CHAPTER 1

INTRODUCTION

Research in the arid areas has always been hampered by these regions' inaccessibility and harsh environmental conditions. The southern Kalahari is no exception and only limited and usually broadscale information is available on the biotic component and dynamics of the region. Basic and applied research on a number of aspects regarding the functioning and management of the ecosystem is therefore needed (Van Rooyen *et al.* 1996).

For a more complete understanding of the population dynamics of tropical trees, and consequently their sustained management, information on their age and growth rates are required (Gourlay & Grime 1994). It is obvious that before any attempts can be made to identify climatic conditions that relate to successful regeneration, it is necessary to develop a technique for dating the tree. One of the possible techniques of age determination is the counting of annual growth rings in wood samples. In the tropics and sub-tropics growth periodicity may however not be clearly limited to a particular season, so that it is necessary first to ascertain whether any anatomical structures delimit annual periods.

In order to date any tree by means of dendrochronology it is essential to assume that one growth-ring can be equated with one year's growth. Tree growth-rings are widely applied in ecological studies for determining tree ages, for investigating changes in growth rates and elucidating their causes. Age measurements are usually used to determine the age-class distribution of a tree population from which inferences on the dynamics of that population can be drawn (Fritts & Swetnam 1989).

Quantitative analyses of tree rings also gives information on the frequency of droughts and floods beyond the limited period of hydrological records. Tree rings are the most geographically widespread entity that can provide actual year-to-year dating of current and prehistoric environmental changes (Jacoby & Wagner 1993).

The relationship between ring counts and age is likely to be unique to a particular geographical area on the basis of climate. Even within one area, there is a high degree of variability in the relationship. This suggests that site characteristics may be important (e.g. moisture holding capacity of the soil; browsing pressure) and necessitates that sampling be done over a wide range of sites and ages (Martin & Moss 1997).

The Kalahari Gemsbok National Park is most suitable for vegetation studies as it is representative of the entire southern Kalahari duneveld and the vegetation, being protected from the over-utilization common in the adjacent farming areas, is in good condition (Lubbinge 1998).

The vegetation of the Kalahari Gemsbok National Park is both unique and sensitive. *Acacia erioloba* plays a pivotal role as keystone species in this environment and is of special ecological importance (Milton & Dean 1995). To manage the Kalahari Gemsbok National Park in a sustainable manner it is therefore of vital importance to study this keystone species to obtain as much information as possible.

Preliminary data (Van Rooyen *et al*. 1996) showed that a large proportion of the northern Nossob Riverbed in the Kalahari Gemsbok National Park exhibits an unhealthy *Acacia erioloba* population structure in that there is a poor survival of seedlings and an almost complete absence of juvenile plants. This recruitment failure leads to a decline in isolated mature trees, which may result in a change in the population structure of *Acacia erioloba* (Jeltsch *et al*. 1996) as well as their function in the ecosystem (Milton & Dean 1995). A decline in scattered mature trees may have serious implications for species diversity in the southern Kalahari (Milton & Dean 1995).

Should a tree ring analysis of the wood of *Acacia erioloba* be possible, this would allow more precise quantification of plant growth rates and population age structure in relation to soils, disturbance, succession and climate than has been previously possible for this species.

The objectives of this study were therefore to:
- investigate whether a wood anatomical feature, that has been shown to delimit annual periods in some African *Acacia* species, can be used to determine age in *Acacia erioloba*;

✦ determine whether growth-ring counts correlate with actual age as determined by carbon dating in *Acacia erioloba*;

✦ relate age and growth rate to stem circumference data;

✦ relate age and growth rate to meteorological data available for sites;

✦ develop age-size relations for *Acacia erioloba* on the basis of ring counts and carbon dated ages;

✦ analyse the age structure of the dominant species, i.e. *Acacia erioloba* in an attempt to infer both past and future states of the population; and

✦ make recommendations for future sustained management of the *Acacia erioloba* population.