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The marsh vegetation of Kleinmond Lagoon

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ABSTRACT

The vegetation of Kleinmond Lagoon suggests that this system is in transition from an estuary to a coastal lake. Two major types of vegetation were recognized, one which is subjected to soil and water conditions of marine origin and the other which is subjected to conditions of terrestrial origin. These vegetation types are discussed and compared to the vegetation of other estuarine systems. Artificial manipulations of the mouth seem to have resulted in sediment deposition and a freshening of the system. These unseasonable manipulations also threaten the continued existence of a number of species in the system.

UITTREKSEL

Die plantegroei van Kleinmondvlei dui daarop dat hierdie vlei in oorgang is van 'n getyrivier tot 'n strandmeer. Twee hoofsoorte plantegroei is erken: dié wat onderworpe is aan grond- en watertoestande van mariene oorsprong, en dié wat onderworpe is aan toestande van landoorsprong. Hierdie plantegroeitipes word bespreek en met dié van ander getyriviere vergelyk. Die plantegroei toon dat die kunsmatige manipulasie van die mond tot afsetting van sediment en vervarsing van die stelsel gelei het. Hierdie buitenstydse manipulasies bedreig ook die voortbestaan van sommige spesies in die stelsel.

INTRODUCTION

The term 'lagoon' is usually applied to a semi-enclosed marine system with a permanent (albeit restricted) connection to the sea and with little or no fresh water input (Caspers 1967). This definition does not apply to Kleinmond, but the term is retained for historical reasons (Bally 1985). This system receives fresh water from various small streams, more saline water as an overflow from the adjacent Bot River Lagoon, and marine water in the form of overtopping and during short periods when the mouth is open to the sea. However, the stabilization of dunes and overflow areas by alien acacias and the manipulation of the Bot River mouth have somewhat reduced the saline input into Kleinmond Lagoon.

The hydrological régime of this lagoon differs substantially from that of Langebaan Lagoon, the Berg River and Uilkraals River (O'Callaghan 1994a, b, c). The mouth of the Kleinmond Lagoon is closed for most of the year. There is usually a connection to the sea after the first winter rains (June) and again in December. These breachings are usually man-induced, and remain for a period varying from a few days to a few weeks. Unfortunately, until recently, no record was kept regarding the dates or duration of these connections to the sea, nor of the depth of the water at the time of opening (D. Coetzee, Kleinmond Municipality, pers. comm.). The reasons given for opening the mouth are related to either a threat to adjacent recreational developments [approximately 2 m above mean sea level (MSL)] or the presence of decaying mats of green filamentous algae (*Enteromorpha*, *Chaetomorpha* and/or *Cladophora*) which detract from the aesthetic appeal of the area. This *ad hoc* management strategy, together with other developments have led to a silting up and freshening of the lagoon, especially the western parts. The more the lagoon silts up, the lower the volumes of sea water which can flow into the lagoon when the mouth is open, suggesting an evolution towards a coastal lake. This will be advantageous to the growth of plants which thrive under less saline conditions. The spread of *Phragmites* has already been noted (O'Callaghan 1982). This scenario is in opposition to the opinions of Van Heerden (1985) who suggests that the lagoon is becoming deeper.

There are five basic types of wetland vegetation associated with Kleinmond Lagoon (O'Callaghan 1982):

1, the tall reed marshes dominated by *Phragmites australis*, *Schoenoplectus littoralis* or *Typha capensis*;

2, the shorter sedge marshes dominated by *Juncus kraussii*;

3, the seasonally inundated vegetation on sandy substrata usually dominated by *Sporobolus virginicus*;

4, the seasonally exposed vegetation including *Salicornia meyeriana*, *Cotula filifolia* and *Triglochin bulbosa*;

5, the aquatic vegetation with *Potamogeton pectinatus*, *Chara globularis* and *Zannichellia palustris*.

Vegetation types 3, 4 and 5 may overlap or interchange seasonally.

The aim of this study is to gain a clearer understanding of the relative distribution and structure of these vegetation types.

METHODS

After studying aerial photographs, orthophotographic maps and following field reconnaissance, six transects were demarcated across the marshes of Kleinmond

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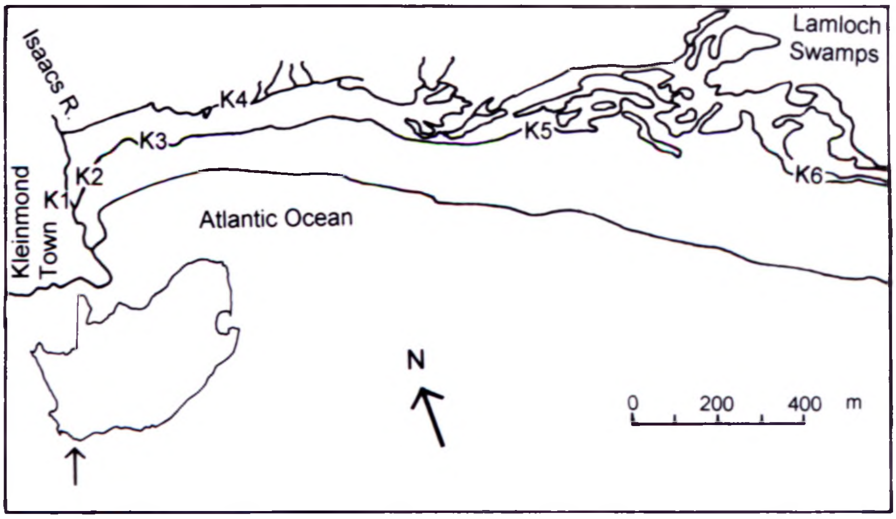

FIGURE 1.—Kleinmond Lagoon, Transects K1 to K6.

Lagoon (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, May, 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 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 (1994d). The letters MOC refer to indeterminate voucher specimens.

TABLE 1.—Details of transects

Transect	Description	Length (m)	Tidal range (cm to MSL)
K1	Northern shore, 10 m south of footbridge, in westerly direction	8	71.8–138.3
K2	Southern shore, 60 m east of footbridge, in southeasterly direction	14	62.3–156.3
K3	Southern shore, 200 m east of footbridge, in southerly direction	19	72.3–139.8
K4	Northern shore, 500 m east of footbridge, in northerly direction	79	57.8–123.8
K5	Southern shore, 1.6 km east of footbridge, in southerly direction	118	79.3–147.3
K6	Southern shore, 2.4 km east of footbridge, in westerly direction	88	80.8–180.8

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 K1 to K6 are shown in Figures 2–7. Additional species in Transects K4 to K6 are listed in Tables 3–5.

At first glance, these transects seem to fall into two groups: Transects K1 to K3 and Transects K4 to K6.

Transects K1 to K3

These transects were exposed to stronger marine influences, albeit seasonal. The soils were coarse, of marine origin, alkaline and contained very little organic matter.

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

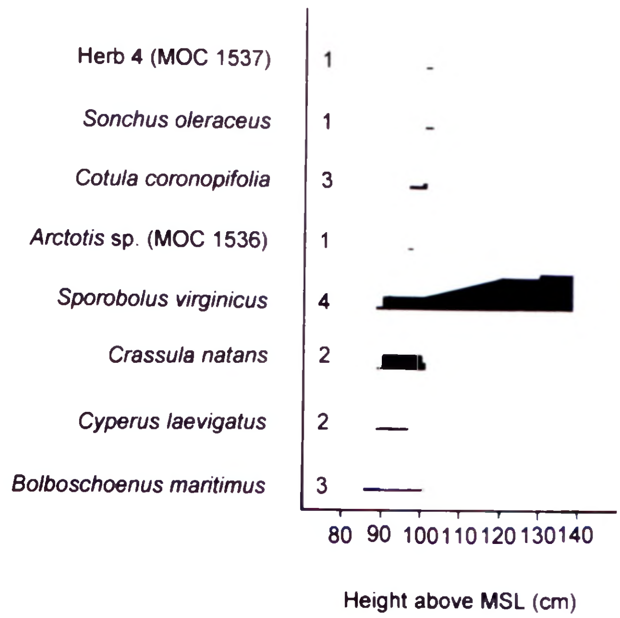

FIGURE 2.—Distribution of species along an elevation gradient on Transect K1. 1–4, number of times species located through year.

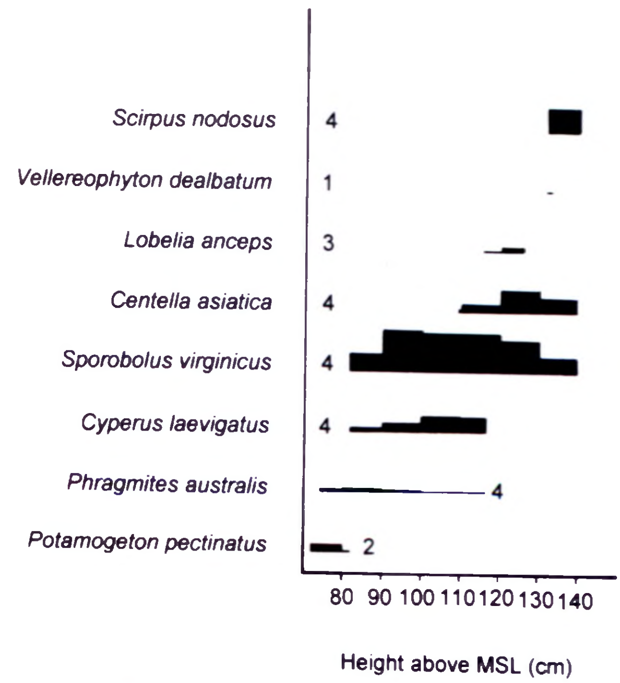

FIGURE 4.—Distribution of species along an elevation gradient on Transect K3. 1–4, number of times species located through year.

Sporobolus virginicus dominated the vegetation, particularly near the bottom of the transects.

Relatively few species were found on these shorter transects when compared with K4 to K6 (Figures 2–7).

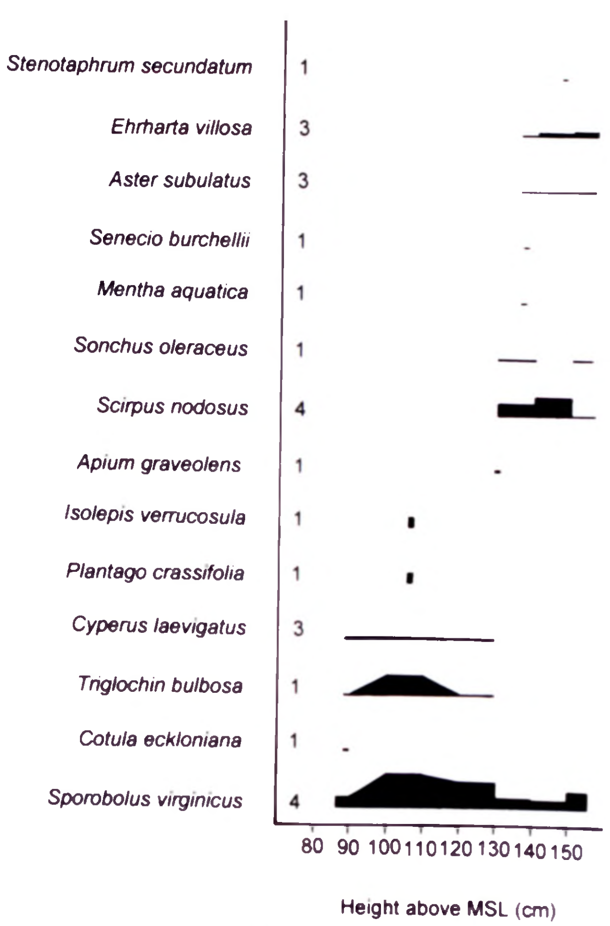

FIGURE 3.—Distribution of species along an elevation gradient on Transect K2. 1–4, number of times species located through year.

Phragmites australis was only found at K3. This species was restricted to the Lamloch area (the eastern part of the lagoon) until 1983, with a small patch at the mouth of the Isaacs River. A number of factors have led to its spread:

a) during the 1980/1981 summer season, the footbridge embankment was extended towards the seaward side. This restricted the outflow channel to an area underlain by a rocky sill. The amount and rate of outflow during subsequent openings of the mouth was thus reduced. As a result, previously transient sediments accumulated in the western parts of the lagoon as they are not being washed out to sea;

b) the regular opening of the mouth prevented the water in the lagoon from rising more than 2 m above MSL. An increased frequency of mouth opening (pers. obs.) resulted in a retention of sediments in the system as outflowing water velocities would be reduced;

c) the stabilization of the dunes by alien shrubs drastically reduced the amount of saline water entering the western parts of the lagoon. These shrubs trap wind-blown sand, but do not have the soil binding capabilities of the natural

TABLE 3.—Additional species at Transect K4

Species	Number of times found	Distribution above MSL (cm)
Gladiolus carneus	1	86.8–86.8
Typha capensis	2	86.8–91.3
Eleocharis dregeana	1	98.8–98.8
Conyza ulmifolia	3	109.8–123.3
Cotula eckloniana	1	57.8–104.3
Orphium frutescens	1	87.8–119.8
Herb 8 (MOC 15/11/7)	1	109.8–123.8
Ficinia acuminata	1	115.3–123.8
Vellereophyton dealbatum	1	122.3–122.3
Grass 3 (MOC 5/11/9)	1	122.3–123.8

MOC numbers refer to voucher specimens.

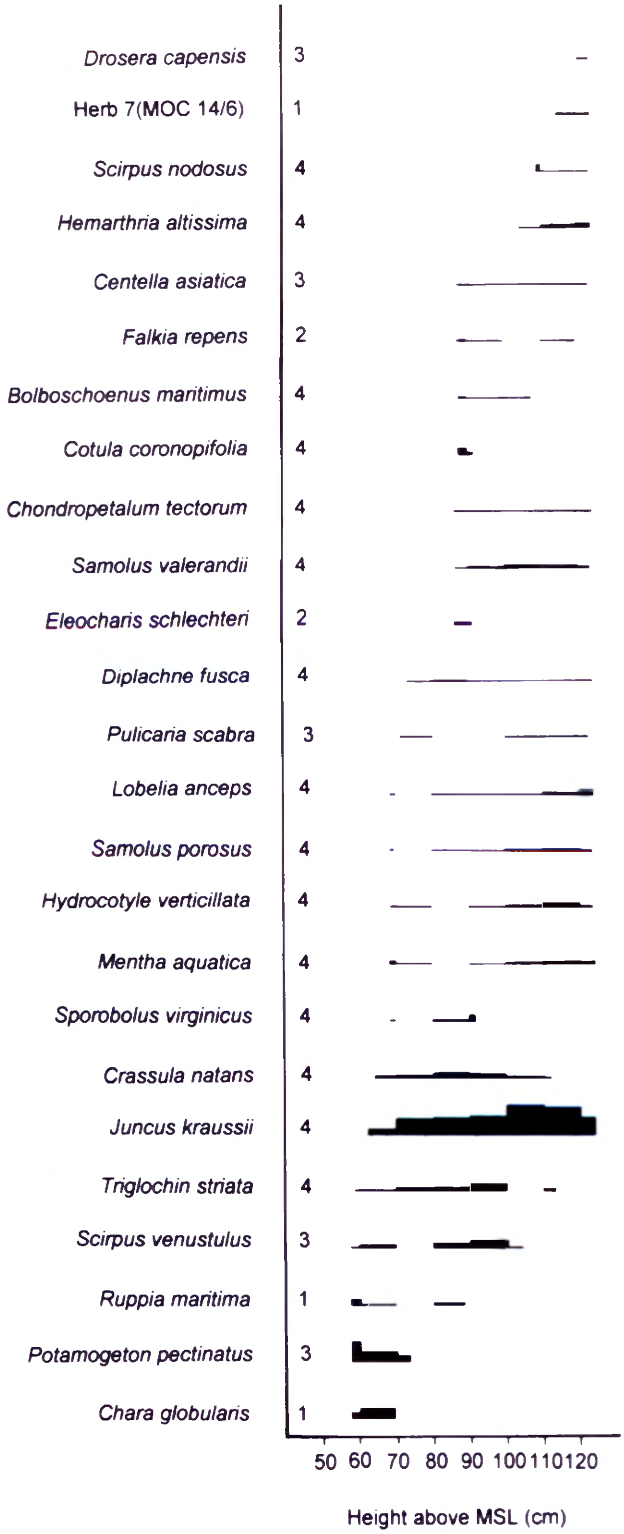

FIGURE 5.—Distribution of species along an elevation gradient on Transect K4. 1–4, number of times species located through year.

vegetation. Slumping thus takes place from beneath the canopy;

d) the increased residential development to the north of the western part of the lagoon resulted in the destruction of the natural vegetation and increased hard surfaces. These resulted in an increased fresh water runoff entering the lagoon via creeks and rivulets.

These developments had the nett effect of altering the equilibrium between fresh water and marine input in the system to one which is aggrading and freshening, at least in the vicinity of K3. These are ideal conditions for the spread of *Phragmites australis* (Heinecken & Damstra 1983).

TABLE 4.—Additional species at Transect K5

Species	Number of times found	Distribution above MSL (cm)
Spergularia media	4	114.8–117.3
Falkia repens	2	115.3–133.3
Mentha aquatica	3	111.3–115.3
Cotula filifolia	2	104.3–115.3
Bolboschoenus maritimus	2	115.3–115.3
Romulea tabularis	2	108.8–123.3
Tribolium hispidum	2	133.3–144.8
Lobelia anceps	1	84.3–117.3
Crassula decumbens	1	112.3–112.3
Fuirena sp. (MOC 4/11/29)	1	114.8–115.3
Romulea cf. *cruciata* (MOC 4/11/26)	1	133.3–133.3

MOC numbers refer to voucher specimens.

Transects K4 to K6

The soils were of terrestrial origin, acidic and with a higher organic content. The soils at K6 were slightly different in that they were acidic at the lower reaches of the transect, but became more alkaline near the top.

Although *Juncus kraussii* dominated, *Sporobolus virginicus* was present and sometimes co-dominated, particularly on the upper parts of the transect where the effects of the acidic lagoon water were not as pronounced.

Sporobolus virginicus was rare at K4 when compared to the other transects. This was the only transect on the northern side of the lagoon (between the lagoon and the mountains). Preliminary soil analyses indicated differences in soil conductivity at this transect relative to K5 and K6. This might indicate a qualitative difference in the mineral content of the soils between K4 and the others.

TABLE 5.—Additional species at Transect K6

Species	Number of times found	Distribution above MSL (cm)
Scirpus venustulus	1	88.8–103.3
Spergularia media	4	103.3–103.8
Samolus porosus	4	103.3–135.8
Cotula filifolia	3	111.3–141.8
Juncus scabriusculus	1	114.8–129.8
Sebaea minutiflora	1	116.8–116.8
Senecio burchellii	3	119.8–135.8
Romulea tabularis	2	120.3–145.8
Parapholis incurva	1	127.3–127.3
Crassula glomerata	4	129.8–145.8
Acacia cyclops	1	130.8–133.8
Lolium perenne	1	131.3–133.8
Sonchus oleraceus	2	131.3–145.8
Grass 7 (MOC 16/16)	1	133.8–133.8
Tribolium hispidum	2	141.8–141.8
Gladiolus carneus	1	145.8–145.8
Anagallis arvensis	1	168.8–168.8

MOC number refers to voucher specimen.

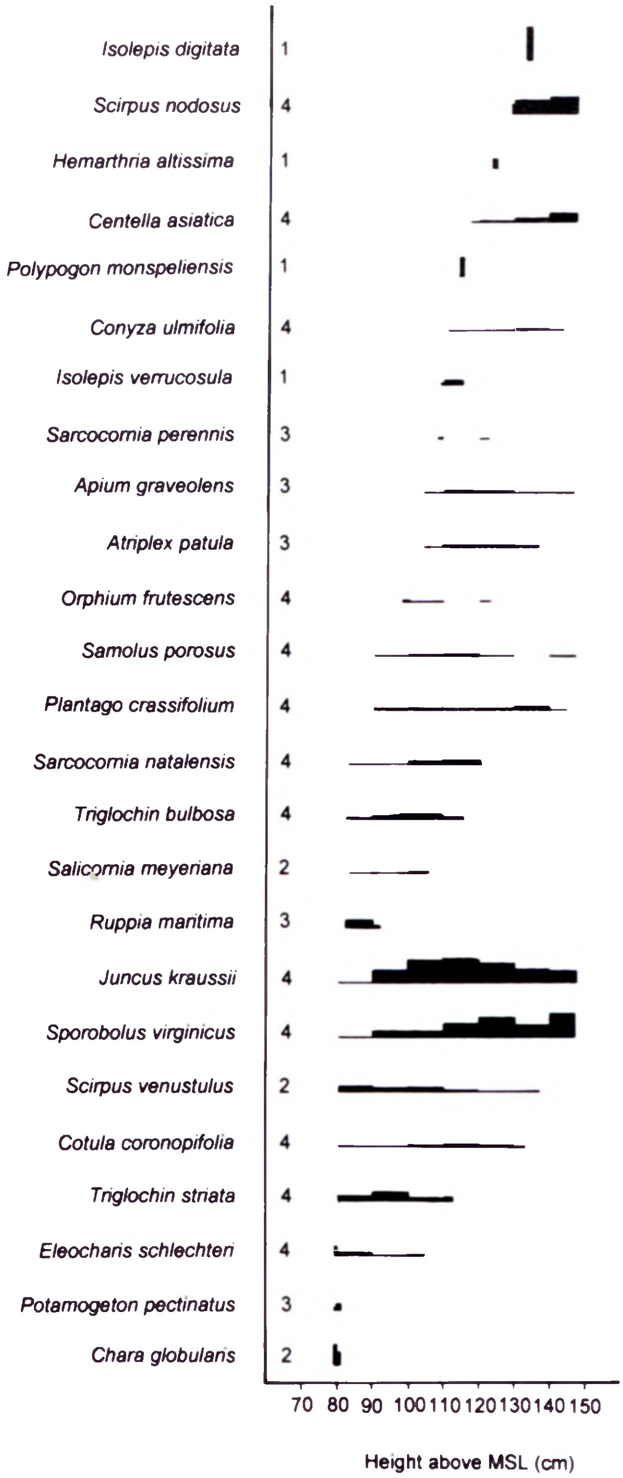

FIGURE 6.—Distribution of species along an elevation gradient on Transect K5. 1–4, number of times species located through year.

Much seepage was also noted along the northern shore, resulting in a permanently high water table. Although *Sporobolus virginicus* might withstand seasonal flooding, it might not withstand a permanently flooded rhizosphere.

When comparing the vegetation of this system with that of Langebaan Lagoon, the Berg River and Uilkraals River (O'Callaghan 1994a, b, c), the following are immediately noticeable:

1, an increased preponderance of sedges. In the other systems, sedges are mostly restricted to less saline areas and largely consist of *Juncus kraussii*. At Kleinmond Lagoon, much of the vegetation is dominated by this species, but many other sedges are also present. This increased dominance by sedges indicates the decreased saline conditions which prevail in this system;

2, an increased proportion of annual and ephemeral herbs. This indicates a less predictable system (limited tidal interaction, seasonality, irregular mouth-opening).

Aquatic vegetation is important in this system. *Potamogeton pectinatus* was found at K3 to K6. This species disappeared from the western parts during spring and summer when salinities increased and the water levels dropped as a result of mouth-opening. This species was present throughout the whole year at K6. In contrast, *Chara*

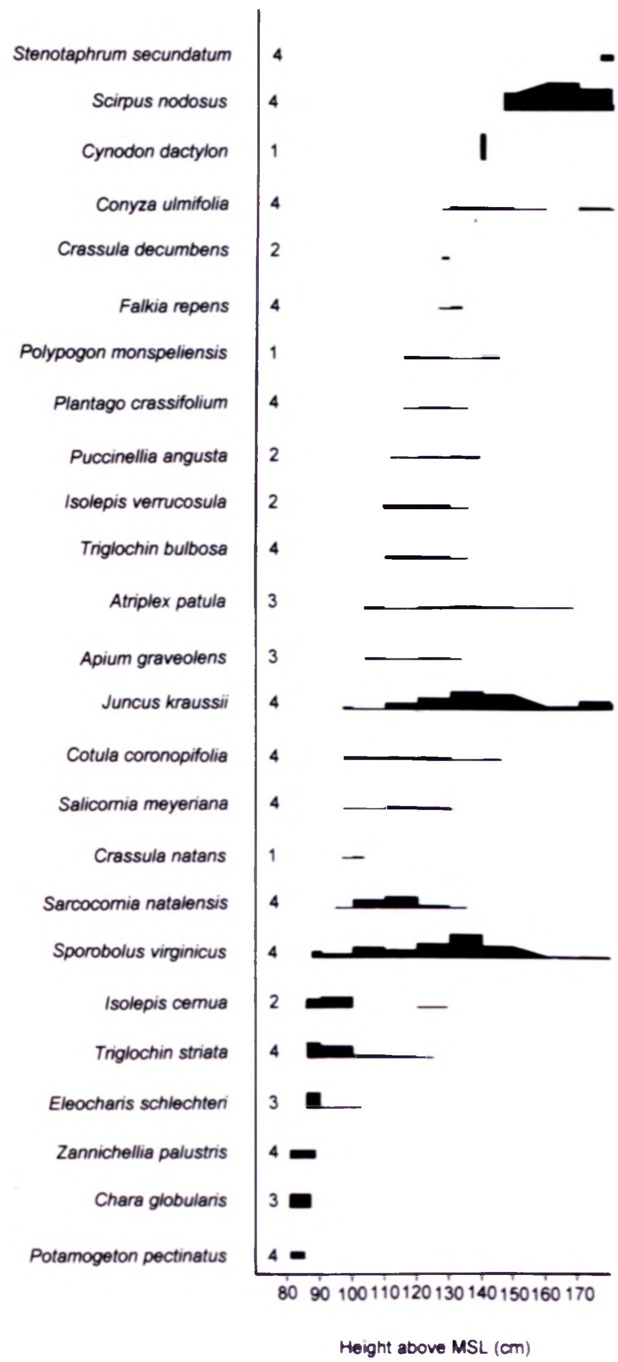

FIGURE 7.—Distribution of species along an elevation gradient on Transect K6. 1–4, number of times species located through year.

globularis is a seasonal plant. It was found at K4 during autumn, at K5 during late summer and autumn, and was only absent from K6 during midwinter.

Although *Ruppia maritima* is the most important aquatic species in the adjacent Bot River Estuary (Bally *et al.* 1985), it was only found at K4 and K5 during late summer. Even though it is regarded as a perennial plant (Obermeyer 1966), it can only grow when favourable conditions prevail: when local depressions fill with fresh water after the mouth closes. It attained its greatest cover after winter, but it died off in summer as the depression again dried out. Under these conditions, *Ruppia maritima* might be regarded as a 'facultative annual', i.e. a plant which is seasonally absent due to the seasonal demise of its habitat. On these transects, *Triglochin bulbosa* and *Sarcocornia natalensis* might also be regarded as facultative annuals with an opposite seasonal phase. They were found in these depressions when the water was low.

This induced seasonal demise of habitat should be an important management consideration. The flowering season for *Ruppia maritima* is early summer (Bond & Goldblatt 1984), when conditions at Kleinmond Lagoon are not favourable for growth and it is not found in a flowering state. A compromise should be sought between the needs of winter facultative annuals, summer facultative annuals and obligate annuals. The induced seasonal conditions prevailing at this site were unsuitable for both the facultative and obligate annuals. The correct management option would be to allow this area to remain flooded until early midsummer, after which it should remain exposed until autumn.

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