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Longevity, population stage and size structures, morphology and reproduction of four long-lived grassland suffrutices

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Abstract

Little is known about the longevity of grassland suffrutex plants and the relationship between longevity and plant morphological structures and seedling growth strategies. The aim of this study was to determine the longevity of four grassland suffrutex plant species, namely *Berkheya insignis, Callilepis laureola, Protea insignis* and *Tephrosia kraussiana*. Seed viability, seedling growth, morphology, habitat and population structure and demography were also assessed and related to plant age.

The rhizomes, seeds (if available) and canopies of *B. insignis*, C. *laureola, P. simplex* and *T. kraussiana* were removed from a site near Port Edward in the Pondoland region, KwaZulu-Natal, South Africa in April 2008. Seeds were available for *P. simplex* and *T. kraussiana* only. Seed germination and viability were tested in the field and laboratory using germination trials and tetrazolium tests. Greenhouse and field grown seedlings were used to monitor seedling growth and to record seedling morphology. The aerial and rhizome morphologies of adult plants excavated from the field were also recorded. The largest of these rhizomes were aged using radiocarbon dating. Attempts were made to develop morphological surrogates for plant age as no method currently exists. Plant density, demographies, number of inflorescences and various environmental variables of wild populations of *B. insignis*, C. *laureola, P. simplex* and *T. kraussiana* were sampled from the Red Desert Nature Reserve and the Umtamvuna Nature Reserve.

Species morphologies varied, however important similarities suggest convergent evolution. These included a single vertical main stem rhizome with multiple side branches, early rhizome development in seedlings, and high root: shoot ratios. Seed viability was high in the laboratory but low seedling emergence was observed in the field. Seedling growth was rapid for *T. kraussiana* and slow for *P. simplex*. The population stage structure for all four species comprised primarily adults with few or no juveniles. Wild population plant height and main stem diameter followed normal distributions. Number of stems, basal area, canopy area and the number of floral structures had distributions favouring the smaller size classes. Soil P, N, K and organic carbon were important soil nutrients in a PCA analysis of the habitats of the four species. Radiocarbon dating yielded the following ages: *B. insignis*: 49-51 years*, C. laureola*: 49-50 years*, P. simplex:* 49-51 years and *T. kraussiana:* 51 years. There was a significant relationship between rhizome mass and canopy area, basal area, height, number of stems and main stem diameter. Since rhizome mass had a positive relationship with age- a relationship between age and aerial structures is likely. Therefore, creating surrogates for age may be possible.

Overall, these species have moderate longevity, are poor seed producers with possibly slow population growth and are closely associated with soil nutrients. Therefore, these and other suffrutex species are particularly vulnerable to habitat destruction and climate change. The results of this study indicate that there needs to be a greater focus on below ground growth during ecological assessments in order to better understand the ecology of our diverse grassland biome plants.

Keywords: Demography, longevity, morphology, radiocarbon dating, rhizome, size structure, suffrutex, surrogates, viability.