Survival limitation of African wild olive seedlings by browsing livestock in the highlands of Tigray, Ethiopia

R. Aerts[1]*, E. November[2], I. Van der Borght[1], W. Maes[1], Melaku Tafere[3] and B. Muys[1]

[1] Laboratory for Forest, Nature and Landscape Research, Katholieke Universiteit Leuven, Vital Decosterstraat 102, B-3000 Leuven, Belgium; [2] Laboratory for Soil and Water, Katholieke Universiteit Leuven, Vital Decosterstraat 102, B-3000 Leuven, Belgium; [3] Faculty of Veterinary Science, Mekelle University, P.O. Box 231, Mekelle, Ethiopia; * raf.aerts@agr.kuleuven.ac.be



Figure 1 **a** Experimental grazing plot **b** Simulated *Olea* seedlings in 05

Abstract

An experimental grazing plot in Central-Tigray, Ethiopia, was enriched with simulated seedlings of African wild olive (*Olea europaea* subsp. *cuspidata*) under two early-successional shrubs (*Euclea schimperi* and *Acacia etbaica*) and in open areas and subjected to controlled grazing by goats. Seedling survival curves were calculated from grazing pressure (LSU h ha^{-1}) and corrected/uncorrected seedling survival ratios. Results indicate that both *Euclea* and *Acacia* shrubs offer adequate protection for *Olea* recruits against browsing animals. However, if a certain grazing pressure threshold is exceeded, both seedlings in open areas and under shrubs will be detected and predated by goats resulting in a rapid decline of survival and finally in 100% mortality. Single browsing events in regenerating forest land or recently closed rangeland should not exceed a grazing pressure of 45 goat-hours per hectare. In forest rehabilitation areas, large herds of goats should be kept out at all times.

Keywords: African wild olive, Ethiopia, goat herbivory, *Olea europaea* subsp. *cuspidata*, seedling survival

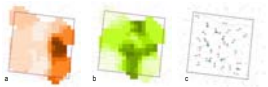

Figure 2 Experimental grazing plot with **a** *Acacia etbaica* densities (13-60/ha), **b** *Euclea schimperi* densities (0-6/ha) and **c** selected enrichment positions (size of dots in relation to crown diameter for *Euclea* and *Acacia*)

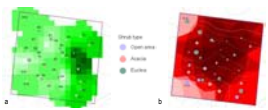

Figure 3 **a** Experimental grazing plot with combined *Acacia* and *Euclea* shrub densities and **b** overall grazing activity (darker shades in red = higher grazing activity) and seedling survival (larger dots = higher survival) – open area dots are remarkably smaller

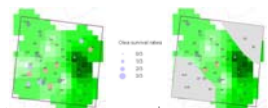

Figure 4 *Olea* seedling survival after 20 grazing by 13 goats: **a** uncorrected data (GP = 9.08 LSU.hr/ha) and **b** corrected data (GP = 13.84 LSU.hr/ha)

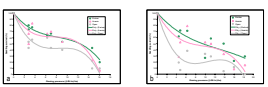

Figure 5 *Olea* seedling survival curves: **a** uncorrected data and **b** corrected data

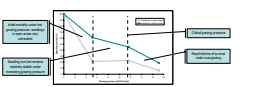

Figure 6 Simplified (empirical) *Olea* seedling survival curves for seedlings in open areas and seedlings under shrubs (both *Euclea* and *Acacia*)

Introduction

Goats are often blamed for the destruction of vegetation, when the real problem is the overuse people make of vegetation in fragile environments, through tree-felling and over-grazing by all species of livestock (Peacock, 1996). Goats have feeding habits, however, which differ from those of other ruminants, and lead to the destructiveness of the former when uncontrolled (Devendra & Burns, 1983). The goat's natural preference for browse means that they must be controlled, along with other livestock, in areas where young trees have been planted or recently cut forests are regenerating. Young trees can be eaten by hungry cattle and sheep, as well as by goats (Peacock, 1996). We studied the interaction between goat herbivory, seedling survival and existing natural vegetation in order to align natural forest regeneration with maximum allowable grazing pressure.

Materials and methods

A 30 × 30 m² experimental grazing plot was enriched 9 times with 90 simulated seedlings of African wild olive (fresh cuttings of *Olea europaea* subsp. *cuspidata*; *Oleaceae*) under 10 *Euclea* shrubs, 10 *Acacia* shrubs and in 10 open spaces (Figure 1,2,3a) and subjected to controlled grazing. Grazing pressure was calculated in terms of livestock unit-hours per hectare (LSU.h ha^{-1}) (1 goat = 0.2 LSU). Seedling survival was measured as number of seedlings left per enrichment position after grazing. During experiments with low grazing pressure, not all enrichment positions were visited by the goats, resulting in skewed survival ratios. By means of spatial selections in a GIS environment (ESRI ArcView GIS 3.2a), mean survival rates were corrected for actual grazing activity within the grazing plot (Figure 3b,4). Seedling survival curves were calculated from grazing pressure and seedling survival ratios. All results were condensed in a simplified (empirical) seedling survival curve.

Results

Both in the uncorrected and corrected dataset, seedlings planted in open areas suffered from higher mortality, even under low grazing pressures (Figure 5,6). Results indicate that both *Euclea* and *Acacia* shrubs offer adequate protection for *Olea* recruits against browsing animals. However, no significant differences in seedling survival could be detected between these two shrubs. Protection against browsing animals is therefore not the key-factor that explains why the majority of natural *Olea* regeneration occurs under *Euclea* and not under the dominant *Acacia* (see Aerts *et al.*, 2004).

Conclusions and recommendations

This study indicates that early-successional shrubs have the potential to facilitate natural forest regeneration by protecting new recruits against grazing and browsing animals. However, if a certain grazing pressure threshold is exceeded, all seedlings will be detected and predated by goats. Therefore, large herds of goats should be kept out of forest rehabilitation areas at all times. Recruitment of *Olea* is possible in partially closed rangeland if single grazing events do not exceed a maximum grazing pressure of 45 goat-hours per hectare. Experiments with subsequent grazing treatments could offer deeper insights. The installation of complete grazing exclosures for natural forest regeneration decreases the total surface area available for browsing significantly. This decrease in browsing area has to be compensated for by an increase in the supplemental feed supply.

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