Freshwater Biology

Algal richness and life-history strategies are influenced by hydrology and phosphorus in two major subtropical wetlands

Journal:	*Freshwater Biology*
Manuscript ID	FWB-P-Jun-16-0277.R3
Manuscript Type:	Standard Paper
Date Submitted by the Author:	11-Oct-2016
Complete List of Authors:	Marazzi, Luca; Florida International University, Biological Sciences Gaiser, Evelyn; Florida International University, Biological Sciences Jones, Vivienne; University College London, Geography Tobias, Franco; Florida International University, Biological Sciences Mackay, Anson; UCL, Geography
Keywords:	Floodplains < Habitat, Microalgae < Taxonomic Group / Assemblage, Hydrology < Process / Approach / Methods, Community < Level of Organisation, Wetlands / mires / bogs / marshes < Habitat, Taxonomy < Process / Approach / Methods, Conservation / biodiversity < Applied Issues

Running head: Algal richness in subtropical wetlands

Title: **Algal richness and life-history strategies are influenced by hydrology and phosphorus in two major subtropical wetlands**

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Key words: Algae, Biodiversity, Subtropical Wetlands, Hydrology, Phosphorus

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Summary

1. We explored controls of algal taxon richness (hereafter richness) in complex and hydrologically dynamic flood-pulsed wetlands by comparing results from independent studies in two globally important subtropical wetlands: the Okavango Delta (Botswana) and the Florida Everglades (USA). In both wetlands, the flood pulse hydrology is regulated by distinct wet and dry seasons, and creates floodplain landscapes with heterogeneous habitats; algal growth is limited by phosphorus (P); and water uses threaten ecosystem function. To inform future comparisons of algal richness and distribution patterns, we assessed the role of hydrology and P as key controls of richness, and identified indicator taxa of desiccation disturbance and P scarcity in these wetlands under increasing hydrological, nutrient and habitat changes.

2. We used the intermediate disturbance hypothesis, and the species-energy theory to explain algal richness patterns, and the competitive, stress-tolerant, ruderal (CSR) framework to classify indicator taxa. We collected algal samples, environmental data and information expected to influence community structure (water depth, relative depth change, P concentrations, hydroperiod, and habitat type) over several years at sites representing a broad range of environmental characteristics. To account for sample size differences, we estimated algal richness by determining the asymptote of taxon accumulation curves. Using multiple regression analysis, we assessed if and how water depth, depth change, P, hydroperiod, and habitat type influence richness within each wetland. We then compared the strength of the relationships between these controlling features and richness between wetlands. Using indicator species analysis on relative abundance data, we classified C, S and R indicator taxa with shorter/longer hydroperiod, and lower/higher P concentrations.

3. In either wetland, we did not observe the negative unimodal relationship between site-specific richness and water depth change that was expected following the intermediate

disturbance hypothesis. It is possible that this relationship exists at more highly resolved temporal scales than the semi-annual to annual scales hypothesized here. However, as nutrient flows and algal habitats depend on these wetlands' flood pulse, maintaining the Okavango's natural pulse, and increasing freshwater flow in the Everglades would help protect these wetlands' algal diversity. Chlorophyta richness (Okavango), and total, Bacillariophyta, Chlorophyta and cyanobacteria richness (Everglades) increased with higher P concentrations, as per species-energy theory. In the Okavango, we classified 6 C and 49 R indicator taxa (e.g. many planktonic Chlorophyta), and, in the Everglades, 15 C, 1 S, and 9 R taxa (e.g. benthic Bacillariophyta and planktonic/benthic Chlorophyta), and 1 stress- and disturbance-tolerant cyanobacterium species.

4. Our results offer baseline information for future comparisons of richness, and abundance of C, S, and R indicator taxa in subtropical wetlands; this can be used to quantify how algal communities may respond to potential changes in hydrology and P due to water diversion, anthropogenic nutrient loads, and climate change. Examining microhabitat heterogeneity, nitrogen and light availability, and grazing pressure in such wetlands would illuminate patch-scale controls of richness and life-history strategy distribution in algal communities.

Introduction

Higher biological diversity is thought to increase ecosystem functions (Cardinale *et al.*, 2011); for example, different species may use resources complementarily in space or time, or facilitate each other, thus increasing biomass production efficiency (Cardinale *et al.*, 2009). As the loss of biodiversity threatens ecosystem functioning (Ptacnik *et al.*, 2008; Cardinale *et al.*, 2011), fundamental research is needed to identify factors that increase and/or maintain the diversity of biological communities. Freshwater ecosystems, especially wetlands, are facing a severe and global loss of species (Strayer & Dudgeon, 2010), and are among the most vulnerable ecosystems to climate change, due to their sensitivity to alterations of the hydrologic cycle (Erwin, 2009). Subtropical, including many flood-pulsed, wetlands are increasingly threatened reservoirs of freshwater biodiversity (Junk *et al.*, 2002), thus understanding major controls of richness and diversity of primary producers at the base of their food webs is a key task for freshwater ecologists (de Tezanos Pinto *et al.*, 2015).

In flood-pulsed wetlands, the alternation of wet and dry seasons determines nutrient release upon rewetting, and generates a dynamic mosaic of aquatic and terrestrial environments with high habitat heterogeneity (Junk, Bayley & Sparks, 1989). Hydrology, nutrients, and habitat type in turn influence the richness of algae, effective ecological indicators of water quantity/quality, and nutrient loads (McCormick & Cairns, 1994; Gaiser *et al.*, 2011; Mackay *et al.*, 2012; Lee *et al.*, 2013; de Tezanos Pinto *et al.*, 2015). In the Okavango, algae live in open waters, or are attached to plant substrates and silica-rich sediments (Cronberg *et al.*, 1996); in the Everglades, abundant periphyton mats dominated by benthic algae form in the limestone-rich sediments (Ding *et al.*, 2014). To test the effects of hydrological variability (Reynolds, Padisák & Sommer, 1993; Paidere *et al.*, 2007), and available energy (e.g. nutrients and light; Passy, 2008) on algal richness in the Okavango and Everglades, we bring together the intermediate disturbance hypothesis (Connell, 1978), and the species-energy theory (Wright, 1983; Hubbell, 2001). Moreover, we explore the potential importance of habitat complexity on richness. We recognize that other factors influence algal richness, such as water ionic content (Potapova & Charles, 2003), abundance of macrophytes (Borics *et al.*, 2003), and degree of grazing (Liess *et al.*, 2009). To test key hypotheses, we study the effects of hydrology, phosphorus (P), a growth-limiting nutrient in both wetlands, on algal richness, and on how hydrology and P influence algal life-history strategies.

The intermediate disturbance hypothesis states that highest species richness is reached with intermediate frequency/size of, or time since, disturbances, such as flooding, hurricanes and fire (Connell, 1978; Reynolds *et al.*, 1993). Here we focus on site-specific hydrological disturbance, defined as: i) mean water depth change in recent years (2006-2010 in the Okavango, and 2005-2011 in the Everglades); ii) mean hydroperiod, whereby shorter hydroperiod causes higher desiccation disturbance for algae. The species-energy theory (Wright, 1983; Hubbell, 2001) posits that energy supply, i.e. resource quantity, controls and limits species richness. In the Okavango, P limits algal growth, especially during high floods (Ramberg *et al.*, 2010), or is co-limiting with nitrogen (N; Mackay *et al.*, 2011); in the Everglades, natural P supply is extremely low, and so N concentrations are rarely regulatory (Noe, Childers & Jones, 2001). Thus, here we focus exclusively on P, and we expect richness to increase with higher P, as observed in previous research in the Everglades (Gaiser *et al.*, 2011), and other subtropical wetlands (e.g. Rodrigues & Bicudo, 2001b in Rodrigues & Bicudo, 2001a; Izaguirre *et al.*, 2004). Moreover, shallower habitats tend to have higher algal richness due to abundant macrophytes providing substrata for attachment in floodplain landscapes (Borics *et al.*, 2003; Rodrigues & Bicudo, 2004 in Murakami, Bicudo & Rodrigues, 2009). Thus, we expect higher richness in shallower habitats.

Algae are often classified in morphological (Kruk *et al.*, 2010), and functional groups (e.g. diatom guilds; Passy, 2007). Thus, to provide comprehensive ecological interpretations of community structure beyond richness, we analyse the distribution of algae with different life-history strategies in relation to desiccation disturbance, and P scarcity. To this end, we use the well established competitive/opportunistic colonist (C), stress-tolerant (S), and ruderal or disturbance-tolerant (R) framework on life-history strategies (CSR; Grime, 1977) applied to algae (Biggs, Stevenson & Lowe, 1998; Reynolds, 2006; Salmaso, Naselli-Flores & Padisák, 2015). The CSR framework has the potential to contribute to biodiversity and ecosystem functioning research via linking the distribution of traits and ecosystem function (Fry, Power & Manning, 2014).

The aims of this paper are to identify and compare: i) the roles of hydrological disturbance (mean water depth change, and desiccation risk in shorter hydroperiod sites), resources (P), and habitat type as controls of mean site-specific algal richness in the Okavango and Everglades; ii) indicator taxa of shorter/longer hydroperiod, and lower/higher P concentrations in each wetland. To address these aims, we hypothesise that:

a) estimated algal richness is highest in regions with intermediate water depth changes over recent years, as predicted by the intermediate disturbance hypothesis;
b) estimated algal richness increases with higher limiting resource (P) provision, as predicted by the species-energy theory;
c) estimated algal richness increases in shallower habitats due to the often observed higher spatial complexity of benthic habitats;
d) more R taxa are classified in the Okavango due to shorter mean hydroperiods, and benthic C algae are larger, while planktonic C algae are smaller than S, and R taxa in both wetlands.

Methods

Study regions

The Okavango Delta (hereafter Okavango), and the Everglades are subtropical, flood-pulse wetlands with a low-gradient topography, and mean flood pulse amplitude of 1.85 m and 0.5-1 m, respectively (Junk *et al.*, 2006). Both are World Heritage Sites, and so recognized as globally important ecosystems. Whereas the Okavango is a vast inland wetland bound by geological faults, and fed by alluvial deposits carried by the Okavango River (McCarthy *et al.*, 2003), the Everglades is a rainfall-dependent 'river of grass' (Douglas, 1947) flowing from Lake Okeechobee to the Gulf of Mexico and Florida Bay (Lodge, 2010). The Okavango is a largely pristine wetland with minimal technological alteration of water flow (Ramberg *et al.*, 2006). The Everglades however, is a highly regulated system due to agricultural and urban development, but is undergoing a vast restoration program to enhance its water flow and quality (www.evergladesrestoration.gov). In common with other large, flood-pulse systems, their ecosystem functioning faces many challenges, now and into the future, from both changing climate and management of environmental flows (Milzow *et al.*, 2009; Estenoz & Bush, 2015). These potential threats are likely to impact their biological communities, including algae (Lee, Gaiser & Trexler, 2013), leading to uncertainties in future ecosystem functioning. In biofilms, algae, together with bacteria, fungi and protozoa, enhance ecosystem functions, such as the retention of nutrients and water (Battin *et al.*, 2003; Gaiser *et al.*, 2011). Thus, comparing the controls of algal richness between wetlands with similar natural features, but different anthropogenic impact histories, can inform management strategies to enhance their ecosystem resilience (Folke *et al.*, 2004; Rojo *et al.*, 2012).

Field and sampling protocols

Okavango Delta

To determine spatial patterns of algal richness in the Okavango, we collected 130 algal samples from 46 sites in five regions spanning most of the 28,000 km^2 total area of the Delta (Upper Panhandle, UPH; Lower Panhandle, LPH; Xakanaxa, XAK; Boro, BOR; Santantadibe, SAN; see Table 1 and Fig. 1a). The sampling sites represent the hydrological (permanently, seasonally, and occasionally flooded sites), and nutrient gradients from upstream to downstream areas, and habitats with different water depths (see Marazzi, 2014). The methods were different between Campaign 1 (Mackay *et al.*, 2011, 2012), and Campaign 2 (Siziba *et al.*, 2011, 2012). In Campaign 1, we collected 61 samples in 38 sites using 1.5 L PVC bottles filled at ~ 30 cm below surface in September 2006 (flood recession), April/May 2007 (flood expansion), and July/August 2007 (high water; Mackay *et al.*, 2012), whereas no samples were available for the ‘low water’ phase (Marazzi, 2014). In Campaign 2, we took 69 samples in 8 seasonally and occasionally flooded floodplains in the distal reaches (BOR and SAN) by pushing a plexiglass tube (6 cm in diameter, 0.5 m in length) through the macrophytes or water column in May 2009 (flood expansion), July/August 2009 (high water), October 2009 (flood recession) and February 2010 (low water). We preserved all the samples in Lugol’s iodine solution in 30 mL (Campaign 1) and 50 mL (Campaign 2) tubes, transported them back to the laboratory, and stored them in a refrigerator until analysis. We measured water depth (cm) using a graduated metal pole (Campaign 1; Mackay *et al.*, 2011), and a stadia rod (Campaign 2; Siziba *et al.*, 2011). The Okavango P data were volumetric water concentrations. In Campaign 1, we analysed TP (µg L^{-1}) at the Okavango Research Institute in unfiltered samples using an air segmented flow analyser after persulphate digestion (Mackay *et al.*, 2011). In Campaign 2, we analysed total dissolved phosphorus (TDP; µg L^{-1}) in samples filtered with GF/C paper, using the ascorbic acid procedure (APHA, 1998). These P measurements were made for different purposes; TP was measured to identify controls of diatom abundance (Mackay *et al.*, 2012), and of diversity, biomass and abundance of algae (Marazzi, 2014), and TDP to assess the response of microinvertebrates to flooding (Siziba *et al.*, 2011; 2012).

Everglades

To determine spatial patterns of algal richness in the Everglades, between September and December 2005-2011 we collected 947 algal samples from 165 sites in four main regions, representative of the 5,000 km^2 area of this wetland: 1. LKO: Lake Okeechobee; 2. LOX: the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Water Conservation Area 1, WCA 1) and Pal Mar (PAL); 3. the Everglades National Park (ENP): Pennsuco (PEN), Lostman's Creek (LMC), the 'Oligohaline' area (OLG), Southern Marl Prairie (SMP), Shark River Slough (SRS) and Taylor Slough (TSL); 4. Out_ENP: Holey Land Wildlife Management Area (HOL), Water Conservation Areas (WCAs) 2 and 3 (Table 1; Fig. 1b). Using generalized random-tessellation stratification (Stevens & Olsen 2004), we chose a representative set of locations (800 m x 800 m principal sampling units, PSU), within which we sampled three sites in a habitat drawn from a pool of GPS coordinates (Philippi, 2005). At sites where depth was < 1 m, and vegetation not too dense to hamper the formation of periphyton, and our movement in the field, we threw a 1 m^3 enclosure, open both at the top and bottom (Gunderson, 1994), and collected samples of periphytic algae with a 120 mL plastic beaker from floating or benthic periphyton mats, depending on the depth (Jordan, Coyne & Trexler, 1997). Where no mats were present, we took flocculent detritus from the benthos, as this also hosts algae (Pisani, Yamashita & Jaffé, 2011); we then transported the samples back to the laboratory and froze them until analysis. We measured water depth (cm) with a metal ruler, and TP concentrations in the periphyton (μg g^{-1} dry weight) by means of colorimetry after dry combustion (EPA, 1983) because water column concentrations are often below detection in this extremely oligotrophic wetland (Gaiser *et al.*, 2004).

Site classification

To assess algal richness patterns across the major hydrological gradient present in each wetland, we classified each site by hydroperiod (flooding duration). Using information from Murray-Hudson *et al.* (2015) based on a 1989-2007 data series for the Okavango, and mean annual hydroperiod data from the Everglades Depth Estimation Network (EDEN; http://sofia.usgs.gov/eden/) for the Everglades, we grouped sites in three hydroperiod classes of flooding duration: 1) < 90 days, 2): 90-240 days, and 3): 240-365 days. In the Okavango, we sampled open water, marginal vegetation or floodplain; in the Everglades, open water, freshwater marsh/prairie or shrubland (groups derived from vegetation classes; Pearlstine *et al.,* 2002). In the Okavango, we collected 25% of the algal samples from sites with hydroperiod class 1 (HP 1; mean depth=71 cm), 50% from HP 2 (mean depth=107 cm), and 25 % from HP 3 sites (mean depth=229 cm); in the Everglades, we took 4% of the samples from HP 1 sites (mean depth=25 cm), 41% from HP 2 (mean depth=28 cm), 44% from HP 3 sites (mean depth=57 cm), while hydroperiod data was not available in the rest of the sites. In the Okavango, we took 32% of the samples from open waters, 14% from marginal vegetation sites, and 54% from floodplains; in the Everglades, we took 7% of the samples from open waters, 75% from marsh/prairie sites, and 15% from shrublands (Table 1).

Algal analyses

Okavango Delta

Prior to microscopy, we resuspended algae by shaking the tubes for 2 minutes. We then filled chambers of 5, 10 or 15 mL volume (depending on cell density) and let them settle for at least

8 to 12 hours to obtain a random distribution of the algal units (i.e. cells, coenobia, colonies, and filaments; European Standard, 2005). One of us (LM) identified and counted at least 400 algal units at 100x and 400x magnification using an inverted microscope (Utermöhl, 1958), scanning the chamber in random fields of view. We identified taxa to the lowest possible taxonomic unit (genus, species or variety) using John, Whitton & Brook (2002), Cronberg *et al.* (1996), Coesel & Van Geest (2008; 2009), and other sources (see Marazzi, 2014).

Everglades

We modified standard methods for preparing wet mounts for counting algae (APHA *et al.*, 2005) for periphyton from frozen samples (Stevenson & Bahls, 1999). We homogenized thawed samples with a hand blender, and dried samples onto a cover glass. When $CaCO_3$ crystals were noticeable on the slide, we added a solution of 0.01 mL 10% HCl, dried the cover slip, and inverted it onto a microscope slide in 0.02 ml of water, then sealed it by ringing the glass with fingernail polish (Stevenson, McCormick & Frydenborg, 2002). One of us (FACT) counted at least 500 algal units (i.e. cells, coenobia, colonies, and filaments of 100µm) at 1000x magnification, using a compound light microscope, and identified them to the lowest possible taxonomic unit (genus, species, or variety) using Prescott (1962), Komárek & Hindak (1975) and Komárek & Anagnostidis (1986, 1989, 1999).

Statistical methods

To determine whether the algae observed were planktonic, benthic or planktonic/benthic (not clearly classifiable as either planktonic or benthic; Fig. 2), we used Wehr, Sheath & Kociolek (2015). To standardize comparisons among sites within wetlands, we estimated richness as the value of the asymptote of the species accumulation curve, using abundances of taxa identified at variety, species, genus, or higher levels. We used the Chao 1 estimator (Chao, 1984; Equation 1), a non-parametric estimator appropriate for analysis of microorganisms, using the R package iNEXT (available online at: https://chao.shinyapps.io/iNEXT/).

$$\square_{\mathbf{Chao1}} = \mathbf{S_{obs}} + \left(\frac{\square-\square}{\square}\right)\frac{\square\square\,(\square\square-\square)}{\square(\square\square+\square)} \qquad (1)$$

where F1 is the number of taxa that have exactly 1 individual when all samples are pooled (singletons or uniques), and F2 is the number of taxa with two individuals (doubletons or duplicates). We used the results of our estimates to compare the controls of algal richness in the Okavango and the Everglades.

To identify significant differences between estimated algal richness among sites in different regions and habitats, and with different hydroperiod class within each wetland (see '*Site classification*'), we used the parametric One-Way ANOVA and Tukey HSD tests when variables were normally distributed, and with homogeneous variance (assessed via the Kolmogorov-Smirnov test), and the non-parametric Kruskal-Wallis (K.W.) and Mann Whitney-U (M.W.U.) tests, when variables were either not normal and/or had non-homogeneous variance (p-value=0.05).

To identify statistically significant predictors of mean estimated algal richness (i.e. the total number of taxa, and the richness of each major phylum) among the continuous environmental variables (no multicollinearity observed) over the sampling period (depth, % depth change, and P), and the categorical variables hydroperiod class and habitat, we undertook multiple linear regression analysis with stepwise selection (p-value=0.05). To explain variations of richness across space, we used the mean values of estimated richness, and environmental conditions by site over the sampling years. To account for the different length of the environmental gradients (continuous variables) in the wetlands, we used the deviations from the respective means (i.e. Z-scores; log- or square-root transformed if not normally distributed). We used SPSS® (version 17) for statistical tests, regressions, and for Fig. 3; ArcGis® (version 10.3) for the maps, and Excel® for the other figures (version 2013).

Indicator species analysis

To inform future comparisons of algal community structure beyond richness, we used indicator species analysis to classify the algal taxa observed in relation to their relative abundance and site-specific P concentrations and hydroperiod, according to the CSR framework applied to periphytic (Biggs *et al.*, 1998) and planktonic algae (Reynolds, 2006). Indicator species analysis combines information on species relative abundance in preassigned groups, and the faithfulness of occurrence of species in these groups. Following Dufrêne & Legendre (1997), we produced indicator values for algal taxa (varieties, species, genera and higher taxonomic levels), and tested their statistical significance using a Monte Carlo technique (p-value=0.05).

We aggregated sites in four metagroups using PC-ORD 6 (McCune & Mefford, 2011), according to their hydroperiod and P conditions (to which algal life-history strategies respond): C = low desiccation disturbance (longer hydroperiod, i.e. >240 days, equivalent to hydroperiod class 3 in both wetlands; Table 1), low nutrient stress (higher P); S = high disturbance (shorter hydroperiod, i.e. < 240 days, equivalent to hydroperiod classes 1 and 2 in the Okavango, and 2 in the Everglades; Table 1), high stress (lower P); R = high disturbance (shorter hydroperiod), low stress (higher P; see Table 2). In the Okavango, P was below upper limits for oligotrophy in water (TP < 10-15 $\mu g\ L^{-1}$) only in a few sites, thus we classified sites as mesotrophic (TP < 47 $\mu g\ L^{-1}$) and eutrophic (TP >= 47 $\mu g\ L^{-1}$; South African "Trophic Status Assessment"; Van Ginkel, 2002). We classified 16 sites in Campaign 2 as eutrophic with certainty as their TDP concentrations were >= 47 $\mu g\ L^{-1}$. However, 24 sites had mean TDP <47 $\mu g\ L^{-1}$ over the sampling period (mean 30 $\mu g\ L^{-1}$); we classified these as mesotrophic, under the conservative assumption that the unmeasured Particulate Phosphorus (PP) concentrations would not have been sufficiently high to make these sites fall into the eutrophic category. For the Everglades, we set the ‘lower/higher’ periphyton P limit following Gaiser (2009): TP < 250 µg g^{-1} and ‘higher P’ as TP >= 250 µg g^{-1}. This was done to statistically identify CSR indicator taxa for nutrient stress (P scarcity) and desiccation disturbance (i.e. shorter hydroperiods mean higher desiccation risk for algae).

To consolidate our preliminary list of CSR taxa, we cross-checked it with information on the typical cell size of C, S, and R algae in the periphyton (Biggs *et al.*, 1998), and phytoplankton (Reynolds, 2006). Cell size is a basic morphological information with ecological value, as smaller/larger algae tend to grow faster/slower (Reynolds, 2006). Other important features were only present in one source, e.g. mode of attachment, growth form, reproduction type (Biggs *et al.*, 1998), and dispersal (Reynolds, 2006), and thus were not used. Among benthic taxa, we retained: i) for S and R taxa, algae with comparably small cells to those listed by Biggs *et al.* (1998; Fig. 2); ii) in the C group, algae with medium to large cells (Biggs *et al.*, 1998). Among planktonic taxa, using our biovolume data, and following Reynolds (2006; Box 5.1), we retained small algae (biovolume of the algal units, i.e., cells, coenobia, colonies, or filaments: 10^{-1}-10^{3} µm^3) in the C group, and medium-large algae (biovolume of the algal units: 10^{3}-10^{5} µm^3) in the S and R groups. We retained all the planktonic/benthic taxa identified, as applying either cell size criterion would be arbitrary.

To test hypotheses a, b, and c, we used estimated algal richness, depth, depth change, TP concentrations, hydroperiod class, and habitat type. To test hypothesis d, we used algal relative abundance data, hydroperiod and TP, as well as information from prior work on the CSR framework (Biggs *et al.*, 1998; Reynolds, 2006).

Results

In the Okavango, the algae observed were a mix of planktonic and planktonic/benthic algae, dominated by Chlorophyta (Fig. 2a; Table S1). By contrast, in the Everglades, benthic algal richness was highest, dominated by Bacillariophyta (“Observed richness” in Fig. 2b, Tables S2), which also comprised the largest proportion of benthic algal richness in the Okavango (Fig. 2a). The mean site-specific algal richness estimated using the Chao 1 estimator (“Estimated richness” in Fig. 3, 4, and 5; see “*Statistical methods*”) was 76 in the Okavango and 21 in the Everglades; Kruskal Wallis, K.W.: χ^2: 109.77, Mann-Whitney U, M.W.U.: $p<0.001$). In the Okavango, algal richness was higher in BOR and SAN (shorther hydroperiod) than in UPH, LPH (longer hydroperiod), and in XAK than LPH (One-Way ANOVA: $F=8.225$; $p<0.001$; Tukey HSD: $p<0.005$; Fig. 1a, Table 3, and Fig. 4a). In the Everglades, richness was significantly higher in sites with higher TP in LOX than LKO, Out_ENP, and ENP, and in Out_ENP than in sites with lower TP in ENP (One-Way ANOVA: $F=29.193$; $p<0.001$; Tukey HSD: $p<0.005$; Fig. 1b, Table 3, and Fig. 4b). The site-specific coefficients of variation of water depth change were not statistically significantly different between wetlands (Kruskal-Wallis test: $\chi^2=0.544$; $p=0.461$). In the Okavango, mean water TP was 39 $\mu g\ L^{-1}$ in 2006-2007 from UPH, LPH, XAK, BOR, and SAN, and TDP=48 $\mu g\ L^{-1}$ in 2009-2010 from BOR, and SAN); in the Everglades, mean periphyton TP was 615 $\mu g\ g^{-1}$ (Table 3).

Site-specific algal richness was not significantly predicted by water depth change in either wetland (Table 4), and did not exhibit the expected negative unimodal relationship posited by the intermediate disturbance hypothesis (Fig. 3). Regression analyses showed that, among the tested variables, water depth (negative relationship) and TP (positive relationship) were the most important controls of richness in the Okavango and Everglades, respectively. In the Okavango, total richness and Chlorophyta richness increased in shallower sites, while

Bacillariophyta richness decreased with higher P at whole-wetland scale (Table 4); in BOR, Bacillariophyta and Chlorophyta richness decreased and increased with higher P, respectively (Table 4). In the Everglades, total richness increased with higher TP at whole-wetland scale, and within Out_ENP and ENP; richness of Bacillariophyta, and Chlorophyta in LOX and ENP increased in deeper sites, and cyanobacteria richness increased with hydroperiod class in LOX (Table 4). TP in LKO was about six times higher than in the other Everglades regions (Table 3), but it did not significantly predict algal richness in this region (Table 4). Richness was not statistically significantly different across habitats in either wetland (Fig. 5). However, in the Okavango, seasonal floodplains of intermediate depth had the highest algal richness (97 taxa); here vascular plant richness was estimated to be higher (240 species) than in deeper permanently flooded sites (205 species), and in less frequently flooded, shallower grasslands (213 species; see Table 3 in Ramberg *et al.*, 2006); the latter two groups of sites also had fewer algal taxa (Fig. 5). In the Everglades, algal richness was the same (22 taxa) in deeper habitats (open waters) that have, on average, 3.2 macrophyte taxa, as in shallower (marshes/prairies, and shrublands) habitats, with 3.6 macrophyte taxa (Joel Trexler, unpublished data).

We pre-classified 84 CSR taxa in the Okavango, of which 9 competitive (C), no stress-tolerant (S), and 75 ruderal (R), and 45 in the Everglades (15 C, 1 S and 1 stress-disturbance tolerant), and 28 R (Table S3). Of these taxa, 65% in the Okavango (55) and 58% in the Everglades (26) met the expectations on their cell size for benthic (Biggs *et al.*, 1998) and planktonic algae (Reynolds, 2006), and were thus included in the final list (Table 5): 6 C, 0 S, and 49 R taxa in the Okavango, and 15 C, 1 S, 1 stress-disturbance tolerant, and 9 R taxa in the Everglades (Fig. 6 a and b). Also, in the Okavango, the share of R desiccation-resistant indicator taxa was much higher (89%) than in the Everglades (35%), where hydroperiod tends to be longer (Table 5). In the Okavango, we classified species of larger diatoms

(*Eunotia*, *Frustulia,* and *Stauroneis*), and a *Micrasterias* species as C taxa indicating longer hydroperiod and higher P (low desiccation disturbance, and low P scarcity stress); species of coenobial green algae, such as *Pediastrum* and *Scenedesmus*, and of desmids (e.g. *Cosmarium*, and *Staurastrum*), but also Euglenophyta, Cryptophyta, cyanobacteria, Pyrrophyta, and Xanthophyta, as R taxa indicating shorter hydroperiod and higher P; whereas no stress-tolerant taxa emerged from our analysis (Table 5). In the Everglades, we classified two large diatom species, and various green algae (particularly desmids), as C taxa that indicate low desiccation disturbance and low P scarcity stress; small diatoms (e.g. species of *Encyonopsis*, *Eunotia*, and *Nitzschia*), two desmids (*Cosmarium* and *Micrasterias*), and the cyanobacterium *Johannesbaptistia*, as R taxa that indicate high desiccation disturbance and low P scarcity stress; *Scytonema* emerged as a stress/disturbance tolerant taxon (Table 5).

Discussion

Hydrology

Comparisons of algal richness controls across the two wetlands revealed that mean site-specific richness did not follow the negative unimodal relationship predicted by intermediate disturbance hypothesis (Connell, 1978). Water depth changes were higher in the Okavango than in the Everglades, which is likely due to the much more heavily managed water flows (Estenoz & Bush, 2015), and smaller flood amplitude (Junk et al., 2006) in the latter. Depth change did not significantly predict algal richness, and depth was a weak predictor of richness in the Okavango (Table 4). Contrary to our hypothesis, algal richness was not highest in sites where water depth change over recent years (a proxy for hydrological disturbance) was intermediate in the Okavango or in the Everglades (Fig. 3). Our data do not concur with observations of higher algal richness or diversity with intermediate water depth changes in temperate floodplain lakes, measured, for example, as rate of daily water level change (Paidere *et al.*, 2007) or amplitude of water level fluctuations (Gruberts *et al.*, 2005); in subtropical floodplain systems, species richness was also associated with flood pulse disturbances (Rodrigues & Bicudo, 2001a; O'Farrell *et al.*, 2003). Expectations of the intermediate disturbance hypothesis were however not met, for example, in a hypertrophic lake in Spain, where hydrological disturbance was measured as frequency and intensity of mixing events (Rojo & Alvares-Cobelas, 1993); other studies only found partial support, for example, in lakes in Germany where disturbance was measured as mixing events (Sommer, 1993), and Texas, where rainfall, inflow, and water level change corresponded to disturbance (Grover & Chrzanowski, 2004). Environmental and ecological complexity, and the consequent methodological challenges of measuring disturbance most likely impact the shape of the relationships observed. Although we did not find support for the intermediate disturbance hypothesis with the sampling frequency used (4 times a year over 4 years in the Okavango, and once a year over 7 years in the Everglades), processes occurring at finer temporal scales may determine highest richness with intermediate hydrological disturbance.

Therefore, collecting algal samples weekly or bi-weekly over several years as recommended by Sommer *et al.* (1993) would enable us to assess with higher temporal resolution the extent to which algal richness depends on water level fluctuations in these flood pulsed wetlands; such sampling could be undertaken at key sites where biological and environmental variables are already monitored. Although algal richness shows only a weak increase with mean water depth in the Okavango, and no increase with mean water depth in the Everglades, maintaining and restoring the flood pulse of these wetlands, respectively (which vital nutrient flows and habitats depend on) is likely important for the preservation of their algal diversity.

Phosphorus

Algal richness was mostly controlled by water depth in the Okavango, and by TP in the Everglades. In the Okavango, higher P concentrations increased Chlorophyta richness in the BOR region; this is likely due to nutrient mobilization via flooding which indirectly increases productivity, and thus richness (Davidson *et al.*, 2012). In the Everglades, richness increased with higher periphyton TP, which accurately reflects P availability to algae that rapidly uptake it from the water (Gaiser *et al.*, 2004). Here, P loads from agricultural sources tend to cause a replacement of cohesive periphyton mats dominated by cyanobacteria with floating mats with more Chlorophyta, and higher richness (Pan *et al.*, 2000; Stevenson *et al.*, 2008; Gaiser *et al.*, 2011). Therefore, our results meet the expectations of species-energy theory, i.e. higher richness with higher resource provision (Wright, 1983). The key underpinning ecological mechanism may be that abundant nutrients allow the formation of complex biofilms with understory and overstory benthic algae (Passy, 2008), where large filamentous algae provide attachement substrata for other species (Hillebrand, 2003).

The patterns we observed concur with a study in a floodplain wetland in the Upper Paraná River basin (Rodrigues & Bicudo, 2001b in Rodrigues & Bicudo, 2001a). Algal richness was shown to increase with low N in the N-limited Otamendi wetland (Argentina; deTezanos Pinto *et al.*, 2015); thus collecting algal richness, and nutrient data (TN and TP, but also dissolved forms of P and N), in subtropical wetlands with different nutrient limitation can help expand our comparisons. We demonstrated that higher P increases total algal richness in the Everglades, and Chlorophyta richness in the Okavango (Table 4); however, high agricultural P loads continue to threaten the Everglades, and increased tourism with unsustainable waste management may negatively impact the Okavango ecosystems (Darkoh & Mbaiwa, 2014). Therefore, preservation and restoration activities in these wetlands remain crucial to maintain, if not enhance, the respective diversity of their algal communities.

Habitat

Shallower habitats did not show significantly higher algal richness than deeper habitats, and habitat type was not a significant control of richness in either wetland. We speculate that in the Okavango, more diverse vascular plants may increase algal richness in shallow floodplains by providing benthic taxa with different substrata for attachment. Relationships between macrophyte abundance and diversity, and algal diversity were observed in other wetlands at temperate (Borics *et al.*, 2003), and subtropical latitudes (Izaguirre *et al.*, 2004; Rodrigues & Bicudo, 2004 in Murakami *et al.*, 2009). Complex microhabitats on plants, for example due to high leaf surface area, create numerous ecological niches for a variety of organisms, including algae (Thomaz & Cunha, 2010; Kovalenko *et al.*, 2012). On the other hand, where plant density or biomass are too high, light penetration may become limiting for algae (Izaguirre *et al.*, 2004), thus potentially reducing their diversity. Therefore, to isolate the influence of habitat type and heterogeneity on algal richness, we recommend the collection of data on plant and sediment substrata, and the development of habitat complexity metrics on, e.g. surface area, and structure of plant leaves and stems (Kovalenko *et al.*, 2012), and indices accounting for plant abundance and diversity (Thomaz & Cunha, 2010). Such data can help predict how modified hydrology may alter floodplain landscapes, and algal community structure in these and other wetlands in view of ongoing and future threats.

Life-history strategies

Most of our CSR indicator taxa had varying relative abundances across gradients of desiccation and P scarcity that well reflected the expectations of the CSR framework applied on algae; benthic C taxa were larger than S and R taxa, while S and R planktonic algae were larger than C taxa. In the Okavango, the R taxa *Aulacoseira ambigua*, and *A. granulata* indicated higher P, consistent with Mackay *et al.* (2012). In the Everglades, one taxon indicated both desiccation and P scarcity (*Scytonema*, most likely *S. hoffmanii*), as previously observed by Gaiser *et al.* (2011). Some of the small algae we identified as indicator taxa have been previously classified as R-strategists in Lake Okeechobee (LKO; Fig. 1b), e.g. *Achnanthes minutissima* (now called *Achnanthidium minutissimum*; Tables S1-S2), and species of *Lyngbya*, *Fragilaria* and *Chroococcus* (Carrick & Steinman, 2001). *Fragilaria* and *A. minutissimum* have been also classified as R taxa in temperate streams (Biggs *et al.*, 1998). In the Okavango, the share of R desiccation-resistant algae among indicator taxa was much higher than in the Everglades (Table 5), as was expected due to sampling sites having shorter hydroperiod in the Okavango (Table 1). Our R taxa in the Everglades (e.g. benthic diatoms), were concentrated in shorter hydroperiod sites, analogous to observations made by Carrick & Steinman (2001) in shallow epipelic habitats in LKO. Despite differences between C, S, and R in nutrient requirements, and surrounding environmental gradient structure in the benthos and plankton (Law *et al.*, 2014; Tapolczai *et al.*, 2016), overall, 63% of the CSR taxa we classified matched expectations on algal cell size for periphyton (Biggs *et al.*, 1998) and phytoplankton (Reynolds, 2006). Therefore, our CSR classification approach is promising for future comparisons in the same sites, and applications in other wetlands.

Limitations and outlook

This study provides a replicable and theory-informed template to design further comparative research to examine controls of algal richness at finer temporal and habitat scales than those analysed in this study. As we sampled algae in water in the Okavango, and in periphyton mats in the Everglades, the total algal richness is underestimated in each study; thus we recommend that future work jointly sample algae in water, and on plant and sediment/soil substrata. In the Everglades, TP comprises P in algal cells, and carbonates to which P is chemically adsorbed; as water TP is often below detection limits, periphyton TP remains however the best measure of P availability to algae in the Everglades (Gaiser *et al.*, 2004). The periphyton mat is the environmental matrix for benthic algae, analogous to the water column (in which TP is usually measured) for planktonic algae. Our approach to classify CSR indicator taxa can be further developed taking into account other features than cell size, such as shape, surface/volume ratio, and life-forms; these influence growth rate, buoyancy regulation, light capture, nutrient uptake, and susceptibility to grazing (Reynolds, 2006), and are thus important elements for elaborating joint classification of planktonic and benthic algae. The much higher mean algal richness in the Okavango than in the Everglades is likely in part due to methodological differences between the studies. Further research with standardized protocols would help understand whether the Everglades' lower richness may be due not only to its extreme oligotrophy, but also to its young geological history and peninsular character.

Our findings provide a robust baseline for future comparisons of algal richness, and life-history strategy distribution in relation to hydroperiod and P; measuring N would allow a deeper understanding of the role of limiting nutrients on richness and CSR strategies. In the Okavango, upstream hydropower plants could attenuate the flood pulse, thus impacting the Delta's algal communities (Milzow *et al.*, 2009; Mackay *et al.*, 2012; Darkoh & Mbaiwa, 2014). In the Everglades, water purification schemes, and controlled water releases are already restoring water quality and flow with potential widespread return of characteristic benthic algal communities adapted to very low P (Gaiser *et al.*, 2011). Taxonomically and functionally diverse algae likely enhance these wetlands' resilience to environmental change, as complementary species make primary production and other ecosystem functions more efficient (Cardinale *et al.*, 2009). Continued monitoring of these wetlands' algal communities is therefore key to assess the effectiveness of their conservation and management, and detect future environmental change impacts.

Acknowledgments

We are grateful to the Royal Geographical Society, the UCL Graduate School, the DEFRA Darwin Initiative (162/14/029), and the South Florida Water Management District and the US Army Corps of Engineers for funding fieldwork and laboratory analyses. We also thank: Nqobizitha Siziba, Okavango Research Institute and FIU staff for sampling and laboratory work; Jan Axmacher for statistical advice; Mike Rugge and Daniel Gann for GIS support; Leonard Pearlstine for providing Everglades habitat data, and Joel Trexler for leading the Everglades program; Lars Ramberg and Sophie des Clers for co-mentoring LM's Ph.D; Nick Schulte and John Kominoski, and two anonymous reviewers for providing thoughtful comments. This research was developed in collaboration with the Florida Coastal Everglades Long Term Ecological Research program, and represents paper number ### of the Southeast Environmental Research Center.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. List of the all the algal taxa observed in the Okavango Delta.

Table S2. List of the all the algal taxa observed in the Everglades.

Table S3. Results of the Monte Carlo significance tests on the indicator taxa identified.

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Table 1. Number of algal samples collected in the Okavango (OW: Open Water with floating vegetation; MV: Marginal Vegetation: F: Floodplain) and Everglades (OW: Open Water with floating vegetation; MP: Marsh/Prairie; SL: Shrubland). * Habitat or hydroperiod class not available (n.a.); see Fig. 1 for abbreviations.

Hydroperiod	**Okavango**							**Everglades**					
	Region							**Region**					
	Habitat	**UPH**	**LPH**	**XAK**	**BOR**	**SAN**	**Subtotal**	**Habitat**	**LKO**	**LOX**	**Out_ENP**	**ENP**	**Subtotal**
1: < 90 days	**OW**					12	12	**OW**			1		1
	MV							**MP**			1	30	31
	F			3		15	18	**SL**			3	2	5
	-							**n.a.**					
2: 90-240 days	**OW**			2	13		15	**OW**		1	5	7	13
	MV				4		4	**MP**		20	85	174	279
	F				48		48	**SL**		65	15	11	91
	-							**n.a.**				6	6
3: > 240 days	**OW**	9	3	2			14	**OW**			26	9	35
	MV	4	7	4			15	**MP**		1	269	84	354
	F	2		2			4	**SL**		7	14	7	28
	-							**n.a.**				4	4
HP class n.a.	**OW**							**OW**	2		11		13
	MV							**MP**	6		28	12	46
	F							**SL**	16		4	2	22
n.a.*	**-**							**n.a.***			7	12	19
	Subtotal	**15**	**10**	**13**	**65**	**27**	**130**	**Subtotal**	**24**	**94**	**469**	**360**	**947**

Table 2. Number of sites classified in the metagroups created using hydroperiod class (HP) and P concentrations [associated with algal life-history strategies, i.e. competitive (C), S (stress-tolerant), R (ruderal) and stress-disturbance tolerant (SD)].

Strategy	**C**	**S**	**R**	**SD**	
Region Group	**longer HP higher P**	**shorter HP lower P**	**shorter HP higher P**	**longer HP lower P**	**Total**
UPH	2			5	7
LPH	2		1	3	6
XAK	1		4	6	11
BOR		10	4		14
SAN			2		2
Total	**5**	**10**	**11**	**14**	**40**
Strategy	**C**	**S**	**R**	**SD**	
Group Region	**longer HP higher P**	**shorter HP lower P**	**shorter HP higher P**	**longer HP lower P**	**Total**
LKO	2				2
LOX	13		3		16
ENP	2	31	1	22	56
Out_ENP	31	33	4	4	72
Total	**48**	**64**	**8**	**26**	**146**

Table 3. Summary of environmental data and estimated richness (mean ± standard deviation).

Okavango	**Depth (cm)**	**Depth change (%)**	**TP (µg L^{-1})**	**TDP (µg L^{-1})**	**Estimated richness**
UPH	240±111	70±0	34±16		65±19
LPH	345±89	38±14	54±14		45±9
XAK	90±38	5±7	44±29		91±17
BOR	97±77	64±35	29±14	46±31	102±15
SAN	79±34	100±24		54±10	103±32
Everglades	**Depth (cm)**	**Depth change (%)**	**TP (µg g^{-1})**		**Estimated richness**
LKO	58±7.1	69±16	1,608±352		22±7
LOX	44±14	58±21	445±126		28±5
Out_ENP	61±19	49±19	262±123		19±4
ENP	34±12	63±27	147±117		19±3

Table 4. Multiple stepwise regression results: statistically significant predictors of estimated algal richness. *P was measured as TP in 2006-2007 in UPH, LPH, XAK and BOR, and as TDP in 2009-2010 in BOR and SAN.

WETLAND/Region	Predictor	F (model)	Coefficient	p-value	R^2_{adj}
OKAVANGO					
Total					
All regions	Depth	5.867	-0.558	0.031	0.258
Bacillariophyta					
All regions	P^*	6.167	-0.583	0.029	0.284
BOR	P	9.194	-0.778	0.023	0.539
Chlorophyta					
All regions	Depth	8.865	-0.652	0.012	0.377
BOR	P	16.027	0.853	0.007	0.682
EVERGLADES					
Total					
All regions	TP	22.279	0.364	<0.001	0.126
Out_ENP	TP	17.086	0.443	<0.001	0.185
ENP	TP	8.056	0.355	0.006	0.110
Bacillariophyta					
LOX	Depth	6.098	0.551	0.027	0.254
Out_ENP	TP	4.326	0.241	0.041	0.045
ENP	TP	4.434	0.271	0.040	0.057
Chlorophyta					
Out_ENP	TP	10.556	0.362	0.002	0.119
ENP	Depth	4.296	0.267	0.043	0.055
Cyanobacteria					
LOX	HP class	5.640	0.536	0.032	0.236
ENP	TP	4.613	0.276	0.036	0.060

Table 5. List of the C, S and R and stress - and disturbance tolerant taxa identified via indicator species analysis (in bold italics the indicator taxa identified in both wetlands).

Strategy	**Okavango**
Competitive (C) 1 Planktonic/Benthic (P/B), 5 Benthic (B)	**Bacillariophyta - (B)**: ***Eunotia flexuosa***, *Frustulia rhomboides*, *F. saxonica*, *Frustulia sp.*, *Stauroneis phoenicenteron* **Chlorophyta - (P/B)**: *Micrasterias foliacea*
Stress-tolerant (S)	-
Ruderal (R) 28 Planktonic (P), 20 Planktonic/Benthic (P/B), 1 Benthic (B)	**Bacillariophyta - (P)**: *Aulacoseira ambigua*, *Aulacoseira granulata* **Chlorophyta - (P)**: *Botryococcus sp.*, *Chlamydomonas sp.*, *Chlorococcum sp.*, Chlorococcales, *Coelastrum sp.*, *Crucigeniella crucifera*, *Eremosphaera sp.*, *E. viridis*, *Oocystis sp.*, *Pediastrum angulosum*, *P. boryanum*, *P. duplex*, *Scenedesmus falcatus*, *S. maximum*, *S. obtusus*, *S. planctonicum*, *S. serratus*, *Tetraedron caudatum* **(P/B)**: *Cosmarium contractum*, *C. obsoletum*, *C. pseudopyramidatum*, *C. regnesii*, *C. trilobulatum*, *Euastrum bidentatum*, *E. binale*, *E. denticulatum*, *E. elegans*, *Euastrum sp.*, *Hyalotheca sp.*, *Micrasterias pinnatifida*, *Staurastrum furcatum*, *S. margaritaceum*, *S. tetracerum*, *Staurodesmus convergens*, *S. dickiei*, *S. subulatus*, *Teilingia granulata* **Cryptophyta - (P)**: *Rhodomonas lacustris* **cyanobacteria - (P)**: *Lyngbya sp.* **Euglenophyta - (P)**: *Euglena limnophila*, *E. proxima*, *Phacus sp.*, *P. pusillus* **Xanthophyta - (P)**: *Goniochloris sp.;* **(B)**: *Tribonema sp.* **Pyrrophyta - (P)**: *Peridinium sp.* (P); **(P/B)**: *Amphidinium sp.*
Strategy	**Everglades**
Competitive (C) 3 Planktonic, 8 Planktonic/Benthic, 4 Benthic	**Bacillariophyta – (B)**: *Encyonopsis ftsp02, Eunotia flexuosa* **Chlorophyta - (P)**: *Pediastrum tetras*, *Scenedesmus bijuga*, *Tetraedron minimum* **(P/B)**: *Cosmarium sp.*, *C. calcareum*, *C. ocellatum*, *C. phaseolus*, *C. pyramidatum*, *Staurastrum cyathipes*, *S. excavatum*, *S. longebrachiatum* **(B)**: *Oedogonium (small)* **cyanobacteria - (B)**: *Lyngbya sp.*
Stress-tolerant (S) 1 Benthic	**Bacillariophyta - (B)**: *Nitzschia serpentiraphe*
Ruderal (R) 1 Planktonic, 2 Planktonic/Benthic, 6 Benthic	**Bacillariophyta – (B)**: *Diploneis parma*, *Encyonopsis microcephala*, *Eunotia incisa*, *Fragilaria nana*, *Nitzschia amphibia*, *N. nana* **Chlorophyta - (P/B)**: *Cosmarium inaequalis, Micrasterias crux-mellitensis* **cyanobacteria - (P)**: *Johannesbaptistia sp.*
Stress/disturbance tolerant 1 Planktonic/Benthic (P/B)	**cyanobacteria - (P/B)**: *Scytonema sp.*

FIGURE LEGENDS

Fig. 1 a) and b). Map of estimated algal richness in the a) Okavango and b) Everglades, respectively located in NW Botswana and SE USA, as shown in the inset maps. a) Okavango (site averages); UPH= Upper Panhandle; LPH=Lower Panhandle; XAK=Xakanaxa; BOR=Boro; SAN=Santantadibe; b) Everglades; LKO=Lake Okeechobee; LOX=Loxahatchee; Out_ENP=Outside of Everglades National Park (including the Water Conservation Areas, WCA 2 and 3); ENP=Everglades National Park. The total area of the Okavango is 28,000 km^2 while today's Everglades' area is ~ 5,000 km^2, reduced from its original pre-drainage size of > 10,000 km^2 by agriculture and urbanization (Junk *et al.*, 2006). Due to the their outstanding geographic features and biodiversity, both these wetlands are protected as World Heritage sites (http://whc.unesco.org/), and are included in the Ramsar Convention on Wetlands of International Importance (http://www.ramsar.org/).

Fig. 2 a) and b). Observed species richness of planktonic, planktonic/benthic, and benthic algae by phylum in the a) Okavango and b) Everglades.

Fig. 3. Mean site-specific estimated algal richness in relation to mean water depth change (%). Okavango (empty circles); Everglades (black fill triangles). Depth change was not a significant predictor in either wetland (linear regression p-values > 0.05; quadratic models did not yield better results).

Fig. 4 a) and b). Mean site-specific estimated algal richness across groups of sites with different hydroperiod class (HP) and phosphorus (P) for Fig. 6 (C=competitive; S=stress-tolerant; R=ruderal; SD=stress and disturbance tolerant). Significant differences (Kruskal-Wallis, K.W., and Mann Whitney U, M.W.U., tests: p<0.05): Okavango: Total (K.W.: χ^2=

9.061), Chlorophyta (Chl; K.W.: χ^2= 11.097) and cyanobacteria (Cya; K.W.: χ^2=12.482); Other phyla: K.W.: χ^2=8.440. Statistically significant post-hoc differences in phylum mean richness as per M.W.U. tests ($p<0.05$) are marked with (in decreasing order) a and b; total richness with A and B. Everglades: Total (χ^2=36.275), Bacillariophyta (Bac; K.W.: χ^2=10.139), Chl (K.W.: χ^2=22.474), and Cya (K.W.: χ^2=10.380). Statistically significant post-hoc differences in phylum mean richness as per M.W.U. tests ($p<0.05$) are marked with (in decreasing order) aa, a and b; total richness with AA, A and B.

Fig. 5. Mean estimated habitat-specific algal richness in the Okavango and Everglades. No statistically significant differences (p-value=0.05) were found within each wetland.

Fig. 6 a) and b). Summary of the distribution of competitive (C), stress-tolerant (S), ruderal (R) indicator taxa, and stress-disturbance tolerant (SD) at sites with varying desiccation disturbance and P scarcity in the a) Okavango, and b) Everglades. The number of C, S, and R indicator taxa in each wetland is included.

Figure 1a.

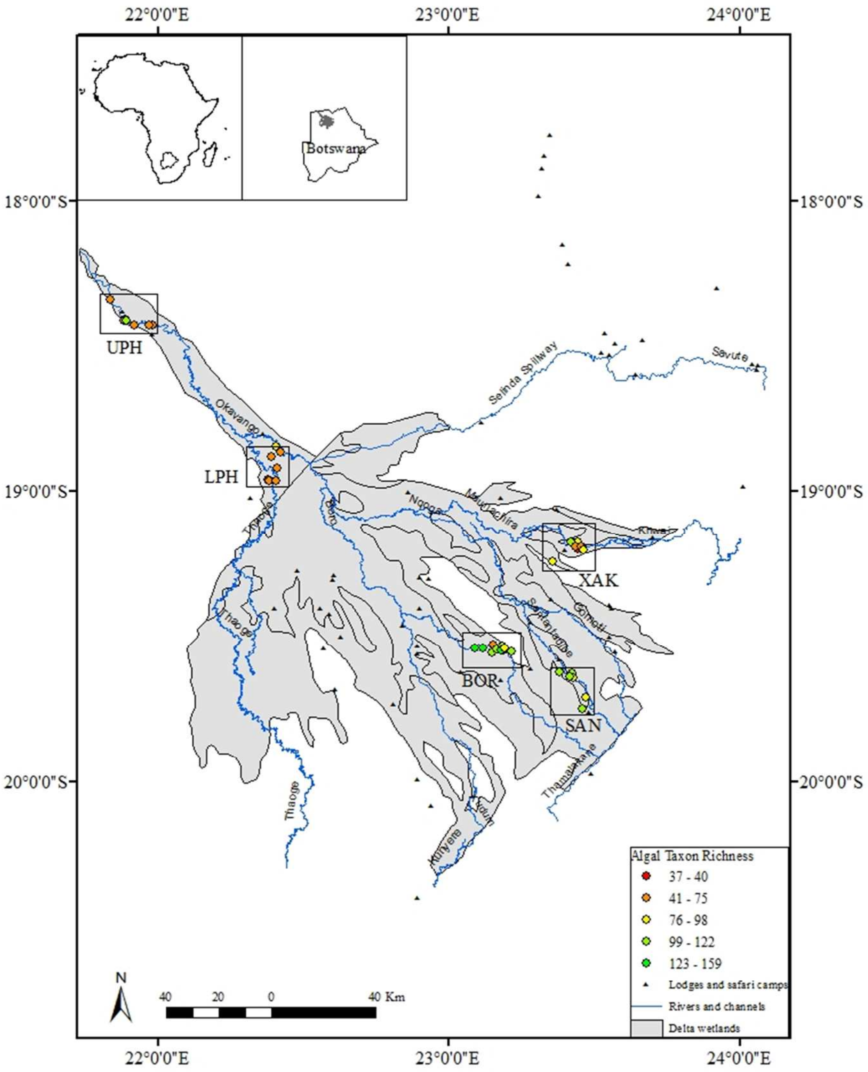

Figure 1b.

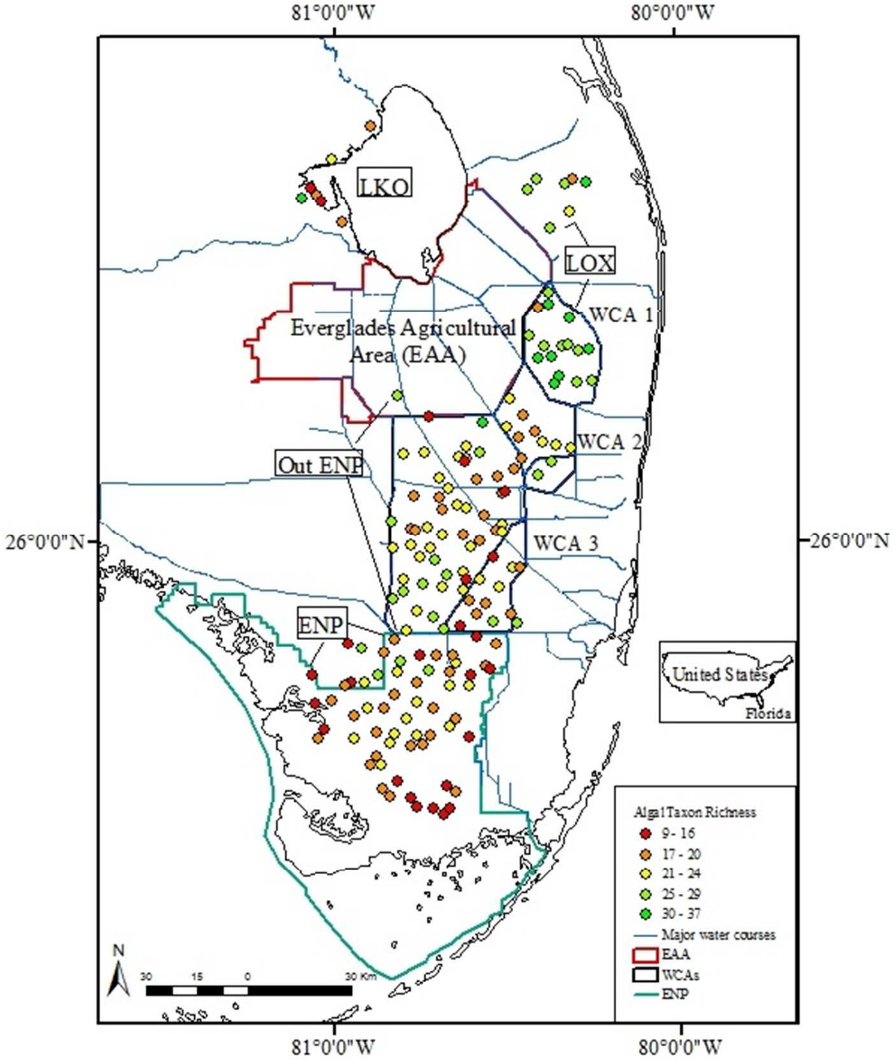

Figure 2a.

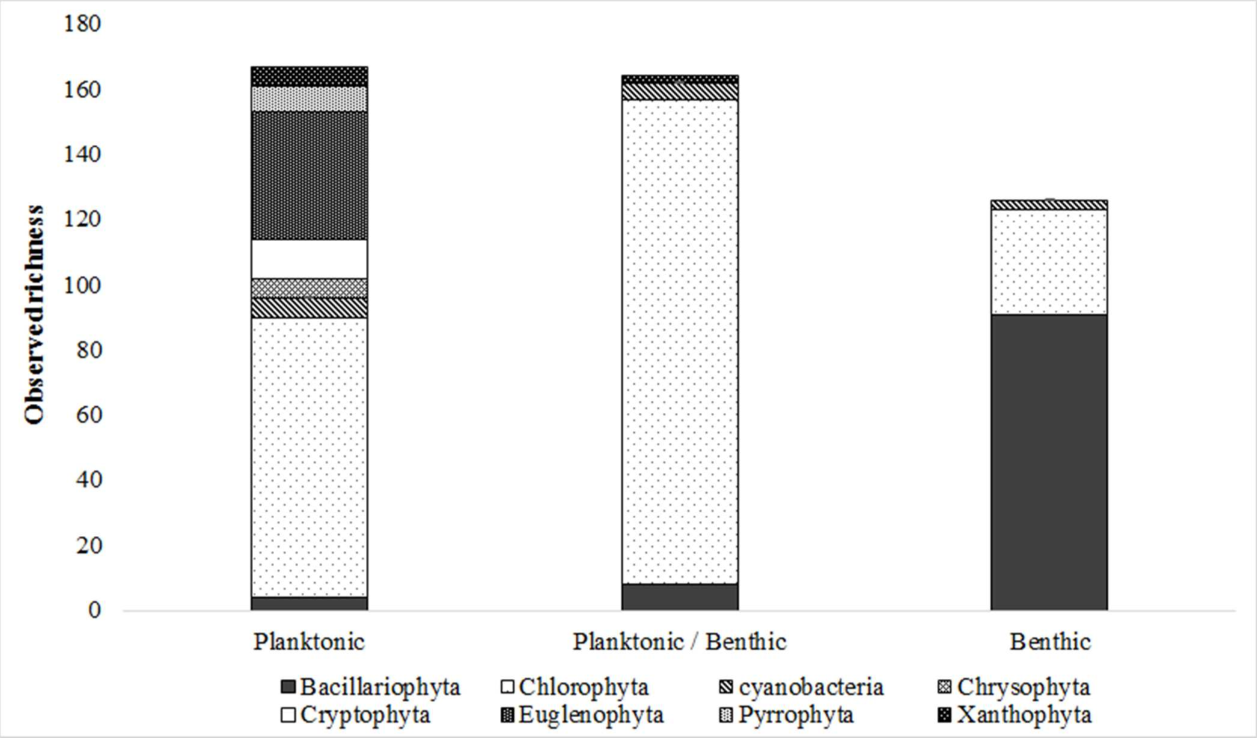

Figure 2b.

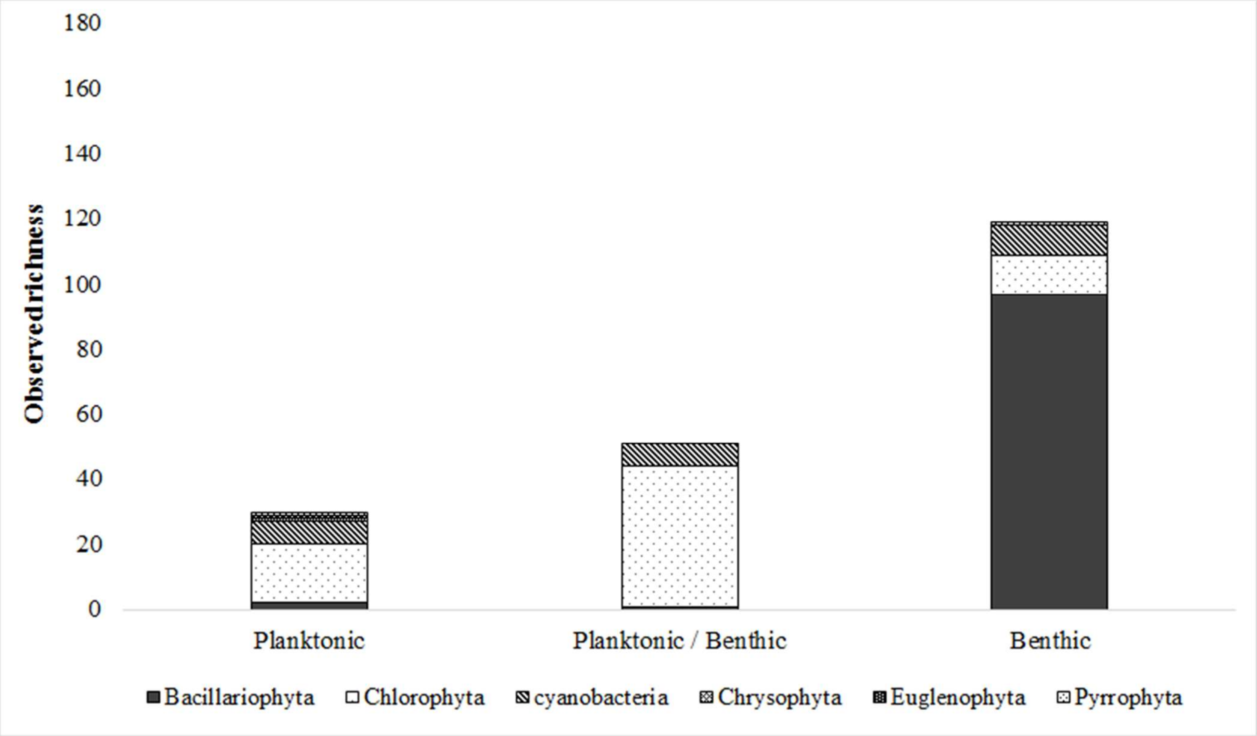

Figure 3.

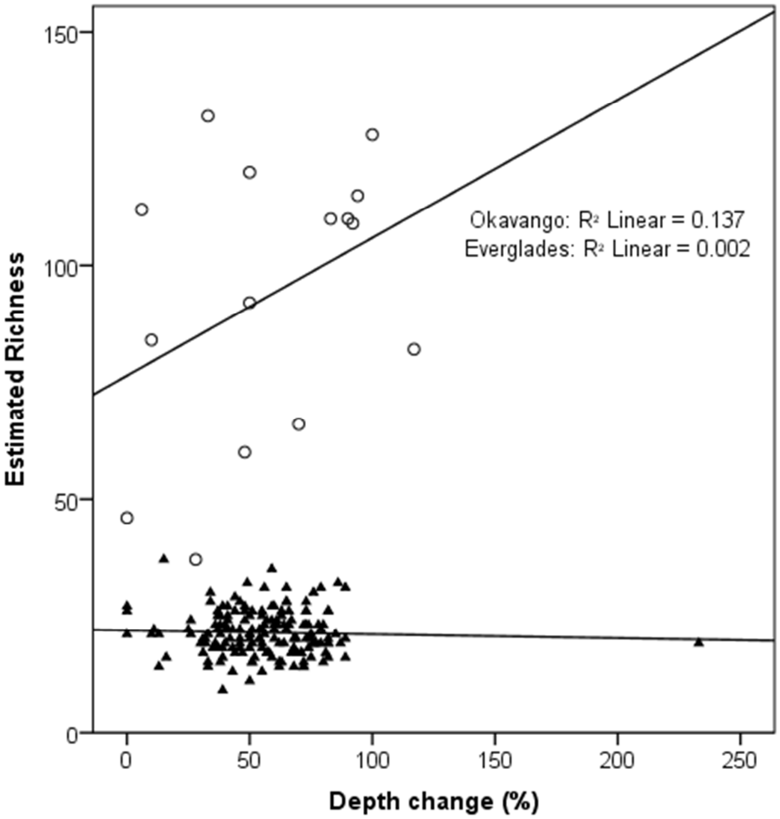
Okavango: R² Linear = 0.137
Everglades: R² Linear = 0.002
Estimated Richness
150
100
50
0
0
50
100
150
200
250
Depth change (%)

Figure 4a.

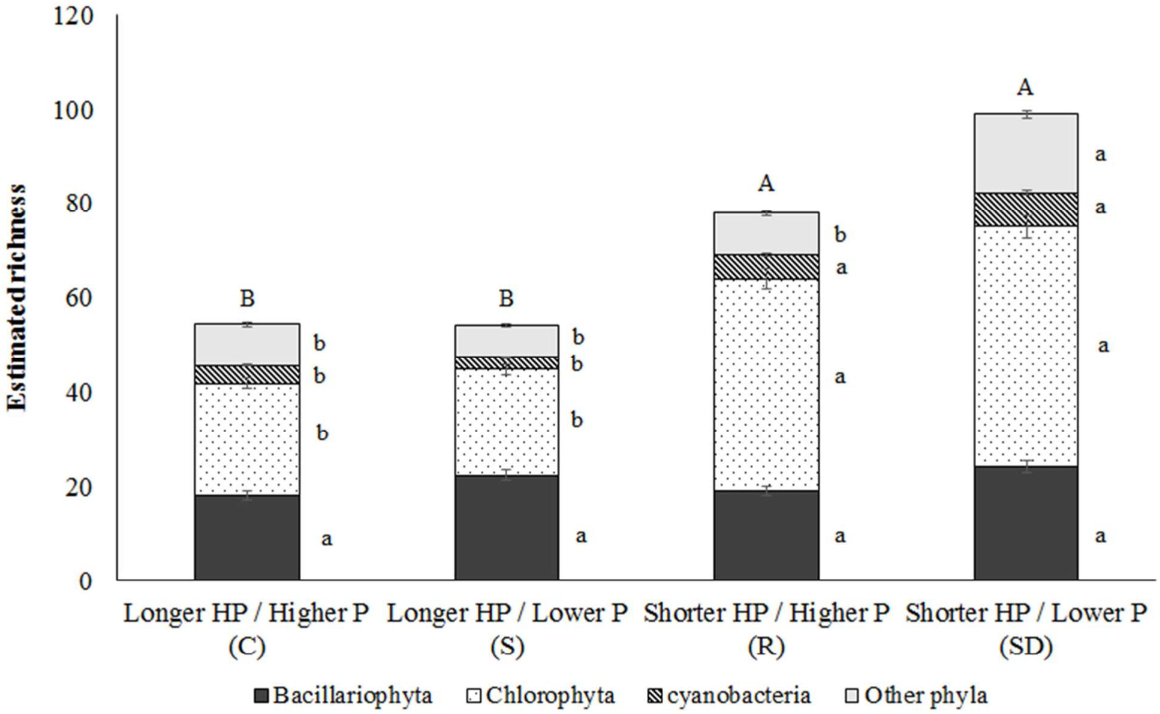

Figure 4b.

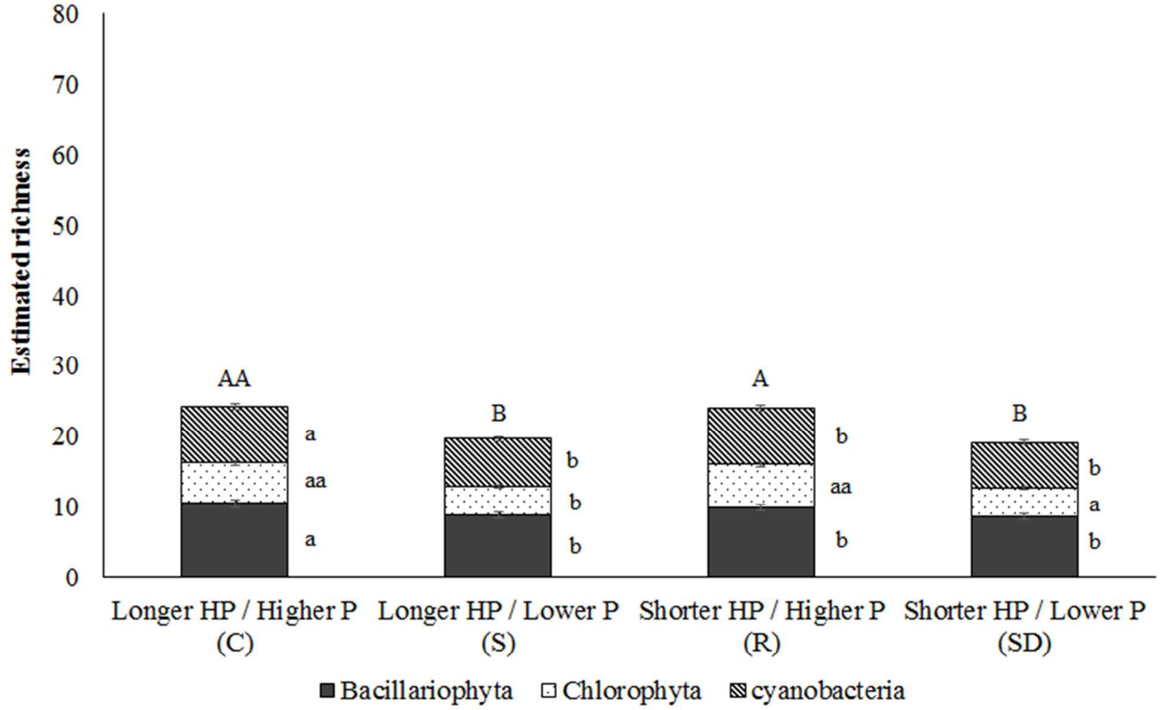

Figure 5.

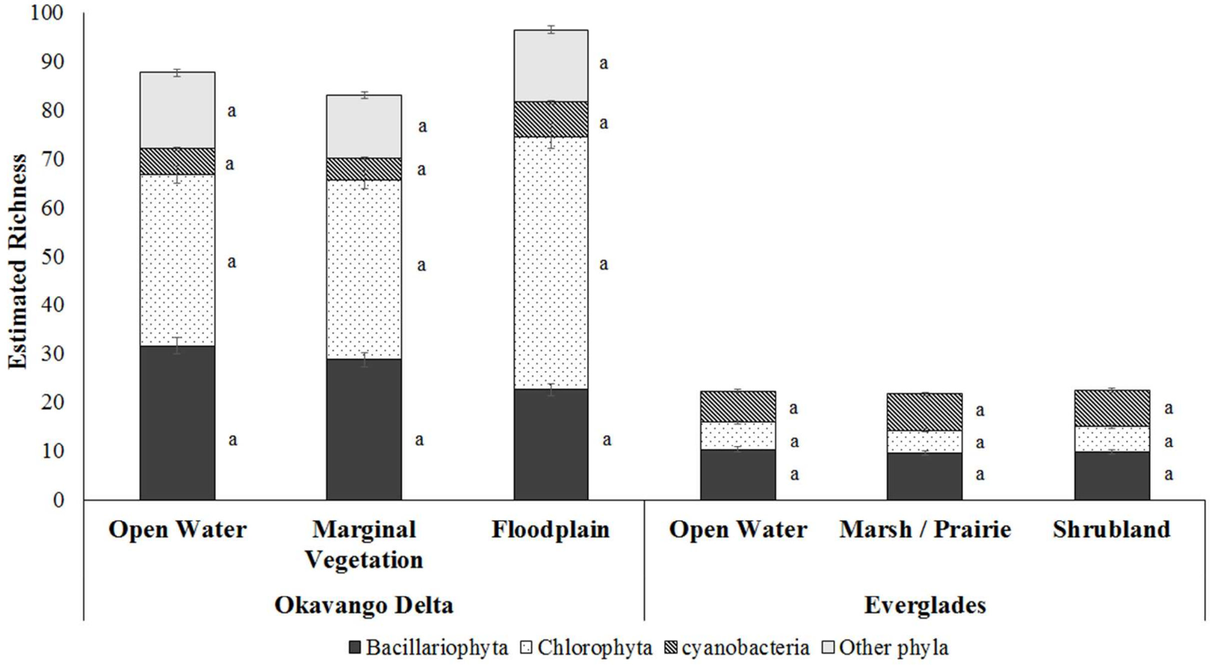
Estimated Richness
100
90
80
70
60
50
40
30
20
10
0
a
Open Water
Marginal Vegetation
Floodplain
Open Water
Marsh / Prairie
Shrubland
Okavango Delta
Everglades
■ Bacillariophyta ⬚ Chlorophyta ▨ cyanobacteria □ Other phyla

Figure 6a.

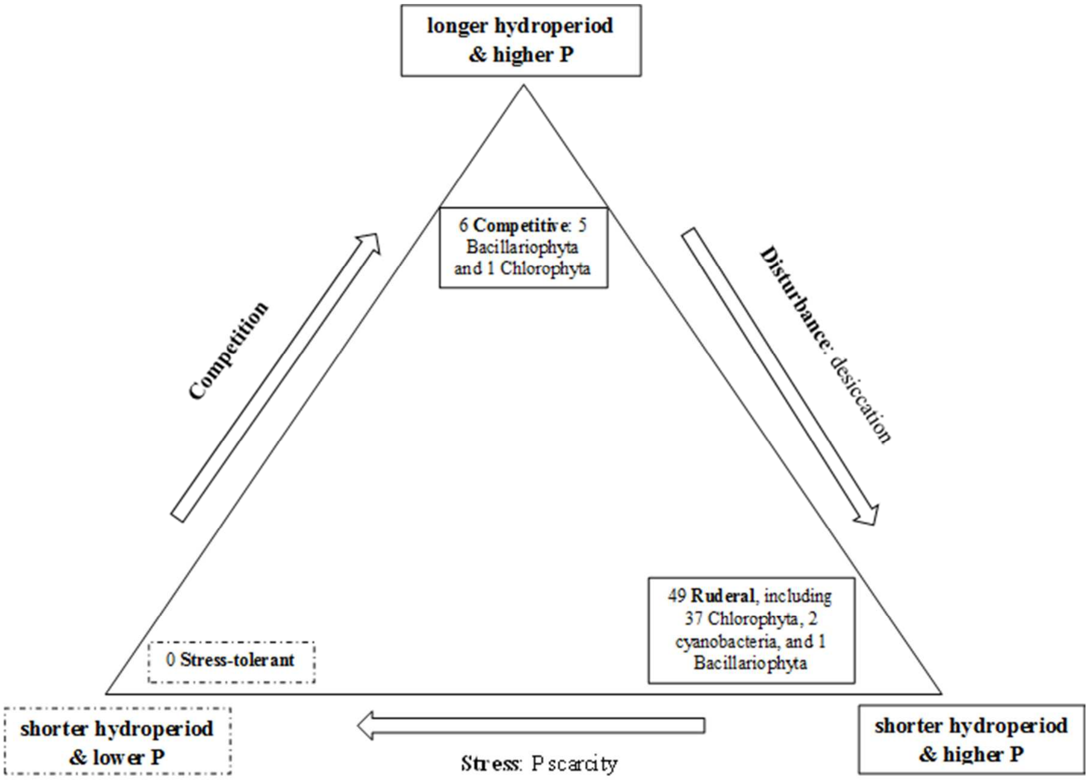

Figure 6b.

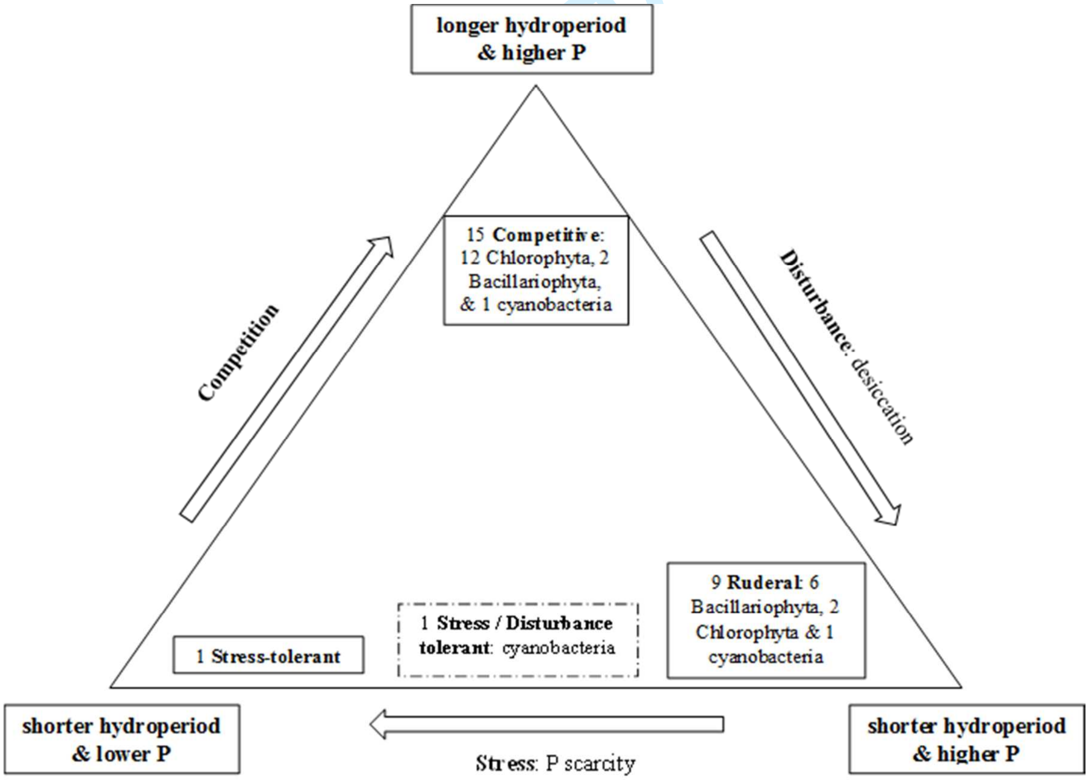

Table S1. List of all the algal taxa observed in the Okavango Delta (main source of authorities: www.algaebase.org; information on planktonic / benthic mostly from Wehr J.D., Sheath R.G. & Kociolek J.P. (Eds). (2015). "Freshwater algae of North America. Ecology and classification". Academic Press, San Diego).

BACILLARIOPHYTA		**Planktonic / Benthic**
Species	**Authority**	
Achnanthidium minutissimum	(Kützing) Czarnecki 1994	B
Amphora libyca	Ehrenberg 1840	B
Amphora ovalis	Kützing 1844	B
Amphora pediculus	(Kützing) Grunow in Schmidt 1875	B
Asterionella formosa	Hassall (1850)	P
Aulacoseira ambigua	(Grunow) Simonsen 1979	P
Aulacoseira granulata	(Ehrenberg) Simonsen 1979	P
Caloneis bacillum	(Grunow) Cleve 1894	B
Caloneis tenuis	(W.Gregory) Krammer	B
Caloneis undulata	(W.Gregory) Krammer	B
Craticula cuspidata	(Kützing) Mann 1990	B
Cymatopleura solea	(Brébisson and Godey) W. Smith (1851)	B
Cymbella cuspidata	Kützing 1844	B
Cymbella naviculiformis	(Auerswald) Cleve (1894)	B
Epithemia adnata	(Kützing) Brébisson 1838	B
Eunotia alpina	(Nägeli) Hustedt in Schmidt *et al.* 1913	B
Eunotia arcus	Ehrenberg 1837	B
Eunotia asterionelloides	Hustedt 1952	B
Eunotia bilunaris	(Ehrenberg) Schaarschmidt 1880	B
Eunotia exigua	(Brébisson ex Kützing) Rabenhorst 1864	B
Eunotia faba	(Ehrenberg) Grunow in van Heurck 1881	B
Eunotia flexuosa	(Brébisson ex Kützing) Kützing 1849	B
Eunotia incisa	W.Smith ex W.Gregory 1854	B
Eunotia intermedia	(Krasske) Nörpel and Lange-Bertalot	B
Eunotia minor	(Kützing) Grunow in van Heurck 1881	B
Eunotia muscicola	Krasske 1939	B
Eunotia naegellii	Migula 1907	B
Eunotia okawangoi	Cholnoky	B
Eunotia pectinalis	(Kützing) Rabenhorst 1864	B
Eunotia praerupta	Ehrenberg 1843	B
Eunotia rhomboidea	Hustedt 1950	B
Eunotia serra	Ehrenberg 1837	B
Eunotia soleirolii	(Kützing) Rabenhorst 1864	B
Fragilaria africana	Hustedt	P
Fragilaria crotonensis	Kitton 1869	P
Fragilaria ulna	(Nitzsch) Lange-Bertalot 1980	P/B
Frustulia rhomboides	(Ehrenberg) De Toni 1891	B
Frustulia saxonica	Rabenhorst 1853	B
Gomphonema angustum	C. Agardh 1831	B
Gomphonema augur	Ehrenberg 1840	B
Gomphonema clevei	Fricke in Schmitd *et al.* 1902	B
Gomphonema globiferum	Meister 1913	B
Gomphonema gracile	Ehrenberg 1838	B
Gomphonema hebridense	W.Gregory 1854	B
Gomphonema lanceolatum	Kützing 1844	B
Gomphonema olivaceum	(Hornemann) Brébisson 1838	B
Gomphonema parvulum	(Kützing) Kützing 1849	B
Gomphonema pfannkucheae	Cholnoky	B
Gomphonema resendei	Moura	B
Gomphonema subtile	Ehrenberg 1843	B

BACILLARIOPHYTA		**Planktonic / Benthic**
Gomphonema truncatum	Ehrenberg 1832	B
Gyrosigma spencerii	(W.Smith) Griffith and Henfrey 1856	B
Hantzschia amphioxys	(Ehrenberg) Grunow	B
Meridion circulare	(Greville) C.Agardh 1831	B
Navicula cryptocephala	Kützing 1844	B
Navicula cryptotenella	Lange-Bertalot in Krammer and Lange-Bertalot 1985	B
Navicula halophila	(Grunow) Cleve 1894	B
Navicula laevissima	Kützing 1844	B
Navicula menisculus	Schumann 1867	B
Navicula radiosa	Kützing 1844	B
Navicula veneta	Kützing 1844	B
Neidium ampliatum	(Ehrenberg) Krammer in	B
Neidium productum	(W.Smith) Cleve 1894	B
Nitzschia acicularis	(Kützing) W.Smith 1853	B
Nitzschia linearis	(C.Agardh) W.Smith 1853	B
Nitzschia pellucida	Grunow 1880	B
Nitzschia perminuta	(Grunow) M.Peragallo 1903	B
Nitzschia recta	Hantzsch ex Rabenhorst 1862	B
Nitzschia scalaris	(Ehrenberg) W.Smith 1853	B
Nitzschia sigma	(Kützing) W.Smith 1853	B
Nitzschia sigmoidea	(Nitzsch) W.Smith 1853	B
Nitzschia subacicularis	Hustedt	B
Nitzschia vermicularis	(Kützing) Hantzsch in Rabenhorst 1860	B
Pinnularia abaujensis	(Pantocsek) R.Ross 1947	B
Pinnularia braunii	(Grunow) Mills 1934	B
Pinnularia divergentissima	(Grunow) Cleve 1895	B
Pinnularia gibba	Ehrenberg 1843	B
Pinnularia interrupta	W.Smith 1853	B
Pinnularia lundii	Hustedt 1954	B
Pinnularia maior	Kutzing (Rabenhorst) 1997	B
Pinnularia mesolepta	(Ehrenberg) W.Smith 1853	B
Pinnularia nobilis	(Ehrenberg) Ehrenberg 1843	B
Pinnularia subcapitata	W.Gregory 1856	B
Pinnularia subrostrata	(A.Cleve) Cleve-Euler 1955	B
Pinnularia viridis	(Nitzsch) Ehrenberg 1843	B
Rhopalodia gibba	(Ehrenberg) O. Müller (1895)	B
Sellaphora bacillum	(Ehrenberg) D.G.Mann 1989	B
Sellaphora pupula	(Kützing) Mereschkovsky 1902	B
Stauroneis anceps	Ehrenberg 1843	B
Stauroneis phoenicenteron	(Nitzsch) Ehrenberg 1843	B
Stauroneis producta	Grunow in van Heurck 1880	B
Surirella capronii	Brébisson ex F.Kitton	B
Surirella elegans	Ehrenberg	B
Surirella linearis	W.Smith 1853	B
Synedra acus	Kützing 1844	P/B
Synedra amphicephala	Kützing 1844	P/B
Synedra capitata	Ehrenberg (1836)	P/B
Synedra nana	F.Meister 1912	P/B
Synedra rumpens	Kützing 1844	P/B
Tabellaria fenestrata	(Lyngbie) Kützing 1844	P

CHLOROPHYTA		**Planktonic / Benthic**
Species	**Authority**	
Actinastrum hantzschii	Lagerheim 1882	P

Actinotaenium cucurbitum	Teiling	P/B
Ankistrodesmus falcatus	(Corda) Ralfs 1848	P
Ankistrodesmus spiralis	(W.B.Turner) Lemmermann 1908	P
Bambusina borreri	(Ralfs) Cleve 1864	P/B
Bambusina brebissonii	Kützing ex Kützing 1849	P/B
Chlamydomonas mirabilis	Pascher 1927	P
Chlorobion braunii	(Nägeli) Komàrek 1979	P/B
Closteriopsis acicularis	(Chodat) J.H.Belcher and Swale 1962	P
Closterium acerosum	Ehrenberg ex Ralfs 1848	B
Closterium aciculare	West 1860	B
Closterium acutum	Brébisson in Ralfs 1848	B
Closterium attenuatum	Ralfs 1848	B
Closterium closterioides	(Ralfs) A.Louis and F.Peeters 1967	B
Closterium cornu	Ehrenberg ex Ralfs 1848	B
Closterium dianae	Ehrenberg ex Ralfs 1848	B
Closterium directum	W.Archer 1862	B
Closterium ehrenbergii	Meneghini ex Ralfs 1848	B
Closterium gracile	Brébisson ex Ralfs 1848	B
Closterium idiosporum	West and G.S.West 1900	B
Closterium incurvum	Brébisson 1856	B
Closterium jenneri	Ralfs 1848	B
Closterium juncidum	Ralfs 1848	B
Closterium kuetzingii	Brébisson 1856	B
Closterium leiblenii	Kutzing ex Ralfs 1848	B
Closterium littorale	F.Gay 1884	B
Closterium lunula	Ehrenberg and Hemprich ex Ralfs 1848	B
Closterium monoliferum	(Bory) Ehrenberg ex Ralfs 1848	B
Closterium navicula	(Brebisson) Lutkemuller 1902	B
Closterium parvulum	Nägeli 1849	B
Closterium ralfsii	Brébisson ex Ralfs 1848	B
Closterium setaceum	Ehrenberg ex Ralfs 1848	B
Closterium subfusiforme	Messikommer	B
Closterium venus	Kutzing ex Ralfs 1848	B
Coelastrum microporum	Nägeli 1855	P
Coelastrum pseudomicroporum	Korshikov 1953	P
Coelastrum sphaericum	Nägeli 1849	P
Cosmarium annulatum	(Nägeli) de Bary 1849	P/B
Cosmarium australe	Raciborski (Lütkemüller)	P/B
Cosmarium binum	Nordstedt in Wittrock and Nordstedt 1880	P/B
Cosmarium bioculatum	Brébisson ex Ralfs 1848	P/B
Cosmarium biretum	Ralfs, J. (1848)	P/B
Cosmarium blythii	Wille 1880	P/B
Cosmarium botrytis	Meneghini ex Ralfs 1848	P/B
Cosmarium brebissonii	Meneghini ex Ralfs 1848	P/B
Cosmarium caelatum	Ralfs 1848	P/B
Cosmarium connatum	Brébisson in Ralfs 1848	P/B
Cosmarium contractum	Kirchner 1878	P/B
Cosmarium cucumis	Corda ex Ralfs 1848	P/B
Cosmarium depressum	(Nägeli) P.Lundell 1871	P/B
Cosmarium difficile	Lütkemüller 1892	P/B
Cosmarium elegantissimum	P.Lundell 1871	P/B
Cosmarium formulosum	Hoff in Nordstedt 1888	P/B
CHLOROPHYTA		**Planktonic / Benthic**
Cosmarium geminatum	P.Lundell 1871	P/B
Cosmarium granatum	Brébisson in Ralfs 1848	P/B
Cosmarium haynaldii	Schaarschmidt 1883	P/B

Cosmarium impressulum	Elfving 1881	P/B
Cosmarium margaritatum	(P.Lundell) J.Roy and Bisset 1886	P/B
Cosmarium meneghinii	Brébisson ex Ralfs 1848	P/B
Cosmarium moniliforme	Ralfs 1848	P/B
Cosmarium monomazum	P.Lundell 1871	P/B
Cosmarium obsoletum	(Hantzsch) Reinsch 1867	P/B
Cosmarium okavangicum	Coesel and van Geest 2009	P/B
Cosmarium ornatum	Ralfs ex Ralfs 1848	P/B
Cosmarium portianum	Archer 1860	P/B
Cosmarium pseudoconnatum	Nordstedt 1870	P/B
Cosmarium pseudoprotuberans	O.Kirchner 1878	P/B
Cosmarium	P.Lundell 1871	P/B
Cosmarium pseudosulcatum	Rich in F.E.Fritsch & Rich 1937	P/B
Cosmarium pseudotus	Coesel and Van Geest 2009	P/B
Cosmarium pygmaeum	W.Archer 1864	P/B
Cosmarium pyramidatum	Brébisson ex Ralfs 1848	P/B
Cosmarium quadratulum	(F.Gay) De Toni 1889	P/B
Cosmarium ralfsii	Brébisson ex Ralfs 1848	P/B
Cosmarium regnellii	Wille 1884	P/B
Cosmarium regnesii	Reinsch 1867	P/B
Cosmarium reniforme	(Ralfs) W. Archer 1874	P/B
Cosmarium richianum	Compère 1987	P/B
Cosmarium taxichondrum	P.Lundell 1871	P/B
Cosmarium trilobulatum	Reinsch 1866	P/B
Cosmarium turpinii	Brebisson 1856	P/B
Cosmarium undulatum	Corda ex Ralfs 1848	P/B
Cosmarium zonatum	P.Lundell 1871	P/B
Crucigenia tetrapedia	(Kirchner) West et G.S. West 1902	P/B
Crucigeniella crucifera	(Wolle) Komarek 1974	P/B
Crucigeniella rectangularis	(Nägeli) Komàrek 1974	P/B
Desmidium grevillei	(Ralfs) De Bary 185	P/B
Desmodesmus communis	Hegewald 2000	P
Docidium baculum	Brébisson ex Ralfs 1848	P/B
Eremosphaera gigas	(W.Archer) Fott and Kalina 1962	P/B
Eremosphaera viridis	De Bary 1858	P/B
Euastrum africanum	(Bourrelly) Coesel and Van Geest 2008	P/B
Euastrum ansatum	Ralfs 1848	P/B
Euastrum attenuatum	Wolle	P/B
Euastrum bidentatum	Nägeli 1849	P/B
Euastrum binale	(Turpin) Ehnrenberg ex Ralfs 1848	P/B
Euastrum denticulatum	F. Gay 1884	P/B
Euastrum divergens	Joshua 1886	P/B
Euastrum dubium	Nageli 1849	P/B
Euastrum elegans	(Brebisson) Kützing ex Ralfs 1848	P/B
Euastrum mononcylum	(Nordstedt) Raciborski 1885	P/B
Euastrum pectinatum	Brebisson ex Brebisson in Ralfs 1848	P/B
Euastrum sphyroides	Nordstedt 1888	P/B
Euastrum spinulosum	Delponte 1876	P/B
Euastrum truncatiforme	G.S. West 1907	P/B
Euastrum verrucosum	Ehrenberg ex Ralfs 1848	P/B
Golenkinia paucispina	(J.W.G.Lund) Fott 1981	P
Golenkiniopsis chlorelloides	West and G.S.West 1902	P
CHLOROPHYTA		**Planktonic / Benthic**
Gonatozygon aculeatum	Hastings 1892	P/B
Gonatozygon brebissonii	De Bary 1858	P/B
Gonatozygon kinahanii	(Archer) Rabenhorst 1868	P/B

Gonatozygon monotaenium	De Bary 1856	P/B
Gonatozygon pilosum	Wolle 1882	P/B
Groenbladia undulata	(Nordstedt) Kurt Förster 1973	P/B
Haplotaenium minutum	(Ralfs) T.Bando 1988	B
Haplotaenium rectum	(Delponte) Bando 1988	B
Hyalotheca dissiliens	Brébisson ex Ralfs 1848	P/B
Kirchneriella irregulare	(G.M.Smith) Korshikov 1953	P/B
Kirchneriella obesa	(G.S.West) West and G.S.West 1894	P/B
Koliella spiculiformis	(Vischer) Hindák 1963	P
Korshikoviella	(Elenkin) P.C.Silva 1959	B
Micrasterias americana	Ehrenberg ex Ralfs 1848	P/B
Micrasterias crux-melitensis	(Ehrenberg) Trevisan 1842	P/B
Micrasterias foliacea	Bailey ex Ralfs 1848	P/B
Micrasterias	Brühl and Biswas	P/B
Micrasterias oscitans	Ralfs 1848	P/B
Micrasterias pinnatifida	Ralfs 1848	P/B
Micrasterias pusilla	G.C.Wallich	P/B
Micrasterias rotata	Ralfs 1848	P/B
Micrasterias tropica	Nordstedt 1870	P/B
Micrasterias truncata	Ralfs 1848	P/B
Monoraphidium arcuatum	(Korshikov) Hindák 1970	P
Monoraphidium contortum	(Thuret) Komàrková-Legnerová 1969	P
Monoraphidium convolutum	(Corda) Komárková-Legnerová 1969	P
Monoraphidium griffithii	(Berkeley) Komárková-Legnerová 1969	P
Monoraphidium irregulare	(G.M.Smith) Komárková-Legnerová	P
Monoraphidium komarkovae	Nygaard 1979	P
Monoraphidium minutum	(Nägeli) Komárková-Legnerová 1969	P
Monoraphidium obtusum	(Korshikov) Komárková-Legnerová 1969	P
Monoraphidium pusillum	(Printz) Komárková-Legnorová 1969	P
Monoraphidium tortile	(West and G.S.West) Komárková-Legnerová 1969	P
Netrium digitus	(Brébisson ex Ralfs) Itzigsohn and Rothe	P/B
Netrium interruptum	(Brébisson ex Ralfs) Lütkemüller 1902	P/B
Onychonema filiforme	(Ehrenberg ex Ralfs) J.Roy and Bisset 1886	P/B
Oocystis natans	(Lemmermann) Lemmermann 1908	P/B
Oocystis solitaria	Wittrock 1879	P/B
Pediastrum angulosum	Ehrenberg ex Meneghini 1840	P
Pediastrum boryanum	(Turpin) Meneghini 1840	P
Pediastrum duplex	Meyen 1829	P
Pediastrum simplex	Meyen 1829	P
Pediastrum tetras	(Ehrenberg) Ralfs 1844	P
Penium cylindrus	Brébisson ex Ralfs 1848	P/B
Penium gonatozygiforme	Claassen	P/B
Penium margaritaceum	Brébisson in Ralfs 1848	P/B
Pleurotaenium coronatum	Rabenhorst 1868	B
Pleurotaenium ehrenbergii	(Brébisson ex Ralfs) Delponte 1878	B
Pleurotaenium trabecula	(Ehrenberg) Nägeli 1849	B
Scenedesmus acuminatus	(Lagerheim) Chodat 1902	P
Scenedesmus acutus	Meyen 1829	P
Scenedesmus alternans	Reinsch	P
Scenedesmus arcuatus	Lemmermann 1899	P
Scenedesmus armatus	(Chodat) R.Chodat 1913	P
Scenedesmus brasiliensis	Bohlin 1897	P
CHLOROPHYTA		**Planktonic / Benthic**
Scenedesmus communis	Hegewald 1977	P
Scenedesmus ellipsoideus	Chodat	P
Scenedesmus ellipticus	Corda 1835	P

Scenedesmus falcatus	Chodat 1894	P
Scenedesmus longispina	Chodat 1913	P
Scenedesmus magnus	Meyen 1829	P
Scenedesmus maximus	(West and G.S.West) Chodat 1913	P
Scenedesmus obtusus	Meyen 1829	P
Scenedesmus planctonicus	(Korshikov) Fott 1973	P
Scenedesmus protuberans	F.E. Fritsch and M.F. Rich 1929	P
Scenedesmus quadricauda	(Turpin) Brébisson in Brébisson & Godey 1835	P
Scenedesmus serratus	(Corda) Bohlin 1901	P
Scenedesmus verrucosus	Roll 1925	P
Schroederia robusta	Korshikov 1953	P
Selenastrum bibraianum	Reinsch 1866	P
Selenastrum gracile	Reinsch 1866	P
Sorastrum americanum	(Bohlin) Schmidle 1900	P/B
Spirotaenia condensata	Brébisson in Ralfs 1848	P/B
Staurastrum arachne	Ralfs ex Ralfs 1848	P/B
Staurastrum arctiscon	(Ehrenberg ex Ralfs) P.Lundell 1871	P/B
Staurastrum armigerum	Brébisson 1856	P/B
Staurastrum avicula	Brébisson in Ralfs 1848	P/B
Staurastrum cerastes	P.Lundell 1871	P/B
Staurastrum chaetoceras	(Schröder) G.M.Smith 1924	P/B
Staurastrum convergens	(Ehrenberg) Meneghini	P/B
Staurastrum denticulatum	(Nägeli) W.Archer 1861	P/B
Staurastrum excavatum	West and G.S.West 1895	P/B
Staurastrum fuelleborniforme	Coesel and Van Geest 2009	P/B
Staurastrum furcatum	Brébisson 1856	P/B
Staurastrum gemelliparum	Nordstedt 1870	P/B
Staurastrum gracile	Ralfs ex Ralfs 1848	P/B
Staurastrum hagmannii	Grönblad	P/B
Staurastrum hexacerum	Ehrenberg ex Wittrock 1872	P/B
Staurastrum hirsutum	Ehrenberg ex Ralfs 1848	P/B
Staurastrum hystrix	Ralfs 1848	P/B
Staurastrum johnsonii	West and G.S.West 1896	P/B
Staurastrum leptocladum	Nordstedt, 1869	P/B
Staurastrum longispinum	(Bailey) Archer 1861	P/B
Staurastrum margaritaceum	Meneghini ex Ralfs 1848	P/B
Staurastrum muticum	Brébisson ex Ralfs 1848	P/B
Staurastrum paradoxum	Meyen ex Ralfs 1848	P/B
Staurastrum planctonicum	Teiling 1946	P/B
Staurastrum proboscideum	(Brébisson) Archer in Prichard 1861	P/B
Staurastrum productum	(West and G.S.West) Coesel 1996	P/B
Staurastrum quadrangulare	Brébisson in Ralfs 1848	P/B
Staurastrum rzoskae	Grönblad and Scott 1958	P/B
Staurastrum sebaldi	Reinsch 1866	P/B
Staurastrum tetracerum	Ralfs ex Ralfs 1848	P/B
Staurastrum volans	West & G.S.West 1895	P/B
Staurastrum wildemanii	Gutwinski 1902	P/B
Staurodesmus aversus	(P.Lundell) S.Lillieroth 1950	P/B
Staurodesmus brevispina	(Brébisson) Croasdale 1957	P/B
Staurodesmus convergens	(Ehrenberg ex Ralfs) S.Lilleroth 1950	P/B
Staurodesmus crassus	(West and G.S.West) M.-B.Florin 1957	P/B
Staurodesmus cuspidatus	(Brébisson) Teiling 1967	P/B
CHLOROPHYTA		**Planktonic / Benthic**
Staurodesmus dejectus	(Brébisson) Teiling 1967	P/B
Staurodesmus dickiei	(Ralfs) S.Lillieroth 1950	P/B
Staurodesmus extensus	(Borge) Teiling 1948	P/B

Staurodesmus glaber	(Ralfs) Teiling 1948	P/B
Staurodesmus mamillatus	(Nordstedt) Teiling 1967	P/B
Staurodesmus megacanthus	(P.Lundell) Thunmark 1948	P/B
Staurodesmus mucronatus	(Ralfs ex Ralfs) Croasdale 1957	P/B
Staurodesmus sellatus	(Teiling) Teiling 1948	P/B
Staurodesmus subulatus	(Kützing) Thomasson 1963	P/B
Teilingia excavata	(Ralfs ex Ralfs) Bourrelly 1964	P/B
Teilingia granulata	(J.Roy and Bisset) Bourrelly 1964	P/B
Tetmemorus euastroides	A.M.Scott and Prescott	P/B
Tetraedron caudatum	(Corda) Hansgirg 1888	P
Tetraedron incus	G.M.Smith 1926	P
Tetraedron minimum	(A.Braun) Hansgirg 1888	P
Tetraedron regulare	Kutzing 1845	P
Tetraedron triangulare	Korshikov 1953	P
Tetraselmis cordiformis	(Carter) Stein 1878	P
Tetrastrum elegans	Playfair 1917	P
Tetrastrum triangulare	(Chodat) Komárek 1974	P
Triploceras gracile	J.W.Bailey 1851	B
Trochiscia hirta	Hansgirg 1888	P/B
Ulothrix zonata	(Weber and Mohr) Kützing 1843	B
Xanthidium antilopaeum	(Brébisson) Kützing 1849	P/B
Xanthidium bifidum	(Brébisson) Deflandre 1929	P/B
Xanthidium cristatum	Brébisson ex Ralfs 1848	P/B
Xanthidium fascicolatum	Ehrenberg ex Ralfs 1848	P/B
Xanthidium octocorne	Ehrenberg ex Ralfs 1848	P/B
Xanthidium subhastiferum	West 1892	P/B
Xanthidium subtrilobum	West and G.S.West 1897	P/B
CHRYSOPHYTA		
Bitrichia chodatii	(Reverdin) Chodat 1926	P
Mallomonas caudata	Iwanoff 1899	P
Mallomonas insignis	Penard 1919	P
CRYPTOPHYTA		
Chroomonas acuta	Utermöhl 1925	P
Chroomonas baltica	(J.Büttner) N.Carter 1937	P
Chroomonas coerulea	(Geitler) Skuja 1948	P
Cryptomonas acuta	Butcher 1952	P
Cryptomonas anomala	Fritsch 1914	P
Cryptomonas curvata	Ehrenberg 1831	P
Cryptomonas erosa	Ehrenberg, 1832	P
Cryptomonas marssonii	Skuja 1948	P
Cryptomonas ovata	Ehrenberg 1832	P
Cryptomonas platyuris	Skuja 1948	P
Rhodomonas lacustris	Pascher and Ruttner 1913	P
CYANOBACTERIA		
Anabaena circinalis	Rabenhorst ex Bornet and Flahault 1886	P/B
Anabaena cylindrica	Lemmermann 1896	P/B
Chroococcus limneticus	Lemmermann 1898	P
Lyngbya contorta	Lemmermann 1898	P
Merismopedia elegans	Braun ex Kützing 1849	P/B
Oscillatoria limnetica	Lemmermann 1900	P
Oscillatoria limosa	C.Agardh ex Gomont 1892	B
Oscillatoria redekei	Van Goor	P
CYANOBACTERIA		**Planktonic / Benthic**
Oscillatoria rubescens	De Candolle 1826	P
Oscillatoria tenuis	Agardh 1813	B
Phormidium lucidum	(C.Agardh) Kützing 1843	B

Phormidium luridum	(Kützing) Gomont 1892	B
Snowella lacustris	(Chodat) Komárek and Hindák 1988	P/B
Spirulina maior	Kützing ex Gomont 1892	P/B
Woronichinia naegeliana	(Unger) Elenkin 1933	P
EUGLENOPHYTA		
Euglena acus	(O.F.Müller) Ehrenberg 1830	P
Euglena ehrenbergii	Klebs 1883	P
Euglena elongata	Schewiakoff 1891	P
Euglena geniculata	F.Schmitz 1884	P
Euglena granulata	(Klebs) F.Schmitz 1884	P
Euglena limnophila	Lemmermann 1898	P
Euglena mutabilis	F.Schmitz 1884	P
Euglena oblonga	F.Schmitz 1884	P
Euglena oxyuris	Schmarda 1846	P
Euglena proxima	P.A. Dangeard 1901	P
Euglena repulsans	J. Schiller 1952	P
Euglena sociabilis	P.A.Dangeard 1901	P
Euglena spirogyra	Ehrenberg 1832	P
Euglena splendens	P.A.Dangeard 1901	P
Euglena texta	(Dujardin) Hubner 1886	P
Lepocinclis caudata	A.M. Cunha 1913	P
Lepocinclis fusiformis	(H.J.Carter) Lemmermann 1901	P
Lepocinclis playfairiana	Deflandre 1932	P
Lepocinclis steinii	Lemmermann 1901	P
Phacus acutus	Pochmann 1941	P
Phacus alatus	G.A.Klebs 1886	P
Phacus anomalus	F.E.Fritsch and M.F.Rich 1929	P
Phacus caudatus	Hübner 1886	P
Phacus circumflexus	Pochmann 1941	P
Phacus curvicauda	Svirenko 1915	P
Phacus elegans	Pochmann 1942	P
Phacus helicoides	Pochmann 1942	P
Phacus longicauda	(Ehrenberg) Dujardin 1841	P
Phacus nordstedtii	Lemmermann 1904	P
Phacus orbicularis	K.Hübner 1886	P
Phacus pusillus	Lemmermann 1910	P
Phacus suecicus	Lemmermann	P
Phacus triqueter	(Ehrenberg) Perty 1852	P
Strombomonas deflandrei	(Y.V.Roll) Deflandre 1930	P
Trachelomonas caudata	(Ehrenberg) Stein 1878	P
Trachelomonas planctonica	Svirenko 1914	P
PYRROPHYTA		
Gymnodinium cnecoides	T.M.Harris 1940	P
Gymnodinium triceratium	Skuja 1939	P
XANTHOPHYTA		
Goniochloris fallax	Fott 1960	P
Goniochloris mutica	(Braun) Fott 1960	P
Goniochloris smithii	(Bourrelly) Fott 1960	P
Ophiocytium capitatum	Wolle 1887	P/B
Ophiocytium parvulum	(Perty) A.Braun 1855	P/B
Pseudostaurastrum enorme	(Ralfs) R.Chodat 1921	P
GENERA		**Planktonic / Benthic**
BACILLARIOPHYTA		
Achnanthes	Bory de Saint-Vincent, 1822	B
Actinella	Lewis 1864	B

Anomoeoneis	E.Pfitzer, 1871	B
Cocconeis	Ehrenberg 1837	B
Cyclotella	Brebisson 1838	P/B
Diatoma	Bory de St-Vincent (1824)	P/B
Diploneis	(Ehrenberg) Cleve 1894	P/B
Encyonema	Kützing 1833	B
Melosira	Agardh 1824	P/B
Placoneis	Mereschkovsky, 1903	B
Staurosira	Ehrenberg, 1843	P/B
Stenopterobia	Brebisson ex Van Heurck, 1896	B
CHLOROPHYTA		
Actinochloris	Korschikov, 1953	P
Ankyra	Fott, 1957	P
Botryococcus	Kutzing 1849	P/B
Bulbochaete	Agardh 1817	B
Carteria	Diesing, 1866	P
Chilomonas	Ehrenberg ex Ralfs 1831	P
Chlamydocapsa	Fott 1972	P
Chlorella	Beijerinck 1890	P
Chlorococcum	Meneghini 1842	P
Cladophora	Kutzing 1843	B
Coccomixa	Schmidle 1901	P/B
Cylindrocapsa	Reinsch, 1867	B
Cylindrocystis	Meneghini ex De Bary, 1858	B
Dictyosphaerium	Nageli 1849	P/B
Didymogenes	Schmidle, 1905	P
Dimorphococcus	Braun 1855	P/B
Elakatothrix	Wille 1898	P
Eudorina	Ehrenberg 1832	P
Gonium	O.F. Muller, 1873	P
Haematococcus	Flotow, 1844	P
Hydrodictyon	Roth, 1797	B
Microspora	Thuret 1850	B
Mougeotia	C. Agardh, 1824	P
Nephrocytium	Nageli, 1849	P
Oedogonium	Link ex Hirn, 1900	P/B
Phacotus	Perty, 1852	P
Pteromonas	Seligo, 1887	P
Radiofilum	Schmidle, 1894	B
Sphaerocystis	Chodat, 1897	P/B
Sphaerozosma	Corda ex Ralfs, 1848	B
Spirogyra	Link, 1820	B
Spondylosium	Brebisson ex Kutzing, 1849	B
Stigeoclonium	Kutzing, 1843	B
Volvox	Linnaeus, 1758	P
Zygnema	Agardh 1817	B
CHRYSOPHYTA		
Chromulina	Cienkowsky 1870	P
Cystodinium	Klebs 1912	P
Dinobryon	Ehrenberg 1834	P
Synura	Ehrenberg 1834	P
Uroglena	Ehrenberg 1834	P
CHRYSOPHYTA		**Planktonic / Benthic**
Kephyrion	Pascher 1911	P
CRYPTOPHYTA		
Chilomonas	Ehrenberg, 1831	P

CYANOBACTERIA		
Calothrix	Agardh 1824	B
EUGLENOPHYTA		
Peranema	Dujardin, 1841	P
PYRROPHYTA		
Amphidinium	Claparède and Lachmann, 1859	P/B
Glenodinium	Ehrenberg 1836	P
Katodinium	Fott 1857	P/B
Peridiniopsis	Lemmermann, 1904	P
Peridinium	Ehrenberg, 1832	P
Woloszynskia	Thompson 1951	P
XANTHOPHYTA		
Centritractus	Lemmermann 1900	B
Tribonema	Derbès and Solier 1851	B

Table S2. List of all the algal taxa observed in the Everglades (asterisks indicate species also found in the Okavango Delta (main source of authorities: www.algaebase.org; information on planktonic / benthic mostly from Wehr J.D., Sheath R.G. & Kociolek J.P. (Eds). (2015). "Freshwater algae of North America. Ecology and classification". Academic Press, San Diego).

BACILLARIOPHYTA		
Species	**Authority**	**Planktonic / Benthic**
Achnanthes caledonica	Lange-Bertalot in Lange-Bertalot & Moser 1994	B
Achnanthes gracillima	Hustedt 1927	B
_Achnanthidium minutissimum_*	(Kützing) Czarnecki 1994	B
_Amphora ovalis_*	Kützing 1844	B
Amphora sulcata	Gregory 1854	B
Amphora coffaeiformis	(C.Agardh) Kützing	B
Amphora holsatica	Hustedt 1925	B
Amphora veneta	Kützing 1844	B
Anomoeoneis sphaerophora f. costata	(Kützing) A.-M.Schmid 1977	B
Bacillaria paxillifer	(O.F.Müller) T.Marsson 1901	B
Brachysira aponina	Kützing 1836	B
Brachysira brebissonii	R.Ross in Hartley 1986	B
Brachysira neoacuta	Lange-Bertalot 1994	B
Brachysira neoexilis	Lange-Bertalot in Lange-Bertalot & Moser 1994	B
Brachysira serians	(Brébisson) Round & D.G.Mann 1981	B
Caponea caribbea	A.C.Podzorski	B
Cocconeis placentula	Ehrenberg 1838	B
Cyclotella meneghiniana	Kützing 1844	P
Diadesmis confervacea	Kützing 1844	B
Diploneis oblongella	(Nägeli ex Kützing) Cleve-Euler in Cleve-Euler & Osvald 1922	B
Diploneis parma	Cleve 1891	B
Diploneis puella	(Schumann) Cleve 1894	B
Encyonema evergladianum	Krammer 1997	B
Encyonema silesiacum	(Bleisch) D.G.Mann in Round, Crawford & Mann 1990	B
Encyonema silesiacum var. elegans	Krammer	B
Encyonopsis floridana	Krammer	B
Encyonopsis microcephala	(Grunow) Krammer 1997	B
Encyonopsis subminuta	Krammer & E.Reichardt 1997	B
Eunotia camelus	Ehrenberg	B
_Eunotia flexuosa_*	(Brébisson ex Kützing) Kützing 1849	B
_Eunotia incisa_*	W.Smith ex W.Gregory 1854	B
Eunotia monodon	Ehrenberg 1843	B
_Eunotia naegelii_*	Migula 1907	B
Eunotia rabenhorstiana var. elongata	(Patrick) D.Metzeltin & Lange-Bertalot 1998	B
Eunotia zygodon	Ehrenberg 1843	B
Fragilaria minuscula	(Grunow) D.M.Williams & 1987	B
Fragilaria nana	Lange-Bertalot 1991	B
Fragilaria synegrotesca	Lange-Bertalot 1993	B
Fragilariformis virescens	(Ralfs) Williams & Round	B
_Frustulia rhomboides_* + _var. crassinervia_	(Ehrenberg) De Toni 1891 + (Brebisson) Ross 1947	B
Gomphonema affine	Kützing 1844	B
Gomphonema auritum	A.Braun ex Kützing 1849	B
Gomphonema coronatum	Ehrenberg 1840	B

BACILLARIOPHYTA		**Planktonic / Benthic**
Gomphonema cf. clavatulum	Ehrenberg 1832	B
Gomphonema gracile[*]	Ehrenberg 1838	B
Gomphonema intricatum var. vibrio	(Ehrenberg) Cleve 1894	B
Gomphonema maclaughlinii	Reichardt 1999	B
Gomphonema parvulum[*]	(Kützing) Kützing 1849	B
Gomphonema parvulum var. exilissimum	Grunow in van Heurck 1880	B
Gomphonema parvulum var. lagenula	(Kützing) Frenguelli	B
Gomphonema pratense	Lange-Bertalot & E.Reichardt	B
Gomphonema vibrioides	Reichardt & Lange-Bertalot 1998	B
Hantzschia amphioxys[*]	(Ehrenberg) Grunow	B
Lemnicola hungarica	(Grunow) F.E.Round & P.W.Basson 1997	B
Mastogloia braunii	Grunow 1863	B
Mastogloia lanceolata	Thwaites ex W.Smith 1856	B
Mastogloia smithii	Thwaites ex W.Smith 1856	B
Mastogloia smithii var. lacustris	Grunow 1878	B
Navicella pusilla	Krammer 1997	B
Navicula constans	Hustedt 1944	B
Navicula constans var. symmetrica	Hustedt 1957	B
Navicula cryptocephala[*]	Kützing 1844	B
Navicula cryptotenella[*]	Lange-Bertalot in Krammer and Lange-Bertalot 1985	B
Navicula palestinae	Gerloff 1978	B
Navicula radiosa[*]	Kützing 1844	B
Navicula radiosafallax	Lange-Bertalot 1993	B
Navicula salinicola	Hustedt 1939	B
Navicula subtilissima	Cleve 1891	B
Nitzschia amphibia	Grunow 1862	B
Nitzschia amphibia f. frauenfeldii	(Grunow) Lange-Bertalot 1987	B
Nitzschia filiformis	(W.Smith) Hustedt 1896	B
Nitzschia lacunarum	Hustedt 1930	B
Nitzschia nana	Grunow in van Heurck 1881	B
Nitzschia palea	(Kützing) W.Smith 1856	B
Nitzschia palea var. debilis	(Kützing) Grunow 1880	B
Nitzschia serpentiraphe	Lange-Bertalot 1993	B
Pinnularia acrosphaeria	W.Smith 1853	B
Pinnularia braunii[*]	(Grunow) Mills 1934	B
Pinnularia gibba[*]	Ehrenberg 1843	B
Pinnularia microstauron	(Ehrenberg) Cleve 1891	B
Pinnularia viridis[*]	(Nitzsch) Ehrenberg 1843	B
Pinnularia stomatophora	(Grunow) Cleve 1895	B
Pinnularia streptoraphe	Cleve 1891	B
Placoneis porifera var. opportuna	Novelo et al. 2007	B
Planothidium frequentissimum	(Lange-Bertalot) Round & Bukhtiyarova 1996	B
Pleurosigma salinarum	(Grunow) Grunow in Cleve & Grunow 1880	B
Pseudostaurosira brevistriata	Grunow in Van Heurck 1885	B
Rhopalodia gibba[*]	(Ehrenberg) O. Müller (1895)	B
Rossithidium lineare	(W. Smith) Round & Bukhtiyarova 1996	B
Sellaphora laevissima	(Kützing) D.G.Mann 1989	B
Sellaphora pupula[*]	(Kützing) Mereschkovsky 1902	B
Stauroneis phoenicenteron[*]	(Nitzsch) Ehrenberg 1843	B
Stenopterobia curvula	(W.Smith) Krammer in Lange-Bertalot & Krammer 1987	B

BACILLARIOPHYTA		**Planktonic / Benthic**
Stauroneis pachycephala	Cleve 1881	B
Synedra filiformis	Cleve-Euler	B
Synedra ulna	(Nitzsch) Ehrenberg 1832	P/B
CHLOROPHYTA		
Cosmarium amoenum	Brébisson ex Ralfs 1848	P/B
Cosmarium calcareum	Wittrock 1872	P/B
Cosmarium commissurale	Brébisson ex Ralfs 1848	P/B
*Cosmarium contractum**	Kirchner 1878	P/B
*Cosmarium cf. depressum**	(Nägeli) P.Lundell 1871	P/B
Cosmarium excavatum	Nordstedt 1870	P/B
Cosmarium panamense	Prescott	P/B
Cosmarium phaseolus	Brébisson ex Ralfs 1848	P/B
*Cosmarium pyramidatum**	Brébisson ex Ralfs 1848	P/B
*Cosmarium cf. regnesii**	Reinsch 1867	P/B
*Cosmarium reniforme**	(Ralfs) W. Archer 1874	P/B
Cosmarium inaequalis		P/B
Cosmarium isthmium	West 1890	P/B
*Cosmarium monomazum**	P.Lundell 1871	P/B
*Cosmarium obsoletum**	(Hantzsch) Reinsch 1867	P/B
Cosmarium ocellatum	Eichler & Gutwinski 1894	P/B
Cosmarium smolandicum	Lundell 1871	P/B
Crucigenia quadrata	Morren 1830	P/B
Desmidium aptogonum	Brébisson ex Kützing 1849	P/B
Desmidium baileyi	(Ralfs) Nordstedt 1880	P/B
Desmidium swartzii	C.Agardh ex Ralfs 1848	P/B
Euastrum cornubiense	West & G.S.West 1905	P/B
*Euastrum pectinatum**	Brebisson ex Brebisson in Ralfs 1848	P/B
Genicularia elginensis		P/B
*Micrasterias crux-melitensis**	(Ehrenberg) Trevisan 1842	P/B
Micrasterias floridana / floridae		P/B
Micrasterias pinnatifida	Ralfs 1848	P/B
*Pediastrum simplex**	Meyen 1829	P
*Pediastrum tetras**	(Ehrenberg) Ralfs 1844	P
Pleurotaenium minutum var. attenuatum	(Ralfs) Hilse 1866	B
Pleurotaenium minutum var. excavatum	(Ralfs) Hilse 1866	B
*Scenedesmus arcuatus**	Lemmermann 1899	P
*Scenedesmus armatus**	(Chodat) R.Chodat 1913	P
Scenedesmus bijuga	(Turpin) Lagerheim 1893	P
*Scenedesmus serratus**	(Corda) Bohlin 1901	P
Staurastrum alternans	Brébisson in Ralfs 1848	P/B
Staurastrum connatum	(P.Lundell) J.Roy & Bisset 1886	P/B
Staurastrum cyathipes	Scott & Grönblad 1957	P/B
Staurastrum dejectum	Brébisson in Ralfs 1848	P/B
Staurastrum depressum	(C.W.Nägeli) W.B.Turner	P/B
Staurastrum disputatum	West & G.S.West 1912	P/B
*Staurastrum excavatum**	West and G.S.West 1895	P/B
Staurastrum grallatorium	Nordstedt 1870	P/B
Staurastrum longebrachiatum	(Borge) Gutwinski	P/B
Staurastrum ophiurum f. cambriatum		P/B
Staurastrum pinnatum	W.B.Turner	P/B

CHLOROPHYTA		**Planktonic / Benthic**
Staurastrum cf. sonthalium	W.B.Turner	P/B
_Tetraedron caudatum_*	(Corda) Hansgirg 1888	P
_Tetraedron minimum_*	(A.Braun) Hansgirg 1888	P
Tetraedron pentaedricum	West & G.S.West 1895	P
CYANOBACTERIA		
Rhabdoderma sigmoideum	G.T.Moore & N.Carter 1923	P
Rhabdoderma lineare	Schmidle & Lauterborn in Schmidle 1900	P
EUGLENOPHYTA		
_Phacus orbicularis_*	K.Hübner 1886	P
GENERA		
BACILLARIOPHYTA		
Genus	**Authority**	
_Caloneis_*	Cleve, 1894	B
Coscinodiscus	Ehrenberg, 1839	P
Fragilariforma	D.M.Williams & Round, 1988	B
Parlibellus	E.J.Cox, 1988	B
Thalassiosira	Cleve, 1873	P
CHLOROPHYTA		
_Ankistrodesmus_*	Corda, 1838	P
_Bulbochaete_*	Agardh 1817	B
_Centritractus_*	Lemmermann 1900	B
Characium	A. Braun in Kützing, 1849	B
_Closterium_*	Nitzsch ex Ralfs, 1848	B
_Coelastrum_*	Nägeli, 1849	B
_Desmidium_*	C.Agardh ex Ralfs, 1848	P/B
_Dimorphococcus_*	Braun 1855	P
Gloeocystis	Nägeli, 1849	P
Gloeotaenium	Hansgirg, 1890	P/B
_Gonatozygon_*	De Bary, 1858	P/B
_Hyalotheca_*	Ehrenberg ex Ralfs, 1848	P/B
_Kirchneriella_*	Schmidle, 1893	P/B
_Mougeotia_*	C. Agardh, 1824	B
_Oedogonium_*	Link ex Hirn, 1900	B
Onychonema	Wallich, 1860	P/B
_Oocystis_*	Nägeli ex A.Braun, 1855	P/B
_Ophiocytium_*	Nägeli, 1849	P/B
Palmodictyon	Kützing, 1845	P/B
Quadrigula	Printz, 1916	P
_Spirogyra_*	Link, 1820	B
_Spondylosium_*	Brebisson ex Kutzing, 1849	B
Stigeoclonium	Kutzing, 1843	B
_Teilingia_*	Bourrelly, 1964	P/B
_Triploceras_*	J.W.Bailey, 1851	B
CHRSYOPHYTA		
_Dinobryon_*	Ehrenberg, 1834	P
Lagynion	Pascher, 1912	B
CYANOBACTERIA		
_Anabaena_*	Bory de Saint-Vincent ex Bornet & Flahault, 1886	P/B
Aphanothece	C.Nägeli, 1849	B

CYANOBACTERIA		**Planktonic / Benthic**
Aphanocapsa	C.Nägeli, 1849	B
Chroococcidiopsis	Geitler, 1933	B
Chroococcus[*]	Nägeli, 1849	P/B
Coelosphaerium[*]	Nageli 1849	P
Dactylococcopsis	Hansgirg, 1888	P
Fischerella	(É.Bornet & C.Flahault) M.A.Gomont, 1895	B
Gloeocapsa[*]	Kutzing 1843	P/B
Gloeothece	C.Nägeli, 1849	B
Gomphosphaeria[*]	Kutzing 1836	P
Johannesbaptistia	G.De Toni, 1934	P/B
Lyngbya[*]	C.Agardh ex Gomont, 1892	B
Merismopedia[*]	F.J.F.Meyen, 1839	P
Microchaete	G.Thuret ex É.Bornet & C.Flahault, 1886	B
Microcystis[*]	Lemmermann 1907	P
Oscillatoria[*]	Vaucher ex Gomont, 1892	P/B
Schizothrix	F.T.Kützing ex M.Gomont, 1892	B
Scytonema[*]	C. Agardh ex Bornet and Flahault, 1886	P/B
Spirulina[*]	P.J.F.Turpin ex M.Gomont, 1892	P/B
Stigonema[*]	C. Agardh ex Bornet and Flahault, 1886	B
PYRROPHYTA		
Peridinium[*]	Ehrenberg, 1832	P
XANTOPHYTA		
Stipitococcus sp.	West & G.S. West, 1898	B

Table S3. Results of the Monte Carlo significance tests on the indicator taxa identified (in bold, the algal taxa retained in the final list, see Table 5).

Taxon	Indicator Value	Mean	Standard deviation	p-value
OKAVANGO				
COMPETITIVE				
Amphora sp.	64.4	48.1	5.80	0.0126
Eunotia flexuosa	75.0	46.3	5.92	0.0002
Eunotia praerupta	42.9	15.2	4.95	0.0004
Eunotia serra	19.0	8.7	3.66	0.0282
Frustulia rhomboides	28.4	13.1	4.81	0.0050
Frustulia saxonica	19.0	8.9	3.78	0.0300
Frustulia sp.	56.4	23.9	6.03	0.0002
Micrasterias foliacea	19.0	9.7	3.80	0.0320
Stauroneis phoenicenteron	46.4	31.5	6.83	0.0344
RUDERAL				
Amphidinium sp.	40.7	18.1	5.52	0.0018
Aulacoseira ambigua	29.6	15.2	5.39	0.0136
Aulacoseira granulata	33.3	15.3	5.04	0.0072
Botryococcus sp.	44.9	24.2	6.50	0.0042
Bulbochaete sp.	37.2	22.2	5.44	0.0180
Caloneis bacillum	29.6	14.1	4.81	0.0176
Chlamydomonas sp.	41.4	27.5	6.81	0.0434
Chlorococcum sp.	70.3	44.0	6.24	0.0004
Chlorococcales	29.6	17.1	5.41	0.0180
Chroococcus sp.	56.9	38.7	5.98	0.0100
Closterium acicularis	38.6	19.8	5.81	0.0060
Closterium acutum	29.6	14.2	4.91	0.0146
Closterium gracile	25.9	13.4	5.03	0.0324
Closterium incurvum	37.0	16.7	5.35	0.0022
Closterium leiblenii	33.3	15.5	5.19	0.0080
Coelastrum sp.	45.1	27.9	5.78	0.0110
Colony	27.7	15.3	5.02	0.0276
Cosmarium contractum	22.2	11.6	4.42	0.0486
Cosmarium obsoletum	22.2	11.3	4.20	0.0332
Cosmarium pseudopyramidatum	22.2	11.3	4.26	0.0440
Cosmarium regnesii	29.6	13.9	4.80	0.0152
Cosmarium trilobulatum	29.6	14.0	4.81	0.0158
Crucigeniella crucifera	25.9	12.7	4.53	0.0256
Elakatothrix sp.	37.4	23.4	5.39	0.0180
Eremosphaera sp.	22.2	11.3	4.21	0.0342
Eremosphaera viridis	22.2	11.3	4.23	0.0366
Euastrum bidentatum	33.3	17.4	5.06	0.0116
Euastrum binale	32.0	17.6	5.27	0.0188
Euastrum denticulatum	33.3	15.1	4.82	0.0046
Euastrum elegans	29.6	14.0	4.77	0.0130
Euastrum sp.	69.4	51.3	4.87	0.0014
Euglena limnophila	25.9	13.0	4.78	0.0260
Euglena proxima	31.5	17.2	5.53	0.0190
Eunotia naegellii	38.4	22.2	6.50	0.0192
Gomphonema lanceolata	29.5	17.9	5.37	0.0448
Gomphonema parvulum	57.3	34.8	6.99	0.0054
Goniochloris sp.	54.0	26.6	5.66	0.0006

Taxon	Indicator Value	Mean	Standard deviation	p-value
Hyalotheca sp.	22.2	11.5	4.35	0.0458
Kirchneriella irregulare	33.3	15.1	4.76	0.0052
Kirchneriella obesa	39.3	19.9	5.34	0.0030
Lyngbya sp.	33.3	15.3	5.00	0.0082
Melosira sp.	29.6	14.8	5.31	0.0150
Merismopedia sp.	44.7	22.2	6.16	0.0024
Micrasterias pinnatifida	37.0	16.5	5.16	0.0032
Micrasterias truncata	22.2	11.3	4.28	0.0474
Monoraphidium minutum	49.3	35.0	6.39	0.0344
Monoraphidium pusillum	38.7	21.2	5.56	0.0126
Neidium sp.	33.3	15.2	4.97	0.0068
Oocystis sp.	57.0	44.3	6.25	0.0436
Pediastrum angulosum	28.3	15.6	5.19	0.0350
Pediastrum boryanum	53.1	36.6	6.04	0.0154
Pediastrum duplex	29.6	15.0	5.27	0.0160
Peridinium sp.	38.3	21.8	6.02	0.0150
Phacus pusillus	56.1	25.0	6.06	0.0006
Phacus sp.	66.8	41.9	5.98	0.0012
Pinnularia subcapitata	25.9	12.9	4.77	0.0306
Pleurotaenium trabecula	33.3	15.4	4.95	0.0066
Rhodomonas lacustris	34.0	18.3	5.66	0.0146
Scenedesmus alternans	25.9	12.7	4.68	0.0270
Scenedesmus arcuatus	58.5	38.5	5.76	0.0040
Scenedesmus falcatus	68.4	32.8	7.00	0.0004
Scenedesmus maximum	22.2	11.3	4.30	0.0386
Scenedesmus obtusus	29.6	13.9	4.78	0.0134
Scenedesmus planctonicum	29.6	13.9	4.53	0.0164
Scenedesmus serratus	26.9	15.3	4.98	0.0390
Selenastrum sp.	40.5	26.6	5.61	0.0240
Sphaerocystis sp.	25.9	14.1	4.99	0.0330
Staurastrum furcatum	42.1	22.3	6.14	0.0064
Staurastrum margaritaceum	25.9	12.8	4.64	0.0276
Staurastrum tetracerum	29.6	14.1	4.88	0.0166
Staurodesmus convergens	29.6	14.1	4.86	0.0182
Staurodesmus dickiei	22.2	11.3	4.24	0.0430
Staurodesmus subulatus	32.0	19.8	5.25	0.0340
Stenopterobia sp.	25.9	12.8	4.63	0.0290
Teilingia granulata	25.9	12.9	4.73	0.0278
Tetraedron caudatum	37.0	16.3	4.89	0.0032
Tribonema sp.	46.2	25.2	6.57	0.0044
EVERGLADES				
COMPETITIVE				
Cosmarium calcareum	34.6	16.6	5.56	0.0138
Cosmarium ocellatum	26.4	14.4	5.36	0.0400
Cosmarium phaseolum	27.7	15.8	5.44	0.0402
Cosmarium pyramidatum	42.6	14.9	5.52	0.0042
Cosmarium sp.	40.9	28.2	4.77	0.0234
Encyonopsis ftsp02	41.7	29.0	4.27	0.0162
Encyonema subminuta	30.0	9.3	4.70	0.0064
Eunotia flexuosa	21.7	10.2	4.83	0.0358
***Oedogonium sp.* (small)**	43.3	25.9	5.32	0.0134
Pediastrum tetras	15.2	7.6	4.19	0.0496

Taxon	Indicator Value	Mean	Standard deviation	p-value
Scenedesmus bijuga	20.7	7.7	4.41	0.0282
Staurastrum cyathipes	23.8	9.5	5.00	0.0264
Staurastrum excavatum	42.2	24.8	5.76	0.0158
Staurastrum longebrachiatum	39.0	10.9	5.12	0.0022
Tetraedron minimum	40.1	16.6	5.33	0.0050
STRESS-TOLERANT				
Nitzschia serpentiraphe	34.4	24.0	4.88	0.0416
RUDERAL				
Brachysira brebissonii	35.7	13.1	5.74	0.0094
Brachysira neoacuta	18.6	8.2	4.43	0.0330
Brachysira serians	18.7	8.5	4.66	0.0372
Bulbochaete (filament)	31.6	19.5	5.22	0.0366
Cosmarium inaequalis	18.5	8.1	4.49	0.0384
Diploneis parma	33.1	18.1	5.37	0.0264
Encyonopsis microcephala	39.9	28.9	4.17	0.0224
Eunotia incisa	25.3	7.7	4.45	0.0126
Eunotia monodon	35.3	6.4	3.82	0.0004
Eunotia naegellii	32.0	12.5	5.29	0.0114
Fischerella sp.	25.0	13.5	5.30	0.0384
Fragilaria nana	45.0	25.3	5.63	0.0124
Frustulia rhomboides var. crassinervia	26.8	10.0	4.91	0.0156
Gomphonema intricatum var. vibrio	35.3	23.3	5.54	0.0380
Johannesbaptista sp.	34.4	11.2	4.95	0.0054
Lagynion sp.	26.9	9.5	4.82	0.0118
Mastogloia sp.	11.9	3.4	2.91	0.0270
Micrasterias crux-melitensis	11.8	4.5	3.06	0.0290
Nitzschia amphibia	38.9	17.7	5.50	0.0090
Nitzschia nana	28.0	11.1	5.17	0.0148
Pinnularia gibba	17.4	7.6	4.42	0.0378
Pinnularia microstauron	23.9	7.6	4.23	0.0122
Pinnularia (large)	17.2	5.8	3.79	0.0230
Pinnularia sp.	19.9	6.2	3.79	0.0096
Stauroneis phoenicenteron	22.3	5.0	3.51	0.0060
Unknown girdle	49.8	10.6	4.98	0.0002
Unknown alga	17.5	7.5	4.35	0.0418
STRESS / DISTURBANCE TOLERANT				
Scytonema sp. **(light brown)**	44.3	24.9	5.48	0.0106