Decomposition rate in different successional stages in mires

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Abstract

Development of fens to bogs is accompanied by the invasion of Sphagnum species. The purpose of this study was to compare the decomposition rate in fens influenced by the transition from a calcitorerant Sphagnum species (*Sphagnum warstorfii* and *S. teres*) to calcicole *Sphagnum* species (*Sphagnum flexuosum* and *S. palustre*). We carried out a tea bag experiment, using TBI (Tea Bag Index) method in a fens dominated by *Sphagnum* species from different successional stages. Decomposition rate was measured after 3, 6 and 12 months.

Decomposition rate was highest for the green tea bags and lowest for the rooibos tea bags. There was a significant difference between site with *S. warnstorfii* and *S. palustre*. The decomposition in *S. palustre* site was significantly lower than in *S. warnstorfii* site. Our results show that in early successional stages the decomposition rate is higher than in late successional stages.

Keawords: Sphagnum, Rooibos, Green, Tea, TBI

Introduction

Low decomposition rates, rather than high production rates, are the major cause of carbon accumulation in peatlands (Clymo & Hayward 1982). Changes in dominant plant species may change rates of plant production and decomposition and consequently, carbon and nutrient cycles and accumulation rates may be altered (Scheffer et al. 2001). In last decades the ongoing process of succession was triggers by increased nutrient availability, what results in shift of plants communities (Kooijman 2012; Hájek et al. 2015; Navrátilová et al. 2017). The most notable shift is being in the bryophyte layer. This shift took place in Netherlands where pristine fens typically occupied with brown mosses where colonized by *Sphagnum subnitens* (calcicole species) and later by *S. squarrosum* (calcifuge species) (Kooijman & Bakker 1995). The same process with similar species take place in Czech Republic and Slovakia where we want to test on large-scale experiment:

Does the decomposition rate different during the succession?

Method

Tea material

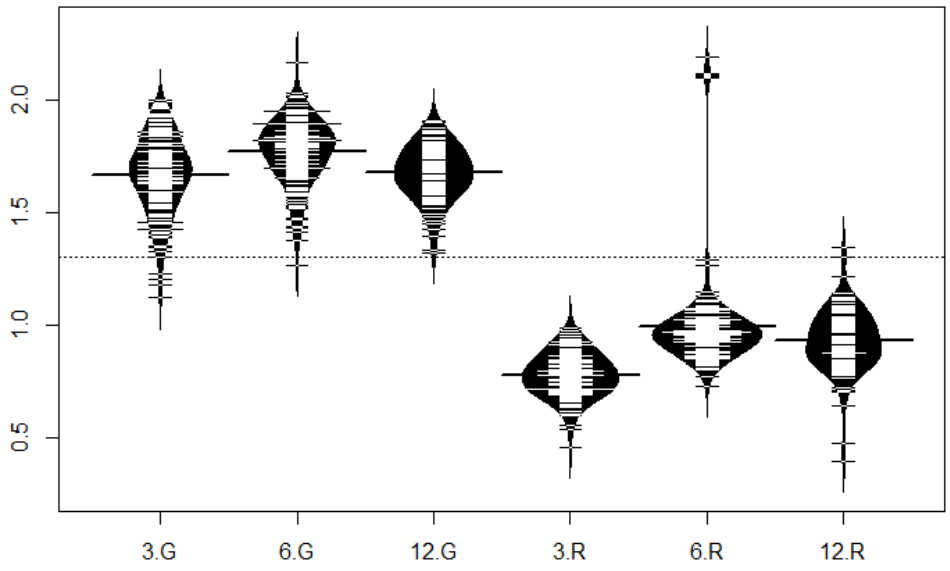
A simplified litter bag experiment was carried out with commercially available synthetic tea bags with sides of 5 cm containing c. 2 g of green tea or rooibos tea. Mesh size of 0,25 mm allowed microorganisms and mesofauna to enter the bags, but excluded macrofauna (Setälä et al. 1996). Application of tea bags was following TBI protocol (Keuskamp et al. 2013).

Statistical analyzes

We analysed rate of decomposition in R using package „beanplot“ to visualized the data. Function “lm” linear regression model and function “anova” was applied on data to found out if there is some connection between *Sphagnum* and rate of decomposition. In a case of positive association we used function “TukeyHSD” Tukey multiple comparisons of means to compare which *Sphagnum* species differ.

Results and discussion

Considering Fig.1 the decomposition between green tea and roibos tea differ. Mean decomposition rate of green tea was much higher than rate of roibos tea. In both cases, we investigated similar trend of increase of decomposition rate from 3 to 6 month and decrease after 12 months. That suggest the method is not suitable for period of 12 months. This fact



will be taken for consideration in next step of analyses.

Fig.1 Decomposition rate of G (grenn tea) and R (roibos tea) vizualized after 3, 6 and 12 months.

Linear regression and anova

model <- lm (Roibos~Sphagnum, data = XY)

anova (model)

ROIBOS

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
After 3 months Sphagnum	3	0.10428	0.034761	1.5062	**0.2163**
After 6 months Sphagnum	3	0.00984	0.003279	0.0456	**0.9865**
After 12 months Sphagnum	3	0.02346	0.007821	2.6642	**0.1112563**

GREEN

After 3 months Sphagnum	3	0.14236	0.047454	3.3613	**0.020997 ***
After 6 months Sphagnum	3	0.12441	0.041470	2.6171	**0.09528 .**
After 9 months Sphagnum	3	0.00019	0.0000646	0.0085	**0.99884**

From results above is clear significant association between *Sphagnum* and rate of decomposition just in a case of green tea and decomposition rate after three months. In next step of our analyzes we will work with this significant result.

Plotting and tukey multiple comparisons of means

beanplot(Green~Sphagnum, data= XY)

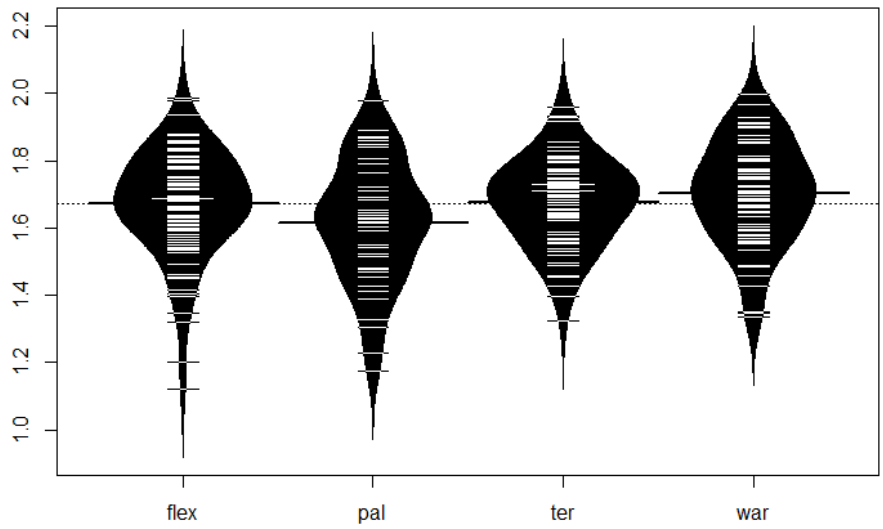


Fig.2 Bean plots visualized the decomposition rate of Green tea after 3 months of decomposition

aov.model<- aov(Green~Sphagnum, data = XY)

TukeyHSD(aov.model)

	diff	lwr	upr	p adj
pal-flex	-0.056391812	-0.127990365	0.01520674	0.1774229
ter-flex	0.003811785	-0.057197800	0.06482137	0.9984980
war-flex	0.028920158	-0.034570057	0.09241037	0.6416434
ter-pal	0.060203596	-0.013829134	0.13423633	0.1550275
war-pal	0.085311970	0.009222002	0.16140194	**0.0210233**
war-ter	0.025108373	-0.041114732	0.09133148	0.7609580

We found out significant a significant difference between site with *S. warnstorfii* and *S. palustre*. The decomposition in *S. palustre* site was significantly lower than in *S. warnstorfii* site. Our results show that in early successional stages the decomposition rate is higher than in late successional stages. Our results show that in early successional stages the decomposition rate is higher than in late successional stages what is in agreement also with another studies.

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