Applied Geography 74 (2016) 23–29

Contents lists available at ScienceDirect

Applied Geography

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

Diversity patterns of plant place names reveal connections with environmental and social factors

Jaime Fagúndez [a, *], Jesús Izco [b]

[a] Department of Animal and Plant Biology and Ecology, Faculty of Science, Zapateira Campus, University of A Coruña, 15071, A Coruña, Spain
[b] Department of Botany, Faculty of Pharmacy, University of Santiago de Compostela, 15782, Santiago de Compostela, A Coruña, Spain

ARTICLE INFO

Article history:
Received 24 February 2016
Received in revised form
30 June 2016
Accepted 30 June 2016
Available online 12 July 2016

Keywords:
Biocultural diversity
Phyto-toponymy
Landscape change
Land abandonment
Conservation areas
Land management
Land-use change
Rural landscape

ABSTRACT

There is a strong connection between cultural and biological diversity at a global scale, especially in the linguistic domain, but less is known at regional scales. Indicators of such reciprocity are found in the linguistic expression of natural elements, and their representation in the landscape through toponymy. Here we evaluate the geographic distribution of phyto-toponyms, places named after a native local flora, in Galicia, NW Spain. We created the concept of toponymic species (topo-species) for groups of places named after a plant taxon. By using different regression models assuming global effects of the variables (Ordinary Least Squares, OLS) or non-stationarity (Geographically Weighted Regression, GWR), we explored the connection of topo-species richness and diversity with environmental (river density, altitude and natural habitats density) and social (total density of toponyms, population density) factors.

Topo-species richness and diversity were significantly correlated with the studied factors. Total density of toponyms, river density, altitude and natural habitats density showed significant positive values in the models, while population density had little or no effects. GWR performed better for all variables, especially for Shannon diversity index. We conclude that place names of natural elements depict human's interaction with the environment. They are stable, spatially-explicit elements that may be used as indicators of bio-cultural diversity. In addition, they represent an intangible cultural heritage that should also be preserved.

1. Introduction

Globalization unifies cultural expressions across the world, threatening the singularity of local cultural manifestations, especially for minorities in rural areas tightly bound to natural resources (Johns & Sthapit, 2004). Similarly, global scale factors such as climate change or biological invasions of non-native species are responsible for a general decline in narrowly distributed species and ecosystems, and, in contrast, the promotion of common and widespread ones (Davis, 2003; Sala et al. 2000; Chapin III et al. 2000). Such process affect pristine ecosystems, highly sensitive to reduction and fragmentation of natural habitats, but also takes place in more resilient, strongly humanized systems as in large areas of Europe (Jongman, 2002; Strijker, 2005). Land-use intensification combines with the abandonment of traditional agro-pastoral practices and people migration to urban areas, followed by the disappearance of the cultural substratum hold in the rural communities (Antrop, 2004). A continuous loss of bio-cultural knowledge such as ethnobotanical uses or traditional management practices is rapidly taking place (Benz, Cevallos, Santana, & Rosales, 2000; Berkes, Colding, & Folke, 2000), in parallel with a continuous loss of biodiversity in sensitive areas (Maffi, 2005).

A strong correlation between areas of high biodiversity and cultural diversity has been found at a global scale (Gorenflo, Romaine, Mittermeier, & Walker-Painemilla, 2012; Maffi, 2005; Pretty et al. 2009), partially explained by the heterogeneity of landscape elements. For example, linguistic diversity correlates positively with density of river courses and landscape roughness, which are expressions of complex and fragmented geographical patterns (Axelsen & Manrubia, 2014). In addition, similar trends affect languages and living organisms, in terms of increasingly extinction rates (Sutherland, 2003). The connection between cultural diversity and biodiversity offers the opportunity to establish indicators in both directions, either biological or cultural elements to be used as indicators of the other, especially if such elements can be accurately spatially located.

* Corresponding author.
E-mail address: jaime.fagundez@udc.es (J. Fagúndez).

http://dx.doi.org/10.1016/j.apgeog.2016.06.012
0143-6228/

Place names (toponyms) are a powerful source of landscape information. A relevant proportion of place names are coined after natural elements, and these names may persist long after those elements have changed or disappeared (Conedera, Vassere, Neff, Meurer, & Krebs, 2007; Tent & Blair, 2011). In such cases, place names may tell us about the settlers' perception of their surroundings in a historical context (Burenhult & Levinson, 2008; Hunn, 1996). These names may retain information of human perception long after the cultural environment has changed. Exploring the geographic distribution of such names provides valuable information on historical changes of landscapes or species distributions, although their use in ecological research is scarce (Cox, Maehr, & Larkin, 2002; Fagúndez & Izco, 2016; Sousa & García-Murillo, 2001).

In this study, we explore the patterns of the geographic spatial distribution of bio-cultural diversity, using phyto-toponyms (i.e. place names derived from plants) as bio-cultural indicators. In a novel approach, we create the concept of toponymic species (topo-species) as groups of toponyms that refer to a plant taxon (mainly species, or groups of related species). Thus, each phyto-toponym is treated as a "topo-individual", and classic diversity and evenness indexes (i.e. Simpson and Shannon diversity and evenness) can then be applied.

It has repeatedly been shown that linguistics can be used as a proxy of cultural diversity, and that cultural diversity are tightly related to the diversity of natural elements such as species richness or landscape heterogeneity (Axelsen & Manrubia, 2014; Gorenflo et al. 2012; Grant, 2012; Harmon, 1996; Maffi, 2005; Pretty et al. 2009) mainly at global scales. Based on this previous knowledge, we test whether this relationship applies at a regional scale. We use environmental variables (altitude, river density, natural habitat density), and social factors (population density, density of toponyms) as potential explanatory variables for the differences in such measures across the territory. Since phyto-toponyms are a result of the human perception of natural elements used to his convenience, we hypothesize that both natural and social variables play a role on the location and diversity patterns of these names. Moreover, we introduce a new perspective in the conservation policies at a regional scale, in which bio-cultural elements such as phyto-toponyms may be used as ecological indicators. We claim that toponymy should be considered when designing conservation plans on rural areas of humanized landscapes like those of Galicia.

2. Methods

2.1. Study area

Galicia is an autonomous community located at the North West of Spain, bordering the Cantabrian sea (North), Atlantic Ocean (West), Portugal (South) and Castilla y León and Asturias regions (East). It covers a total area of 29,754 km^2 that holds a population of 2.75 million people, mainly in the coast area of the so-called "Atlantic axis", where nearly 80% of the population lives, and includes five of the seven cities of Galicia with over 50,000 inhabitants, and most of the municipalities with higher densities (Fig. 1). In contrast, inland Galicia has a more dispersed, rural population that inhabits a mainly agro-pastoral traditional landscape. Although both Galician and Spanish are official languages, toponymy in Galicia derives almost entirely from the Galician language. Galicia has an extremely rich toponymic heritage, with almost half of the total number of place names recorded in the whole Spain (García, 2007). Plant names, either for cultivated or wild plant species, are frequent in the toponymy (Navaza, 2006).

Galicia holds significant biodiversity in terms of biogeographic diversity, natural habitats and endemic and rare species. In the Atlantic environment, which represents over 80% of the region, deciduous forests of *Quercus robur* and *Quercus pyrenaica* are the main formations of potential natural vegetation. Other natural vegetation types include different types of heathlands and other shrublands, mountain meadows, mires and fens, coastal dunes and cliffs, and others. The remaining 20% is part of the Mediterranean Region, where *Quercus rotundifolia* and *Quercus suber* are the main tree species in the natural potential vegetation, and *Cistus* spp., *Erica* spp. and *Cytisus* spp. shrublands are frequent. The traditional agro-system in Galicia includes remnants of natural vegetation intermixed with cultivated land, meadows and sparse villages, creating a mosaic with a rich variety of ecosystems (Calvo-Iglesias, Fra-Paleo, & Diaz-Varela, 2009).

2.2. Geolocated toponymy database

We built a complete toponymic dataset of Galicia from the digital database found at the Spanish National Institute of Geographic Science (http://www.ign.es). Two hundred and seventy eight maps (1:25,000 scale) covering the whole area of Galicia were used. We filtered all place names of geographic point features and pooled them in a single geo-referenced layer. The polygon layers of villages and population centres were converted by creating a point for each feature located at its centroid, and adding it to the point layer. We clipped the layer to the Galician borders, obtaining a final dataset of 99,233 place names.

2.3. Plant place names

We followed a conservative approach for the identification of plant place names in order to select only those that we could confidently relate to a specific plant species. Mainly based on the study by Navaza (2006), we chose plant names clearly and unambiguously dedicated to significant plant species, common or abundant throughout the territory. We selected native, uncultivated species, and left out other species that are frequent in the toponymy such as *Figueira* (from *Ficus carica*, the fig tree), or *Nogueira* (from *Juglans regia*, the walnut tree), which only occur as cultivated or naturalized. We did not include other frequent plant place names that refer to complex communities rather than particular species such as *Fraga* or *Souto* (names for mixed forest), or *Herbeira* (grassland). However, names that refer to monospecific formations were included (e.g. *Carballeira*, a forest of *Quercus robur*, vernacular name: *Carballo*, oak). In a few cases, more than one name for each plant taxon was selected, as some species may be called with different names (see Fagúndez & Izco, 2016 for a case study with heathers). We finally selected 32 taxa (Table 1). Thus, we created a geo-located matrix dataset of place names that refer to those 32 taxa in Galicia.

2.4. Explanatory variables

We selected three environmental (river density, altitude, and natural and semi-natural habitat density) and two social variables (total number of toponyms excluding the selected phyto-toponyms and human population density) to be used as explanatory variables in our analyses. Population density was obtained from the Spanish National Institute of Statistics (http://www.ine.es) for each of the 314 municipalities in Galicia, and transformed into a 5 km × 5 km grid dataset by cubic interpolation of the polygon values. River density was calculated from the hydrographic dataset in the basic cartography downloaded from http://www.ign.es. A 0.5 km × 0.5 km grid with river presence-absence was created, and then upscaled to a 5 km × 5 km grid by counting positive values within each grid cell. Thus, cell values range from 0 to 100. We