

## ***Interactive comment on “Unusually negative nitrogen isotopic compositions ( $\delta^{15}\text{N}$ ) of mangroves and lichens in an oligotrophic, microbially-influenced ecosystem” by et al.***

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Review of Fogel et al. - Unusually negative nitrogen isotopic compositions ( $\delta^{15}\text{N}$ ) of mangroves and lichens in an oligotrophic, microbially-influenced ecosystem.

General comments

This paper presents an extensive dataset on the nitrogen stable isotope composition of mangroves, lichens and potential N sources for these producers from a mangrove system where distinctly low  $\delta^{15}\text{N}$  signatures have been previously reported for mangroves. The authors reasonably argue that ammonia from the atmosphere and in rainwater are likely important N sources, and that the  $\delta^{15}\text{N}$  signatures observed in mangrove leaves

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reflect a balance between these N sources and N uptake from sediment porewaters. This balance is also demonstrated to be governed by the availability of P in this P-limited system. The paper is a nice contribution to our understanding of N cycling in mangrove systems, and relevant more generally for our understanding of N isotope patterns in vegetation and its utility to understand ecosystem nutrient cycling. I recommend publication in Biogeosciences, although the ms. could be improved if a number of issues are clarified - I have listed some questions and suggestions below.

### Specific comments

#### Introduction

The introduction could benefit from introducing more specifically how the d15N signatures reported here compare to d15N data from other mangrove (or terrestrial forest) systems. Besides the work by Fry et al. (1999, cited in the ms) and earlier data from some of the authors of this ms, a number of other studies have also reported negative d15N signatures in mangrove leaf tissues (France 1998, Muzuka & Shunula 2006), although the majority of data are indeed in the 0-10 per mil range.

France, R., 1998. Estimation the assimilation of mangrove detritus by fiddler crabs in Laguna Joyuda, Puerto Rico, using dual stable isotopes. *J. Trop. Ecol.* 14, 413-425.

Muzuka, A.N.N., Shunula, J.P., 2005. Stable isotope compositions of organic carbon and nitrogen of two mangrove stands along the Tanzanian coastal zone. *Estuar. Coast. Shelf Sci.* 66, 447-458.

Similarly, it might be relevant to include some literature data on d15N in lichens: are these values similar to those in other systems ? For mangrove systems, d15N values as low as -8.2 have also been reported for epiphyte crusts on mangroves from India, Sri Lanka and Kenya (Bouillon et al. 2004, *MEPS* 278: 77-88). There should be other d15N data on lichens in the literature, e.g. in:

Huiskes et al. (2006) Stable isotope ratios as a tool for assessing changes in carbon

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and nutrient sources in Antarctic terrestrial ecosystems. *Plant Ecology* 182: 79-86.

## Materials and Methods

P 942, section 2.2 Fertilization experiments: 12 R. mangle trees are mentioned to be used in a P fertilization experiment: 3 as controls, 3 with P addition adjacent to prop roots, and 3 with P addition at distance from the prop roots. What about the other 3.. ? The data in Figure 4 suggest that there was also a treatment where P was applied on the leaves; if so this should be mentioned and resulting data discussed. P949 L2-5 mentions an increase in d15N in "all P treatments", but here also only direct root application and distant root application are specified.

Sections 2.4 and 2.5 : I would not mind seeing some additional details on both methodologies, overall reproducibility, and pitfalls if any. For example, can a certain degree of fractionation be expected in the methods used here to trap ammonia from the atmosphere or from porewater solutions ?

Section 2.6: here also, an estimate of the reproducibility on these flux measurements would be nice.

## Results

P944, line 21-22: to be consistent with the rest of the paragraph, the reported ranges in d13C and d15N should give the most negative values first.

P945 L 25: "floc zone": this term is used here for the first time but never really explained except in the caption of Table 5. I would introduce this term earlier in the ms.

Section 4 "P and N concentrations and ratios": I assume this should be section 3.4. Also, this paragraph does not mention any data on N concentrations in either leaves or sediment, nor P concentrations in sediments. Also in this section: to be consistent, mention number of data in all cases where averages and stdev's are reported.

## Discussion

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- Although obviously not the primary focus of this ms, the d13C data deserve some discussion as well.

- The authors have good arguments to link d15N in mangrove leaves in this system (and thus, the relative importance of foliar N uptake vs. root uptake) to P availability, but the possible mechanism(s) explaining such a link is/are not really articulated, only in the last sentence of the Discussion where it is suggested that the larger belowground energy allocation in plants that are not P-limited may be responsible. Would a less extensive root systems really limit N uptake from porewaters ? Is there any relevant information from other forest ecosystem types ?

### Tables and Figures

Table 1: "Recruits": not clear in which zone these were collected.

Table 6: why would rain on Twin Cays and Carrie Bow have such distinct d15N signatures ? Also, not clear how to fit in the reported value for the ammonium standard; this is not mentioned in the Materials and Methods. Are the reported values for ammonia+ammonium in air, rain and porewaters not corrected using this standard ?

Figure 1 and 2: Not entirely clear to me whether the data for R. mangle should be the same in both Figures or not. There are clearly some data on R. mangle in Figure 1 which are not in Figure 2, and vice versa. Data in Fig. 2 but not in Fig. 1 suggests that Figure 2 includes data from fertilization experiments ? But why do some data appear in Figure 1 but not in Figure 2 ?

Figure 4: see earlier comment re. P fertilization through a "foliar spray". Also, the values plotted are averages, I assume - why not plot error bars as well ?

Figure 5: check units for Y axis, not very clear. This plot presents the time course of NH<sub>3</sub> concentrations, I assume. There appear to be large differences over time in the actual rate of NH<sub>3</sub> emissions - how should we interpret the average and range of fluxes mentioned in the text (e.g. p947 lower paragraph) ?

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Figure 7: - "Diagrammatic scheme" : I would settle for either scheme or diagram - nitrogen isotope pathways: perhaps reword.

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