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Ecology of Martens in Southeast Alaska

by
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and
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Study 7.16
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SUMMARY

During the second year of field work on this project, we captured 44 martens (*Martes americana*) (23 males and 21 females) 110 times in 890 trap nights on the northeast Chichagof Island study area. We radiocollared 30 new martens (14 males and 16 females) for the first time. Altogether, we monitored 54 martens (32 males and 22 females) during at least part of the year. Seventeen radio-collared martens (12 males and 5 females) reside in the study area; all resident martens were adults.

We recorded habitat use of the radio-collared martens at 625 aerial locations during the fall/winter/spring season. Habitat selection data were not analyzed this report period.

Twenty-nine radio-collared martens (20 males and 9 females) died during the period. Nine deaths (7 males and 2 females) resulted from natural causes; 20 martens (13 males and 7 females) were killed by humans, most during the trapping season. We estimated annual survival of radio-collared martens at 0.25. Marginal survival functions indicated that nonhuman causes contributed 0.25 to the annual mortality rate; human causes contributed 0.66.

The marten catch (513) on northern Chichagof Island was the largest recorded since sealing began in 1984. We examined 436 trapper-caught carcasses for age, sex, body condition, reproductive condition, and parasites. The number of juveniles in the catch was low (34%), indicating low recruitment. Only 22% of the adult female martens were pregnant.

Median home range size (95% convex polygons) of 10 resident adult males was 5.5 km^2; 6 resident females had a median home range size of 2.7 km^2. Transient martens, both males and females, traveled extensively with the maximum distance between relocations averaging 24.1 km for males and 35.6 km for females.

The snapt-trap index for small mammal numbers decreased 60% from last year with long-tailed voles decreasing 86%. Because small mammals are an important food source for martens, the lower snap-trap index indicated a reduction in food availability.

The marten population on northern Chichagof Island appeared stressed during 1991-92, probably in response to reduced food availability. The response was characterized by poor recruitment, high adult mortality from human and nonhuman causes, low body weights, and greater movements.

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

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BACKGROUND

This report contains information collected during the second year of ecological research on martens on northeast Chichagof Island, southeast Alaska. The radio collaring of a sample of martens on the study area was the primary emphasis of the first reporting year. Extensive live-trapping of the primary study area resulted in the radio-collaring of additional martens. The movements, demography, and habitat use of these animals were studied during this report period. The marten catch by trappers was monitored closely, and carcasses were collected to provide additional demographic data. Field and lab procedures were further refined. Although designed as a broad ecological study, the project has been divided into 10 specific jobs. Progress on each job was presented separately. During this report period, all jobs were active, but the emphasis was on jobs

1, 4, and 5. Some aspects of this study were partially supported by the USDA Forest Service, Alaska Region, through contract 43-0109-9-0749. This report was also submitted to the Forest Service to satisfy its reporting requirements.

Martens have been associated with late-successional 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 between 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 to log an additional 708, 000 ha (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 winter diet 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

Northeast Chichagof Island was chosen as the study area because the topography and habitats were 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. Because several martens moved off the primary study area after capture, the remainder of northern Chichagof Island was treated as a secondary study area.

The primary 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 primary 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 (Fig. 1). Most habitats typical of northern southeast Alaska occur on the study area 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 primary 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. The logging activity was suspended for the winter and resumed again in April 1992.

Twenty-one martens (5 males, 8 females, 8 unknown) were introduced to 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 Cape Fanshaw), Stikine River (5), Wrangell Island (4), Mitkof Island (2), Ketchikan (1), and Anchorage area (3). All transplanted martens were released near Pelican. Red squirrels (Tamiasciurus hudsonicus) were introduced at several sites on Chichagof Island in 1930 (Elkins and Nelson 1954) to establish a food source for the martens.

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 on 24 January 1992 by emergency order because of concern about the overharvest of martens.

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 located systematically 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. We 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, we 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, Natl. 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). All captured martens were radio collared (Telonics, Mesa, AZ). A 40 g radio collar (MOD-070, expected life of eight months) was placed on females and a 55 g collar (MOD-080, expected life of 12 months) was placed on males. After a marten had recovered from the immobilization, we released it near the capture site. If we recaptured a marten within one month, we released it without any additional processing. After a month had passed, all recaptures were chemically restrained, weighed, and measured. Collars were replaced as needed, and we replaced the collars on several animals during the year. Often, the portion of the radio antenna extending from the collar was broken off. We replaced any damaged collars.

We attempted to capture all resident martens on the study area to determine number present and their sex and age composition. Martens that remained on the study area throughout the year and showed fidelity to a home range area were considered residents. Martens that remained on the study area for less than a year but for more than a month were considered temporary residents. Martens that remained on the study area for less than a month and showed no site fidelity were called transients. Martens more than 1-year-old were considered adults, and young-of-the-year animals were called juveniles.

Job 1. Habitat use and selection. We located radio-collared martens from small aircraft (Mech 1974, Kenward 1987) during daylight hours throughout the year. Mostly we 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, we 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. We 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 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 winter. In future analyses, the habitat use of each animal will be compared with the availability of habitats in its home range area and in 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 (Et) (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., HCIi = Et i/Et max).

Job 2. Habitat composition. 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.

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

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 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 were compared with habitat capability coefficients in the marten habitat capability model (Suring et al. 1992). Also, we compared the estimated density of adult resident martens on the primary study area with assumptions in the model.

Job 4. Population characteristics. The primary study area was trapped intensively several times during the year to monitor the sex and age composition of martens present there. Sex and age composition of resident martens were compared with transients. We recorded the time and location of all known deaths of radio-collared martens. We attempted to retrieve the carcasses of several martens that died naturally and examined them for cause of death. Tissue samples of fresh carcasses were sent to the Animal Disease Laboratory, Washington State University, for viral isolation. 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 experiments. 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), we 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, we used the number of radio-collared martens on the study area during the trapping session as n1, the total number of martens captured as n2, and the number of collared martens recaptured as m2. A Lotus spreadsheet, developed by Sterling Miller and converted to Excel, was used for the numeric analyses, including the population estimate, variance, and 95% confidence intervals. 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 study wasn't trapped each session, we split the study area into eastern and western portions. Each portion was about the same size. At this point, we 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.

We 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. 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 that 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).

We attempted to collect the carcasses of 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 $5.00 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, we kept them frozen until processing. All the carcasses were examined 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, unpubl. report, ADF&G, Douglas, AK). We measured each skull according to Magoun (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 they were 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). We examined the stomachs of each carcass for the presence parasites, especially Soboliphyme baturini worms. The stomach contents were frozen for future diet evaluation. We extracted the ovaries from the reproductive organs of females and preserved them in 10% formalin. All of the ovaries from adult females (yearlings and older) were sent to Matson's Laboratory (Milltown, MT) for evaluation for the presence and number of corpora lutea.

Job 5. Spatial patterns and movements. We estimated home ranges of resident martens from radio-telemetry locations (Kenward 1987). Radio-collared martens were located from small aircraft about once a week depending on weather conditions. Although we 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. We 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). We 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).

We searched the entire secondary study area monthly 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. We 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, old-growth stand; and a 5-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 three consecutive nights. We operated traplines in September when small mammal populations should be at their annual peak. We recorded the number of animals of each species caught per transect and per 100 trap nights.

Job 7. Winter diet. 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.

Job 8. Evaluation of field sexing and aging technique. Skulls of trapper-caught martens were collected from trappers operating on northeast 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 the 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). Skull measurements will be analyzed according to Magoun et al. (1988) and compared with samples from other parts of Alaska.

RESULTS AND DISCUSSION

During the 1991-92 report period, 42 martens (21 males and 21 females) were captured 108 times on the primary study area in 835 trap nights (Table 1). Two additional males were caught in 55 trap nights in upper Game Creek. Of the animals captured, 30 martens (14 males and 16 females) were captured for the first time. We recorded the highest capture rates for all animals and new martens during November. All captured martens were radio collared, weighed, and aged by cementum analysis (Table 2).

Job 1. Habitat use and selection. Radio-collared martens were located 625 times from small aircraft during the fall/winter season to determine habitat use. This information was recorded and stored on a computer file, but not analyzed for this report. Habitat selection appeared similar to 1990-91 (Flynn 1991). More information on the selection of old-growth forest types will be collected next year and included in the final report.

Job 2. Habitat composition. Information on the composition of habitats in the primary study area was provided by Forest Service staff from their GIS "points" database (Flynn 1991). No additional data was collected this report period. Next year we will collect additional landscape attributes such as roads, corridors, and stand size to evaluate landscape-level effects. We began a cooperative habitat assessment project with the Hoonah Range District staff in June and will continue the project next year.

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 characteristics. Of the 54 martens monitored during at least part of the year, 32 were males and 22 were females. Seventeen martens (12 males and 5 females) were classified as residents on the primary Salt Lake Bay study area, and 17 martens (7 males and 10 females) were temporary residents (Table 3). Sixteen martens (9 males and 7 females) were transients that spent little time on the primary study area and traveled extensively. Three male martens (#27, #29, and #30) moved off the primary study area and established home ranges on other parts of northeast Chichagof Island. One male marten (#54) was captured in upper Game Creek and remained there. Most resident martens on the primary study area had probably been captured because the recapture rates during the August and April trapping sessions were relatively high (50% and 70%).

During August 1991, a minimum of 22 martens were on the Salt Lake Bay study area for a minimum density of 0.26 martens/km^2 (Fig. 2). The mark-recapture estimate was 29 martens (95% CI = +/-9.5) for a density of 0.35 martens/km^2. Because of the logging activity on the western portion of the study area, we were unable to operate the entire trapline during the fall. On the eastern portion of the study area, the estimated density of martens decreased 50% from August to February (Fig. 3), primarily as a result of resident animals being trapped. Also, some temporary residents left during this period and some natural mortality was recorded. By April, the estimated marten density had increased 38% to 0.28 martens/km^2 (Fig. 3). The new martens on the entire primary study area consisted of transient martens that established residency there (79%) and other transients that passed through (21%).

Body weights of male martens captured during autumn were substantially lower than those of males captured during winter/spring 1991. For five males recaptured during fall 1991, their body weights averaged 11% less than body weights of males captured during winter/spring 1991. The body weight of a male marten found dead during October 1991 was 18% less than last winter. For the year, the mean coefficient of variation of male body weight (7.5%) was larger than for females (3.4%). The maximum weight change by a male was 195 g; a female changed 97 g.

The age structure of monitored martens was older compared with 1990-91 (Fig. 4). The young:100 adult ratio was 13:100 verses 57:100. The older age structure of the monitored martens probably reflected poor juvenile recruitment this year. All resident martens were more than 1-year-old, and transient martens were mostly juveniles (31%) or yearlings (63%). A large number of monitored martens (31%) resided only temporarily in the primary study area. These animals either left the study area during the late fall or appeared on the study area during late winter. Temporary residents represented a wide range of age classes with 12% juveniles, 29% yearlings, and 59% older than yearlings. Some animals were not monitored long enough to determine residency status clearly.

Twenty-nine radio-collared martens (20 males and 9 females) died during the period. Nine deaths (7 males and 2 females) resulted from natural causes. Because most of the carcasses were not recovered promptly after death, the actual cause of death was difficult to determine. Two animals (#21 and #32) were recovered shortly after death from under large old-growth trees. Both of these animals were thin and appeared to have died from starvation. Three carcasses were mostly decomposed upon recovery, and we could not determine the cause of death. Marten #31 had a broken foreleg and marten #16's skull had a broken zygomatic arch indicating that injuries may have contributed to their deaths. Four carcasses were not recovered; one was tracked to the top of a 30 m tree (#29), another to the base of a large stump (#33), and two animals (#40 and #41) were located by aircraft on an inaccessible mountain slope.

Humans killed 20 radio-collared martens (13 males and 7 females). A deer hunter shot one juvenile male (#42) before the trapping season opened. During the open trapping season, 16 martens (10 males and 6 females) were reported trapped. Two martens (1 male and 1 female) were trapped after the season was closed by emergency order. The cut-off collar of an adult male (#15) was found on the study area after trapping season. The resident female in the same area (#10) disappeared at the same time, and she was probably trapped by the same party. Also, all of the lower right foot of male marten (#36) was missing when he was recaptured in July 1992, apparently from a trap injury. The radio-collars on four trapped martens had failed before trapping season began. These animals were considered as censored observations in the survival analysis.

Much of trapping effort on northern Chichagof Island was along the shores of Port Frederick, and three parties reported trapping within the primary study area. At least one additional party trapped the primary study area illegally from the road system and did not report. The trapping effort was quite effective and all of the resident animals (5 males and 3 females), except one male (#45), that had home ranges bordering Port Frederick during the trapping season were caught (Fig. 5). Besides the radio-collared animals, the three trappers caught six uncollared martens (2 males and 4 females) on the primary study area. No one reported trapping the north shore of Tenakee Inlet within the primary study area. Transient animals were caught near Tenakee Springs (2 males), Hoonah (1 male), and Seagull Flats (1 male and 2 females) located just north of the primary study area (Fig. 5).

Annual survival functions were computed for radio-collared martens (Fig. 6). The annual survival rate for 1991-92 was estimated to be 0.25 (95% C.I. = 0.16-0.34). In contrast, the annual survival rate radio-collared martens during 1990-91 was estimated at 0.88 (95% C.I = 0.76-1.00). We computed marginal survival functions for trapping and natural mortality during 1991-92 (Fig. 7). According to this analysis, natural mortality contributed to an annual survival rate of 0.74 (95% C.I. = 0.58-0.90) with most mortality occurring during September and October. Trapping contributed to an annual survival rate of 0.34 (95% C.I. = 0.22-0.45) with most mortality occurring during the 1 December to 24 January trapping season. This analysis assumed that natural and trapping mortality are independent (Pollock et al. 1989) which may not be the situation. The influence of density on marten survival needs additional study.

The marten catch on northern Chichagof Island during 1991-92 was the largest recorded since sealing began in 1984 with 513 marten (257 males, 238 females, and 18 unknown) reported taken by trappers. Thirty of these martens were taken illegally at the West Port logging camp before the trapping season opened. At least 11 additional martens were probably taken illegally, but these were not sealed or included here. Because martens were frequently observed around logging camps and work sites, substantial interest in marten trapping developed.

We collected 436 carcasses (84.8%) of the martens reported trapped on northern Chichagof Island during 1991-92. Sealing records indicated that the catch consisted of 48% females, but the carcasses consisted of 53% females. The difference was probably because of the difficulty in identifying the sex of a marten by hide examination. The percentage of adults in the catch was high (66%) (Table 4) with a juvenile:adult female ratio of 0.96 and a juvenile:adult female >2-years-old ratio of 2.2. Juvenile:adult female ratios in the trapper catch were higher than for the live-trapping (0.96 vs. 0.37 and 2.20 vs. 0.58) indicating that juveniles were more vulnerable to trapping with the current regulations (i.e., restrictions on motorized vehicle use). Both data sets indicated low recruitment during 1991-92. 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 ratio in the catch (0.96) was substantially less than 3.0, an overharvest of adult female probably occurred.

Trapped female martens showed extremely low fertility with only 22% of the adult females pregnant based on corpora lutea counts (Table 5). Although a lower percentage of yearlings (14%) were pregnant than older females (36%), corpora lutea counts of pregnant females averaged 3.0 with no difference by age class (Table 5). These pregnancy rates were among the lowest reported by Strickland and Douglas (1987). Because the trapped females would have given birth in May 1992, fecundity rates (i.e., recruitment) for 1992-93 will be extremely low.

Tissue samples collected from 2 martens (#21 and #32) that were retrieved shortly after death from natural causes were submitted to the Washington Animal Disease Laboratory, Washington State University, for viral isolation. Samples for viral isolation, submitted frozen, included lung and bowel loop. Male marten #21 was originally captured during fall 1990 and weighed 1380 g. On his last capture (24 September 91), he weighed 1230 g. We retrieved his carcass on 16 October 91 within a day of death, and the carcass weight was 1130 g with no obvious signs of decomposition. Marten #32, original capture on 31 July 91 with weight of 1140 g, was recaptured during the next three consecutive nights. Marten #32's carcass, weight of 935 g, was found on 2 August 1991 within 12 hours of his death. Because both carcasses had been frozen, a histological exam was impossible. Viral isolation revealed the presence of coronavirus in both animals. Although evidence of infection was present, a disease process was not observed. Coronavirus was not diagnosed as the cause of death for the two study animals (pers. comm., Dr. K. Potter, Washington Animal Disease Laboratory, Washington State University). Coronavirus occurs commonly in domestic dogs and cats (normally in 85% of domestic cats). Although known to cause a 3-day enteritis in mink, it is not necessarily fatal (pers. comm., Dr. K. Potter, Diagnostician, Washington State Univ.).

In an attempt to establish whether this virus was commonly found in martens and whether it is endemic to one area, one age class, or more likely in emaciated animals, additional samples were sent from carcasses received from trappers. Samples were sent from two study animals (#6 and #34) whose carcasses were retrieved before freezing, allowing histological exam. Histology samples, preserved in formalin, included heart, liver, lung, spleen, kidney, small and large intestine. Seven additional samples were sent for viral isolation including four study animals (#19, #22, #26, #28) and three other trapper-caught carcasses. Samples submitted were a representative of several different geographical areas including juveniles, adults, males, females, emaciated and with high fat levels.

All additional samples were negative for coronavirus. The samples submitted for histological evaluation were of marginal quality (moderately to severely autolyzed). No infectious process was evident, but enteric disease was not ruled out because of the poor quality of the intestinal sections. Samples from any future study animals collected shortly after death will be submitted for histological evaluation including samples of urinary bladder and stomach to rule out canine distemper, a disease to which martens are extremely susceptible.

The marten population on northeast Chichagof Island appeared stressed in 1991-92 and responding to a reduction in food availability (see Job 6). The response was characterized by low recruitment, low body weights, and low adult survival. The reduction in food availability probably caused martens to be more vulnerable to trapping because of increased movements (see Job 5) and attraction to bait because of hunger. The net result was a substantial reduction in population size during the year. Thompson and Colgan (1987) described a similar response by a marten population in Ontario, Canada.

Job 5. Spatial patterns and movements. Annual home ranges were modeled for resident martens with an adequate number of relocations (Table 6). Because of the large turnover in the resident population this year, many of the animals were monitored for less than half the year, resulting in fewer relocations and a shorter time period. Harmonic mean estimates were quite variable, and sample sizes were not adequate to use this method. Although convex polygons using 75%, 95%, and 100% contours were presented (Table

6), 95% convex polygons best represented home range areas and are the only polygons discussed below.

Home range size of adult males was larger (Wilcoxon 2-sample test, $P < 0.05$) and more variable than for adult females (CV = 109% and 47%). Because none of the females were monitored for the entire year, their annual home range sizes were probably underestimated. Male marten home range sizes were quite variable, ranging from 1.8 km^2 (#15) to 31.0 km^2 (#36). Marten #36 had a long narrow home range located along the north shore of Tenakee Inlet.

All three male martens monitored during the 1990-91 and 1991-92 periods had larger home ranges in 1991-92. The mean size increase was 99%. Marten #4 increased his home range area by 127% and occupied most of the area vacated by his trapped male neighbors (#7 and #31). Marten #5 remained in the same location and increased his area by 24%. Marten #9 increased his home range area (147%) by shifting west into the area used by #21 before his death in October. As observed in 1990-91 (Flynn 1991), adult martens showed little intrasexual overlap of home ranges as described by 95% convex polygons.

Transient martens of both sexes spent little time on the primary study area and traveled extensively (Table 7). Because of the short transmission range of the radio collars, transient martens were difficult and expensive to locate. Although an attempt was made to locate all radio-collared martens every month, some transient martens were difficult to locate regularly. Because of the costs involved, little search effort was made on the west side of Port Frederick. Three male martens that were transients during 1990-91 established home ranges on northern Chichagof Island outside of the primary study area. Several transients appeared to locate temporarily in an area before moving to a new location, often a great distance away. At least six transients (1 male and 4 females) moved from the east side of Port Frederick to the west side. Three females returned to the east side of Port Frederick after spending some time on the west side.

<u>Job 6. Small mammal abundance</u>. During September 1991, 24 rodents (22 Sitka mice, and 2 long-tailed voles) were captured on three transects in 450 trap nights (5.3 captures/100 trap nights). Transects were 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. The number of captures on the three transects were similar (6.0, 5.3, and 4.7 captures/100 trap nights). Species composition was similar on all transects with mostly Sitka mice captured on all transects (92%).

Based on the snap-trap index, small mammal numbers on the primary study area decreased 60% from last year (Fig. 8). Long-tailed voles showed the greatest reduction in numbers with captures down 86%. We observed a reduction in small mammal numbers on old-growth forest and clearcut areas, with the greatest reduction on the clearcut transect (-67% vs. -36%). 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 1991-92.

Job 7. Winter diets. We collected 20 marten scats in the primary study area and froze them for future analyses. We also collected contents from 430 stomachs of trapper-caught martens for future analyses.

Job 8. Evaluation of field sexing and aging technique. We collected skulls from 430 trapper-caught martens from northern Chichagof Island. The skulls of these martens were measured, and cementum ages obtained. These data will be analyzed and evaluated for the next report. A preliminary review of the information indicated that the technique works well to separate juvenile from adult martens.

Job 9. Scientific meetings and workshops. None were attended because of budget limitations.

Job 10. Reports and scientific papers. Besides completing this progress report, I contributed to the publication "A strategy for maintaining well-distributed, viable populations of wildlife associated with old-growth forests in southeast Alaska" including the chapter "A strategy for maintaining well-distributed, viable marten populations in southeast Alaska". I participated in completing a technical report on "Ecological definitions for old-growth forest types in southeast Alaska" in conjunction with the Forest Service Regional Old-growth Definition Task Group.

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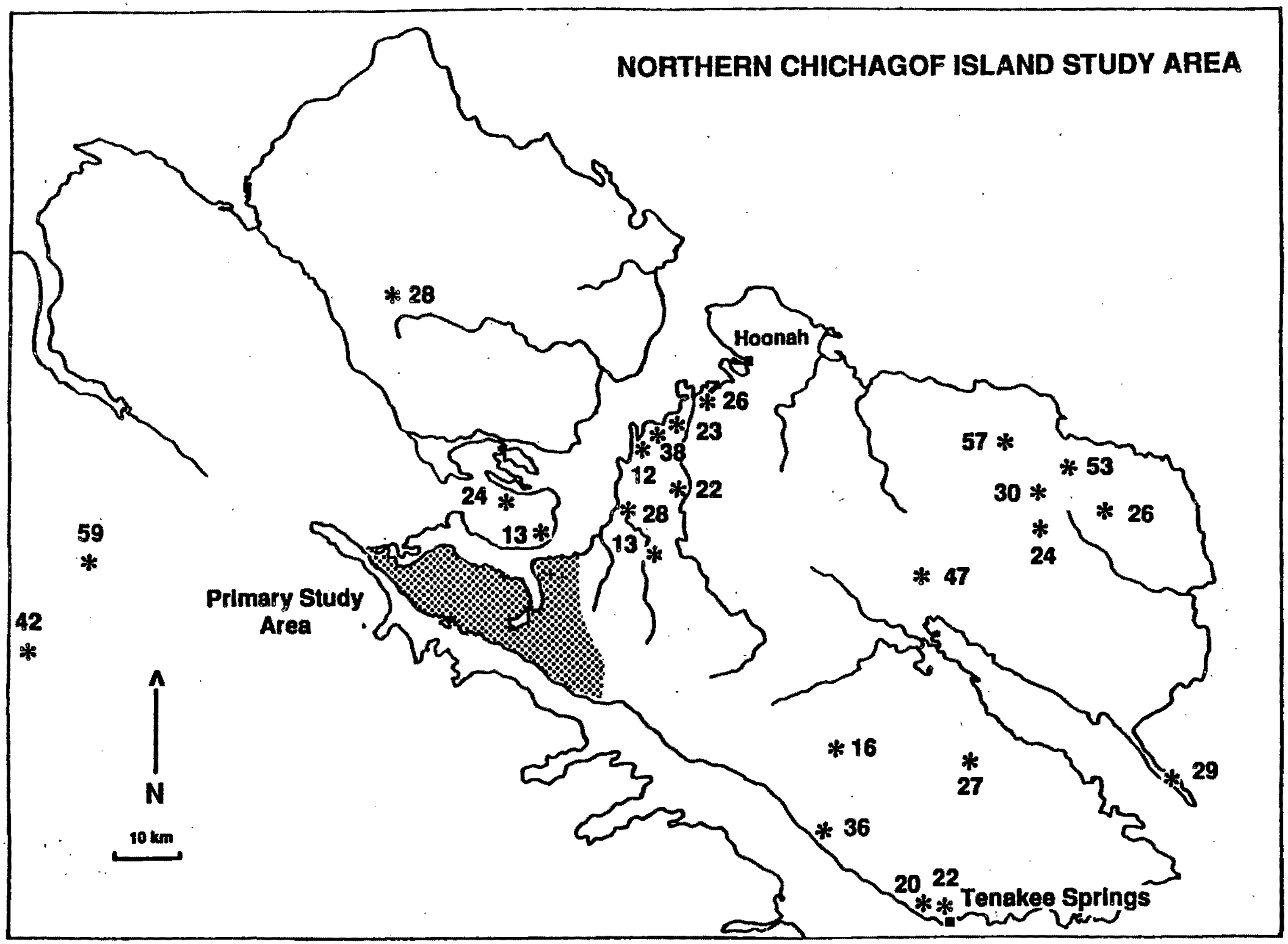


Figure 1. Northern Chichagof Island study area with the primary study area at Salt Lake Bay indicated by cross-hatching. The most widely separated locations of transient martens are shown.

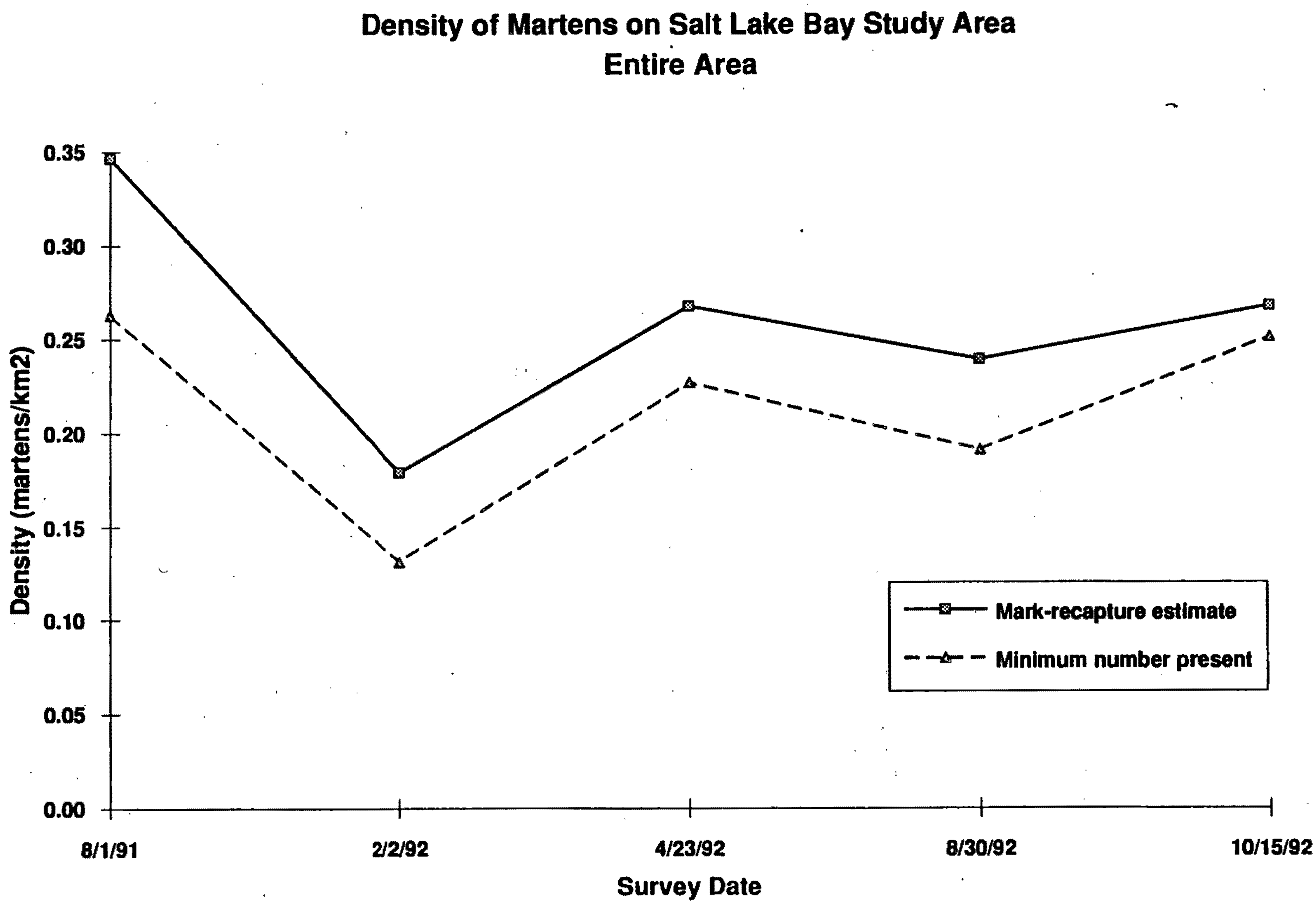


Figure 2. Density of martens on Salt Lake Bay study entire area, northern Chichagof Island, during 1991-92.

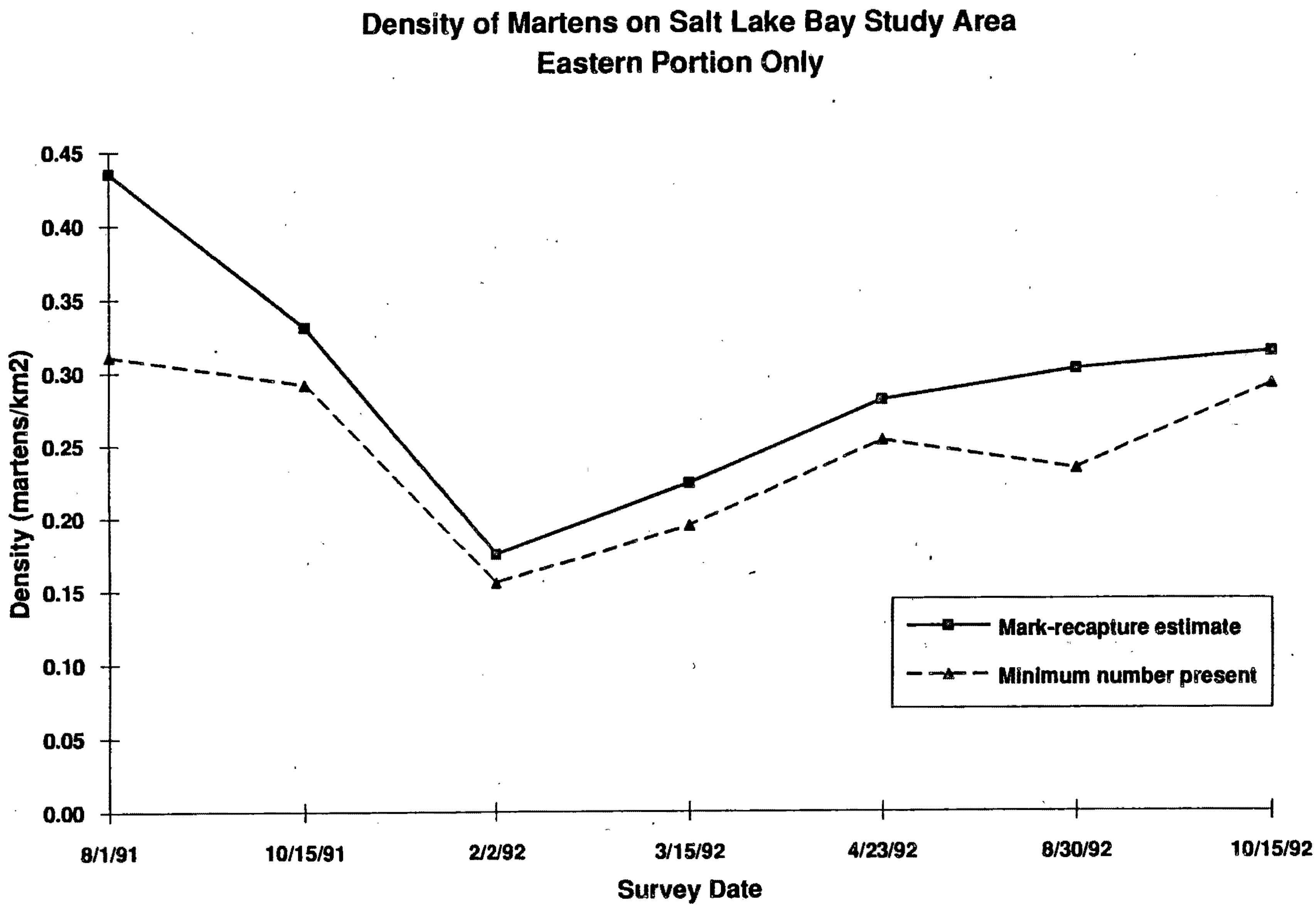


Figure 3. Density of martens on eastern portion of Salt Lake Bay study area, northern Chichagof Island, during 1991-92.

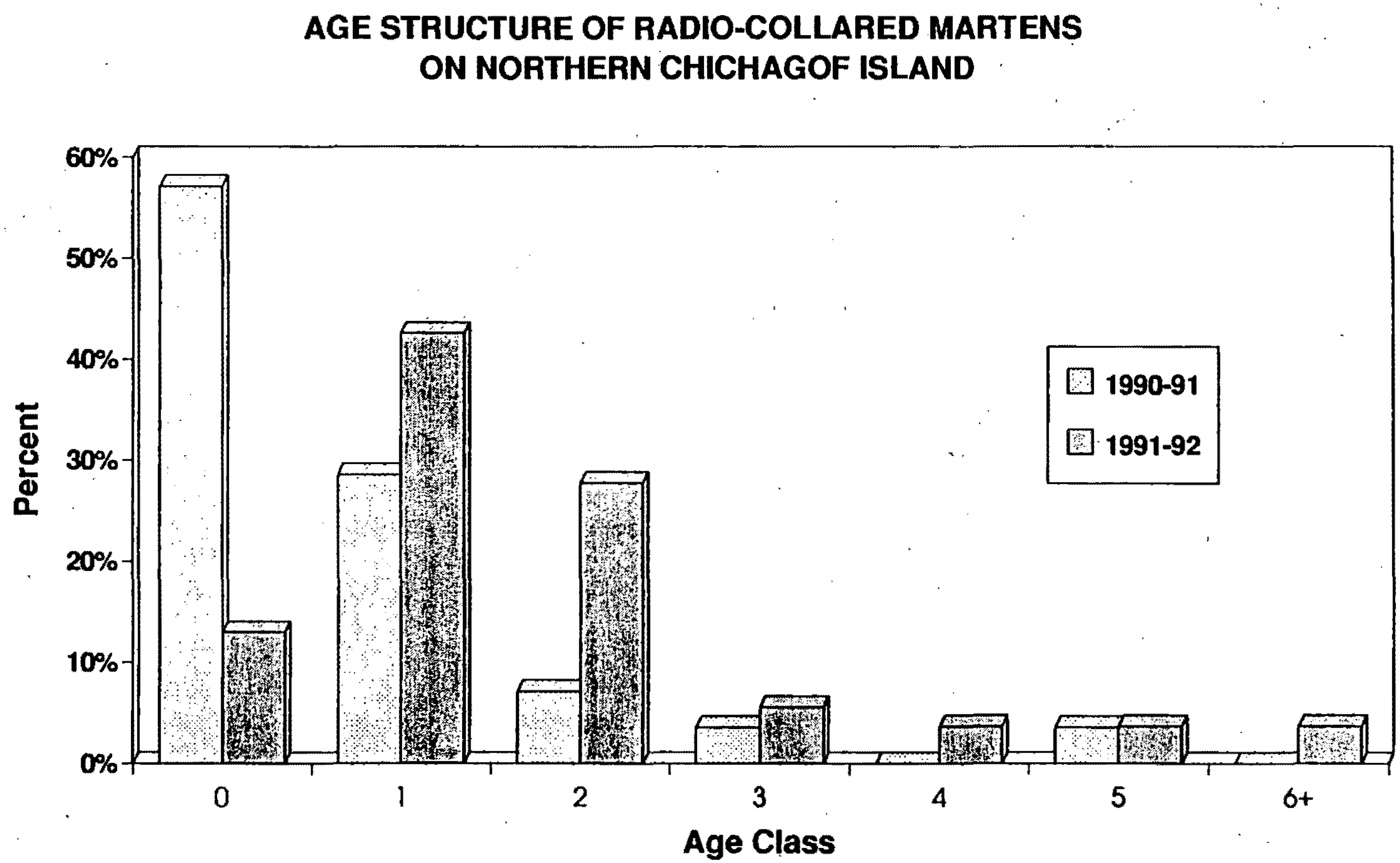


Figure 4. Age structure of martens monitored on northern Chichagof Island during 1991-92 compared with 1990-91.

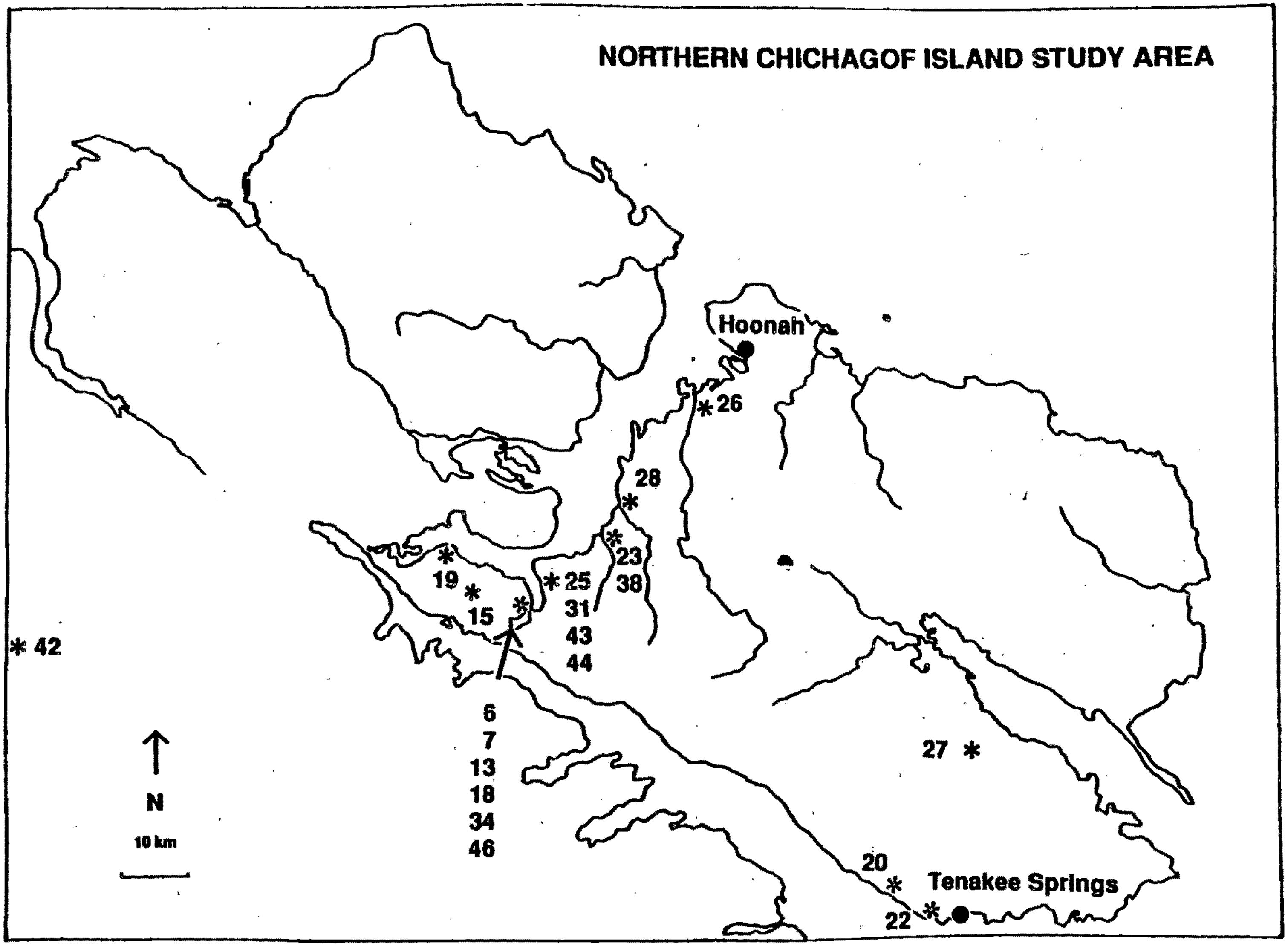


Figure 5. Trap site locations of radio-collared martens captured by trappers during 1991-92.

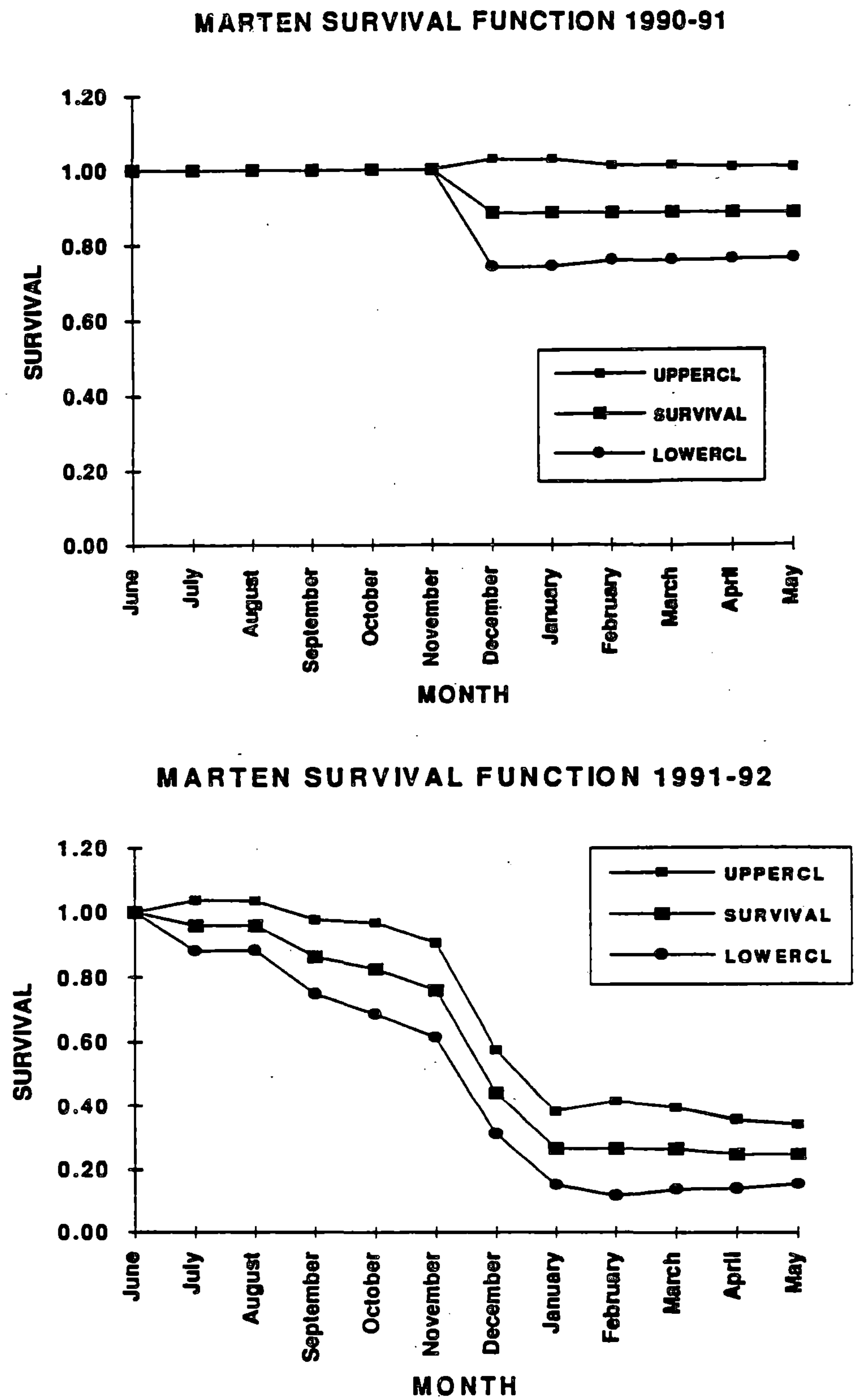


Figure 6. Kaplan-Meier survival estimates for radio-collared martens on northern Chichagof Island for 1990-91 and 1991-92.

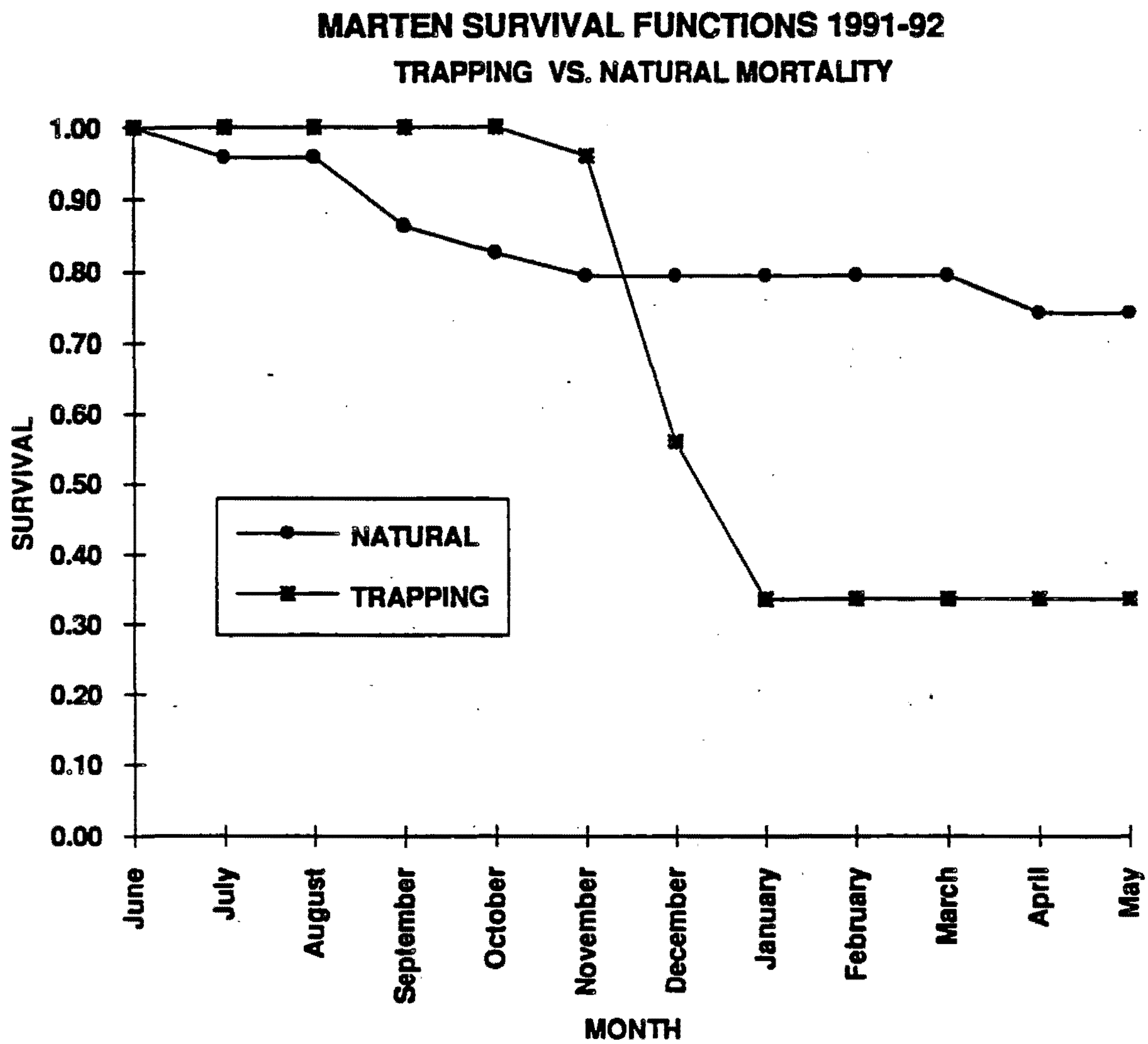


Figure 7. Kaplan-Meier survival estimates for radio-collared martens on northern Chichagof Island by cause of mortality for 1991-92.

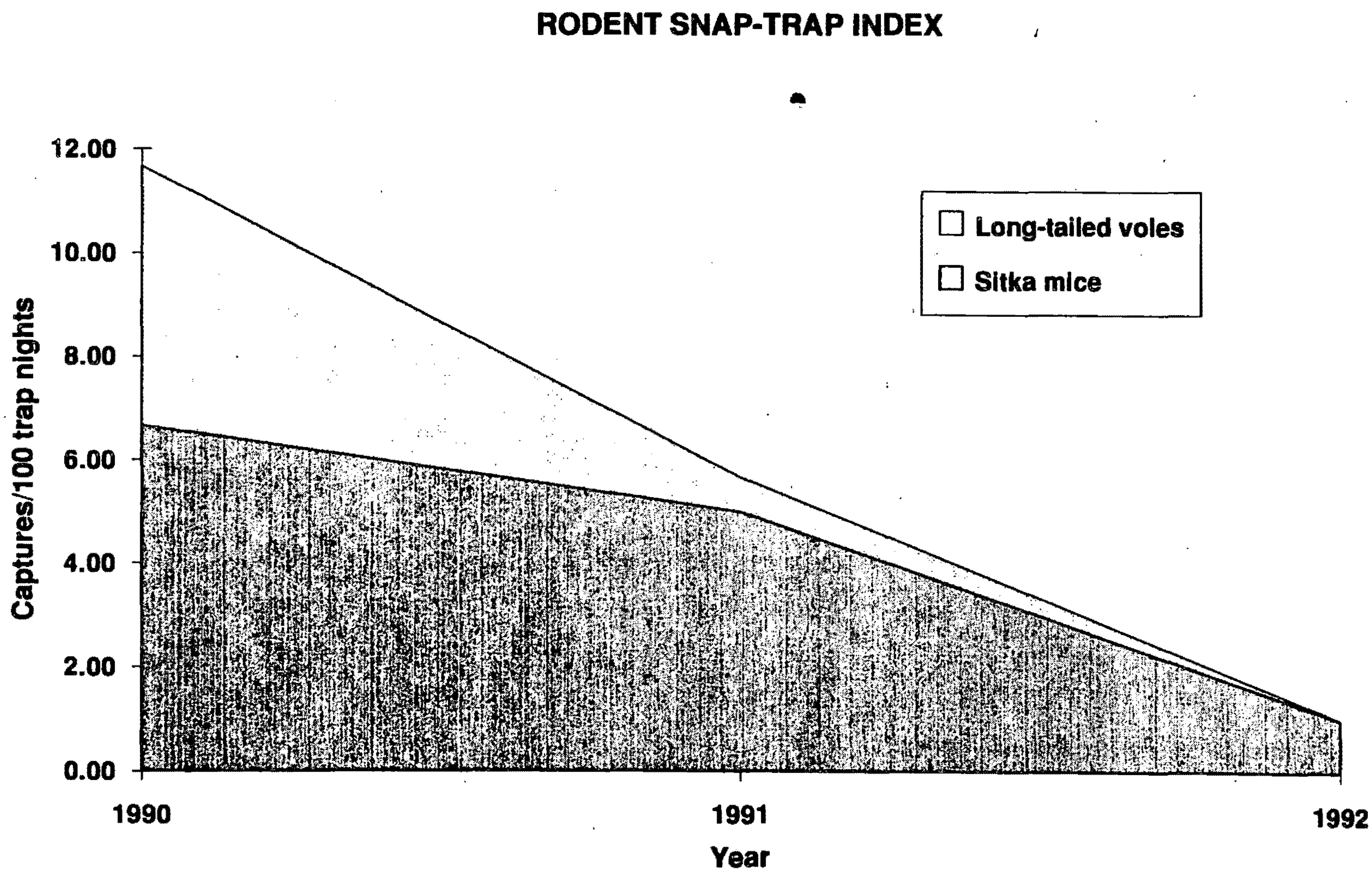


Figure 8. Snap-trap indices for Sitka mice and long-tailed voles on northeast Chichagof Island, 1990-92.

Table 1. Live-trapping effort and success rates for martens on northeast Chichagof Island, southeast Alaska during 1991-92[a].

Month	No. of trap nights	Total captures	Captures/ 100 trap nights	New captures	New captures/ 100 trap nights
June	0	0	0.0	0	0.0
July	88	8	9.1	2	2.3
August	82	11	13.4	6	7.3
September	43	7	16.3	0	0.0
October	106	16	15.1	4	3.8
November	32	10	31.3	2	6.3
December	112	10	8.9	2	1.8
January	0	0	0.0	0	0.0
February	128	10	7.8	4	3.1
March	87	5	5.7	3	3.4
April	212	31	14.6	6	2.8
May	0	0	0.0	0	0.0
Totals	890	110	12.4	30	3.4

[a] Includes 2 new martens captured in 55 trap nights during March in Game Creek.

Table 2. Age, sex, weight, and status of radio-collared martens monitored on northeast Chichagof Island during 1991-92. Sample size for mean weight usually less than the number of recaptures. For residency status: R = resident, TR = temporary resident, OR = other resident, and T = transient.

Animal no.	Sex	Age Class	Date Collared	No. of Captures	Capture weight (g) x	Capture weight (g) SD	Residency Status	Comments
4	M	2	06/13/90	10	1154	84	R	Survived
5	M	3	06/14/91	8	1103	98	R	Survived
6	M	2	06/15/90	2	1118	109	R	Trapped - 01/29/92
7	M	3	07/27/90	7	1222	107	R	Trapped - 12/20/91
9	M	2	09/14/90	4	1148	138	R	Survived
10	F	3	09/21/90	1	820		R	Censored - Dec. '91
12	M	1	10/11/90	0			T	Censored - Feb. '92
13	F	1	10/26/90	3	810	42	T	Trapped - 12/30/91
15	M	2	10/28/90	1	1180		R	Trapped - 12/10/91
16	M	6	11/17/90	0			TR	Natural death - Sept. '91
18	M	1	11/19/90	0			R	Censored Oct. '91; Trapped - 12/30/91
19	F	5	11/20/90	1	625		R	Trapped - 01/02/92
20	M	1	11/20/90	0			TR	Censored Nov. '91; Trapped - 12/26/91
21	M	3	11/21/90	1	1180	71	R	Natural Death - 10/16/91
22	M	2	12/07/90	0			T	Censored Sept. '91; Trapped - 12/03/91
23	M	1	12/08/90	3	1190		TR	Trapped - 01/14/92
24	F	1	01/09/91	3	820		TR	Censored Sept. '91; recaptured - 04/29/92
25	F	1	01/10/90	1	750		R	Trapped - 12/05/91
26	M	1	01/10/91	0			T	Trapped - 12/02/91
27	M	1	01/11/91	0			OR	Trapped - 12/03/91
28	F	1	01/11/91	0			T	Censored Sept. '91; Trapped - 12/19/91
29	M	1	03/01/91	0			OR	Natural death - 10/15/91
30	M	1	04/24/91	0			OR	Survived
31	M	1	05/14/91	4	1165	99	R	Trapped - 12/04/91
32	M	1	07/31/91	4	1140		T	Natural death - 08/05/91
33	M	2	07/31/91	3	1200	14	R	Natural death - 04/22/92

continued

Table 2. Continued.

Animal no.	Sex	Age Class	Date Collared	No. of Captures	Capture weight (g) x	SD	Residency Status	Comments
34	F	2	08/01/91	3	1000	85	R	Trapped - 01/29/92
35	F	0	08/01/91	2	600		TR	Natural death - 09/27/91
36	M	1	08/02/91	2	1230		R	Survived
37	F	3	08/03/91	1	800		TR	Censored - Sept. '91
38	F	4	08/03/91	5	823	28	TR	Trapped - 01/14/92
39	M	1	08/03/91	1	1090		TR	Natural death - 09/18/91
40	F	11	10/15/91	1	620		TR	Natural death - 12/30/91
41	M	0	10/15/91	1	1050		T	Natural death - 01/06/92
42	M	0	10/15/91	1	1220		T	Shot - 11/17/92
43	F	1	10/17/91	1	750		T	Trapped - 12/05/91
44	M	0	11/16/91	4	905		T	Trapped - 12/05/91
45	M	2	11/16/91	6	1090	85	R	Survived
46	M	1	12/14/91	1	1020		T	Trapped - 12/30/92
47	M	1	12/16/91	4	1275	50	T	Survived
48	F	0	02/02/92	5	703	18	TR	Survived
49	F	2	02/04/92	1	682		R	Survived
50	F	2	02/04/92	4	712	69	TR	Survived
51	F	1	02/07/92	1	780		T	Survived
52	F	2	03/05/92	2	768	18	TR	Survived
53	M	0	03/29/92	1	915		T	Survived
54	M	1	03/30/92	1	1180		OR	Survived
55	M	5	04/27/92	1	930		TR	Survived
56	F	2	04/27/92	1	760		TR	Survived
57	F	0	04/27/92	1	705		T	Survived
58	F	1	04/28/92	2	800		TR	Survived
59	F	1	04/30/92	1	710		T	Survived
60	M	1	05/01/92	1	1000		TR	Survived
61	F	4	05/01/92	1	810		TR	Survived

Table 3. The sex and residency status of martens monitored on northeast Chichagof Island, southeast Alaska, during 1991-92.

Status	Males	Females	Total
Resident	12	5	17
Temporary resident	6	11	17
Transient	10	6	16
Other residents	4	0	4
Totals	32	22	54

Table 4. Age distribution of martens captured by trappers on northern Chichagof Island, southeast Alaska, during 1991-92.

Age	Males		Females		Totals		Females
class	N	%	N	%	N	%	(%)
0	69	16.2	76	17.8	145	34.0	52.4
1	83	19.4	85	19.9	168	39.3	50.6
2	25	5.9	38	8.9	63	14.8	60.3
3	5	1.2	16	3.8	21	4.9	76.3
4	3	0.7	0	0.0	3	0.7	0.0
5	2	0.5	2	0.5	4	0.9	50.0
6	5	1.2	6	1.4	11	2.6	54.5
7	2	0.5	2	0.5	4	0.9	50.0
8	2	0.5	1	0.2	3	0.7	33.3
10	1	0.2	1	0.2	2	0.5	50.0
11	2	0.5	0	0.0	2	0.5	0.0
13	1	0.2	0	0.0	1	0.2	0.0
Totals for ages >0	131	30.7	151	35.4	282	66.0	53.5

Table 5. Mean counts of corpora lutea and percentage of females pregnant by age class of martens collected by trappers on northern Chichagof Island, southeast Alaska, during 1991-92.

Age class	No. females examined	% females pregnant	Corpora lutea per pregnant female x	SE	Corpora lutea per female x	SE
1.5	72	14	3.20	0.13	0.44	0.13
2.5	24	25	2.83	0.31	0.71	0.27
3.5	4	25	3.00		0.75	0.75
4.5	3	100	3.00	0.58	3.00	0.58
5.5	2	50	3.00	0.00	1.50	1.50
6.5	5	40	3.00	0.00	1.20	0.73
>6.5	7	43	3.00	0.00	1.29	0.61
Totals	117	22	3.04	0.10	0.68	0.12
Totals for ages >1.5	45	36	2.94[a]	0.14	1.04[b]	0.22

[a] Mean not significantly different from 1.5 age class ($t = 1.25$, $df = 24$, $P = 0.22$).

[b] Mean significantly different from 1.5 age class ($t = 2.35$, $df = 76$, $P = 0.02$).

Table 6. Home range size estimates for adult resident martens on northeast Chichagof Island, southeast Alaska, 1991-92. Median home range size of males was larger compared with females at each contour level (Wilcoxon 2-sample test, $P<0.05$).

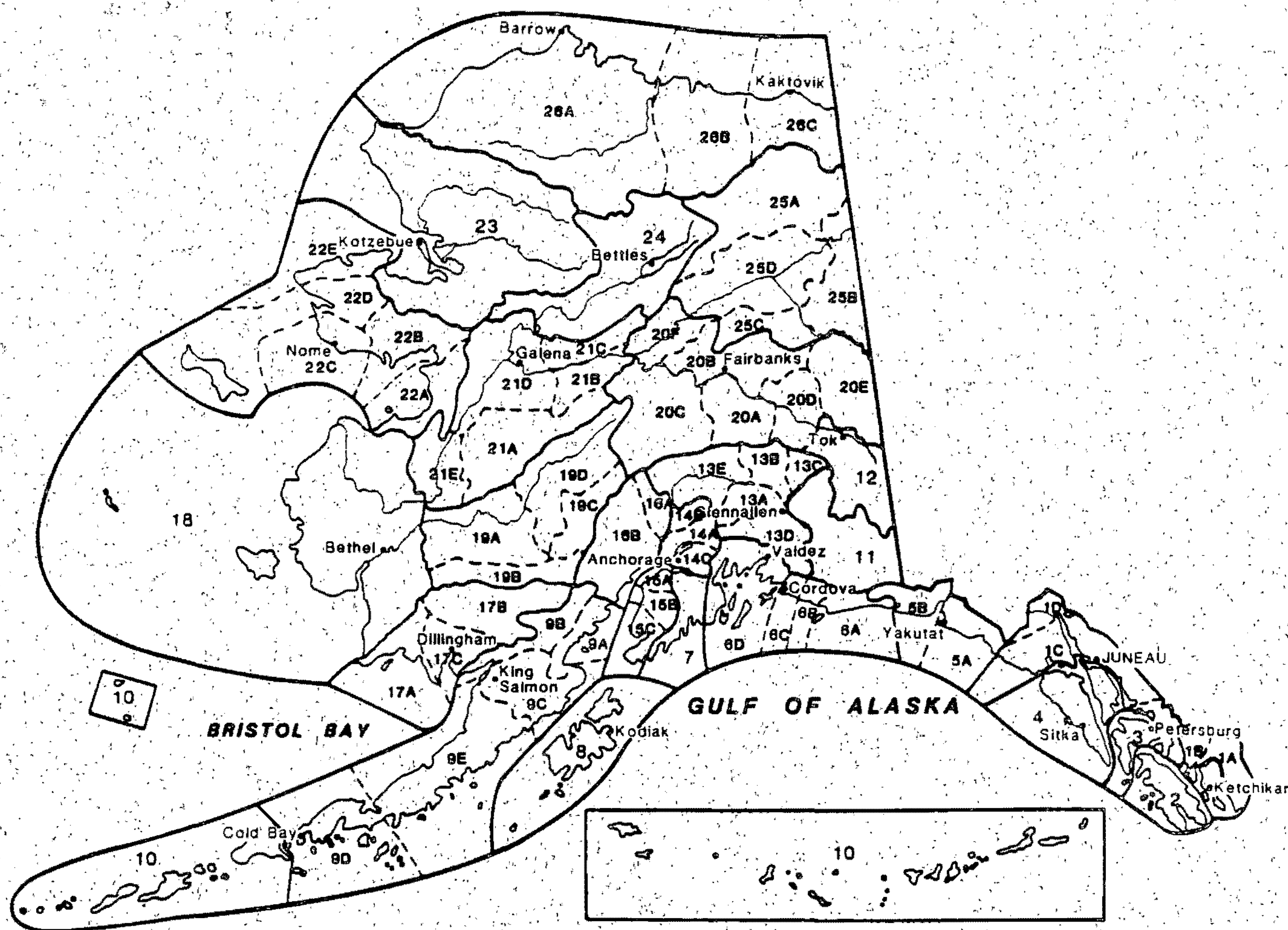
Animal		Convex polygons (km^2)		
no.	*N*	75%	95%	100%
Males				
04	33	2.9	10.0	11.1
05	36	3.4	4.6	5.0
06[a]	21	4.5	5.7	6.1
09	35	2.7	7.9	10.5
15[a]	18	1.1	1.8	2.1
30	16	3.4	6.0	8.3
31[a]	16	1.6	1.9	2.0
33	21	1.2	4.1	4.5
36	28	24.6	31.0	43.2
45	19	2.9	5.3	6.9
Medians		2.9	5.5	6.5
Females				
10[a]	19	2.0	4.4	5.8
19[a]	12	0.8	1.5	2.0
25[a]	14	1.8	2.2	2.6
34[a]	16	1.3	2.5	3.5
49[b]	14	1.7	2.9	4.0
52[b]	11	0.5	5.4	5.8
Medians		1.5	2.7	3.8

[a] Animal was trapped during mid year.
[b] Animal was radio collared during mid year.

Table 7. Maximum travel distances from capture sites and between relocations of radio-collared transient martens on northeast Chichagof Island, southeast Alaska during 1991-92.

	Distance (km)	
Animal no.	Capture site	Relocations
Males		
12	20	20
16	11	16
20	18	18
22	17	32
23	17	17
26	35	35
27	29	29
30	29	29
42	45	45
47	24	24
53	22	22
Mean	20.8	24.1
SD	12.7	10.5
Females		
13	32	35
24	27	57
28	25	25
57	32	32
59	29	29
Mean	29.0	35.6
SD	3.1	12.5

Alaska's Game Management Units



WILDLIFE RESTORATION

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