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The distribution and state of mangroves along the coast of Transkei, Eastern Cape Province, South Africa

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Abstract

The mangrove communities along the coastline of the former Transkei, now part of the Eastern Cape Province, have not been looked at in detail since Ward and Steinke's survey in 1982. Mangroves previously occurred in 17 estuaries but were now found in only 14 of the 76 estuaries visited, with a complete loss of mangroves evident in the Mnyameni, Mzimvubu and Bulungula estuaries amounting to 7.5 ha. Total mangrove loss amounted to 17.6 ha which represents a 6.5% loss over 17 years or 1.04 ha per annum. Tree cover had increased by 16.15 ha in eight other estuaries. This increase could be attributed to the inaccessibility of mangrove stands or to protection afforded by provincial nature reserves and hotel resorts. No new mangrove stands were recorded, although Steinke (pers. comm.) has recently recorded mangroves along the north bank of the Kei River. There has been little change in mangrove species composition in the different estuaries over the past 17 years. Total mangrove loss amounted to 17.6 ha which represents a 6.5% loss over 17 years or 1.04 ha per annum and the species recorded included *Avicennia marina*, *Bruguiera gymnorhiza* and *Rhizophora mucronata*. The mangrove fern *Acrostichum aureum* L. was recorded for the first time in the Mkozi estuary. Tree density for all estuaries was between 10 and 2594 trees ha^{-1}. The Mngazana and Mntafufu estuaries had the highest tree densities of 2594 and 1402 trees ha^{-1} respectively, typical of riverine mangrove forests. Fringe mangroves were evident in most other systems. Removal of trees for wood has the greatest impact on mangrove cover. Fringe mangrove stands are particularly accessible to harvesters. Only 6% of the current area of trees is afforded some protection in conservation areas. The Mdumbi, Mzamba and Kobonqaba estuaries receive no conservation protection and harvesting has resulted in more than 50% of the trees being removed. The density of dead tree stumps was greater than the number of living trees and no seedlings or juvenile trees were found. Further removal of mangroves within the estuaries south of the Mzimvubu River is expected in the fringe mangroves, as most are unprotected and easily accessible.

Introduction

Mangroves extend over an area of approximately 15.5 million ha along the coasts of North America, South America, Australia and Asia. Three million ha occur along the east and west African coasts (Blasco et al. 1998). The destruction of mangrove forests is a problem that is fast becoming a global crisis. At least 35% of the total area of mangrove forests have been destroyed in the last two decades (Valiela et al. 2001). In Indonesia losses in some regions are said to reach 50–80% (Wolanski et al. 2000). Mangroves are important in stabilising coasts, providing a nursery habitat and refuge for invertebrates, fish and birds (Snedaker 1978; Marshall 1994). They are an important source of primary production in coastal areas with energy transfer taking place through detrital food chains

(Snedaker 1978; Robertson 1996). Mangroves are particularly important to subsistence economies providing firewood, building supplies and other wood products as well as water quality maintenance, storm wave protection, fish habitat and ecotourism activities (Ewel et al. 1998; Cole et al. 1999).

Mangroves occur along the east coast of South Africa in 37 estuaries and cover approximately 1688 ha (0.05% of Africa's total). The largest mangrove areas occur in estuaries furthest north towards the tropics, e.g., the Mhlathuze (28° 49′ S 32° 05′ E, 652 ha) and St Lucia (28° 18′ S 32° 26′ E, 279 ha) estuaries in KwaZulu-Natal (Riddin 1999). The Mngazana estuary (31° 42′ S 29° 25′ E, 145 ha) in the former Transkei has the third largest area of mangroves. The size (area cover) and species composition of South African mangroves differ from those in the tropics, with the exception of the Kosi Bay system that has tropical affinities and contains *Avicennia marina* (Forrsk.) Vierh., *Bruguiera gymnorrhiza* (L.) Lam., *Rhizophora mucronata* Lam., *Ceriops tagal* (Perr.) CB Robinson, *Lumnitzera racemosa* Willd. and *Xylocarpus granatum*. The latter three species are only found north of this area, e.g., in Mozambique, Tanzania and Kenya (MacNae 1963).

The Transkei region bordering the east coast of South Africa between the Great Kei and Mtamvuna Rivers was an independent homeland from 1963 until 1976 when it became a Republic. After 1994, it was re-incorporated into South Africa and became part of the Eastern Cape Province. Political instability, poor infrastructure and lack of funds have limited research activities in the region. Consequently, ecological studies on estuaries were confined to only a few estuaries (Wooldridge 1974, 1977; Dye 1977, 1978, 1983a, b; Plumstead et al. 1985, 1989a, b; 1991; Plumstead 1990; Steinke and Ward 1990; Emmerson and McGwynne 1992). Before this study, little was known about current structure and state of mangroves in this region. The most recent account of distribution and extent of mangroves is that of Ward and Steinke (1982).

The mangroves along the Transkei region are threatened chiefly by the harvesting of trees for poles for houses and animal enclosures (Moll et al. 1971). Poor soil conservation practices in river catchments have led to an increase in suspended sediment loads. This sediment accumulates at a rate that often exceeds the optimal rate for root and pneumatophore growth. This results in their being smothered (Moll et al. 1971; Steinke 1999).

Until recently, mangroves were considered wasteland (Bryant 1998), particularly in economically advanced countries that were rapidly developing their coastal lands. In Asia, e.g., most mangroves have been destroyed or modified to make way for housing, roads, harbours and aquaculture industries (Primavera 1991; Dierberg and Kiattisimkul 1996). Within KwaZulu-Natal, mangroves have been removed from the Isipingo, Mgeni and Mkomazi estuaries and have been replaced by industrial, residential or agricultural areas. One of the largest mangrove stands in South Africa occurred in Durban Bay, where harbour and industrial development have removed approximately 200 ha of mangroves (Moll et al. 1971). Removal of mangroves results in a loss of diversity and estuarine functioning as productivity is reduced (Steinke 1999).

For the effective protection of mangrove stands, scientists and managers require information on the structure and function of the communities and their sensitivity to disturbance (Steinke 1999; Tam et al. 1997). In this paper, the following is addressed: (1) the distribution, size and composition of mangrove stands along the coast of former Transkei; (2) the colonisation and removal of trees on a regional scale; (3) the reasons for change in mangrove area; and (4) the proportion of the mangrove cover that occurs in declared conservation areas.

Materials and methods

Study area

The Transkei coast is a rugged and undeveloped region extending from the Great Kei River (32° 41′ S 28° 23′ E) to the boundary between the Eastern Cape and KwaZulu-Natal provinces (Mtamvuna River, 31° 04′ S 30° 11′ E) (Figure 1). The average temperatures ranged between 16 °C (winter) and 26 °C (summer) and rainfall ranged between 750 mm y^{-1} (southern Transkei) and 1100 mm y^{-1} (northern Transkei) (South African Weather Bureau 1997–1999).

The Transkei coast, also known as the Wild Coast, is approximately 270 km in length and forms the transition between the warm temperate

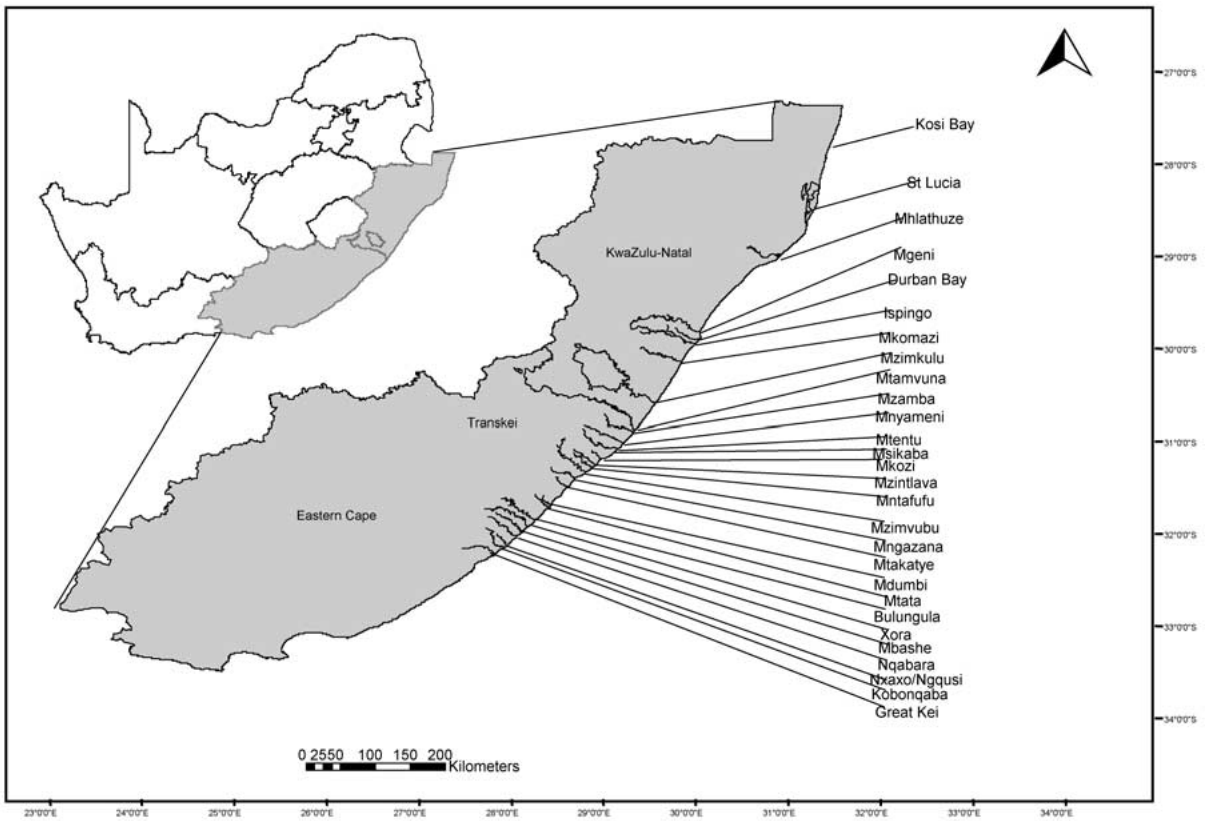

Figure 1. A map of South Africa indicating KwaZulu-Natal and the estuaries with mangroves in the former Transkei region, Eastern Cape Province.

and subtropical biogeographic regions. One hundred and twenty river outlets occur along the coast, of which 76 are estuaries. Seventeen of these estuaries are permanently open, 58 temporarily open/closed and one is a river mouth (Harrison et al. 1999). Five marine and nature reserves cover 19% of the coastline, while the remaining coastal land is under tribal tenure. The only estuaries that are afforded conservation protection include the Mtamvuna, Msikaba, Mtentu and Mbashe estuaries. The southern portion of this region is composed of coastal lowlands and meandering rivers while the north consists of steep valleys and gorges.

Field surveys

Estuaries in the Transkei region (76 estuaries) were surveyed on two occasions between December 1997 and August 1999. Mangrove species composition and the extent of cover of each species was identified for each estuary in which mangroves occurred (Figure 1). "Species" includes all mangroves and mangrove-associates such as *Hibiscus tiliaceus* L. and the mangrove fern *Acrostichum aureum* L. Nomenclature used is based on Arnold and De Wet (1993).

Line intercept transects were used to assess the mangrove stands. Each randomly placed transect was 20 m long and five replicate transects were positioned within each stand. Seedlings (part of propagule still visible), juveniles (<1 m in height) and trees (>1 m in height) were identified and counted along each transect to compare the population structure of the different mangrove stands. A distinction was made between dead and living trees, where the number of stumps indicated dead trees. Ideally, the condition of mangrove stands is monitored using permanent transects visited on a monthly basis for a minimum of two years (Ward and Steinke 1982). Due to the inaccessibility of some Transkei estuaries this was not possible.

Table 1. Present area (1999) of mangroves and percentage of total area cover for the Transkei region. The past area cover values were taken from Ward and Steinke (1982).

	Past cover (1982)		Present cover (1999)		
Estuary	ha	%	ha	%	Change over time
Mtamvuna	1	0.4	0.25	0.09	–
Mzamba	1	0.4	0.15	0.06	–
Mnyameni	3	1.1	0	0	–
Mtentu	1	0.4	2	0.74	+
Mzintlava	1.5	0.5	1.75	0.65	+
Mntafufu	10	3.7	12.4	4.58	+
Mzimvubu	1	0.4	0	0	–
Mngazana	150	55	145	53.59	–
Mtakatye	7.5	2.8	9	3.33	+
Mdumbi	1	0.4	0.5	0.18	–
Mtata	34	12.5	42	15.52	+
Bulungula	3.5	1.3	0	0	–
Xora	16	5.9	16.5	6.1	+
Mbashe	12.5	4.6	14	5.17	+
Nqabara	9	3.3	8.5	3.14	–
Nxaxo/Ngqusi	14	5.1	15	5.54	+
Kobonqaba	6	2.2	3.5	1.29	–
Total	272	100	270.55	100	

Key: + = increase in area cover and − = decrease in mangrove cover.

Tree density was measured by counting the numbers of individuals along each replicate transect. This information was then used in conjunction with aerial photographs (1 : 10 000) to estimate the total number of individuals, and their density per unit area, in each estuary.

Mapping and image analysis

The area (ha) covered by the mangroves was measured using 1 : 50 000 topographic maps and aerial photographs (Institute for Environmental and Coastal Management, University of Port Elizabeth collection 1996, scale 1 : 5000) and Surveys and Mapping 1961 and 1974 (scale 1 : 10 000). These were converted into scaled digital images (Hewlett–Packard Scanner 4C). The digital images were calibrated using orthophoto or topographic maps of the region. The area covered by mangroves was measured using image analysis software (analySIS 3.0, ISAT). These measurements were verified through field surveys. Mangrove cover and species composition in each estuary was compared with Ward and Steinke's (1982) observations and this information used to determine the direction and rate of change of mangrove cover.

Results

Mangroves were recorded in 14 of the 76 estuaries surveyed, with complete loss of trees evident in the Mnyameni, Mzimvubu and Bulungula estuaries (Figure 1 and Table 1). This amounted to a loss of 7.5 ha of mangrove area (Table 1). No new stands were recorded in the remaining estuaries.

The total area of mangroves in the Transkei differed from that of past surveys (Table 1). There has been an increase in mangrove area in eight of the estuaries, i.e., the Mtentu (50%), Mzintlava (15%), Mntafufu (20%), Mtakatye (17%), Mtata (19%), Xora (4%), Mbashe (11%) and Nxaxo (7%) estuaries. These increases were randomly distributed amongst the estuaries, i.e., no distribution trends from a north versus south perspective. Compared with the survey by Ward and Steinke (1982), this increase represents a total of 16.15 ha over the past 17 years. The larger estuaries, i.e., Mtentu, Mtakatye, Mntafufu, Mbashe and Mtata showed the greatest increase in mangrove area (Table 1). The loss of mangrove cover over the whole area for the same period was approximately 17.6 ha. Thus a net loss of only 1.45 ha was observed.

Table 2. A comparison of species found in this survey compared with past surveys, including comments on possible reason for changes in composition and total area covered, as well as conservation protection.

Estuary	Species present in past literature (Ward and Steinke 1982)	Present in this survey	Comments	Conservation status
Mtamvuna	*B. gymnorrhiza*	*B. gymnorrhiza*	A total of five trees in the upper reaches of the estuary	Protected
Mzamba	*B. gymnorrhiza*	*B. gymnorrhiza*	A total of three trees in the mid reaches of the estuary	Unprotected
Mnyameni	*A. marina*, *B. gymnorrhiza*	None	Cause of loss not known possibly due to harvesting	Unprotected
Mtentu	*B. gymnorrhiza*	*A. marina*, *B. gymnorrhiza*	Small *A. marina* trees are found on the mudflats in the mid reaches	Protected: Mkambati Nature reserve
Mzintlava	*B. gymnorrhiza*	*B. gymnorrhiza*	Increase in stand cover	Unprotected, but inaccessible
Mntafufu	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	Increase in stand cover	Unprotected, but inaccessible
Mzimvubu	*A. marina*, *B. gymnorrhiza*	None	Loss possibly due to scouring by floods	Unprotected
Mngazana	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	Decrease in mangrove cover due to harvesting	Unprotected
Mtakatye	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	Increase in mangrove cover	Unprotected
Mdumbi	*A. marina*	*A. marina*	Decrease in mangrove cover due to harvesting	Unprotected
Mtata	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	Increase in mangrove cover	Unprotected
Bulungula	*A.marina*, *R. mucronata*, *B. gymnorrhiza*	None	Complete loss of mangrove cover due to drought that resulted in mouth closure	Unprotected
Xora	*A. marina*, *B. gymnorrhiza*	*A. marina*, *B. gymnorrhiza*	No evidence of change	Protected by local community
Mbashe	*A. marina*, *B. gymnorrhiza*	*A. marina*, *B. gymnorrhiza*	Increase in mangrove cover	Protected: Dwesa and Cebe Nature reserves
Nqabara	*A. marina*	*A. marina*	No evidence of change	Unprotected
Nxaxo	*A. marina*, *B. gymnorrhiza*	*A. marina*, *B. gymnorrhiza, R. mucronata*	Increase in cover, with *B. gymnorrhiza* juvenile trees and *R. mucronata* found	Protected by local community
Kobonqaba	*A. marina*	*A. marina*	Loss due to harvesting of trees	Unprotected

From estimates in this survey (Tables 1 and 2), approximately 16.25 ha (6%) of the current mangrove area occurs in the Mtamvuna, Mtentu and Mbashe estuaries that are protected by the Department of Economic Affairs, Environment and Tourism – Eastern Cape Province. The Xora and Nxaxo estuaries have shown increases in mangrove cover that is probably attributable to the implementation of conservation measures by hotel owners and residents along the estuaries. Cooperation from the local community is due to the hotel owners providing employment and environmental education for the children of the region (Hewson, pers. comm.).

The only mangrove species recorded during these surveys were *A. marina*, *B. gymnorrhiza* and *R. mucronata* (Table 2). The mangrove fern *A. aureum* was recorded for the first time during this survey. This fern was dominant in the middle and upper reaches of the Mkozi estuary, 15 km

north of the coastal town of Mbotyi. The total area covered was approximately 1.3 ha of the estuary fringe (55% of the total estuary surface area).

The data show that there has been little change in mangrove species composition within the different estuaries (Table 2). Previously, the Mtentu estuary only had *B. gymnorrhiza* in the middle reaches; however, a number of *A. marina* trees were found in this survey. Previous research indicated that *R. mucronata* was absent from the Nxaxo estuary (Ward and Steinke 1982). This study found a number of small *R. mucronata* trees. *A. marina* and *B. gymnorrhiza* were the most common mangrove trees occurring in 65% of the all the estuaries surveyed. The Mtamvuna and Mzamba estuaries only had *B. gymnorrhiza* and *H. tiliaceus* (Table 2).

The highest tree density (2594 tree ha^{-1}) was recorded in the Mngazana estuary. This was followed by the Mntafufu (1402 trees ha^{-1}), Mtata (210 trees ha^{-1}) and the Mbashe (174 trees ha^{-1}) (Table 3). No significant correlation was found between the area covered by the mangrove stands and tree densities ($r = 0.2, p < 0.05$). Moderate size estuaries such as the Nqabara estuary (9 ha) had a low tree density of 74 trees ha^{-1}, whereas the Mtakatye estuary of the same size had 162 trees ha^{-1}. The Mbashe, Xora, Mtakatye, Mtata and Nxaxo estuaries were characterised by fringe mangrove stands and intertidal islands that were also colonised by mangroves and showed high tree densities (between 121 and 210 trees ha^{-1}, Table 3).

The density of dead trees, recorded as stumps, was greater or equal to that of the living trees in the Mdumbi, Mtamvuna and Kobonqaba estuaries (Table 3). Tree removal has had its greatest impact on the fringe mangroves. Mangroves found in protected areas such as the Mtentu and Xora estuaries had a high density of juveniles (between 20 and 26 trees ha^{-1}, Table 3). These surveys showed that tree removal no longer occurs in these estuaries as no tree stumps were observed. In the other 12 estuaries, with the exception of the Mngazana estuary, the juvenile density ranged between 32 and 603 juveniles ha^{-1}.

Estuaries in which mangrove survival is threatened include the Mdumbi, Mzamba, Kobonqaba and Mtamvuna. These estuaries receive no form of conservation protection and large-scale harvesting has resulted in more than 50% of the trees being removed. No seedlings or juveniles were found in these estuaries and the regeneration potential of the stands is therefore limited.

Discussion

Saenger and Bellan (1995) suggested that mangroves along the east coast of Africa are threatened with over-utilisation (wood harvesting). This increases the conservation importance of such systems and must be a consideration for the mangrove estuaries in the Transkei. Mangrove ecosystems world-wide are valued as a timber resource, and for the contribution they make to the stabilisation of coastlines and the creation of land, filtration of runoff, as well as providing habitats and nurseries for invertebrates and fish. The importance of mangrove systems to the estuarine and surrounding environments has been highlighted by the loss of such systems in many parts of the world, especially in North America and the Philippines. These losses have adversely affected fish recruitment and led to a decline in fisheries in these regions (Sheridan 1997; Gilbert and Janssen 1998). Subsistence and recreational fishermen predominantly use estuaries in South Africa. With no large-scale fishery associated with any of the mangrove systems along the Transkei coast and due to agricultural activities that dominate this region, South African mangroves are considered more important as a wood resource.

With no major development occurring in Transkei compared with the rest of the South African coast, it was expected that there would be a negligible change in mangrove cover over time in the region. However, 17.6 ha have been lost in nine estuaries while there was an increase in 16.15 ha in eight estuaries over the last 17 years, therefore a net loss of 1.45 ha. No new areas of mangrove stands were recorded.

Mangroves previously occurred in 17 estuaries but are now only found in 14. Entire stands of *B. gymnorrhiza* and *A. marina* have been lost in the Mzimvubu River as a result of excessive bank scour related to flooding. The increase in flooding events could possibly be due to shifts in the natural cycles or due to poor catchment management practices. In the Bulungula estuary the mouth closed during a drought, fresh water continued to flow, which caused back flooding and the mangrove

Table 3. Tree density of respective mangrove species found in the Transkei estuaries.

	Trees ha^{-1}				
	Living	Dead	Height (<1 m)	Height (>1 m)	Total
Mtamvuna					
A. marina	0	0	0	0	0
B. gymnorrhiza	4	4	0	4	5
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					5
Mzamba					
A. marina	0	0	0	0	0
B. gymnorrhiza	5	0	0	5	5
R. mucronata	0	0	0	0	0
H. tiliaceus	5	0	0	5	5
					10
Mtentu					
A. marina	15	0	15	0	15
B. gymnorrhiza	18	2	4	16	20
R. mucronata	0	0	0	0	0
H. tiliaceus	5	0	0	5	5
					40
Mzintlava					
A. marina	23	0	4	19	23
B. gymnorrhiza	57	2	0	59	59
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					82
Mntafufu					
A. marina	749	40	54	735	789
B. gymnorrhiza	201	4	31	174	205
R. mucronata	256	0	36	220	256
H. tiliaceus	152	0	0	152	152
					1402
Mngazana					
A. marina	952	148	289	811	1100
B. gymnorrhiza	754	78	602	230	832
R. mucronata	436	85	32	489	521
H. tiliaceus	141	0	0	141	141
					2594
Mtakatye					
A. marina	77	20	14	85	97
B. gymnorrhiza	35	20	8	47	55
R. mucronata	10	0	0	10	10
H. tiliaceus	0	0	0	0	0
					162
Mdumbi					
A. marina	10	15	1	24	25
B. gymnorrhiza	0	0	0	0	0
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					25
Mtata					
A. marina	89	65	16	138	154
B. gymnorrhiza	42	6	1	47	48
R. mucronata	8	0	0	8	8
H. tiliaceus	0	0	0	0	0
					210

Continued on next page

Table 3. Continued.

	Trees ha^{-1}				
	Living	Dead	Height (<1 m)	Height (>1 m)	Total
Xora					
A. marina	117	31	11	75	86
B. gymnorrhiza	91	20	15	56	71
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					157
Mbashe					
A. marina	141	23	12	152	164
B. gymnorrhiza	102	97	5	45	5
R. mucronata	0	0	0	0	0
H. tiliaceus	5	0	0	5	5
					174
Nqabara					
A. marina	62	12	8	66	74
B. gymnorrhiza	0	0	0	0	0
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					74
Nxaxo					
A. marina	87	15	7	95	102
B. gymnorrhiza	5	0	2	3	5
R. mucronata	14	0	14	0	14
H. tiliaceus	0	0	0	0	0
					121
Kobonqaba					
A. marina	8	9	8	9	17
B. gymnorrhiza	0	0	0	0	0
R. mucronata	0	0	0	0	0
H. tiliaceus	0	0	0	0	0
					17

stands were inundated for a five-month period (Plumstead and Knight, pers. comm.). Consequently, the trees died and have since been harvested leaving only tree stumps. This estuary was one of five that previously contained all three species (*A. marina*, *B. gymnorrhiza* and *R. mucronata*). Mangroves in the Mnyameni estuary have been completely removed for wood leaving dead tree stumps. Ward and Steinke (1982) had observed both *B. gymnorrhiza* and *A. marina* in this system. This presents an interesting opportunity to start rehabilitation and restoration trials in these estuaries. Mangrove propagules are easily transplanted and establish well as shown internationally and in local estuaries. Mangroves transplanted from Durban Bay (KwaZulu-Natal) to the Nahoon estuary in East London (Eastern Cape Province) have survived and colonised significant areas on intertidal mudflat near the mouth (Steinke 1999).

The increase in mangrove cover was evident in eight estuaries. These estuaries either have some form of conservation protection or are inaccessible due to the steep terrain of the region. This has afforded the mangroves in the Mtentu, Mzintlava, Mntafufu, Mtakatye, Mtata, Xora, Mbashe and Nxaxo estuaries opportunity to grow and colonise new areas. However, the small increase in area colonised over 17 years indicates the limited area available for mangrove expansion in these estuaries.

The development of large mangrove stands is restricted by the natural geomorphology of the area. Some estuaries, such as the Mngazana and Mntafufu, have extensive intertidal floodplain deltas that support mangrove trees in the form of

complex riverine forests. The high tree densities that were recorded in the Mngazana and Mntafufu estuaries testify to the dense form of mangrove that is able to develop in these two estuaries. Currently cattle browse the foliage on these trees. A browse line occurred on the trees at approximately 1.5 m, while the upper canopy remained intact. In other estuaries cattle browsing has aggravated the effects of chopping, e.g., browsing on *A. marina* in the Kobonqaba Estuary (Steinke, pers. comm.).

Fringe mangroves are different to riverine mangrove forest (Lugo and Snedaker 1974). This vegetation is adapted to a lower freshwater input and narrow channel geomorphology (Medina and Francisco 1997). They had low tree densities and few mangrove associates such as *H. tiliaceus*. Most mangroves found in South Africa could be classified as fringe mangroves with the exception of the large intertidal areas of the Mhlathuze estuary (KwaZulu-Natal coast).

The overall protection status of mangroves in Transkei was low with only 6% occurring in nature reserves. Most of the terrestrial and marine ecosystems in this region are underprotected and overutilised (Cowling and Hilton-Taylor 1996). Further removal of mangroves within the estuaries south of the Mzimvubu River is expected in the fringe mangroves because most are unprotected and easily accessible. Low tree density in these estuaries also results in a low sustainable yield. Mature trees are usually selectively removed and this has affected mangrove regeneration, as there were a low percentage of juveniles present in the Mtamvuna, Mzamba, Mtakatye, Mtata, Mdumbi, Mzintlava and Kobonqaba estuaries. This will inhibit the future generation of propagules because these mangrove stands can only survive if there is sufficient parent stock to produce enough propagules to saturate seed predators (Dahdouh-Geubas et al. 1997) and leave some over for recruitment. Pole cutting, if done in an unplanned way and on a large scale, can reduce the genetic pool and endangers reproduction of mangroves (Semesi 1992).

Although regeneration can occur from coppicing (Steinke 1999), this was only evident in four estuaries, namely: Mbashe, Mtakatye, Nxaxo and Mngazana, and only by *A. marina*. The conservation of mangroves in the Mdumbi, Mzamba and Mtamvuna estuaries is of particular concern due to the high levels of harvesting from these systems, with little or no recruitment observed.

The mangrove fern, *A. aureum*, was only found in the Mkozi estuary. This was the first record of the distribution of this fern in this area. The Mkozi estuary has a large intertidal area and is almost permanently open (Harrison et al. 1999). No major developments or settlements occur around the Mkozi estuary and the only factor that could threaten the fern's existence is the expansion of forestry from the adjacent Mbotyi River catchment to the Mkozi River catchment. Impacts usually associated with forestry include runoff that contains elevated sediment loads that can affect the mouth dynamics of an estuary. If the mouth remains closed for an extended period, back flooding could occur and result in drowning.

Bruguiera gymnorrhiza and *A. marina* were found in more estuaries than *R. mucronata*. Estuaries that have a high density of *R. mucronata* are the Mngazana and Mntafufu estuaries. This elevates the conservation importance (increased biodiversity) of these estuaries.

Mangroves on the east and west African continent, excluding those found in Madagascar, are estimated to cover approximately 3 million ha (Blasco et al. 1998). In Africa, with estimated rates of loss of between 1500 and 2000 ha per annum by harvesting and the expansion of agriculture, the loss of mangroves in the Transkei region by comparison appears insignificant. This does not mean that the South African mangroves should be ignored, they should be protected because of their unique species composition (MacNae 1963) and because they occur at the southernmost limit of their distribution (MacNae 1963; Saenger and Bellan 1995; Spalding et al. 1997).

Conclusion

The Transkei mangroves are near the southerly limit of their distribution. There is also a lack of suitable habitat for colonisation due to the limited number of permanently open estuaries with intertidal regions. Although there was little net change in mangrove cover, through a combination of natural events and human activities, mangroves have been lost completely from three estuaries. Protection and rehabilitation of mangroves in this

area is important for the various reasons given and should be the focus of future conservation proposals. The proposal for a Marine Protected Area for the northern area of the Transkei coast would increase the conserved area of mangroves from 6% to 23%. This protected area would include the Mtamvuna and Mzamba estuaries as well as the unique Mkozi estuary that contains the mangrove fern. The Mtentu estuary is already protected within the Mkambati Nature Reserve. With the increased demand for crops, water and land for development, the value and conservation priorities need to be set for those estuaries that can sustain mangroves.

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