DINTERIA NO. 24:29-37 WINDHOEK, NAMIBIA - MAY 1994

A contribution to the algal phytogeography of the southern African west coast - a case study at Elizabeth Bay, Namibia

Antje Günster*

ABSTRACT

The diversity of the macroalgal flora at Elizabeth Bay was determined at relatively undisturbed sites to serve as baseline data for further monitoring of a possible impact of mine tailings disposal. Twenty-two species had never been recorded at Elizabeth Bay before, which is attributed to the poor sampling record.

INTRODUCTION

The Namibian coastline is known for its diverse fauna and flora, caused by the cold Benguela current and regular upwelling (Andrews & Hutchings 1980; Branch & Griffiths 1988). Although the general biogeography of the Namibian seaweed flora has been studied (Lawson *et al.* 1990; Engledow *et al.* 1992), detailed surveys are lacking for most of the coastline (Bolton 1986; Molloy 1990). The area south of Lüderitz is of special interest, since it is (a) affected by a centre of strong upwelling and (b) because of the abundance of diverse rocky habitats with different degrees of exposure to wave action which offer a variety of niches for seaweed species (Molloy 1990; Engledow *et al.* 1992). Seaweed species had been collected in 1957 at Elizabeth Bay, about 30 km south of Lüderitz (Lawson *et al.* 1990), but only 45 species were identified. Today, the bay is used to dispose fine tailings (1.4 mm) remaining after extracting diamonds. There has been considerable concern that the tailings affect the marine flora and fauna in the vicinity of the bay. The aim of this study was to describe the seaweed flora in relatively undisturbed habitats with exposure to different degrees of wave action similar to those in the impacted bay. This survey focuses on the diversity of the macroalgal flora, thus complementing a study of intertidal rocky shores at Elizabeth Bay (Bustmante *et al.* 1993). In addition, the algal collections provide phytogeographical data to contribute to the ongoing discussion whether or not the west coast flora of southern Africa is cold temperate (Brown & Jarman 1978) or warm temperate (Bolton 1986).

* Botany Department, University of Namibia, P/Bag 13301, Windhoek, Namibia. FAX: 061-3072444

MATERIALS AND METHODS

The study was undertaken at three sites near Elizabeth Bay (26°55'S and 15°15'E). Two sites were semi-exposed, one was sheltered. The semi-exposed sites were located on the west side of the northern headland (Elizabeth point), the sheltered site in a small bay 5 km northwest of Elizabeth Bay. The rocky outcrops consist of medium- to fine-grained granites of the Sinclair Series (Geological Survey 1980).

The survey and collections were undertaken on three days in September 1993 at the end of a spring tide. For this purpose, at each site three transect were located randomly perpendicular to the shore and 0.5 x 0.5 m quadrates were placed at 3 m intervals as far as accessible from land. Within the quadrates all algae species were identified and cover was recorded per species according to a Braun-Blanquet scale (Mueller-Dombois & Ellenberg 1974). The height difference between the quadrates was determined and a habitat description given for each quadrat. In addition, algae species which were not recorded in the quadrates were selected at each site for later identification. The same sites were sampled in November 1993 again during a spring tide. Voucher specimens of all species are kept at the reference collection of the Botany Department at the University of Namibia. Articulated corallines such as *Corallina, Jania* and encrusting algae such as *Lithothamnion* species are currently under revision. Thus identifications to genus level were included, where possible (Simpson 1976).

The zonation patterns of all transects were analyzed in kite diagrams and summarised in a table (Appendix I). The transects were divided into high intertidal (= supra littoral and supra littoral fringe) and mid- and lower intertidal (= mid littoral and sublittoral fringe) according to the distance from the high water mark (Brown & Jarman 1978).

RESULTS

Distribution

A total of 58 species was encountered, although only 29 species were recorded on the transects. Collections in the vicinity of the transects revealed an additional 27 species (see Appendix I). *Callithamnion* sp., *Carpoblepharis flaccida, Ceramium capense, Ceramium diaphanum, Corallina* sp., *Ectocarpus* sp., *Gigartina bracteata, Gigartina clathrata, Gelidium capense, Gymnogongrus complicatus, Gymnogongrus corymbosus, Gymnogongrus polycladus, Gymnogongrus vermicularis, Hypnea spicifera, Jania* sp., *Lithothamnion* sp., *Nothogenia erinacea, Nothogenia* cf. *ovalis, Papenfussiella gracilis, Plocamium comutum, Plocamium rigidum* and *Pterosiphonia cloiophylla* are new records for Elizabeth Bay, but have their normal distributional range in the west coast area.

Zonation

Semi-exposed rocky shore

Enteromorpha sp. and *Porphyra capensis* were the two species dominating in the high intertidal zone (Fig. 1).

The mid- and lower intertidal was dominated by *Cladophora capensis, Chordariopsis capensis* and *Enteromorpha* sp., which occurred mainly in pools. *Caulacanthus ustulatus, Cladophora contexta, Codium fragile* subsp. *capense, Corallina* sp., *Gigartina stiriata* and *Lithothamnion* sp. also occurred in pools, but in lower quantities. Recorded in this zone outside pools were *Aeodes orbitosa, Ceramium capense, Ceramium diaphanum, Champia lumbricalis, Ectocarpus* sp., *Leathesia difformis, Nothogenia* cf. *ovalis, Porphyra capensis* and *Ulva* species (Fig. 1).

Sheltered rocky shore

In the high intertidal *Cladophora capensis, Cladophora contexta, Enteromorpha* sp. and *Ulva* sp. were recorded in rock pools (Fig. 2). Only *Porphyra capensis* occurred also outside the pools.

Lithothamnion sp. were dominant in the mid- and lower intertidal. Less abundant were *Aeodes orbitosa, Centroceras clavulatum, C. capensis, C. ustulatus, C. contexta, Corallina* sp., *Gigartina radula, G. scutellata, Gymnogongrus vermicularis, Grateloupia filicina, Iridaea capensis, Leathesia difformis, N.* cf. *ovalis, Porphyra capensis, Ralfsia expansa, Splachnidium rugosum* and *Ulva* species.

Aeodes orbitosa, C. clavulatum, C. lumbricalis, Corallina sp., *Ecklonia maxima, Epymenia obtusa, G. radula, G. stiriata, Lithothamnion* sp. and *Ulva* sp. occurred in the infratidal zone (Fig. 2).

DISCUSSION

Distribution and diversity

Although 22 species were new records for Elizabeth Bay, they do not extend beyond their normal distributional range. The total of 58 species at Elizabeth Bay is a good representation of the 82 species reported for the entire southern Namibian coast, but is certainly not ranging as a hot spot of diversity compared to Lüderitz with 80 species alone (Lawson *et al.* 1990). Thus Elizabeth Bay is not a unique site in terms of diversity of the macroalgal flora of the southern African west coast. However, the proposed decline in algal species northwards is attributed to lack of collections and published records (Hommersand 1986) and should be corrected accordingly with more collections taking place.

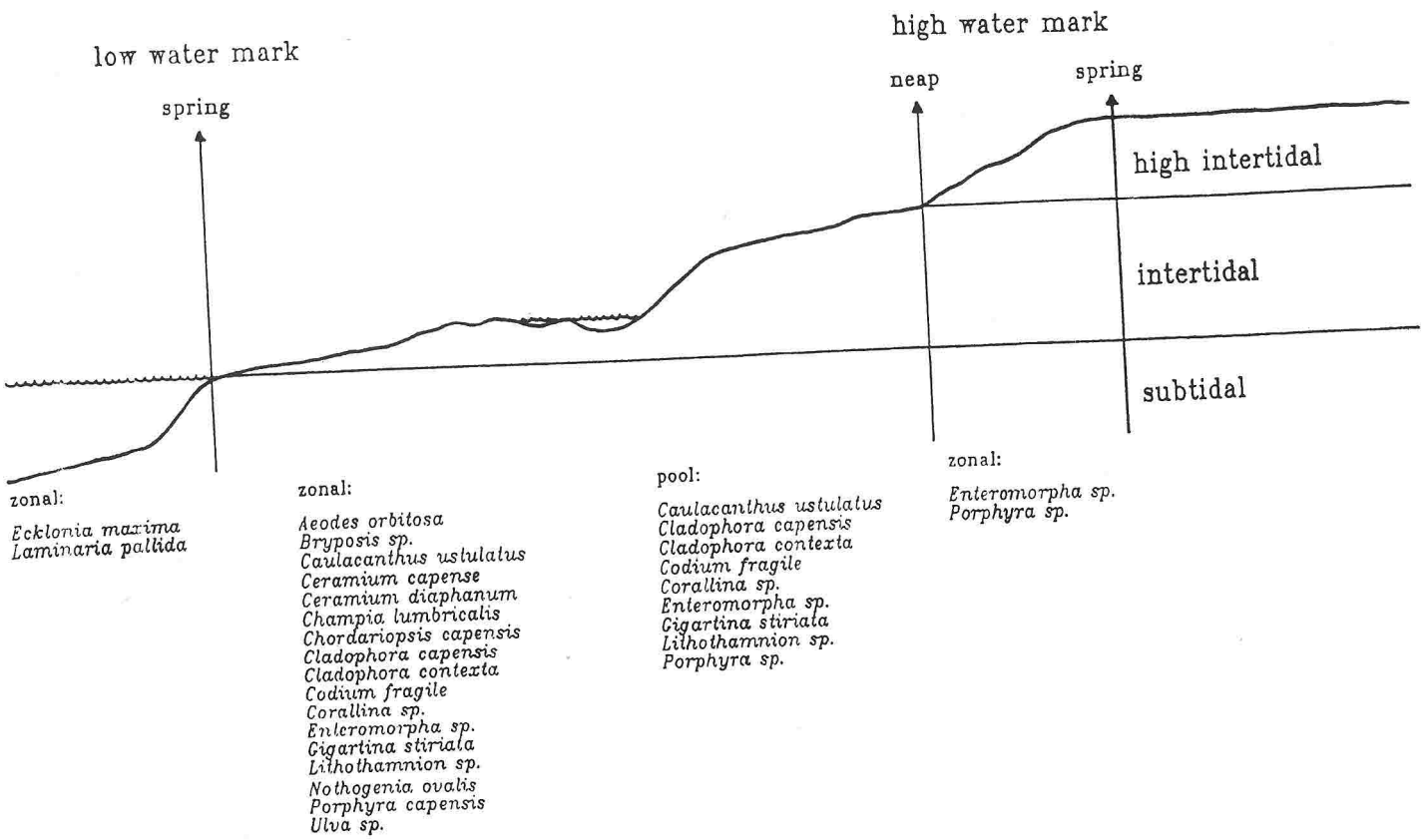

Figure 1: Zonation of macroalgal species at semi-exposed rocky shore at Elizabeth Bay (adapted from Brown & Jarman 1978).

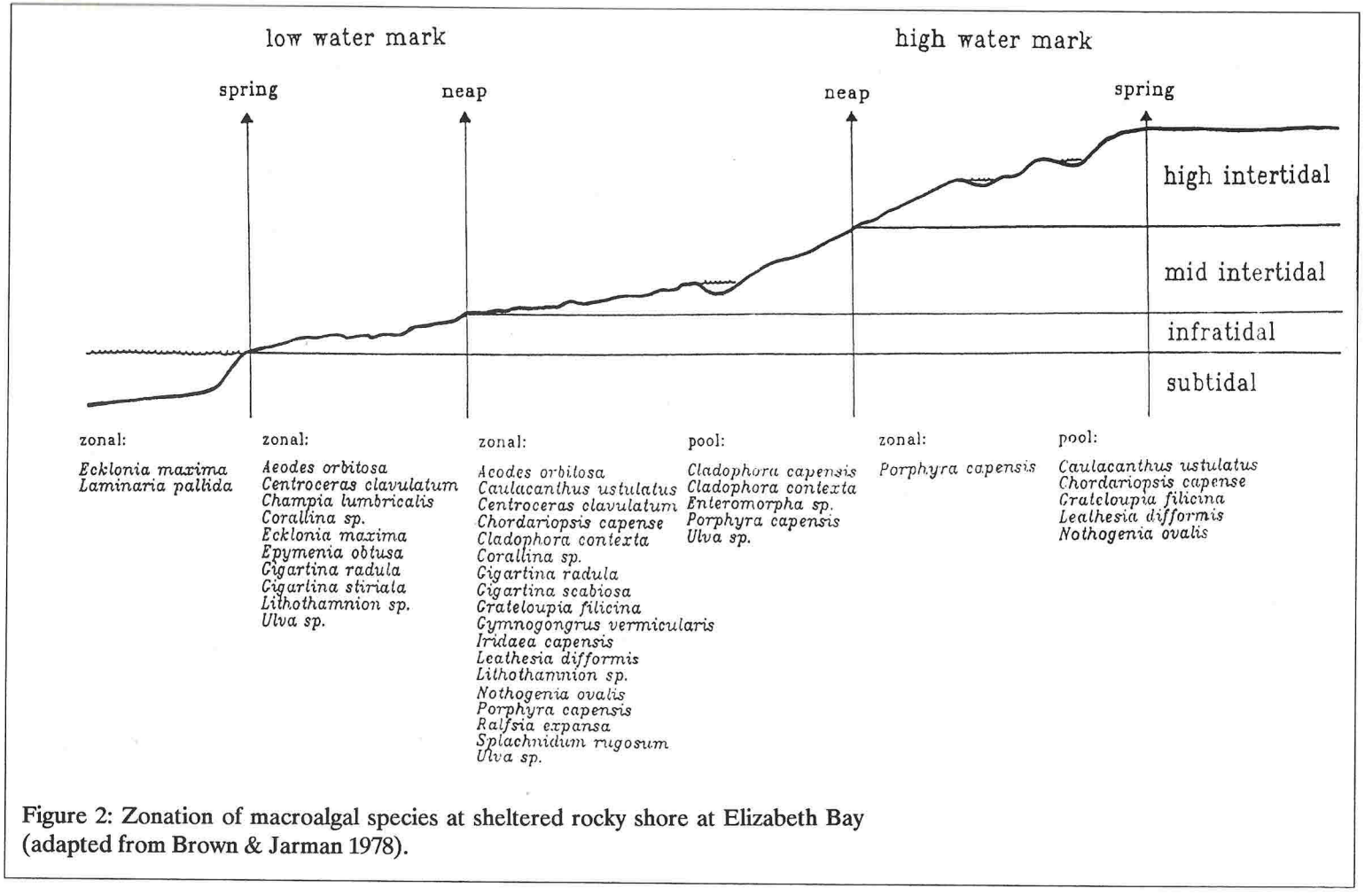

Figure 2: Zonation of macroalgal species at sheltered rocky shore at Elizabeth Bay (adapted from Brown & Jarman 1978).

Zonation

Porphyra capensis occurred in all zones, except for the infratidal, which is attributed to its high tolerance to desiccation (Branch & Branch 1981). The highest macroalgal diversity was recorded in tide pools, which are retreats for algae species that cannot tolerate desiccation during low tide (Branch & Branch 1981).

Comparing growth forms of semi-exposed and sheltered sites showed that foliose and filamentous forms dominated in semi- exposed sites, while crustose forms occurred in sheltered sites only. According to resistance to wave action an opposite trend might be expected (Branch & Branch 1981). Yet, grazers such as different limpet species (e.g. *Patella granularis* and *P. argenvillei*) were abundant at the semi-exposed sites possibly, reducing crustose algae at these sites (Bustamente *et al.* 1993).

In turn, more species of filigrane Ceramiaceae were found at the sheltered sites, which might be explained by their higher susceptibility to wave action.

This study gives an account of the diversity of the macroalgal flora at Elizabeth Bay, thus serves as a baseline data set. The possible impact of fine tailings should receive attention in detailed studies comparing impacted and not-impacted sites on short-term and long-term basis (Bustamante *et al.* 1993).

ACKNOWLEDGEMENTS

Thanks to Mathilda Schoeman, Angie Kanandjembo and Dave Joubert for field assistance and to CDM for giving permission to work at Elizabeth Bay as well as for providing facilities. This survey would not have been possible without the help of Joanne Daneel, George and Margo Branch, as well as Rodrigo Bustamante and Claudio Velasquez, whose input ranged from scientific advice to providing excellent meals after cold, wet and windy nights in the field.

REFERENCES

Andrews, W.R.H. & Hutchings, L. (1980). Upwelling in the southern Benguela current. *Prog. in Oceanogr.* 9:1-82.

Bolton, J.J. (1986). Marine phytogeography of the Benguela upwelling region on the west coast of southern Africa: a temperature dependent approach. *Bot. Mar.* XXIX:251-256.

Branch, G.M. & Branch, M. (1981). *The living shores of Southern Africa.* Struik, Cape Town.

Branch, G.M. & Griffiths, C.L. (1988). The Benguela ecosystem Part V. The coastal zone. *Oceanogr. Mar. Biol. Ann. Rev.* 26:395-486.

Brown, A.C. & Jarman, N. (1978). *Coastal marine habitats*. In: M. Werger (ed.), *Biogeography and Ecology of Southern Africa*. Junk, The Hague:1239-1277.

Bustamante, R.H., Branch, G.M., Velasquez, C. & Branch, M. (1993). *Intertidal survey of rocky shores at the Elizabeth Bay area (Sperrgebiet-Namibia)*. Report to CDM (Pty) Limited. Cape Town.

Engledow, H., Bolton, J. & Stegenga, H. (1992). *The biogeography of the seaweed flora of Namibia.* In: K.E. Mshigeni, J. Bolton, A. Critchley & G. Kiangi (eds.), *Sustainable seaweed resource development in sub-saharan Africa*, Workshop proceedings, Windhoek.

Geological Survey (1980). *Geological map of South West Africa/Namibia*. Geo. Surv., Windhoek.

Hommersand, M.H. (1986). The biogeography of the south African marine red algae: a model. *Botanica Marina* XXIX:257-270.

Lawson, G.W., Simons, R.H. & Isaac, W.E. (1990). The marine algal flora of Namibia: its distribution and affinities. *Bull. Br. Mus. Nat. Hist. (Bot.)* 20:153-168.

Molloy, F.J. (1990). Utilized and potentially utilizable seaweeds on the Namibian coast: biogeography and accessibility. *Hydrobiologia* 204/205:293-299.

Mueller-Dombois, D. & H. Ellenberg (1974). *Aims and Methods of Vegetation Ecology.* John Wiley & Sons, New York, London, Sydney, Toronto.

Simons, R.H. (1976). *Seaweeds of southern Africa: Guide-lines for their study and identification*. Fisheries Bulletin 7, Cape Town.

APPENDIX I: SPECIES FOUND AT ELIZABETH BAY

Chlorophyta

Cladophora capensis (C. Ag.) De Toni
Cladophora contexta Levr.
Codium fragile subsp. *capense* Silva
Enteromorpha sp.
Ulva sp.

Phaeophyta

Chordariopsis capensis (Kuetz.) Kylin
Ecklonia maxima (Osbeck) Papenf.
Ectocarpus sp.
Laminaria schinzii (Foslie)
Leathesia difformis (L.) Aresch.
Myriogloea sp.
Papenfussiella gracilis Kylin N.
Scytosiphon lomentarius (Lynbye) Link
Splachnidium rugosum (L.) Grev.

Rhodophyta

Aeodes orbitosa (Suhr) Schmitz
Aristothamnion collabens (Rudolphi) Papenf.
Arthrocardia sp.
Botryoglossum platycarpum (Turner) Kuetz.
Callithamnion sp.
Carpoblepharis flaccida (C. Ag.) Kuetz.
Caulacanthus ustulatus (Turner) Kuetz.
Centroceras clavulatum (C. Ag. in Kunth) Montagne
Ceramium capense Kuetz.
Ceramium diaphanum (Lightf.) Roth
Ceramium obsoletum Agardh
Champia lumbricalis (Roth) Desvaux
Corallina sp.
Epymenia obtusa (Grev.) Kuetz.
Geligium capense
Gigartina bracteata (Gmelin) Setch. et Gard.
Gigartina clathrata
Gigartina radula (Esper) J. Ag.
Gigartina scutellata (Her.) Simons
Gigartina stiriata (Turner) J. Ag.
Grateloupia filicina (Lamour.) C. Ag.
Gymnogongrus complicatus (Kuetz.) Papenf.
Gymnogongrus corymbosus J. Ag.
Gymnogongrus polycladus (Kuetz.) J. Ag.
Gymnogongrus vermicularis (Ag.) J. Ag.
Hymenena venosa (L.) Kylin
Hypnea spicifera (Suhr) Harvey
Iridaea capensis J. Ag.
Jania sp.
Lithothamnion sp.
Neuroglossum binderianum Kuetz.
Nothogenia erinacea (Turner) Parkinson
Nothogenia ovalis (Suhr) Parkinson
Pachymenia carnosa (J. Ag.) J. Ag. AF
Plocamium cornutum (Turner) Harv.
Plocamium rigidum Bory in Belanger
Polysiphonia sp.
Polysiphonia urbana Harv.
Polysiphonia virgata (C. Ag.) Sprengel
Porphyra capensis Kuetz.
Pterosiphonia sp.
Pterosiphonia cloiophylla (C. Ag.) Falkenb. in Schmitz
Ralfsia expansa
Suhria vittata (L.) J. Ag.