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Demographic characteristics of American marten populations in Jackson Hole, Wyoming

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DEMOGRAPHIC CHARACTERISTICS OF AMERICAN MARTEN POPULATIONS IN JACKSON HOLE, WYOMING

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ABSTRACT.—Some American marten population characteristics (numbers, density, body weights, sex and age ratios, natality, mortality-survivorship, immigration-emigration, home ranges) were studied at four sites in the southern part of the Greater Yellowstone Ecosystem, Teton County, Wyoming, in 1975–1979. Ninety-eight different martens were examined. Males (n = 25) weighed 1,111 g (± 110 SD, range 875–1,235), whereas females (n = 17) averaged 743 g (± 83 SD, range 600–900). Live-trapping showed sex ratios of 1.5M:1.0F, whereas carcasses showed 3.0M:1.0F. Of 27 males that were aged, 12 (44%) were less than 1 year old and 2 were 9–10 years old. Of 10 females, 6 were less than 1 year old and 1 was 12–13 years old. The mean length of time a male was present on the major study area was 144 days (± 266 SD, range 1–1,364), and for females it was 145 days (± 45 SD, range 1–560). Home ranges for six males averaged 3.2 km^2 (± 20 SD, range 0.7–5.8) on the main study area. Some management implications are given.

American martens (*Martes americana vulpina*) are medium-sized, solitary carnivores that were historically abundant in North American mature and old-growth coniferous forests (Strickland and Douglas 1987, Clark et al. 1987). Martens have been significantly reduced over the last 100+ years by extensive habitat alteration and overexploitation and have been completely extirpated in some portions of their range. Today, most states and Canadian provinces classify martens either as furbearers subject to regulated trapping or as a rare and protected species. Reintroductions to unoccupied former range in Saskatchewan, Ontario, Manitoba, British Columbia, Michigan, Wisconsin, Arkansas, South Dakota, Oregon, Washington, and Colorado in the last few decades have been relatively successful (Richardson et al. 1986: 171).

Martens are relatively abundant in the Greater Yellowstone Ecosystem (GYE) of northwestern Wyoming, southeastern Idaho, and southern Montana. This is largely the result of relatively little habitat alteration (e.g., timber harvests) and limited trapping occurring in this mostly intact biogeographic area, which includes Yellowstone National Park, Grand Teton National Park, and seven national forests. However, because small marten populations are susceptible to local extinction, the species has been classed as "sensitive" and as an "indicator species" on Bridger-Teton, Targhee, and Gallatin National Forests under the 1976 National Forest Management Act. To aid marten conservation and management, we present data on population characteristics from four sites in Teton County, Wyoming, in the southern part of the GYE.

STUDY AREA

The general study area encompasses Jackson Hole in Teton County, Wyoming, and largely comprises Grand Teton National Park and Bridger-Teton National Forest. Four study sites within this area are compared in Table 1: Grand Teton National Park (GTNP), Bridger-Teton National Forest (BTNF), Teton Wilderness (TW), and Targhee National Forest (TNF). Live martens were studied in GTNP and BTNF, whereas trappers provided marten carcasses from TW and TNF.

The climate is characterized by low mean annual temperatures and long, cold winters with deep snows (U.S. Dept. Commerce Weather Bureau 1975). Geomorphology and physiography of the area are described by Love and Reed (1968); soils are described by Young (1982). Elevations range from 1,964 m to 4,185 m above sea level. Vegetation is largely coniferous forests and shrub-grasslands (Reed 1952).

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TABLE 1. Comparison of four American marten study sites, Teton County, Wyoming.

Study area	Size (ha)	Physiography	Vegetation	Study history, methods, authors
Grand Teton National Park	1,554	flat bench on east slope of Teton Mts.; 2,200 m	lodgepole pine (*Pinus contorta*)	(39 mo) Apr 1975–Aug 1976; May 1977–Apr 1979
			spruce/fir (*Picea engelmannii*, *Abies lasiocarpa*)	live trapping/radiotelemetry
				Hauptmann (1978), Clark (1984)
Bridger-Teton National Forest	646	north slope, Topping Lake area; 2,300–2,700 m	Douglas fir (*Pseudotsuga menziesii*)	(6 mo) Sept.–Oct 1974; June–Sept 1976
			lodgepole pine	live trapping/radiotelemetry
			spruce/fir	Campbell (1979), Clark (1984)
Teton Wilderness	2,300	varied, mountainous; 2,300–2,800 m	Douglas fir	(6 mo) fall–winter 1975–1977
			lodgepole pine	skulls from trappers
			spruce/fir	
Targhee National Forest	5,100	west slope of Teton Mts.; 2,000–2,600 m	Douglas fir	(6 mo) fall–winter 1975–1977
			lodgepole pine	skulls from trappers
			spruce/fir	

METHODS

Marten population data come from live-trapped and radio-collared martens and from trapper-harvested carcasses collected from 1975 through 1979. Double-door National live traps were set in lines with traps about 0.2 km apart and checked daily for 7–10 days each month. Topography, vegetation, and marten signs determined trap sets. Trap locations were plotted on topographic maps. Captured martens were weighed to the nearest 25 g, aged, sexed, and examined; capture date and location were recorded. Animals were identified using color-coded, numbered ear tags and distinguishing characteristics (e.g., color pattern of venter, broken or discolored teeth, scars, etc.) when possible. Some martens were radio-collared with transmitters (model #SB2 IV) and monitored with a receiver (model #LA 12) and hand-held Yagi antennae (AVM Instrument Co., Dublin, California). Information on home ranges was obtained from live-trapping and telemetry. Home ranges were determined in two ways: (1) joining the outer points of locations or captures (minimum polygon method), and (2) measuring the greatest distance between points of capture or telemetry-determined locations and using this measure as the diameter of a circle to give an area estimate (range length method; Stickel 1954).

Marten skulls of known sex were collected from commercial trappers and cleaned in a dermestid beetle colony at Idaho State University. A canine was removed from each skull and sectioned, and cementum annuli were counted following Kelly (1977) and Strickland et al. (1982) to provide ages.

RESULTS

Trapping efforts, marten numbers, population densities, body weights, sex and age ratios, survivorship, residential status, immigration and emigration characteristics, and home ranges are summarized for the four study sites in Table 2. In all, 98 different martens were examined. The GTNP site yielded 46% of all martens, and much of the following information was collected from this population.

TABLE 2. American marten population characteristics, Teton County, Wyoming.

Study area	No. different marten	Sex ratio (M:F)	Age[1] [x yrs (± SD) range]	Length of time in study area [x days (± SD) range]	Residential status[4] [x days (± SD) range]			Young born on site	Unknown
					Resident	Temporary resident	Transient		
Grand Teton National Park	45	1.5:1.0	M 2.3 (± 1.2) 1–5 n = 3	M 144 (± 266) 1–1,364 n = 13	M 281 (± 332) 90–1,364 n = 13	M 28 (± 16) 13–62 n = 7	M 2 (± 1.6) 1–5 n = 5	3 M	—
			F 2 n = 1	F 145 (± 145) 1–560 n = 5	F 266 (± 159) 145–560 n = 5	F 46 (± 16) 33–69 n = 3	F 1 (± 0.4) 1–2 n = 9		
Bridger-Teton National Forest	17	1.4:1.0	—	—	6 M 3 F	0 M 1 F	3 M 1 F	2 M 0 F	1
Teton Wilderness[2]	16	3.0:1.0	M 5.4 (± 2.8) 0–5 n = 11	—	—	—	—	—	—
			F 7.2 (± 4.7) 0–13 n = 4						
Targhee National Forest[3]	20	3.0:1.0	M 6.0 (± 4.9) 0–7 n = 15	—	—	—	—	—	—
			F < 1 yr n = 5						
TOTALS OR MEANS	98	1.9:1.0	—	—	—	—	—	—	—

[1]Based on cementum layers.
[2]Unexploited population trapped for first time 1975.
[3]Heavily exploited population trapped annually.
[4]Resident (90+ days), temporary resident (7–89 days), transient (less than 7 days).

TRAP EFFORT

Trapping efforts on the GTNP and BTNF sites totaled 10,377 trap-days (one trap-day equals one trap set for 24 hrs) and resulted in 590 total captures and a capture rate of 5.7 marten per 100 trap days. Capture rates were 5.9 per 100 trap-days in GTNP and 4.9 per 100 trap-days in BTNF. The mean number of captures per individual and the number of different locations per individual varied between the two study sites (Table 3). Few previously untrapped marten were captured after 10 consecutive days of trapping (Fig. 1).

Numbers and Density

The 1,554-ha GTNP site showed a mean monthly population of 5.3 martens (± 2.2 SD, range 2–10) over 39 months (Fig. 2). Mean monthly populations, including transients, peaked in October, November, and December of each year (Fig. 3). The monthly mean for males in GTNP was 3.8 (± 1.8 SD, range 1–9), and for females it was 1.5 (± 1.4 SD, range 0–5). The 646-ha BTNF site had a mean monthly population of 6.8 martens (± 2.2 SD, range 1–9) over a six-month period. The monthly mean for BTNF males was 4.3 (± 1.1 SD, range 1–5), and for females it was 3.7 (± 0.9 SD, range 0–4).

Densities on the GTNP site, based on home range estimates, averaged one marten (males only) per 3.2 (± 2.0 SD) km^2. The BTNF site showed one male per 1.0 (± 0.8 SD) km^2 and one female per 0.3 (± 0.3 SD) km^2.

Body Weights

Body weights of martens fluctuated monthly (Fig. 4). For the GTNP site, 25 males caught for the first time averaged 1,111 g (± 110 SD, range 875–1,235), whereas 17 females averaged 743 g (± 83 SD, range 600–900). Females were 67% of the mean weight of males. For the BTNF site, 72 male weights (many weights of the same animal over successive trap-days) averaged 1,198 g (± 109 SD, range 875–1,450), whereas 24 females averaged 735 g (± 71 SD, range 650–875). Females were 61% of the mean weight of males.

Sex and Age Ratios

Sex ratios were nearly identical for GTNP (1.5M:1.0F) and BTNF (1.4M:1.0F), the two study sites sampled with live-traps. On the

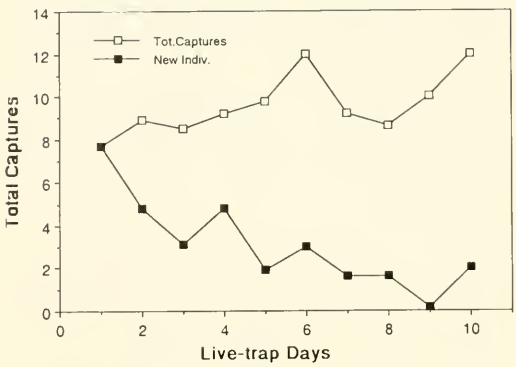

Fig. 1. Comparison of capture rates between total capture of marten and previously unmarked individuals on the Grand Teton National Park site, Teton County, Wyoming.

two study sites in which marten were harvested, the sex ratio was the same [3.0M:1.0F (Table 2)].

Age ratios were sampled via counts of cementum annuli on canine teeth (Table 2). Three of four male mortalities on the GTNP site averaged 2.3 years (± 1.2 SD, range 1–5), and a single female was 2 years old. Eleven males on the TW site averaged 5.4 years (± 2.8 SD, range 0–9), and 4 females averaged 7.2 years (± 4.7 SD, range 0–13). Fifteen males on the TNF site averaged 6.0 years (± 4.9 SD, range 0–7), and 5 females were all less than 1 year. Sex structure of the GTNP population varied monthly (Fig. 5); males were more numerous than females in 30 of the 39 months of study.

Mortality-Survivorship

The 27 males and 10 females from the GTNP, TW, and TNF sites whose ages were determined provided estimates of mortality-survivorship rates. Twelve males were less than 1 year old; five were 1–2 years old; three were 2–3 years old; one was 3–4 years old; two were 4–5 years old; one was 5–6 years old; one was 7–8 years old; and two were 9–10 years old. Six females were less than 1 year old; one was 1–2 years old; one was 5–6 years old; one was 8–9 years old; and one was 12–13 years old.

Immigration and Losses (Emigration and Mortality)

Marten losses from live-trapped study sites cannot be distinguished by cause (i.e.,

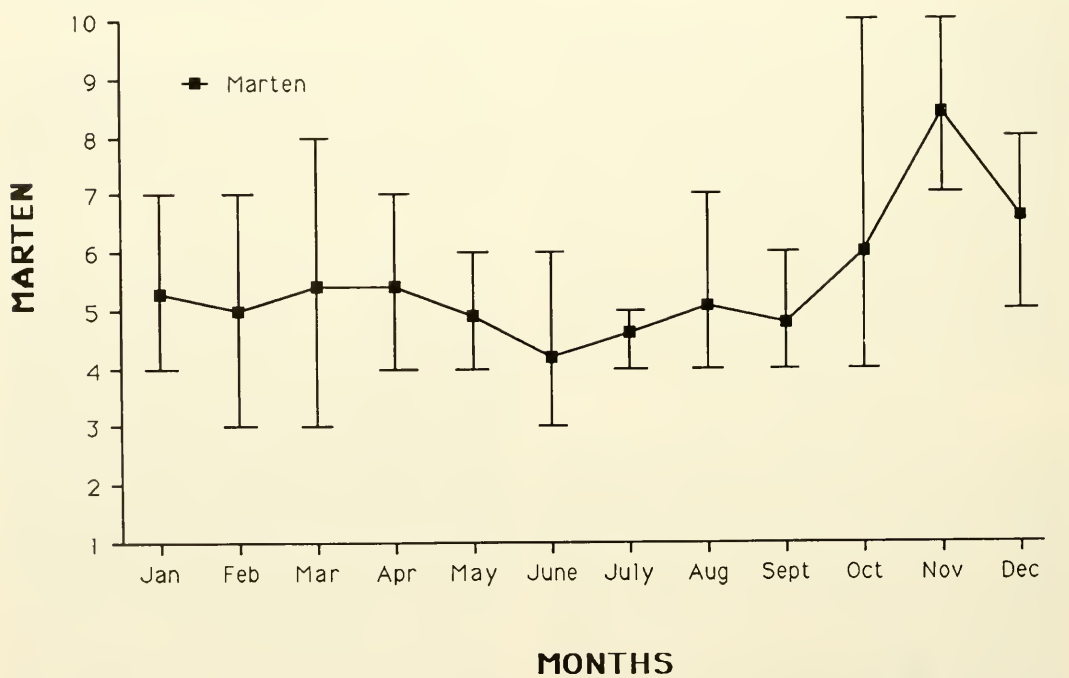

Fig. 2. Monthly mean numbers of American marten on the Grand Teton National Park study site, Teton County, Wyoming.

TABLE 3. Trap effort and capture rates for American marten, Teton County, Wyoming.

Study area	Trap-days[1]	No. different marten captured	Total captures	Martens per 100 trap-days	Captures per individual [x (± SD) range]	No. different locations [x (± SD) range]
Grand Teton National Park	8,390	45	493	5.9	11 (± 14) 1–96	5 (± 7) 1–27
					M 12 (± 19) 1–96	M 5 (± 6) 1–27
					F 9 (± 17) 1–76	F 3 (± 4) 1–12
Bridger-Teton National Forest	1,987	17	97	4.9	6 (± 6) 1–21	3 (± 2) 1–9
					M 7 (± 7) 1–21	M 3 (± 2) 1–9
					F 3 (± 3) 1–9	F 2 (± 1) 1–9
TOTALS OR MEANS	10,377	62	590	5.7	$\bar{x}$ = 8.5 $\bar{x}$ = 9.5 $\bar{x}$ = 6.0	$\bar{x}$ ± 4.0 $\bar{x}$ = 4.0 $\bar{x}$ = 2.5

[1]Trap-days are traps set for 24 hours.

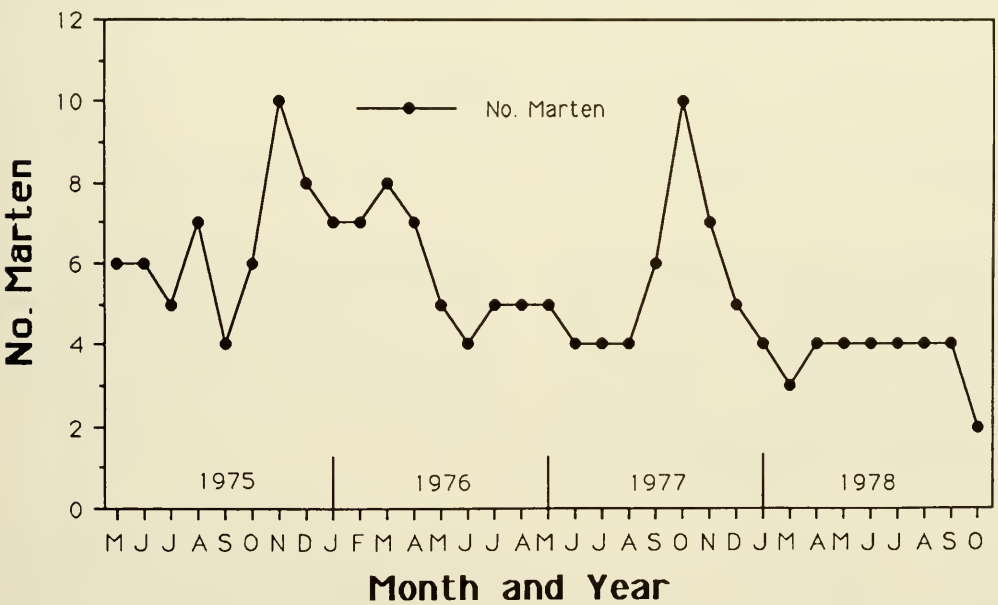

Fig. 3. Number of American marten captured by month on the Grand Teton National Park study site, Teton County, Wyoming.

emigration or death), and so are treated simply as losses. Further, only the GTNP site was trapped long enough to obtain data on the movement of martens into or out of the site (Table 4). Between 1975 and 1979, male losses occurred 11% more often than female losses. Only 3% of all marten losses occurred between January and March, while 48% occurred during October and November. between August and November, 68% of all male immigration and 79% of all male losses were observed. In contrast, 67% of all female immigration and 50% of all female losses occurred during the same months. Monthly marten immigration rates were similar to loss rates during each given month.

The mean length of time a given male was present on the GTNP was 144 days (± 266

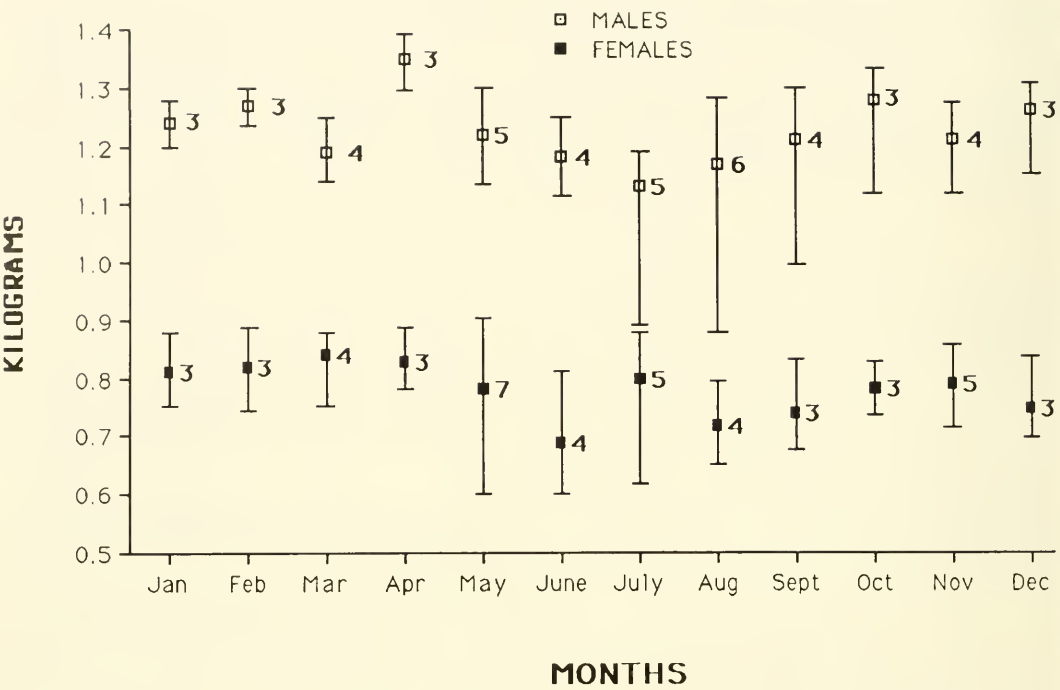

Fig. 4. Mean body weights and weight ranges of male and female American marten on the Grand Teton National Park study site, Teton County, Wyoming.

SD, range 1–1,364); for females it was 145 days (± 145 SD, range 1–560; Table 2). Martens were classified as residents if they remained on the site over 90 days, as temporary residents (8–89 days), and transients (< 7 days), following Hawley and Newby (1957). Table 3 shows the durations of residents, temporary residents, and transients on the site. Less than half the GTNP population were residents.

Home Ranges

Males on the GTNP and BTNF study sites had different home range sizes (Table 4). Six GTNP male home ranges averaged 3.2 km^2 (± 2.0 SD, range 0.7–5.8), whereas six BTNF male home ranges averaged 1.0 km^2 (± 0.8 SD, range 0.1–2.4). Female home ranges were estimated only on BTNF, where three females occupied a mean of 0.3 km^2 (± 0.3 SD, range 0.1–0.7). On the BTNF site, male home ranges were about three times larger than female home ranges; insufficient data were collected on GTNP females to make a similar comparison.

Home range estimates varied depending on the method of calculation (Table 5). On the GTNP, estimates of two male home ranges were 5.4 and 5.8 km^2, based on live-trapping and radio-telemetry locations. In contrast, four other males had home ranges of 3.3, 3.1, 0.7, and 0.7 km^2, based only on captures.

Discussion

Capture rates for Teton County martens of 5.9 and 4.9 per 100 trap-days were less than recorded elsewhere. Miller et al. (1955) captured 7.0 martens per 100 trap-days, and Hawley and Newby (1957) captured 13.1 martens per 100 trap-days. This may be a result of trapping techniques or differences in marten behavior or habitat.

Teton County martens showed pronounced sexual dimorphism in body weight, as they do throughout North America (Clark et al. 1987). Teton County females weighed about 65% of the weights of males.

Sex ratios in Teton County martens were nearly identical in the two live-trapped samples (1.5M:1.0F) and the two harvested samples

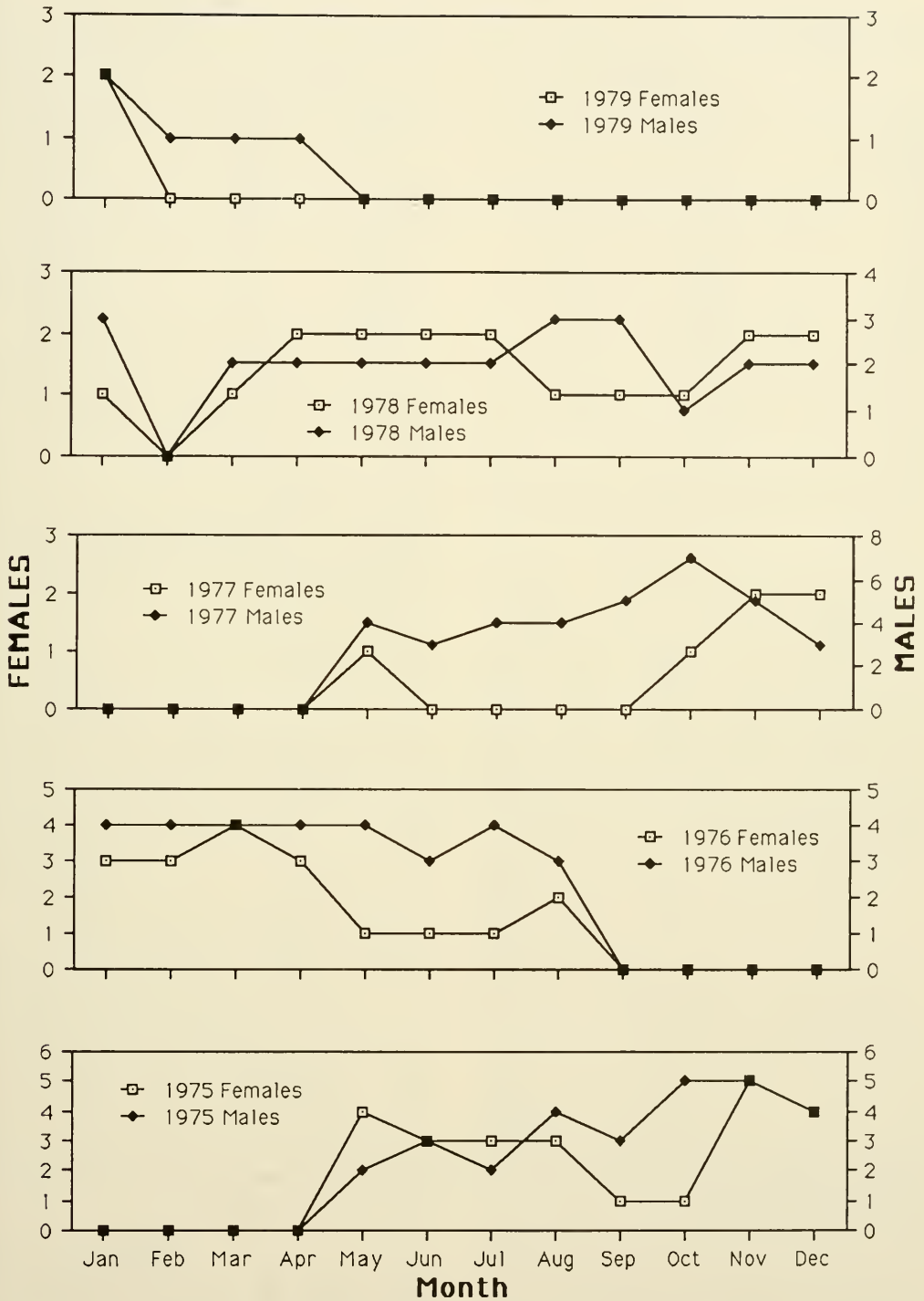

Fig. 5. Sex structure of captured American marten on the Grand Teton National Park site, Teton County, Wyoming.

TABLE 4. American marten immigration and loss statistics for the Grand Teton National Park population, Teton County, Wyoming.

Month	Immigration		Losses		
	Male (%)	Female (%)	Male (%)	Female (%)	Totals (%)
January	0	0	0	1 (8.3)	1 (1.6)
February	0	0	0	0	0
March	0	1 (7.8)	0	1 (8.3)	2 (3.1)
April	0	2 (15.4)	0	3 (2.5)	5 (7.8)
May	2 (10)	1 (7.8)	3 (15.8)	1 (8.3)	7 (10.9)
June	2 (10)	0	0	0	2 (3.1)
July	2 (10)	0	1 (5.3)	0	3 (4.7)
August	3 (15)	1 (7.8)	4 (30.1)	1 (8.3)	9 (14.1)
September	3 (15)	0	1 (5.3)	0	4 (6.3)
October	5 (25)	1 (7.8)	7 (36.8)	1 (8.3)	14 (21.9)
November	2 (10)	6 (46.1)	3 (16)	4 (33.3)	15 (23.4)
December	1 (5)	1 (7.8)	0	0	2 (3.1)
TOTALS	20 (31.3)	13 (20.3)	19 (29.7)	12 (18.7)	64 (100)

TABLE 5. Home range estimates for American marten, Teton County, Wyoming.

Study area	No. locations	No. days	Home range estimates	
			Minimum area (km)[2]	Range length (km)[3]
Grand Teton National Park				
Male No.				
17	14	78	3.3	—
25	16	74	0.7	—
26	9	66	0.7	—
29	13	141	3.1	—
30	34	160	5.4[1]	—
100	53	164	5.8[1]	—
Means (± SD)	23 (± 15)	114 (± 42)	3.2 (± 2.0)	—
Bridger-Teton National Park				
Male No.				
4	7	16	1.6	1.4
5	4	378	0.1	0.4
7	14	365	0.2	0.6
8	31	385	1.6[1]	1.4[1]
12	31	220	2.4[1]	1.8[1]
13	4	80	0.4	0.7
Means (± SD)	15 (± 12)	241 (± 148)	1.0 (± 0.8)	1.1 (± 0.5)
Females No.				
1	16	347	0.7[1]	1.0[1]
9	2	320	0.2[1]	0.6[1]
10	2	263	0.1	0.4
Means (± SD)	7 (± 7)	310 (± 35)	0.3 (± 0.3)	0.6 (± 0.2)

[1]Both trap and telemetry; all other martens, traps only.
[2]Based on minimum polygon method.
[3]Based on range length as diameter of a circle.

(3.0M:1.0F), but differed considerably between live- and kill-trap samples. Similar sex ratios (two to three times as many males as females) have been reported elsewhere. Twining and Hensley (1947), DeVos and Guenther (1952), Yeager (1950), Lensink (1953), and DeVos et al. (1959) found males predominant in harvest samples. The preponderance of males in these samples may be accounted for by the larger home ranges of males and by the extensive wandering of juvenile males in search of unoccupied home

ranges—both characteristics making them more likely to encounter traps (Quick 1956a, 1956b, Yeager 1950). Male predominance in catches may be accentuated by a greater mortality in females and juveniles during periods of prey scarcity and the more vulnerable energy balance of females (Hawley and Newby 1957, Weckwerth and Hawley 1962). However, the sex ratio of martens at birth is not significantly different from 1:1 (Brassard and Bernard 1939, Markley and Bassett 1942, Ritchie 1953).

Forty-four percent of 29 male Teton County martens, nearly all of which were trapper-harvested, and 60% of 10 females were less than 12 months old. Strickland et al. (1982) noted that 60–80% of trap-harvested martens are young-of-the-year. Lensink (1953) found that the proportion of adults caught in hunter harvests is higher in newly or lightly trapped areas than on heavily trapped lines. The oldest marten we caught showed 13 annuli, the same as the oldest marten that Strickland et al. (1982) reported in a hunter-harvest sample of 718 from Ontario. Martens are known to live up to 15 years in captivity (Strickland et al. 1982).

No data were gathered on natality rates from the Teton County martens. A few young marten were identified each summer and fall, but aging techniques in the field are limited. According to Strickland et al. (1982) martens produce a litter of three or slightly less annually.

Martens are taken by several avian and mammalian predators (Clark et al. 1987), but predation is not thought to cause significant impact on wild populations (Raine 1981). No predations were observed in this study. Strickland et al. (1982) found that about 50% of males and 54% of females died before reaching 12 months of age. For older martens, 20% of males and 15% of females died between 1 and 2 years of age; 13% of males and 12% of females died between the age of 2 and 3 years; few wild marten live over 4 years. The limited survivorship data from Teton County show a similar pattern.

Numerous martens immigrated into and emigrated from the two Teton County live-capture study sites. Many of these movements were in the fall, and males tended to move more often than females. In the GTNP site over the four years of study, overall marten numbers immigrating or emigrating were almost equal. Similar patterns have been seen elsewhere (DeVos 1951, Hawley and Newby 1957, Francis and Stephenson 1972). Weckwerth and Hawley (1962) found juvenile male dispersal movements of 27–40 km. No actual dispersal movements were recorded for Teton County martens, but some probably occurred and went undetected.

Teton County martens resided on the study sites for different lengths of time. On the GTNP site, 43% of the martens were residents, 24% temporary residents, and 33% transients, whereas on the BTNF site, 67% were residents, 7% temporary residents, and 26% transients. In contrast, Weckwerth and Hawley (1962) found 47% residents, 21% temporary residents, and 32% transients in Montana. The greater percentage of residents on the BTNF site may be due to the site's better habitat quality (i.e., spruce and fir forest as compared with lodgepole pine forest in GTNP).

Teton County males had home ranges of about 1.0 km^2 ($\pm$ 0.8 SD) to 3.2 km^2 ($\pm$ 2.0 SD), depending on site characteristics. Female ranges were about one-third the size of male home ranges. Most data for these estimates came from tag and recapture trap studies. Elsewhere, live-capture studies have shown home range size calculated by the minimum area method to be 2–3 km^2 for males and 1 km^2 for females, whereas radiotelemetry studies have shown ranges of 10–20 km^2 for males and 3–6 km^2 for females (Clark et al. 1987).

Because home ranges overlap, densities can be relatively high. At peak densities in early fall when family groups disperse, there may be 1.2–1.9 martens per km^2 (Francis and Stephenson 1972, Soutiere 1979). This compares with the GTNP site, where male martens occurred at 1 per 3.2 km^2, and the BTNF site, where males occurred at 1 per 1.0 km^2. Differences are due to different temporal sampling and variations in habitat quality.

The American marten is vulnerable to local extinction as indicated by abundant historical data (e.g., Marshall 1942, Strickland and Douglas 1987, Clark et al. 1987). Understanding local and regional marten population characteristics is fundamental to sound management. The data presented here, combined with cited data, can be used to model the

effects of systematic habitat changes (e.g., logging) and stochastic events (e.g., diseases) on small marten populations. Such a viability assessment can estimate extinction probabilities of marten populations of various demographics. Viability assessment, determination of area requirements, and careful habitat management are essential for conservation of this important forest carnivore and indicator species on national forests in the Greater Yellowstone Ecosystem.

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LITERATURE CITED

BRASSARD, J. A., AND R. BERNARD. 1939. Observations on breeding and development of marten. Canadian Field-Nat. 53: 15–21.

CAMPBELL, T. M. III. 1979. Short-term logging effects on pine martens. Unpublished thesis, Colorado State University, Fort Collins. 65 pp.

CLARK, T. W. 1984. Analysis of pine marten population organization and regulatory mechanisms in Jackson Hole, Wyoming. Nat. Geog. Soc. Res. Rep. 1975: 131–143.

CLARK, T. W., E. ANDERSON, C. DOUGLAS, AND M. STRICKLAND. 1987. *Martes americana*. Mammalian Species 289: 1–8.

DEVOS, A. 1951. Overflow and dispersal of marten and fisher from wildlife refuges. J. Wildl. Manage. 15: 164–175.

DEVOS, A., A. T. CRINGAN, J. K. REYNOLDS, AND H. G. LUMSDEN. 1959. Biological investigations of traplines in northern Ontario, 1951–1956. Ontario Dept. Lands For. Tech. Bull. Wildl. Ser. 8: 1–61.

DEVOS, A., AND S. E. GUENTHER. 1952. Preliminary live-trapping studies on marten. J. Wildl. Manage. 16: 207–214.

FRANCIS, G. R., AND A. B. STEPHENSON. 1972. Marten ranges and food habits in Algonquin Provincial Park, Ontario. Ministry Nat. Res. Rep. No. 91: 1–53.

HAUPTMAN, T. N. 1979. Spatial and temporal distribution and feeding ecology of the pine marten. Unpublished thesis, Idaho State University, Pocatello. 84 pp.

HAWLEY, V. D., AND R. E. NEWBY. 1957. Marten home ranges and population fluctuations. J. Mammal. 38: 174–182.

KELLY, G. M. 1977. Fisher (*Martes pennanti*) biology in the White Mountain National Forest and adjacent areas. Unpublished dissertation. University of Massachusetts, Amherst. 178 pp.

LENSINK, C. 1953. The home range of marten and its significance in management. U.S. Fish and Wildl. Serv. Rep. (unpublished). 6 pp.

LOVE, J. D., AND J. C. REED, JR. 1968. Creation of the Teton landscape. U.S. Geol. Surv. 120 pp.

MARKLEY, M. H., AND C. F. BASSETT. 1942. Habits of captive marten. Amer. Midl. Nat. 28: 604–616.

MARSHALL, W. H. 1942. The biology and management of the pine marten in Idaho. Unpublished dissertation, University of Michigan, Ann Arbor. 107 pp.

MILLER, R. G., R. W. RITCEY, AND R. Y. EDWARDS. 1955. Live-trapping marten in British Columbia. Murrelet 36: 1–8.

QUICK, H. F. 1956a. Effects of exploitation on a marten population. J. Wildl. Manage. 20: 267–273.

———. 1956b. Analysis of marten exploitation as criteria of management. Trans. N. Amer. Wildl. Conf. 21: 355–364.

RAINE, R. M. 1981. Winter food habits, responses to snow cover and movements of fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. Unpublished thesis, University of Manitoba, Winnipeg. 144 pp.

REED, J. F. 1952. The vegetation of the Jackson Hole Wildlife Park, Wyoming. Amer. Midl. Nat. 48: 700–729.

RICHARDSON, L., T. W. CLARK, S. C. FORREST, T. M. CAMPBELL III. 1986. Black-footed ferret recovery: a discussion of some options and considerations. Great Basin Nat. Mem. 8: 169–184.

RITCHIE, J. W. 1953. Raising marten for twenty-four years. Fur Trade. J. Canada 30: 10.

SOUTIERE, E. C. 1979. The effects of timber harvesting on the marten. J. Wildl. Manage. 43: 850–860.

STICKEL, L. F. 1954. A comparison of certain methods of measuring ranges of small mammals. J. Mammal. 35: 1–15.

STRICKLAND, M. A., C. W. DOUGLAS, M. NOVAK, AND N. P. HUNZINGER. 1982. Marten (*Martes americana*). Pages 599–612 *in* J. A. Chapman and G. A. Feldhamer, eds., Wild mammals of North America. Johns Hopkins University Press, Baltimore. 1,147 pp.

TWINING, H., AND A. HENSLEY. 1947. The status of pine martens in California. California Fish and Game 33: 133–137.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU. 1975. Climatological data of Wyoming. Natl. Ocean. and Atmos. Admin., Asheville, North Carolina. Nos. 1–12.

WECKWERTH, R. P., AND V. D. HAWLEY. 1962. Marten food habits and population fluctuations in Montana. J. Wildl. Manage. 26: 55–74.

YEAGER, L. E. 1950. Implications of some harvesting and habitat factors on pine marten management. Trans. N. Amer. Widl. Conf. 15: 319–335.

YOUNG, J. F. 1982. Soil survey of Teton County, Wyoming—Grand Teton National Park area. USDA Soil Conserv. Serv. 173 pp.