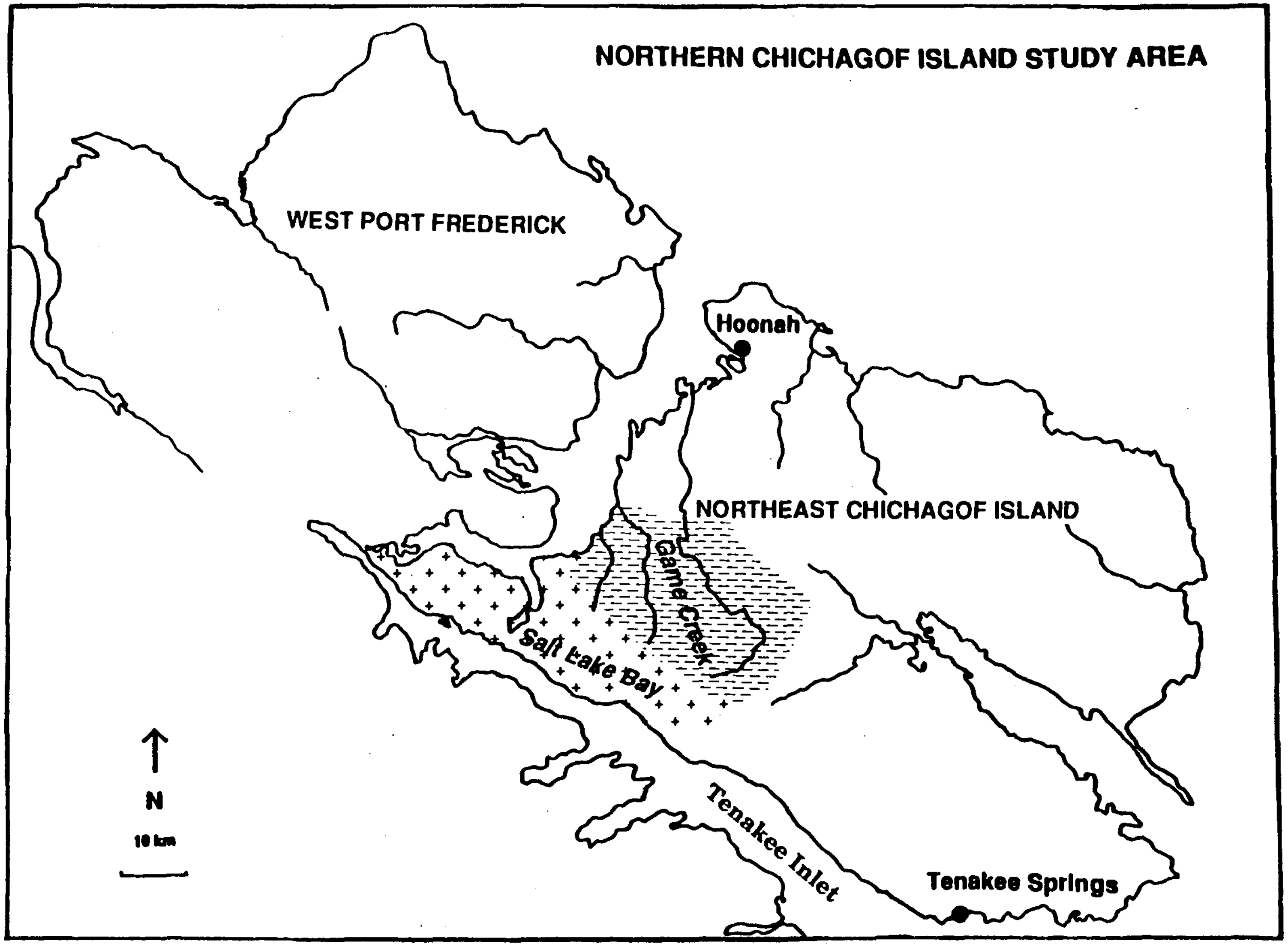

Figure 1. Location map of northern Chichagof Island study areas. The primary study areas at Salt Lake Bay and Upper Game Creek are indicated by cross-hatching.

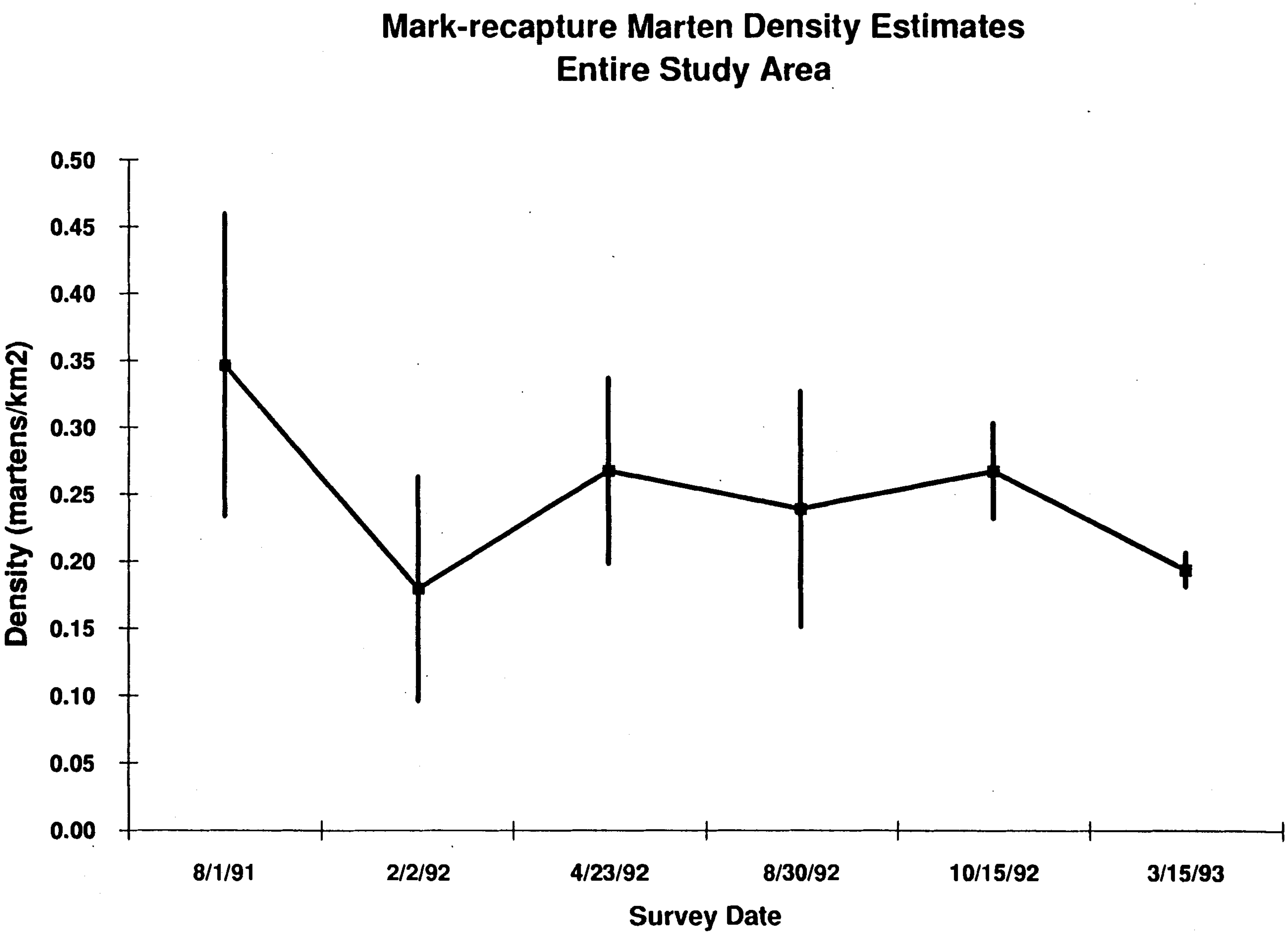

Figure 2. Density of martens on Salt Lake Bay study area, northern Chichagof Island, during 1991-93.

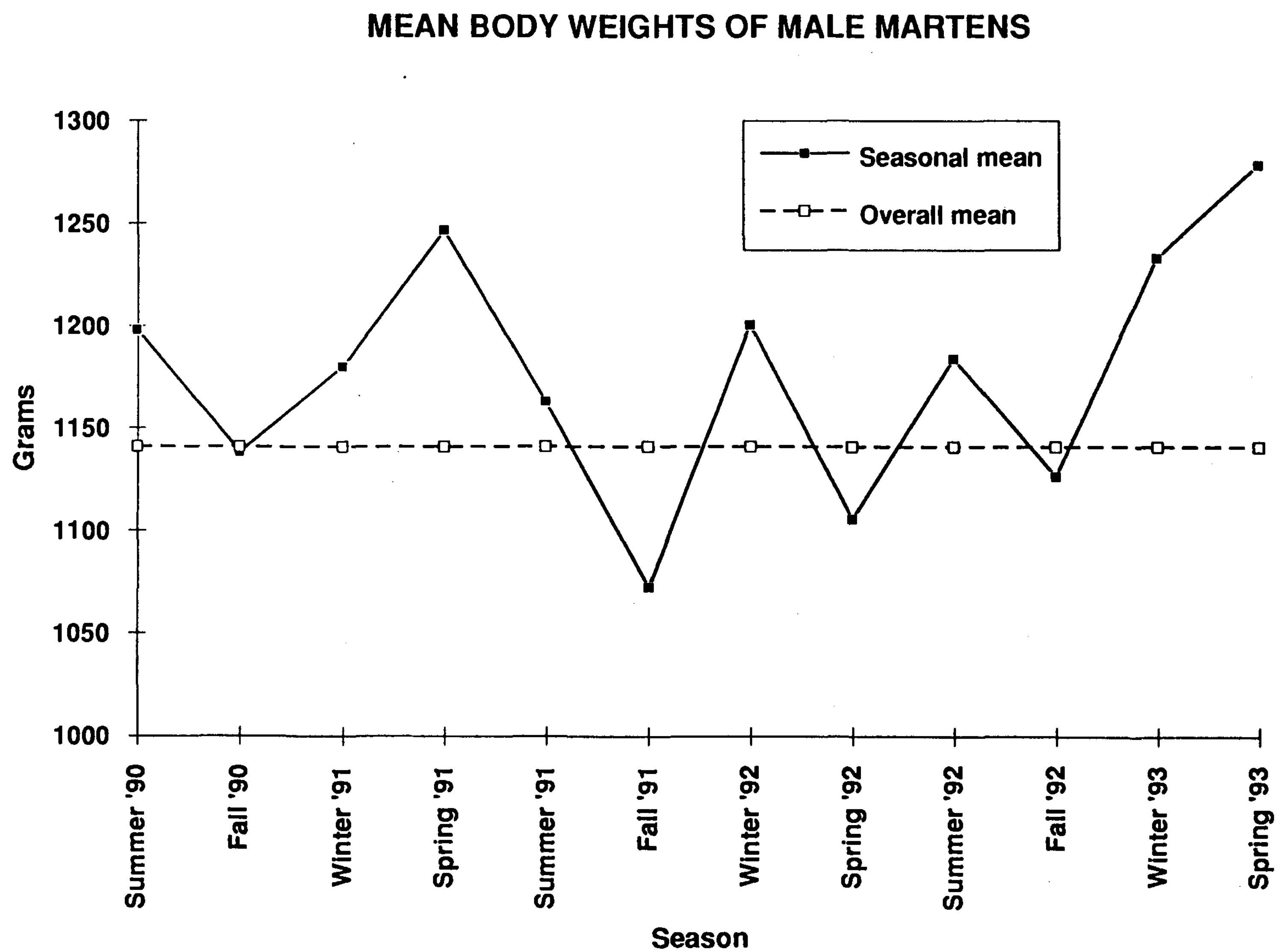

Figure 3. Mean body weights of male martens captured on northern Chichagof Island, 1990-93.

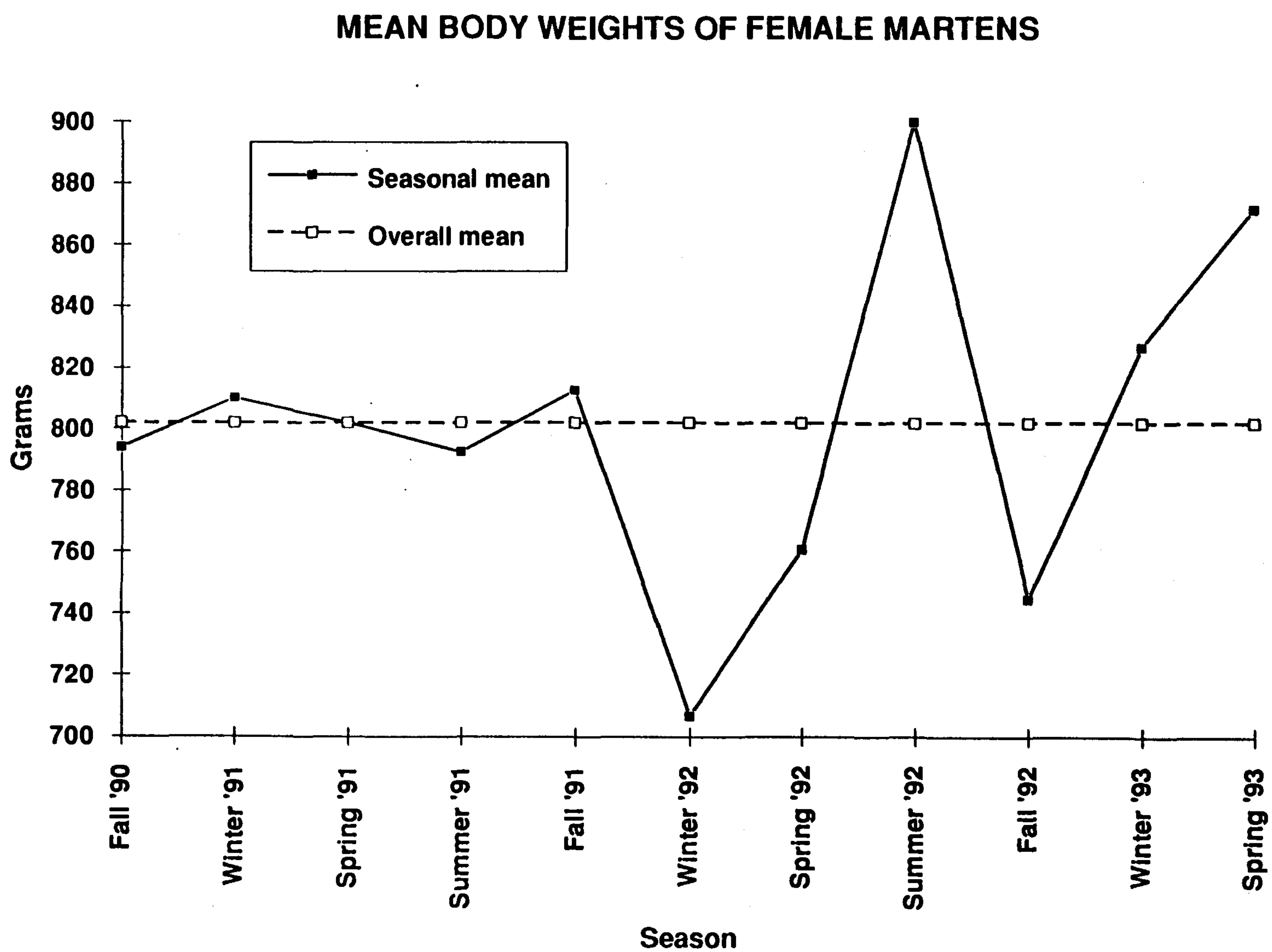

Figure 4. Mean body weights of female martens captured on northern Chichagof Island, 1990-93.

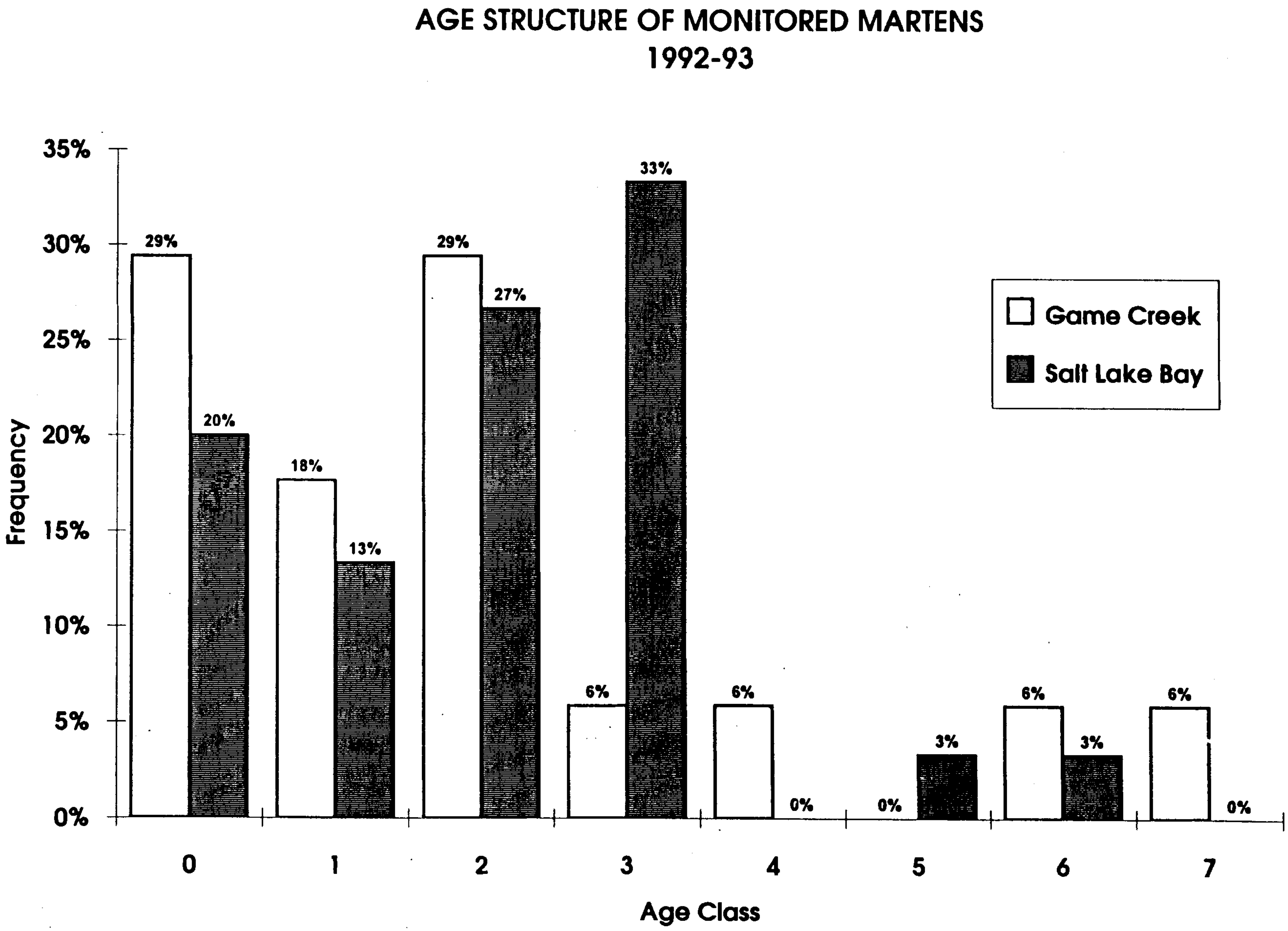

Figure 5. Age structure of martens monitored on northern Chichagof Island, 1992-93.

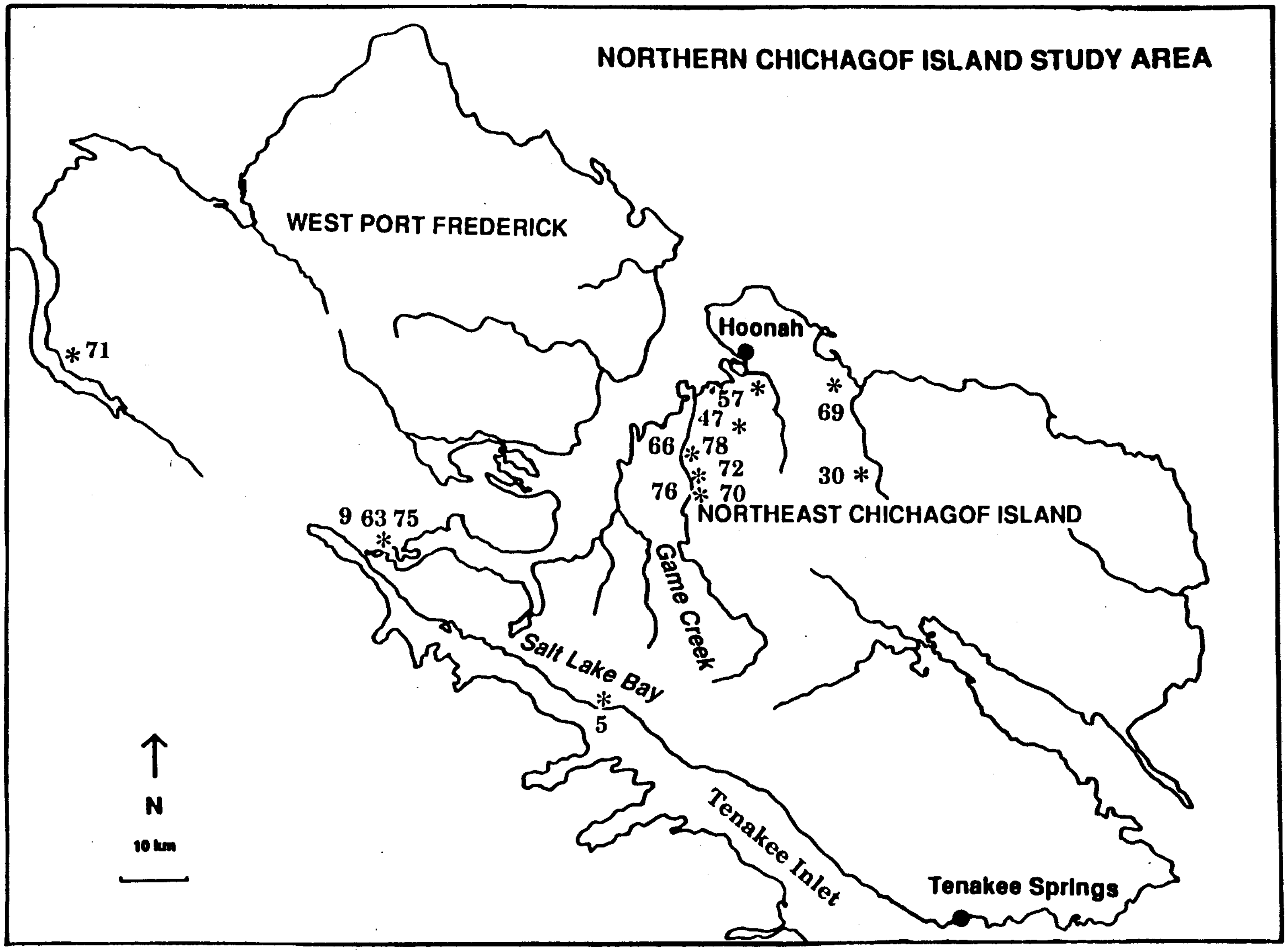

Figure 6. Trap site locations of radio-collared martens captured by trappers during 1992-93.

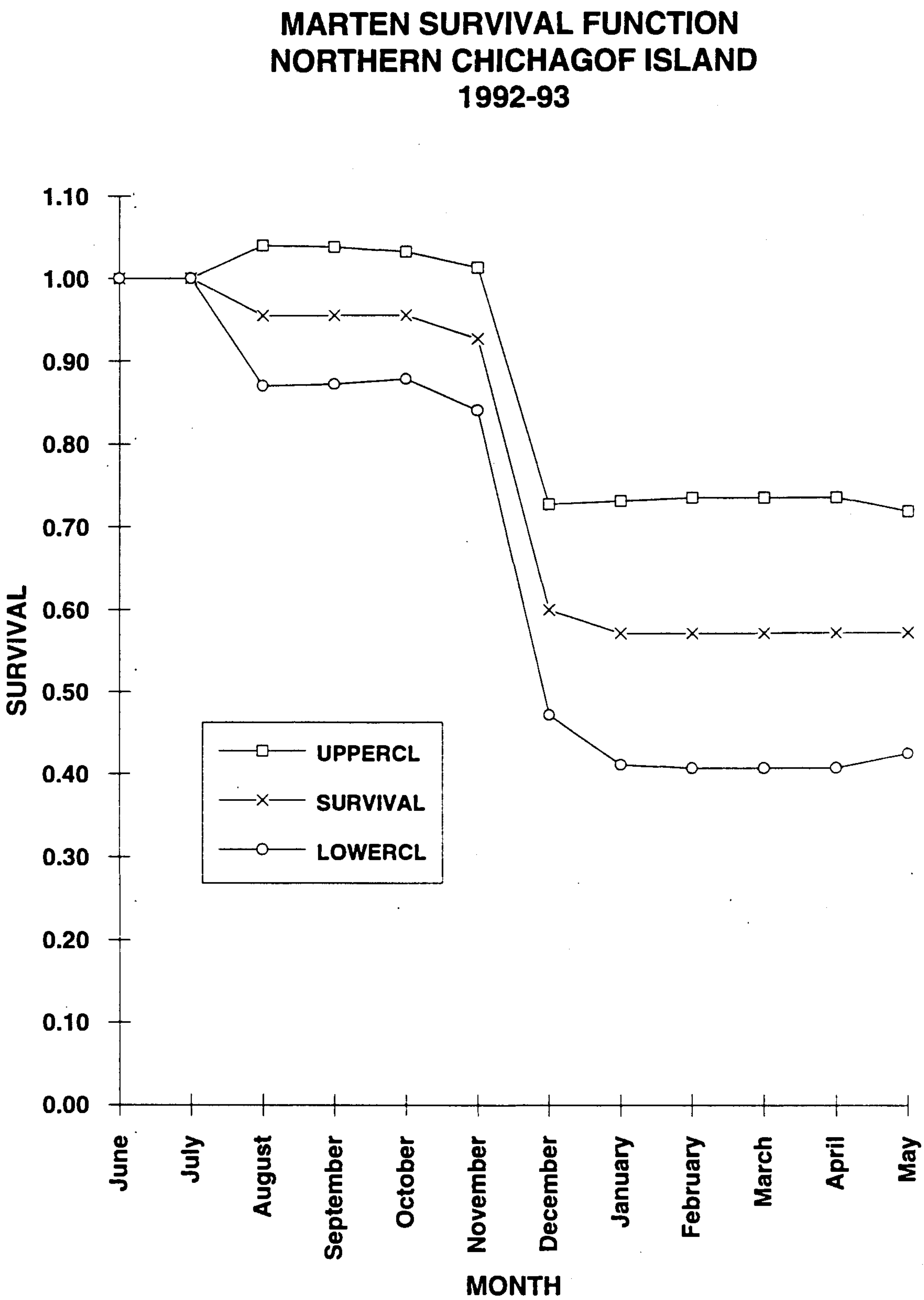

Figure 7. Kaplan-Meier survival estimates for radio-collared martens on northern Chichagof Island for 1992-93.

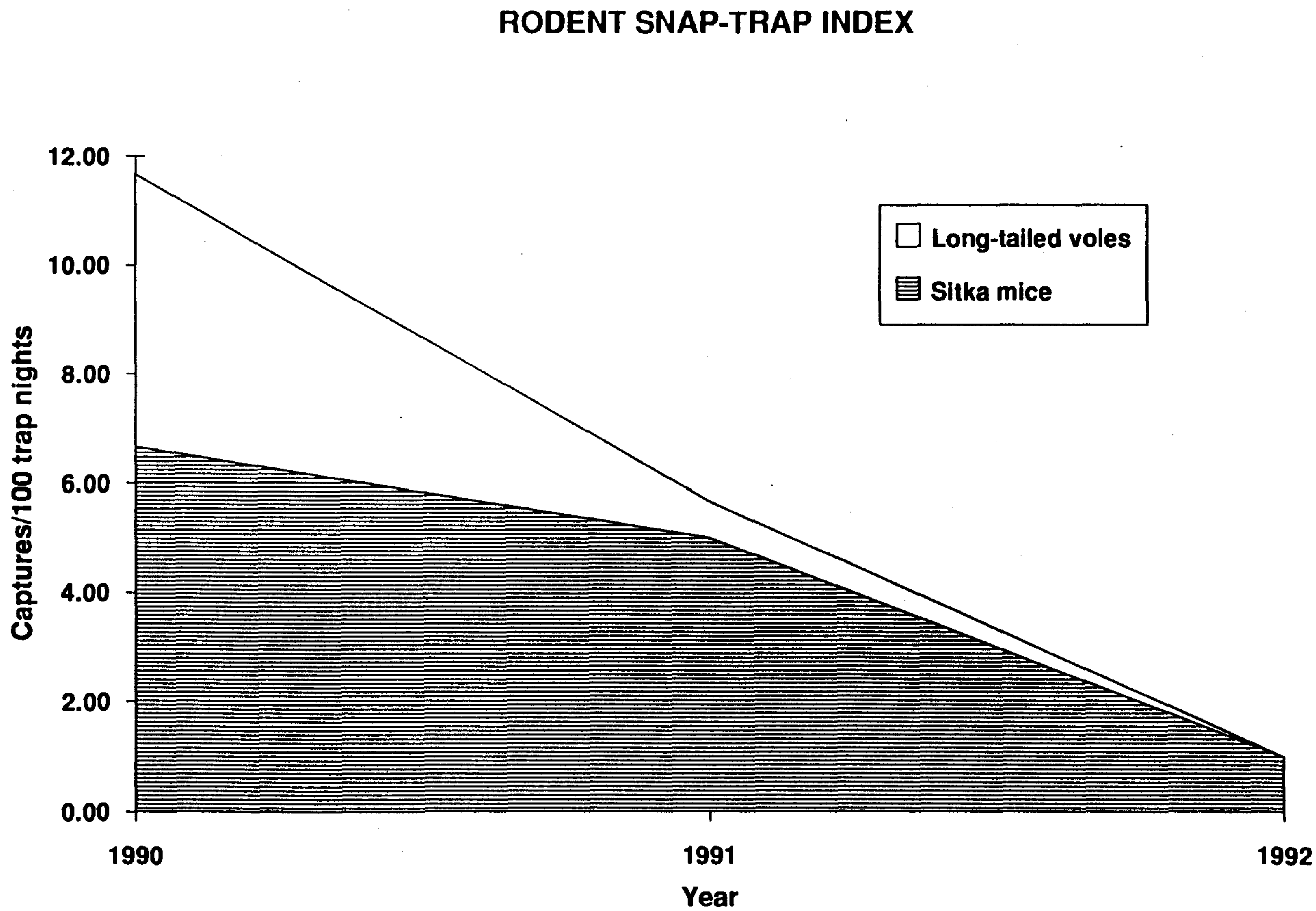

Figure 8. Snap-trap indices for Sitka mice and long-tailed voles on northeast Chichagof Island, 1990-92.

Table 1. Live-trapping effort and success rates for martens on Salt Lake Bay study area, northeast Chichagof Island, southeast Alaska during 1992-93.

Month	No. of trap nights	Total captures	Captures/ 100 trap nights	New captures	New captures/ 100 trap nights
June	93	3	3.2	1	1.1
July	0				
August	244	6	2.5	2	0.8
September	0				
October	191	29	15.2	6	3.1
November	0				
December	39	1	2.6	1	2.6
January	77	8	10.4	1	1.3
February	0				
March	311	20	6.4	1	0.3
April	81	4	4.9	0	0.0
May	31	0	0.0	0	0.0
Totals	1067	71	6.7	12	1.1

Table 2. Live-trapping effort and success rates for martens on Upper Game Creek study area, northeast Chichagof Island, southeast Alaska during 1992-93.

Month	No. of trap nights	Total captures	Captures/ 100 trap nights	New captures	New captures/ 100 trap nights
June	0				
July	0				
August	0				
September	156	6	3.8	5	3.2
October	0				
November	124	6	4.8	4	3.2
December	0				
January	0				
February	0				
March	0				
April	211	13	6.2	6	2.8
May	0				
Totals	491	25	5.1	15	3.1

Table 3. Age, sex, and status of radio-collared martens monitored on northeast Chichagof Island during 1992-93.

Animal no.	Sex	Age class	Date collared	No. of captures	Study[a] area	Residency[b] status	Survival status[c]
4	M	2	06/13/90	0	SLB	R	Censored - May
5	M	3	06/14/91	3	SLB	R	Trapped - Dec.
9	M	2	09/14/90	3	SLB	R	Trapped - Dec.
24	F	1	01/09/91	2	SLB	R	Survived
30	M	1	04/24/91	0	SLB	OR	Trapped - Dec.
36	M	1	08/02/91	4	SLB	R	Survived
45	M	2	11/16/91	4	SLB	R	Survived
47	M	1	12/16/91	0	SLB	T	Trapped - Dec.
48	F	0	02/02/92	5	SLB	R	Survived
49	F	2	02/04/92	1	SLB	R	Survived
50	F	2	02/04/92	4	SLB	TR	Natural death - Aug.
51	F	1	02/07/92	0	SLB	T	Censored - Sept.
52	F	2	03/05/92	3	SLB	R	Survived
53	M	0	03/29/92	0	GC	T	Censored - March
54	M	1	03/30/92	0	GC	T	Censored - April
55	M	5	04/27/92	7	SLB	R	Survived
56	F	2	04/27/92	3	SLB	R	Survived
57	F	0	04/27/92	0	SLB	T	Trapped - Dec.
58	F	1	04/28/92	9	SLB	R	Survived
59	F	1	04/30/92	0	SLB	T	Censored - Nov.

Table 3. Continued.

Animal no.	Sex	Age class	Date collared	No. of captures	Study[a] area	Residency[b] status	Survival status[c]
60	M	1	05/01/92	3	SLB	R	Survived
61	F	4	05/01/92	1	SLB	R	Censored - Jan.
62	F	2	06/30/92	4	SLB	R	Survived
63	M	0	08/28/92	1	SLB	T	Trapped - Dec.
64	M	0	08/31/92	1	SLB	T	Natural death - Nov.
65	F	2	09/18/92	1	GC	R	Survived
66	M	0	09/19/92	2	GC	U	Trapped - Dec.
67	M	2	09/20/92	1	GC	R	Survived
68	M	0	09/30/92	1	GC	U	Censored - Dec.
69	M	0	09/30/92	1	GC	U	Trapped - Dec.
70	M	0	10/10/92	2	SLB	T	Trapped - Dec.
71	M	0	10/10/93	2	SLB	T	Trapped - Dec..
72	M	1	10/10/92	2	SLB	T	Trapped - Dec.
73	F	0	10/11/92	1	SLB	T	Survived
74	M	0	10/12/92	2	SLB	T	Censored - Dec.
75	M	1	10/13/92	1	SLB	T	Trapped - Dec.
76	M	0	11/10/92	2	GC	U	Trapped - Dec.
77	M	2	11/10/92	6	GC	R	Survived
78	M	0	11/14/92	1	GC	U	Trapped - Dec.
79	M	3	12/20/92	2	SLB	TR	Survived
80	M	3	01/15/93	4	SLB	TR	Survived

Table 3. Continued.

Animal no.	Sex	Age class	Date collared	No. of captures	Study[a] area	Residency[b] status	Survival status[c]
81	M	3	03/12/93	1	SLB	TR	Survived
82	M	2	04/07/93	1	GC	R	Survived
83	F	1	04/08/93	1	GC	U	Survived
84	F	1	04/27/93	2	GC	T	Survived
85	F	7	04/28/93	1	GC	T	Survived
86	F	4	05/02/93	1	GC	R	Survived
87	F	3	05/02/93	1	GC	R	Survived

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

Table 4. The sex and residency status of martens monitored on northeast Chichagof Island, southeast Alaska, during 1992-93.

Status	Males	Females	Total
Salt Lake Bay			
Resident	8	8	16
Temporary resident	3	0	3
Game Creek			
Resident	2	4	6
Temporary resident	0	0	0
Unknown	5	1	6
Transients	10	6	16
Other residents	1	0	1
Totals	29	19	48

Table 5. Home range size estimates for adult resident martens on northeast Chichagof Island, southeast Alaska, 1992-93. Home range sizes of males were larger than females at each contour level (Wilcoxen 2-sample test, $P < 0.10$).

Animal no.	*N*	Convex polygons (km²)		
		75%	95%	100%
Males				
04	29	7.4	14.5	18.0
05	11	4.5	6.9	12.7
09	13	2.1	4.2	5.3
36	32	2.3	6.1	24.8
45	27	1.7	3.1	3.8
55	34	5.6	10.2	10.8
60	33	9.5	18.6	22.3
67	29	2.9	3.9	4.2
79	19	4.4	11.7	19.1
80	16	3.7	8.0	9.3
Medians		4.1	7.5	11.8
Females				
24	40	5.2	9.1	11.7
48	36	2.8	8.6	11.2
49	35	6.0	8.2	9.2
52	39	1.5	2.4	4.2
56	30	5.0	6.8	7.2
58	31	2.2	6.1	15.4
61	16	1.2	6.4	12.8
62	34	1.6	4.7	5.2
65	25	0.8	1.8	2.5
77	21	0.4	0.9	2.0
Medians		1.9	6.3	8.2

APPENDIX A

AGE STRUCTURE AND FECUNDITY OF MARTENS TRAPPED ON CHICHAGOF ISLAND AND NORTHERN BARANOF ISLAND, SOUTHEAST ALASKA, DURING 1992-93

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Abstract: Marten (*Martes americana*) carcasses were collected from trappers on Chichagof Island and northern Baranof Island to determine age structure and maximum fecundity. On each area, the marten catch decreased substantially in 1992-93 from the 1991-92 trapping season. Age structures differed by area with few juveniles on northern and southern Chichagof Island (32% and 22%). On northern Baranof Island, juveniles comprised a greater percentage of the catch (49%). Few martens were older than 4 years on either area. Juvenile:adult female ratios differed by area with low ratios on southern (0.95:1.00) and northern (1.39:1.00) Chichagof Island and a high ratio on Baranof Island (5.00:1.00). Corpora lutea counts indicated that age-specific fecundity rates differed by area. Yearling female martens showed low fertility on all areas (0% to 20% pregnant). Pregnancy rates of females aged 2 years and older ranged from 56% to 75%. Trappers caught few adult females on Baranof Island. The mean number of corpora lutea per pregnant female was similar between areas and among age classes. Thus, marten fecundity appeared most affected by female pregnancy rates and less by the number of ovulations per pregnant female. Marten fecundity was highly variable among areas and among years within the same area. On Chichagof Island, the reduced trapper catch and low proportion of juveniles in the catch probably resulted from low fecundity in 1992-93. Based on the corpora lutea counts, the trend of low fecundity is expected to continue in 1993-94.

Population managers need to understand marten demographics, so informed decisions on harvest regulations can be made. Recent fluctuations in the marten catch in southeast Alaska have raised concerns among management agencies. In 1990, a research project on marten demographics in northern southeast Alaska was initiated by the Alaska Department of Fish and Game in conjunction with the USDA Forest Service (Flynn, 1990). For this study, marten carcasses were collected from trappers operating in northern Chichagof Island during 1991-92 (Flynn and Blundell 1992). Because of population management concerns raised by the demographic information collected in 1991-92 (Flynn and Blundell 1992), I expanded the carcass collection for the 1992-93 trapping season to include all of Chichagof Island and northern Baranof Island. This report presents age structure and fecundity information on martens captured by trappers on Chichagof Island and northern Baranof Island during 1992-93.

Many individuals and agencies contributed to the project. Gail Blundell was field and lab technician for the project and processed most of the carcasses from northern Chichagof Island. Loyal Johnson collected and processed the carcasses from southern Chichagof and northern Baranof islands under a contract with the Department of Fish and Game. E. L. Young, Area Management Biologist, was instrumental in initiating the study. Trooper David Jones, Division of Fish and Wildlife Protection, provided field and office support in Hoonah and helped with obtaining carcasses. The assistance of USDA Forest Service cooperators, Ted Schenck and Kris Rutledge, greatly facilitated the study. The cooperation of the local trappers who provided carcasses - G. Coutlee, N. Gallagher, J. Carter, Z. Strong, and F. Moore - was appreciated. Gary Matson evaluated the teeth for cementum age and the ovaries for corpora lutea. Support for the project was provided by the Alaska Department of Fish and Game through Federal Aid in Wildlife Restoration Project W-23-4, Job 7.16 and the USDA Forest Service through contract 43-0109-2-0623.

STUDY AREA

Because of concerns for marten populations there, I chose Chichagof Island and northern Baranof Island, located in the northern portion of southeast Alaska (57-58°N, 135-136°E; 80-160 km west of Juneau), for this project (Fig. 1). Most habitats typical of northern southeast Alaska occurred on the study area including a range of physiographic types from beach fringe to alpine (Flynn 1991). Landscapes included substantial amounts of logged and unlogged areas. Access for trappers varied depending on the locations of logging road systems, protected waters for small boats, and lodging facilities provided by logging camps, private cabins, and communities. Most of the lands were within the Hoonah and Sitka ranger districts, Chatham Area, Tongass National Forest, USDA Forest Service.

Federal Fish and Wildlife Service personnel introduced martens to Baranof and Chichagof islands to establish populations for human use (Elkins and Nelson 1954). Seven martens (4 males and 3 females), captured on the mainland near Cape Fanshaw, were released on Baranof Island in 1934. Twenty-one martens (5 males, 8 females, 8 unknown) were released near Pelican on Chichagof Island between 1949 and 1952 (Elkins and Nelson 1954). The animals were captured from several geographic areas including Baranof Island (6, original population source was near Cape Fanshaw), Stikine River area (5), Wrangell Island (4), Mitkof Island (2), Revillagigedo Island near Ketchikan (1), and near Anchorage (3).

The trapping season on Baranof Island for martens was first opened in 1950-51, and the first marten trapping season on Chichagof Island was in 1962. Since state management began in 1961, marten trapping seasons in southeast Alaska have ranged from 30 to 100 days during November, December, January, and February. Because of conflicts over subsistence, the state and federal government began dual harvest management in 1990-91. Recreational and subsistence trapping seasons for martens, mink, and weasels on the northeast portion of Chichagof Island were closed during 1990-91 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. During 1991-92, the trapping season for both portions of northern Chichagof Island opened on 1 December. On northeast Chichagof Island, federal subsistence regulations prohibited trapping with the use of a motorized land vehicle on federal lands. The trapping seasons for marten, mink, and weasels on northern Chichagof Island were closed on 24 January 1992 by state and federal emergency orders because of concern about the overharvest of martens. For 1992-93, the restriction on the use of land vehicles for trapping was expanded to federal lands on the portion of northern Chichagof Island west of Port Frederick and north of a line from Tenakee Inlet to Idaho Inlet. Also, federal subsistence regulations restricted marten trapping on northern Chichagof Island to rural residents of the state. The season for northern Chichagof Island ran from 1-31 December. For Baranof Island and southern Chichagof Island, the marten season remained from 1 December to 15 February with no additional restrictions.

METHODS

Marten catch

The total number of martens caught by trappers in the area was obtained from the department's regular furbearer sealing program. Regulation required that all martens trapped in southeast Alaska be sealed by the department within 30 days of season closure. During sealing, the number, sex, location, and month of capture were recorded by an authorized representative of the department. The sealing information was summarized by the same geographic areas as the carcass data.

Carcass collection

The marten carcass collection was handled in two ways depending on area. For northern Chichagof Island, I attempted to collect the carcasses from all martens trapped during the 1-31 December 1992 trapping season. Before the opening of the trapping season, I sent a letter to everyone who had trapped on northern

Chichagof Island during the past three years. Trappers were provided with information on the objectives of the study and offered $3.00 for each carcass received in good condition. Trappers were instructed to record the date and capture location on an aluminum tag, attach the tag to the appropriate carcass, and to freeze each carcass immediately after skinning. Upon receiving carcasses from trappers, I kept them frozen at the Douglas office until processing. For the marten carcasses collected from southern Chichagof Island and northern Baranof Island, Loyal Johnson contacted area trappers, collected carcasses from them, and processed the carcasses following the procedures described below. All the carcasses were processed within 2 months of capture.

Each carcass was weighed, and an index of internal and external fat content assigned using an ocular estimation procedure developed by Blundell (1992). Total, body, and tail lengths of each carcass were measured along with the method of skinning (i.e., feet skinned out or not). The stomachs of each carcass were examined for the presence parasites, and the number of *Soboliphyme baturini* worms was recorded. Each skull was measured and classified as juvenile or adult according to Magoun et al. (1988). The skulls were heated in water for 2-4 hours at 80° C, then the lower canine and premolar 4 extracted. The teeth were stored frozen until sent to Matson's Laboratory (Milltown, MT) for age class determination by tooth cementum analysis.

Each carcass was assigned a code for geographic area following the department's hierarchical numbering system. For analysis, I grouped the samples by the following major geographic areas: northern Chichagof Island was the area north of Tenakee Inlet and east of Idaho Inlet; southern Chichagof Island was the area south of Tenakee Inlet and north of Peril Strait; and northern Baranof Island was the area north of Goddard and Redoubt Lake. For some analyses, northern Chichagof Island was further divided into northeast Chichagof Island, the portion east of Port Frederick.

Ovarian analysis

The ovaries of each female were removed and preserved in a solution of 10% formalin. Before shipment to Matson's Laboratory (Milltown, MT), the ovaries were washed in water 3 times and subsequently packed in water. Ovaries were serially sectioned at 10 microns, and sections for evaluation were taken at 0.4 mm intervals throughout the series. Preparations were stained in a trichrome solution. A standard protocol developed by G. Matson was used to determine the presence and number of corpora lutea in each ovary.

Corpora lutea form in either ovary upon shedding of an ovum and remain in the ovary during pregnancy (Strickland and Douglas 1987). The martens for this study were trapped during the period of arrested development of the blastocyst and before its implantation in the uterus (Clark et al. 1987). Because ovulation is induced during mating, a female marten with corpora lutea present in either ovary was considered pregnant at the time of death. The proportion of females in an age class with corpora lutea was expressed as an age-specific pregnancy rate. I summed the counts for a pair of ovaries to determine the total number of corpora lutea present for an individual female marten. The total number of corpora lutea was considered a measure of maximum fecundity of the female marten at the next birth pulse (i.e., spring 1993) because some shed ova will not result in live births. The mean number of corpora lutea was computed by age class to estimate age-specific fecundity rates. Several age-class groupings were used for determining fecundity and pregnancy rates. Juveniles were young of the year, and adults were yearlings (age class 1) and greater. Also, adult females were grouped as yearlings (i.e., age class 1), and mature females (age class 2^+). No juveniles were pregnant, so this age class was dropped from any additional analyses.

RESULTS AND DISCUSSION

Total Catch

The marten catch in 1992-93 was greatly reduced from 1991-92 in each area. On northern Chichagof Island, 113 martens (32% females) were reported taken by trappers compared with 513 martens (48% females) during the 1991-92 trapping season, a 78% decrease. On southern Chichagof Island, the catch declined 58% from 610 (42% females) in 1991-92 to 254 (33% females) last year. The catch on north Baranof Island decreased 75.8% from 347 (42% females) to 84 (30% females). Although the trapping regulations on northern Chichagof Island were more restrictive in 1992-93 with a 30-day season and a restriction on the use of motorized vehicles on federal lands west of Port Frederick, the reduced catch probably reflected reduced numbers of martens in the area. The private lands on the east side of Port Frederick were trapped from the road system in 1992-93, and nearly all of the catch on the east side of Port Frederick came off the road system. The same trapping regulations were in effect on the other areas both years, and the reduced catch was probably the result of reduced marten numbers.

I collected carcasses from 88% (100) of the martens reported trapped on northern Chichagof Island during 1992-93. On southern Chichagof, carcasses were collected from 29% of the 254 martens reported trapped there. Of the 84 martens trapped on northern Baranof Island, 86% of the carcasses were collected.

Age Structure

Age structures differed by area ($\chi^2 = 14.7$, df = 4, $P = 0.005$) (Fig. 2). The percentage of juveniles in the catch was low on northern and southern Chichagof Island (32.0% and 22.0%) (Table 1, 2). On northern Baranof Island, juveniles comprised 48.6% of the catch (Table 3). For northern Chichagof Island, the juvenile percentage was similar to 1991-92 (32.0% versus 34.0%) (Flynn and Blundell 1992).

The percentage of females in the catch was lower in 1992-93 for each area, and the amount of decrease was similar. On northern Chichagof Island, the female percentage decreased from 48% to 35%. On the basis of the sealing records, the female percentage declined on southern Chichagof Island from 42% to 33% and on northern Baranof Island from 42% to 30%. The percentage of females in the catch was independent of age class for each area (Baranof (χ^2 = 4.6, df = 2, P = 0.11); northern Chichagof (χ^2 = 1.9, df = 2, P = 0.38); and southern Chichagof (χ^2 = 3.9, df = 2, P = 0.14)). The reason for the reduced number of females in the catch was unclear. Either females comprised less of the pretrapping marten population, or males were more vulnerable to trapping last year. Preliminary information from radio-collared martens on northeast Chichagof Island indicated that males were more vulnerable last season (R. Flynn, unpubl., Alaska Dep. Fish and Game, Douglas, AK).

Juvenile:adult female ratios varied by area from 0.95:1.0 to 5.00:1 (Table 4). On northern Chichagof Island, the juvenile:adult female ratio increased to 1.39 from 0.96 in 1991-92. The ratio of juveniles:female age 2^+ ranged from 1.12:1 on southern Chichagof to 17.5:1 on northern Baranof. On northern Chichagof, the juvenile:female age 2^+ ratio increased 2.67 from 2.20. Although the percentage of juveniles was similar both years on northern Chichagof, the lower percentage of adult females in the catch resulted in increased juvenile:adult female ratios. I suspect that recruitment remained low during 1992-93 on Chichagof Island, but adult females were less vulnerable to trapping. Strickland and Douglas (1987) recommended that the juvenile:adult ratio in the catch should be greater than 3.0 to avoid an overharvest of adult females. Because the juvenile:adult female ratios in the catch for both portions of Chichagof Island (0.95 and 1.39) were substantially less than 3.0, an overharvest of adult females probably occurred there. On northern Baranof Island, the juvenile:adult female ratio was well above the guideline of Strickland and Douglas (1987) because few adult females were captured.

Fecundity

Age-specific potential fecundity rates of trapped female martens varied by area (Tables 5-7). Yearling female martens showed low fertility on all areas with pregnancy rates varying from 0 to 20%. Although pregnancy rates of yearling females were lower, pregnant yearling females on northern Chichagof Island had a similar number of corpora lutea as older females (Table 5). None of the three females greater than age 6 was pregnant. On Chichagof Island, pregnancy rates for female martens age 2^+ ranged from 56% on the southern portion to 75% on northern Chichagof (Table 5). The mean number of corpora lutea per pregnant female was similar between areas and among age classes. Marten fecundity appears strongly influenced by pregnancy rates.

For northern Chichagof Island, the mean number of corpora lutea per adult female increased to 1.65 from 0.68 in 1991-92 (143%). The mean number of corpora lutea per pregnant female increased 21% from 2.94 to 3.55. The increase in the mean number corpora lutea indicated an increase in potential fecundity on northern Chichagof Island for the 1993-94 biological year. Because the trapped females would have given birth in May 1993, fecundity rates (i.e., recruitment) for 1992-93 will remain low, especially on southern Chichagof Island. Although increased from 1991-92, fecundity rates were still low compared to those reported by Strickland and Douglas (1987). Over a 12-year period in Ontario, Strickland and Douglas (1987) found pregnancy rates for adult females varying from 81 to 100% with an overall yearling pregnancy rate of 78% and a 93% rate for mature females (age class 2^+). In Ontario, Thompson and Colgan (1987) found reduced ovulation rates by female martens in response to food scarcity, especially in yearlings. They found that pregnancy rates for yearling female martens decreased from 7% to 0% during a decline in the availability of small mammal prey while pregnancy rates of mature females varied from 50% to 72%.

MANAGEMENT IMPLICATIONS

Age structure information from the expanded marten carcass collection during the 1992-93 trapping season indicated low recruitment across Chichagof Island, especially on the southern portion. The reduced marten catch in 1992-93 probably reflected lower population numbers resulting from the low recruitment and high trapper catch during the 1991-92 season. The low corpora lutea counts indicated that low recruitment can be expected in 1993-94. Because of the continued low recruitment and substantial trapping pressure over the last several years, marten numbers will be low across Chichagof Island during fall 1993.

On northern Chichagof Island, the pregnancy rate for age 2^+ female martens increased from 36% in 1991-92 to 75% in 1992-93, but the pregnancy rate for yearlings remained low (14 to 18%). The increased pregnancy rates by older females should result in a small increase in recruitment unless young survival is poor this fall. The increased fecundity of older females suggests a response to increased nutrition on northern Chichagof Island. Additional study is needed to further explore the relationship between marten fecundity and nutrition. Also, more research on marten demographics in the area is needed to clarify relationships among reproductive parameters, recruitment, catch statistics, and food abundance.

This project has shown that useful management information can be obtained on marten population demographics from the examination of trapper-caught carcasses. Juvenile:adult ratios provide an estimate of recruitment for the harvest year. Age structure provides additional insight on population dynamics over the past several years. The ovarian analysis provides a measure of potential recruitment for the following year. If a commercial laboratory is available for the tooth cementum and ovarian analyses, the data collection procedures are relatively easy for the investigator to complete.

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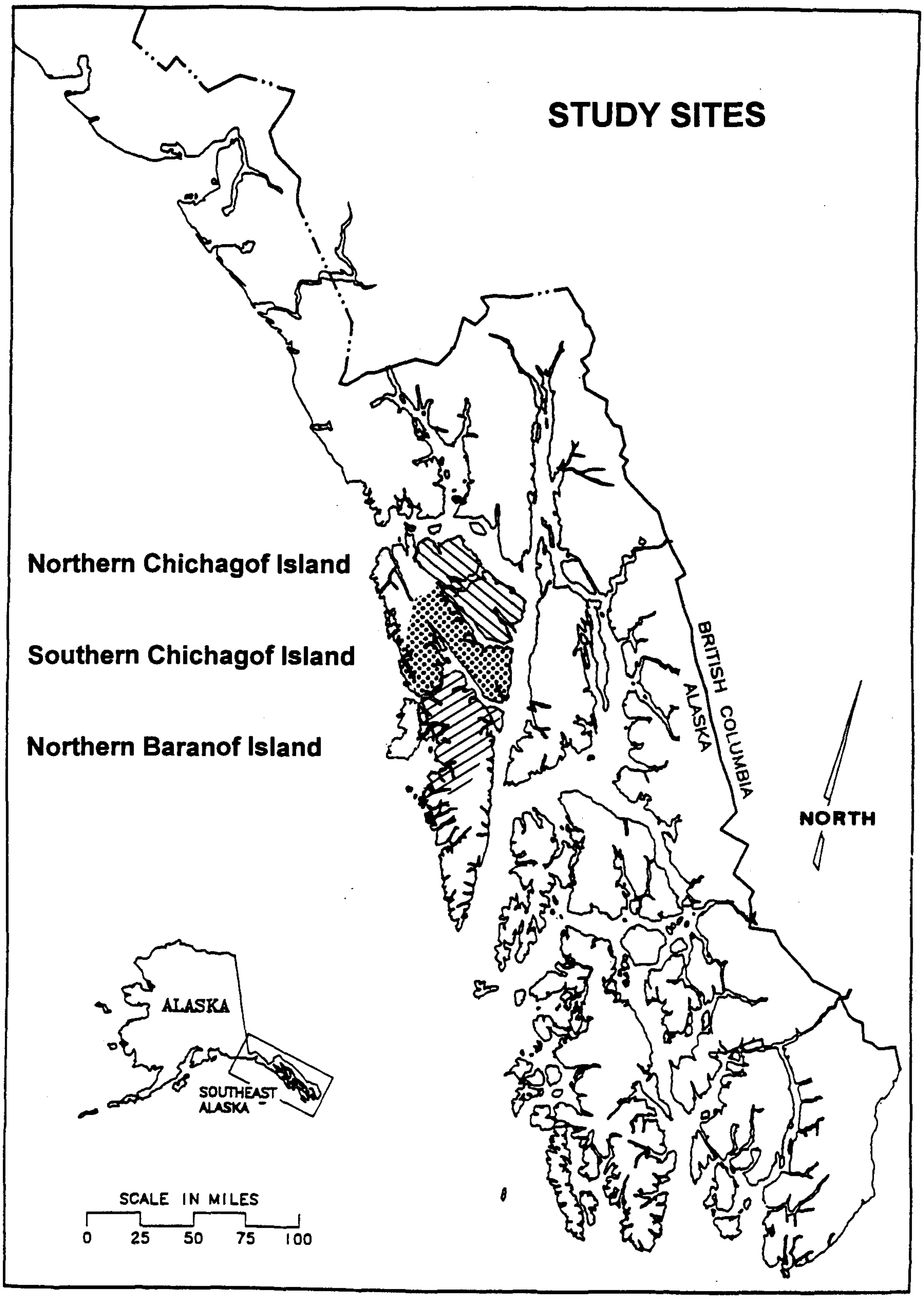


Figure 1. Study sites on northern Chichagof Island, southern Chichagof Island, and northern Baranof Island in southeast Alaska.

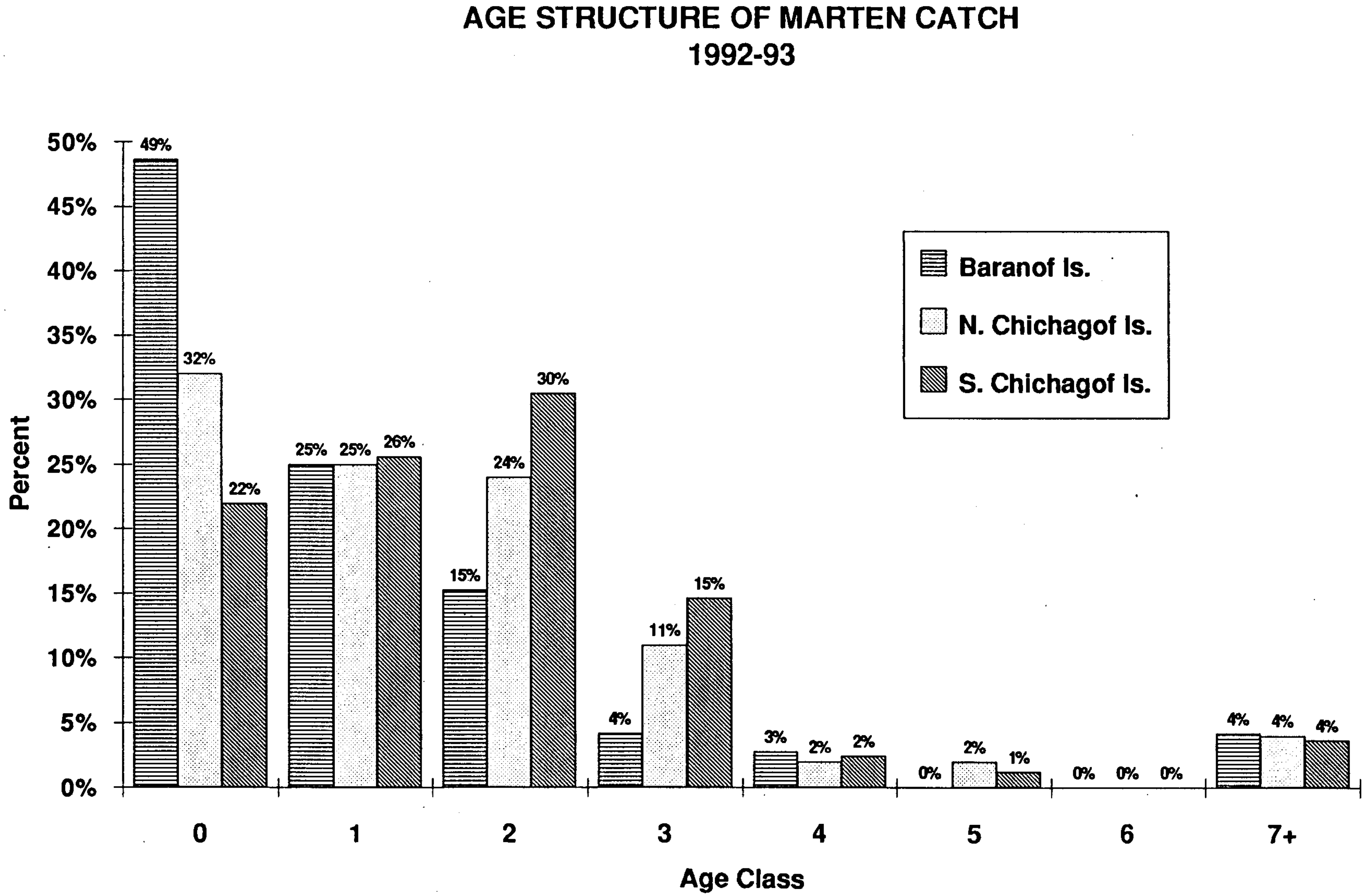


Figure 2. Age structure of martens trapped on Chichagof Island and northern Baranof Island during 1992-93.

Table 1. Age distribution of martens captured by trappers on northern Chichagof Island, southeast Alaska, during 1992-93.

Age class	Males		Females		Totals		Females (%)
	N	%	*N*	%	*N*	%	
0	20	20.0	12	12.0	32	32.0	37.5
1	14	14.0	11	11.0	25	25.0	44.0
2	18	18.0	6	6.0	24	24.0	25.0
3	8	8.0	3	3.0	11	11.0	27.3
4	2	2.0	0	0.0	2	2.0	0.0
5	1	1.0	1	1.0	2	2.0	50.0
6	0	0.0	0	0.0	0	0.0	
>6	2	2.0	2	2.0	4	4.0	50.0
Totals for ages >0	45	45.0	23	23.0	68	68.0	33.8

Table 2. Age distribution of martens captured by trappers on southern Chichagof Island, southeast Alaska, during 1992-93.

Age class	Males		Females		Totals		Females (%)
	N	%	*N*	%	*N*	%	
0	11	13.4	7	8.5	18	22.0	8.5
1	18	22.0	3	3.7	21	25.6	14.3
2	15	18.3	10	12.2	25	30.5	40.0
3	8	9.8	4	4.9	12	14.6	33.3
4	1	1.2	1	1.2	2	2.4	50.0
5	1	1.2	0	0.0	1	1.2	0.0
6	0	0.0	0	0.0	0	0.0	
>6	2	2.4	1	1.2	3	3.7	33.3
Totals for ages >0	45	54.9	19	23.2	64	78.0	23.2

Table 3. Age distribution of martens captured by trappers on northern Baranof Island, southeast Alaska, during 1992-93.

Age class	Males		Females		Totals		Females (%)
	N	%	*N*	%	*N*	%	
0	22	30.6	13	18.1	35	48.6	37.1
1	13	18.1	5	6.9	18	25.0	27.8
2	9	12.5	2	2.7	11	15.3	18.2
3	3	4.2	0	0.0	3	4.2	0.0
4	2	2.8	0	0.0	2	2.8	0.0
5	0	0.0	0	0.0	0	0.0	0.0
6	0	0.0	0	0.0	0	0.0	
>6	3	4.2	0	0.0	3	4.2	0.0
Totals for ages >0	45	41.7	7	9.7	37	51.4	18.9

Table 4. Age ratios of martens captured by trappers in northern southeast Alaska, during 1992-93.

Area	Juveniles/ adult	Juveniles/ age 1^+ female	Juveniles/ age 2^+ female
Northern Chichagof Is.	0.47	1.39	2.67
Southern Chichagof Is.	0.28	0.95	1.12
Northern Baranof Is.	0.95	5.00	17.50

Table 5. Mean counts of corpora lutea and percentage of females with corpora lutea by age class of martens collected by trappers on northern Chichagof Island, southeast Alaska, during 1992-93. Female martens with corpora lutea were considered pregnant.

Age class	No. females examined	% females pregnant	Corpora lutea per pregnant female		Corpora lutea per female	
			$\bar{x}$	SE	$\bar{x}$	SE
1	11	18	3.00	0.00	0.55	0.37
2	6	100	3.50	0.43	3.50	0.43
3	3	67	3.50	0.50	2.33	1.20
4	0					
5	1	100	4.00		4.00	
6	0					
>6	2	0				
Totals	23	48	3.45	0.25	1.65	0.39
Totals for age classes >1	12	75	3.55[a]	0.29	2.67[b]	0.51

[a] Mean not significantly different from age class 1 ($t = 0.85$, $df = 9$, $P = 0.41$).

[b] Mean significantly different from age class 1 ($t = 3.31$, $df = 21$, $P = 0.003$).

Table 6. Mean counts of corpora lutea and percentage of females with corpora lutea by age class of martens collected by trappers on southern Chichagof Island, southeast Alaska, during 1992-93. Female martens with corpora lutea were considered pregnant.

Age class	No. females examined	% females pregnant	Corpora lutea per pregnant female		Corpora lutea per female	
			$\bar{x}$	SE	$\bar{x}$	SE
1	3	0			0.00	0.00
2	10	70	3.43	0.20	2.40	0.54
3	4	25	3.00		0.75	0.75
4	1	100	2.00		2.00	
5	0					
6	0					
>6	1	0			0.00	
Totals	19	47	3.22	0.22	1.52	0.39
Totals for age classes >1	16	56	3.22[a]	0.22	1.81[b]	0.43

[a] Sample sizes too small for meaningful statistical testing.

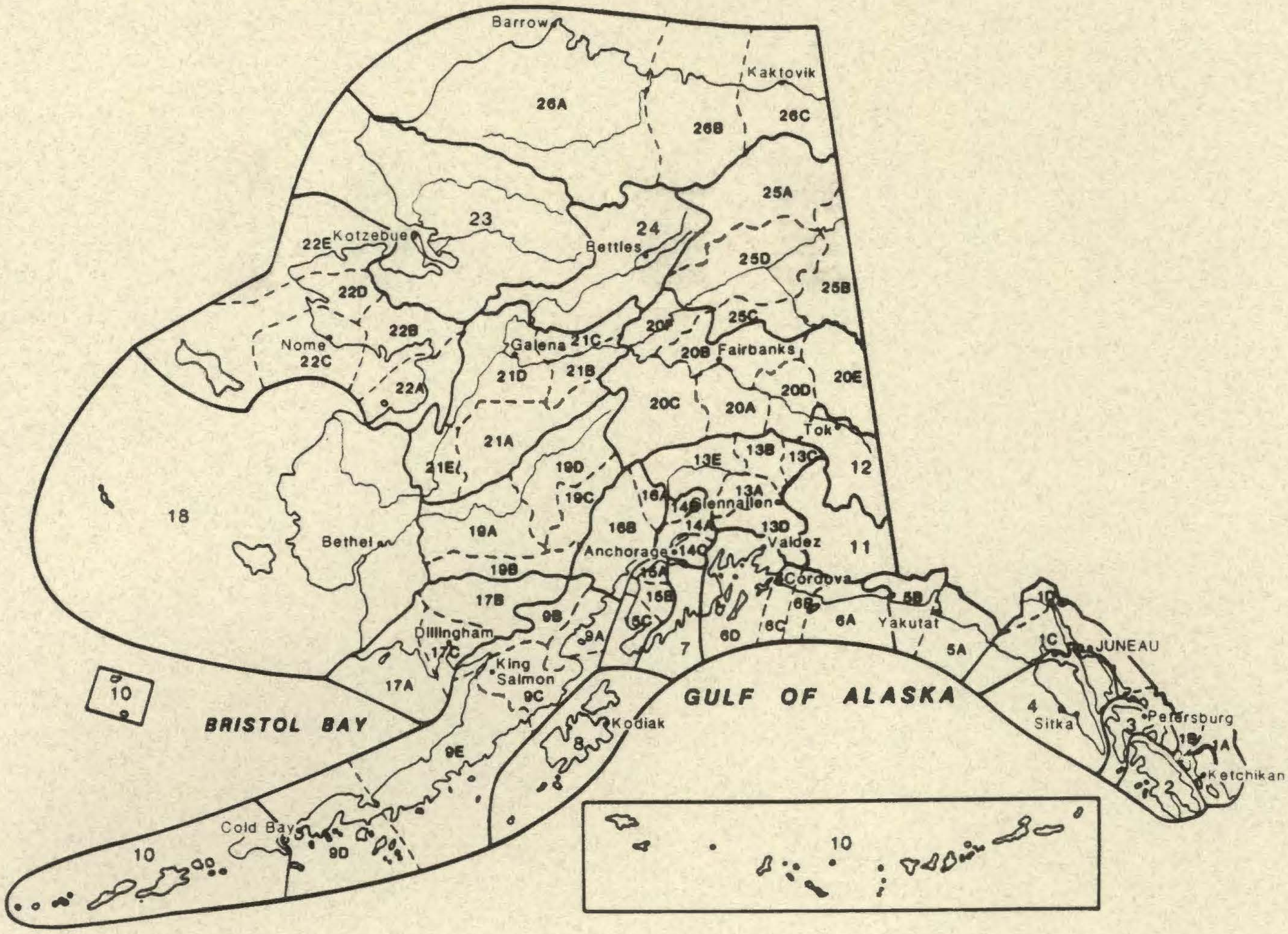
[b] Mean significantly different from age class 1 ($t = 4.21$, $df = 15$, $P = 0.001$).

Table 7. Mean counts of corpora lutea and percentage of females with corpora lutea by age class of martens collected by trappers on northern Baranof Island, southeast Alaska, during 1992-93. Female martens with corpora lutea were considered pregnant.

Age class	No. females examined[a]	% females pregnant	Corpora lutea per pregnant female		Corpora lutea per female	
			$\bar{x}$	SE	$\bar{x}$	SE
1	5	20	3.00		0.60	0.60
2	2	0			0.00	0.00
3	0					
4	0					
5	0					
6	0					
>6	0					
Totals	7	14	3.00		1.52	0.39
Totals for age classes						
>1	2	0			0.00	0.00

[a] Sample sizes too small for statistical significance testing.

Alaska's Game Management Units



Federal Aid in Wildlife Restoration

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 then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.