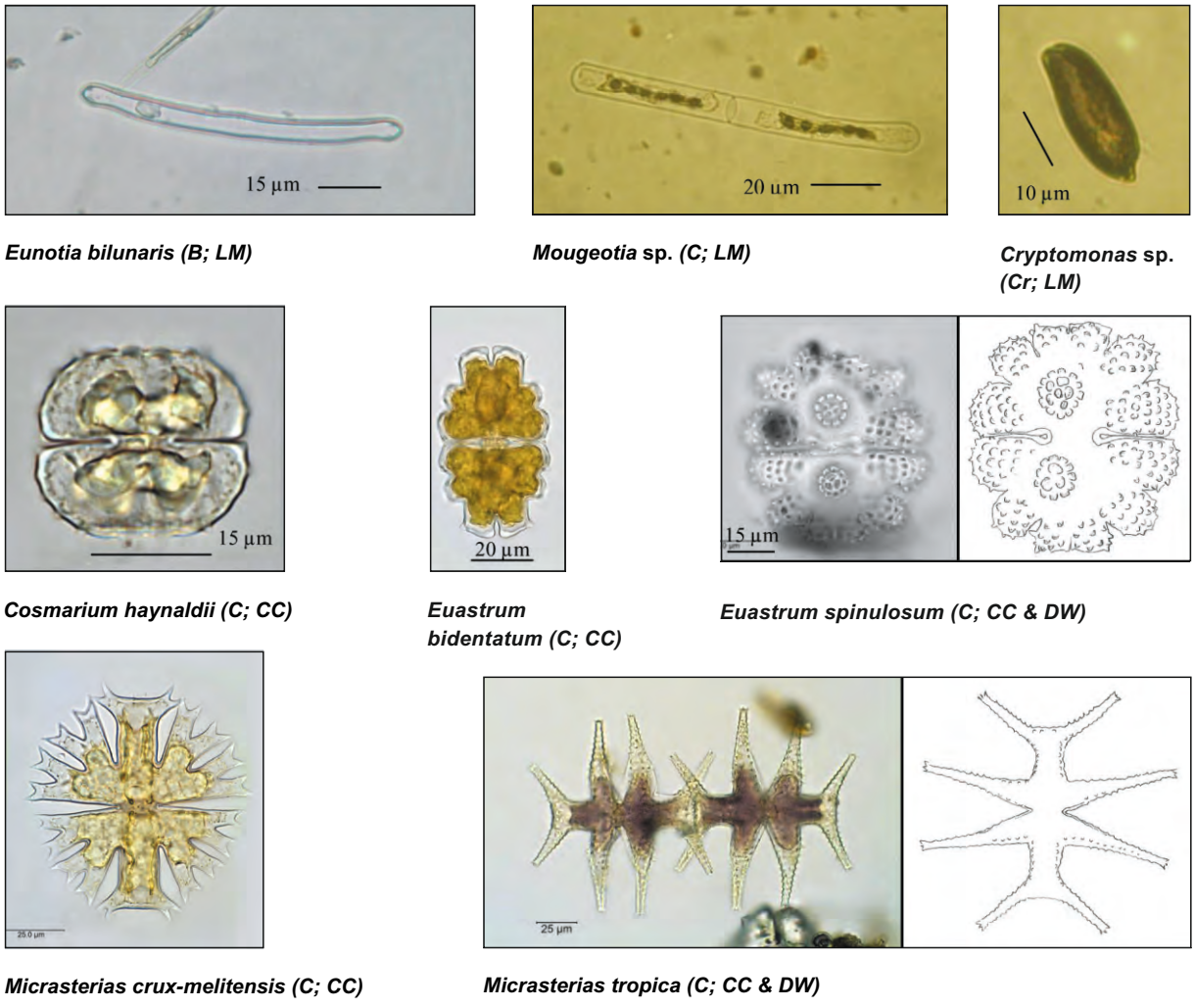
Okavango Delta - Biodiversity of Microalgae, precious invisible plants

Microalgae contribute to key ecosystem services, such as purification of water from pollutants. When people think of microalgae, it is often with negative connotations because some species, e.g. of Cyanophyta / Cyanobacteria, cause toxic blooms in various aquatic environments. In the Okavango Delta, microalgae form the base of the aquatic food webs on which subsistence and commercial fisheries rely, and are therefore fundamentally important in the functioning of this subtropical wetland. The fact that microalgae sustain the Delta's food webs, on which edible fish, large mammals and birds of international importance live, make of them a vital part of the natural heritage of Botswana. Knowing better the ecology and distribution patterns of algae can help us understand how natural and/or human-induced changes in, e.g. water quality and quantity, may have an impact on their communities. Observing ecological changes at algae-scale can allow us to estimate the repercussions of pollution on the livelihoods of the Delta's inhabitants. For example, what would more algal blooms due to increased nutrient contamination of the Delta's waters mean for human health directly (via uptake of toxins) or indirectly (via lower fish quantity and quality)?

However, microalgae are often neglected because they are so small, and an extensive survey of algae across the Okavango Delta is still missing. The aims of my Ph.D. project are to assess biodiversity, biomass and distribution patterns of algae in the Okavango Delta (Botswana), a near-pristine subtropical flood-pulsed wetland protected by the Ramsar Convention. The roles of spatial, temporal and environmental factors in shaping algal communities are investigated, e.g. hydrology, seasonality, water chemistry and habitat. This extensive survey of algae can provide scientific insight complementary to that produced in the TFO (The Future Okavango) project in relation to processes such as nutrient cycling mediated by algae at the land-water interface.



Eunotia bilunaris (B; LM)

Mougeotia **sp.** *(C; LM)*

Cryptomonas **sp.** *(Cr; LM)*

Cosmarium haynaldii (C; CC)

Euastrum bidentatum (C; CC)

Euastrum spinulosum (C; CC & DW)

Micrasterias crux-melitensis (C; CC)

Micrasterias tropica (C; CC & DW)

Fig. 1: Algal species found in the Okavango Delta (B=Bacillariophyta, i.e. diatoms; C=Chlorophyta, i.e. green algae; Cr=Cryptophyta, i.e. cryptomonads). Pictures and drawings: CC=Chris Carter, LM=Luca Marazzi, DW=David Williamson).

In: Oldeland, J., Erb, C., Finckh, M. & Jürgens, N. (2013) [Eds.]: Environmental Assessments in the Okavango Region. – Biodiversity & Ecology **5**: 161–163. DOI: 10.7809/b-e.00272.

a) Floodplain in Santantadibe with sedges and grasses (photo: L. Marazzi).

b) Lagoon in Boro with *Nymphaea* (photo: L. Marazzi).

c) Main river channel with papyrus in Upper Panhandle (photo: L. Marazzi).

Fig. 2: Some of the Okavango Delta's habitats where algae were sampled.

Table 1: Sites and periods of sampling.

51 sites were sampled in seven periods over four years (41 in Campaign 1 and 10 in Campaign 2):
Campaign 1: I. September 2006 (Flood Recession); II. April-May 2007 (Flood Expansion); III. July-August 2007 (High Water)
Campaign 2: I. May 2009 (Flood Expansion); II. July-August 2009 (High Water); III.October 2009 (Flood Recession); IV. February 2010 (Low Water)
Sites sampled (Fig. 3): Upper Panhandle (UPH); Lower Panhandle (LPH); Xakanaxa (XAK); Boro (BOR); Santantadibe (SAN); a few additional samples were taken from Ngami (NGA) and Thamalakane (THA).

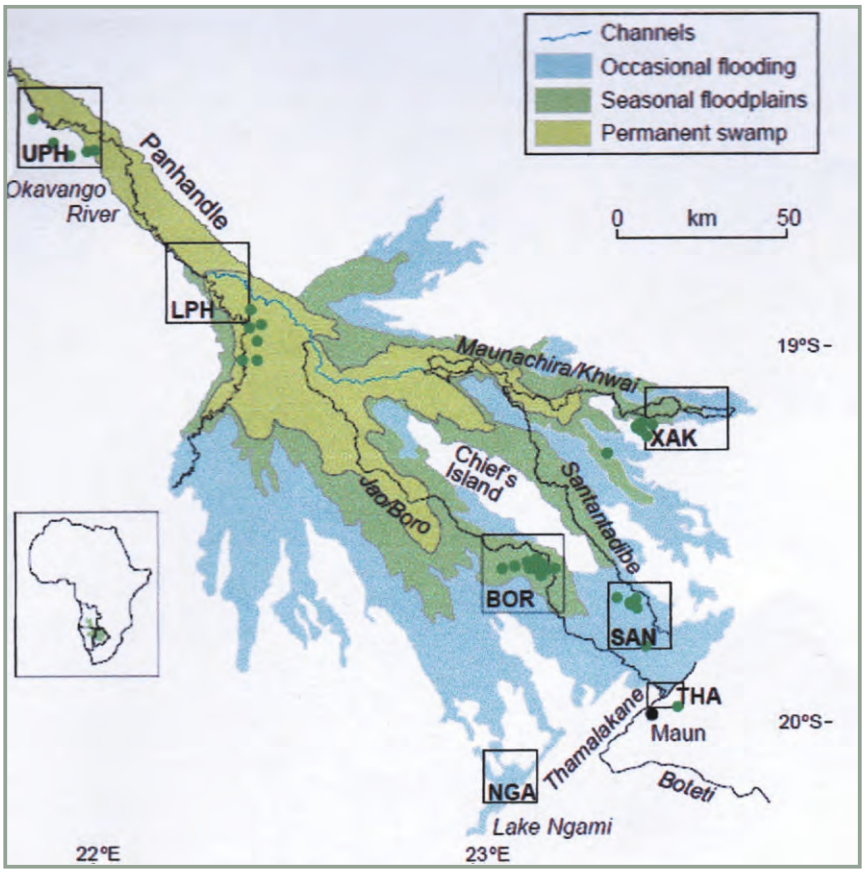


Fig. 3: Map of the sampling sites in the Okavango Delta (UPH= Upper Panhandle; LPH= Lower Panhandle; XAK= Xakanaxa; BOR= Boro; SAN= Santantadibe; NGA=Ngami; THA= Thamalakane).

The algae shown in Figure 1 were found in three floodplain grasslands in the distal reaches of the Delta (Boro site; BOR – Fig. 3). Six green algae, one diatom, and one cryptomonad are depicted. *Eunotia bilunaris* is an epiphytic diatom frequently living on filamentous algae in acidic standing and flowing waters of low conductivity (Craticula, 2013). Algae of the genus Mougeotia are filamentous bloom-forming green algae found in acid waters in every continent and in most biomes; they belong to the family *Zygnemataceae*, have unbranched filaments and reproduce sexually by conjugation producing resistant zygospores (Graham et al., 1996). Species of Cryptomonas are flagellated algae with high carbon content, hence having high food value for pelagic herbivorous grazers (Klaveness, 1988). Cosmarium, Euastrum and Micrasterias are desmids, a group of green algae well adapted to clear and nutrient-poor freshwater environments, typical of periphytic or metaphytic habitats (see five desmid species, Fig. 1). Desmids are increasingly studied by ecologists to assess and monitor wetlands (Digital Image Collection of Desmids, 2013). During this project, 15% of the algae identified belonged to this group; 184 desmid species (23 genera) were observed, representing 65% of the total species of green algae sampled (26% of genera). Table 2 shows the number of species and genera observed in the 132 algal samples collected from the Okavango Delta between 2006 and 2010; a total of 496 species and 173 genera were found, belonging to 9 of 15 algal phyla known worldwide. A new variety, *Cosmarium pseudosulcatum* var. *okavangicum*, has been described (Williamson & Marazzi 2013).

Table 2: Total species richness and number of genera found by this study.

Phylum	N° Species	N° Genera
Bacillariophyta	113	37
Chlorophyta	283	86
Chrysophyta	8	7
Cryptophyta	11	3
Cyanophyta	28	22
Euglenophyta	37	6
Prasinophyta	1	1
Pyrrophyta	8	7
Xanthophyta	7	4
Total	**496**	**173**

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