Global Ecology and Conservation 4 (2015) 405–413

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Original research article

Regional vegetation change and implications for local conservation: An example from West Cornwall (United Kingdom)

A. Kosanic [a,*], K. Anderson [b], C.H. Frère [c], S. Harrison [a]

[a] College of Life and Environmental Sciences, University of Exeter, Penryn Campus Penryn TR10 9EZ, United Kingdom
[b] College of Life and Environmental Sciences, ESI, University of Exeter, Penryn Campus Penryn TR10 9EZ, United Kingdom
[c] GeneCology Research Centre, University of Sunshine Coast, 90 Sippy Downs Drive, Sippy Downs QLD 4556, Australia

ARTICLE INFO

Article history:
Received 2 April 2015
Received in revised form 26 August 2015
Accepted 26 August 2015
Available online 9 September 2015

Keywords:
Vegetation change
Herbarium records
Regional identity
Local conservation

ABSTRACT

This study tracks local vegetation change in West Cornwall (South West England) within regional context, using historic herbarium (pre-1900) and recent vegetation records (post-1900). The focus centres on species lost from the region over the past century. For this study we used a collection of herbarium records published in 1909 (Davey's "Flora of Cornwall") and contemporary records from the "New Atlas of British and Irish Flora" downloaded from the National Biodiversity Network (NBN), online database. Both data sets were spatially analysed using ArcGIS in order to detect local scale species loss. Our results showed that species loss was highest in the south (11 plant species), compared to the loss from middle areas (6 plant species) and in the northern area (8 plant species) of West Cornwall. Results on species change at the local scale were different to the changes that are happening at the national scale. Loss from West Cornwall was detected for two plant species, Mountain Melick (*Melica nutans*) and Field Eryngo (*Eryngium campestare*). These key results amplify the importance of local scale research and conservation in order to protect ecosystems functioning, genetic diversity, ecosystem services and regional identity.

1. Introduction

Recent climate change has led to changes in the geographical distribution and phenological responses of plant species and in some places, to species extinction (Hannah et al., 2002; Parmesan and Yohe, 2003; Thomas et al., 2004; Thuiller et al., 2005a). It has been generally accepted that anthropogenic climate change, during the 20th and 21st century has induced changes in plant species geographic distribution which have mostly followed two patterns: poleward movements (Auer and King, 2014; Chen et al., 2011; Pacifici et al., 2015; Parmesan, 2006; Parmesan et al., 1999; Parmesan and Yohe, 2003) and/or elevation shifts (Feagan, 2007; Kelly and Goulden, 2008; Lenoir et al., 2008; Moritz and Agudo, 2013; Parmesan, 2006; Root et al., 2003; Walther et al., 2005, 2002). For example changes in the altitudinal range of 1–4 m per decade have been detected for plant species in the European Alps in response to climate change (Grabherr et al., 1994), as well as changes in the altitude of tree lines associated with seasonal warming. However, the magnitude of such changes has been dependent on local annual and seasonal temperature change (Harsch et al., 2009; Körner and Paulsen, 2004). Furthermore, changes in latitudinal range have been observed for European forest herb species (Skov and Svenning, 2004), as well as in woody plant species in the

* Corresponding author.
E-mail address: ak352@exeter.ac.uk (A. Kosanic).

http://dx.doi.org/10.1016/j.gecco.2015.08.006

Arctic region (Crawford and Jeffree, 2007), and distributional change of plant species in the UK (Braithwaite et al., 2006). Some authors have suggested that changes in geographical distribution result in an increase in the risk of extinction, as changes in distribution lead to habitat fragmentation and reduction in population size (Dawson et al., 2011; Krauss et al., 2010; Potts et al., 2010; Spielman et al., 2004). It is likely that such changes will be even more pronounced given the climate change predicted for the end of 21st century (Chen et al., 2011; Parmesan, 2006; Thomas et al., 2004). Nevertheless, the magnitude of extinction risk will vary regionally and locally depending on the magnitude of climate change in the region but also on other factors such as the rate of land use change (e.g. habitat destruction and fragmentation) (Loarie et al., 2009; Ordonez et al., 2014). Vegetation loss will impact species individually, as some species will not be able to adapt to rapid climate change due to a lower range in their climatic envelope (i.e. climatic conditions in which species can persist) and therefore will become more vulnerable to regional and local losses (Corlett and Westcott, 2013; Davis and Shaw, 2001; Gilbert and O'Connor, 2013; Pignatti et al., 2001; Thomas et al., 2004; Thuiller, 2004).

National extent mapping of plant species is frequently used to identify species current distribution and conservation status (Braithwaite et al., 2006; Preston et al., 2002), however it does not carry much useful information about patterns of such changes at the local scale. Local and regional scale research is important for conservation as it helps to elucidate an understanding of species geographical changes and their current distribution patterns (e.g. extent of habitat fragmentation) as well as fine scale extinction rates (Foley et al., 2005; Maclean et al., 2015). Such research can identify the species that experience changes in local distribution or loss local locally, and this can be important for assessing and understanding regional identity or by the 'terroir' concept (Bassett et al., 2007; Feagan, 2007; Paasi, 2012; Van Leeuwen and Seguin, 2006). Regional identity is defined as an important trait of a region (e.g. landscape, biodiversity, place names, historical monuments, dialects, local food), (Paasi, 2012) where the terroir approach considers social dimension and geographical characteristics of local areas (e.g. climate, topography, soil) and uses this in driving policy making (Bassett et al., 2007; Van Leeuwen and Seguin, 2006). Both concepts are crucial for policy making (keeping species locally and regionally) in order to preserve local and regional landscape and socio-natural heritage, and suggesting the direction of planning, marketing and conservation in order to maintain and improve regional economic development.

Changes in species range and their loss at the local and regional scale leads to changes in ecosystem composition, and consequently this can affect the delivery of ecosystem services (e.g. provisioning, regulating, cultural and supportive services), which are thought to be essential in supporting human wellbeing (Beaumont et al., 2011; de Oliveira and Berkes, 2014; MEA, 2005; Rands et al., 2010). Ecosystem composition could be changed with a loss of single 'key species' (species that play an important role in ecosystem composition) or even multiple species, but it is still unknown to what extent this can impact ecosystem functioning (Bertrand et al., 2011; Hooper et al., 2005; Lavergne et al., 2006). Therefore an approach to management has been developed which places the focus on species that have been identified throughout the literature as "keystone-species", "identity species" or "landscape species". These are assessed as being crucial for regional ecosystem identity and ecosystem services (Gibbons and Boak, 2002; Manning et al., 2006; Mills et al., 1993; Natural England, 2012; Rates, 2001; Sanderson et al., 2002; Schaich et al., 2010; Simberloff, 1998). We argue that conservation should not solely focus on threatened or rare species. The characteristics of common species differ from those of rare species (Kunin and Gaston, 1993); however, both are susceptible to population genetic response to habitat fragmentation (Honnay and Jacquemyn, 2007). Instead of focusing on just rare and/or a common species (Gaston and Fuller, 2008) at the local or regional scale, more is gained by improving an understanding about which species are vulnerable (i.e. species experiencing loss and not just part of IUCN Red List) locally or regionally (Matthies et al., 2004). With this information, appropriate conservation strategies can be put in place to protect vulnerable plant species (McCarty, 2001; Rands et al., 2010; Root et al., 2003; Thuiller et al., 2005b). This research here is based on the approach that analyses vegetation change using historical records at a local versus national scale. We argue that this is important for the appropriate management of vulnerable plant species and provides a baseline for better projections in the face of climate change (Beissinger and Westphal, 1998; Thuiller et al., 2008).

The area on which this research is focused is West Cornwall (1335 km^2), the south western Peninsula of Great Britain (Fig. 1). West Cornwall and its 'regional identity' is of particular importance to the United Kingdom given its outstanding natural beauty and diverse habitats (i.e. wetlands, headlands, woodlands) as well as its cultural and historical heritage (Cornish hedges, old mining sites, archaeological sites). Furthermore, West Cornwall is suitable for this type of research as it has a good data availability and spatial coverage of historical and current vegetation records (Davey, 1909; NBN, 2013) and climate records.

2. Aims

When concepts of natural and static distributions are more unstable than ever, and when many geographic distributions are likely to show little overlap between current and future distributions (Thomas, 2013), it is becoming increasingly important to understand whether vegetation conservation strategies should aim at local and/or regional scales. Protection of existing ecosystems will be far less expensive than losing them (Cardinale et al., 2012; Purvis and Hector, 2000; Rands et al., 2010), because the loss of species at local and/or regional scale will result in the need to either 'import' or travel to 'benefit' from unique ecosystem services, which will be more costly than having them at hand (Queiroz et al., 2015; Turner et al., 2007). Here, we concentrated on the following three aims. First, we investigated changes in plant species distribution at the local scale. Second, we examined whether changes in plant species distribution over the local scale mirror the changes at the national scale. Third, we sought to identify which plant species were lost from the region in the period since 1900. We