

Sphagnum distribution patterns along environmental gradients in Bulgaria



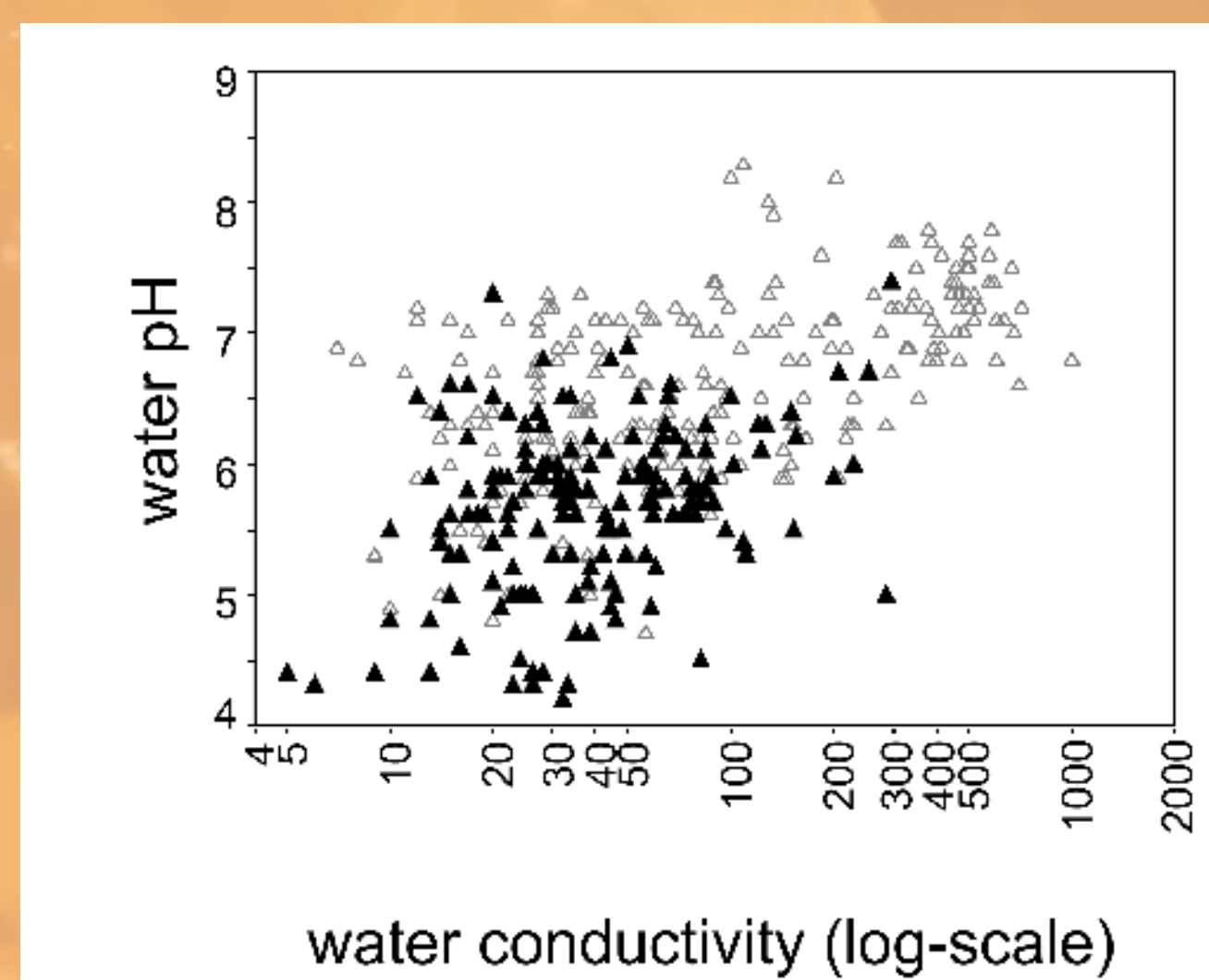
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The distribution patterns of 18 *Sphagnum* species along base-richness and altitudinal gradients were studied in Bulgarian treeless wetlands which are noteworthy because of the edge-of-range occurrence of many mire species including *Sphagna*. From 483 spring and mire sites studied, 202 samples contained some *Sphagnum* species. The most common species were *S. subsecundum* (n = 85), *S. platyphyllum* (46), *S. contortum* (41), *S. teres* (40) and *S. capillifolium* (26). The significance of *Sphagnum* responses to environmental gradients were tested by comparing GAM models against null model. Many of *Sphagnum* species displayed significant response to the altitudinal, water pH and base-richness gradients. Some species (*S. warnstorffii*, *S. teres*, *S. subsecundum*) exhibited different demands to water pH and water conductivity above and below the timberline. These *Sphagnum* species inhabited mineral-rich mires below the timberline, whereas they occurred in extremely mineral-poor mires above the timberline. It could be explained by adaptation to local conditions during long-term isolation on mineral-poor bedrock or by changed competition pressure.

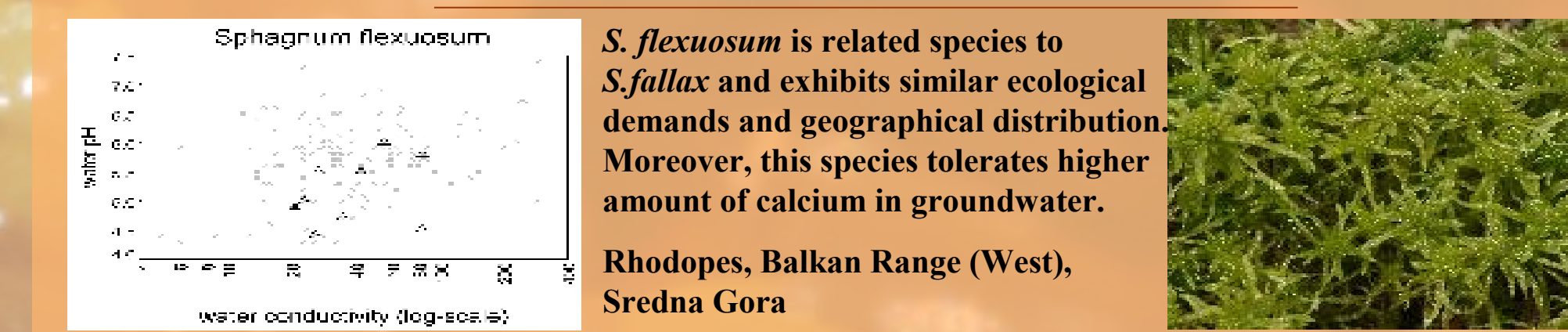
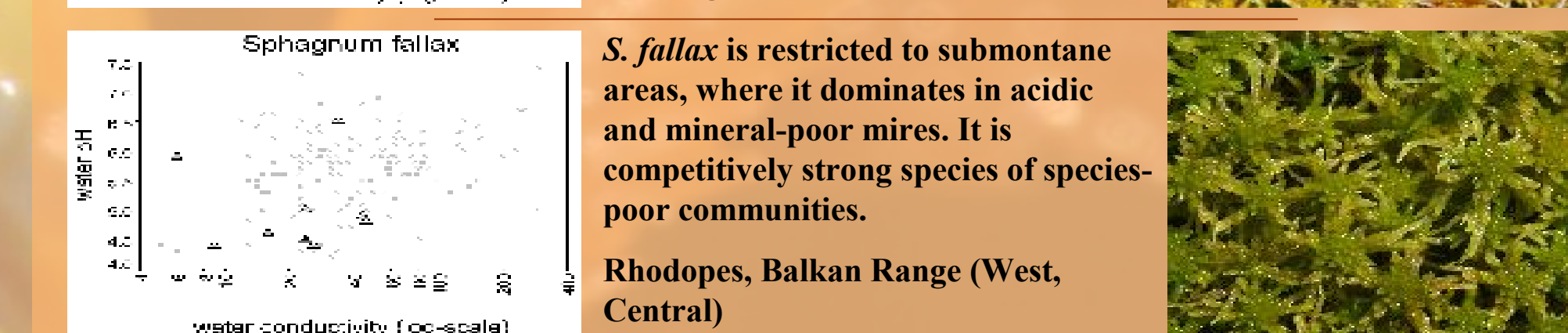
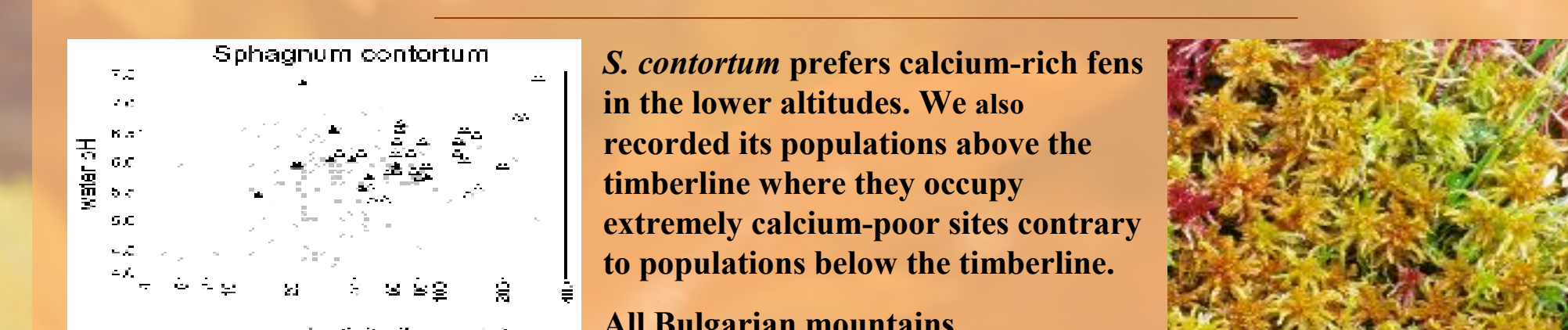
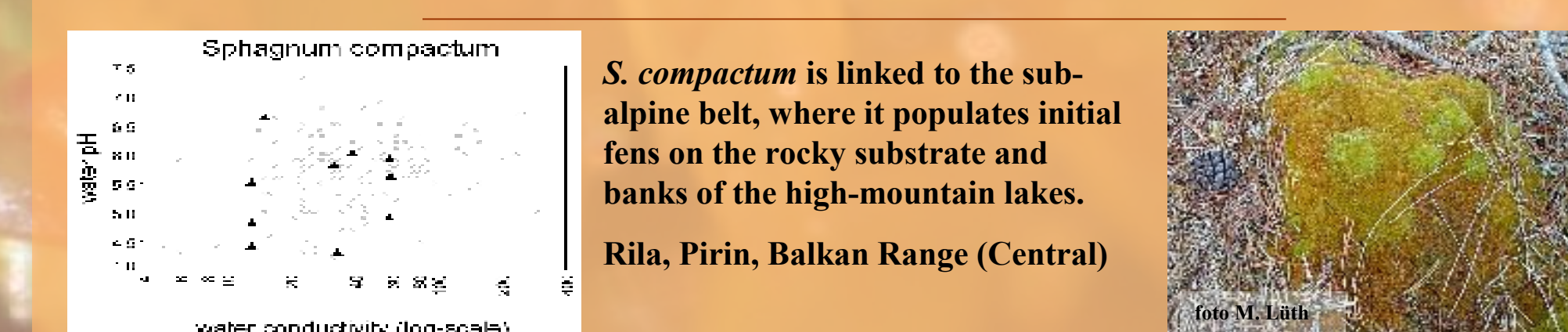
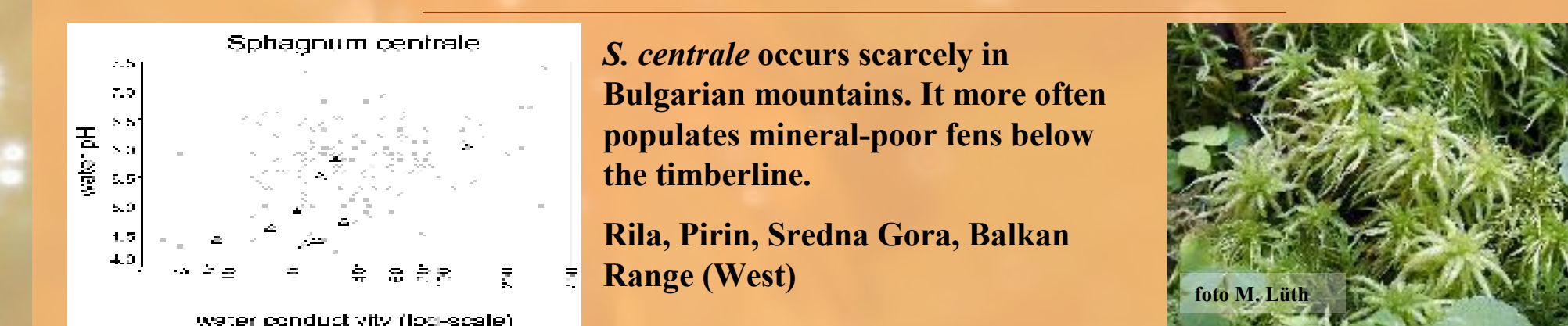
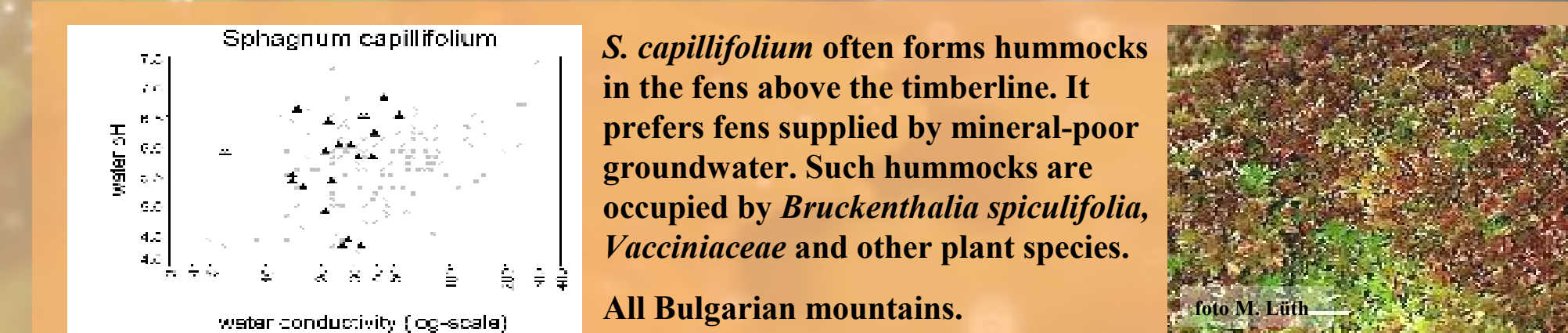
Relationship between water conductivity and water pH in Bulgarian mires. Samples without *Sphagnum* presence are indicated by empty triangles, samples with *Sphagnum* presence are indicated by full triangles. Correlation between these two variables was significant in the total data set ($r = 0.556$; $P < 0.001$) as well as in the data set of only *Sphagnum*-fens ($r = 0.322$; $P < 0.001$).

The highest water conductivity, under which occurrence of some *Sphagnum* species was possible, reached 280 $\mu\text{S}/\text{cm}$. *S. contortum* was the species, which tolerated such conditions.

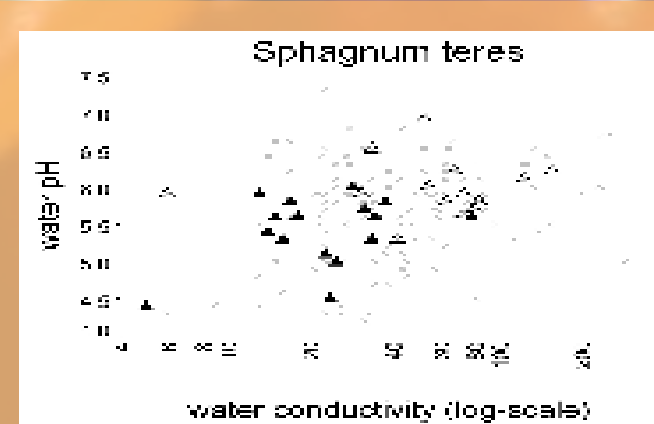
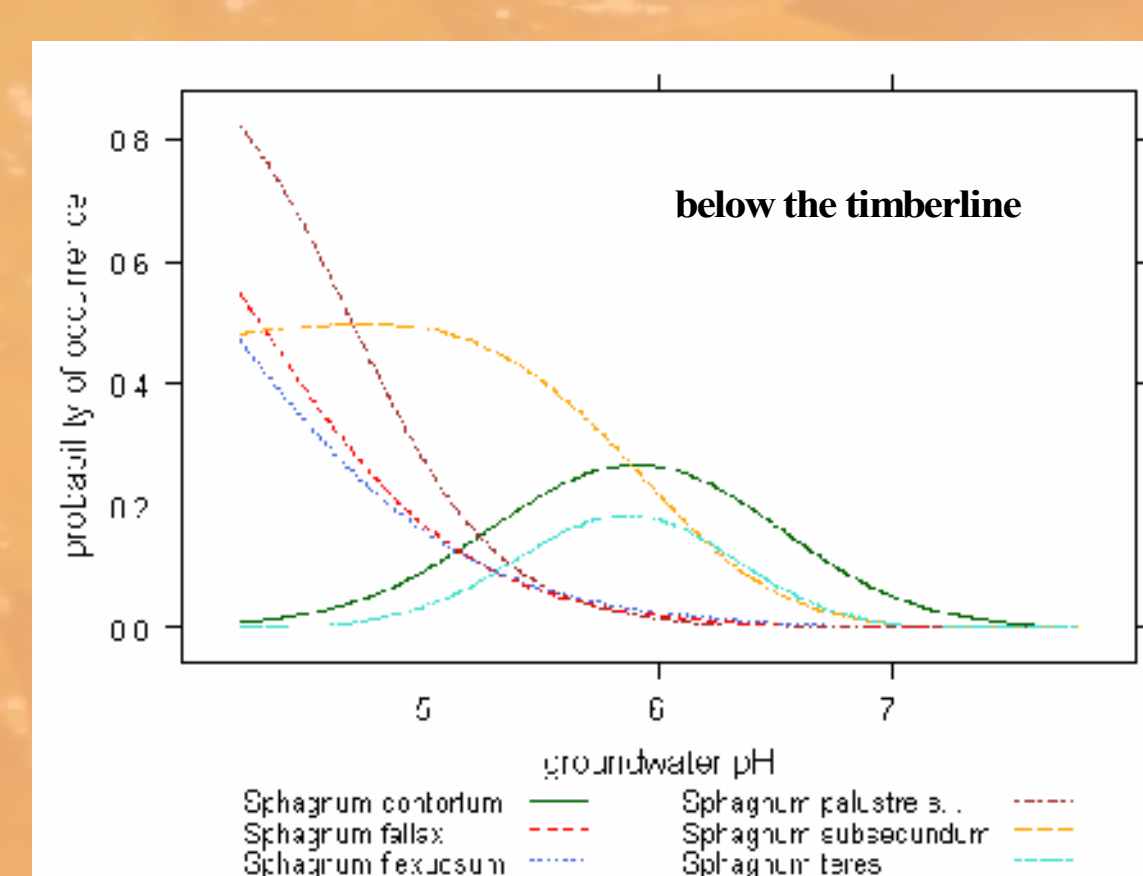
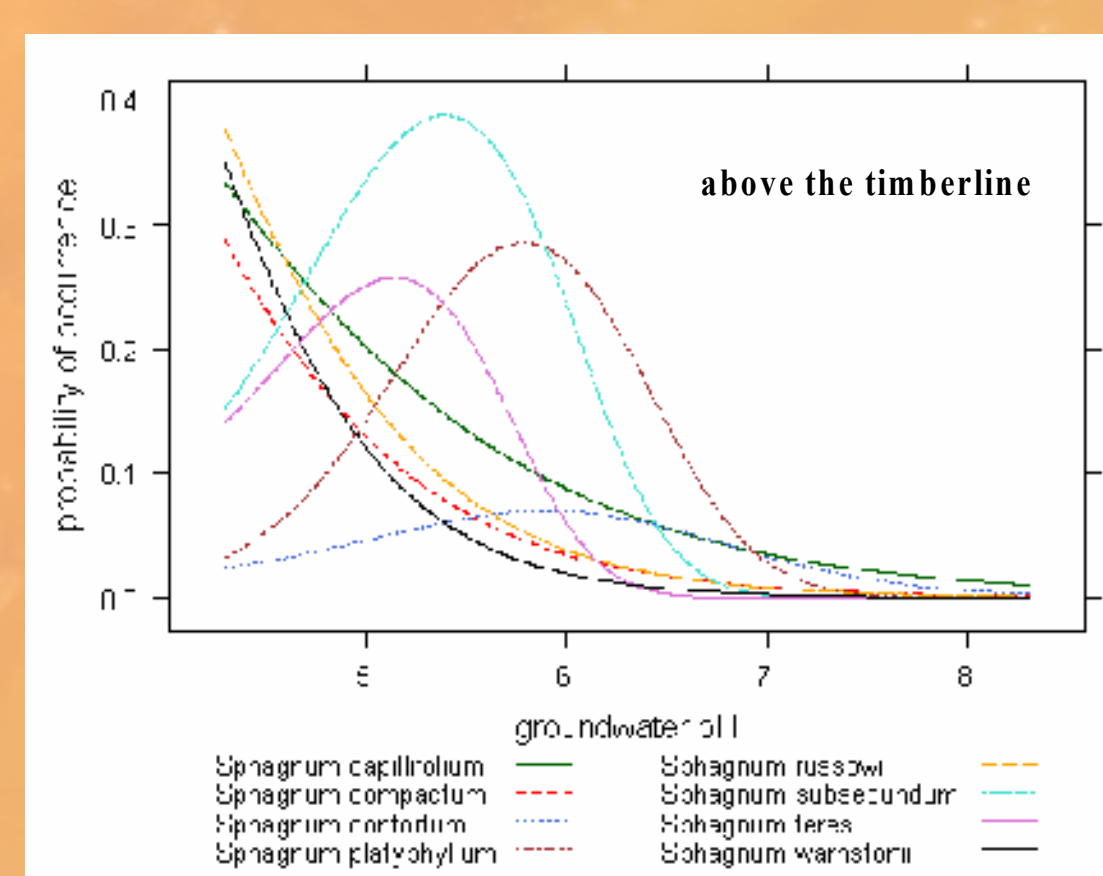


Figures show demands of the most common Bulgarian *Sphagna* to the water reaction and water mineral-richness. Black triangles assign occurrences above the timberline, leer triangles assign occurrences below the timberline.

Note: Photos are not from the Bulgarian territory in all cases.

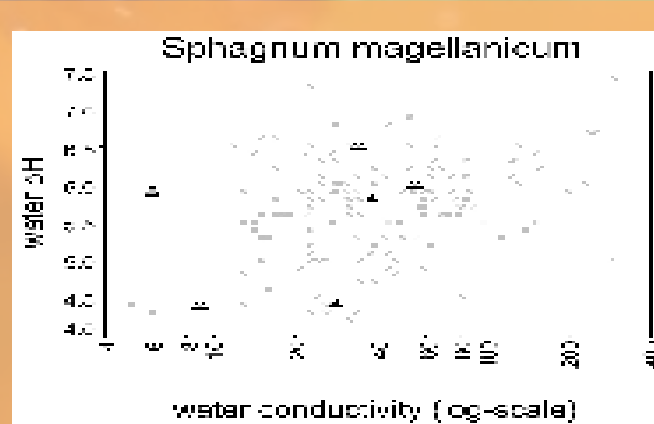


The significance of *Sphagnum* responses to environmental gradients were tested by comparing GAM models against null model. Figures show species response curves to groundwater pH in two subsets: Bulgarian high-mountains mires above the timberline and submontane mires below the timberline.



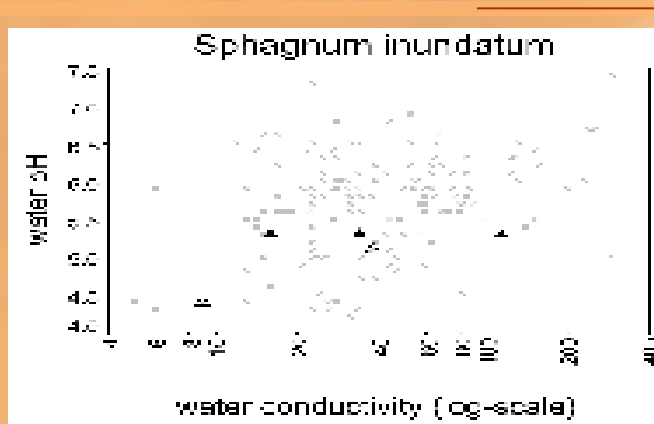
S. teres displays significant differences in water-conductivity demands between the submontane (calcitolerant) and sub-alpine (calcifuge) populations.

Pirin, Rila, Rhodopes, Balkan Range (Central), Vitoshka



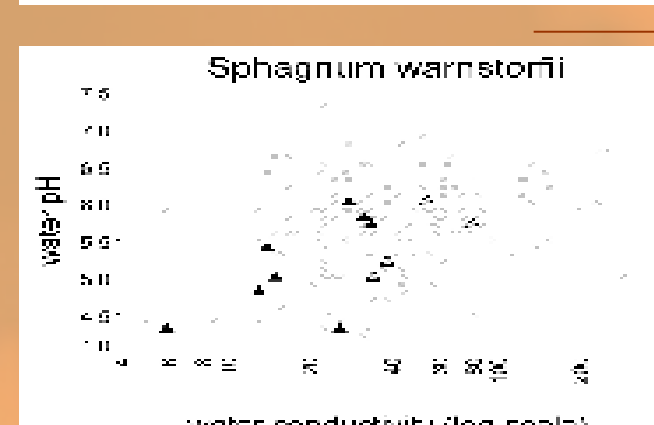
S. magellanicum exhibits similar distribution pattern like *S. fallax*. This species builds small hummocks in mineral-poor fens.

Rhodopes, Balkan Range (West, Central)



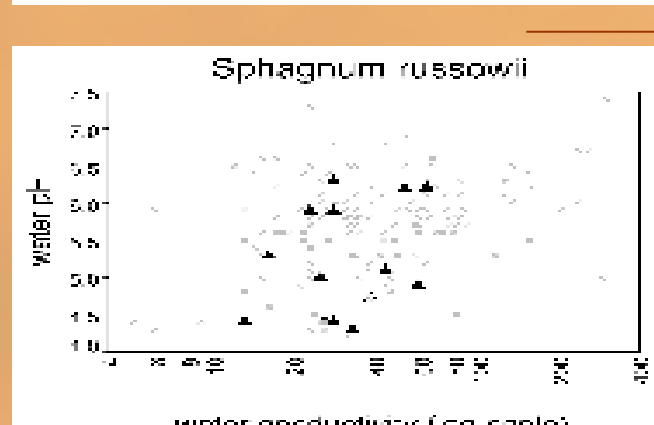
S. inundatum is species without any clear response to the water chemistry and altitude in Bulgaria. We recorded only 11 localities during our research (water chemistry was measured only at 5 sites). The species populates small streams and the wettest places in fens.

Rila, Rhodopes, Balkan Range (West, Central), Vitoshka



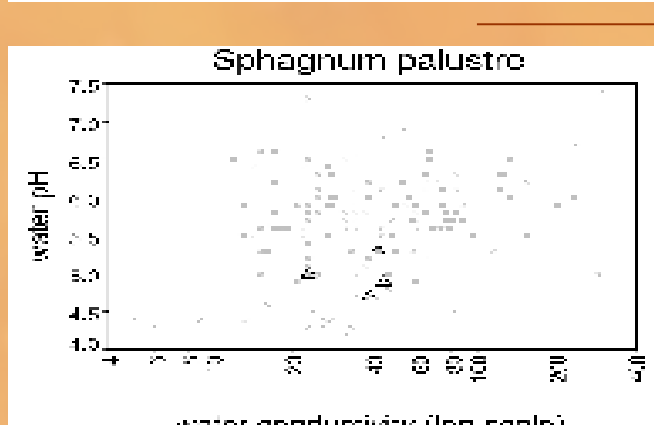
S. warnstorffii is rather rare *Sphagnum* species in Bulgaria. By analogy to *S. teres*, submontane populations tolerate more calcium than do the sub-alpine ones.

Pirin, Rila, Rhodopes, Balkan Range (Central), Vitoshka



S. russowii occurs mainly in sub-alpine belt, where builds hummocks together with *S. capillifolium*. It prefers mineral-poor fens.

Pirin, Rila, Rhodopes, Balkan Range (West, Central)



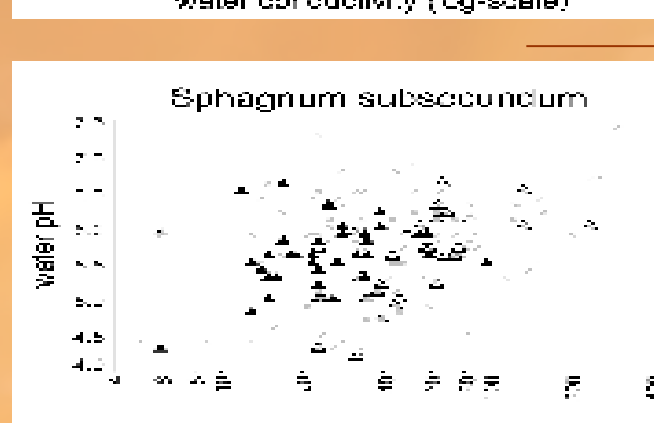
S. palustre is less common species than the related species *S. centrale*. It occupies acidic and mineral-poor fens below the timberline.

Rhodopes, Balkan Range (Central), Vitoshka

We recorded species *S. fuscum* only one time in mire woodland with *Pinus sylvestris* in Shiroka Poljana region in the Rhodopes. It built high hummocks.

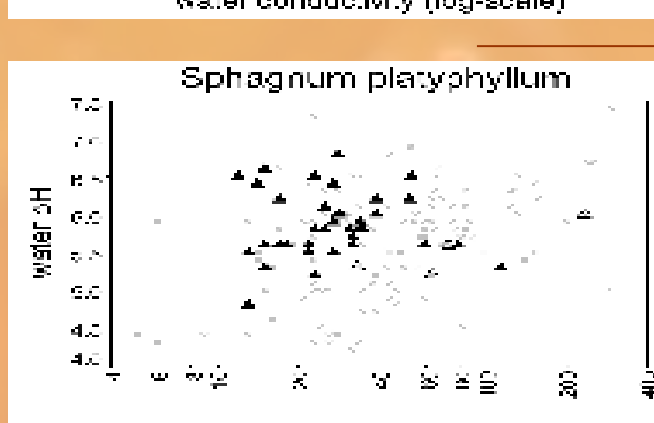
S. auriculatum is the species with a sub-oceanic tendency in distribution, therefore it is rather rare in Bulgaria. We recorded 5 its localities.

S. girgensohnii prefers woodland habitats, out of such habitats it occurs only sporadically.



S. subsecundum is the most common *Sphagnum* species in Bulgarian fens at all. The submontane populations tolerate more calcareous stands than the sub-alpine ones.

All Bulgarian mountains.



S. platyphyllum very often populates streams in fens above the timberline and it descends only rarely into lower altitudes (Rhodopes).

Pirin, Rila, Vitoshka, Balkan Range (West, Central), Rhodopes



Sphagnum nomenclature follows Natcheva & Ganeva (2005)