



The influence of Saharan agro-pastoralism on the structure and dynamics of acacia stands



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ABSTRACT

Trees play a crucial role in drylands, where they are often considered as keystone species for ecosystems and for local livelihoods. In particular in the Saharan region, *Vachellia tortilis* subsp. *raddiana* (ex. *Acacia tortilis* subsp. *raddiana*) are multi-purpose acacia trees for people and contribute to the overall ecosystem functioning. Despite progress in research, acacia stands in this region are poorly documented and little is known on their interactions with human Saharan populations. On the basis of a multidisciplinary approach, the aim of this study was to assess the structure and dynamics of Saharan acacia stands in south-western Morocco and the influence of human activities and practices. Interviews and participant observations were performed in two villages and individual acacia trees were measured in contrasting topography, microhabitat and land use situations. The acacia stands were located in cultivated and browsed areas where trees were used and shaped in the framework of human subsistence activities. In this context, the low-density acacia stands (4.8 trees/ha) showed high regeneration (47.8%) and recruitment rates, and low mortality (3.3%). Land use had more effect on stand structures than topography or microhabitat. Tree regeneration and density were especially high in cultivated areas. Most trees showed traces of pruning (60.3% of them) and debarking (33.9%), but with no correlation with tree mortality. Environmental and anthropogenic factors jointly contributed to the structure and dynamics of acacia stands, and no threat to their sustainability was observed. Even though further investigation would be required to better distinguish environmental and anthropogenic factors and to draw long-term conclusions, our results suggest that Saharan agro-pastoralism activities are not necessarily incompatible with acacia tree conservation, contrary to the commonly admitted postulate in Morocco.

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1. Introduction

Drylands – defined as areas with an aridity index lower than 0.65 – cover about 41% of the Earth's land surface and harbour 38% of the global human population (MEA, 2005). Drylands are environmentally and socially vulnerable, in particular in the face of desertification, that is irreversible land degradation resulting from multiple climatic and anthropogenic factors (MEA, 2005). Despite early studies that highlighted worrying rates of desertification and identified humans as the main cause (Lamprey, 1975), recent research has cast doubt on these conclusions (Helldén and Tottrup, 2008). A better understanding of climatic variability, socio-economic processes and political dimensions, associated with a shift in rangeland ecology paradigms, have provided a basis

for highlighting the non-uniformity of desertification and for more nuanced conclusions on the role of human activities in the face of climatic variations (Herrmann and Hutchinson, 2005). Yet desertification remains subject to scientific debate mainly because finding accurate indicators of long-term changes – such as “slow” variables (Carpenter and Turner, 2001) – is challenging. Considering the crucial ecological role of trees in dryland ecosystems (Belsky et al., 1989), monitoring woodlands in drylands may constitute accurate “slow” indications of potential degradation and desertification.

Vachellia tortilis (Forssk.) Galasso & Banfi subsp. *raddiana* (Savi) Kyal. & Boatwr. – ex *Acacia tortilis* (Forssk.) Hayne subsp. *raddiana* (Savi) Brenan (Kyalangalilwa et al., 2013), further noted *V. raddiana* or acacia tree in this paper – is the most widespread native acacia tree in the Saharan region. Considered as a keystone species (Munzbergova and Ward, 2002; Noumi et al., 2012), *V. raddiana* improves soil fertility, decreases potential evapo-transpiration and consequently affects the establishment, development and survival of other plants (Abdallah et al., 2008; Noumi and Chaieb, 2012). In

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addition, *V. raddiana* is a precious source of forage, fuel wood and other materials (Grouzis and Le Floch, 2003). Hence, conserving *V. raddiana* is a crucial challenge in the Saharan region, both for its role in terms of ecosystem conservation and for the preservation of local livelihoods. Nevertheless, the conservation of *V. raddiana* still remains uncertain as the literature has reported contrasting conclusions. On the one hand, *V. raddiana* stands showed positive trends in Israel (Lahav-Ginott et al., 2001), in Algeria (Sahraoui et al., 1996) and in Tunisia (Noumi et al., 2010b). On the other hand, negative trends were reported in Egypt (Andersen and Krzywinski, 2007), in Israel (Ward and Rohner, 1997) and in Tunisia (Noumi and Chaieb, 2012). These contrasting dynamics are associated with contrasted local conditions in terms of rainfall regime (Sahraoui et al., 1996), runoff and water flux (BenDavid-Novak and Schick, 1997; Ward and Rohner, 1997; Wiegand et al., 2000b), seed predation by insects (Derbel et al., 2007), browsing intensity (Noumi et al., 2010b) or anthropogenic exploitation (Andersen and Krzywinski, 2007). Given such local variations, extending the carrying out of local studies is crucial to fill the knowledge gap on the dynamics of *V. raddiana* at regional scale and to better assess conservation priorities.

In Morocco, no study has investigated the structure and dynamics of *V. raddiana* stands. Furthermore, most Moroccan *V. raddiana* stands are located outside protected areas and are embedded in local agro-pastoral and pastoral systems. Except for some descriptions of local practices for *V. raddiana* in Egypt (Andersen et al., 2014; Hobbs et al., 2014), no study has addressed the effects of local practices, uses or management on the structure and dynamics of *V. raddiana* stands. Such studies may help to achieve a better understanding of coupled human–environment systems in drylands (Reynolds et al., 2007) in the interests of sounder and more efficient conservation methods.

The aim of the present study was (1) to assess the structure and dynamics of *V. raddiana* stands, and (2) to identify human activities and related practices and their influence on tree stands. We hypothesised that, in complement to environmental variables, human activities and practices may substantially influence the structure and the dynamics of *V. raddiana* stands. To test this prediction, we adopted a multidisciplinary approach in an agro-pastoral landscape and in two neighbouring villages in south-western Morocco. We combined (1) socio-anthropological investigations in order to identify and characterise human activities and

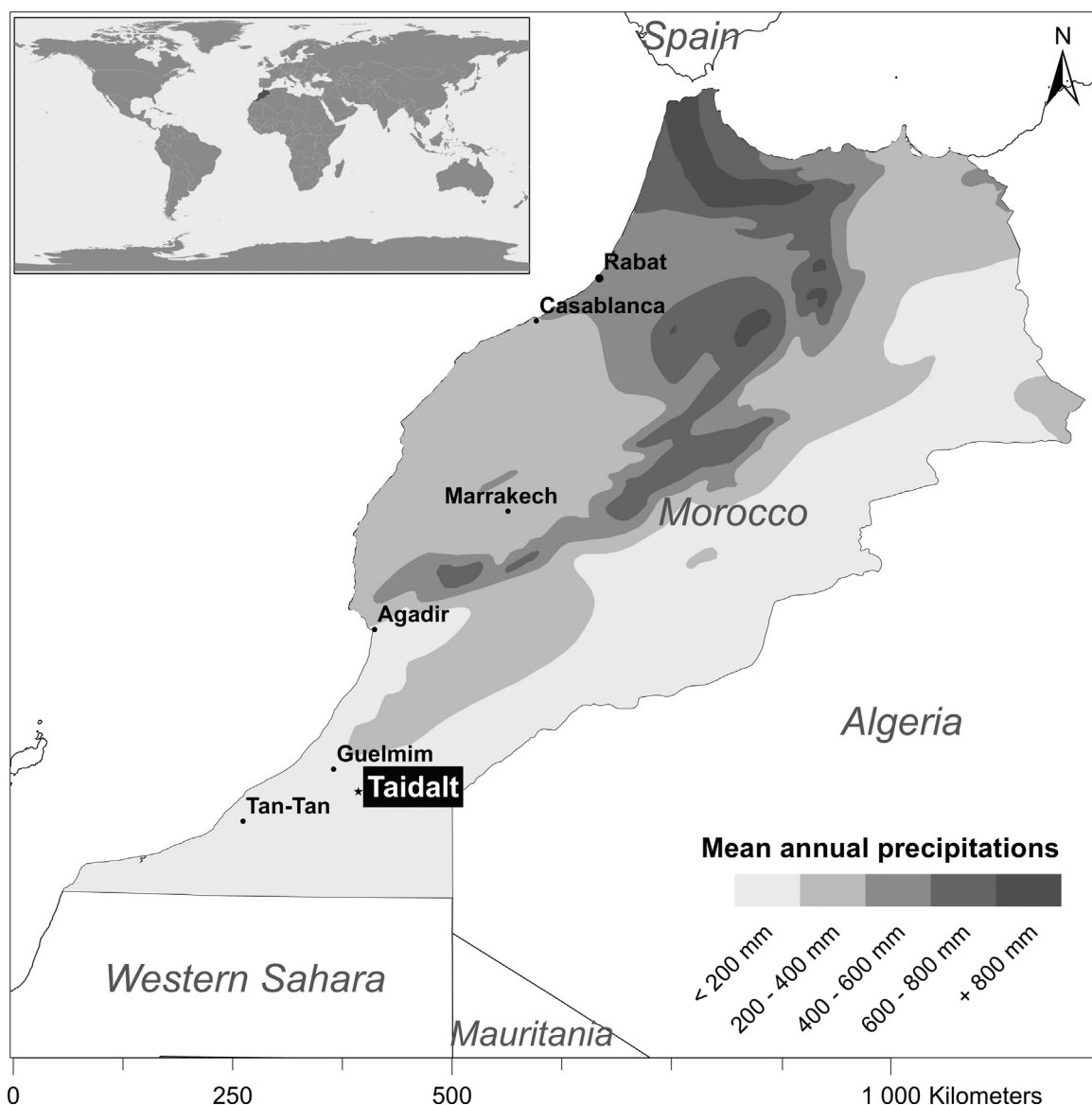


Fig. 1. Study site location (Taidalt village) in south-western Morocco, province of Guelmim.

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