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Floristic characteristics of the wetland sites on dry southern slopes of the Alborz Mts., N. Iran: The role of altitude in floristic composition

Alireza Naqinezhad[a,b,c,*], Adel Jalili[d], Farideh Attar[a], Ahmad Ghahreman[a], Bryan D. Wheeler[c], John G. Hodgson[c], Susan C. Shaw[c], Aliasghar Maassoumi[d]

[a]*Department of Botany, School of Biology, University College of Sciences, University of Tehran, P.O. Box 14155-6455, Tehran, Iran*
[b]*Department of Biology, Faculty of Science, University of Mazandaran, Babolsar, P.O. Box 47416-95447, Mazandaran, Iran*
[c]*Department of Animal and Plant Sciences, Alfred Denny Building, University of Sheffield, Western Bank, Sheffield S10 2TN, UK*
[d]*Department of Botany, Research Institute of Forests and Rangelands, Tehran, Iran*

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Abstract

The Alborz Mountains, the second largest range in Iran, is, on its southern slopes, mainly covered by steppe vegetation. These dry slopes also include 'green islands' of wetland. Floristic diversity and environmental characteristics of 45 of these little-studied wetland sites have been assessed along an altitudinal gradient using one-way ANOVA, Pearson *r* and detrended correspondence analysis/canonical correspondence analysis (DCA/CCA) analyses. The wetlands proved to be of conservation importance with 310 plant taxa, including 35 endemics or subendemics. Predictably, and consistent with the phytosociological classification of Klein [2001. La végétation altitudinale de L'Alborz Central (Iran): Entre les régions Irano-Touranienne et Euro-sibérienne. Institut Français de Recherche en Iran, Téhéran], there were parallel changes in vegetation both within wetlands and the surrounding steppes and in DCA/CCA analyses altitude appeared to be the primary determinant of floristic composition. Upper mountain wetlands are particularly species-rich and contain many endemics and other species of a narrow phytogeographical distribution. Soil pH declined with altitude, perhaps in part as a consequence of low salinity (and high pH) in the mountains. Consistent with the work of Raunkiaer [1934. The life forms of plants and statistical plant geography. Clarendon Press, Oxford], hemicryptophytes are mainly restricted to upper mountain areas. Though correlated both directly with altitude and with correlation in DCA/CCA plots, phytogeography, life-form and soil pH fail to adequately explain the ecological processes that maintain the altitudinal gradient in vegetation types and species composition. Further studies on site productivity, soil chemistry and climate-related variables are, therefore, on-going in an attempt to understand more fully the ecosystem processes maintaining the diversity of these important wetland sites.

Keywords: Biodiversity; Iran; Life-form; Mountain wetlands; Ordination; Phytogeographic elements

Introduction

Because major environmental change can occur over short distances (Baruch, 1984), mountain regions are

*Corresponding author at: Department of Biology, Faculty of Science, University of Mazandaran, Babolsar, P.O. Box 47416-95447, Mazandaran, Iran.
E-mail address: a.naqinezhad@umz.ac.ir (A. Naqinezhad).

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ideal for describing and studying the environmental responses of plant communities. Altitudinal gradients importantly distinguish between vegetation zones (Klimeš, 2003) and have also become increasingly popular for investigating patterns of species richness (Grytnes, 2003; Grytnes and Vetaas, 2002; Jones et al., 2003; Kessler, 2000; Kessler et al., 2001; Rahbek, 1995), life-form (e.g. Bhattarai and Vetaas, 2003; Klimeš, 2003; Montana and Valientebanuet, 1998; Pavón et al., 2000; Wang et al., 2002) and phytogeographic elements (PE) (e.g. Morefield, 1992; Sklenář and Balslev, 2007). Moreover, studies relating altitude, pH, slope inclination and vegetation have been carried out in many mountain wetland habitats (e.g. Hájek et al., 2008; Hájková et al., 2006; Miserere et al., 2003; Rolon and Maltchik, 2006).

The Alborz Mountains, the second largest mountain range in Iran, form a gently sinuous east–west range across northern Iran, south of the Caspian Sea. They face the humid Caspian depression to the north and southwards grade into the arid plateau of Central Iran. Steppic plant assemblages associated with the dry climate on the south-facing slopes of the Alborz Mountains (e.g. Klein, 2001) are very different from the forest vegetation associated with the wet climate of the north-facing aspects (e.g. Assadollahi et al., 1982; Djazirei, 1965; Frey and Probst, 1986; Tregubov and Mobayen, 1970; Zohary, 1973). These dry Irano-Turanian steppe communities separate into three phytosociological groupings, each with a different altitudinal range (Klein and Lacoste, 1998). A further distinctive feature in these mountains is the occurrence within this dry steppe of a large number of wetlands as 'green islands'. Similar ecosystems have also been recorded in other mountainous areas in both the Irano-Turanian and Euro-Siberian regions (e.g. the Hindu-Kush of Afghanistan (Gilli, 1971), Caucasus (Onipchenko, 2002), Turkey (Parolly, 2004), Bulgaria (Hájková et al., 2006), Carpathian Mountains (Hájek et al., 2002) and Rhaetian Alps, Italy (Gerdol and Bragazza, 2001)). Nevertheless, despite the many general floristic and vegetation studies of the Alborz ranges (e.g. Gilli, 1939; Klein, 1984, 2001; Kotschy, 1861; Nazarian et al., 2004; Zohary, 1973), and more recent work focussing on wetland habitats (Klein and Lacoste, 1995), detailed ecological and floristic accounts remain very scarce particularly for the wetland sites. This situation contrasts with that for other freshwater wetlands, especially in the Caspian lowlands (e.g. Naqinezhad et al., 2006, 2008b; Shokri et al., 2004) and on Zagros Mountains (Karami et al., 2001), which have been well studied. The dearth of information on the wetlands of the Alborz Mountains is particularly unfortunate because, as a result of a history of overgrazing, there has been a prolonged period of degradation of these steppic and wetland ecosystems.

The current investigation is part of a project to study vegetation and ecology of wetland sites on dry mountainous slopes of the Alborz. The objective of this study was to provide urgently needed scientific support for programs of biodiversity conservation. To these ends a research program was instituted to characterize the floristic composition and some ecological properties of the wetland sites in the Alborz Mountains. The first stage of this work was to provide a base-line vegetation survey of the wetlands and to determine the interrelationships between species richness, life-form, PE, soil pH and slope of the terrain and their variation in relation to altitude in the Alborz Mountains. The findings should provide insights into: (1) the conservation value of these wetland habitats, (2) altitudinal variation in floristic composition and environmental variables, including an investigation as to whether our studied variables fit the three altitudinal belts identified by Klein and Lacoste (1998) and (3) a comparison of the ecological trends within our wetland sites with those recorded from mountain ranges in other phytogeographic areas.

Study area

The study area corresponds to a west–east belt transect across the southern part of the Central Alborz Mountains, located between 51°05′ and 52°59′E and between 35°40′ and 36°10′N (Fig. 1). This sector, which is nearly 55 km long and 45 km wide, separates Mazandaran province to the north from the Tehran province to the south and rises to 5756 m high on Mount Damavand. The area lies between two main roads, the Karaj-Chalus road in the west and the Firuzkuh road in the east that crosses the Alborz Mountains and leads towards the Caspian Sea.

Eocene volcanic and volcaniclastic rocks form the most prominent geological feature of the southern section of the Alborz Mountains. However, in the northern section of the Alborz, Middle Jurassic to Upper Cretaceous limestone formations become much more important and form some very high rock cliffs along the East–West directed thrust fault zones (Stöcklin, 1974). Evidence for Tertiary and Quaternary volcanic activities is shown by the presence of the 5671-m-high Damavand Volcano (Davidson et al., 2004) and granitic intrusions within the Alamkuh area of the west-central Alborz Mountains (Axen et al., 2001). The northern foothills of the Alborz are mainly composed of Neogene continental clastic and marine sediments with some high peaks of Mesozoic limestones along the main faults. Within the southern foothills of the Alborz, the Mio-Pliocene Upper Red Formation and Plio-Pleistocene Conglomerates are the dominant geological features (Amini, 1997).