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Short Communication

Effects of camel grazing on density and species diversity of seedling emergence in the Dubai (UAE) inland desert

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Abstract

Germination in the arid rangelands of the UAE occurs as an 'event' following a mid-winter to spring rainfall. A fence line study of germination events was conducted in 2005 and 2006 to identify the response to differential grazing regimes. Fifty-six 1 m^2 seedling plots were destructively sampled each season. Heavy grazing reduced species richness and diversity without significantly reducing seedling density. Both annual and perennial species were impacted, though the reduction in richness of annual species was less pronounced than the natural variation among locations. Direct grazing of seedlings is limited to a few weeks, due to the short annual plant life span. Reduction of perennial seedling density and species richness was likely caused by the reduced size of adult plants under grazing. Recruitment of perennial species could be affected by heavy grazing, leading to loss of habitat, though under moderate grazing levels this could easily be compensated by greater survival.

Keywords: Conservation; Germination; Grazing; Rangeland; Species richness; United Arab Emirates

1. Introduction

Seed germination on the arid rangelands of the United Arab Emirates (UAE) occurs usually less than once a year in a mass event. The resultant seedlings are predominantly of annual species which have a life span of 2–3 months. Plant community structure in the region is considered to be most threatened by excessive livestock grazing (Hellyer et al., 2001), due to observations of perennial plant species. The aim of this study was to determine whether annual plant population structure and germination patterns of both annual and perennial species were influenced by two grazing systems of differing intensity.

Rangeland herbivore populations of the UAE have changed radically in the last half-century. The domestic camel population has expanded, while native herbivore populations have suffered varying degrees of decline (Gallacher and Hill, 2006b). Herbivore populations have thus trended toward a single, large species. Perennial plants use a combination of physical and chemical defenses against herbivory, but annual species rely on the reduced risk of exposure that comes from a short life cycle and coordinated mass germination. Overall grazing

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intensity is thought to be much greater today, and animals are no longer free to move to regions that have experienced localized rainfall.

Plants in arid environments must use highly unpredictable occurrences of soil moisture to grow from seed to reproduction. On average, fewer than half of all desert annual plants reach reproductive maturity (Beatley, 1967), and many reach maturity in poor condition (Went, 1953, 1955). Germination occurs in response to environmental cues that make their survival to reproduction likely (Del Pozo and Aronson, 2000). Arid species generally mature in a shorter time and at a smaller size, and allocate proportionally more synthate to reproductive structures than do wetter climate species (Bell et al., 1979). Germination in the United Arab Emirates is triggered by rain events from mid-winter to spring. All species appear to exhibit seasonal seed dormancy, preventing them from responding to rainfall at other times. Elsewhere, germination percentages were greater in seeds that had undergone dormancy (Boeken et al., 2004; Capon and Asdall, 1967). Amount and timing of rainfall is the most important factor influencing seed germination (Baskin et al., 1993; Brown, 2003; Freas and Kemp, 1983; Gutierrez and Whitford, 1987; Halwagy, 1962; Shreve, 1942) and species composition (Brown, 2003; Guo et al., 2000). Chemical cues are also important (Boeken et al., 2004), such as the presence of soil nitrogen (Skujins 1981; West and Skujins, 1978). Spatially, variable soil water and chemistry could therefore contribute to variable germination patterns over small areas. Seedling density and size in the UAE exhibit wide temporal and spatial variation in both plant density and size. Abundance of a desert species within a season is correlated with frequency among seasons, and rare species are more likely to appear in good seasons (Guo et al., 2000). Most species in Oman had higher germination densities in open spaces, but a few preferred microhabitats under trees such as *Acacia tortilis* (Robinson, 2004).

The objective of this study was to determine whether species abundance, diversity and richness of annual and perennial seedlings differed between the two grazing systems, one characterized by heavy camel grazing and the other by lighter oryx and gazelle grazing.

2. Study site

Observations were made on either side of a 24.12 km looped fence that mainly transects dunes, but also crosses 150 m of gravel substratum. Dunes vary from highly active (Southern fence) to stable and well-vegetated with perennial plants (North Western fence). Outside the fence is the Dubai Desert Conservation Reserve (DDCR) in which the density of camels is approximately 0.05 camels ha^{-1}. Camels are given supplementary feed by their owners, so the effective grazing pressure on desert plants is lower. The inner enclosure (Al Maha) was formed in July 1999 with the completion of the fence under study. The 27.09 km^2 Al Maha enclosure is kept free of camels, but is stocked with approximately 250 oryx and 200 gazelles. Since 2005 these livestock have been free to move between Al Maha and the DDCR. Perennial shrub studies have shown that grazing intensity in the DDCR is much greater than in Al Maha (Gallacher and Hill, 2006a). Hence, 'heavy grazing' will be used to refer to DDCR plots.

Perennial vegetation throughout the research site is dominated by *Leptadenia pyrotechnica*. Although considered a fodder species in the UAE (Khan, 1980), it is only moderately palatable and is often avoided by livestock, particularly cattle (Ould Soulé, 1998). Perennial grasses exist but are rare. Further details of perennial vegetation can be found in other publications from this research (Gallacher and Hill, 2005, 2006a).

Plants recorded in this study were the result of several rainfall events in and around January 2005, and a single downpour on 23 February 2006. Rainfall had been very low for the previous 5 years. Accurate weather data for the site is unavailable, since there is no weather station in this ecological zone. Records from the Dubai International Airport approximately 70 km northeast of the DDCR indicate an average annual rainfall of 93.8 mm that falls mostly between December and April (World Meteorological Organization, 2006).

3. Plant density, species richness and diversity

Four Al Maha and four DDCR 1 m^2 plots were sampled near each of six midpoints of the main fence sections, 6–8 weeks after germination, in 2005 and 2006. Specific plot coordinates were chosen visually to sample patches of high seedling emergence, and to exclude perennial plants with a canopy diameter larger than 10 cm. This sampling was used because seedling emergence is highly spatially heterogeneous (Brown 2003;