CHAPTER 8

GENERAL DISCUSSION

The focus of this study was to understand the extent and nature of *Phragmites australis* reed use by the neighbouring communities of the Tembe Elephant Park. The utilisation of reeds by the Sibonisweni community was specifically examined because the area that members of this community utilise is by far the largest and presents the most concern for the Tembe Elephant Park management. It is foreseeable that trends regarding the effects of reed utilisation in the other neighbouring communities are similar, but the trends are not as pronounced there because of the lesser scale and intensity at which these communities harvest reeds.

To learn more about how the Muzi Swamp is being affected by reed harvesting, various facets were considered. Visually, it appeared at the beginning of the study that reed quality was generally poorer in the southern parts of the Muzi Swamp then elsewhere and that there was a gradual improvement in reed quality further away from the gate of the Tembe Elephant Park at KwaMsomi. It was believed that this was brought about by the tenet that people will use the least amount of energy to obtain maximal rewards. Because the reed harvesters have to carry their harvested reed bundles out of the Tembe Elephant Park at the gate at KwaMsomi in the south, it was hypothesised that there would be a degradation gradient in reed quality from south to north. As reed harvesting was expected to be concentrated in the south, it would then result in much fewer and poorer quality reeds in these areas, with a gradual increase in reed quality further north of the entrance and exit point at KwaMsomi Gate.

It was for this reason that a study of the reeds in a south to north direction was conducted to determine whether there was indeed such a degradation gradient. The effects of reed harvesting were measured in terms of measurable properties that included reed height, reed diameter, reed density, reed yield and mean reed mass. The effects of reed harvesting were shown to be similar for reed height and diameter, with both these properties being inextricably linked (Van der Toorn & Mook 1982; Hara *et al*. 1993). However, reed height and diameter did not reflect a degradation gradient from south to north. However, mean reed height and diameter oscillated at various intervals along the gradient because of the nature of the harvesting regime employed by the reed harvesters. Once an area, which is often discrete, has been harvested, the harvesters will only return after they regard this area to have recovered sufficiently. This was shown by the significant positive linear correlation between reed height and the time elapsed since the reeds of a specific area were last harvested.

There was also no distinct degradation gradient when reed density was examined at the various intervals along the south to north transect. In fact, reed harvesting in the Muzi Swamp had no predictable effect on reed density whatsoever. These conclusions are contrary to what Granéli (1989) found in southern Sweden, when he concluded that reed density and above-ground biomass in a winter-harvested area was significantly higher than in an area that had not been harvested. An increased amount of light resulting from the removal of reeds in the winter is one of the factors that have been believed to cause to this response. The increased light is believed to stimulate the emergence of latent buds on vertical rhizomes. The other possible factor given for the higher reed density was the increase in water temperature because of higher solar radiation, which in the case of the Muzi Swamp is not relevant because of its subtropical climate when compared to Granéli's study, where the climate was temperate. Reed density can be affected by various environmental and human causes with the number of standing but dead culms being dependent on the degree of damage inflicted by man and the environment over time (Thompson & Shay 1984; Marks, Lapin & Randall 1994). Burning of the reed beds, whether it is a natural or man-induced fire, can increase reed density depending on the frequency and temporal range of these fires (Thompson & Shay 1984). Burning of the reeds in the winter months would have a similar effect on reed density as a winter harvest (Granéli 1989). Accurate dates cannot be given as to when the fires in the Muzi Swamp occurred but it is presumed that they spread from areas outside the Tembe Elephant Park in the autumn months (April to May) when widespread burning takes place in Maputaland. Purposely lit fires are common in Maputaland at this time of year, as it is believed to stimulate the production of forage for cattle in the spring. Other environmental factors such as the type of substrate that the reeds are growing in and the water depth will also affect the density of reeds (Van der Werff 1991). The substrate in the Muzi Swamp is consistently similar throughout the study area (Grundling 1999) and was not considered to be a significant environmental variable. The environmental variables that were recorded in this study did not show any significant relationship with the reed densities at the respective harvesting intervals. This is possibly because harvesting, especially that of the large reeds and dead culms, had a dominant influence on the reed densities in the harvesting areas. Further study of the effects of environmental factors on reed density in the unharvested areas could provide more conclusive answers.

Trends regarding reed yield and mean reed mass were similar to those for reed height and diameter. There was a positive linear relationship between reed height and mean mass. The mean reed yield did not correlate directly with mean reed mass at a specific site along the south to north transect. This was because of differences in reed density along the transect. Some of the harvested areas had a high density of shorter and thinner reeds, producing a high reed yield, whereas other areas had taller and thicker reeds but they occurred at a much lower density, producing similar yields. One of the aims of reed bed management in the Muzi Swamp should be to get a positive correlation between mean reed mass and yield. It would be preferable to have a relatively low reed density, but with a greater proportion of the reeds having a high mean reed mass resulting in an increased abundance of harvestable reeds.

It was shown conclusively that there was no degradation gradient in a south to north direction in the Muzi Swamp where the Sibonisweni community harvests their reeds. There was, however, evidence that the general condition of the reeds in the harvesting area is deteriorating. This was supported by the results of the study of the long-term effects of burning and utilisation on *Phragmites australis* in the Muzi Swamp.

The mean reed height and diameter in areas that are utilised was lower than the mean height and diameter of reeds in the unutilised areas. Ideally, sustainable utilisation of reeds should not have any effect on the production potential, and therefore on the mean reed height and diameter, of reed beds over time (Granéli 1984). The reduced mean reed height and diameter in the harvesting area, when compared to the unutilised areas, was a direct result of continual harvesting throughout the year. Summer harvests reduce reed quality substantially and this type of harvesting system is used in other parts of the world to eliminate *Phragmites australis* from wetland systems (Haslam 1969; Granéli 1984; Ostendorp 1989; Marks *et al*. 1994).

The results showed a significant difference in the mean height and diameter of reeds in 2000 and 2002 over the entire sampling area. The reduced mean reed height and diameter in the unutilised and unburnt areas in 2000 could be attributed to the catastrophic floods that occurred there just before the present study in 2000. The rapid flow of water and prolonged elevation of water levels damaged the already standing reeds and could have also prevented the emergence of replacement shoots because of the extended inundation period caused by the flooding (Armstrong *et al*. 1999). The unutilised unburnt reed beds in 2002 showed a markedly significant increase in mean reed height and diameter from that of 2000, indicating a good recovery after this catastrophic event. Were it not for the flooding that took place before the study in 2000 it might have been expected there to have been a significant difference between the mean reed height and mean reed diameter in the utilised areas of 2000 and 2002. Harvesting of reeds throughout the year might well have reduced the mean reed height and diameter of reeds in the utilised areas between the two years of sampling, and this would have been reflected by a reduction in these mean reed characteristics for 2002.

There were no conclusive tendencies with regard to mean reed height and diameter when burnt and unburnt areas were compared in the utilised areas. The opposite is true for reed density. Both the burnt treatment plots had similar reed densities, whether they were utilised or not. The burnt, utilised treatment plots had a significantly lower reed density than the utilised unburnt treatment ones. The combination of stresses of burning and utilisation therefore markedly reduced the number of reeds present per unit area.

Reducing the amount of accumulating material in the Muzi Swamp could happen in one of two ways. Reeds could either be burnt in the winter to the early spring, or they can be harvested in the winter (Mook & Van der Toorn 1982; Granéli 1984). A thick litter mat, which forms as a result of the accumulation of decaying reed material, was often found in areas that were not burnt or utilised. The litter mat reduced the density of reeds by preventing light from reaching the developing shoots (Thompson & Shay 1985). A combination of the two actions will be detrimental to the production and quality of the reeds produced. Burning also resulted in a lower mean reed mass than what would be expected in unburnt areas, which was not ideal for the production of a high proportion of good quality reeds (Thompson & Shay 1985). The lowered mean reed mass was the result of the breaking of apical dominance of the parent reed and subsequent formation of vegetative side shoots. The use of fire in the spring to promote the vegetative spread of *Phragmites australis* has been used with great success in the past (Thompson & Shay 1985) and this type of management should be implemented in the Muzi Swamp in an attempt to re-establish a healthy, utilisable reed bed outside the Tembe Elephant Park.

The re-establishment of *Phragmites australis* in the Muzi Swamp outside the Tembe Elephant Park is a fundamental concern for the Tembe Elephant Park Management. Although reeds do occur in these communal areas of the Muzi Swamp, the extent and condition of the reed beds was believed to be inadequate for sustainable use. Overutilisation of reeds in the communal area, as well as an indiscriminate and unmanaged use of the resource, was responsible for its current state. It has become a “tragedy of the commons” situation in which reeds in the communal areas are utilised by members of the Sibonisweni community as and when they need them. Management programmes designed and implemented for the Muzi Swamp inside the Tembe Elephant Park should be applicable and be implemented outside the conservation area as well. There should be a broader understanding of the management programme that is implemented in the Muzi Swamp, not just by the Tembe Elephant Park management and the Sibonisweni Reed Cutters Association, but also by the Sibonisweni community as a whole.

In order to understand the local community needs for sustenance, cultural requirements, and their impacts on natural resources, baseline data were collected in the Sibonisweni community. This type of information is invaluable to reserve managers if they are to successfully coordinate decision-making with resident political structures, as well as for setting sustainable levels of local economic activity, whilst still protecting the Tembe Elephant Park's objectives (Machlis 1995). Although this part of the study was somewhat superficial and mostly addressed the concerns regarding reed use in the Sibonisweni community it did emphasise the importance of incorporating social sciences in protected area management strategies. It is important that natural resource managers are continually updated on the key issues relevant to the communities neighbouring nature reserves. Information that is made available to conservation authorities must be imminently usable and should also be predictive. Protected area managers must know what the consequences of their actions will be before they apply new management decisions. The social sciences can provide useful strategies for dealing with the consequences of management decisions. These include the use of economic incentives, communication techniques and conflict resolution (Machlis 1995).

Research based on interviews and questionnaires performed in the Sibonisweni community showed that the majority of people living in this area are completely reliant upon reeds. Most of the respondents (96.5 %) used reeds for the building of huts and other structures on their homesteads. The reason that reed use was so dominant was because reeds are easily obtainable in the area and reeds are also relatively inexpensive when compared with the more modern construction materials.

Only a small percentage of the community is allowed to harvest reeds in the Tembe Elephant Park as a result of the permit allocation. Most of these permit holders are women, with only a handful of men making the decisions regarding reed utilisation. An even smaller percentage (<10 %) of the rest of the community harvest reeds outside the Tembe Elephant Park. They ascribe this small percentage of use to a lack of availability and poor quality of reeds found in the communal area. Most of the people of the Sibonisweni community have to buy reeds from the reed markets at Sicabazeni. Although a seemingly nominal price by western standards of ZAR 4.50 per bundle was paid for the reeds, the mean number of 57 bundles required to complete one hut was quite substantial. This equates to an expenditure of ZAR 427.50. This is almost a full month's income to most of the community members. Results also indicated that the same price was paid for reed bundles containing thinner and shorter reeds, but it requires four times the number of bundles to complete a hut. It was therefore obvious from these results that the production of better quality reeds would be beneficial to all community members, including the harvesters. The number of bundles being harvested and the number of bundles being sold would then reach equilibrium, reducing wastage and increasing earnings. Reed buyers will also benefit from the improved reed quality, which will save them money in hut construction.

Members of the Sibonisweni Reed Cutters Association realise the benefits of producing and delivering a better quality reed. Interviews conducted with them showed that their understanding of reed growth dynamics was reasonable. Evidence found in the present study, including well-documented results from the literature, support their comments and statements. The Sibonisweni reed cutters commented that reeds usually take shoot and grow in the late spring and summer months, but can produce replacement shoots all year round. These replacement shoots are not of a good quality and rarely suitable for use in hut building. This is confirmed by Haslam (1969), Mook & Van der Toorn (1989) and McKean (2001). According to the reed cutters, a water depth of about waist deep (0.7 m) also seemed to be an important factor that would result in the production of good quality reeds. Viljoen (1976), Van der Werff (1991) and Vretare *et al*. (2001) have all published data that corroborate this statement, suggesting that *Phragmites australis* grows better in submerged conditions and that the plant will allocate proportionately more nutrient reserves to shoots growing in water that is around 0.7 m deep. The shoots growing in these conditions will benefit from the increased allocation of reserves and if they are allowed to mature will become tall and thick. The reed cutters also prescribe a winter burn to produce a replacement crop that is similar, if not better than the previous year's crop. The literature, however, states that a winter burn will have similar effects on the following year's production as a winter harvest (Van der Toorn & Mook 1982; Thompson & Shay 1984). The reed cutters also say that they prefer to harvest the reeds under the water, at substrate level, as they will then grow better the following season. It is possible that they said this because they were able to obtain a longer reed by cutting it under the water, rather than above it. The reed cutters also mentioned that reeds that are cut as close to the substrate as possible resulted in a reed stubble that did not hurt their feet while they were harvesting other reeds. The depth at which reeds are cut will be a contentious issue. It is obvious from a practical standpoint that they should be cut as close to the substrate as possible, not only because of the added length of the reed in deeper water, but also to reduce the damage that the reeds cause to the harvester's feet. In theory, however, cutting the reeds below water level is damaging to the rhizosphere. It is known that cutting reeds below the water in the growing period (or summer months) will reduce gaseous exchange between the atmosphere and the rhizomes. This results in an almost total inhibition of re-growth of shoots the following season (Brix 1989; Weisner & Granéli 1989). It is not clear what the effect of the reduction in gaseous exchange has on the reeds in the Muzi Swamp and this is a possible direction for further study.

Indigenous knowledge is not employed as well as it should be. One of the reasons for this is a communication problem between researchers, reserve management and community representatives. Not only is the language barrier a problem but there is also little understanding as to the correct way to approach and talk to members from these different societies. The lack of will to implement strategies that the reed harvesters themselves admit will benefit reed production in the Muzi Swamp is problematic and not easy to explain. One theory is that reed harvesters view the harvesting of reeds as a job, one in which there is a potential to earn income from the products of the harvest. If they only harvest in the winter months then they are effectively "unemployed" for the rest of the year. The solution to this problem might be to explore secondary industries evolving from reed harvesting. In this way reeds could be harvested in the winter and for the rest of the year value added reed products can be manufactured to supplement the Sibonisweni Reed Cutters Association income.

One suggested secondary industry was explained in Chapter 7 where the manufacturing prefabricated panels made of sustainably harvested forest timber and reeds are examined. The making of huts from the assembly of these panels was compared with the cost of building a hut from bought reeds or modern construction material. The cost of materials for a prefabricated reed and forest timber hut was calculated as being less than half the cost of materials for a cement-block house. Although this seems like a more reasonable price to pay for a habitation, the trend in rural Maputaland is for the head of the household to have a hut made of western building materials. This does not mean, however, that there is not a potential market for prefabricated reed and forest timber huts. Families living in the poor rural communities neighbouring the Tembe Elephant Park will probably only be able to afford one such professionally built brick hut. The cost of builder's fees will favour the erection of prefabricated reed and forest timber huts for use as secondary living quarters. These secondary living quarters are used for extended family, children's sleeping quarters, kitchens and grain stores.

The research hypothesis behind this chapter was to offer an alternative employment opportunity during the summer months, thereby ameliorating the negative effects of a year-round reed harvest. Harvesting reeds and forest timber according to the suggested management recommendations and scientifically based harvesting quotas would mean that the reed harvesters could produce the reed and forest timber panels when the harvesting season was finished, effectively "employing" them during this time. The manufacture of prefabricated reed and forest timber panels would also add value to the resource. The sale of processed articles from natural resources would amount to a greater income earned per harvested unit as opposed to merely selling the raw materials.

The financial value added through the processing of the reed resource can possibly result in two very different conclusions. The increased value of manufacturing finished articles form the harvested reeds might well increase the demand for the resource because of the greater income generated from it. This could place further strain on the Tembe Elephant Park management in terms of a more vociferous call for freer access and increased reed harvesting quotas in the Muzi Swamp. It is hoped that the Sibonisweni Reed Cutters Association will have the foresight to appreciate what could be done with the resources available to them, utilising the same resource, at the same levels, for an increased profit. It is also hoped that the reed harvesters' involvement in the monitoring and subsequent setting of quotas will be based on scientific evidence and an appreciation for the value of sustainability, maintaining the resource for future use, not merely seeing how much financial reward can immediately be gained. This culture of conservation has to be instilled through education, involvement in management decisions and processes and tangible benefits offered by the resources that are being protected.

There will undoubtedly be reservations to the proposal of allowing sustainable forest timber harvesting in the Tembe Elephant Park. Although there is scientific evidence that suggests that forest timber harvesting in the Tembe Elephant Park is sustainable there will more than likely be political issues that decide whether or not this can take place. In the Tembe Elephant Park, as in most protected areas surrounded by rural communal land, it will be difficult to allow one neighbouring community access to a newly available resource and not another. The Tembe Elephant Park management will be loath to go ahead with another resource-use programme when the current programme is such a political headache. In all likelihood the other neighbouring communities will have to be apportioned similar quotas, depending on the population size of the community, thereby reducing the effective harvesting area and harvesting quota of the Sibonisweni community. Perhaps the correct way forward in this case would be to encourage a pilot project within the Sibonisweni community only. Thereafter, should there be continued interest by other communities, new quotas and designated harvesting areas can be apportioned. In this way neighbouring communities will also be able to learn from mistakes and successes made by the Sibonisweni community.

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