

SUPPLEMENTARY DATA

TABLE S1. Data used for our regression analysis of temperature optima of net photosynthesis in relation to mean habitat temperature of the respective growing season, based on 19 studies on 61 bryophyte species from a wide range of ecosystems: polar, alpine, temperate, dessert and tropical regions. Growing-season temperatures are based on data from the nearest climate station (monthly averages from 1970–2009 or less). Mean temperatures of the study sites were adjusted according to altitude (moist adiabatic lapse rate: 0.6 °C per 100 m). When altitude was not specified we assumed sea level. Where results were ranges we chose the arithmetic mean of the range for the analysis. We averaged optimum temperatures where species showed seasonal acclimation. If species were studied more than once, i.e. at different altitudes or latitudes, we averaged the optimum temperature and the mean temperature of the study sites for the regression analysis in order to avoid including several data points for the same species as though these were independent. Climate data were taken from NOAA (<http://gis.ncdc.noaa.gov/map/cdo/?thm=themeMonthly>), from the original article (Pannewitz *et al.* 2005) or from our own measurements. All studies measured net photosynthesis at normal atmospheric CO₂ concentrations and at close to saturating irradiances.

Species	Optimum temperature of NP (°C)	Mean temperature of growing season (°C)	Definition of growing season	Altitude (m a.s.l)/Mean temperature lapse rate adapted?	Study region	Nearest climate station found/altitude (m a.s.l.)	System used	Reference
<i>Atrichum undulatum</i>	15.0	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Bryopteris filicina</i>	24.6	22.0	Whole year	500	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Bryum pseudotriquetrum</i>	12.0	-2.4	Summer	N/A	Antartica	Pannewitz et al. 2005 (found in Rudolph 1966)	compact mini-cuvette systems (CMS4P, Walz GmbH)	Pannewitz et al. 2005
<i>Bryum subrotundifolium</i>	13.9	-2.4	Summer	N/A	Antartica	Pannewitz et al. 2005 (found in Rudolph 1966)	compact mini-cuvette systems (CMS4P, Walz GmbH)	Pannewitz et al. 2005
<i>Ceratodon pupureus</i>	6.6	-2.4	Summer	N/A	Antartica	Pannewitz et al. 2005 (found in Rudolph 1966)		Pannewitz et al. 2005
<i>Dicranum fuscescens</i>	11.25	6.2	April-October	260/Yes	Mary Jo, Schefferville, Quebec, Canada	Schefferville airport, CA/522	Beckman 215A (IRGA, differential mode)	Hicklenton and Oechel 1976
<i>Dicranum fuscescens</i>	11.25	3.2	April-October	750/Yes	Timmins, Schefferville, Quebec, Canada	Schefferville airport, CA/522	Beckman 215A (IRGA, differential mode)	Hicklenton and Oechel 1976
<i>Dicranum longatum</i>	5	5.6	April-October	N/A	Kevo, FI	Karasjok/130	IRGA	Kallio and Heinonen 1975
<i>Dicranum scoparium</i>	12.0	14.6	April-October	N/A	Southern Germany	Ohringen, Germany /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Dicranu mmajus</i>	20.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/88	Not specified	Proctor 1982
<i>Drepanocladus uncinatus</i>	12.5	0.9	December-February	N/A	Antartica	Base esperanza/0	Grubb Parson IRGA, closed system	Collins 1977
<i>Durmortiera hirsuta ssp.</i>	19.7	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz)	Present study

<i>Eurhynchium striatum</i>	15.0	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	GmbH Not specified	Seidel 1976* (in Proctor 1982)
<i>Frullania mirabilis</i>	16.1	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Grimmia laevigata</i>	16.5	15.8	Whole year	850/Yes	Echo valley, San Diego, CA, USA	Bishop airport, California, USA/1250	IRGA, open flow system	Alpert and Oechel 1987
<i>Grimmia apocarpa</i>	17.8	15.8	Whole year	850/Yes	Echo valley, San Diego, CA, USA	Bishop airport, California, USA/1250	IRGA, open flow system	Alpert and Oechel 1987
<i>Herbertus anundus</i>	20.0	12.9	April-October	N/A	W Ireland	Galway, IR/0	Not specified	Proctor 1982
<i>Herbertus divergens</i>	20.7	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Homalothecium serceum</i>	10.0	13.5	April-October	0	N Sealand, DK,	KoebenhavnLandbohojskolen, SE/0	Method of Boysen Jensen (1928)	Romose 1940
<i>Hylocomium parietinum</i>	18.5	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma, SE/0	Not specified	Stålfelt 1937
<i>Hylocomium proliferum</i>	18.5	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma, SE/0	Not specified	Stålfelt 1937
<i>Hylocomium splendens</i>	13.5	14.6	April-October	N/A	Southern Germany	Ohringen, D/276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Hylocomium squarrosom</i>	18.5	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma/0	Not specified	Stålfelt 1937
<i>Hylocomium triquetrum</i>	15.5	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma/0	Not specified	Stålfelt 1937
<i>Lepidopilum polytrichoide</i>	24.2	22.0	Whole year	0	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Leucobryum antillarum</i>	22.7	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Leucobryum glaucum</i>	13.5	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Octoblepharum pulvinatum</i>	25.1	22.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Orthostichopsis tetragona</i>	22.0	22.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Orthothecium rufescens</i>	22.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/88	Not specified	Proctor 1982
<i>Orthotrichum rupestre</i>	21.0	15.8	Whole year	850/Yes	Echo valley, San Diego, CA, USA	Bishop airport, California, USA/1250	IRGA, open flow system	Alpert and Oechel 1987
<i>Phyllogonium fulgens</i>	16.8	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Phyllogonium viscosum</i>	22.6	19.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Pilotrichum bipinnatum</i>	22.9	22.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Plagiochila sp.1</i>	23.7	25.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Plagiochila sp.2</i>	26.2	22.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study

<i>Plagiochila asplenioides</i>	18.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/90	Not specified	Proctor 1982
<i>Plagiomnium cuspidatum</i>	22.0	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Plagiomnium rhynchophorum</i>	15.0	18.7	Whole year	1300-1700/yes	Malayan peninsula, MAL	Sitiawan, MAL/0	IRGA	Frahm 1990
<i>Pleurizium schreberi</i>	15.0	10.2	April-October	N/A	S_Finland	Jokioinen//103	IRGA	Kallio and Kärenlampi 1975
<i>Pleurizium schreberi</i>	5.0	5.6	April-October	N/A	Kevo, FI	Karasjok/130	IRGA	Kallio and Kärenlampi 1975
<i>Pleurizium sp.</i>	22.6	10.4	April-October	N/A	BOREAS project, CA	Green Lake, CA/470	Open flow IRGA (MPH 1000, Campbell Scientific)	Williams and Flanagan 1998
<i>Polytrichum alpestre</i>	10.0	0.9	December-February	N/A	Antartica	Base esperanza/0	Grubb Parson IRGA, closed system	Collins 1977
<i>Polytrichum formosum</i>	10.0	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Polytrichum juniperum</i>	13.3	6.6	April-October	1850/yes	Mt Washintom, USA	Attica 2E, USA/200	Grubb Parson IRGA, closed system	Bazzaz et al. 1970
<i>Polytrichum juniperum</i>	10.0	17.7	April-October	190	Portland Arch, USA	Attica 2E, USA/200	Grubb Parson IRGA, closed system	Bazzaz et al. 1970
<i>Porella platyphylla</i>	19.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/90	Not specified	Proctor 1982
<i>Ptilium crista castrensis</i>	20	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma/0	Not specified	Stålfelt 1937
<i>Racomitrium lanuginosum</i>	5.0	5.6	April-October	N/A	Kevo, FI	Karasjok/130	IRGA	Kallio and Heinonen 1975
<i>Racomitrium lanuginosum</i>	5.0	10.2	April-October	N/A	Turku, FI	Jokioinen//103	IRGA	Kallio and Heinonen 1975
<i>Racomitrium lanuginosum</i>	5.0	4.5	April-October	N/A	Spitzbergen, NO	Barenburg/80	IRGA	Kallio and Heinonen 1975
<i>Racomitrium lanuginosum</i>	5.0	12.9	April-October	N/A	W Ireland, IR	Galway, IR/0	IRGA	Kallio and Heinonen 1975
<i>Racomitrium lanuginosum</i>	5.0	9.7	April-October	N/A	E-Scotland, UK	Eskdalemuir/240	IRGA	Kallio and Heinonen 1975
<i>Racomitrium lanuginosum</i>	5.0	13.0	April-October	N/A	Wales, UK	Camborne, UK/90	IRGA	Kallio and Heinonen 1975)
<i>Racomitrium lanuginosum</i>	5.0	15.2	April-October	N/A	Austrian Alps, A	Innsbruck, A/580	IRGA	Kallio and Heinonen 1975)
<i>Racomitrium lanuginosum</i>	5.0	0.9	Decembe-February	N/A	South Georgia, UK	Base esperanza/0	IRGA	Kallio and Heinonen 1975)
<i>Racomitrium lanuginosum</i>	14.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/90	0.01M NaHCO3 in flasks (4-8h) titrated against NaOH, methyl red as indicator	Tallis 1959
<i>Rhytidadelphus loreus</i>	13.5	14.6	April-October	N/A	Southern Germany	Ohringen, D /276	Not specified	Seidel 1976* (in Proctor 1982)
<i>Scapania gracilis</i>	18.0	13.0	April-October	N/A	SW-England, UK	Camborne, UK/90	Not specified	Proctor 1982

<i>Spagnum sp.</i>	22.7	10.4	April-October	N/A	BOREAS project, CA	Green Lake, CA/470	Open flow IRGA (MPH 1000, Campbell Scientific)	Williams and Flanagan 1998
<i>Spagnum australe</i>	21.7	9.1	April-October	450/yes	NZ, three different sites	New Plymouth, NZ/30	IRGA, open flow system	Maseyk et al. 1999
<i>Spagnum cristatum</i>	20.0	9.1	April-October	450/yes	NZ, three different sites	New Plymouth, NZ/30	IRGA, open flow system	Maseyk et al. 1999
<i>Spagnum fallax</i>	17.0	12.6	April-October	N/A	Bloomington Bog, USA	Gabriels, USA/500	IRGA, open flow system	<i>Titus and Wagner 1984</i>
<i>Spagnum fuscum</i>	15.0	10.2	April-October	N/A	Turku, FI	Jokioinen//103	IRGA, Hartmann & Braun system	Silvola and Heikkinen 1979
<i>Spagnum girgensohnii</i>	18.0	12.1	April-October	N/A	Stockholm, SE	Stockholm Bromma/0	Not specified	Stålfelt 1937
<i>Spagnum nemoreum</i>	17.0	12.6	April-October	N/A	Bloomington Bog, USA	Gabriels, USA/500	IRGA, open flow system	<i>Titus and Wagner 1984</i>
<i>Stictolejeunea squamata</i>	25.2	25.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Symbiezidium spp.</i>	27.3	25.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Symbiezidium spp.</i>	25.4	22.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study
<i>Syntrichia caninerivs</i>	15.0	20.0	Whole year	N/A	Deserts of North America, USA	Pers. comm..	Not specified	Kirsten Coe, pers comm.
<i>Syrrophodon incompletus</i>	26.6	22.0	Whole year	Whole year	1200	Panama	Own measurement	Present study
<i>Tortula ruralis</i>	18.3	15.8	Whole year	850/Yes	Echo valley, San Diego, CA, USA	Bishop airport, California, USA/1250	IRGA, open flow system	Alpert and Oechel 1987
<i>Zelometeorium patulum</i>	25.5	25.0	Whole year	1200	Panama	Own measurement	GFS 300 (Walz GmbH)	Present study

References

- Alpert P, Oechel WC (1987)** Comparative patterns of net photosynthesis in an assemblage of mosses with contrasting microdistributions. *American Journal of Botany* **74**: 1787–1796
- Bazzaz FA, Paolillo DJ, Jr., Jagels RH (1970)** Photosynthesis and respiration of forest and alpine populations of *Polytrichum juniperinum*. *Bryologist* **73**: 579–585
- Collins NJ (1977)** *The growth of mosses in two contrasting communities in the maritime Antarctic: measurement and prediction of net annual production*. In: Llano GA (ed) Adaptations within Antarctic ecosystems. Smithsonian Institution, Washington, pp 921–933
- Frahm J-P (1990)** The effect of light and temperature on the growth of the bryophytes of tropical rain forests. *Nova Hedwigia* **51**: 151–164
- Hicklenton PR, Oechel WC (1976)** Physiological aspects of the ecology of *Dicranum fuscescens* in the subarctic. I. Acclimation and acclimation potential of CO₂ exchange in relation to habitat, light and temperature. *Canadian Journal of Botany* **54**: 1104–1119
- Kallio P, Heinonen S (1975)** CO₂ exchange and growth of *Racomitrium lanuginosum* and *Dicranum elongatum*. In: Wielgolaski FE (ed) Fennoscandian tundra ecosystems. Part 1. Plants and microorganisms. Springer, New York, pp 138–148
- Kallio P, Kärenlampi L (1975)** *Photosynthesis in mosses and lichens*. In: Cooper JP (ed) Photosynthesis and productivity in different environments. Cambridge University Press, London, pp 393–423
- Maseyk KS, Green TGA, Klinac D (1999)** Photosynthetic responses of New Zealand *Sphagnum* species. *New Zealand Journal of Botany* **37**: 155–165
- Pannewitz S et al. (2005)** Photosynthetic responses of three common mosses from continental Antarctica. *Antarctic Science* **17**: 341–352
- Proctor MCF (1982)** *Physiological ecology: water relations, light and temperature responses, carbon balance*. In: Smith AJE (ed) Bryophyte Ecology. Chapman and Hall, London New York, pp 333–381
- Romose V (1940)** Ökologische Untersuchungen über *Homalothecium sericeum*, seine Wachstumsperioden und seine Stoffproduktion. *Dansk Botanisk Arkiv* **10**: 1–134
- Silvola J, Heikkinen S (1979)** CO₂ Exchange in the Empetrum-nigrum-Sphagnum community. *Oecologia* **37**:273–283
- Stålfelt MG (1937)** Der Gasaustausch der Moose. *Planta* **27**:30–60
- Tallis JH (1959)** Studies in the biology and ecology of *Racomitrium lanuginosum* Brid .2. growth, reproduction and physiology. *Journal of Ecology* **47**:325–350
- Titus JE, Wagner DJ (1984)** Carbon balance for two *Sphagnum* mosses: water balance resolves a physiological paradox. *Ecology* **65**:1765–1774
- Williams TG, Flanagan LB (1998)** Measuring and modelling environmental influences on photosynthetic gas exchange in *Sphagnum* and *Pleurozium*. *Plant Cell and Environment* **21**:555–564