

CHAPTER 6

Towards the development of a sustainable use management strategy for the Muzi Swamp, Tembe Elephant Park: an examination of trends in *Phragmites australis* reed use in the Sibonisweni Community

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ABSTRACT

Increasing rural population growth in Africa leads to an increasing reliance on natural resources for survival. Gross per capita income is supplemented by the utilisation of common pool resources within various communities in rural South Africa. The depletion of common pool resources in rural areas results in a greater demand for access to natural resources that are found in areas designated for conservation. This places reserve managers and conservation authorities under pressure to resolve the resultant issue of demands on such natural resource utilisation within the conservation areas. Management strategies for the sustainable use of natural resources within conservation areas have to be designed and implemented not only by reserve management but also by members of the local rural communities. Acceptance and implementation of suggested management

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strategies are more likely to succeed if decisions are made that recognise the need for, and incorporate the use of indigenous knowledge.

Key words: Sibonisweni, *Phragmites australis*, Tembe Elephant Park, Socio Economic, Indigenous Knowledge

INTRODUCTION

The importance and implications of incorporating local indigenous knowledge into natural resource management plans and conservation policies are underestimated and underutilised in many areas in South Africa. Although the responsible conservation bodies in the nine provinces in South Africa advocate interaction with local communities as part of their policy statements, the implementation and measurable rewards of these practices is still lacking in most cases (Els & Bothma 2000). The inclination, although correct in isolated cases, is to manage protected areas as islands. Using recognised and scientifically correct management practices, many natural areas, specifically those harbouring rare and endangered fauna and flora, have been successfully protected from the influence of increasing human population and subsequent over-exploitation of the natural resources.

Traditionally, it is believed that land-use and resource strategies that are implemented by rural populations in developing countries are in balance with nature because these people are so completely reliant upon it for survival. However, these views have become outdated as they are based mainly on ecological principles of balance and equilibrium (Thomas 2003). Rural populations are often perceived by many to be living in harmony with the land, as they have done for years, but this is not always true. Accounts of changes, from

as far back as 150 years ago, in ecological conditions due to the depressive effects of man on the environment have been recorded in regions of southern Africa by Campbell and Child (1971). These changes were effected when rural populations were much smaller than at present and when the people living in these times practised a far less intensive type of agriculture than today.

There is an increasing demand for land and natural resources in rural areas as the human population increases. Increases in population densities amongst rural communities are due to greater survival rates. This comes about through the development theory of improved living conditions for the poorest of the poor without taking into account the need for subsequent economic growth (Tiffen 2003). Advancements in basic health care (including the control of disease-carrying mosquitoes and malaria), growing economies in rural towns, and the provision of basic amenities such as readily available sources of potable water in remote areas, all have an impact on the rate of human population growth. This population growth, which is often accompanied by unemployment and a consequent lower per capita income, leads to a greater reliance on natural resources for survival. Although improvement in the living conditions of rural people is desirable, the effect on natural resources within these communities is often severe. Depletion of economically important natural resources outside conservation areas has led to greater pressure being exerted on conservation areas to allow access to said resources to the benefit of the rural population. Many of these natural resources are to be found exclusively in conservation areas such as the Tembe Elephant Park because of their complete protection or prudent management

The tendency has been to allow access to national and provincial parks and reserves only to tourists who can afford to pay for the experience. Local rural communities adjacent to these protected natural areas are often ignored and hence do not gain any financial or social benefit from an extensive natural resource base. There has to be a paradigm shift towards managing the environment for the benefit of people rather than managing and excluding them for the benefit of the environment (Els & Bothma 2000). Strategies therefore have to be devised for the sustainable use of the natural resources within protected areas.

The use of natural resources in low-income regions throughout South Africa is commonplace. People in the Maputaland region have used natural resources for thousands of years and have shaped the ecological balance in the area (Munnik 1991). The gathering of firewood, construction material, medicinal plants, fruit, honey and bushmeat (including birds and reptiles) are but a few of the resources that are known to be utilised by the people of Maputaland (Pooley 1980). Traditionally, reeds are used for hut building, craftwork and socio-cultural ceremonies (Cunningham 1985; Browning 2000). Reeds are also used for the making of fish traps, household utensils and musical instruments (Pooley 1980). Although reeds and forest timber are traditionally used for the making of huts, the more western style of housing by using concrete blocks and aluminium roofing is favoured if at all financially possible (Gaugris *pers. comm.*¹). The trend in rural Maputaland remains a major use of natural resources that can be obtained through self-collection, or bought at a cheaper price than manufactured materials. This inclination places pressure on environmentally sensitive areas such as the sand forest and

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swampland. In the case of the Tembe Elephant Park, access is granted to permit holders to harvest reeds in a limited area within the Muzi Swamp. This was one of the terms and conditions of the proclamation of the Tembe Elephant Park as is written in a letter² from the regional nature conservation officer to the Tembe Tribal Authority on 26 November 1982.

The aim of the present study was to examine the extent of not only reed use, but also of indigenous knowledge regarding the dynamics of reed growth in the Muzi Swamp, within the Sibonisweni Community. One of the determining factors for the development of a sustainable use management strategy for the Muzi Swamp is to determine the demand for reeds within the surrounding communities. If there is a massive demand for reeds from such community members, the current harvesting strategy will have to be improved to yield a greater production of reeds with an improved quality, without jeopardising the ecological integrity of the Muzi Swamp.

STUDY AREA

The study area comprised the neighbouring rural communities surrounding the Tembe Elephant Park situated in northern KwaZulu-Natal, South Africa. The core focus of this study, however, was in the neighbouring Sibonisweni community, being the stakeholders with the largest interest in the condition of the Muzi Swamp. The Sibonisweni Community borders the Tembe Elephant Park to the southeast (Fig. 1), with its southern boundary extending to the main tar road. The tar road is an important factor in the development of the trade in reeds in the area. The tar road leads to the largest town, KwaNgwanase, in

² KwaZulu Government Services, Department of Natural Resources, File 11/14/25/1, Volume1, Ref: 11/2/2/A.

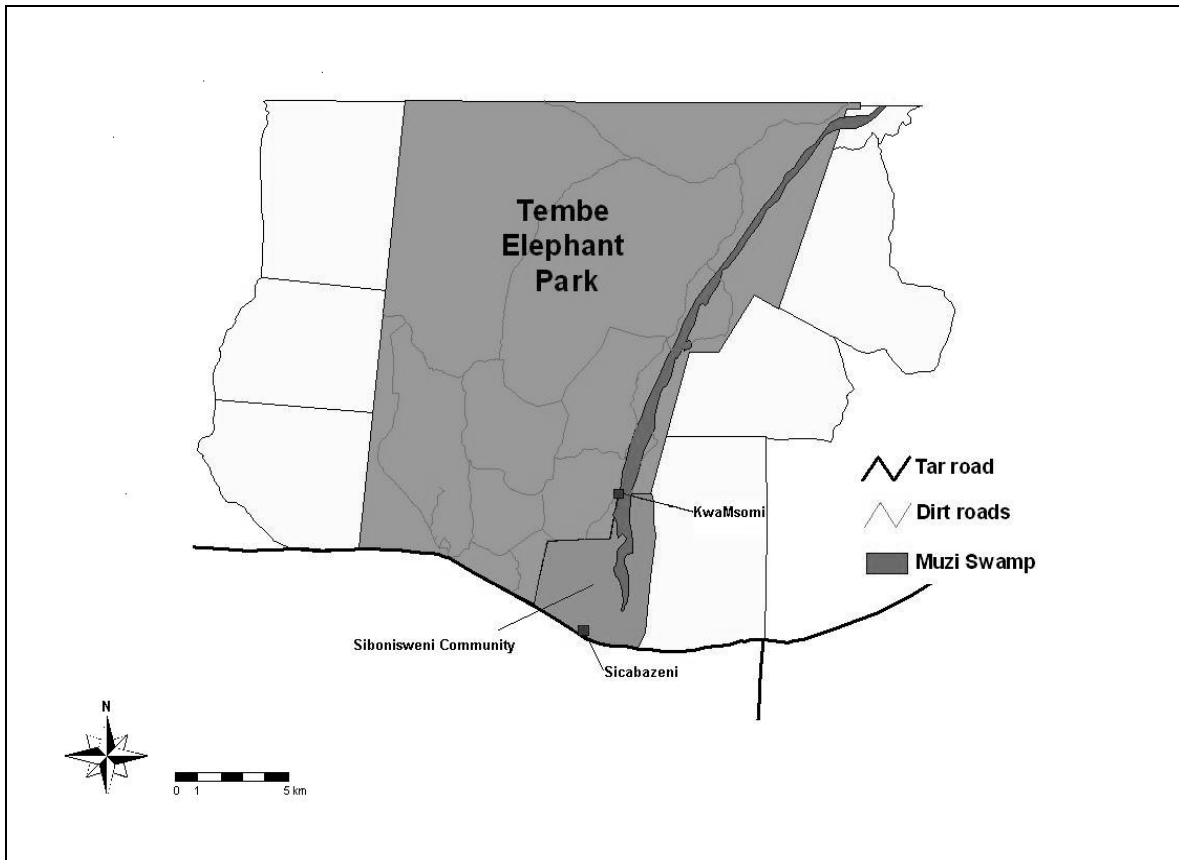


Figure 1: The study area showing the position of the Muzi Swamp within the Tembe Elephant Park as well as the Sibonisweni Community in northern KwaZulu-Natal, South Africa. Map compiled by J.L Jones (2003), University of Pretoria.

northern Maputaland as well as the southernmost border post (Kosi Bay) into Mozambique. Therefore it is also a major tourist artery for the region. The tourist traffic to Mozambique is largely responsible for the use of natural resources for the production of curios in this area, a substantial supplement to local resident's income.

METHODS

A trained interviewer conducted discussions with a representative from each of the 170 households within the Sibonisweni Community, with the questionnaires being completed by one member of each household. The interviewer was a Zulu-speaking member of the local community and as such the members of the community were quite willing and responsive during the survey process. The use of a local interviewer was found to be less intrusive than using an outsider. The questions were based on information obtained during the interview stage of the study. It is important that the researcher first gains an insight into what aspects of the study are important to the respondents before posing quantitative questions to them (Pratt & Loizos 1992). Although such questionnaire data are not statistically significant because of the non-random character of the sample (Pelto & Pelto 1978) the aim of the present study was not to do a statistical analysis, but merely to quantify the qualitative data obtained during the study. The data from the questionnaires were analysed by using a SPSS (Statistics Package for the Social Sciences) for Windows[®] computer package.

With the help of a local assistant to act as a translator the researcher was able to conduct interviews with members of the Sibonisweni Reed Cutters Association. Interviews were semi-structured, having predetermined questions as well as interactive conversation. Several of these qualitative data were used to structure the questions in the household

survey. Some questions had to be structured in such a way as to confirm interviewee answers. These questions were basic, with the interviewer already knowing the scientifically correct answer. This was to make certain that answers were honest and not what the interviewees perceived the researcher wanted to hear. The local community members do not favourably accept research into the reeds in the Muzi Swamp as they believe that any findings will have a negative influence on their harvesting quotas. It was made clear that the research was done on behalf of an independent organisation without a vested interest in the outcome of the study.

The interviews and conversations were conducted at the KwaMsomi Scout Camp for the purpose of approximating the extent of local knowledge and understanding of the dynamics of reed production within the Muzi Swamp. Members of the Sibonisweni Reed Cutters Association volunteered their time.

RESULTS

Respondent demographics

Interviews conducted at the 170 households showed that 46 (27.1 %) of the respondents were male, while 124 (72.9 %) of the respondents were female. The respondents had a high social status (Krige 1988) within the community with the majority of the questionnaires being completed by the only wife in the household (48.8 %), the male head of the household (21.2 %) or grandmothers (10.0 %). The total population of the Sibonisweni Community is estimated at 995 people, the second largest in the area (Jones 2004 *pers. comm.*³). Although the survey involved all the households in the Sibonisweni Community,

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the gender demographics may not reflect a true ratio within the community. The mean age of the respondents was 43.6 years (SD= ± 17.3 years). The majority (60.4 %) of the respondents were older than 36 years of age. Respondents from the 26 to 35-year age category comprised 28.6 % of the survey, while 11 % of the respondents were 25 years old or younger.

Extent of reed utilisation in the Sibonisweni Community

Of the 170 households, 164 (96.5 %) of the respondents said that they utilise reeds for various reasons. The majority response in the Sibonisweni Community indicates a preference to reeds for construction material because reeds are readily available in the area (56.5 %) and that reeds make for excellent building material (29.4 %). Six (3.5 %) respondents said that they did not utilise reeds as they preferred not to use them in construction. Reeds were used for construction by 85.9 % of the households, while 4.1 % of the respondents sold the reeds that they harvested. A further 7.6 % of the respondents harvested reeds for both construction material and to supplement their income.

Reed utilisation in Tembe Elephant Park

Within the Sibonisweni Community, 48 respondents (28.4 %) confirmed that they harvested reeds within the Tembe Elephant Park, with the majority (87.5 %) of these harvesters being women, whilst 122 (71.6 %) of the respondents did not harvest reeds within the Tembe Elephant Park. Of the 122 respondents who were not harvesting within the Tembe Elephant Park, only 10 (8.2 %) harvested reeds outside the Tembe Elephant Park. The reasons for not harvesting inside the park's boundaries included a lack of strength and time (18.7 %) and that not all the members of the Sibonisweni Community are granted access to the park (11.3 % of the respondents). The reasons for not

harvesting reeds outside the park boundaries included a lack of availability of the resource (19.4 %) and not having the strength or time to harvest the reeds there (11.2 %).

The respondents harvesting reeds inside the Tembe Elephant Park suggested that it is the most desirable place to harvest reeds because the resource is readily available there. Community members also believe that the reeds inside the Tembe Elephant Park are of a better quality than those found outside the park. Yet, although the reed beds inside the Tembe Elephant Park are more extensive than those outside the park, there is a decline in reed quality in the allotted harvesting area within the park compared to reeds found in the excluded zones within the reserve. The majority of the respondents harvesting reeds inside the Tembe Elephant Park harvest them once a week (58.1 %), although 27.9 % of the respondents harvest reeds every day. Of the harvesters, 95.0 % harvest one reed bundle at a time, while 7 % indicated that they harvested two reed bundles at a time. This seven percent possibly reflects the allocation of harvesting permits to members within the same household, as it is physically impossible to harvest more than one bundle of reeds per day.

Economic importance of the reeds

When asked if the respondents bought reeds, 114 (67.5 %) of them said that they did so, while 56 (32.5 %) said that they did not buy reeds. The majority (68.6 %) of the reeds are bought at Sicabazeni (Fig. 1). Other respondents indicated that they bought reeds at KwaMsoni and/or Sicabazeni (27.9 %), KwaMsoni (1.9 %) and other markets (1.6 %). Reed prices were consistent throughout the survey, with the same prices quoted by all the respondents. The price of reeds, irrespective of the market at which they were purchased, was ZAR 4.50. The mean number of reed bundles required to construct a house was 56.6

(SD= ± 38.42)(maximum price of ZAR 427.50) when using tall reed bundles, while the mean for short reed bundles was 231.8 (SD= ± 63.1)(maximum price of ZAR 1327.05).

Sibonisweni Reed Cutters Association's interview

The summer months, September to February, are when the reeds are most productive, although in this subtropical climate they will also take shoot and grow in the winter months. Reeds that have taken shoot in the winter months are, however, not considered to be of a high quality. Side shoots develop after harvesting, but the side shoots are not of the best quality. Reeds that are tall and thick produce side shoots that are of a similar nature when cut. If the "mother plant" is strong and healthy it will produce relatively good side shoots. Wildlife such as the buffalo (*Syncerus caffer*), warthog (*Phacochoerus africanus*) and reedbuck (*Redunca arundinum*) prefer to graze the shoots of freshly cut reeds. All the reeds produce a flower (panicle) and it is not dependent on the height of the reed but rather their age. Reeds with flowers are generally good for construction because of their thickness and height. Reeds flower in February after approximately one year. Reeds cut under the water, as close as possible to the base, will grow better than those cut above the water. Reeds cut under the water, close to the soil surface, also do not damage the feet of the harvesters. Water levels are highest in the Muzi Swamp in the summer months, during the rainy season. Reeds grow better in waist high (approximately 0.8 m deep) water, compared with drier conditions. Burning in the winter months leads to a greater fire intensity because the standing crop of reeds is drier than in the summer months. Burning of reeds in the winter months will result in a replacement crop that is of a good quality. Burning is more beneficial than cutting to the production of a good replacement crop.

The interviews showed that the reed harvesters have a fair understanding of the conditions under which reeds perform optimally in terms of production. Recent, as well as historical literature tends to support these views, as is shown below:

Reed growth occurs mainly in the summer, with replacement buds being produced throughout the year but remaining dormant and/or stunted at or near the soil surface (Van der Toorn & Mook 1982). Buds in various stages of maturity produce a succession of replacement shoots (McKean 2001) after the reed has been damaged or cut. *Phragmites australis* is heavily grazed according to Zacharias (1990) and moderately to lightly grazed as a tall or mature grass (Haslam 1970; Viljoen 1976; Van Oudtshoorn 1999). Flowers are produced from December to June but not necessarily all the culms produce panicles (Gibbs-Russell, Watson, Koekemoer, Smook, Barker, Anderson, & Dallwitz 1980; Zacharias 1990; Van Oudtshoorn 1999). The cutting or harvesting of reeds below water level is, however, not desirable during the growing season. Although harvesters obtain reeds that are longer than those cut above the water, there is evidence that suggests below-water harvesting at certain times of the year (growth period) negatively influences the replacement crop the following year (Weisner & Granéli 1989) because of a reduction in oxygen transport to the root system. This is especially evident in reed beds where the substrate is highly anaerobic, such as in the peat found in the Muzi Swamp. This further increases the motivation for a winter harvest. *Phragmites australis* grows better in submerged conditions where there is constant inundation (Viljoen 1976; Van der Werff 1991). Reeds growing in water that is 0.70 m to 0.75 m deep allocate proportionately more reserves to the above-ground parts (culms) resulting in taller, thicker stems (Vretare, Weisner, Strand, & Granéli 2001). Burning of the reed beds in the winter months will result in a total replacement crop the following season (Van der Toorn & Mook 1982).

DISCUSSION

Although the questionnaires included all of the 170 households within the Sibonisweni Community the results that are reflected in this paper are merely an indication of trends regarding reed use within the community. All of the community members could not be interviewed individually as this would have proven to be too time consuming. The interviewer's mandate was, however, to interview members of the households with a high social ranking or elder position within the community. The majority of the people interviewed were indeed senior members of the household, being either the first wife or the head of the household (Krige 1988). One of the most important trends to emerge from the questionnaires was that the majority of the reed users were women. This was also reflected in the number of women harvesting reeds within the Tembe Elephant Park. Seeing that there is a significantly ($p = 0.04$) higher ratio of female to male harvesters there must be a greater input in the decision-making and involvement by women in the management of the reed beds in the Muzi Swamp. Women are also largely responsible for the management of the finances within the household, budgeting and paying for food, clothing and their children's education (Els *pers.comm.*⁴) It is for this reason that their grasp for the monetary value of commodities would be greater than that of the men within the households. Therefore it is important that women are actively involved in the formulation and implementation of the sustainable use management strategy for the Muzi Swamp.

The human population density within communities neighbouring protected areas should be taken into consideration when devising reed harvesting quotas in a management strategy.

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Communities with a high population density should be allocated a proportionately larger quota than communities with fewer members. Sibonisweni Community, being the most populous of the communities that harvest reeds in the Tembe Elephant Park should therefore have a major share of the total.

Reed use seems to be limited to construction material for the building of houses, although the interpretation of the question might have lead to a skewed answer. Many of the respondents might have interpreted the question as, “what is the end use for reeds?” instead of “what do *you* use reeds for?” The main reason for harvesting reeds within the Tembe Elephant Park is to supplement or is indeed the only source of income for reed harvesters. Reeds are used personally if and when they need to, but the excess is sold. Although not reflected in the questionnaire data, a third of the respondents are believed to sell reeds to supplement their income.

Another important aspect was that there is little reed harvesting being done outside the Tembe Elephant Park. This was ascribed to a lack of availability of the resource. This point emphasises the belief that the Muzi Swamp has become severely degraded outside the conservation area due to uncontrolled communal use. Reed beds within the Tembe Elephant Park are possibly the last remaining viable natural population of *Phragmites australis* within the northern Maputaland region in terms of sustainable use. This is not to say that they should not be utilised. *Phragmites australis* is a resilient species and can maintain itself at relatively high levels of utilisation when compared to other species (Haslam 1969a; Van der Toorn & Mook 1982). When the resource is managed correctly harvesting can even improve production potential.

At present there are 55 permit holders (the questionnaire indicated 48), and all are members of the Sibonisweni Reed Cutters Association. In the winter months only a certain portion of these harvesters with permits are allowed to enter the reserve to harvest reeds. A further reduced quota applies for the summer months in an effort by the Tembe Elephant Park management to reduce harvesting pressure in the growing season. The reserve management has made it clear that were the harvesting to take place solely after the growing season in the winter months then the full quota would be allowed to be harvested during that period.

A large majority of the Sibonisweni Community buy reeds from various markets, the most important one being Sicabazini. Being situated next to the tar road, Sicabazini is easily accessible not only to the local members of the community but also to bulk buyers wanting to supply markets further afield. Given the nominal price for a bundle of reeds, this external commercialisation of reeds could lead to a greater demand by reed harvesters for a larger quota. The price of reeds per bundle has increased by 12.5% over the last four years, from ZAR 4.00 to ZAR 4.50 at the local markets. The mean increase of 3.1% per annum is below South Africa's annual inflation rate. If the sale price of the resource is not adjusted according to the rate of increase of the price of general goods then the demand by the harvesters for a greater volume of reeds to be harvested will increase concomitantly. In this regard there has to be a development of secondary industries surrounding and supplementing the harvest of reeds in Tembe Elephant Park. Resources should be made more profitable by manufacturing secondary products and not only by collecting the raw material for sale. The development of secondary industries and their markets will not only benefit the reed harvesters but also the sustainable use programme implemented by Tembe Elephant Park management and the Sibonisweni Community. Secondary

industries undertaken in the summer months when harvesting should not take place will alleviate community pressure for year-round access to the reed beds.

CONCLUSIONS

Increasing human population will not be supported by the environment alone. For there to be decreased dependency on the environment for day to day living there have to be alternative sources of income. Correct management of a resource coupled with sustainable use will falter if it is not accompanied by secondary economic growth in the area. An increase in the demand for the resource without a proportional increase in the price of the resource over time will increase the utilisation demand.

The environment can, however, be used as a tool for economic and social growth within rural areas. Partnerships should be encouraged between wildlife reserve managers and local rural communities. Ideas and proposals shared among parties might lead to tangible benefits to both. Encouraging input in the form of local knowledge from local rural communities, especially within already existing interested parties and associations, will reduce animosity between the people who live in the area and the people that are paid to protect it. By collating local knowledge, the managers not only gain an insight into the views of resource-users, but also create a vehicle for communicating proposed management activities. Indigenous and local knowledge have been shown to correlate with research results that take years of study before firm conclusions are reached in some instances (Thomas 2003). The more public participation there is in formulating and implementing natural resource management actions, the more likely they are to succeed (Robertson & McGee 2003). The encouragement and involvement in natural areas management by local rural communities will also promote environmental education. This

will benefit protected areas by stimulating conservation and wise natural resource use outside these areas, thereby reducing utilisation pressure within them. Conservation outside natural protected areas will also reduce the island effect that is created by fences, and will in turn effectively increase the diversity and range of species under protection.

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REFERENCES

- BROWNING, T.C. 2000. Preliminary study of the socio-economic value of *Phragmites* reeds to the people neighbouring Tembe Elephant Park, KwaZulu-Natal. BA (Hons) APL 770 Project Report. University of Pretoria, Pretoria.
- CAMPBELL, A. & CHILD, G. 1971. The impact of man on the environment of Botswana. *Botswana Notes and Records* 3: 91-110.
- CUNNINGHAM, A.B. 1985. The resource value of indigenous plants to rural people in a low agricultural potential area. PhD (Botany) thesis, University of Cape Town, Cape Town.
- ELS, H. & BOTHMA, J. DU P. 2000. Developing partnerships in a paradigm shift to achieve conservation reality in South Africa. *Koedoe* 43: 19-26.
- GIBBS-RUSSELL, G.E., WATSON, L., KOEKEMOER, M., SMOOK, L., BARKER, N.P., ANDERSON, H.M. & DALLWITZ, M.J. 1990. Grasses of southern Africa. National Botanical Institute, Pretoria.
- HASLAM, S.M. 1969a. The development of shoots in *Phragmites communis* Trin. *Ann. Bot-London* 33: 695-709.
- HASLAM, S.M. 1970. The development of the annual population in *Phragmites communis* Trin. *Ann. Bot-London* 34: 571-591.
- KRIGE, E.J. 1988. The social system of the Zulus. Shuter & Shooter, Pietermaritzburg.
- MCKEAN, S.G. 2001. Productivity and sustainable use of *Phragmites* in the Fuyeni reed bed - Hluluwe-Umfolozi Park - Management guidelines for harvest. *S. Afr. J. Bot.* 67: 274-280.
- MUNNIK, F. 1991. Incema is money: transforming tradition. *New Ground: the journal of development and environment* 2: 12-13.

- PELTO, P.J. & PELTO, G.H. 1978. Anthropological research: the structure of inquiry. Cambridge University Press, London.
- POOLEY, E.S. 1980. Some notes on the utilization of natural resources by the tribal people of Maputaland. In: M.N. Bruton & K.H. Cooper (Eds.), Studies on the ecology of Maputaland (pp. 467-479). Rhodes University & Natal Branch of the Wildlife Society of Southern Africa, Durban.
- PRATT, B. & LOIZOS, P. 1992. Choosing research methods: data collection for development workers. Oxfam, Oxford.
- ROBERTSON, H.A. & MCGEE, T. 2003. Applying local knowledge: the contribution of oral history to wetland rehabilitation at Kanyapella Basin, Australia. *J. Environ. Manage.* 69: 275-287.
- SPSS for Windows®. Standard Version 11.5.0. SPSS Inc. South Africa.
- THOMAS, W.H. 2003. One last chance: tapping indigenous knowledge to produce sustainable conservation policies. *Futures* 35: 989-998.
- TIFFEN, M. 2003. Transition in Sub-Saharan Africa: Agriculture, urbanization and income growth. *World Development* 31: 1343-1366.
- VAN DER TOORN, J. & MOOK, J.H. 1982. The influence of environmental factors and management on stands of *Phragmites australis* L. Effects of burning, frost and insect damage on shoot density and shoot size. *J. Appl. Ecol.* 19: 477-499.
- VAN DER WERFF, M. 1991. Common Reed. In: J. Rozema & J.A.C Verkleij (Eds.), Ecological responses to environmental stresses (pp. 172-182). Kluwer Academic Publishers, Netherlands.
- VAN OUDTSHOORN, F. 1999. Guide to grasses of southern Africa (p. 178). Briza Publications, Pretoria.
- VILJOEN, L. 1976. Uses of *Phragmites australis*. *Hand. Weidingsveren. S. Afr.* 11: 19-22.

VRETARE, V., WEISNER, S.E.B., STRAND, J.A. & GRANÉLI, W. 2001. Phenotypic plasticity in *Phragmites australis* as a functional response to water depth. *Aquat. Bot.* 69: 127-145.

WEISNER, S.E.B & GRANÉLI, W. 1989. Influence of the substrate conditions on the growth of *Phragmites australis* after a reduction in oxygen transport to below-ground parts. *Aquat. Bot.* 35: 71-80.

ZACHARIAS, P.J.K. 1990. Acock's Notes: key grasses of South Africa. Grassland Society of South Africa, Howick.