Review and synthesis

Landscape-scale habitat selection by fishers translocated to the Olympic Peninsula of Washington

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ABSTRACT

The fisher was extirpated from much of the Pacific Northwestern United States during the mid- to late-1900s and is now proposed for federal listing as a threatened species in all or part of its west coast range. Following the translocation of 90 fishers from central British Columbia, Canada, to the Olympic Peninsula of Washington State from 2008 to 2010, we investigated the landscape-scale habitat selection of reintroduced fishers across a broad range of forest ages and disturbance histories, providing the first information on habitat relationships of newly reintroduced fishers in coastal coniferous forests in the Pacific Northwest. We developed 17 a priori models to evaluate several habitat-selection hypotheses based on premises of habitat models used to forecast habitat suitability for the reintroduced population. Further, we hypothesized that female fishers, because of their smaller body size than males, greater vulnerability to predation, and specific reproductive requirements, would be more selective than males for mid- to late-seral forest communities, where complex forest structural elements provide secure foraging, resting, and denning sites. We assessed 11 forest structure and landscape characteristics within the home range core-areas used by 19 females and 12 males and within randomly placed pseudo core areas that represented available habitats. We used case-controlled logistic regression to compare the characteristics of used and pseudo core areas and to assess selection by male and female fishers. Females were more selective of core area placement than males. Fifteen of 19 females (79%) and 5 of 12 males (42%) selected core areas within federal lands that encompassed primarily forests with an overstory of mid-sized or large trees. Male fishers exhibited only weak selection for core areas dominated by forests with an overstory of small trees, primarily on land managed for timber production or at high elevations. The amount of natural open area best distinguished the use of core areas between males and females, with females using substantially less natural open area than males. Although sex-specific selection has been suspected for fishers, we identified factors that distinguish the selection of core areas by females from those of males, information which will be valuable to managers planning reintroductions or providing suitable habitat to promote fisher recovery in the Pacific Northwest.

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Contents

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1. Introduction

The fisher is a mid-sized forest carnivore that once occurred broadly throughout boreal and temperate forests of North America, but was extirpated from much of the northern United States and southern Canada during the mid to late 20th century as a result of over-trapping, incidental capture, poaching, incidental mortality through predator-control campaigns, and loss of habitat (Powell, 1993; Powell and Zielinski, 1994; Lewis and Zielinski, 1996; Lewis et al., 2012). These factors contributed to the extirpation of the fisher from Washington State by the mid-1900s (Aubry and Lewis, 2003; Hayes and Lewis, 2006), and its listing as an endangered species in Washington State in 1998. The fisher is also currently proposed for federal listing as a threatened species in all or part of its West Coast range in the United States (western Washington, western Oregon, and California; USFWS, 2014).

From 2008 to 2010 we translocated 90 fishers from British Columbia, Canada, to northwestern Washington State in an effort to restore fishers and enhance the species' conservation status throughout the Pacific Northwest coastal region (Lewis, 2014). Because fishers were extirpated from Washington and much of Oregon by the mid-1900s (Aubry and Lewis, 2003), there was little information beyond museum and trapping records and anecdotal observations as a basis for identifying the most suitable habitats for supporting a reintroduced fisher population in the Pacific Northwest. Consequently, we assessed habitat suitability and identified optimum reintroduction sites in Washington based on resource selection studies from other regions, which suggested low to mid-elevation late-seral forest stands were the highest-quality habitats (Lewis and Hayes, 2004). However, forested environments in coastal Washington, and particularly the Olympic Peninsula, are unique compared to forests elsewhere in the Pacific Northwest due to the protection of large areas of late-seral temperate rainforests within Olympic National Park and Olympic National Forest, the extraordinary productivity and size of trees present in late-seral stands, and the diversity of forest management practices on the peninsula. We examined landscape-scale selection patterns of fishers translocated to Washington's Olympic Peninsula as a basis for refining habitat models for future reintroductions and understanding fisher-habitat relationships in the Pacific Northwest coastal region.

Where their habitat associations have been studied in western North America, fishers commonly prefer low- and mid-elevation landscapes dominated by mid- to late-seral forests with moderate-to-high canopy cover (Buskirk and Powell, 1994; Powell and Zielinski, 1994; Lofroth et al., 2010; Raley et al., 2012; Weir et al., 2012; Aubry et al., 2013), where large woody structures such as large cavity trees, snags, and logs are relatively common features (Hansen et al., 1991; Spies and Franklin, 1991). Forests with moderate-to-high canopy closure are likely to provide: (1) overhead cover and escape cover for fishers (which are good climbers; Powell, 1993), (2) cover for fisher prey, (3) suitable microclimates for den and rest sites (Weir et al., 2004), and (4) a sufficient canopy to intercept snow that would otherwise accumulate in greater depths on the forest floor and potentially impede efficient travel (Krohn et al., 1995, 1997, 2004). Fishers will cross small forest openings to access forest stands within their home ranges, however they will typically avoid large open areas (*e.g.*, wetlands, meadows, agricultural fields, and clearcuts; Buskirk and Powell, 1994; Powell and Zielinski, 1994; Zielinski et al., 2004a). Recent studies suggest that female fishers may be more selective of habitats than males at the home range scale, and at finer scales, as a result of their dependence on woody structures for den sites and greater security requirements than males (Zielinski et al., 2004a,b; Raley et al., 2012), although these relationships remain poorly understood.

Our objectives in this study were to identify forest-structure and landscape characteristics associated with home range establishment by translocated male and female fishers, and determine if landscape-scale habitat selection differed by sex. First we examined the premise of the initial habitat suitability model (Lewis and Hayes, 2004), which was based on the hypothesis that fishers would favor relatively dense, low to mid-elevation (<1300 m, i.e., average upper limit of the Pacific silver fir [*Abies amabilis*] zone) conifer forests dominated by mid- to late-seral forest stages of development (>25 cm quadratic mean diameter [QMDA]), and would avoid open areas (<40% canopy closure) and early-seral stands that lacked complex forest structures associated with denning and resting. Moreover, because developed areas, paved roads, and areas with an abundance of human activity (*e.g.*, campgrounds, off-road vehicle recreation areas, timber harvest units, ski areas) may pose threats to fishers (Naney et al., 2012), we speculated that fishers would likely avoid areas with more paved roads (i.e., more vehicle traffic), where human disturbances were likely to be greatest.

Further, we examined whether translocated fishers exhibited different levels of selectivity that may reflect sex-specific differences in reproductive requirements and body size (Powell, 1993). Because females give birth and raise young in large snags, cavity trees, and down logs, we hypothesized that females would be more selective than males of landscapes dominated by contiguous mid- or late-seral forests, where these structural components of forests are most abundant (Raley et al., 2012). Females are also smaller than males (2–3 kg versus 4–6 kg; Powell, 1993; Lewis et al., 2011), which results in greater vulnerability to predation by other mid-sized carnivores (e.g., bobcats [*Felis rufus*] and coyotes [*Canis latrans*]; Wengert et al., 2013). We therefore hypothesized that this would reinforce their selection for continuous mid- to late-seral forests and avoidance of highly fragmented forest landscapes (e.g., industrial timberlands), where bobcat and coyote densities were likely greatest (Voigt and Berg, 1987; Anderson and Lovallo, 2003). In recognition that resource selection following translocations may reflect social and behavioral factors as well as habitat cues that signal requisite prey and security values (Stamps, 1988; Smith and Peacock, 1990; Stamps and Swaisgood, 2007), we con-