

Fire and vegetation change in coastal grasslands , South Africa

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Introduction Successional progression from grassland dominated to tree dominated vegetation is common in both arid and humid areas . Factors influencing the successional processes vary depending on environmental conditions , with fire playing an increasingly important role with increasing rainfall . The influences of fire on these successional processes were investigated in the iSimangaliso Wetland Park (IWP) , located on the east coast of South Africa . This area experiences annual summer rainfall in excess of 1000 mm , with a mean maximum temperature in January of 25° C and frost free winters with a mean maximum of 18° C in July . Land use (and associated fire regime) in the area has changed in recent decades from rural shifting agriculture to commercial forestry plantations (during the 1950s) , conservation areas or wilderness areas . Fire and groundwater have been recognized as the main determinants of the coastal grasslands where regular inundation encourages a sedge rich hygrophilous grassland and above this , exclusion of fire results in succession through to forest scrub savanna and Dune Forest (Taylor 2003 ; Weisser & Marques 1979 ; Weisser & Muller 1983) . Where large areas have been afforested with *Pinus elliottii* , the use of fire in the surrounding grasslands was prohibited . In the wilderness area , active management has been kept to a minimum , and fires , whether natural or anthropogenic , have not been extinguished . This resulted in regular and extensive fires in the wilderness areas .

Materials and methods Aerial photography from 1937 , 1975 , and 2000 was georectified , digitized , and analyzed using a GIS to examine broad vegetation changes in the natural vegetation adjacent to the plantations (zero to low fire frequency) and in the wilderness area (high fire frequency) . Sites of comparable size and catenal position were located in each area . Vegetation changes , and the direction of change , were quantified on these sites . Vegetation was classified as grassland , scattered trees or dune forest .

Results and discussion In the low fire frequency areas adjacent to plantations , grassland and scattered trees decreased in extent from approximately 266 ha (39%) and 249 ha (36%) in 1937 to 61 ha (9%) and 80 ha (11%) in 2000 respectively , whereas Dune Forest increased from 111 ha (16%) in 1937 to 503 ha (73%) in 2000 . Dune Forest and Scattered Trees increased at the expense of grassland up to 1975 , after which Dune Forest increased at the expense of Scattered Trees . In the high fire frequency area , grassland was the dominant vegetation category in 1937 , however this category decreased in extent from approximately 1615 ha (55%) to 970 ha (33%) in 2000 . Dune Forest and Scattered Trees increased consistently from 732 ha (25%) and 537 ha (18%) in 1937 to 981 ha (33%) and 997 ha (33%) in 2000 respectively . Compared with the low fire frequency area where Dune Forest increased to dominate 60% of the vegetation these increases within the high fire frequency area are minimal . In the low fire frequency area Scattered Trees increased and then decreased with a change through to Dune Forest and Grassland decreased drastically . Within the high fire frequency area this change was not as drastic or as large . This difference still indicates a natural progression of these coastal grasslands to a woody dominated vegetation type but in the presence of regular disturbance , largely by fire , this progression is inhibited .

Conclusions The exclusion of fire from these coastal grasslands has a significant impact on the structure and composition of the vegetation , resulting in a complete transformation of the higher lying areas into a predominantly closed canopy dune forest . This transformation varied depending on proximity to higher lying areas and orientation within the catena where west facing sites showed the greatest degree of change . Lower lying sections tended towards scattered trees or a savanna-like vegetation type before ultimately progressing to Dune Forest . This implies that fire can be successfully applied or excluded as a management tool to manipulate vegetation composition and structure .

References

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