



# All ecosystems look messy, but some more so than others: A case-study on the management and acceptance of Mediterranean urban grasslands



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## ARTICLE INFO

### Article history:

Received 17 July 2014

Received in revised form 23 October 2015

Accepted 17 November 2015

Available online 21 November 2015

### Keywords:

Biotic homogenization

Brownfields

Multitemporal analysis

Urban flora

Urban parks

Wasteland vegetation

## ABSTRACT

The spontaneous revegetation of a disused demolition waste landfill in Rome (Italy) led to a very high vascular plant species density (269 species in 0.2 km<sup>2</sup>). Vegetation was dominated by Mediterranean annual species (Therophytes), and floristic assemblage was consistent with the regional species pool. No significant levels of biotic homogenization were found. Local activists successfully campaigned to save the site from development, which resulted in its designation as an Urban Nature Reserve; however, it was essentially managed as a conventional neighbourhood park. As a consequence, vascular plant species richness decreased by 50%. The functional and biogeographic groups most typical of Mediterranean habitats saw the largest decrease (the steno-Mediterranean element decreased by 80%), leading to biotic homogenization via changes in native species only (no increases in alien species were observed). The removal of most of the old demolition-waste mounds was probably the main cause for these observed changes. These mounds provide well-drained, oligotrophic soils and micro-habitat heterogeneity.

Mediterranean grassland vegetation, especially within urban areas, is often perceived as “untidy” and undesirable by local residents and decision-makers, who tend to overlook or ignore the ecological value of spontaneous grasslands—perhaps distracted by their apparently “messy” aesthetics. Mediterranean urban wastelands that are “saved” with the scope of creating public green spaces are particularly at risk of being inappropriately managed from the ecological perspective. Thus, in dry-climate regions, ecologists should be particularly careful not to dismiss the importance of aesthetic issues and cultural acceptance in urban nature conservation. Considering the results of this case-study, we offer some generalized management guidelines that can help render urban dry grasslands acceptable for recreational use, while at the same time preserving their biodiversity and educational value.

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## Introduction

Within urban landscapes, the remnants of natural vegetation and the secondary plant communities that develop in unused sites may harbour endangered species and high levels of native plant biodiversity (Pickett et al., 2008; Kantsa et al., 2013; Schmidt et al., 2014). The contribution that these habitats make towards biodiversity conservation on the regional and global scale is controversial and probably limited (McKinney, 2002; Battisti and Gippoliti, 2004; Kowarik, 2011; Nielsen et al., 2014). Nevertheless, preserving native biodiversity and natural ecosystems within

urban landscapes is crucial for raising awareness and promoting support for global environmental issues (McKinney, 2002). People are more likely to take or approve conservation actions when they have direct experiences in the natural world, and urban biodiversity provides the only opportunities for such experiences for nearly half of the world's people (Miller, 2005; Dunn et al., 2006; Dearborn and Kark, 2009). Moreover, some studies have suggested that high levels of wild plant biodiversity within cities may increase the psychological benefits gained by green-space users (Fuller et al., 2007; Lindemann-Matthies et al., 2010; but see Dallimer et al., 2012) and may contribute to human well-being in other ways, such as preventing immune dysfunctions (Hanski et al., 2012).

However, in urban green spaces, recreational activities often come into conflict with biodiversity conservation (e.g. Altherr et al., 2007), and aesthetic preference does not always relate positively to ecological quality and/or biodiversity level (Dallimer et al., 2012;

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Qiu et al., 2013). The human population tends to attribute higher value to “formal landscapes” (green areas that are designed and managed, thus requiring high inputs of resources), while the remnants of native vegetation and other “informal” green habitats (such as the secondary plant communities that develop in disused allotments) are considered to be of low value and not perceived to be “safe” by city dwellers and policy-makers (Breuste, 2004; Freeman, 2011; Hofmann et al., 2012; Jansson et al., 2013; Qiu et al., 2013).

Thus, the adopted management decisions and processes concerning natural vegetation remnants and disused spontaneously revegetated sites in urban areas are often more influenced by the perceptions of the general public than based on a scientific approach (Breuste, 2004). Ecological function is not readily recognized by those who do not have the appropriate education (Nassauer, 1995), and even decision-makers can be completely unaware of the ecological differences between a managed garden and a spontaneous plant community (Breuste, 2004; Kopnina, 2013). However, a designed and managed green area requires the input of resources and energy. Thus, although it provides some benefits to the urban environment (e.g. Bolund and Hunhammar, 1999), its creation and maintenance can actually result in a large ecological footprint; this ultimately means that an area of productive land, somewhere else on Earth, is continuously required to produce all the resources consumed and to assimilate all the wastes produced (Rees and Wackernagel, 1996). Instead, a natural plant community is a self-sustained system, which, without requiring artificial inputs, produces ecosystem services (outputs that satisfy the needs of humans and other living species: e.g. de Groot et al., 2002).

The appearances of wild plant communities are often misleading and may be misinterpreted, even by people who are genuinely interested in preserving natural habitats; such misinterpretation may lead such people to incorrect conclusions about the ecological value of wild plant communities (Nassauer, 1992, 1995; Gobster et al., 2007). Unfortunately, the mismanagement of urban undeveloped sites by well-meaning conservationists through the seeding of grasslands or planting of trees can be almost as detrimental to biodiversity as urban development (Kamvasinou, 2011). Even professional ecologists have more frequently focussed on preserving ‘relict’ natural biotopes encaptured by urban growth, while little attention has been paid to the values of secondary vegetation in disused sites of artificial origin (Freeman, 2011; Kowarik, 2011; Rupprecht et al., 2015). Revegetated urban wastelands, however, are potentially of great importance for biodiversity (Bonthoux et al., 2014).

Understanding how to integrate biodiversity and ecosystem services into urban planning and design is a key research goal for the development of urban ecology (Nassauer, 1995; Gobster et al., 2007; James et al., 2009), and local case-studies can help our comprehension of the urban socio-ecological interface on the global scale (Niemelä, 2014). Very few data are available on the importance of management for maintaining biodiversity in informal urban green spaces, and little is known about how different cultural contexts influence these spaces (Rupprecht et al., 2015). These research issues are even more critical in Mediterranean cities. On the one hand, they host a very rich native flora and a low percentage of alien species compared to cities in other biomes (Celesti-Grapow and Blasi, 1998). They also feature a very low degree of floristic homogenization (*sensu* McKinney, 2006), because the strong ecological filtering provided by the summer-dry climate maintains a high degree of similarity with the surrounding natural vegetation (Celesti-Grapow and Blasi, 1998; Filibeck et al., 2012). On the other hand, native Mediterranean ecosystems may look particularly unattractive or even “dirty” to local residents, because of the high percentage of short-lived annual plants (Therophytes) that die off in the summer, and the abundance of thorny

growth-forms (Misgav, 2000; De La Fuente De Val and Mühlhauser, 2014); this is probably also true for other dry-climate regions of the world (Breuste, 2004). The biodiversity drivers and the ecosystem processes of Mediterranean plant communities are particularly counter-intuitive and are easily misunderstood by decision-makers and by the media (Grove and Rackham, 2001). Moreover, the biodiversity patterns of urban wastelands have been mostly studied in humid-temperate ecoregions, while there is a lack of knowledge about the biodiversity of informal green spaces in dry climates (Rupprecht et al., 2015).

The city of Rome, in the Mediterranean biome, features remarkable plant species richness, with 1300 recorded vascular plants in the urban area (Capotorti et al., 2013). The early-successional herbaceous vegetation of fallow lands and wastelands is valued the least by most local people (Bonnes et al., 1989), but it is actually of great floristic importance: approx. 60% of the species in the flora of Rome are found in herbaceous communities only (Fanelli, 2002).

In this paper, we analyze the results of a case-study and investigate the links between biodiversity multitemporal patterns, management decisions and issues pertaining to cultural acceptance. The study site is located in the north-east district of Rome, Italy's capital city. The district is notorious for its lack of green spaces, and as far back as 1975 local residents' associations began a long campaign to ensure that Pratone delle Valli, a privately-owned area of 20 ha, was saved from development and opened to the public (Bonomo, 2007). In 1992, a floristic survey of the site (Cornellini, 1993) found that it featured a surprisingly high diversity of autochthonous species, despite constituting a former demolition-waste landfill.

In 1997, the Regional Government of Lazio designated the site as part of the Aniene River Nature Reserve, a 600-ha urban nature reserve. In the 90s, many undeveloped areas within or around Rome were declared nature reserves, for reasons often disconnected from conservation biology. The regional government needed to establish a network of protected areas to fulfil national requirements and to gain the favour of pro-conservation voters, but in order to avoid opposition from the pro-hunting lobby, areas were selected where hunting was already prohibited, such as in urban and sub-urban landscapes (Battisti and Gippoliti, 2004). Another reason for the surprisingly high density of nature reserves in the suburban sector of Rome probably reflects a fear of local decision-makers that their “ordinary” urban planning tools were at risk of being opposed in courts by the powerful developers' lobby, or that they would be dropped following political changes.

However, even after the nature reserve designation, the site remained a private property, not accessible to the public, until in 2003 the land was bought by Rome City Council. Surprisingly, in spite of the nature reserve status, the municipality then decided that the site needed to be “reclaimed” and “greened” before being made accessible to citizens (Bonomo, 2007). When the project was presented to local stakeholders for consultation, the activists objected that it was “not appropriate for a Nature Reserve” (Anon., 2011). A new project was then presented by city authorities, and the local associations claimed it was now “consistent with both the needs of the local residents and the regulations ruling Nature Reserves” (Anon., 2011). However, the activists' objections probably referred mostly to aesthetic issues, since important ecological issues, such as the value and management of the native plant communities, appear to have been completely ignored by all stakeholders. Thus, the “reclamation” works on the site were aimed at producing a conventional urban park. As pointed out in previous case-studies (De Sousa, 2003; Altherr et al., 2007), extensive community involvement in derelict land reclamation can lead to the emergence of a debate over what type of green space is to be implemented, and local ad-hoc groups will most probably lobby for a conventional green area. However, it is interesting that in

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