DIET OF FISHERS (*MARTES PENNANTI*) AT THE SOUTHERNMOST EXTENT OF THEIR RANGE

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Fishers (*Martes pennanti*) in the mountains of California's Sierra Nevada occur at the southwestern margin of their distribution and inhabit different forest types with different potential prey than elsewhere in their range. Two typical fisher prey, the snowshoe hare (*Lepus americanus*) and the porcupine (*Erethizon dorsatum*), are absent from our Sierra Nevada study area. We characterized the diet of fishers in the southern Sierra Nevada by analyzing the content of 201 feces (44 males: 157 females) collected either from trapped animals or from the rest sites of radio-collared animals. Mammals were the most frequent food item; however, unlike previous reports, reptiles (20.4% of feces) and insects (55.7%) were major components of the diet. We also sampled 24 feces for the presence of spores of hypogeous fungi (false truffles) and found that 91.7% had spores representing at least six fungal species. Diversity of the diet was indicated by the fact that remains of no single family of animal or plant group were found in >22% of feces. The fisher is reputed to be a habitat specialist in the late-seral mixed conifer-deciduous forests of the western United States. Perhaps it is for this reason that our data depict the species as a dietary generalist, for whom it may be necessary to forage on many of the animal, plant, and fungal species that occur in and near mature coniferous habitat.

Key words: *Martes pennanti,* fisher, diet, food habits, fecal analysis, Sierra Nevada, California

The fisher (*Martes pennanti*) is a relatively uncommon carnivore in the conifer and mixed conifer-deciduous forests of North America. Historically, it occurred from the northern Atlantic coast through the Appalachian Mountains, across the upper Midwest and southern Canada and south into the western mountains (Gibilisco, 1994; Powell and Zielinski, 1994). The ecology of the fisher is best understood in the eastern United States where it occurs in a variety of forest types and has rebounded from overtrapping and loss of forest habitat and has reoccupied much of its former range (Baker and Longley, 1966; Brander and Books, 1973; Gibilisco, 1994). In western forests where the conservation of fishers currently is a concern (Powell and Zielinski, 1994), they occur primarily in late-successional conifer forests but also use younger stands, especially as foraging habitat (Buck et al., 1994; Buskirk and Powell, 1994; Jones, 1991; Powell and Zielinski, 1994; Rosenberg and Raphael, 1986; Weir, 1995).

Most of the information of the diet of fishers comes from studies in eastern North America (Martin, 1994). Only one study is published from California (the contents of eight stomachs-Grenfell and Fasenfest,

1979) and several studies have reported the food habits of reintroduced (Jones, 1991; Roy, 1991) and native (Weir, 1995) populations of fishers in the Rocky Mountains. Virtually no information is available on the diet of fishers in the Pacific states. Our study population in the Sierra Nevada Mountains is unique in that in addition to being one of the westernmost and southernmost populations of fishers in North America, it also is a region where two prey species most commonly eaten by fishers elsewhere, the snowshoe hare (*Lepus Americanus*) and the porcupine (*Erithezon dorsatum*), are absent. Furthermore, understanding the diet of fishers in the southern Sierra Nevada has acute conservation importance because this population is isolated by >400 km from the nearest population to the north (Zielinski et al., 1995).

Like many other carnivores, fishers probably exploit foods that are temporally ephemeral, spatially patchy, and difficult to capture and subdue. Fishers switch prey in response to availability (Kuehn, 1989; Powell and Brander, 1977), and across their geographic range they have a relatively diverse diet (Martin, 1994). Given this lability, the greatest diversity in the diet of fishers should be expected where snowshoe hares and porcupines are absent. Our objective was to describe the diet of fishers in the southern Sierra Nevada, where this condition occurs. This information will help define the range of dietary plasticity in fishers and also will inform us of the prey species and the habitat that may be necessary to conserve populations of fishers in California.

MATERIALS AND METHODS

Study area.-We collected feces as part of a 3-year study of the habitat ecology of fishers in the southern Sierra Nevada Mountains of California. The 250-km= study area was located in Tulare Co. in the watershed of the Middle Fork of the Tule River on land administered primarily by the 1ule River Ranger District of the Sequoia National Forest, Mountain Home Demonstration State Forest (California Department of Forestry and Fire Protection), and the Tule River Indian Reservation. Elevations range from 700 m to >3,000 m above mean sea level at the crest of the Sierra Nevada.

Plant communities range from mixed chaparral (composed largely of *Adenostema, Cercocarpus, Arctostaphylos, Ceanothus*) in the lower and drier elevations to true fir forests (*Abies concolor* and *A. magnifica*) and wet meadow at higher elevations. With increasing elevation and moisture, the chaparral community was replaced first by montane hardwood forest dominated by canyon live oak (*Quercus chrysolepis*) and California black oak (*Q. kelloggi*) and then by ponderosa pine (*Pinus ponderosa*) and mixed coniferous forest. The latter was characterized by a dense canopy of several conifer species (i.e., white fir, incense cedar, *Calocedrus decurrens,* sugar pine, *Pinus lambertiana,* ponderosa pine, and giant sequoia, *Sequoiadendron giganteum*), and an often dense understory of black oak and shade-tolerant conifers. Timber harvest primarily has been by individual selection of the largest diameter trees, particularly pines. Clearcutting was not common in the southern part of the Sierra Nevada (McKelvey and Johnston, 1992).

The closest weather station for temperature and precipitation was at Grant Grove in Sequoia-Kings Canyon National Park (elevation ca. 2,000 m, 40 km to the north), where information was available for 1965-1994 (National Oceanic and Atmospheric Association, Washington, D.C.). Mean minimum and maximum temperatures over this period for winter (1 November-30 April) were 2.7°C and 7.6°C, respectively, and for summer (1 May-31 October) were 7.4°C and 19.3°C, respectively. Mean annual precipitation was 104.9 cm. Mean snow depth on April 1 (1937-1983) at Mountain Home Demonstration State Forest headquarters (elevation ca. 2,000 m) was 57.7 cm (California Department of Water Resources, 1997).

Fecal collection.-We collected feces from three sources: chemically immobilized fishers, feces on the floors of traps where fishers were confined, and rest sites used by radio-collared individuals. Chicken was used as bait in traps, so remains of prey in feces were not confused with the remains of trap bait. Most feces collected at rest sites were found ≤ 5 m of the rest site, although a minority were collected ≤ 50 m away. In both cases, we assumed that feces were

from the individual that had used the rest site. Prior to analysis, feces were frozen or air-dried and stored at room temperature.

Fecal analysis.-We measured the volume of each feces by the water it displaced in a graduated cylinder. We collected and set aside a small sample from each feces for subsequent analysis for fungal material, due to previous documentation of hypogeous fungi (false truffles) in stomachs of fishers (Grenfell and Fasenfest, 1979). Those samples were stored in ethyl alcohol, and 24 of them (11.9%), 65% from female fishers, were examined, and fungal spores were identified to genus. From each sample, three subsamples were collected, and each was stirred thoroughly, a drop of Melzers reagent was added, and 0.08 ml was placed on a slide for examination at 400×. Twenty-five randomly selected fields of view were selected for analysis from each slide resulting in an index of fungal occurrence for each of 24 feces based on the total of 75 fields of view.

Most dietary analyses required removal of hair, bone, claws, feathers, and other hard parts from the feces for identification. Gamberg and Atkinson (1988) tested two methods for extracting hair and bone from feces. They found that feces that were enclosed in a tight weave nylon mesh and agitated in an automatic washer and dryer (Johnson and Aldred, 1982) lost 21.6% of the hair sample. That was contrasted with only a 2.8% loss when lipids were removed by soxhelet extraction and washing occurred over a sieve (Horwitz, 1980). We omitted the soxhelet extraction but enclosed the feces in nylon mesh and substituted an overnight soaking in soapy tap water and 10 min of hand agitation for the use of the automatic washer and dryer. Any residual fecal matrix was removed by placing the feces on a 500-micron sieve under a stream of tap water.

After a sample was washed, all distinguishable macroscopic components were identified to the finest taxonomic level possible based on available literature and comparison with a voucher collection of hair, scales (for reptiles), and skeletons. All vertebrate remains were assumed to be from species reported to occur in the study area (Ingles, 1965; Jameson and Peters, 1988; Stebbins, 1966). After preliminary identification of skeletal remains using the keys of Glass (1951), Ingles (1965), and Lawlor (1979), we compared all skeletal material to reference skeletons in the collection of the Humboldt State University Vertebrate Museum. Because skeletal remains were quite fragmentary and identifications made to genus or species based only on hard parts usually were made from teeth or claws, considerable effort was made to identify individual guard hairs. We washed and cleaned hair in xylene for 1-24 h (based on thickness of hair) and identified guard hairs using keys to cuticle scale and medulla patterns (Adorjan and Kolenosky, 1969; Mayer, 1952; Moore et al., 1974). A voucher collection of hair from various body locations of each species of mammal found in the study area was created by collecting hair from prepared mammal skins and scales from reptiles preserved in alcohol. We made no attempt to identify birds more specifically than to Class. Seeds or fruit of plants was compared with a collection of seeds gathered in the study area and several keys (Schopmeyer, 1974). All other plant material was grouped together. We did not distinguish life stages (i.e., larvae, pupae, adult) of insect remains.

We represented the contribution of a particular food item in the diet by reporting the percentage of feces in which the item was found. This is identical to what others have referred to as either percentage of feces, frequency of occurrence, or percent occurrence (Kelly, 1991; Martin, 1994; Powell et al., 1997). Although it is preferable to estimate the original biomass of prey represented by fecal remains, this requires the ability to estimate the volumetric proportion of each food item in feces and data from feeding trials to develop correction factors for relative digestibility of items (Kelly, 1991; Reynolds and Aebischer, 1991; Zielinski, 1986). We found it difficult to estimate relative proportion by volume of each item in each fecal sample because: 1) remains varied in their detectability and identifiability, ranging from impossible-to-identify underfur hairs of mammals to distinctive seeds and mammal teeth and 2) the uncertainty that the unidentifiable remains represented the same categories of foods as the identifiable remains (Reynolds and Aebischer, 1991).

Because of unknown digestibilities of different foods that fishers eat, our use of percentage of feces as our index of fisher diet precluded us from quantitative comparisons of the relative importance of food items. Our method overestimated importance of small prey and underes-

TABLE 1.-*Number of feces collected from 26 fishers (16 females, 10 males), analyzed by in dividual and sex. Number of feces examined, 201 (157 females, 44 males).*

Female		Male	
Individual	No. of feces (%)	Individual	No. of feces (%)
02	9 (5.7)	01	10 (22.7)
03	5 (3.2)	05	6 (13.6)
04	13 (8.2)	13	1 (2.3)
06	26 (16.6)	16	9 (20.5)
07	45 (28.7)	17	2 (4.5)
09	3 (1.9)	23	6 (13.6)
10	17 (10.8)	25	1 (2.3)
12	1 (0.6)	26	1 (2.3)
15	1 (0.6)	29	5 (11.4)
18	3 (1.9)	32	3 (6.8)
20	7 (4.5)		
21	11 (7.0)		
24	11 (7.0)		
27	1 (0.6)		
31	2 (1.3)		
33	2 (1.3)		

timated importance of large prey (Floyd et al., 1978; Lockie, 1959; Zielinski, 1986). However, percentage of feces is a basic measure of how common a food item is in the diet (Kelly, 1991) and is comparable with most other studies of the diet of fishers.

RESULTS

Fisher diet.-We analyzed 201 feces (44 from males and 157 from females), representing 26 different individual fishers (10 males and 16 females; Table 1). Most feces (48%) were collected during summer, and the majority (72.1%) were collected either directly from the animal while it was immobilized or <5 m from one of its rest sites (Table 2).

Most food remains were mammalian but a substantial quantity carne from the other terrestrial vertebrate classes, with the exception of the Amphibia (Fig. 1). No fish scales or bones were discovered in our sample. Especially noteworthy among vertebrates was the preponderance of reptiles (especially the alligator lizard, *Elgaria*) in the diet. Their remains were found in 20.4%

TABLE 2. *Distribution of feces (n = 201) by season and location of collection.*

	Feces (%)
Season	
Spring (20 March-20 June)	53 (26.4)
Summer (21 June-21 September)	98 (48.8)
Autumn (22 September-20 December)	26 (12.9)
Winter (21 December-19 March)	24 (11.9)
Location type	
Trap Box	16 (7.9)
Processing	61 (30.3)
Rest Site 1[a]	84 (41.8)
Rest Site 2[b]	16 (7.9)
Rest Site 3[c]	24 (11.9)

[a] Found <5 m from a resting structure verified by telemetry.
[b] Found >5 m but <25 m from a resting structure verified by telemetry.
[c] Found >25 m but <50 m from a resting structure verified by telemetry.

of feces annually and 37.7% of feces collected in spring (20 March-20 June; Table 3). The fact that no single family of animal or plant group was identified in more than ca. 22% of feces attested to the diversity of the annual diet.

Seasonal variation among food groups was not profound. Mammals were consumed during all seasons but as expected, reached their peak in winter when many other groups were unavailable. Although the sample of feces in winter was low (n = 24), results were predictable. Hibernators (*Tamias, Sperntophilus beecheyi,* and rep-

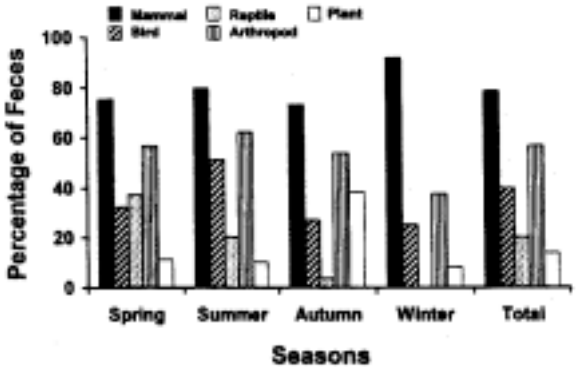

FIG. 1.-Percentage of major taxonomic groups in the diet of fishers in the southern Sierra Nevada from 201 feces that contained a species within the group.

tiles) were absent, presumably because they were inaccessible in their refuges. Frequency of deer (*Odocoileus hemionus,* presumably eaten as carrion) increased from <5% during any other season to 25% in winter and may have compensated partially for the absence of hibernating reptiles and mammals. Although hairs of carnivores were relatively common in feces, most were identified to the genus *Martes* and were assumed to be fisher hair consumed during grooming. Despite their perceived seasonal variation in abundance, remains of insects were found in feces evenly across seasons. Surprisingly, beetles and social wasps were found in ca. 20% of feces collected from 21 December to 19 March. Seasonal variation in remains of fruits was predictable in its occurrence in autumn and winter (Table 3).

Sexual variation in diet was difficult to discern due to the disparity in sample size of feces from each sex. Interpretation was confounded further by differences in proportion of feces collected in different seasons from each sex. For example, 88.9% of feces from summer were collected from females. Despite those problems, a few observations were noteworthy. Although mammals were found in about the same proportion of feces annually (78.3 for females and 84.1 for males), seasonal distribution was quite different (Table 4). For males, 48.6% of feces that contained mammal remains were collected in autumn and winter, but only 19.5% of feces from females with mammal remains were collected during that period. Most mammal remains in feces from females occurred in summer (56.1%), but mammal remains in summer comprised only 24.3% of all feces with mammals for males. Much of this apparent difference was due to more frequent occurrence of rodents (particularly *Peromyscus, Tamiasciurus,* and *Thomomys*) from summer feces of females compared with males. There was a substantially higher incidence of deer remains in feces from males (11.4%) compared with females (1.9%).

Fungal material was ubiquitous in the sample of 24 feces selected for analysis. Twenty-two samples (91.7%) contained spores of hypogeous fungi, representing at least six genera. In decreasing rank order of frequency (number of feces in which they occurred in parentheses) they were: *Melanogaster* (19), *Rhizopogon* (8), a *Genea*-like genera (2), *Balsamia* (1), *Gautieria* (1), and *Hysterangium* (1). Spores of unidentified hypogeous fungi were identified in four feces. Spores usually were quite abundant in each sample. In two feces, *Melonogaster* spores comprised 25-50% of the volume of the sample, and in 15 other fecal samples, spores comprised 5-24%. In two samples, spores were attached to their support structures, the basidia.

DISCUSSION

Martin (1994) reviewed 13 studies of the diets of fishers published through 1991 and found that five foods were reported repeatedly as important components of the diets of fishers in almost all studies: snowshoe hares, porcupines, deer, passerine birds, and vegetation. Powell (1993) summarized a similar set of studies and concluded that snowshoe hare was the most commonly found item in the gastrointestinal tracts and feces. The most recent study of the diet of fishers in the west (Weir, 1995) also reported that snowshoe hare was the most common species of prey, followed by red squirrels (*Tamiasciurus hudsonicus*). Our results are unique in two respects when compared with previous studies. First, the population of fishers we studied occurred outside the geographic range of snowshoe hares, and porcupines have not been reported in the vicinity of the study area for many years (S. Anderson, pers. comm.). Furthermore, other leporids did not compensate for snowshoe hares in the diet of fishers because remains of *Lepus* and *Sylvilagus* were found in < 1 % of feces, yet occurred throughout the study area. Second, reptiles occurred in 20.4% of feces but have been reported infrequently (< 1 % of feces) in the diet of fishers elsewhere (Brown and Will, 1979;

TABLE 3. *Number (percentage of 201 feces or of seasonal total) of feces in which each taxa was found by season. Each taxon listed includes some items identified only to that level of taxonomy as well as all items identified to each subsequent level of taxonomy within that taxon. Spring includes feces collected from 20 March to 20 June, summer from 21 June to 21 September, autumn from 22 September to 20 December, winter from 21 December to 19 March.*

Taxa	Total	Spring	Summer	Autumn	Winter
Mammalia	158 (78.6)	39 (73.6)	77 (78.6)	20 (76.9)	22 (91.7)
Insectivora	9 (4.5)	3 (5.7)	5 (5.1)	1 (3.8)	0
Talpidae					
Scapanus latimanus	4 (2.0)	2 (3.8)	2 (2.0)	0	0
Soricida e					
Sorex	5 (2.5)	1 (1.9)	3 (3.1)	1 (3.8)	0
Lagomorpha					
Leporidae	1 (0.5)	1 (1.9)	0	0	0
(Lepus/Sylvilagus)					
Rodentia	96 (47.8)	21 (39.6)	53 (54.1)	8 (30.8)	14 (58.3)
Scuiridae	41 (20.4)	13 (24.5)	19 (19.4)	4 (15.4)	5 (20.8)
Spermophilus beecheyi	8 (4.0)	3 (5.7)	4 (4.1)	1 (3.8)	0
Sciurus griseus	8 (4.0)	1 (1.9)	4 (4.1)	1 (3.8)	2 (8.3)
Tamiasciurus douglasii	15 (7.5)	6 (11.3)	6 (6.1)	1 (3.8)	2 (3.8)
Tamias	3 (1.5)	0	1 (1.0)	2 (7.7)	0
Glaucomys sabrinus	1 (0.5)	0	1 (1.0)	0	0
Geomyidae					
Thomomys bottae	10 (5.0)	3 (5.7)	6 (6.1)	1 (3.8)	0
Cricetidae	45 (22.4)	8 (15.1)	26 (26.5)	2 (7.7)	10 (41.7)
Neotoma cinerea	1 (0.5)	0	0	1 (3.8)	0
Peromyscus	21 (10.4)	3 (5.7)	16 (16.3)	0	2 (8.3)
Microtus	11 (5.5)	3 (5.7)	5 (5.1)	0	3 (12.5)
Carnivora					
Mustelidae	43 (21.4)	16 (30.2)	15 (15.3)	10 (38.5)	2 (8.3)
Martes	41 (20.4)	15 (28.3)	15 (15.3)	9 (34.6)	2 (8.3)
Mustela	1 (0.5)	1 (1.9)	0	0	0
Spilogale putorius	1 (0.5)	0	0	1 (3.8)	0
Artiodactyla					
Cervidae					
Odocoileus hemionus	8 (4.0)	2 (3.8)	0	0	6 (25.0)
Aves	80 (39.8)	17 (32.1)	50 (51.0)	7 (26.9)	6 (25.0)
Reptilia	41 (20.4)	20 (37.7)	20 (20.4)	1 (3.8)	0
Squamata	31 (15.4)	16 (30.2)	15 (15.3)	0	0
Scincidae					
Eumeces	1 (0.5)	0	1 (1.0)	0	0
Iguanidae-					
Sceloperus	4 (2.0)	1 (1.9)	3 (3.1)	0	0
Anguidae					
Elgaria	24 (11.9)	11 (20.8)	12 (12.2)	1 (3.8)	0
Colubridae/Viperidae	4 (2.0)	4 (7.5)	0	0	0
Insecta	112 (55.7)	28 (52.8)	61 (62.2)	13 (50.0)	10 (41.7)
Orthoptera	5 (2.5)	1 (1.9)	3 (3.1)	1 (3.8)	0
Acrididae	5 (2.5)	1 (1.9)	3 (3.1)	1 (3.8)	0

TABLE 3.-*Continued.*

Taxa	Total	Spring	Summer	Autumn	Winter
Coleoptera	37 (18.4)	12 (22.6)	22 (22.4)	I (3.8)	2 (8.3)
Cicindellidae	1 (0.5)	1 (1.9)	0	0	0
Silphidae	1 (0.5)	0	1 (1.0)	0	0
Neuroptera	1 (0.5)	1 (1.9)	0	0	0
Rhalphidae	1 (0.5)	1 (1.9)	0	0	0
Lepidoptera	2 (1.0)	1 (1.9)	0	0	1 (4.2)
Hymenoptera	45 (22.4)	8 (15.1)	23 (23.5)	10 (38.5)	4 (1.7)
Vesidae/Eumenidae	33 (16.4)	2 (3.8)	19 (19.4)	9 (34.6)	3 (12.5)
Formicidae	5 (2.5)	1 (1.9)	4 (4.1)	0	0
Arachnida					
Acarina	1 (0.5)	1 (1.9)	0	0	0
Planta	41 (20.4)	6 (11.3)	16 (16.3)	14 (53.8)	5 (20.8)
Ericaceae					
Arctostaphy(os	14 (7.0)	0	5 (5.1)	5 (19.2)	4 (16.7)
Grossulariaceae					
Ribes roedii	1 (0.5)	0	1 (1.0)	0	0
Ribes nevadense	3 (1.5)	0	2 (2.0)	1 (3.8)	0
Other					
Egg shell	10 (5.0)	3 (5.7)	6 (6.1)	1 (3.8)	0
Woody debris	33 (16.4)	7 (13.2)	12 (12.2)	6 (23.1)	8 (33.3)
Rock	13 (6.5)	3 (5.7)	5 (5.1)	2 (7.7)	3 (12.5)

Clem, 1975; Giuliano et al., 1989; Kuehn, 1989; Powell et al., 1997). Due to their relatively small size, and therefore relatively high percentage of indigestible matter, lizard remains in feces may overrepresent their importance in the diet. This bias, however, also would occur for most other studies, given that most use the same measurement to represent the importance of a food item in the diet. Reptiles appear to be an important component of the diet of fishers in the Sierra Nevada of California.

The frequent occurrence of hypogeous fungal material in feces of fishers (spores in 91.7% of feces analyzed) is unique to studies of fishers in California. Interestingly, the contents of four of eight stomachs from fishers in northern California contained portions of sporocarps of hypogeous fungi (Grenfell and Fasenfest, 1979). Although these same samples also included remains of western harvest mouse (*Reithrodontomys megalotis*) and deer mouse (*Peromyscus*), one stomach contained 90% false truffle by volume compared to only 10% harvest mouse. Thus, the authors concluded that direct consumption of fungi by fishers was a possibility. The density of fungal spores in the samples we analyzed were considered similar to the density discovered in feces of the northern flying squirrel (*Glaucomys sabrinus*-J. Ditto, pers. comet.), a mycophagus rodent (Waters and Zabel, 1995). This, combined with the occasional observation of the fragile basidial structure, which would be unlikely to survive two gastrointestinal tracts (that of the rodents and fishers), make it difficult to conclude that all fungal remains in feces of fishers originated from gastrointestinal tracts of rodent prey. Because no other researchers have examined feces of fishers for these items, we could not estimate how common this food group may be in diets of fishers elsewhere. Fungi are common food items for a number of vertebrates, especially rodents (Fogel and Trappe, 1978; Hall, 1991; Maser et al., 1978; Tevis, 1953), and given that truffles provide olfactory cues that attract vertebrate consumers that assist in their dispers-

TABLE 4. *Number (percentage of total) of feces containing identified taxa, by sex (Female 157: Male 44) and .reason.*

	Female					Male				
Category	Total	Spring[a]	Summer[b]	Autumn[c]	Winter[d]	Total	Spring[a]	Summer[b]	Autumn[c]	Winter[d]
Mammalia	123 (78.3)	30	69	10	14	37 (84.1)	10	9	10	8
Insectivora	5 (3.2)	1	3	1	0	4 (9.1)	2	1	I	0
Lagomorpha	1 (0.6)	1	0	0	0	0	0	0	0	0
Rodentia	78 (49.7)	18	48	6	6	18 (40.9)	4	3	4	7
Carnivora	26 (16.6)	9	11	4	2	17 (38.6)	6	4	6	1
Artiodactyla	3 (1.9)	0	0	0	3	5 (I 1.4)	2	0	1	2
Aves	67 (42.7)	10	47	5	5	13 (29.5)	7	3	2	1
Reptilia	33 (21.0)	14	18	0	1	9 (20.5)	5	3	1	0
Squamata	33 (21.0)	14	18	0	1	7 (15.9)	5	1	1	0
Insecta	86 (54.8)	21	53	5	7	26 (59.1)	7	8	8	3
Arachnida	1 (0.6)	1	0	0	0	0	0	0	0	0
Planta	30 (19.1)	5	15	6	4	11 (25.0)	1	2	7	1

[a] 20 March-20 June; female, n = 40; male, n = 13.
[b] 21 June-21 September; female, n = 87; male, n = 11.
[c] 22 September-20 December; female, n = 15; male, n = 11.
[d] 21 December-19 March; female, n = 15; male, n = 9.

al, it is not surprising that fishers may detect and consume these fungi. This hypothesis should be tested using laboratory feeding trials.

The preliminary results of another study of the food habits of fishers in northern California (R. Golightly, pers. comm.) suggest a number of similarities to the diet of fishers in our study. Reptiles also comprised a relatively large proportion of the diet and neither snowshoe hares nor porcupines (whose ranges overlapped parts of the study area in northern California but which are not abundant members of the fauna) were more than trace components of the diet. Moles (*Scapanus*), gray squirrels (*Sciurus griseus*), and striped skunks (*Mephitis mephitis*) were important items.

Other carnivores were not an important component of the diet of fishers in the southern Sierra Nevada. There was only one incident each of weasels (*Mustela*) and spotted skunks (*Spilogale gracilis*), although elsewhere other carnivores are not infrequently reported (R. Golightly, pers. comm.; Martin, 1994; Powell, 1993; Powell et al., 1997). Although we could not distinguish hair of martens (*Martes caurina*) from fishers in feces, the incidence of hair of *Martes* was relatively high (ca. 20% of all feces). Martens occurred in our study area and were the subject of a collateral study, but after 3 years of study, we could not confirm any incidence of predation by a fisher on a marten, although circumstantial evidence has been used to suggest that it occurs (de Vos, 1952; Krohn et al., 1997; Raine, 1991). We suspect that most, if not all, of the hair of *Martes* in our samples originated from grooming because the incidence was highest in each of the seasons of molt (28.3% and 34.6% in spring and autumn versus 15.3 and 8.3 in summer and winter). Moreover, hairs of *Martes* were always found individually, never in clumps as is typical of remains of mammalian prey.

It is tempting to conclude that the uniqueness of the diet in California is due to differences in the availability of classic fisher prey-snowshoe hares and porcupines-or geographic differences between eastern and western North America. A recent study of food habitats of fishers in New England (Powell et al., 1997), however, provided one example of the weakness of this conclusion. Gray squirrels (*Sciurus*

carolinensis) and raccoons (*Procyon lotor*) were found in 19% and 12% of feces, but the total incidence in feces of snowshoe hares, porcupines, deer, and passerine birds (taxa that comprised the majority of diets of fishers as concluded by Martin (1994)) was only 18%. These results are consistent with the observation by Powell (1993) of a correlation between low incidence of snowshoe hares and high incidence of the remains of birds, deer, mice and squirrels, and together with our data further distinguish the fisher as an opportunistic predator.

Only limited inference can be made about the habitat of fishers from the habitat of their prey because fishers spend much of their time in habitat other than that where they forage (i.e., resting sites). Despite this shortcoming, much of what is known about habitats of the fisher's prey confirms the limited information available on habitat use by fishers in the western United States (Powell and Zielinski, 1994). Some sciurid prey (*T. douglasii, G. sabrinus, S. griseus, S. beechyi*) are found most commonly in the Sierra Nevada in conifer or oak habitats dominated by medium to large-size trees (Verner and Boss, 1980), a habitat type favored also by fishers in northern California (Buck et al., 1994; Dark, 1997). Furthermore, most of the reptiles and fossorial mammals that are prey of fishers find optimal habitat in deciduous riparian habitats (Verner and Boss, 1980), where fishers also have been reported to spend considerable time (Jones, 1991; Seglund, 1995). Other prey species (e.g., *Peromyscits, Scapanus, Thomomys*) occur frequently in early-seral stages of some of the conifer types, and chaparral provides optimal habitat for some reptiles, lagomorphs, deer mice, and deer (Verner and Boss, 1980) and shrub species that produce fruits that were consumed by fishers. Clearly, fishers include in their diet prey that occur in a variety of habitats, although we have no information on the specific habitat requirements of each prey species in the southern Sierra Nevada, nor their relative abundances.

The diet of fishers in the southern Sierra Nevada of California is substantially different than reported elsewhere. The fisher is an adaptable predator whose diet is a function of the availability, detectability and vulnerability of the prey with which it co-occurs (Grinnell et al., 1937; Powell and Zielinski, 1994). As a reputed habitat specialist, it may be adaptive for fishers to consider many of the other species with which they occur as potential foods. Perhaps this is the reason that fishers are capable of finding, capturing, and eating so many of the species that occur in, or near, late-seral conifer forests in the Sierra Nevada. Fishers in the southern Sierra Nevada also occur in and near habitats that generally are viewed as drier and more heterogenous than elsewhere in their range, which may influence the relative abundances of potential prey and perhaps the diversity of the diet of the fishers. Throughout their range fishers consume a diversity of prey species. This is especially evident in the southern Sierra Nevada, where the community of potential prey are merely one component of the unique ecological circumstances that confront fishers at the southern margin of their geographic range.

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