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Comparing the effect of salvage logging on birds in the Mediterranean Basin and the Rocky Mountains: Common patterns, different conservation implications

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ABSTRACT

Postfire salvage logging is currently a controversial issue because of the impact that the removal of snags has on ecosystem structure and function. Although it is a common practice worldwide, the absence of comparisons across regions hinders the development of broad generalizations. Here we compare bird response to postfire salvage logging in two regions with significant differences in landscape and bird communities, the Mediterranean Basin and the Rocky Mountains. The Mediterranean Basin features a landscape dominated by a mosaic of small-sized forests, farmland and shrublands, while the Rocky Mountains have large extensions of continuous forests. Bird conservation priorities are also different. In the Mediterranean Basin, priorities are oriented toward farmland birds, while they are oriented toward fire-specialists in the Rocky Mountains. We used databases describing bird species occurrence in burned forests from both regions and defined three groups of species based on their level of association with snags. We then compared the richness of each group among logged and unlogged sites, and also between regions. We found a higher proportion of species that showed some degree of association with snags in burned forests of the Rocky Mountains than in the Mediterranean Basin. Highly snag-associated birds from both regions showed a common negative response to salvage logging. Not snag-associated species increased in salvaged areas, but only in the Mediterranean Basin. The general negative effect of salvage logging on forest-dwelling species that are associated with trees or snags is a noteworthy pattern given the big differences between regions. Nevertheless, in the Mediterranean, some threatened farmland species benefit from logging, so the overall effect of the removal of snags appears to be relatively more detrimental to birds in the Rocky Mountains.

1. Introduction

Wildfires are a crucial part of the natural dynamics of many forest ecosystems worldwide. Species living in environments that have been repeatedly affected by fire show adaptations to a particular disturbance regime; in some instances, species even appear to have evolved to depend on the presence of relatively intense fire events (Hutto, 2008; Pausas and Keeley, 2009). Wildfire is a natural component of the forest dynamics in most systems, but in areas where forests are managed for wood harvesting, wildfire is usually considered to be a problem because it destroys economically valuable timber. Consequently, the prevailing public perception in many countries is still that wildfires are environmental disasters that have to be avoided, and that burned forests must be "restored" or rehabilitated to re-create "healthy" forests as rapidly as possible (Swanson et al., 2011). This public perception has also led to a level of fire suppression that has affected forest structure and dynamics (Hessburg and Agee, 2003; Pausas et al., 2008), and to current postfire management practices that emphasize salvage logging over a hands-off management strategy. In private forests aimed at timber production, postfire logging allows the landowner to recoup some of the economic losses caused by fire, which seems reasonable given the primary objective of the landowner. In public forests, however, ecological sustainability should be the overarching management goal and, therefore, salvage logging for the sake of mining the economic value tied up in the standing dead timber is not as easily justified. After all, there are values associated with a standing dead forest to consider. Specifically, snags and other coarse woody debris play important roles in the ecosystem after fire, being sources of nutrients and providing habitat to species that need burned forest conditions (McIver and Starr, 2000; Lindenmayer and Noss, 2006). Nevertheless, public land managers tend to couple economic values with a perceived need for "forest restoration" to gain public support for salvage logging operations.

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Salvage logging profoundly affects the process of natural forest succession after fire and can be viewed as a second form of disturbance rather than a restoration activity. The impact of salvage logging on the biota living in burned forests has been studied mostly with birds, which show responses that differ among species (Llimona et al., 1993; Kotliar et al., 2002; Morisette et al., 2002). In general, forest birds are negatively affected by the removal of snags, while early-successional species may benefit from this practice. Interestingly, most studies that have focused on the issue of salvage logging have been developed primarily in conifer forests from two regions: northwestern United States and Canada (e.g. see Saab and Dudley, 1998; Morisette et al., 2002; Hutto, 2008) and, to a lesser extent, the Mediterranean Basin (e.g. Izhaki and Adar, 1997; Rost et al., 2010; Castro et al., 2010). For millennia, wildfires have played (and still play) an important role in the vegetation and landscape dynamics of both regions (Arno et al., 2000; Hessburg and Agee, 2003; Pausas et al., 2008), which also share salvage logging as the most commonly performed management treatment after a conifer forest burns (Lindenmayer and Noss, 2006).

Despite the shared importance of fire and postfire management in these regions, they differ in many important ways, regarding forest management, fire regime, human settlement and land-use histories, and the landscape configuration and composition of their bird communities. Northwestern North American forests have undergone lower human pressure and management intensity than those in the Mediterranean Basin (Hessburg and Agee, 2003), and they harbor a higher number of forest specialist birds, including several fire specialists (Hutto, 2006). In contrast, Mediterranean forests have been deeply modified by humans for centuries (Pausas et al., 2008), and their bird communities are basically composed of species that are widely distributed across most European forests (Blondel and Aronson, 1999). On the other hand, the bird species that have captured most conservationists' concerns and efforts in Europe in recent decades are those from steppes and farmlands because those species have sharply declined due to habitat loss and degradation (BirdLife International, 2004). Some of these species colonize recently burned areas, apparently benefitting from fire (Pons and Bas, 2005; Brotons et al., 2008) and logging (Castro et al., 2010; Rost et al., 2010). Therefore, differences in the avifauna and conservation priorities in different regions need to be considered when assessing the impact of salvage logging on bird communities.

The plant species of both regions show several common adaptations to fire, which reflect the fact that they may have evolved with a long history of fire (Pausas and Keeley, 2009). There are pines with serotinous cones that open and release the seeds in the presence of fire (Aleppo pine (*Pinus halepensis*) in the Mediterranean Basin, Lodgepole pine (*Pinus contorta*) in the Rocky Mountains), there are species with thick bark, high canopy and few low branches that avoid torching, that can survive surface fires (European black pine (*Pinus nigra*) in the Mediterranean Basin, Ponderosa pine (*Pinus ponderosa*) in the Rocky Mountains), and even some species that resprout after being burned (Holm and Cork oaks (*Quercus ilex* and *Quercus suber*) in the Mediterranean Basin, Western larch (*Larix occidentalis*) in the Rocky Mountains).

However, there are fundamental differences in the fire regimes between the two regions. Although most fires occur in the same season (late summer) in both regions, in the western Mediterranean Basin most fires are human-caused, while in northern Rocky Mountains most fires ignite by natural causes (lightning). This is not surprising, given that the population density in Catalonia (about 230 people/km^2) is roughly 50 times that of western Montana. The average fire size is much smaller in the western Mediterranean Basin than in the Rocky Mountains (Table 1), which is partly a consequence of the differences in landscape configuration between the two regions. Most fires in the western Mediterranean Basin are high-severity, stand-replacement fires, which have increased in number in recent decades (Pausas, 2004; González and Pukkala, 2007) due to rural depopulation, farmland abandonment (Pausas et al., 2008), and fire exclusion policies that contributed to increases in fuel loads and forest connectivity. In the northern Rocky Mountains, most fires are mixed-severity fires, and the fire regimes associated with all but the lowest elevation dry forest type are well within what is expected of the natural fire regimes in the region (Arno et al., 2000; Baker, 2009).

The way salvage logging is carried out in both regions also has some particularities that are worth highlighting here. In our study area in Catalonia, 80% of the forests are privately owned, so salvage logging is mainly intended to recoup the economic losses caused by fire. This means that the most usual postfire treatment consists in logging everything except the smallest snags and the trees that were not killed by fire, which results in large clearcuts. Selective logging is rare, and carried out almost entirely on publicly owned forests under the guise of creating a certain level of habitat heterogeneity, sometimes in an experimental way. In contrast, most forests in the northern Rocky Mountains are public and managed by the US Forest Service. There, postfire salvage logging occurs in relatively small patches or management units (which average about 40 ha in extent). Managed burned forests in the northern Rocky Mountains usually consist of a mix of unlogged patches, lightly logged patches, and clearcuts.

In this study, we compare the response of birds from these two distant regions to postfire salvage logging to understand the effects of postfire forest management when placed in different geographical and political contexts. We would expect that birds with similar levels of association with snags would share common responses to the removal of snags in a burned forest. On the other hand, given that there are more forest specialist species in the Rocky Mountains, and that open-habitat appear more threatened than forest species in the Mediterranean Basin, we would also expect that the impact of postfire salvage logging would be more severe in the Rocky Mountains than in the Mediterranean Basin. With these questions in mind, we took advantage of the availability of information on the occurrence of birds in burned areas gathered in Catalonia (Mediterranean Basin) and western Montana (Rocky Mountains), and studied the response of bird guilds from both regions to salvage logging after fire.

Table 1
Summary of the number of burned sites, their average size (in hectares) and the number of samples included in the study for each region (see Appendix A for further information).

Region	Fires	Mean fire size	Sample sizes[a]		
			Total	UL	LG
West Mediterranean Basin	22	648	309 transects	170	139
Northern Rocky Mountains	17	6944	666 point counts	542	124

[a] Postfire treatment: UL, unlogged; LG, logged.