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Martes americana.

By Tim W. Clark, Elaine Anderson, Carman Douglas, and Marjorie Strickland

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Martes americana (Turton, 1806)

American Marten

Mustela americana Turton, 1806:60. Type locality, eastern North America.
Mustela vulpina Rafinesque, 1819:82. Type locality, "regions watered by the Missouri."
Mustela leucopus Kuhl, 1820:74. Type locality, Canada.
Mustela huro F. Cuvier, 1823:256. Type locality, upper Canada.
Mustela martinus Ames, 1874:69. Presumably an inadvertent renaming of *M. americana.*
Mustela caurina Merriam, 1890:27. Type locality, near Grays Harbor, Grays Harbor Co., Washington.
Mustela atrata Bangs, 1897:162. Type locality, Bay St. George, Newfoundland.
Mustela brumalis Bangs, 1898:502. Type locality, Okkak, Labrador.
Mustela nesophila Osgood, 1901:33. Type locality, Massett, Graham Island, Queen Charlotte Islands, British Columbia.
Martes americana Miller, 1912:92. First use of this binomial.

CONTEXT AND CONTENT. Order Carnivora, Family Mustelidae, Genus *Martes,* Subgenus *Martes.* The genus *Martes* includes seven (Corbet, 1978) or eight (Anderson, 1970) extant species. A close relationship among the Holarctic martens, *M. martes, M. zibellina, M. melampus,* and *M. americana,* was noted by several workers (Anderson, 1970; Coues, 1877; Hagmeier, 1961; Ognev, 1931; Rhoads, 1902).

Hall (1981) continued to recognize 14 subspecies of *M. americana,* but other authors (Anderson, 1970; Hagmeier, 1958) emphasized that the partitioning of the subspecies was completely arbitrary and noted that many of the differences between them were caused by small samples, variable coat color, or an all female sample. We tentatively recognize the following subspecies that can be separated into two subspecies groups: "*americana*" and "*caurina,*" that differ from each other in cranial characters and their fossil history.
"*M. americana*" subspecies group:

M. a. abietinoides Gray, 1865:106. Type locality restricted by Rhoads (1902:451) to edge of the western slope of the Rocky Mountains between Kicking Horse Pass and the Columbia River.
M. a. actuosa (Osgood, 1900:43). Type locality, Ft. Yukon, Alaska (*abieticola* Preble and *boria* Elliott are synonyms; Hagmeier, 1961).
M. a. americana (Turton, 1806), see above (*leucopus* Kuhl, *huro* F. Cuvier, and *martinus* Ames are synonyms).
M. a. atrata (Bangs, 1897), see above (*brumalis* Bangs is a synonym; Hagmeier, 1961).
M. a. kenaiensis (Elliot, 1903:151). Type locality, Kenai Peninsula, Alaska.

"*M. caurina*" subspecies group:

M. a. caurina (Merriam, 1890), see above (*vulpina* Rafinesque, *origenes* Rhoads, *sierrae* Grinnell and Storer, *vancouverensis* Grinnell and Dixon are synonyms).
M. a. humboldtensis Grinnell and Dixon, 1926:411. Type locality, ridge about 8 km NE of Cuddeback (Carlotta), Humboldt Co., California.
M. a. nesophila (Osgood, 1901), see above.

DIAGNOSIS. *Martes americana* differs from the fisher *M. pennanti* (subgenus *Pekania*) by smaller size, lighter pelage, presence of a conspicuous, irregular-shaped buff to orange throat and chest patch, and absence of an external median rootlet on the upper carnassial; and it differs from the mink (*Mustela vison*) by longer fur, bushier tail, and four upper and lower premolars in each jaw half (mink have three). In comparison to the other Holarctic martens (*M. martes, M. zibellina,* and *M. melampus*), the American marten is slightly smaller and has a relatively longer trigonid on the lower carnassial; otherwise, the four species have many morphological similarities (Anderson, 1970).

GENERAL CHARACTERS. The American marten is a long, slender-bodied animal about the size of a mink with relatively large rounded ears, short limbs, and a bushy tail (Fig. 1). The head is roughly triangular and the nose is sharp. The feet are pentadactyl (though the first toe is reduced) and digitigrade. In winter, the soles of the feet are densely furred. The sharp, compressed claws are semiretractable. The long, silky, dense fur ranges in color from pale yellowish buff to tawny brown to almost black. The head usually is lighter than the rest of the body; the legs and tail are darker. A throat and chest bib that ranges in color from pale straw to vivid orange is characteristic. There is considerable individual variation

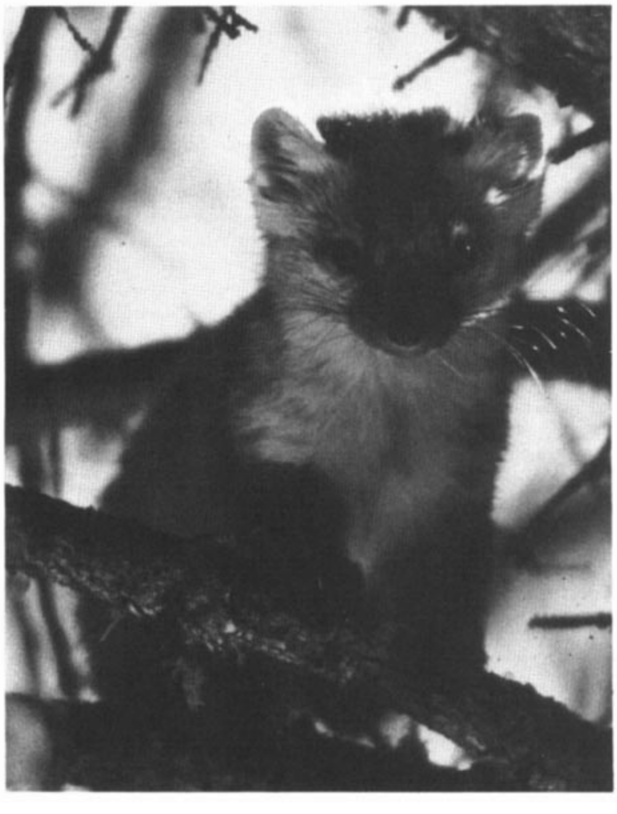

FIG. 1. Photograph of an adult male *Martes americana.* (Photo by Tim Clark).

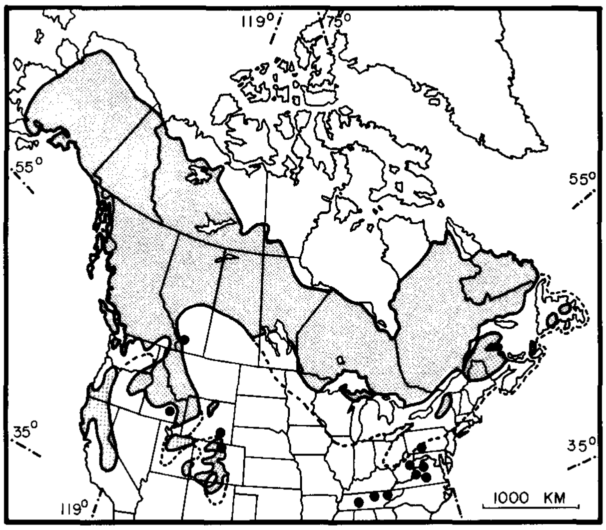

FIG. 2. Geographic distribution of *Martes americana*. Shaded area is the present range; the dotted line indicates the boundary of the historic range (modified from Hall, 1981). Closed circles indicate fossil sites.

in coat color, but sexual variation in pelage color has not been observed (Jackson, 1961). Guard hairs measure 31.8 to 44.5 mm in length and the dense underfur is about 25.4 mm long (Rue, 1981). In summer, the pelage in thinner and coarser and dark greyish-brown or black with a reddish-yellow throat patch (Soutiere and Steventon, 1981). The lustrous fur of the American marten is highly prized by trappers.

Sexual dimorphism is pronounced with males averaging about 15% larger than females in body length and as much as 65% larger than females in body weight. There is considerable variation in size in different locations across the continent. Ranges for adult males are: head and body length, 360 to 450 mm; tail length, 200 to 230 mm; weight, 470 to 1,250 g. For adult females, the ranges are: head and body length, 320 to 400 mm; tail length, 180 to 200 mm; and weight, 280 to 850 g (Burt and Grossenheider, 1976; Jackson, 1961; Nowak and Paradiso, 1983; Peterson, 1966).

DISTRIBUTION. An animal of the boreal forest, the American marten formerly occurred from Alaska across most of Canada, New England, the Alleghenies, the Great Lakes region, the Rocky Mountains south to New Mexico, the Sierra Nevadas, and the Cascades (Fig. 2). It still occurs throughout most of this range, but because of loss of habitat, it has been extirpated from many southeastern areas, including extreme southern Ontario, southern Quebec and Prince Edward Island (Peterson, 1966), most of New England where martens were common in colonial times (Godin, 1977), and portions of the Great Lakes region. Martens still are found in the northern parts of Maine, Vermont, New York, and Minnesota, and were reintroduced recently into Michigan and Wisconsin. A reinvasion of the range by martens is now occurring in northeastern Minnesota and adjacent Ontario (Mech and Rogers, 1977). Several reintroduction programs were undertaken in recent decades and are reported by Berg (1982).

FOSSIL RECORD. The geologic range of *Martes* extends from the lower Miocene to the Recent; a Palearctic origin is indicated. Tertiary martens are poorly known and their relationship to extant species is unclear. Of the true martens (subgenus *Martes*), *M. wenzensis* from the early Villafranchian of Poland may have been a forerunner of the *M. martes* line. In the middle Pleistocene (Biharian), *M. vetus*, the direct ancestor of the *M. martes* group, appears in several European faunas. As noted earlier, *M. martes*, *M. zibellina*, *M. melampus*, and *M. americana* are closely related, and by the Pleistocene their combined circumboreal ranges extended from Britain to North America (Anderson, 1970).

Martes americana reached North America via Beringia in the late Rancholabrean (Wisconsin) and spread eastward. This population became isolated in eastern North America by the ice sheet and only after the ice melted did it reinvade Alaska and western Canada (Kurtén and Anderson, 1980); these martens constitute the "*americana*" subspecies group. A later invasion of martens from Siberia populated the West Coast, Sierra Nevadas, and Rocky Mountains. These populations, the "*caurina*" subspecies group, show more similarities to *M. zibellina* than to the eastern subspecies (Anderson, 1970; Hagmeier, 1961). *M. americana* has been identified in 12 late Rancholabrean faunas in Pennsylvania, Virginia, Tennessee, West Virginia, Colorado, Wyoming, Idaho, and Alberta (Fig. 2).

Martes nobilis, an extinct true marten intermediate in size between male *M. americana* and female *M. pennanti*, has been found in 12 late Rancholabrean-Holocene faunas in California, Nevada, Idaho, Wyoming, Colorado, and Yukon Territory. At Chimney Rock and Bell caves, remains of *M. nobilis* and *M. americana* have been found together (Kurtén and Anderson, 1980). Recently, Grayson (1984) reported *M. nobilis* from two archeological sites in Idaho and Nevada dated less than 5,000 years B.P. Thus, *M. nobilis* survived well into the Holocene. Its extinction was probably related to competition with *M. americana*, a changing climate, and perhaps man's activities.

FORM AND FUNCTION. The skull is relatively long and narrow with slender zygomatic arches. The auditory bullae are elongated, moderately inflated, and relatively close together. On juvenile skulls of both sexes, the space between the temporal ridges forms a broad band extending from the postorbital processes to the occiput (Fig. 3). In adult males, these ridges generally coalesce to form a sharp sagittal crest that, in older individuals, overhangs the occiput. On adult female skulls, the coalescence of the temporal ridges is variable and comparatively minimal so that a distinct and long sagittal crest seldom is formed, and the juvenile conformation is more nearly retained (Marshall, 1951*a*). Both male and female skulls that have a crest are adult, but females without a crest may be of either age class (Brown, 1983). Palpation of the sagittal crest to determine age of live-trapped animals is unreliable. Condylobasal length ranges from 73.0 to 87.4 mm in males and 70.7 to 80.4 mm in females in a large sample of *M. a. actuosa* (Anderson, 1970).

Juveniles may be distinguished from adults by presence of unfused cranial sutures and unfused epiphyseal cartilages of the femur (Dagg et al., 1975) and by absence of the suprafabellar tubercle (Leach et al., 1982). In radiographs of the canine, a larger pulp cavity distinguishes juveniles; juveniles have >36.5% pulp in males, >32.5% in females (Dix and Strickland, in press). The baculum continues to grow throughout life, and a baculum weight less than 100 mg serves to distinguish juvenile males (Marshall, 1951*a*; Strickland et al., 1982). Estimates of age may be determined by counts of annuli in tooth cementum (Strickland et al., 1982). The oldest marten thus aged by us was a 19-year-old wild male.

The dental formula is i 3/3, c 1/1, p 4/4, m 1/2, total 38. The teeth show many similarities to those of *M. zibellina* and *M. martes*. Of the three species, *M. americana* has the narrowest incisor row (I 3 to I 3) and the trigonid of the lower carnassial (m_1) is relatively longer (Anderson, 1970).

The skeleton is relatively unspecialized and does not show extreme modifications. Leach (1977*a*, 1977*b*) and Leach and de Kleer (1978) reported that the hind limbs of *M. americana* can be rotated to permit head-first descent. They noted that the limb bones of males are generally larger than those of females, but there is some overlap. The vertebral formula is 7 C, 14 T, 6 L, 3 S, and 18 Ca, total 48. The reduction or absence of interspinous ligaments in *Martes* permits greater dorsoventral movements and flexibility of the vertebral column which permits a longer stride and greater agility (Leach and de Kleer, 1978). The baculum in young animals is expanded at the tip to form two processes; in adults, the base expands and the distal processes fuse leaving a slitlike opening (Burt, 1960; Fig. 4). Youngman (1975) did not find morphological differences between bacula of *M. americana* and *M. zibellina*.

Both sexes of *M. americana* possess a glandular area on the abdomen that secretes an oily fluid that produces the characteristic marten odor. In males, this area extends from the opening of the penis anteriorly about 40 mm and is marked externally by bundles of shorter stained hairs. In females the gland occupies the same area and is comparable in size. Internally, the glandular area is larger, lobulated, and about 2 mm thick (Hall, 1926). Its function is scent-marking, and both sexes have been observed to drag their bellies over logs and branches to mark them. Both males and females have paired anal scent glands.

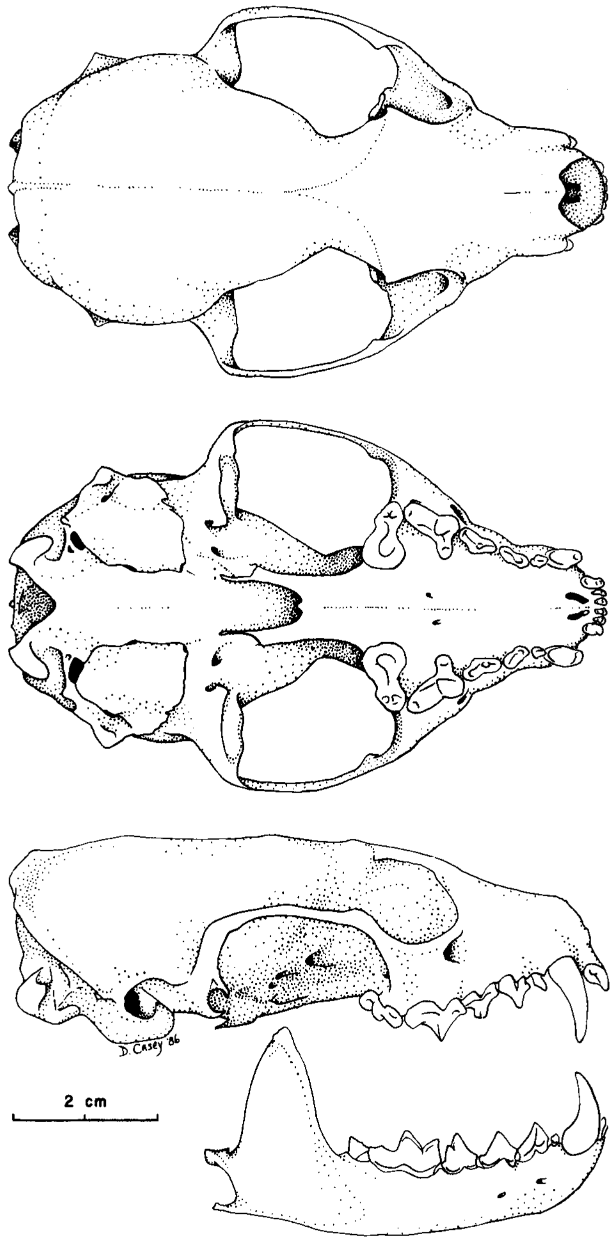

FIG. 3. Dorsal, ventral, and lateral views of the skull, and lateral view of the mandible of an adult male *Martes americana*. (Specimen from private collection of Tim Clark drawn by Denise Casey).

ONTOGENY AND REPRODUCTION. The breeding season of 24 to 46 days generally occurs in July and August [July and August in Montana (Jonkel and Weckwerth, 1963); late June or July in Alaska (Lensink, 1953); 10 July to 2 September in New York (Markley and Bassett, 1942); 18 June to 21 August in Alberta (Ritchie, 1953)]. Enders and Leekley (1941), who described the changes in size and color of the vulva as breeding season approached, reported that copulation occurred at the time of maximal vulvar swelling. Testes remain scrotal and at breeding season increase to the size of "hazelnuts" (Markley and Bassett, 1942). Induced ovulation has been demonstrated in *Martes* (Ewer, 1973) but not, as yet, for *M. americana* although such an occurrence is logical for this species which is usually solitary.

The fertilized ovum develops to a blastocyst 500 to 900 μm in diameter (Marshall and Enders, 1942; Wright, 1942). A period of arrested development of 190 to 250 days (Hamilton, 1943) then ensues, with the blastocysts remaining free in the lumen of the uterus (Wright, 1963). The blastocysts implant and normal development proceeds. After an active pregnancy of about 27 days (Jonkel and Weckwerth, 1963), birth of the young (mean 2.85, range 1 to 5) occurs from midMarch to late April (Strickland et al., 1982). Thus, the total gestation period is 220 to 276 days (Ashbrook and Hanson, 1930; Brassard and Bernard, 1939; Hamilton, 1943; Markley and Bassett, 1942; Ritchie, 1953). The variation of 56 days in gestation period likely is related to differences in date of fertilization. Enders and Pearson (1943) were the first to show that implantation in martens correlates with photoperiod and can be induced by artificial changes in day length on fur ranches.

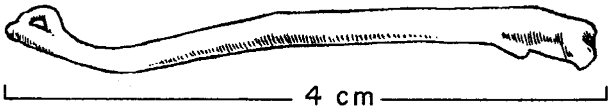

FIG. 4. Lateral view of baculum of adult *Martes americana*; distal tip to left. (Specimen from private collection of Elaine Anderson drawn by Denise Casey).

Brassard and Bernard (1939) described in detail the development of a litter of martens born on March 28. The neonates were altricial and weighed about 28 g; growth was rapid and sexual dimorphism, with males the larger, was apparent at 3 weeks (sexual dimorphism may operate against females in competition with male siblings); a raphe, or ridge from the anus to the preputial orifice, distinguished males at 3 weeks; the ears opened at 24 days, the eyes at 39 days; weaning occurred at about 6 weeks when young began to take solid food; by 46 days, young were able to crawl out of the nest and were active; complete permanent dentition was achieved by 18 weeks; adult length but not necessarily adult weight was achieved by 3 months. The sex ratio at birth is 1:1.1 in favor of males (n = 342, a total from the three studies cited), not significantly different from 1:1 (Brassard and Bernard, 1939; Markley and Bassett, 1942; Ritchie, 1953).

Sexual maturity usually is achieved by both male and female yearlings (15 months), but may not occur until a year later (Markley and Bassett, 1942; Orsborn, 1953; Yerbury, 1947). The average number of corpora lutea per pregnant female is 3.5 (Strickland et al., 1982). Usually, 80% of yearling and 100% of older females become pregnant (Strickland et al., 1982) resulting in a mean fecundity of 3.2. However, sometimes a large proportion of yearlings may not conceive and reproduction in older females also may be reduced. For example, in one area of Ontario, no yearlings and only 30% of adults were pregnant, and the overall fecundity was reduced to one-third of its usual value (Strickland and Douglas, in press). Such failures may be food-related (Hawley and Newby, 1957; Weckwerth and Hawley, 1962). Females in captivity have bred successfully to 15 years of age (Ritchie, 1953; Yerbury, 1947). Strickland and Douglas (in press) have not detected reproductive senility even in wild females 12 years of age.

ECOLOGY. Mature coniferous or mixed forests with at least a 30 to 50% crown density support more martens (Allen, 1982; Brown, 1980; Burnett, 1981; Campbell, 1979; Koehler et al., 1975; Maser et al., 1981; Spencer et al., 1983; Taylor and Abrey, 1982). Optimum habitat elements appear to be mature old-growth spruce (*Picea*)-fir (*Abies*) communities with >30% canopy cover, well established understory of fallen logs and stumps, and lush shrub and forb vegetation to support microtine and sciurid prey (Burnett, 1981). Hargis and McCullough (1984) noted that martens tend to use low overhead cover. A suitability index model for marten habitat was developed to estimate winter habitat (Allen, 1982). Barrett and Spencer (1982) tested the model in the Sierra Nevadas of California and found a significant but weak correlation between habitat suitability predicted by the model and marten habitat-use patterns.

Martens avoid large openings such as clear-cuttings, and if an area is cut over or severely burned, it is of little value to them for about 15 years (Koehler and Hornocker, 1977; Soutiere, 1979). Martens make little use of open clearings (Spencer et al., 1983; Steventon, 1979; Steventon and Major, 1982), but may use riparian areas and meadows (Spencer et al., 1983) and forest edges (Simon, 1980). Some martens use rocky alpine areas above timberline (Streeter and Braun, 1968). They avoid hunting in winter across openings much wider than 100 m, especially when snow is deep, but they might use these in summer if food and cover are available (Hargis and McCullough, 1984; Koehler and Hornocker, 1977; Soutiere, 1979).

Martens use a wide variety of foods (Buskirk, 1983; Clem, 1975; Cowan and MacKay, 1950; Douglass et al., 1983; Francis and Stephenson, 1972; Hargis and McCullough, 1984; Koehler et al., 1975; Lensink, 1953; Lensink et al., 1955; Marshall, 1946; More, 1978; Murie, 1961; Patton, 1925; Quick, 1955; Raine, 1981; Soutiere, 1979; Spencer and Zielinski, 1983; Weckwerth and Hawley, 1962; Zielinski et al., 1983). Small mammals, especially voles (Sigmodontinae), are the main food. Perhaps the largest usual prey of martens is the snowshoe hare (*Lepus americanus*). In some regions, martens appear to have a special relationship with tree squirrels (*Tamiasciurus* sp.), preying on them and using their middens and dens. Martens also eat flying squirrels (*Glaucomys* sp.), chipmunks (*Tamias* sp.), mice (*Peromyscus* sp.), and shrews (*Sorex* sp.). Birds and their eggs, reptiles, amphibians, earthworms, and insects are consumed. In season, fruits and berries (e.g., *Vaccinium* sp.) are used. Marten use of carrion is exploited by trappers to bait trapsites. A marten requires about 80 kcal/day (More, 1978; Worthen and Kilgore, 1981) or about three mice. Winter distribution of martens may be governed more by prey availability than by other habitat factors (Soutiere, 1979). Indeed, marten populations are regulated largely by food throughout the year (Clark, 1984; Simon, 1980; Weckwerth and Hawley, 1962).

The home range of a male is two to three times that of a female (Burnett, 1981; Clark, 1984; Francis and Stephenson, 1972; Hawley and Newby, 1957; Major et al., 1981; Newby and Hawley, 1954; Quick, 1953, 1956*b*). Tag and recapture studies have shown the home range size calculated by the minimum-area method to be 2 to 3 km^2 for males and 1 km^2 for females (Francis and Stephenson, 1972; Hawley and Newby, 1957; Soutiere, 1979), but by radiotelemetry ranges of 10 to 20 km^2 for males and 3 to 6 km^2 for females were reported (Buskirk, 1983; Major et al., 1981; Mech and Rogers, 1977; Raine, 1982; Wynne and Sherburne, 1984). At peak densities in early fall when family groups disperse, there may be 1.2 to 1.9 martens/km^2 (Francis and Stephenson, 1972; Soutiere, 1979). Home range sizes may change with population density, food abundance, and body size (Buskirk, 1983; Soutiere, 1979; Weckwerth and Hawley, 1962). Martens exhibit a common mustelid spatial pattern (Clark, 1984; Powell, 1979); home ranges of adult males overlap home ranges of two to six adult females, and there is intrasexual intolerance.

Weckwerth and Hawley (1962) classified a Montana marten population into residents (present for at least 90 days), temporary residents (present 7 to 90 days), and transients (present less than 7 days). This population was 47% residents, 21% temporary residents, and 32% transients. By use of the same scheme in Wyoming, Clark (1984) found 51% residents, 10% temporary residents, 29% transients, and 10% young-of-the-year.

Horned owls (*Bubo virginianus*), eagles (*Aquila chrysaetos, Haliaeetus leucocephalus*), coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), lynx (*Lynx canadensis*), cougars (*Felis concolor*), and fishers (*Martes pennanti*) are reported as predators. None of these is considered to cause significant impact on marten populations (deVos, 1952; Marshall, 1951*b*; Quick, 1953; Raine, 1981; Williams, 1957).

Competition with fishers and mink is suspected (King, 1983; Powell and Zielinski, 1983). There is a strong suggestion that marten populations fluctuate following changes in density of major prey species (Bulmer, 1974, 1975; Hawley and Newby, 1957) and that a decline of food animals may be followed by a decline in marten survival and reproductive rate (Weckwerth and Hawley, 1962).

Holland (1950) reported martens to host 13 or more species of fleas. DeVos (1952, 1957) found the tick *Ixodes cookei* and the fleas *Monopsyllus vison* and *Megabothrix atrox*. Certain fleas (e.g., *Monopsyllus ciliatus*) on martens carry plague (*Yersinia pestis*), but martens themselves develop resistant antibodies (Zielinski, 1984). Cowan (1955) reported the mite *Listrophorus mustelae* on martens. The helminths *Alaria taxideae, Taenia martis,* and *T. mustelae* were reported to infest martens (Holmes, 1963). R. J. Cawthorn (pers. comm.) and R. C. Anderson (pers. comm.) list *Capillaria* sp., *C. aerophila, Physoloptera* sp., *Uncinaria* sp., *U. stenocephala, Crenosoma* sp., *C. petrowi, Sobolevigyus* sp., and *Ascaris devosi* in Ontario martens. *Trichinella* occurred in 5% of the martens in central Ontario (Dick et al., 1986) and in less than 1% of Manitoba martens (Poole et al., 1983). In central Ontario, 3% of martens were found with *Dioctophyme renale*, 0.5% with the guinea worm (*Dracunculus insignis*), 11% with toxoplasmosis, and 1.4% with Aleutian disease; tests for leptospirosis were negative (Strickland et al., 1982). Martens in central Ontario carry loads of several chemical contaminants (PCB, DDT, mercury; Frank et al., 1979).

Depending on length of season and trapping intensity, young-of-the-year may represent 60 to 80% of the harvest (Strickland et al., 1982). Usually two to three males are taken for each female captured. The larger home range of males and the extensive wandering of the juveniles in search of unoccupied home range make them more likely to encounter traps (Quick, 1956*b*; Yeager, 1950). The predominance of males in the catch also 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).

Trapping limitations are required to prevent overharvest (Strickland and Douglas, 1983). In earlier times when carcasses were poisoned for predator control or furbearer harvesting, martens often were victims. The curiosity of martens draws them to traps, large home ranges make them susceptible to trapping, and low biotic potential makes recovery of numbers slow (Dodds and Martel, 1971). Anthropogenic habitat degradation (land clearing and logging) has been the greatest cause of reduction of habitable marten range (Hagmeier, 1956, 1961).

Exploited populations respond well to management by quota (limited harvest per trapper) and trap spacing, to periodic closed seasons, and to overflows from refuges (deVos, 1951; Quick, 1956*a*; Twining and Hensley, 1947). The animals are readily live-trapped and, in recent years, many successful projects have been undertaken to re-establish populations in areas where extirpation had occurred (Berg, 1982; Davis, 1983).

Habitat management practices that favor martens include maintaining forest diversity through natural processes and human activity, and retaining old-growth spruce-fir communities (Burnett, 1981; Clark, 1984; Koehler et al., 1975). Contiguous optimum habitat of 150 km^2 should be connected to smaller habitat patches by corridors of at least marginal habitat. Clear-cutting should be minimized, and soil, shrub understory, and at least 30% canopy cover should be preserved in selective cutting. Dead standing and leaning trees and snags provide denning and hunting sites for martens and should be retained, in addition to slash piles, downed timber, and other logging debris. Forest managers should preserve known marten den sites. Dispersal from refuges, national parks, and wilderness areas may be important to recolonize or maintain exploited populations (Strickland et al., 1982). The U.S. Forest Service and Canadian Ministries of Natural Resources are developing management and logging guidelines to protect marten habitat.

BEHAVIOR. Martens are active at all seasons (Halvorson, 1961); generally, but not always, they are solitary (Herman and Fuller, 1974).

Courtship may last 15 days during which there is much playing and wrestling (Brassard and Bernard, 1939). During estrus, the female squats and urinates frequently, and rubs her abdominal gland on stones and other objects. Apparently to attract males, she frequently makes a clucking noise entirely different from that made at other times; she may try to mount a passive male (Ashbrook and Hansen, 1930). Copulation usually occurs on the ground. The male restrains the female by biting the hair or skin of her neck behind the ears. The vulva is exposed voluntarily. Matings may last as long as 90 min. Two or three matings may occur between a single pair each day; females may readily accept another male the next day (Markley and Bassett, 1942). Females may have two or more periods of estrus separated by 1 to 2 weeks (Ashbrook and Hanson, 1930). Young are born in a den often located in a hollow tree or log (Gebo, 1975; Hamilton, 1943; Seton, 1929) or rock den (O'Neil, 1980). Wynne (1981) found natal dens in hollow cedar (*Thuja occidentalis*) logs or mature cedars and one in a mature maple (*Acer* sp.); natal dens were in tree cavities before the kits became active but later were moved to ground level. Maternal den selection may reflect the special logistic and energetic requirements of rearing kits (Wynne and Sherburne, 1984). Young eventually travel with the mother until the family group disperses in late summer or early fall (Francis and Stephenson, 1972). Males are not known to assist in rearing young, but their exclusion of other adult males from their own territory may enhance foraging opportunities for females and juveniles resident within that area (Clark, 1984).

On fur farms, martens of opposite sex have been kept together during most of the year, but separation is advisable near the end of the breeding season. Females should not be kept together during the breeding season and females with kits should be isolated (Ashbrook and Hanson, 1930; Markley and Bassett, 1942; Yerbury, 1947). Hawley and Newby (1957) reported aggressive behavior between two wild juvenile males and found many martens with scars and wounds on their heads and shoulders, suggestive of intraspecific strife. A fur grader with the Hudson's Bay Company reported to us the prevalence of scarring on many pelts of male martens that he handled (P. Hall, personal communication). Scarring is not detected except by careful examination because marten pelts usually are marketed fur side out.

Belan et al. (1978) distinguished seven vocalizations along a continuum of sounds, including huffs, pants, chuckles, growls, screams, whines, and "eeps." They noted that their incomplete collection of vocalizations (all made in response to live-trapping and recording procedures) may be supplemented by courtship and mating calls.

During inclement weather, martens may remain in dens (Hauptmann, 1979; Lensink, 1953; More, 1978). If martens become wet in cold weather, as when unusual winter rain occurs during a live-trapping operation, high mortality will occur. Resting sites and dens have been found in hollows in trees, on large branches (Masters, 1980), in hollow logs and stumps (Marshall, 1951*b*), in ground burrows, rock piles, and crevices (Mech and Rogers, 1977), in excavations at the roots of trees, on a brushy slope (Soper, 1970), and in a crevice of a granite outcrop (O'Neil, 1980). Winter resting sites beneath the snow in natural cavities, under stumps and snags, and in bulldozed debris may have thermoregulatory significance (Hauptmann, 1979; Raine, 1983; Steventon, 1979). Buskirk (1983) found resting sites in active squirrel middens. Wynne (1981) reported them in "witches brooms" and declared dead and declining trees to be essential to martens. Large, highly decayed fir snags were most used as resting sites in both summer and winter in California (Spencer et al., 1983).

More (1978) reported activity periods in early morning and evening during summer and in morning during winter. Markley and Bassett (1942) reported martens to be crepuscular throughout the year, whereas Marshall (1942) reported them as nocturnal during winter; Remington (1952) also noted their nocturnal activity. All authors agreed that activity was greater in summer than in winter. Zielinski et al. (1983) related the greater nocturnal activity in winter and diurnal activity in summer to the active periods of their primary prey in those seasons—hares, flying squirrels, and mice in winter, and ground squirrels (*Spermophilus* sp.) and chipmunks in summer.

While traveling and foraging, martens cross and recross their own tracks to investigate areas that might contain food, such as stumps, holes, and brush piles; they often use fallen trees as runways. They often forage beneath snow, tunneling down next to logs and stumps (Francis and Stephenson, 1972; Hauptmann, 1979; Koehler et al., 1975; Marshall, 1951*b*; Raine, 1981). Large foot size relative to body mass permits martens to travel on the surface of soft snow (More, 1978; Raine, 1983). Martens are not hindered as much by soft snow as are fishers (Raine, 1981).

The usual gate is a bound or gallop, but when they carefully examine an area, they walk (Raine, 1983). Tracks can provide an index of marten use of areas (Koehler et al., 1975). The usual track pattern is a typical mustelid "twin-print." Single tracks, with four and sometimes five toes showing, measure about 4.5 cm wide by 4.5 cm long on a hard surface, 5 cm wide by 8 cm long in soft snow. The twin-print in snow may be 10 cm wide and up to 15 cm long. Interstride distances in bounding range from 25 to 100 cm (Halfpenny, 1986; Murie, 1974). Body impressions may appear in the snow associated with tracks when martens leap from trees. Fecal droppings are similar to those of mink and weasels, and may be distinguished from those species by evidence of berries and nuts in season (Murie, 1974).

The method used by martens to restrain captured prey is not reported, but likely they follow a typical weasel pattern; the prey probably is enwrapped by the body and held by the teeth, feet, and claws (Ewer, 1973; Powell, 1982). The kill is likely accomplished by biting the neck (Remington, 1952). Spencer and Zielinski (1983) also reported that martens use the neck bite, but told of a marten subduing a ground squirrel by clamping the thorax with its jaws.

Great arboreal expertise and agility has led to anecdotal reports that martens primarily are arboreal hunters. However, most investigators found that they travel and hunt mostly on the ground (Raine, 1981; Zielinski et al., 1983). Although they are not known to forage in aquatic habitats, martens do not hesitate to swim across a lake or stream (Mech and Rogers, 1977).

Fitting martens with radio-transmitting collars usually requires immobilization. Ketamine hydrochloride injected intramuscularly in the thigh at 10 mg/kg often is used (Burnett, 1981; Ramsden et al., 1976). The martens usually recover within an hour. Martens also have been anesthetized for 1 to 3.5 h with multiple doses of sodium pentobarbital to avoid overdoses; the initial doses were 30–35 mg/kg (More, 1977).

GENETICS. The diploid chromosome number is 38 (Wurster and Benirschke, 1968). No electrophoretic data or reports of albinos or melanistic forms were found.

REMARKS. The four Holarctic marten species replace each other geographically and show many similarities in morphology, habits, and habitat. Hagmeier (1961) thought that the four species might be regarded as a single circumboreal species, and Anderson (1970) considered them a "superspecies." Youngman (1975), noting the relatively long time that populations of *M. zibellina* and *M. americana* have been separated by the Bering Strait, recognized them as distinct species. We follow the same classification and, in this account, treat only the New World forms.

Merriam (1890) observed cranial differences between the eastern and west coast populations and called the latter *M. caurina*. Wright (1953) showed that intergradation was occurring between the two populations and reduced *M. caurina* to subspecific rank. The "americana" subspecies group is characterized by relatively high narrow skulls, long narrow auditory bullae, and small upper molars (Hagmeier, 1961). The "caurina" subspecies group has relatively low, broad skulls, short broad auditory bullae, and larger upper molars (Anderson, 1970; Hagmeier, 1961).

The marten played an important part in the history of the North American fur trade (Innis, 1962), representing a large return to the trapper compared to the effort expended in its capture, preparation, and transport. Throughout most of the currently occupied range, American marten populations and harvests have increased greatly in recent years (Strickland et al., 1982). The International Union for Conservation of Nature and Natural Resources Mammal Red Data Book (1982) does not assign special status to the American marten.

In the fur trade, the American marten is commonly known as the American or Canadian sable. Some authors use the common name "pine" marten, but this is an unwarranted use of the common name usually applied to *Martes martes*; thus, we prefer the name "American marten." The marten's Indian name "wabachis" translates as "rabbit chaser."

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TIM W. CLARK, DEPARTMENT OF BIOLOGICAL SCIENCES, IDAHO STATE UNIVERSITY, POCATELLO, IDAHO 83209; ELAINE ANDERSON, 730 MAGNOLIA STREET, DENVER, COLORADO 80220; CARMAN DOUGLAS, BOX 289, PORT SYDNEY, ONTARIO P0B 1L0, CANADA; MARJORIE STRICKLAND, ONTARIO MINISTRY OF NATURAL RESOURCES, ALGONQUIN REGION, 7 BAY STREET, PARRY SOUND, ONTARIO P2A 1S4, CANADA.