Carbon cycling in contrasting pristine bogs in southern Patagonia (Tierra del Fuego, Argentina)

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Contrasting Bog Ecosystems?

cushion bog

Sphagnum bog

C dynamics?

precipitation, wind force, sea spray → distance from coast

Results 1 → Plant Macrofossils

- *Sphagnum* cores dominated almost exclusively by one *Sphagnum* species, *S. magellanicum*
- cushion peat in *Astelia* lawn core underlaid by *Sphagnum*
- vegetation shift associated with ash layer
- ash layer found in depths corresponding to 1.5 ka BP

→ change in vegetation initiated by ash coverage of the bog surface?

Results 3 → Decomposition Patterns

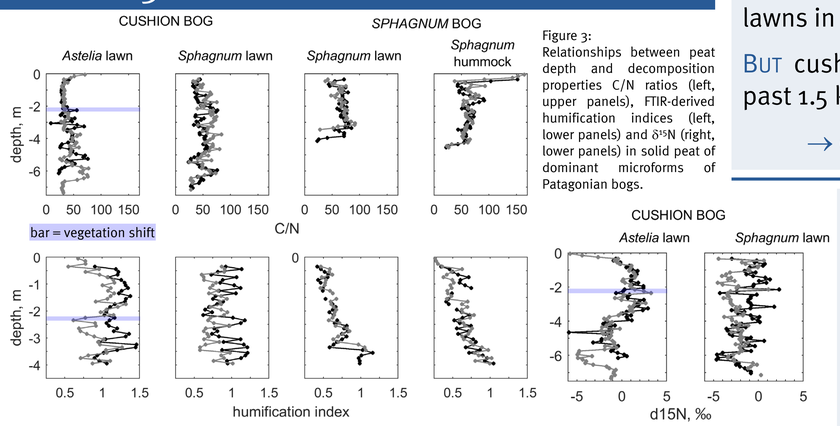

Figure 3: Relationships between peat depth and decomposition properties C/N ratios (left, upper panels), FTIR-derived humification indices (left, lower panels) and $\delta^{15}N$ (right, lower panels) in solid peat of dominant microforms of Patagonian bogs.

Background & Objectives

South Patagonian Peatlands

- cover a wide range of the southern terrestrial area
- have been accumulating organic material since the last deglaciation (~ 15 ka; 1 ka = 1000 calibrated years before present)
- can be either dominated by *Sphagnum* mosses or cushion-building vascular plants such as *Astelia pumila* or *Donatia fascicularis*
- are – unlike many northern hemisphere bogs – virtually unaffected by human activities

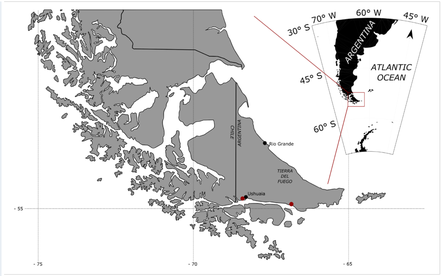

Figure 1: Study sites in Tierra del Fuego.

→ Patagonian bogs provide excellent examples to study the functioning of pristine bogs.

But little attention has been given to these carbon reservoirs.

We aimed to understand variations in carbon cycling and...

- reconstructed the local vegetation development
- determined (changes in) long-term accumulation rates
- evaluated peat decomposition properties

Methods

8 cores were taken in two bogs

- cushion bog:
  Astelia lawn (cushion plant) & *Sphagnum* lawn (specific to the southern hemisphere)
- *Sphagnum* bog:
  Sphagnum lawn & *Sphagnum* hummock (counterparts to northern hemisphere bogs)

Laboratory Analyses

- ^{14}C dating of 4 - 5 samples per core
- C/N ratio, stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$)
- Fourier-Transformed-Infrared Spectroscopy (FTIR)

+ determination of plant macrofossils
+ age-depth modelling applying software routine Bacon

Results 2 → Accumulation Rates

Compared to the *Sphagnum* bog, the cushion bog...

- initiated during early Holocene (around 10 ka BP vs. 6 ka BP)
- accumulated more C in dense and decomposed cushion peat (∅ 550 kg m^{-2} vs. 360 kg m^{-2} total C)
- accumulated C at higher rates (35 g C m^{-2} yr^{1} vs. 31 g C m^{-2} yr^{1})

And recent (past 1.5 ka BP) accumulation rates were highest in cushion lawns of the cushion bog (40 g C m^{-2} yr^{1} vs. 30 g C m^{-2} yr^{1} *Sphagnum* lawns in cushion bog).

But cushion lawns accumulated lowest proportion of total C during past 1.5 ka BP

→ explainable by accelerated C turnover by vascular plants?

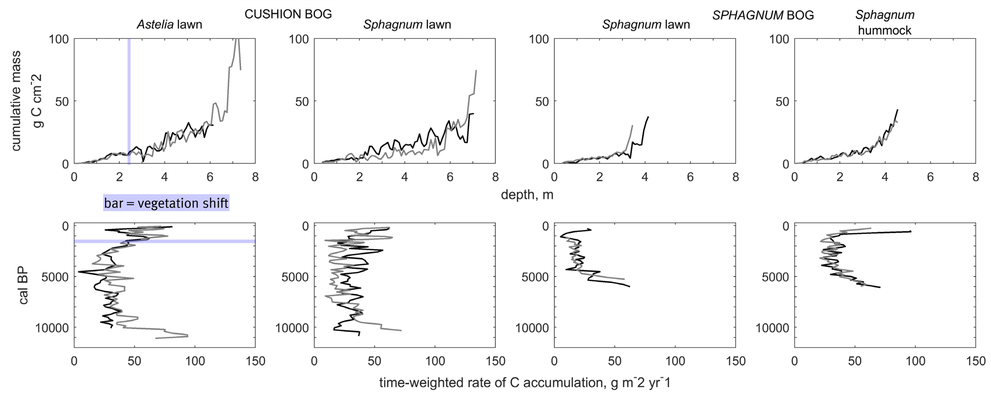

Figure 2: Relationships between peat depth and cumulative C mass (upper panels) as well as long-term C accumulation rates and age (lower panels) in dominant microforms of Patagonian bogs.

- *Sphagnum* bog showed similar decomposition patterns to those known from northern bogs
- cushion peat highly decomposed in upper profile (while C accumulation continues)
- Peat in all cushion bog cores does not show typical trend of a with depth increasing decomposition degree

→ Gross rate of peat accumulation did not remain constant over time?

Conclusions

→ C input trough biomass productivity by the vascular plant *A. pumila* balances enhanced decomposition by root activity

→ Total C contents of Patagonian bogs remarkably higher compared to northern peatlands of e.g. 130 kg C m^{-2} (Gorham 1991)

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References:
Gorham 1991, Ecological Applications
Map generated in Matlab and at simplemappr accessed on 11.12.17

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