

The saltmarsh vegetation of the lower Berg River

M. O'CALLAGHAN*

Keywords: Berg River, saltmarsh, species distribution, zonation

ABSTRACT

The lower Berg River supports approximately 250 ha of estuarine saltmarsh vegetation. Species distribution patterns, as sampled along six transects, are described. Elevation above mean sea level (MSL) is proposed as a strong determinant of these patterns. However, there are no typical patterns. The patchy and irregular distribution patterns possibly result from an inconsistent relationship between species distribution and salinity, tidal inundation and/or competitive interactions.

UITTREKSEL

Die benede Bergrivier onderhou sowat 250 ha soutmoerasplantegroei. Die spesieverspreidingspatrone, soos bemonster langs ses lynopnames, word beskryf. Hoogte bo seevlak (MSL) word voorgestel as 'n sterk bepalende faktor van hierdie patrone, maar tipiese patrone kan nie by hierdie rivier bepaal word nie. Hierdie onsamehangende patrone is moontlik die gevolg van 'n onreëlmatige verband tussen die spesieverspreiding en soutgehalte, getyvfloeding en/of kompetisie.

INTRODUCTION

Much anthropogenic development has taken place around the lower Berg River. The effects that these developments have had on the marshes vary from total destruction (e.g. the development of housing and saltworks), through partial destruction (e.g. the dumping of dredge spoil) to subtle effects brought about by altered tidal and flow patterns with the construction of dams in the catchment and the manipulation of the river mouth to allow access to fishing boats. Nevertheless, Anderson (1991) estimates that the marshes have decreased by only 13% from 1938 to 1986. Unfortunately, he does not distinguish between saltmarshes and reed beds. Saltmarshes currently cover approximately 250 ha around this estuary which constitutes just less than 2% of the saltmarshes of southern Africa.

The Berg River is one of the largest rivers on the western Cape coast (Day 1981) and numerous aspects of its ecology have been investigated (Harrison 1958a & b, 1974; Harrison & Elsworth 1958; Scott 1958; Ratte 1976, 1977; Coetzer 1976, 1978; Summers *et al.* 1976; Gaigher 1979). However, apart from superficial descriptions by Giliomee (1973), Day (1981) and Van Wyk (1983), very little information concerning the saltmarsh vegetation is available. These saltmarshes are increasingly being threatened by the expansion and further development of recreational, housing and water storage (McDowell 1992, 1993). This investigation aims to describe the floristic structure of the saltmarshes around the lower Berg River estuary.

* Stress Ecology Research Unit, National Botanical Institute, Private Bag X7, Claremont 7735.

MS. received: 1993-05-06.

METHODS

After studying aerial photographs, orthophotographic maps and following field reconnaissance, six transects were demarcated across the marshes of the lower Berg River (Figure 1). The siting of these transects was determined subjectively according to variability in species composition and the relatively undisturbed nature of the vegetation. Details of these transects are presented in Table 1. Elevation profiles of the transects were surveyed using a theodolite, and at least one point on each transect was surveyed to sea level.

Sampling took place on four occasions during 1987 (March, June, September and November) in order to include all bulbous and annual plants. Contiguous 1 × 1 m plots were laid along each transect. The cover-abundance of each species within the plots was estimated according to normal phytosociological methods (Braun-Blanquet 1965). Excessive repetition was avoided by not sampling plots in which it was deemed that the floristic data were simply repetitions of data already recorded from adjacent plots. Taxon names follow Arnold & De Wet (1993) and

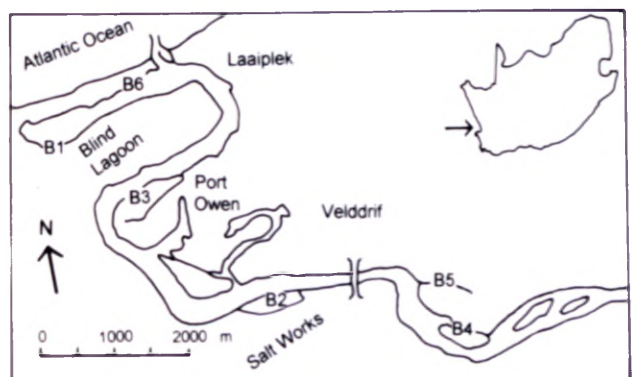


FIGURE 1.—Berg River. Transects B1 to B6.

TABLE 1.—Details of transects

Transect	Description	Length (m)	Tidal range (cm at MSL)
B1	Southern shore of Blind Lagoon, in southeasterly direction	58	- 53.0-157.0
B2	Southern shore, north of salt works, in southerly direction	382	6.5-80.5
B3	Eastern shore, west of Port Owen, in southeasterly direction	392	- 28.3-96.7
B4	Northern shore, south of Velddrif, near main river channel, in easterly direction	91	- 12.0-84.0
B5	Northern shore, south of Velddrif, from creek, in northerly direction	80	- 11.0-64.0
B6	Northern shore of Blind Lagoon, in northwesterly direction	32	- 41.1-123.9

voucher specimens are housed at the herbarium of the National Botanical Institute at Stellenbosch (STE), the National Herbarium (PRE) and at the Stress Ecology Research Unit at Kirstenbosch. These voucher specimens are listed by O'Callaghan (1994a). Aerial photographs are housed at the CSIR at Stellenbosch.

As classical Braun-Blanquet values cannot be manipulated mathematically, these values were converted according to Table 2. To plot the distribution of species, each transect was divided into elevation classes of 10 cm. The converted factors were averaged within each 10 cm class and further averaged over the four sampling periods. As some of the species have annual geophytic or hemicryptophytic life-cycles, the number next to the species name on Figures 2 to 7 indicates the number of times this species was located through the year. The order in which the species occur along the transect is primarily determined by its lowest starting point and secondarily by its termination point along the elevation gradient.

RESULTS AND DISCUSSION

The distribution of species along elevation gradients on Transects B1 to B6 is shown in Figures 2-7.

Transects B1 and B6 (Figures 2 & 7)

Aerial photographs reveal great variability in the distribution of saltmarshes in the Blind Lagoon area (Transects B1 & B6). In 1942 (Job No. 168; Photo No. 38133), the marshes in this area consisted of disjunct patches with some submerged macrophytes (probably *Zostera capensis*). By 1960 (Job No. 137; Photo No. 5110 & 5111), the marshes were greatly reduced and there is no evidence of

submerged macrophytes. This reduction might be related to extensive dredging activities in this area to keep the channel navigable to fishing trawlers before the current artificial mouth had been created.

By 1971 (Job No. 675; Photo No. 137 & 138), the new mouth had been open for five years. The old mouth had already closed (forming the Blind Lagoon) and much sediment had been deposited, especially along the northern shore of the lagoon. Patches of saltmarsh had again developed along this shore.

TABLE 2.—Conversion factors

Cover/abundance	% Cover	Converted factor
0	present but dead	0.1
r	single plant < 0.01	0.2
+	0.01-1	0.3
1	1-5	1
2	5-25	5
3	25-50	10
4	50-75	15
5	75-100	20

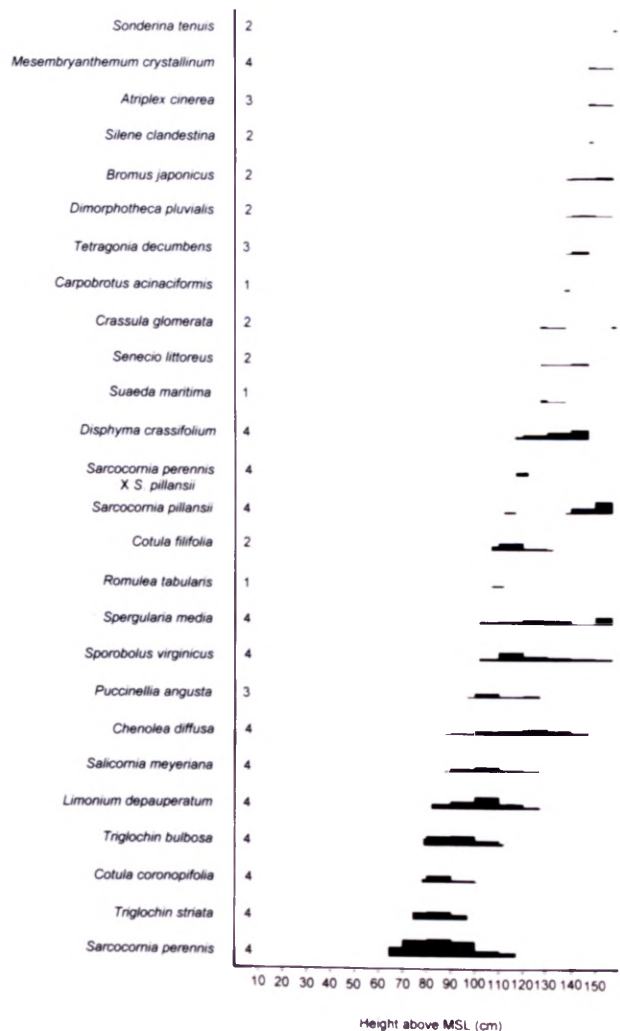


FIGURE 2.—Distribution of species along an elevation gradient on Transect B1. 1-4, number of times species was located through the year

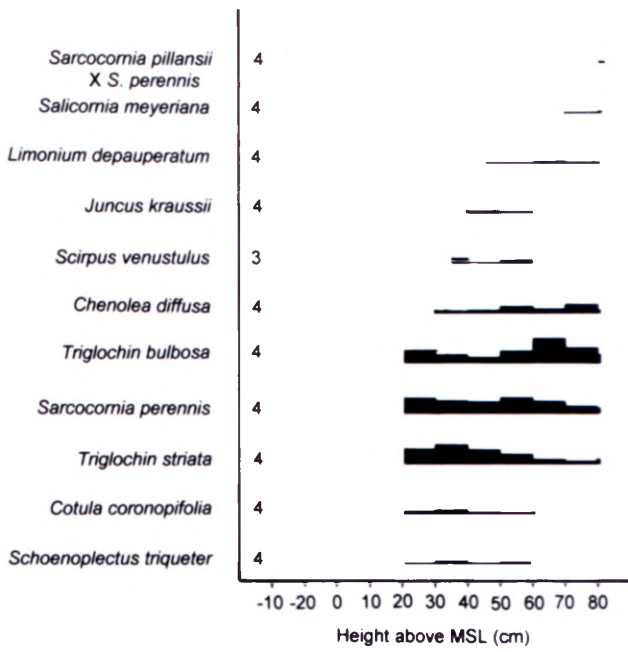


FIGURE 3.—Distribution of species along an elevation gradient on Transect B2. 3, 4, number of times species was located through the year.

Evidence of continued sediment deposition can be seen on the photographs of 1977 (Job No. 326; Photo No. 1016/5). A saltmarsh cliff had developed at Transect B6 and the marshes at B1 were now recognizable. Photo-

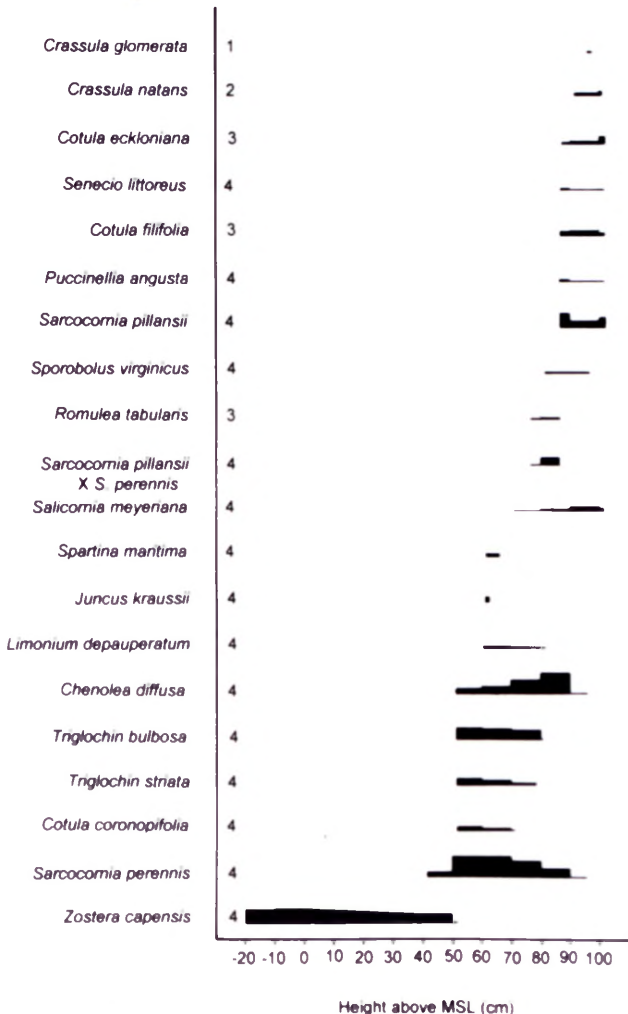


FIGURE 4.—Distribution of species along an elevation gradient on Transect B3. 1-4, number of times species was located through the year.

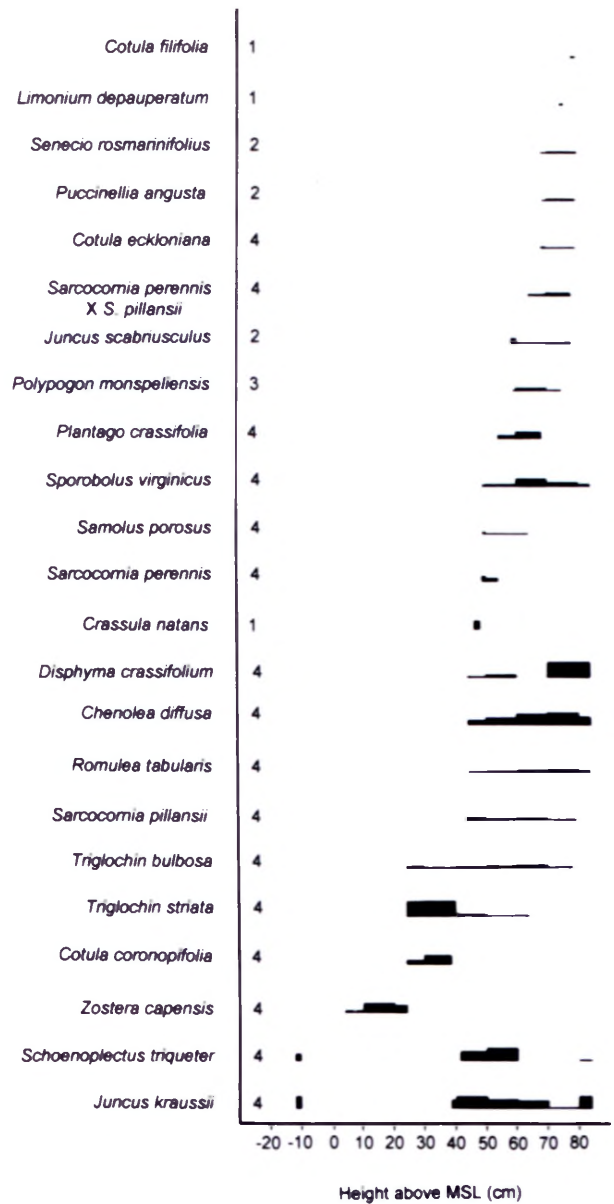


FIGURE 5.—Distribution of species along an elevation gradient on Transect B4. 1-4, number of times species was located through the year.

graphs of 1981 (Job No. 376; Photo No. 628) and 1986 (Job No. 892; Photo No. 5553 & 5667) show increasing sedimentation and an increasing development of saltmarshes, especially along the southern shores of the Blind Lagoon. This might be due to the dumping of dredge spoil on the marshes opposite Laaiplek (Van Wyk 1983) and/or the recent dredging activities at Port Owen (since the late 1970s).

The distribution of species on the lower parts of Transect B6 was similar to the distribution patterns observed at Langebaan Lagoon (O'Callaghan 1994b), with *Zostera capensis*, *Spartina maritima*, *Sarcocornia perennis*, *Triglochin bulbosa*, *Sarcocornia pillansii* (\times *S. perennis*), *Limonium depauperatum* and *Sporobolus virginicus*. The presence of *Triglochin striata* and *Romulea tabularis*, as well as *Cotula eckloniana* and *Crassula glomerata* on the upper parts indicates that salinities in this area decreased to below that of sea water, at least during late winter. The

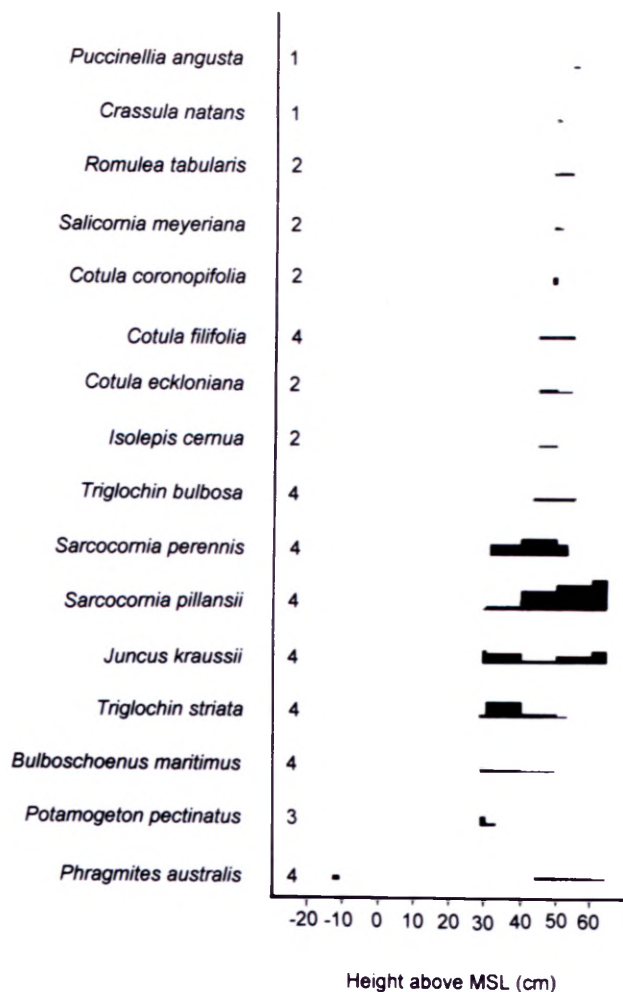


FIGURE 6.—Distribution of species along an elevation gradient on Transect B5. 1–4, number of times species was located through the year.

species on the top of the transect indicate a moist dune environment which abuts onto the marsh.

The rate of elevational increase at Transect B1 was greater than at B6 (5.15 cm/m for B1; 3.62 cm/m for B6). The marshes at B1 are also younger, dating from 1966 at the earliest. The distinction between the marsh vegetation and adjacent terrestrial vegetation was not as clear as at B6.

At B1, *Zostera capensis* was found to ± 53 cm below MSL, especially during summer. From -50 cm to 63 cm, no angiospermous vegetation was present. These mud flats were rich in microflora and filamentous green algae, especially during early summer.

Transects B2 and B3 (Figures 3 & 4)

A saltmarsh cliff limited the development of the lower marsh at both these transects. The area immediately above this cliff was slightly elevated compared with the rest of the marsh. This would impede the drainage and a number of creeks of varying size traversed the marsh. With the exception of these creeks, the marsh consisted of flat expanses with little variation in elevation. Under these conditions, the distribution of the species tended to form patches and seemed to be related to soil drainage characteristics, rather than to changes in elevation alone.

At B3, the elevational distributions of most species overlapped somewhat. *Zostera capensis* was found in a large creek which crossed the marsh. *Juncus kraussii* and *Spartina maritima* were found near a smaller creek where the soils were almost constantly waterlogged. The saltmarsh at B3 can be roughly divided into four sections:

1, the deeper creeks containing *Zostera capensis*;

2, the zone from *Sarcocornia perennis* to *Limonium depauperatum* constituted 90% of the remaining spatial distribution of the marsh. These areas were flooded relatively frequently, usually from water entering and leaving via creeks;

3, the *Juncus/Spartina* zone was found near a smaller creek where the soils were almost constantly waterlogged;

4, the remainder of the marsh constituted less than 10% of the spatial area of this transect. It was characterized by *Salicornia meyeriana* and, except for *Sarcocornia pillansii* (\times *S. perennis*), contained only annual species. These upper areas are seldom flooded, although the soils were rather saline. The top of the transect had been disturbed by residential developments and was largely devoid of vegetation except after rains, during spring.

The physiographic structure of the marsh at B2 was similar to B3. Again, the lower part of the transect (from *Schoenoplectus triqueter* to *Limonium depauperatum*) constituted more than 90% of the spatial distribution of this transect and elevational distribution of most species overlapped. Numerous creeks of varying size traversed this transect, but none were developed to a depth able to support *Zostera capensis*. The soils of B2 seemed to be somewhat wetter than at B3, but the flooding waters were less saline. This decreased salinity was confirmed by the presence of *S. triqueter*, *Triglochin striata*, *Scirpus venustus* and *Juncus kraussii*.

The upper part of B2 had been disturbed by the development of the Salt Works evaporation pans. The soils were highly saline in summer and vegetation was sparse

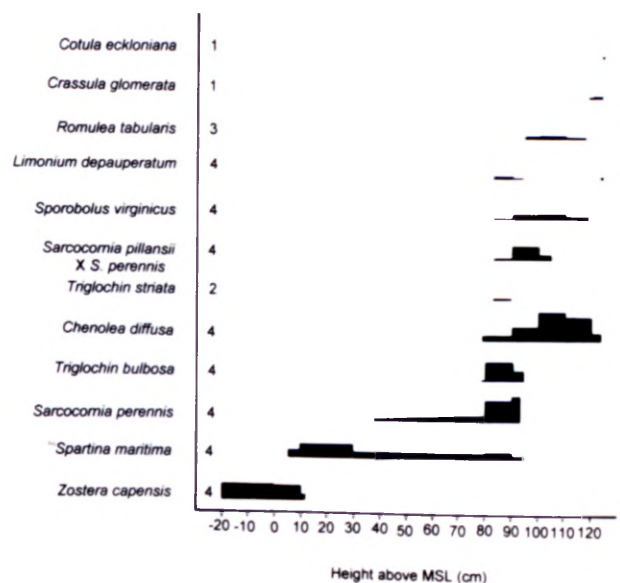


FIGURE 7.—Distribution of species along an elevation gradient on Transect B6. 1–4, number of times species was located through the year.

(*Sarcocornia pillansii* × *S. perennis* and *Salicornia meyeriana*) or absent.

Transect B4 (Figure 5)

The effects of fresher water inputs were more evident at this transect. *Schoenoplectus triqueter* and *Juncus kraussii* were found in a large creek which crossed the marsh. *Zostera capensis* survived at the riverine end of this transect throughout the year, but disappeared from the large creek during spring when fresher waters after the rainy season would limit its growth. Other species which were supported by the lowered salinities include *Crassula natans*, *Samolus porosus* and *Juncus scabriusculus*.

Juncus kraussii covers more than 90% of the spatial area of B4 and *Schoenoplectus triqueter* covers more than 70%, often forming dense monospecific stands. The distribution of some species usually found in more saline marshes (as at B6) did not overlap with the distributions of *Juncus kraussii* and *S. triqueter*. However, *Chenolea diffusa* and *Sarcocornia pillansii* occurred in association with the sedges as well as with more salt-tolerant species. It seems that these taller sedges have a selective competitive effect on the distribution of other species.

The distribution patterns of the more salt-tolerant species were somewhat irregular. Species co-occurring with the taller sedges were lanky and required the sedges for mechanical support.

Although elevation decreased towards the top of this transect, relatively high water would be required to overtop the surrounding higher lying areas. This upper end would therefore be flooded only occasionally by relatively fresh water during the rainy season. A number of grasses and herbs were found here (*Polypogon monspeliensis*, *Sporobolus virginicus*, *Disphyma crassifolium*, *Plantago crassifolia*), reminiscent of the upper extremes of a marsh with a more regular elevation gradient.

Transect B5 (Figure 6)

This transect starts at a creek which traversed the marsh south of Velddrif. The banks of this creek were lined with *Phragmites australis*. The bottom of this creek, which is not included in Figure 6, was constantly filled with fresher water in which *Potamogeton pectinatus* was found. The *P. pectinatus* indicated in Figure 6 occurred in a depression which is seasonally flooded with rain water.

Most of this transect was dominated by *Sarcocornia pillansii*. As the area immediately adjacent to the creek was slightly elevated, riverine water did not often flood this transect. Furthermore, water which might have entered the marsh through rain, surface drainage or storm surges, would not easily drain away. This resulted in relatively saline soils, due to evaporation rather than flooding by saline water. In areas where the soils were slightly less saline (e.g. immediately adjacent to the creek), *Juncus kraussii* co-dominated with *Sarcocornia pillansii*. The remaining species (including most of *J. kraussii*) were concentrically arranged around a depression which was seasonally filled with rain water. The majority of these

species germinated and grew during spring and died back by midsummer.

Phragmites australis was again found on the top of the transect where it was supported by fresh water runoff from adjacent hard surfaces.

CONCLUSIONS

There was no 'typical' saltmarsh at the Berg River. The marshes in the Blind Lagoon showed the clearest zonation patterns, whereas the zonation patterns higher up the estuary were not as easily discernible.

The conditions prevailing in the Blind Lagoon were somewhat different from those in the other parts of the estuary. There was no unidirectional riverine flow in this part. Rather, the vegetation was subject only to tidal inundation originating from the mouth of the estuary. These conditions are similar to those found in a marine lagoon, and the zonation of the vegetation is similar to that of Langebaan Lagoon (O'Callaghan 1994b).

Unlike Langebaan Lagoon, however, the distribution patterns of species along the elevation gradients in the remainder of the Berg River Estuary were not constant, but somewhat patchy. These inconsistencies could be attributed to a number of factors:

- 1, the rate of elevational increase was very low as one moved away from the river channel. The elevations of B1 and B6 increased by an average of 4.35%. In contrast the elevations of B2 and B3 increased by an average of 0.11%. With this relatively flat topography, the flooding and drainage at a particular point on the marsh was not necessarily directly related to the elevation at that point, but rather to the elevation relative to the surrounding marsh. Water could remain dammed in a local depression, resulting in a longer period of inundation. A local elevation would have the opposite result;
- 2, numerous creeks of varying sizes traversed these marshes, adding to the complexity of inundation pattern observed at any particular point. The water which flooded the marsh often did not originate from the main river channel. Usually, the part of the transect adjacent to the river channel was slightly elevated and flooding occurred via the creeks or ground water seepage. The inundation patterns across the marsh were thus rather complex;
- 3, the fresh water input into the system increased as one moved up the river. The effects of salinity on the saltmarsh plants were complex as they varied tidally as well as seasonally.

These complexities would result in an inconsistent relationship between salinity and tidal inundation, affecting the relative distribution and competitive abilities of the various species. These interactions require further investigation.

The species composition of the marshes did vary according to the period of inundation, remembering that the period of inundation is not necessarily related to elevation alone. Precise data concerning salinity and inundation tolerances for each species are not available. In general, as one moved away from the mouth, sedges and reeds

started to dominate in less saline conditions and *Zostera capensis* was replaced by *Potamogeton pectinatus*.

ACKNOWLEDGEMENTS

I thank all local authorities and private land owners for access and comments; also, the National Botanical Institute, The Botany Departments of the University of Cape Town and the University of Stellenbosch, especially Dr C. Boucher.

REFERENCES

- ANDERSON, M. 1991. *Morphological and hydrological characterization of the Berg River estuary: a geographical perspective*. B.Sc. (Hon.) Project, Geography Dept, University of Stellenbosch.
- ARNOLD, T.H. & DE WET, B.S. (eds) 1993. Plants of southern Africa: names and distribution. *Memoirs of the Botanical Survey of South Africa* No. 62.
- BRAUN-BLANQUET, J. 1965. *Plant sociology—the study of plant communities* (translated, revised and edited by D.C Fuller & H.S. Conrad). Hafner, London.
- COETZER, A. 1976. *Verdere resultate van die waterkwaliteit van die Bergrivier*. Department of Nature and Environmental Conservation Research Report: Invertebrates: 39–42.
- COETZER, A. 1978. The invertebrate fauna and biotic index value of water quality of the Great Berg River, Western Cape. *Journal of the Limnological Society of South Africa* 4: 1–7.
- DAY, J.H. 1981. *Estuarine ecology with particular reference to South Africa*. Balkema, Cape Town.
- GAIGHER, C.M. 1979. *A survey of the status of bait organisms in Cape estuaries*. Department of Nature and Environmental Conservation Research Report: Estuaries: 1–18.
- GILIOMEE, J.H. 1973. *Potensiaal vir buiteligontspanning van die benede Bergrivier*. M.Sc. thesis, University of Stellenbosch.
- HARRISON, A.D. 1958a. Hydrobiological studies on the Great Berg River, western Cape Province. Part 2. Quantitative studies on sandy bottoms, notes on tributaries and further information on the fauna, arranged systematically. *Transactions of the Royal Society of South Africa* 35: 227–276.
- HARRISON, A.D. 1958b. Hydrobiological studies on the Great Berg River, western Cape Province. Part 4. The effects of organic pollution on the fauna of parts of the Great Berg River system and of the Krom Stream, Stellenbosch. *Transactions of the Royal Society of South Africa* 35: 299–330.
- HARRISON, A.D. 1974. An ecological survey of the Great Berg River. In J.H.S. Davis, *Ecological studies in South Africa*: 143–158. Junk, The Hague.
- HARRISON, A.D. & ELSWORTH, J.F. 1958. Hydrobiological studies on the Great Berg River, western Cape Province. Part 1. General description, chemical studies and main features of the fauna and flora. *Transactions of the Royal Society of South Africa* 35: 125–226.
- MCDOWELL, C.R. 1992. *Evaluation and impact assessment relating to vegetation affected by the proposed St Helena Marina development, lower Berg River*. Unpublished report to the Cape Provincial Administration.
- MCDOWELL, C.R. 1993. *Vegetation assessment of the Berg River estuary and floodplain with evaluation and likely impacts arising from proposed upstream water impoundments*. Unpublished report to the Department of Water Affairs and Forestry.
- O'CALLAGHAN, M. 1994a. *Salt marshes of the Cape (South Africa): vegetation dynamics and interactions*. Ph.D. thesis, University of Stellenbosch.
- O'CALLAGHAN, M. 1994b. The saltmarsh vegetation of Langebaan Lagoon. *Bothalia* 24: 217–222.
- RATTE, T.W. 1976. *'n Ondersoek na die kommersiële ontginning van die harder Liza richardsoni in die Bergrivier*. Department of Nature and Environmental Conservation Report: Fish: 120–132.
- RATTE, T.W. 1977. *Age and growth of the mullet Mugil richardsoni (Smith) in the Berg River Estuary*. Department of Nature and Environmental Conservation Report: Estuaries: 45–58.
- SCOTT, K.M.F. 1958. Hydrobiological studies on the Great Berg River, western Cape Province. Part 3. The Chromidae. *Transactions of the Royal Society of South Africa* 35: 227–298.
- SUMMERS, R.W., PRINGLE, J.S. & COOPER, J. 1976. *The status of coastal waders in the southwestern Cape, South Africa*. Western Cape Wader Study Group, Cape Town.
- VAN WYK, A. 1983. *Effects of dredging on the Berg River estuary*. M.Sc. thesis, University of Cape Town.