Chapter 4: Fishers and American Martens

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Introduction

Fishers (*Martes pennanti*) and American martens (*M. americana*) are carnivorous mustelids associated with late-successional forests. The distributions of both species have decreased in the Sierra Nevada and southern Cascade region (Zielinski et al. 2005). Fishers occur primarily in lower elevation (3,500 to 7,000 ft) (1067 to 3134 m) Sierran mixed-conifer and ponderosa pine forests, while marten distribution overlaps that of fishers but extends to much higher elevation (4,500 to 10,000 ft) (1372 to 3048 m) red fir and lodgepole pine forests. Fishers and martens have disproportionately large home ranges for their body sizes. Home ranges for male and female fishers average 9,960 ac (4031 ha) and 2,456 ac (994 ha), respectively. Martens have home ranges that average 1,413 ac (572 ha) and 877 ac (355 ha) for males and females, respectively.

Habitat Preferences

Habitat selection occurs at multiple spatial scales. For martens, the strength of habitat selection varies with scale (Minta et al. 1999); selection appears to be strongest at the microhabitat (e.g., resting and denning sites [generally 0.1 to 1 ac] [0.04 to 0.4 ha]) and the landscape scales (> 2,000 ac (809 ha). Fishers are expected to show similar patterns at larger scales, relative to their larger home ranges; however, documentation is lacking. Resting and denning structures are likely the most limiting habitat elements (Martin and Barrett 1991, Porter et al. 2005, Purcell et al. 2009, Spencer et al. 1983, Zielinski et al. 2004), and understanding resting habitat characteristics may be particularly important for conserving both species. The majority of fisher resting sites are cavities or platforms in live trees or snags, whereas martens more often use snags, logs, and stumps (Martin and Barrett 1991, Purcell et al. 2009, Spencer 1987, Zielinski et al. 2004). Trees and snags used as rest sites are typically among the largest available, often >35 in diameter at breast height (d.b.h.) (range 13 to 71 in) (89 cm; range 34 to 180 cm) (Martin and Barrett 1991, Purcell et al. 2009, Spencer 1987, Zielinski et al. 2004). Live trees used by fishers are often of declining health, with resting locations found in cavities caused by heartwood decay or platforms resulting from diseases such as mistletoe and

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Summary of Findings

1. **The distributions of American martens and fishers in the Sierra Nevada and southern Cascade region have decreased, and both species are expected to suffer additional habitat loss under changing climatic conditions.** Habitat selection by both species occurs at multiple spatial scales, ranging from microsite conditions to landscape configuration.

2. **Resting and denning structures are probably the most limiting habitat element for fishers and martens.** Because fishers and martens are nomadic within defined ranges (i.e., they move between rest sites on a daily basis outside the denning season), they require resting structures and resting habitat that are well distributed across the landscape and are sensitive to changes in landscape configuration.

3. **High canopy cover and large trees and snags are important components in both fisher and marten resting habitat.** Results suggest a minimum canopy cover target of approximately 60 percent for fishers and 30 percent for martens. Fishers prefer shade-intolerant species such as oaks and pines while martens use firs and lodgepole pines. Both species select sites characterized by complex vertical and horizontal structure.

4. **Recent findings support recommendations for focusing habitat management for fishers and martens in areas where fire would have burned less frequently historically, such as north-facing slopes, canyon bottoms, and riparian areas.**

5. **Two new analysis tools may be helpful for predicting management impacts on fisher populations.** One tool allows the quantitative evaluation of proposed treatments on fisher resting habitat using FIA data (Zielinski et al. 2006, 2010). A second analysis tool uses growth and disturbance models, combined with landscape trajectory analysis, to provide a visual, intuitive representation of the predicted risk of potential management actions on fisher habitat at the home-range scale (Thompson et al. 2011).

rust brooms. The use of both live trees and snags by these species suggests that, if sufficient numbers of large trees are present over the landscape, requirements for large snags will likely also be met over time (Smith et al. 2005). These findings are consistent with North et al. (2009) regarding the importance of large trees and snags, especially those with defects such as disease or damage. Suitable structures need to be well-distributed throughout their home ranges because reuse of resting sites is typically low. Research shows that fishers prefer to rest in shade-intolerant trees such as pines and oaks (Purcell et al. 2009), which are now less abundant than they were historically (McDonald 1990, Minnich et al. 1995, Roy and Vankat 1999). The North et al. (2009) approach encouraged the retention of oaks and pines, and stressed the importance of hardwoods, especially California black oaks (*Quercus kelloggii* Newberry). Black oaks require openings for regeneration (McDonald 1990), suggesting that the creation of small openings around mature productive trees would aid establishment of young trees needed to replace dying oaks. This should be balanced with retaining smaller trees around oaks that are potential dens for hiding cover. Fishers seldom use oak snags for resting. Most oaks used by fishers are live trees, although dead portions of otherwise healthy trees are important. In the northern Sierra Nevada, martens frequently use large red firs (*Abies magnifica* Andr. Murray), white firs (*Abies concolor* (Gordon & Glend.) Lindley) and lodgepole pines (*Pinus contorta* Douglas ex. Loudon) for resting (Spencer 1987).

Habitat conditions in the immediate vicinity of resting structures (resting sites) are characterized by complex vertical and horizontal structure, dense canopy cover, large trees, and snags (Purcell et al. 2009, Spencer et al. 1983, Zielinski et al. 2004). Canopy cover is consistently the most important variable distinguishing resting sites from available sites for fishers, with results suggesting a minimum canopy cover target of approximately 60 percent (Purcell et al. 2009). Cover is also influential for martens, which generally do not occur in areas where canopy cover is less than 30 percent (Spencer et al. 1983). The typically high diversity of tree sizes surrounding fisher resting sites suggests the need for complex vertical structure, but may be an artifact of past logging practices and fire suppression, which altered forest conditions from stands dominated by large trees and snags to dense stands with size class distributions that include more small stems and fewer large stems (Goforth and Minnich 2008, Minnich et al. 1995). Smaller trees may provide the requisite canopy cover, if a suitably large resting structure is available (Poole et al. 2004, Purcell et al. 2009). The small-diameter tree component of canopy cover may explain why the basal area of small-diameter trees is an important predictor for fisher resting sites (Zielinski et al. 2004).

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Forest Condition and Management Effects

Recent research findings support the validity of the North et al. (2009) recommendations for focusing habitat management for fishers and martens in areas where, historically, fires would have burned less frequently, such as north-facing slopes, canyon bottoms, and riparian areas. Resting sites are often found close to streams and on relatively steep slopes (Bull et al. 2001, Purcell et al. 2009, Zielinski et al. 2004), and fisher telemetry locations include more observations in canyons and fewer observations on ridges than expected (Underwood et al. 2010). Marten habitat typically occurs at elevations where natural fire-return rates are low (e.g., red fir forest) compared to the elevations where fishers occur (McKelvey et al. 1996); consequently, there is generally less need for fuels treatment in marten habitat.

Our knowledge of habitat needs of fishers and martens at larger spatial scales is based largely on studies of martens conducted in other regions. At the landscape scale, martens' preference for mature forest has been well established. Martens rarely occupy landscapes where 25 to 30 percent of mature forests have been removed (Bissonette et al. 1997, Chapin et al. 1998, Hargis et al. 1999, Potvin et al. 1999). In Oregon, Bull et al. (2001) showed that martens preferentially selected unharvested stands compared to stands subjected to regeneration, partial, or selection cuts. Buskirk and Ruggiero (1994) reviewed marten responses to anthropogenic habitat alteration, and found that martens made little use of regenerating clearcuts for several decades after harvest, and that marten populations declined after clearcut logging. Thompson (1994) documented that martens in uncut forests had significantly higher density, survival, and reproduction than in surrounding logged, regenerating forests. These responses may also be occurring in the Sierra Nevada, where a long-term study site in the Tahoe National Forest has documented a significant decline in marten abundance during the last few decades, possibly because of the cumulative effects of timber harvests on forest landscape configuration (e.g., decreases in patch size of mature forest with an increase in interpatch distance) (Moriarty et al. 2011). These studies reinforce the sensitivity of martens, and presumably fishers, to changes in landscape composition and configuration.

At the same time, martens are known to inhabit younger or managed forests as long as some of the structural elements found in older forests remain, particularly those required for resting and denning. In British Columbia, Porter et al. (2005) reported that martens were capable of persisting in a young, manipulated forest as long as structural features characteristic of older forests were retained. On the Lassen National Forest, martens preferentially used shelterwood stands during the summer, when chipmunks and ground squirrels were available in these relatively open areas; however, females showed strong year-round selection for old-growth stands (Ellis 1998). Habitat conditions for martens appear best in old-growth stands, particularly red fir and lodgepole pine in proximity to meadows or riparian areas (Simon 1980, Spencer et al. 1983).

New Analysis Tools

A research need identified in North et al. (2009) was an assessment of proposed treatments on wildlife habitat features of interest. For fisher resting habitat, these predictive models would use either a predictive microhabitat model or a habitat model based on Forest Inventory and Analysis (FIA) data. The effects of forest practices on fisher resting habitat can now be quantitatively evaluated with the development of a model for the southern Sierra Nevada that predicts resting habitat value from plot data (Zielinski et al. 2006, 2010). The model can use FIA data or other types of fixed-area plot data and the Forest Vegetation Simulator (FVS) to forecast future effects of proposed activities on fisher resting habitat. Similar models have not yet been developed for martens.

In general, we still know little about the risks associated with different forest management actions, particularly for fishers. A specific research need identified in North et al. (2009) entailed examination of potential outcomes of proposed forest treatments based on modeling habitat in female fisher home ranges. This shortcoming has been partially addressed through the recent development of an analytical tool that predicts the relative impacts of management actions on fisher habitat (Thompson et al. 2011). Lacking more explicit information, this approach is essentially a form of ecological risk management. We quantified the range of variation in currently occupied female fisher home ranges and assumed that, if we managed landscapes to resemble those occupied home ranges, there is a high likelihood the landscape will remain functional fisher habitat and minimize the risk of negative population impacts. By following the trajectory of the landscape through time, we demonstrate how certain management prescriptions, including “no action,” may involve greater risk to fishers owing to the greater divergence from the reference conditions. Results also indicate that female fishers use landscapes with relatively high proportions of large trees and snags, and where patches of high-quality habitat are connected in a heterogeneous mix of forest ages and conditions. This suggests that some level of management to reduce fire risk may be consistent with the maintenance of landscapes capable of supporting fishers as long as sufficient resting/denning structures are retained. This finding is in agreement with results from other recent efforts that modeled the effects of wildfires and fuels management on fisher

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populations (Scheller et al. 2011, Spencer et al. 2008). These studies found that, although fuels treatments had direct negative effects on habitat suitability, those effects were mitigated by the potential benefits of reducing the likelihood of large wildfires that would eliminate or severely degrade available fisher habitat. This may especially be true if future fire regimes prove to be more extreme than past regimes (Carroll et al., in press; Spencer et al. 2008).

Potential Implications of Climate Change

Climate change is expected to have profound effects on the distributions of animal and plant species. In general, we expect upward shifts in latitude and elevation as warming occurs and species move to areas that suit their metabolic temperature tolerances (Root et al. 2003). Climate change will lead directly to shifts in the abundance and distribution of plant species, which could take decades to centuries to unfold (Davis 1990). Although the potential impacts of climate change have not been evaluated quantitatively in the southern Sierra Nevada, they are likely to alter species and structural composition. Overall, the extent of forested landscape is not expected to change appreciably during the 21st century, but the biggest predicted change is the reduction in area of conifer-dominated forest types, which are generally replaced by mixed woodland and hardwood-dominated forest types. (Lawler et al., in press; Lenihan et al. 2003). Because oaks, especially California black oaks, are a key component of fisher habitat, floristic changes may benefit fishers as long as temperature effects do not result in upward range shifts.

Lawler et al. (in press) recently published a study investigating the possible direct and indirect effects of climate change on selected species of the genus *Martes*. They found that macroclimate conditions closely correlated with Pacific fisher presence in California were likely to change greatly over the next century, resulting in a possibly pronounced loss of suitable habitat. Their results suggested that martens and fishers will be highly sensitive to climate change, and would probably experience the largest climate impacts at their southernmost latitudes (i.e., in the southern Sierra Nevada). The authors noted that fisher habitat is driven to a great extent by mesotopographic and local vegetation features that could not be incorporated into their climatic models. However, since fire occurrence and behavior have substantial effects on local vegetation and these factors are driven to a large extent by climate/weather, they also looked at stand-level implications of fire under a series of future fire scenarios. Lawler et al. (in press) recommended protecting fisher habitat through targeted forest-fuel treatment, and applying more liberal fire-management policies to naturally ignited fires during moderate weather conditions.

Interactions between climate and fire generate further changes in projected vegetation (see Safford et al. this volume). Climate-driven changes in fire regimes are projected to include increases in fire frequency, area, and intensity (Flannigan et al. 2000). Changes in fire regimes are expected to result in loss of late-seral habitat, increasing the probability of local extinction of species—such as fishers and martens—associated with these habitats (McKenzie et al. 2004). Decreases in the density of large conifer and hardwood trees and canopy cover are projected as fire severity increases. As these factors are closely related to fisher rest site and home range use in the southern Sierra Nevada (Purcell et al. 2009; Zielinski et al. 2004, 2005), the expectation is for an overall decrease in the availability of fisher habitat.

Other indirect, complex, interacting, and largely unpredictable effects may also play important roles. Predator-prey relationships may be altered if shifts in prey do not track those of martens and fishers. Reductions in snowpack could alter competitive relationships between martens and fishers, as snow potentially mitigates competitive interactions between the species (Krohn et al. 1997). Increased overlap between martens and fishers is expected to lead to increased competition between the two species, with fishers the likely beneficiary.

For martens, a shift in distribution to higher elevations would drive them toward the limit of forested habitats, which could limit their distribution and lead to decreases in population size. The marten range in the Cascades of California may already be demonstrating such effects (Kirk and Zielinski 2009, Zielinski et al. 2005). At high elevations, martens currently occupy areas with small trees and reduced forest cover (Green 2007), and have also been documented to use boulder fields, talus slopes, and rock slides (Green 2007, Grinnell et al. 1937). While use of these habitats may be more than transitory, they may not provide for year-round habitat needs (Green 2007).

Perhaps the biggest challenge related to climate change lies not simply in the changes per se, but in the rate of increase. Change is expected to occur at a rate and order of magnitude greater than rates of change experienced previously, and beyond the capability of species to adaptation through evolutionary responses (Root and Schneider 1993, Root et al. 2003). Although predictions based on various model projections differ, taken as a whole, martens and fishers are expected to be highly sensitive to climate change.

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Unknowns

At present there is a great deal of uncertainty around predicting impacts on marten and fisher habitat, particularly cumulative effects. This is largely because our knowledge of how habitat change influences survival and reproduction is limited, and because we do not yet understand the importance of landscape heterogeneity to these species. Owing in part to the large home ranges of fishers and martens, multiple spatial scales must be considered in forest management planning. In particular, managers should consider the extent and connectivity of older forest patches, and the heterogeneity and composition of the remaining landscape. For fishers in particular, maintaining habitat in riparian areas and on topographic positions that normally did not burn frequently or severely (North et al. 2009) may help provide connectivity without significantly reducing the effectiveness of fuel reduction efforts. New analytical tools (i.e., Thompson et al. 2011, Zielinski et al. 2010) should be evaluated to assess projected effects at home range and landscape scales.

We still lack important information about reproductive site characteristics for these species, including their requirements for den trees and denning habitat at multiple spatial scales. As suggested in North et al. (2009), one way to help ensure the retention of key forest structures would be to provide a list of attributes and representative photos of resting and denning structures for use by marking crews (fig. 4-1) (see Lofroth et al. 2010 for descriptions of the specific types of structures used by fishers for resting and denning). Because most disturbances in fisher and marten habitat will be the result of treatments to reduce fuels and control forest pathogens, it is important to conduct rigorous studies on the effects of fuel treatments on fishers, martens, and their prey. Also, we know very little about the effects of management activities on important fisher and marten prey species or foraging behavior (Martin 1987). Addressing these information needs will lead to better informed management decisions and a greater likelihood that forest managers can provide the habitat conditions needed to support viable fisher and marten populations.

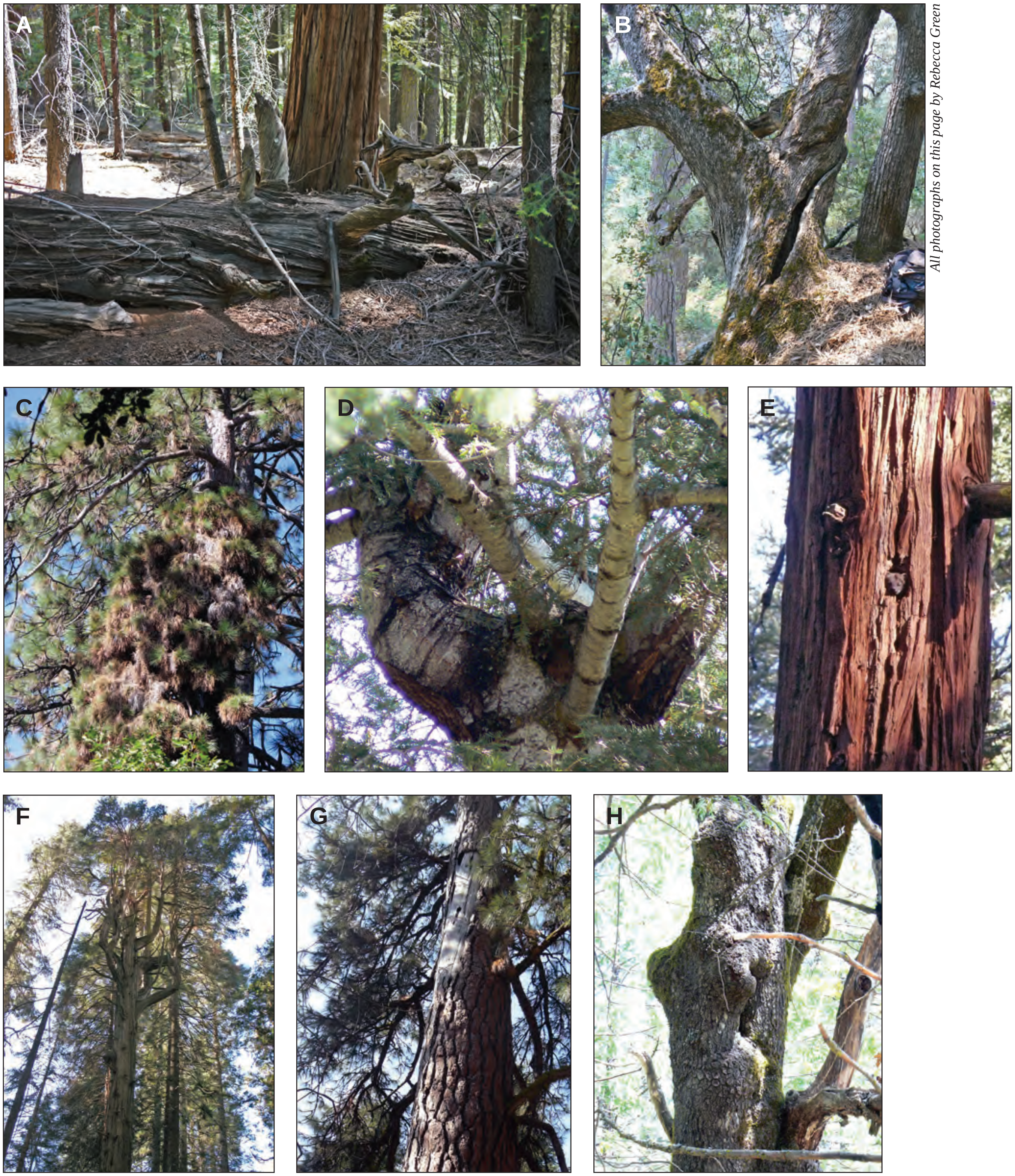

Figure 4-1—Examples of structures used as resting and denning sites by fishers in the Sierra National Forest, California. (A) cedar log (rest), (B) cavity in the base of a black oak (rest), (C) mistletoe broom in a sugar pine (*Pinus lambertiana* Dougl.) (rest), (D) deformity in a white fir (rest), (E) cedar snag with fisher looking out (rest), (F) cedar snag (rest), (G) woodpecker hole in a live ponderosa pine (den), and (H) cavity entrance in a black oak (den).

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