

RESEARCH ARTICLE

Can quarries provide novel conditions for a bird of rocky habitats?

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Highly degraded habitats such as quarries often require active restoration efforts, but classical reclamation practices may undermine the occurrence of species that are locally rare or of conservation concern. We argue that some species can benefit from quarry landform whenever the presence of certain elements in the surroundings is preserved. We uncover the role of quarry landforms as providers of artificial habitat for the establishment of a bird of rocky habitats—the Black Redstart (*Phoenicurus ochruros*). We identified and monitored the location of territories of this species in seven quarries and their surroundings, over an entire breeding season. A multiscale approach was applied in order to take into account optimal spatial scales of response of the species to each habitat descriptor. We found this species mainly associated with quarried areas embedded within an inhospitable landscape. Mean slope, built-up area, and number of habitats were important descriptors for Black Redstart territory location. Black Redstart territories are constrained at two scales. Core areas (0.25 ha) are mainly defined by optimal conditions for nest site location, where inaccessible rocky slopes provide safer places for nesting. At a larger scale (>2.00 ha) territories must enclose other land uses that deliver access to food supplies and offer good display positions to signal the limits of territories, allowing control of possible intruders. Localized actions aiming to maintain novel elements may result in the preservation of species such as the Black Redstart.

Key words: artificial habitat, Black Redstart, green infrastructure, multiscale analysis, novel landscape elements, quarry restoration

Implications for Practice

- Our results show that Black Redstarts' ecological requirements are scale dependent, benefiting from exposed quarry slopes for nesting purposes, and diverse vegetated patches in the vicinity for foraging.
- We recommend practitioners take advantage of novel landscape elements provided by quarries to potentiate rocky habitat species and promote local biodiversity.
- We suggest that preserving novel elements can be regarded as an alternative to restoration practices of degraded sites often involving costly reclamation techniques which may not be biodiversity friendly.

Introduction

The pervasiveness of human-induced impacts in terrestrial ecosystems has led to the emergence of restoration ecology as a key tool to restore and manage damaged ecosystems, as well as to improve policies to preserve species of conservation concern (Hobbs 2007). Anthropogenic disturbance of natural or semi-natural habitats, as a consequence of industrial mineral extraction, generally results in ecologically degraded sites. However, such sites are increasingly attracting the attention of ecologists, and postquarrying restoration processes are being intensively debated (see Prach & Tolvanen 2016 and references therein). This growing interest in degraded sites has been focused on restoration practices and

management purposes (e.g. Wheeler & Cullen 1997; Grant 2006), ecological processes (e.g. ecological succession; Novák & Prach 2003), and experimental approaches to ecological theory (Young et al. 2005). Among these studies, most published research addresses the restoration of vegetation (e.g. Holl 2002; Novák & Prach 2003; Moreno-de las Heras et al. 2008). Evidence regarding the restoration of animal communities, however, remains scarce (Moore et al. 1997; Nichols & Nichols 2003; Fernandes et al. 2018) or mostly retained in gray literature.

As a consequence, many aspects of biodiversity and ecological processes in quarrying areas remain overlooked. For instance, the recognition of the intrinsic value of newly created landscape elements promoted by human intervention has

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