Carbon, nitrogen, and biogenic silica concentrations in *Cyperus papyrus* in the permanent swamp of the Okavango Delta, Botswana

PAPYRUS AND ITS NUTRIENTS 1

Papyrus is an aquatic sedge that dominates the Okavango Delta, southern Africa's greatest wetland. Research on nutrient concentrations is limited, so this study provides new knowledge on the topic. Total nitrogen (TN), total organic carbon (TOC), and biogenic silica (BSi) concentrations were measured. The analysis considers four different factors: the part of the plant, the age of the plants, the sampling area, and the stages of the flood pulse. The major hypotheses that are tested in this study are:

1. Is TN content in younger plants higher than in more mature plants?
2. Are TN and TOC contents higher during high flood than during flood recession?
3. Are TN and TOC contents higher in plants harvested on the channel margins compared to the backswamps?
4. Is BSi content higher in mature plants as compared to juvenile plants?

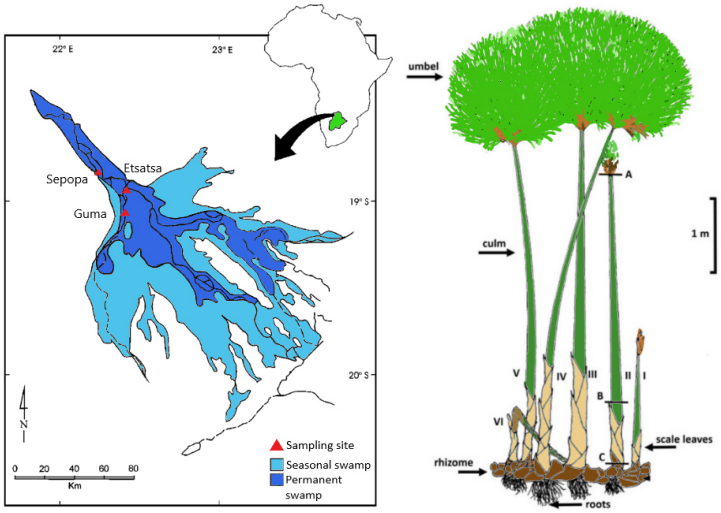

Figure 1. Map of the Okavango Delta with sample sites (on the left, modified from Christison et al. (2005, fig. 1)) and the organs and growth stages of papyrus (on the right, modified from Muthuri & Kinyamario (1989, fig. 1)).

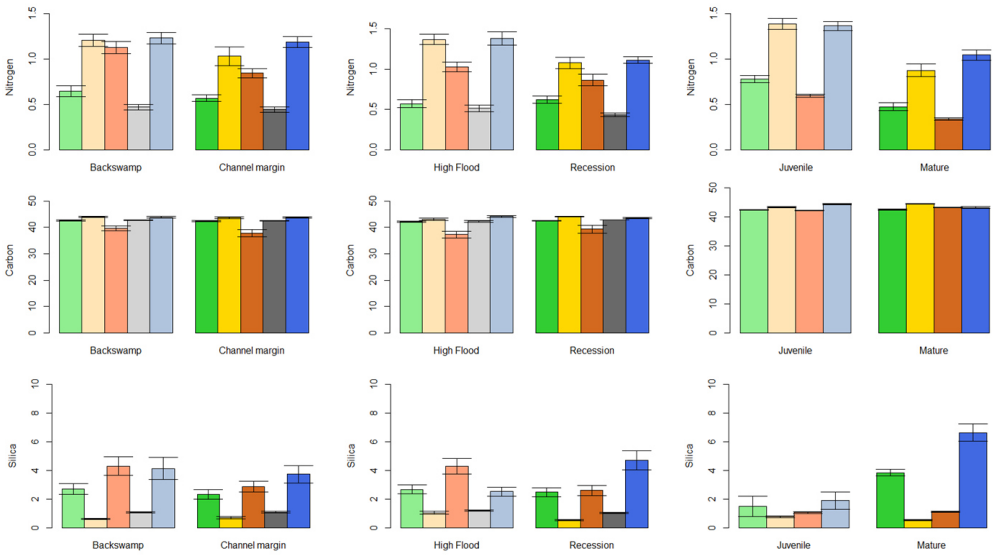

Figure 2. Bar plots representing the data analysed with the two-way ANOVA on nitrogen, carbon, and biogenic silica. Starting from the left, TN, TOC, and BSi concentrations in the different parts of papyrus and their environment are shown; in the centre, TN, TOC, and BSi concentrations in the different parts of the plant during the two flood periods; on the right, TN, TOC, and BSi concentrations in the different parts of the plant (except roots) and their age. Green represents umbels, yellow represents culms, brown represents scales, grey represents roots, and blue represents rhizomes.

METHODS 2

261 samples from papyrus plants were collected at three study sites in the Panhandle region: Sepopa, Guma, and Etsatsa (Fig. 1).

- TN and TOC were measured with a Costech ECS 4010. Subsamples were packed in tin capsules and combusted at 1700-1800°C. The measurements were calibrated with a 5-point calibration curve.
- BSi was measured with a Smartchem 200. Subsamples were digested and analysed for dissolved silicon (DSi) with an automated molybdate-blue method.
- Statistical analyses (*T*-Tests and ANOVA; Fig. 2) were used to investigate if there were differences in TN, TOC, and BSi.

RESULTS 3

- The highest TN concentrations were found in umbels, rhizomes, and roots. Umbels function as both a photosynthetic organ and an inflorescence; rhizomes act as a storage for nutrients; and roots have been found to be colonized by N2-fixing bacteria. TN concentrations in juvenile organs were higher than in mature ones because of the higher productivity of young plants and to the active translocation and recycling of nutrients in the first stages of growth. The environment does not seem to influence TN concentrations, however, during high flood periods there was a higher TN amount in papyrus.
- TOC concentrations were between 39-43%, the highest in umbels and rhizomes and the lowest in the roots. Statistical analyses on TOC concentrations on the environments and the flood periods were not significant.
- The highest BSi concentrations were found in mature organs since silica is accumulated into the plant throughout its life. BSi was not uniformly distributed among the different organs, possibly because of a passive transport of DSi through the transpiration system. The environment does not seem to influence BSi in papyrus. However, BSi in rhizomes was twice as high during high flood periods than during flood recession.

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References:
Christison, K.W., Shinn, A.P., & Van As, J.G. (2005). Gyrodactylus thlapi n. sp (Monogenea) from Pseudocrenilabrus philander philander (Weber) (Cichlidae) in the Okavango Delta, Botswana. Systematic Parasitology, 60(3), 165-173.
Muthuri, F.M., & Kinyamario, J.I. (1989). Nutritive value of papyrus (Cyperus papyrus, Cyperaceae), a tropical emergent macrophyte. Economic Botany, 43(1), 23-30.