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ABSTRACT

Lumbreras, A.; Tahiri, H.; Pinto-Cruz, C.; Pardo, C., and Molina, J.A., 2012. Habitat variation in vernal pool ecosystems on both sides of the Strait of Gibraltar. *Journal of Coastal Research,* 28(5), 1032–1039. Coconut Creek (Florida), ISSN 0749-0208.

We studied vernal pool (VP) ecosystems along a latitudinal gradient crossing the Strait of Gibraltar in order to determine its role in the distribution of VP plant communities. We analyzed flora, vegetation, physical–chemical water parameters, and climatic data from two vernal pool areas on both the European (Iberian) and African (Moroccan) sides of the Strait. Despite the minor distance between both territories, the pools clearly differed in species composition and ecology. However, they showed a similar vegetation zonation in growth forms, including isoetid, batrachiid, and helophytic vegetation. The distribution of the plant communities was related to nutrient load, temperature, and precipitation. Water nitrate concentration was higher in Morocco, where VPs are characterized by *Isoetes velata* subsp. *adspersa* and *Ranunculus saniculifolius* communities. Iberian VPs had lower water nitrate content, and were characterized by *Isoetes velata* subsp. *velata* and *Ranunculus peltatus* communities. We think this nutrient difference is likely to be caused by the different land management regime on each side of the Strait, with more intensive agriculture in Morocco. Long-term (historical) and present-day (ecological) processes have been proposed to account for the habitat variation in vernal pool ecosystems on both sides of the Strait of Gibraltar.

ADDITIONAL INDEX WORDS: *Biogeography, coastal temporary ponds, community ecology ephemeral wetlands, plant growth forms, western Mediterranean Basin.*

INTRODUCTION

Seasonal pools constitute a particular type of wetlands occurring in semiarid and subhumid climates on both sides of the Tropic of Cancer and are linked to local catchment areas or to purely rainwater systems (Deil, 2005). They include periodically inundated depressions as well as temporary water-filled rock pools (Bagella *et al.,* 2009). The Mediterranean climate gives rise to the typical seasonal pools known as Mediterranean temporary ponds or vernal pools (Pinto-Cruz *et al.,* 2009; Solomeshch, Barbour, and Holland, 2007). These occur in depressions that fill with water during the rainy season and dry out throughout spring or early summer (Keeley and Zedler, 1998). This alternation gives rise to one of the most biologically and biogeographically interesting ecosystems in the Mediterranean region (Grillas *et al.*, 2004) with a very characteristic and specific flora and vegetation (Barbour *et al.,* 2005; Braun-Blanquet, 1935; Keeley and Zedler, 1998). Coastal Mediterranean regions are considered particularly rich in VP ecosystems (Zedler, 1987).

The distribution pattern of plant communities, species diversity, and the manifestation of certain types of ecological strategy in wetlands are essentially influenced by the moisture gradient and flooding period (Brock and Casanova, 1997; Keeley and Zedler, 1998; Pinto-Cruz *et al.,* 2009; Zelnik and Čarni, 2008). Vernal pool plant communities occur in concentric belts along a gradient of water duration and relative elevation (Bagella *et al.,* 2009; Barbour *et al.,* 2003; Rhazi *et al.,* 2006). Coastal temporary ponds are considered to be ecosystems with high species richness (Boix *et al.,* 2007; López, Toja, and Gabellone, 1991), but little is known about how vernal pool vegetation diversity varies along ecological gradients on a regional scale (Rudner, 2005).

The historical and current geological characteristics of the Strait of Gibraltar (SG) have involved land bridges and effective sea barriers between the Iberian Peninsula and northwest Africa (Duggen *et al.,* 2003). The land bridges in different Tertiary periods explain why about 75% of the Mediterranean flora of Iberia is shared with northern Morocco (Valdés, 1991). However, the Strait's 14-km length also represents an effective isolating barrier for independent lineages of different plant groups, thus creating disjunct taxa caused by vicariance or dispersal (Escudero *et al.,* 2008; Fiz, Valcárcel, and Vargas, 2002; Lumaret *et al.,* 2002; Toumi and Lumaret, 1998; Vargas, Morton, and Jury, 1999). These

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