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HOME RANGE CHARACTERISTICS OF FISHERS IN CALIFORNIA

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The fisher *(Martes pennanti)* is a forest mustelid that historically occurred in California from the mixed conifer forests of the north coast, east to the southern Cascades, and south throughout the Sierra Nevada. Today fishers in California occur only in 2 disjunct populations in the northwestern mountains and the southern Sierra Nevada. We studied the ecology of fishers in both populations (the north coast [Coastal] and southern Sierra Nevada [Sierra]) to characterize the size and composition of their home ranges, and to compare features between locations. Twenty-one (9 Coastal, 12 Sierra) of 46 radiocollared fishers were relocated frequently enough (>20 times) to estimate home ranges. The home ranges of males (X = 3,934.5 ha) were significantly greater than those of females (980.5 ha), and the home ranges of females were significantly greater in the Coastal than in the Sierra area. The smaller home ranges in the Sierra were probably due to productive habitats rich in black oak *(Quercus kelloggii).* Midseral Douglas-fir *(Pseudotsuga menziesii)* and white fir *(Abies concolor)* types composed the greatest proportion (42.8%) of home ranges in the Coastal study area. The greatest proportion of home ranges in the Sierra study area were in the intermediate tree size class (60.7%), had dense canopy closure (66.3%), and were in the Sierran Mixed Conifer type (40.1%). These measures provide guidelines for managers who wish to influence landscape features to resemble occupied fisher habitat. The recovery of fishers in the Pacific States, however, will also require the consideration of microhabitat elements and characteristics of landscapes that might affect metapopulation dynamics.

Key words: California, fisher, home range, *Martes pennanti*

The fisher *(Martes pennants)* has been the subject of very few ecological studies in western North America (Powell and Zielinski 1994). This is a concern because the fisher has been extirpated from extensive regions of its historical range in the Pacific States (Aubry and Lewis 2003; Gibilisco 1994; Powell and Zielinski 1994). In California, the fisher appears to occupy less than half of the range it did in the early part of the 1900s and the population is represented by 2 remnants separated by approximately 400 km (Fig. 1; Zielinski et al. 1995). Fishers are described as 1 of the most habitat-specialized species of mammals in North America (Buskirk and Powell 1994). However, views differ about the fisher's need for extensive tracts of mature, largely conifer-dominated, forest stands. Most researchers working in the western United States emphasize that fishers are associated with extensive mature conifer forests, and that elements of these forests (such as old live trees, snags and large logs) are requirements (e.g., Buck et al. 1994; Hams et al. 1982; Jones 1991; Rosenberg and Raphael 1986; Weir and Harestad 2003; Zielinski et al., in press). In contrast, research in the northeastern and midwestern United States suggests that mid-successional mixed broad-leaved and coniferous forests provide suitable fisher habitat (Arthur et al. 1989b; Buskirk and Powell 1994; Krohn 1994).

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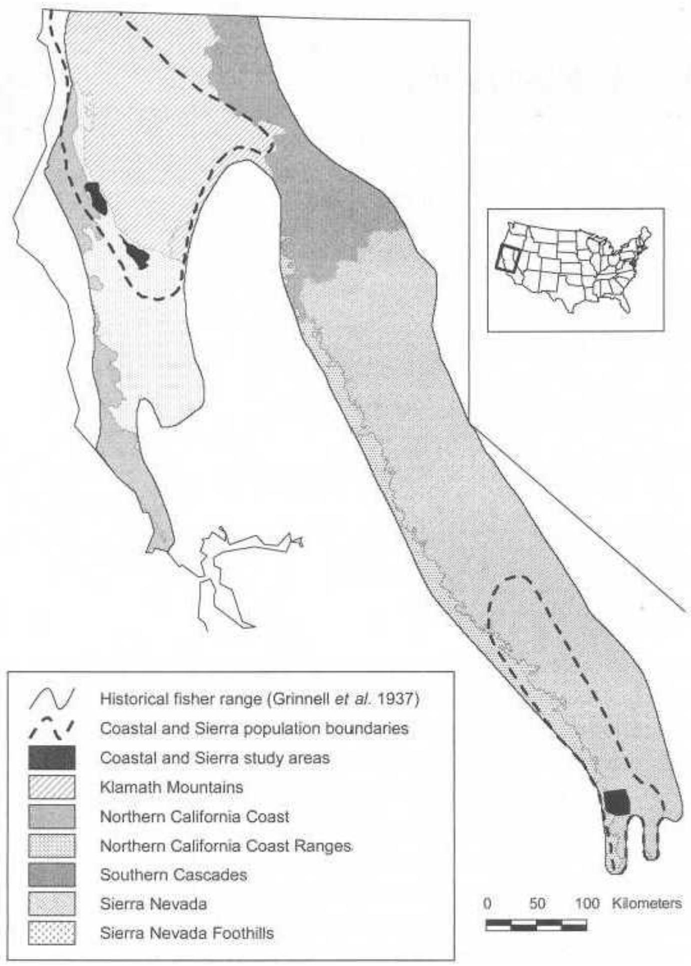

FIG. 1.-North coast (Coastal) and southern Sierra (Sierra) study areas in northern California relative to the approximate boundaries of existing fisher populations and ecological sections (Bailey 1994) within the historical range of the fisher (Grinnell et al. 1937).

The fisher has been petitioned for listing as endangered or threatened under the United States Endangered Species Act on 3 occasions; a decision on the most recent petition found the west coast population (California, Oregon, and Washington) to be warranted for listing as endangered (Federal Register 2004). The population in northwestern California has been the subject of 4 previous studies (Buck et al. 1994; Klug 1996; Seglund 1995; Zielinski et al., in press) but only Buck et al. (1994) collected sufficient data to characterize home ranges for more than a few individuals. Fishers in the southern Sierra Nevada population had not been subjected to intensive study until our work began. This population occupies an environment that differs from the mesic forests of the Pacific Northwest and Rocky Mountains and the wet, hardwood-conifer forests where fishers have been studied in the Lake States (Kohn et al. 1993; Powell 1994) and northeastern North America (Arthur et al. 1989a; Krohn 1994). Fishers in the Sierra Nevada are also at the southernmost extent of their current North American range and, like other species at the periphery of their range, might be genetically or morphologically unique (Lesica and Allendorf 1995). Recent research supports the hypothesis that the fisher population in the southern Sierra Nevada is one of the most genetically depauperate in North America (Drew et al. 2003; Wisely et al., 2004).

Given the paucity of studies on the fisher in the western United States, the history of logging and its potential effect on fisher habitat, and the changing management of the forests of California (United States Department of Agriculture 2001; United States Department of Agriculture and United States Department of Interior 1993) there is an urgent need for new information on the ecology of fishers in California. We assume that fishers in California exhibit the same polygnous mating system described for forest mustelids in general (e.g., Buskirk and Powell 1994; Powell 1979). This system typically leads to intrasexual territoriality and larger home ranges for males than females. We hypothesized that this would be true for fishers in California and we contrast our results on sizes of home range with others studies in western North America. Fishers and the congeneric American marten *(Martes americana)* typically choose home ranges that they occupy from year to year (Arthur et al. 1989b; Phillips et al. 1998). We also characterized the vegetation composition of home ranges for males and females in both California populations to evaluate whether compositions would differ between the sexes. This information will represent a useful tool for those who seek to manage vegetation to mimic the characteristics found in areas occupied by fishers, and also provides a basis for testing hypotheses about sexual difference in habitat use.

MATERIALS AND METHODS

Study areas. The 2 study areas (Fig. 1) shared grossly similar climate and vegetation characteristics. Both are in the Humid Temperate Domain and the Sierran Steppe-Mixed Forest Coniferous Forest Province (Bailey 1994). The southern Sierra (Sierra) study area lies within the Sierra Nevada and the Sierra Nevada Foothills Sections, and the north coast (Coastal) study area is within the Northern California Coast Ranges Section (Bailey 1994). Weather patterns in both areas are typical of California's Mediterranean climate: summers are hot and dry and winters are cool and moist, with precipitation often falling as snow in the higher elevations. Despite these similarities, proximity to the Pacific Ocean and latitude (Fig. 1) have resulted in important differences between the areas. The Coastal study area, located within 50 km of the Pacific Ocean, receives more precipitation; the more southern Sierra study area receives less precipitation, which has produced a landscape with greater heterogeneity.

The Coastal study area is in Humboldt and Trinity Counties on approximately 400 km^2 of the Six Rivers and Shasta-Trinity National Forests. Data were collected from May 1993-September 1997. The study area included 2 subareas: the northern Pilot Creek and the southern Cedar Gap (Fig. 1). Topography in the Pilot Creek area was dominated by South Fork Mountain, a 72-km-long ridge joining the 2 subareas. Elevations ranged from about 600 m to 1,800 m and the area was composed of stands of Douglas-fir *(Pseudotsuga menziesii),* white fir *(Abies concolor),* Oregon white oak *(Quercus garryana),* tanoak *(Lithocarpus densiflora),* red fir *(A. magnifica),* and dry grasslands, with a minor component of California black oak (Q. *kelloggii),* canyon live oak (Q. *chrysolepis),* incense cedar *(Calocedrus decurrens),* and ponderosa pine *(Pinus ponderosa-Jimerson* et al. 1996; United States Department of Agriculture 1995). Mid- and late seral forests, mostly of Douglas-fir and white fir, accounted for 79% of the Pilot Creek subarea. The Cedar Gap subarea included elevations ranging from 850 to 1,800 m. Forest communities consisted primarily of the white fir and Douglas-fir types.

The southern Sierra study occurred on 300 km^2 -in the Sequoia National Forest in Tulare County (Fig. 1). We collected data April 1994-October 1996. Elevations ranged from approximately 800 m in the west-slope foothills to over 3,000 m at the southern Sierra Nevada's Great Western Divide. The primary vegetation types (K. Mayer and B. Laudenslayer, in litt.) were Sierran mixed conifer, ponderosa pine, red fir, montane hardwood, and various chaparral types. Lodgepole pine *(Pinus contorta),* Jeffrey pine *(Pinus* jeffreyi), and grassland and meadow vegetation composed a small part of the area. Terrain was typically steep, although less so than in the younger mountain systems of northwestern California. Individual-tree selection harvest has been the dominant silvicultural technique within the southern Sierra Nevada (McKelvey and Johnson 1992). The landscape was relatively unfragmented by human activities.

Animal capture and handling. Initially we trapped fishers in areas where they had been detected at track plate survey stations (Zielinski and Kucera 1995) and where habitat appeared suitable. We used Tomahawk live traps (model 207, Tomahawk Live Trap Company, Tomahawk, Wisconsin) modified with a plywood cubby box attached to the closed end to provide shelter. We baited traps with chicken and a commercial scent lure (M & M Fur Company, Bridgewater, South Dakota) and checked them daily. We conducted additional trapping to replace failed radiotransmitters or to capture new animals.

We restrained fishers in a metal handling cone and sedated them with a ketamine hydrochloride and diazepam mixture (1 mg diazepam/ 200 mg ketamine; approximately 15-20 mg ketamine/kg body weight). Fishers typically received 0.15-0.20 ml/kg body mass. We fitted them with Telonics transmitters (Mesa, Arizona) model 80 (for females) and model 125 (for males). Capture methods were approved under permit by the California Department of Fish and Game and by the Animal Care and Use Committee at the University of California, Berkeley.

Animal relocation. We attempted to relocate all radiocollared fishers at least once per week by approaching on foot using handheld receivers and antennas (walk-in surveys). We conducted walk-in surveys by following the signal of animals whose transmission indicated they were inactive for at least 30 min. Although most of the relocations were of animals in rest structures, we also included other data that were categorized as either point or nonpoint locations. Point locations consisted of rest sites, natal and maternal den sites, trap sites, active sites (observations of an active animal), and collar and carcass recovery sites. Most of the point locations at the Coastal study area were georeferenced using differentially corrected global positioning system (GPS) receivers (Trimble Navigation Company, Sunnyvale, California). In the Sierra study area approximately 20% of all point locations were georeferenced using GPS; remaining locations were plotted on 1:24,000 scale topographic maps using landscape features and elevation. Data from 20 locations at the Sierra area were mapped using GPS and topographic features to test the accuracy of locations mapped using only topographic features; average (± SD) distance between mapped and GPS locations was 50 m (±42).

Nonpoint locations included stand locations, general locations, remote triangulations, and locations derived from fixed-wing aircraft. Stand and general locations were generated from walk-in surveys that terminated with the conclusion that the observer was within 50 m and within 100 m of the animal, respectively. Because of the success of collecting point locations on the Sierra area we did not locate animals using remote triangulation. In the Coastal area, however, we used triangulation because fishers frequently left their rest sites during walk-in surveys and because of limited access during winter. The locations of receiving stations were determined with GPS and plotted on 1:63,360 scale topographic maps. We took multiple bearings within 15 min and selected the best 3 bearings to estimate each location. Location estimates were generated by the intersection of 2 or more bearings, or by the geometric center of a polygon created by multiple bearings.

We experimentally estimated the telemetry error associated with triangulation (K. Slauson, in litt.). Radiocollars attached to saline-filled plastic bottles were placed in tree hollows at 30 locations within known home ranges. Test transmitter locations were verified using differentially corrected GPS. Four observers, unaware of the transmitter locations, located each test collar using the triangulation method described above. The actual locations were then compared to 6 methods for calculating the estimated location, and the method that resulted in the shortest distance between estimate and true location (Zimmerman and Powell 1995) was used to generate the distribution of error distances. The final location for each point was determined by measuring from the original triangulation location, along a random azimuth, a distance value (m) drawn at random from' the frequency distribution of error distances.

We also conducted radiotracking using fixed-wing aircraft at approximately 1-month intervals. We tested the accuracy of aerial locations by placing transmitters at 22 points throughout the Coastal study area. We determined each final aerial location using an approach similar to that used to represent uncertainty in the triangulation locations. All nonpoint locations were plotted on 1:24,000 scale topographic maps.

Estimation of home range.-We applied a set of criteria to select individual fishers for which we had collected sufficient information to calculate a home range. These focal fishers were those that were monitored continuously for at least 10 months, relocated at a minimum of 10 rest locations, and relocated, using any means, a minimum of 20 times. Final home range estimates for focal animals were calculated for both study areas using 100% minimum convex polygons derived using program CALHOME (Kie et al. 1996).

The estimates of size of home ranges in the Coastal area were less precise than in the Sierra area because home ranges in the former were estimated using significantly more nonpoint locations than in the Sierra study area. To deal with this problem we generated multiple estimates of home ranges for each focal animal in the Coastal area, each using a random selection from the distribution of error distances previously calculated for triangulations and aerial locations, and a random azimuth. This resampling was done for each nonpoint location and resulted in an estimate of the mean and variance for the size of each fisher's home range. Points measured without error (e.g., rest sites) retained the same locations for each iteration during this process. The number of iterations used for each focal fisher was determined by identifying the number that were necessary to stabilize the variance in home range size, ranging from 50-350 per focal fisher.

Vegetation composition of home ranges: The composition of vegetation within home ranges was calculated using existing geographic information system (GIS) vegetation data. In the Coastal study area we used a polygon vegetation coverage developed by the United States Forest Service Ecology Program from interpretation of 1994 aerial photography (Jimerson et al. 1996; United States Department of Agriculture 1995). We aggregated the original set of 19 vegetation series into 5 types (Douglas-fir, True fir *[Abies],* oak-pine, white oak, and grassland) and the original set of 17 seral stage categories and subcategories (Jimerson et al. 1989) into 3: early-, mid-, and late seral. Early-seral included the following categories: shrub-natural, shrub-harvested, shrub-salvaged, pole-natural, pole-harvested, and

TABLE 1.—100% minimum convex polygon estimates of home range size (hectares) for female and male focal fishers at the Coastal and Sierra study areas, California. Different superscripts indicate significant difference ($P < 0.05$) between study areas or sexes.

	Coastal			Sierra		
	n	$\bar{X}$	SE	n	$\bar{X}$	SE
Female	7	1498.2[a]	216.0	8	527.5[b]	65.1
Male	2	5806.5[a]	2958.9	4	2998.4[a]	782.5

pole-salvaged types. Midseral included early mature, early mature-with predominants, early mature-harvest with predominants, and early mature-harvest types. Late-sera] included the late mature, late mature-with harvest, old growth, and old growth-with harvest types.

In the Sierra study area we used a polygon vegetation coverage developed by the United States Department of Agriculture, Forest Service for the Sequoia National Forest (United States Department of Agriculture 1997). This layer was generated using a combination of LANDSAT Thematic Mapper imagery, SPOT imagery and aerial photography, and classifies vegetation from the CALVEG system (Matyas and Parker 1980) to the California Wildlife Habitat Relationship (CWHR) system (K. Mayer and B. Laudenslayer, in litt.). The 11 CWHR vegetation types: 5 CWHR size classes (1 = <2.5, 2 = 2.6-15.2, 3 = 15.3-28.9, 4 = 29.0-61.0, and 5 = 61.0 cm); and 4 CWHR canopy closure classes (Sparse = 10-24, Open = 25-39, Moderate = 40-59, and Dense = 60-100%); were used to estimate the vegetation composition within the home ranges of focal fishers in the Sierra.

The uncertainty in area of home range in the Coastal study area also led to greater uncertainty in estimates of the proportion of each vegetation type within a home range. To consider this, each of the 50-350 home range estimates for each Coastal focal animal was intersected with the vegetation coverage and the proportion of the area in each vegetation type and seral-stage combination was calculated. The sum of the proportions was divided by the number of iterations to estimate the mean proportion (±*SD*) of each class of type and seral-stage combination within each home range.

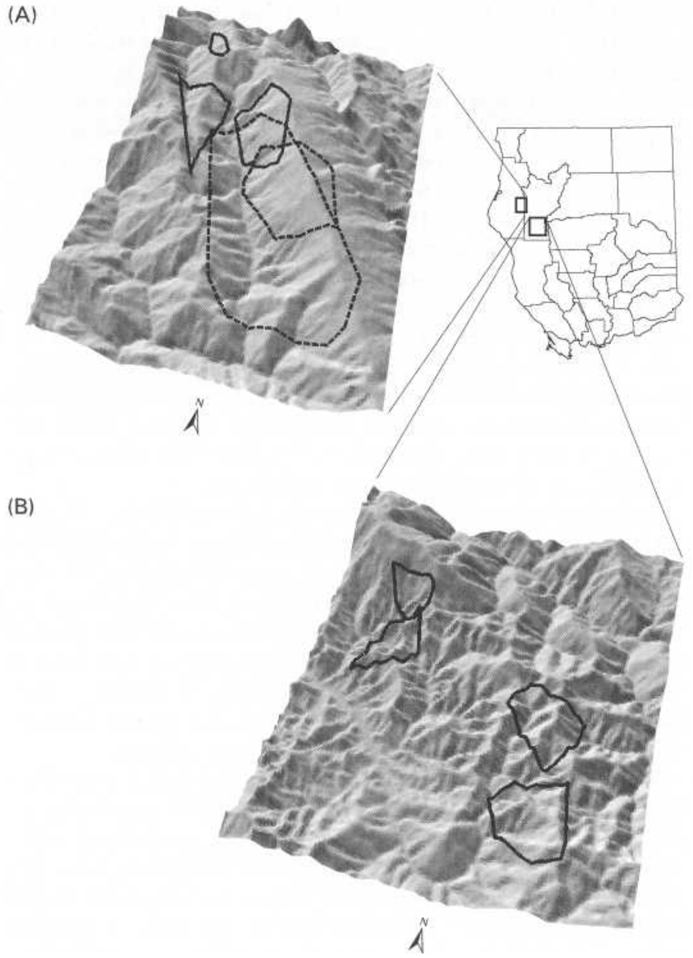

FIG. 2.-Minimum convex polygon estimates (100%) of home ranges for 7 female (solid lines) and 2 male (dotted lines) focal fishers in the Coastal study area at A) Pilot Creek and B) Cedar Gap regions, Humboldt and Trinity counties, northern California. Pixel size is 30 x 30 m and vertical exaggeration of shaded relief is 3 x.

RESULTS

Animal capture and relocation.-We captured 33 fishers (11 males, 22 females) on the Sierra study area and radiocollared 23 of them (8 males, 15 females). We captured 31 fishers (13 males, 18 females) on the Coastal area and we radiocollared 22 of them (8 males, 14 females). Twelve of the radiocollared fishers (4 males, 8 females) on the Sierra study area and 9 on the Coastal study area (2 males, 7 females) met our criteria as focal animals. Rest sites constituted the largest share of the location data, accounting for 42.8% of the data (51% on the Sierra and 33% on the Coastal).

Fishers were relocated throughout the year, although there was a tendency for more frequent relocation during the spring and summer. Only 29 rest sites were located in the Coastal study area during the snow season, compared to 91 in the Sierra study area. A total of 103 remote radiotriangulations were collected (in the Coastal area only), accounting for 22.9% of the locations. The number of locations used to estimate home ranges for focal individuals ranged from 20-91 with a mean of 37.1 locations per male and 46.0 per female.

Size and vegetation composition of home ranges.-Home ranges of males were larger than females ($F = 26.4$, $df. = 1$, $P < 0.0001$; Table 1, Figs. 2, 3) and despite a marginally significant main effect of study area ($F = 3.96$, $df = 1$, $P = 0.063$), the post-hoc comparisons suggested no difference between the sizes of home ranges in the Coastal compared to the Sierra study area ($P > 0.05$). Females, for which data were most numerous, had home ranges on the Coastal study area that were almost 3 times larger than on the Sierra study area ($P < 0.05$; Fig. 2, 3). There was no significant interaction between study area and sex ($F = 2.09$, $df. = 1$, $P = 0.166$).

In the Coastal study area, the midseral-Douglas-fir type composed the largest mean proportion area of the home ranges of focal fishers (24.5%), followed by midseral-true fir (18.3%), and late seral-Douglas-fir (14.0%) (Table 2). Mixed oak-pine type (all seral stages = 5.7%), white oak type (all seral stages = 7.6%), and grassland type (1.5%) were poorly represented. The rank ordering of the proportion of each seral stage and/or type

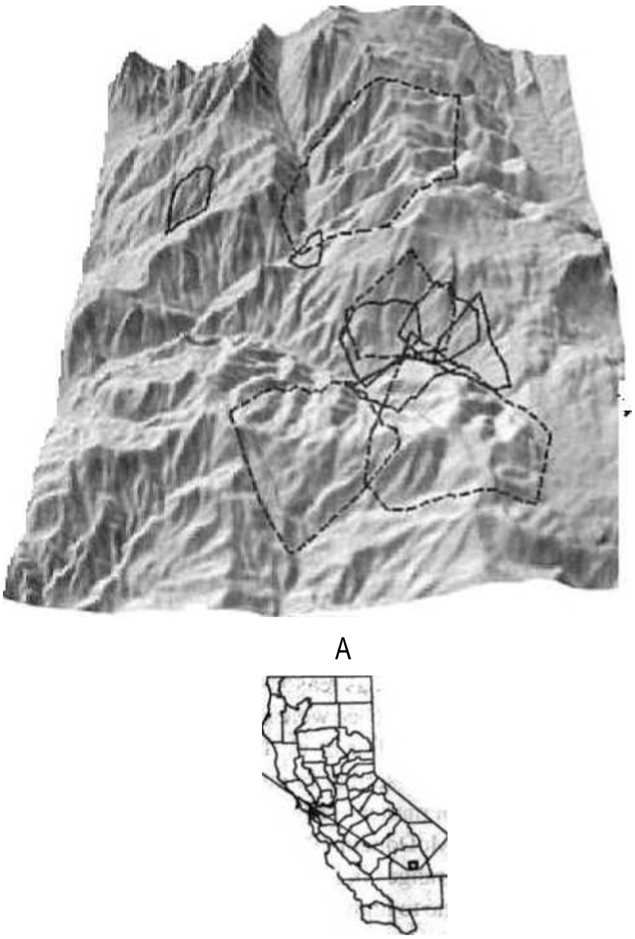

FIG. 3.-Minimum convex polygon estimates (100%) of home ranges for 6 female (solid lines) and 4 male (dotted lines) focal fishers in the Sierra study area, Tulare County, California. Home ranges of only 6 of 8 focal females are plotted due to mortality of 2 monitored females and subsequent monitoring of 2 females whose home ranges encompassed similar portions of the study area. Pixel size is 30 x 30 m and vertical exaggeration of shaded relief is 3 x.

was similar for males and females (Table 2). There were no conspicuous differences between the composition of home ranges of male and female fishers in the Coastal study area (Table 2).

In the Sierra study area the composition of home ranges was characterized by 3 variables: vegetation type, size class, and canopy closure. The Sierran Mixed Conifer type occupied the largest mean proportion area of the home ranges of focal fishers (40.4%), followed by the ponderosa pine type (32.9%), and the montane hardwood type (12.3%; Table 3). *Size* class 4 stands (29.0-61.0 cm dbh) and canopy closure class D stands (60-100% closure) occupied the highest proportion area of the home ranges of focal fishers at 60.7% and 66.3%, respectively. Home ranges of males had more red fir and less ponderosa pine (Table 3). There were no conspicuous differences between the sexes in respect to the proportion of different CWHR size classes of trees within the home ranges. However, home ranges of females included a larger proportion of the densest CWHR canopy closure class (71.7%) 'than home ranges of males

TABLE 2.-Percentage composition of vegetation type and seral stage classes in home ranges of all focal fishers in the Coastal study area, California, and for females (*nn* = 7) and males (*nn* = 2) separately.

	Total		Females		Males	
	Jf	*SD*	*X*	*SD*	*X*	*SD*
Douglas-fir-early-seral	7.23		7.49	4.48	6.32	1.01
Douglas-fir-mid-seral	24.45		25.03	11.06	22.41	5.61
Douglas-fir-late-seral	14.00		15.00	15.22	10.50	2.48
True fir-early-seral	9.61		8.80	8.66	12.45	8.75
True fir-mid-seral	18.30		18.86	10.41	16.33	8.49
True fir-late-seral	13.97		13.80	11.19	14.58	9.16
Oak-Pine-early-seral	1.86		2.46	4.36	0.35	0.23
Oak-Pine-mid-seral	3.85		5.27	4.69	0.32	0.08
Oak-Pine-late-seral	0.03		0.04	0.08	0.003	0.0003
White oak-early-seral	5.07		4.26	4.88	7.10	7.40
White oak-mid-seral	2.51		1.58	1.23	5.79	6.06
White oak-late-seral	0.00		0.00	0.00	0.00	0.00
Grassland	1.48		0.81	0.74	3.81	3.93

(55.6%), which included a more even distribution of closure classes (Table 3).

DISCUSSION

Consistent with previous research (reviewed in Powell and Zielinski 1994), the mean home range of male fishers was significantly greater than that of females. In all previous studies conducted on native populations of fishers in western North

TABLE 3.-Percentage composition of California Wildlife Habitat Relations system types, size classes, and canopy closure classes in home ranges of all focal fishers in the Sierra study area, California, and for females (*nn* = 8) and males (*n n = 4*) separately.

	Total		Female		Male	
	%	*SD*	.	*SD*	*IL*	*SD*
Type						
Sierran Mixed Conifer	40.36	25.43	38.53	29.03	44.02	19.47
Ponderosa Pine	32.94	26.32	40.15	26.89	18.53	20.90
Montane Hardwood	12.27	12.53	13.98	14.65	8.85	7.16
Red Fir	7.30	16.63	0.01	0.04	21.86	24.28
Montane Hardwood Conifer	4.44	3.81	5.73	4.12	1.85	0.40
Montane Chaparral	1.82	1.97	1.16	1.33	3.15	2.56
Barren	0.47	0.87	0.16	0.32	1.09	1.34
Lodgepole Pine	0.21	0.51	0.00	0.00	0.64	0.78
Mixed Chaparral	0.16	0.34	0.24	0.41	0.00	0.00
Urban	0.03	0.09	0.04	0.11	0.00	0.00
Size Class (cm dbh)						
Not determined	2.78	2.62	1.81	1.54	4.72	3.48
1: seedling tree, <2.5 cm	0.30	0.44	0.34	0.52	0.24	0.28
2: sapling tree, 2.6-15.2 cm	1.63	1.66	1.61	1.94	1.67	1.12
3: pole tree, 15.3-28.9 cm	21.84	25.56	22.15	27.81	21.22	24.29
4: small tree, 29.0-61.0 cm	60.68	19.88	61.22	21.04	59.59	20.33
5: medium/large tree, >61.0 cm	12.77	10.93	12.88	13.47	12.56	3.83
Canopy Closure						
X: Not determined	1.44	2.17	0.99	1.57	2.34	3.14
Sparse: 10-24%	1.06	1.27	0.5	0.99	2.18	1.07
Open: 25-39%	5.9	4.46	4.73	3.25	8.22	6.11
Moderate: 40-59%	22.48	8.78	20.26	7.04	26.93	11.3
Dense: 60-100%	66.33	13.81	71.7	9.38	55.59	16.25

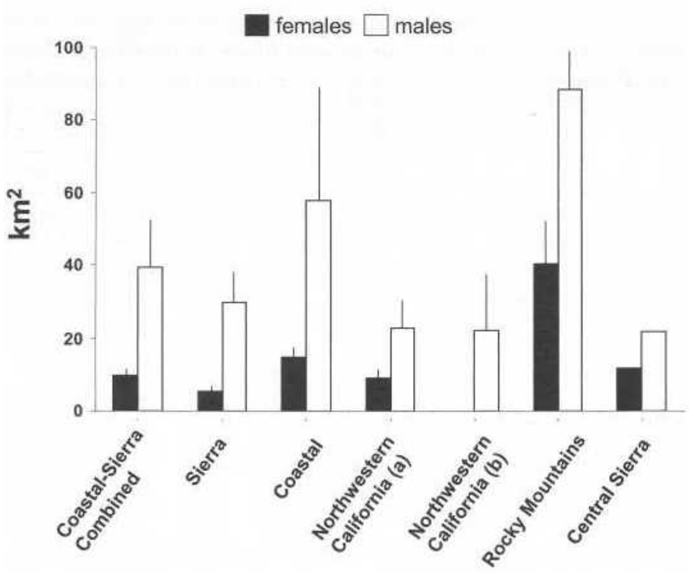

FIG. 4.-Mean estimates of sizes of home ranges (+1 SE), for male and female fishers from studies conducted in western North America. Coastal and Sierra refer to this study; northwestern California (a) from S. Buck et al. (in litt.); northwestern California (b) from Seglund (1995); Rocky Mountains from Jones (1991); and Central Sierra from Mazzoni (2002). All studies involve either native populations or, in the case of Jones (1991), a mixture of native and reintroduced animals studied more than 10 years post reintroduction. Home range values were included only for individuals from each study that were located >20 times. All estimates were minimum convex polygons with the exception of the Rocky Mountain data set, which was based on the 90% harmonic mean. Data necessary to calculate standard errors were not provided for the central Sierra study.

America (Buck et al. 1994; Jones 1991; Mazzoni 2002; Seglund 1995), mean sizes of home ranges of males (including only those fishers with >20 point locations) were at least twice those of females (Fig. 4). In our study, the disparity appeared to be greater, with home ranges of males averaging about 4 times greater than females; the largest difference occurred in the Sierra area.

The lack of statistical difference in sizes of home ranges of males and females in the Coastal area might be due to the relatively small sample of focal males. For this reason, study area effects on home range size are best examined by comparing sizes of female home ranges only. Females had home ranges that were almost 3 times larger in the Coastal than the Sierra study area. We suspect that this is an indication that habitat quality is higher in the southern Sierra Nevada. Black oak is a common constituent of forests occupied by fishers, providing cavities used as rest sites for fishers (Zielinski et al., in press) and acorns used as food by important prey of fishers (Zielinski et al. 1999). The necessity of using different vegetation classifications in each study area makes it difficult to compare the composition of black oak types between study areas. Black oak, however, is found most commonly in the Montane Hardwood and Montane Hardwood Conifer types in the Sierra area and the Oak-Pine type in the Coastal area. These types constitute an average of just 9% of the home ranges of females in the Coastal area, but about 19% in the Sierra. The abundance of this important species in the Sierra might make it possible for female fishers to meet their cover and food needs in a smaller area. The generally lower density of females in the Coastal area (~5/100 km^2) compared to the Sierra area (~8/100 km), grossly estimated by dividing the number of females captured by the area trapped, also supports this conclusion.

Alternatively, home ranges of fishers could be larger in the north than the south because of larger body sizes in the north (consistent with Bergmann's rule-Ricklefs 1979) and, consequently, greater space needs of larger individuals. Females in the Coastal study area weighed more than those in the Sierra ($\bar{X}$ = 2.02 kg compared to 1.93 kg, respectively), but this difference does not appear to be great enough to affect their needs for space. The pattern among studies of fishers in western North America provides some support for the hypothesis that home ranges increase in size with increasing latitude (Fig. 4). However, there are also significant differences in sizes of the home ranges of fishers in 2 study areas that share the same latitude (S. Buck et al., in litt. compared to Coastal area, this study), implicating local factors or sampling variation as reasons for the differences. The home ranges of fishers in Quebec were smaller than those in New Hampshire and Maine (Arthur et al. 1989a; Garant and Crete 1997; Kelly 1977) despite similar latitude. A similar analysis of sizes of home ranges of martens failed to find a relationship with latitude (Buskirk and McDonald 1989). We favor the hypothesis that the smaller home ranges in the Sierra, compared to those in the Coastal area, are due to higher densities in productive habitat space.

The composition analysis reinforced findings of sexual differences previously described for the Sierra area (Zielinski et al., in press). Males included more red fir and less ponderosa pine types in their home ranges than females, which indicates greater use of the higher elevation portions of the study area compared to females. Whether red fir provides some resources for males that females do not use, or the ponderosa pine type is simply preferred by females, is difficult to assess without a formal resource selection analysis (e.g., Manly et al. 1993). We suspect, however, that consistent with sexual differences in microhabitat use (Zielinski et al., in press), females are more selective of habitat features than are males, and they settle predominantly in the more productive, lower-elevation portions of the study area where the ponderosa pine type is most common. Males in the Sierra study area probably include a greater proportion of high-elevation red fir because their interest in females as resources requires them to cross a number of high-elevation ridges to update information on the location and reproductive condition of females. Home ranges of females also include a higher proportion of forest types in the densest canopy class than do the home ranges of males. However, we caution that our analysis cannot distinguish whether it is the proportion or the absolute amount of a forest type that affects the use of a particular area by fishers.

We did not assess home range selection at the landscape scale, but our data on the composition of home ranges is helpful in understanding the vegetation types and structural characteristics (size and canopy) that are contained in areas occupied by fishers. Our data do not permit us to estimate the minimum amount (area) of any vegetation type that is necessary before an area is occupied by fishers.- However, the results provide the 1st information available to managers about proportions of vegetation types associated with areas where home ranges are established. In the Coastal area, for example, there were 3 combinations of vegetational and seral stages that made up the majority of combinations within home ranges: midseral Douglas-fir type made up 14.6-34.3%, midseral true fir type made up 8.7-27.9%, and late seral Douglas-fir type made up 0.4-27.6% (Percentage ranges calculated from X + 1 SD). Thus, the home ranges of fishers in the Coastal area were rarely composed of less than about 15%, or more than 35%, midseral Douglas-fir type. The bounds to the proportions of common vegetation classes were estimated with less uncertainty than uncommon ones, so the mean minus 1 SD is close to 0 for uncommon types. The lower boundary for late-seral Douglas-fir, for example, approached 0, but Coast fishers typically had about 14% (rarely more than 27%) within their home ranges. We hasten to add, however, that these values are not meant to provide thresholds for occupancy of areas by fishers; they are simply descriptions of the areas used by our sample of fishers. Fishers could occupy areas that exceed the values specified here.

In the Sierra area, size class 4 types (29.0-61.0 cm dbh), dense stands (>60% canopy closure), and the Sierra Mixed Conifer type composed the greatest proportion of home ranges. It was rare for home ranges to have less than 15% Sierran Mixed Conifer; less than 5% size class 5, or less than 53% dense stands. It was also rare for home ranges to exceed 3% size class 2 types (2.6-15.2 cm dbh), 10% open canopy closure, or 21% red fir type. Of note is the frequency of hardwood-dominated types in the home ranges in the Sierra. The Montane Hardwood type averaged about 12% of the area of home ranges. The representation of hardwood types in the Sierra of California appears to be greater than anywhere else the fisher has been studied in western North America (Buck et al. 1994; Dark 1997; Jones and Garton 1994; Seglund 1995; Weir and Harestad 1997) with the possible exception of fishers that were reintroduced into aspen parkland habitat in central Alberta (Badry et al. 1997; Proulx et al. 1994). Interestingly, fishers in the southern portion of their range in eastern North America also use hardwood stands more frequently than those in the northern portion of their range (Kilpatrick and Rego 1994), perhaps because hardwoods are generally more common with decreasing latitude.

The upper and lower bounds on proportions of vegetation types characterize landscapes that fishers occupy in each study area. Although these estimates are inferior to spatial habitat models built from empirical data (e.g., Carroll et al. 1999), they provide guidelines for local managers to use when planning for fisher habitat needs and for evaluating the effects of vegetation management on fisher habitat. These should be tested, however, to validate their utility in other regions and to compare the characteristics of home ranges with the general characteristics of landscapes that are available to fishers. We suspect that these guidelines are conservative because it is likely that historical landscapes had higher proportions of late seral vegetation and larger fisher populations than what fishers experience today (Aubry and Lewis 2003; Grinnell et al. 1937).

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