

5.4. Changes in the bird communities of Sierra Nevada

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Abstract

The changes in the composition and abundance of passerine communities were studied along an elevational gradient, comparing the results found by censuses made in three different habitats (oak forest, high-mountain juniper scrublands, and high-mountain summits) at the beginning of the 1980s and at present. The results indicate that in the last 30 years, notable changes have taken place in the composition and, especially, in the abundance of the passerine communities. Significant declines in populations were appreciated in many of the species that were dominant in the 1980s, particularly in oak forests and in high-mountain juniper scrublands. The magnitude of the changes diminishes with elevation, and therefore the ecosystem that has changed the most was the oak woodland and those that changed the least were the ecosystems of the high-summits. The bird communities in Sierra Nevada showed a strong spatio-temporal dynamic that appears to be accentuated by global change.

> Aims and methodology

The censuses of reproductive birds compiled at the beginning of the 1980s and at present (2008-2012) were compared. The sites studied were the same in both periods: an oak forest located at 1700 m.a.s.l., an area of high-mountain juniper scrubland at 2200 m.a.s.l. and the high-summit area, at around 3100 m.a.s.l.. The

censuses were made along linear transects with a fixed bandwidth of 50 m, 25 m on each side of the observer. The sampling effort was similar in both periods. The historical data were compiled by R. Zamora over the first half of the 1980s (oak forests, 1981; high-mountain shrublands 1982, 1985, and 1986; and high-summits 1982

[13 - 17]. The current censuses were undertaken within the framework of the Sierra Nevada Global Change Observatory from 2008 to 2012, during the reproductive period.

> Results

a) Oak forests (1700 m.a.s.l.):

In 1981, 21 species were recorded, while the mean number of species/year recorded in the current period was 18.8±3.7. In the period 2008-2012, a total of 31 species were registered. Out of these, 6 species had not been recorded in 1981: the long-tailed tit (*Aegithalos caudatus*), European crested tit (*Lophophanes cristatus*), black redstart (*Phoenicurus ochuros*), common firecrest (*Regulus ignicapillus*), Eurasian nuthatch (*Sitta europea*), and the subalpine warbler (*Sylvia cantillans*). On the other hand, 3 species, despite being located frequently in 1981, currently have not been cited in any of the

censuses: European goldfinch (*Carduelis carduelis*), Eurasian golden oriole (*Oriolus oriolus*), and European green woodpecker (*Picus viridis*). Consequently, the turnover rate is 37.9 %.

In oak forest the bird density in 1981 was 108.1 birds/10 ha, whereas in the current period was 37.5 birds/10 ha. This was due primarily to the regression of dominant species in 1981, especially the Eurasian blue tit (*Cyanistes caeruleus*), the Western Bonelli's warbler (*Phylloscopus Bonelli*), Eurasian jay (*Garrulus glandarius*), and common blackbird (*Turdus merula*).

b) High-mountain shrubland (2200 m.a.s.l.):

No major changes were detected in diversity (1982, 1984 and 1985: 9.7±1.5 species/year and 2008-2012: 9.4±1.1 species/year). In total, 9 species common to both periods were detected, with a community turnover rate of 29,1 %. One of the most notable changes was the appearance of the European stonechat (*Saxicola rubicola*), which was not detected in the 1980s but is currently a common bird. Also striking was the replacement of the common whitethroat (*Sylvia communis*) by the spectacled warbler (*Sylvia conspicillata*). Species such as the woodlark (*Lullula arborea*), the Thekla lark (*Galerida*

thecklae) or dunnock (*Prunella modularis*) were detected in current censuses but not 30 years ago. The density of bird populations declined from 30.2 birds/10 ha in the 1980s to 10.5 /10 ha at present. The abundance of a key species of these ecosystems such as the wheatear (*Oenanthe oenanthe*) drastically descended from 10.1 birds/10 ha in the 1980s to 2.3 birds/10 ha at present.

c) High summits (3100 m.a.s.l.):

These ecosystems, characterized by a restricted phenological window and a low bird diversity have undergone a certain net gain in species during the last three decades. In 1982, 3 species were located while currently the total number is 5 (4 ± 0.8 species/year). The turnover rate in this period was 13.4 % and, in contrast to the other two locations studied, the density in-

creased from 4 to 4.9 birds/10 ha. The common linnet (*Carduelis cannabina*) appeared to be reproductive, while the black redstart increased in the summit ecosystems of Sierra Nevada. The Alpine accentor became rare during this 30-year period.

> Discussion and conclusions

The two main drivers of global change in Sierra Nevada are climate change and the land-use changes. The climate change for the study period (1981-1986 vs. 2008-2012) consisted of a rise in the temperature of 0.105°C annual (see Chapter 1). The precipitation patterns, on the other hand, are irregular and follow a non-consistent trend. In the low and medium areas,

changes in land-use in the last few decades have led to the expansion and densification of forests and shrublands. Overall, these changes in climate and in land use alone do not appear to explain the substantial alterations in the bird communities over the last 30 years. Despite that the diversity values have not greatly changed, a decline has been confirmed in the density of the

species that were dominant in the 1980s, such as the wheatear in the juniper high-mountain shrublands, or the Eurasian blue tit in the oak forests. A high rate of turnover has been found in the species composition of the community (26.8 % on average). These results suggest that this uncoupling between environmental changes and changes in the communities are related to

Figure 1

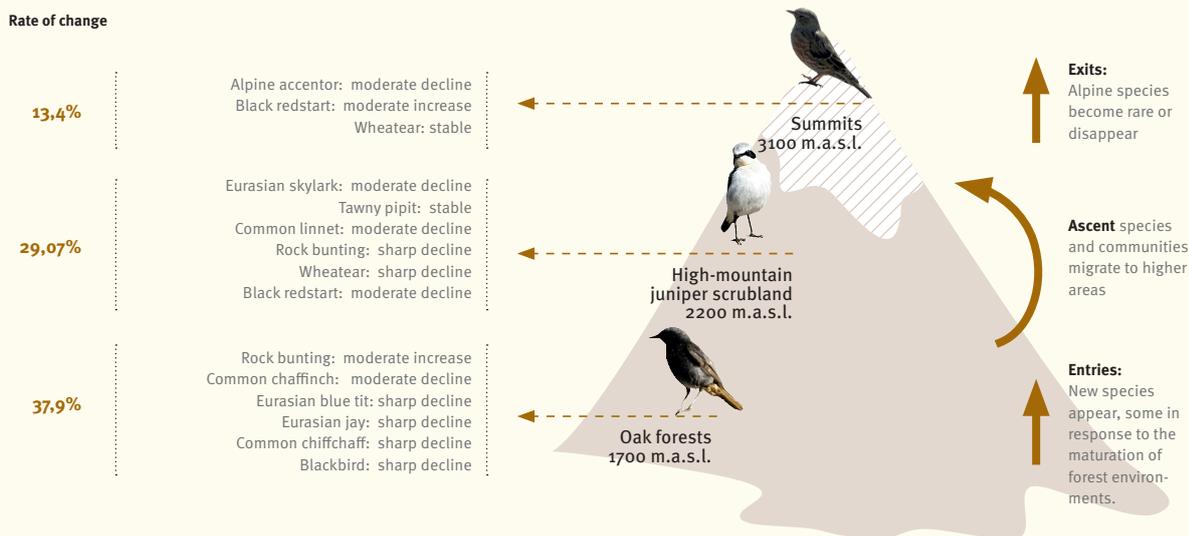


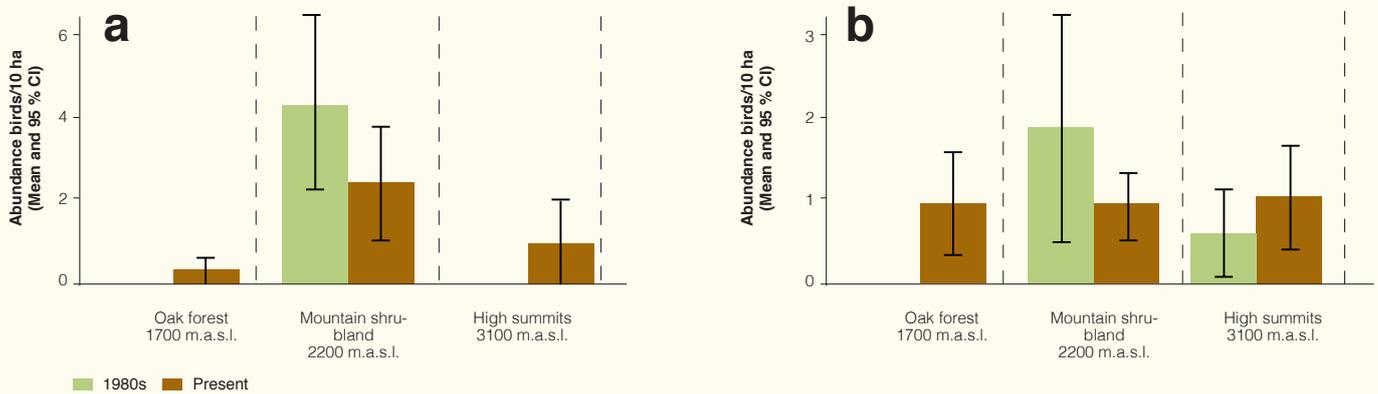
Diagram summarizing the changes found in the high-mountain bird community over the last 30 years over a gradient of elevations and habitats.

the unsaturated character of mountain communities, exposed to constant entries and exits of species. Gradually, the high-mountain bird community of Sierra Nevada is losing its Alpine character and becoming homogenised with the Mediterranean conditions of its surroundings. The clearest example at present is the Alpine

accentor, but hints of this process are also found in the disappearance of other Alpine species that were seen by the first naturalists who visited Sierra Nevada in the 19th century, such as the wallcreeper (*Trychodroma muraria*), the white-winged snowfinch (*Montifringilla nivalis*) or the Alpine chough (*Pyrrhocorax graculus*).

On the contrary, current conditions also offer opportunities for generalist species, such as the black redstart or the common linnet to colonize the high mountain.

Figure 2



Changes in the distribution and abundance of the linnet (a) and black redstart (b) along the altitudinal gradient of Sierra Nevada.



The Alpine accentor (*Prunella collaris*) is the species of nesting bird in Sierra Nevada that is most associated with the Alpine conditions still persisting in the summits of this mountain.