South African Journal of Botany xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Distribution and status of *Zostera capensis* in South African estuaries — A review

J.B. Adams *

Department of Botany, Nelson Mandela Metropolitan University, PO Box 77000, Port Elizabeth 6031, South Africa

ARTICLE INFO

Available online xxxx

Edited by GC Bate

Keywords:
Keystone
Floods
Submerged macrophytes
Eelgrass

ABSTRACT

This review collates the available knowledge on the distribution and area covered by eelgrass *Zostera capensis* and shows that it has a wide distribution occurring in 62 estuaries from the Olifants Estuary on the west coast to Kosi Bay on the east coast. It has protected meristems, a strong root system and flexible leaves which enable it to grow under strong tidal conditions as well as tolerate periods of exposure and desiccation characteristic of the intertidal zone. Estuaries with the largest areas of *Z. capensis* are Olifants, Langebaan, Berg, Knysna, Keurbooms, Swartkops and Bushmans. Only Langebaan and Knysna have some formal protection status. Large populations were lost from KwaZulu-Natal estuaries at the time of Durban Bay harbour development in the 1950s and more recently from St Lucia. There have been a number of studies in South Africa showing the utilisation of eelgrass beds by a variety of invertebrate and fish species for habitat, shelter, foraging sites and nurseries. Fewer studies have addressed nutrient recycling and other ecosystem services such as carbon sequestration. In all estuaries the distribution of *Z. capensis* is highly dynamic and therefore difficult to map, assess changes over time and use as an indicator of estuary health. Cover and biomass are removed after large floods and have been shown to fluctuate in response to bait digging and disturbance by boats. This review identifies eutrophication as an emerging threat that encourages macroalgal growth, which smothers *Z. capensis*. Despite its wide distribution range, *Z. capensis* is sensitive to human impacts which have led to the species being listed as vulnerable in the Red Data List. It is encouraging that approximately 46% of all estuaries with *Z. capensis* have estuary management plans as these strive to protect sensitive habitats using activity zoning. Studies tracking the changes over time of the *Z. capensis* beds in specific estuaries are needed to understand dynamic responses. In addition there is urgency for a national assessment of the distribution and health of this keystone species in South Africa.

© 2016 SAAB. Published by Elsevier B.V. All rights reserved.

1. Introduction

Globally seagrasses play an important ecological role stabilizing sediment, preventing erosion, reducing water flow, trapping nutrients and organic materials and providing sheltered habitat for fish and invertebrates. They serve as a substrate for epiphytes and periphyton which is then a food source for other organisms. Because of these ecological services they provide to coastal zones they are ranked among the most productive and valuable ecosystems on Earth (Costanza et al., 2014). Short et al. (2011) assessed the extinction risk of the world's seagrasses and found that nearly one quarter (24%) of all species were assigned a conservation status of Threatened (Endangered or Vulnerable) or Near Threatened. As a result of coastal development, habitat destruction and its continued decline, *Z. capensis* is listed as vulnerable in the Red Data List of Species (IUCN, 2010; Short et al., 2010). Because it is a keystone species within the coastal environment the loss of seagrass can have significant cascading effects on higher trophic levels and ecosystem functioning. For example in South Africa, Pillay et al. (2010) reported on the decline of *Z. capensis* in the Langebaan Lagoon and the associated decrease in invertebrate species richness resulting in the limpet *Siphonaria compressa* becoming one of South Africa's most endangered marine invertebrates (Mead et al., 2013).

Zostera capensis Setchell, or Cape dwarf-eelgrass, is the dominant seagrass in South Africa that occurs in sheltered estuaries along the nearly 3000 km coastline. It is a low intertidal species that occurs below sea level (i.e. subtidal) to elevations of 0.9 m AMSL (above mean sea level), and only overlaps in zonation with *Spartina maritima* (M.A. Curtis) Fernald (rice grass), which occurs from MSL to below MHWN (mean high water neap, Adams et al., 1999). Due to its protected meristems, strong root system and flexible leaves, *Z. capensis* can grow where there are strong tidal currents while also being able to tolerate periods of exposure and desiccation. It is found predominantly in permanently open estuaries but can occur in estuaries that close periodically to the sea. In these systems when salinity falls below 15 ppt, *Z. capensis* is usually outcompeted by other submerged macrophytes such as *Ruppia*

* Fax: +27 41 583 2317.
E-mail address: Janine.adams@nmmu.ac.za.

http://dx.doi.org/10.1016/j.sajb.2016.07.007
0254-6299/© 2016 SAAB. Published by Elsevier B.V. All rights reserved.

Please cite this article as: Adams, J.B., Distribution and status of *Zostera capensis* in South African estuaries — A review, South African Journal of Botany (2016), http://dx.doi.org/10.1016/j.sajb.2016.07.007

cirrhosa (Petagna) Grande or *Stuckenia pectinatus* (L.) Böerner (Adams and Bate, 1994a). All three are mapped as submerged macrophytes and are often difficult to separate as individual species in temporarily open/closed estuaries (TOCEs) because *R. cirrhosa* and *Z. capensis* frequently grow together.

Mapping the movement and changes in seagrass habitats are good indicators of ecosystem health (Roca et al., 2016). However this is difficult in South African estuaries because of the small areas occupied and the dynamic nature of the eelgrass beds which is highlighted in this review. Available information on the distribution and area covered by *Z. capensis* in South African estuaries is summarised. Available research completed on *Z. capensis* in South African estuaries is highlighted and research gaps identified. This is important as *Z. capensis* is exposed to increasing threats from global change and human pressures. Understanding responses will assist with the conservation and management of estuaries where this plant occurs.

2. Regional distribution

According to Short et al. (2007) there are six main seagrass bioregions; 1) Temperate North Atlantic, 2) Temperate North Pacific, 3) the Mediterranean, 4) Temperate Southern Oceans, 5) Tropical Atlantic and 6) the Tropical Indo-Pacific. The Temperate Southern Oceans includes the coastlines of Australia, Africa and South America. *Z. capensis* has its centre of distribution in this bioregion and occurs from Inhaca Island and Maputo Bay (Moçambique) on the east coast to Olifants Estuary on the west coast of South Africa. Bandeira and Gell (2003) reported that *Z. capensis* is encountered further north along the Mozambican coast as mixed seagrass beds with *Halodule wrightii* Asch. while Green and Short (2003) reported distribution as far as southern Kenya and on the northwest coast of Madagascar. *Z. capensis* is thus an endemic seagrass with a narrow geographic range. It has limited patchy distribution due to a lack of suitable habitat and it occupies less than 2000 km^2 (Short et al., 2010).

Globally and regionally seagrasses are threatened by human impacts. Bandeira (2002) recorded significant losses in *Z. capensis* area at Inhaca Island of 7.2% (from 871 ha in 1991 to 808 ha in 2003) as a result of sand accretion as well as trampling, motorboat activity and jetty construction. Maputo Bay is an important habitat for *Z. capensis* as it occupies nearly 4016 ha on muddy flats or fine sediments within 6 m of water (Bandeira, 2014). Here digging for clam collection is a major impact, while flooding of the Incomati Estuary in 2000 resulted in large scale sedimentation and a massive loss of *Z. capensis* from the Bay (Bandeira and Gell, 2003). Green and Short (2003) estimated a reduction of nearly 50% of *Z. capensis* populations due to bivalve harvesting and habitat destruction. Overall *Z. capensis* is severely fragmented and there is a continuing decline, although it grows fast the plant does not colonize quickly. The area of occupancy is less than 2000 km^2 and therefore meets the threshold for criterion B2 and is listed as Vulnerable (IUCN, 2010; Short et al., 2010).

3. Distribution in South Africa

Table 1 shows the available area cover data for submerged macrophytes and *Z. capensis* in South African estuaries. These data were sourced from published literature and available reports particularly Department of Water and Sanitation environmental flow requirement studies as these usually included a field visit and preparation of a vegetation map. These data are collated in an Estuary Botanical Database which is updated regularly (Adams et al., 2016 in this issue). The National Biodiversity Assessment (Van Niekerk and Turpie, 2012) was the last published record indicating the area covered by different estuary macrophytes. In Table 1 the most recent reference reporting *Z. capensis* cover has been used. The data set does not include herbarium records which would provide a useful analysis of historical distribution. Some of the observations are now old e.g. Colloty (2000) and would need to be checked for a verified up to date record of present distribution. The only estuaries shown in Table 1 where we know that *Z. capensis* does not presently occur are Durban Bay and St Lucia.

Z. capensis is present in 62 of the approximately 300 estuaries (Fig. 1), occurring mostly in the permanently open systems. Submerged macrophyte cover is generally highest in estuarine lakes and bays because of their size. However this area covered is extremely dynamic responding to changes in estuary mouth condition, water level fluctuations and river flooding. For example in St Lucia Estuary, submerged macrophytes can occupy 432 ha of which nearly 181 ha has been recorded as *Z. capensis* (Table 1). Historical collections by Ward show that it mostly occurred in the south lake and over a range of salinity conditions (Table 2). According to Taylor (2006) it is absent from north lake because of large salinity fluctuations which seldom remain within a suitable range long enough for the plant to become established. Since 2005 *Z. capensis* has been absent from St Lucia because of prolonged drought, low water level and lack of intertidal conditions due to a closed mouth (Adams et al., 2013). At times an increase in water level resulted in germination of other submerged macrophytes from seed e.g. *R. cirrhosa* and *S. pectinatus* but there was no recovery of *Z. capensis* as it seldom sets seed. Recovery is likely to be slow as there appears to be no vegetative material to recover from.

The Berg (206 ha) and Knysna (238 ha) estuaries have the largest more permanent *Z. capensis* beds. However the value for the Berg Estuary may be an overestimate as according to Boucher and Jones (2007) this was the area for intertidal mudflats with eelgrass. This area may also include other submerged macrophytes. In the Berg Estuary *Z. capensis* biomass ranged from 70 to 400 g DW m^{-2} at the Blind Lagoon to 70 to 430 g DW m^{-2} at 7.85 km at the mouth.

The Knysna Estuary is the stronghold for *Z. capensis* in South Africa with an estimated area cover of 350 to 390 ha (Barnes and Ellwood, 2011). Schmidt (2013) mapped a lower area cover of 238 ha which was fairly similar to that measured from 1942 aerial photographs (Table 3). Other important populations occur in Olifants (47.74 ha), Langebaan (85.8 ha), Keurbooms (64 ha), Kromme (34 ha), Swartkops (44.7 ha) and Bushmans (39.8 ha). These are all estuaries that remain permanently open to the sea with large intertidal areas and they have sheltered creeks and bays which encourage eelgrass colonisation.

Submerged macrophyte area cover in TOCEs is generally small and consists of a mixture of species such as *Z. capensis*, *R. cirrhosa* and *S. pectinatus*. In these systems *Z. capensis* has rarely been mapped separately because of the small area that they occupy. In comparison submerged macrophytes can cover large areas in some of the estuarine lakes which include Swartvlei (219 ha with 23 ha *Z. capensis*) and Klein (180 ha with 37 ha *Z. capensis*).

Langebaan Lagoon on the west coast is an estuarine embayment that has had a significant area of *Z. capensis*. Despite Pillay et al. (2010) recording a reduction to nearly 25 ha, Van Der Linden (2014) mapped the area of submerged macrophytes at 85.8 ha. Angel et al. (2006) reported two major seagrass crashes in Langebaan Lagoon in 1976 and 2003. The first coincided with blasting and dredging during harbour development in the adjacent Saldanha Bay.

This changed the circulation and current velocities in Saldanha Bay and Langebaan lagoon (Luger et al., 1999) which would have influenced distribution and biomass.

In large permanently open estuaries such as the Olifants the submerged macrophytes are distributed along a salinity gradient with pondweed *S. pectinatus* forming dense beds in the upper reaches and eelgrass *Z. capensis* (47.72 ha) distributed in the lower and middle reaches of the estuary. In estuarine lakes such as the Klein, *R. cirrhosa* favours the shallow, less saline areas of the middle and upper reaches, while *Z. capensis* occurs in the deeper more saline water of the middle and lower reaches near the mouth (De Decker, 1989). In estuaries such as the Klein *Z. capensis* is an important ecosystem engineer facilitating sand bank expansion and providing a stable habitat. In this

Please cite this article as: Adams, J.B., Distribution and status of *Zostera capensis* in South African estuaries — A review, South African Journal of Botany (2016), http://dx.doi.org/10.1016/j.sajb.2016.07.007

Download English Version:

https://daneshyari.com/en/article/5763135

Download Persian Version:

https://daneshyari.com/article/5763135

Daneshyari.com