

# MATTHEW E. GILBERT

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## CURRENT POSITION

2009 to present; Giorgio Ruffolo Sustainability Science Postdoctoral fellow, Kennedy School of Government, Harvard University

2008 to present; Postdoctoral fellow, Organismic and Evolutionary Biology, Harvard University

## ACADEMIC QUALIFICATIONS

Ph.D. in Botany (2008, Rhodes University, South Africa) Thesis: "The zonation of coastal dune plants in relation to sand burial, resource availability and physiological adaptation"  
available here: <http://eprints.ru.ac.za/1326/1/GilbertPhD-TR08-35.pdf>

B. Sc. (Honours) in Botany with Distinction (2002, Rhodes University)

B. Sc. with majors in Botany (Distinction) and Microbiology (2001, Rhodes University)

## FELLOWSHIPS AND AWARDS

2007 – National Research Foundation (NRF) Prestigious Doctoral Scholarship

2002 (Jun)-2003 (Sep) – Research Fellowship, Smithsonian Tropical Research Institute

2001 – NRF Honours Scholarship, and Rhodes University Honours Scholarship

2000 – Lillian Britten Memorial Prize for Botany

2000 and 1998 – Rhodes University Merit Bursary Awards

## RESEARCH SPECIALIZATION

My research addresses the mechanisms by which leaf photosynthesis and water use respond to the environment, and has bearing on both applied and ecological contexts. Where are the sites of evaporation within leaves? What is mechanism of CO<sub>2</sub> diffusion across membranes? What are the mechanisms of stomatal response to light, CO<sub>2</sub> and plant water relations?

## PROFESSIONAL INVOLVEMENT

**Referee for:** *Plant, Cell and Environment; Plant Physiology; American Journal of Botany; Plant Ecology; Journal of Arid Environments; Physiologia Plantarum; Trees, Structure and Function; Tree Physiology; African Journal of Agricultural Research; Arid Land Research and Management; Environmental Management; Estuarine, Coastal and Shelf Science; Journal of Coastal Conservation;*

**Grant agencies:** BARD (Binational Agricultural Research and Development Fund).

## PUBLICATIONS

**Manuscripts submitted** (full text available upon request):

Secchi, F. **Gilbert, M.** and Zwieniecki, M. (in review). Transcriptome response to embolism formation in stems of *Populus trichocarpa* provides insight into signaling and biology of refilling. *Proceedings of the National Academy of Sciences, USA*

**Gilbert, ME.** Pou, A. Zwieniecki, M. Holbrook, NM. (under revision). On the measurement of mesophyll conductance to carbon dioxide with the variable *J* method. *Journal of Experimental Botany*

## Published Papers:

- Gilbert, ME.** Holbrook, NM. Zwieniecki, MA. Sadok, W. Sinclair, TR. (2011a). Field confirmation of genetic variation in soybean transpiration response to vapor pressure deficit and photosynthetic compensation for this effect. *Field Crops Research* - accepted
- Gilbert, ME.** Pammenter, NW. Ripley, BS. (2011b). Do partially buried dune plants grow in optimal trajectories? *Plant Ecology* 212(8): 1263-1274
- Gilbert, ME.** Zwieniecki, M. Holbrook, NM. (2011c). Independent variation in photosynthetic capacity and stomatal conductance leads to differences in intrinsic water use efficiency in eleven soybean genotypes before and during mild drought. *Journal of Experimental Botany* 62(8): 2875-2887
- Buckley, TN. Sack, L. **Gilbert, M.** (2011). The role of bundle sheath extensions and life form in stomatal responses to leaf water status. *Plant Physiology* 156: 962-973
- Ripley, BS. Frole, KM. **Gilbert, ME.** (2010) Differences in drought sensitivities and photosynthetic limitations between co-occurring C<sub>3</sub> and C<sub>4</sub> (NADP-ME) Panicoid grasses. *Annals of Botany* 105(3): 493-503
- Gilbert, ME.** Ripley, BS. (2010) Resolving differences in plant burial responses. *Austral Ecology* 35(1): 53-59
- Powers, JS. [...] **Gilbert, ME.** et al. (2009) Decomposition in tropical forests: a pan-tropical study of the effects of litter type, litter placement and mesofaunal exclusion across a precipitation gradient. *Journal of Ecology* 97(4): 801-811
- Gilbert, ME.** Pammenter, NW. Ripley, BS. (2008) The growth responses of coastal dune species are determined by nutrient limitation and sand burial. *Oecologia* 156(1): 169-178
- Gilbert, ME.** Ripley, BS. (2008) Biomass reallocation and the mobilization of leaf resources support dune plant growth after sand burial. *Physiologia Plantarum* 134(3): 464-472
- Ibrahim, DG. **Gilbert, ME.** Ripley, BS. Osborne, CP. (2008) Seasonal differences in photosynthesis between the C<sub>3</sub> and C<sub>4</sub> subspecies of *Alloteropsis semialata* are offset by frost and drought. *Plant Cell and Environment* 31(7): 1038-1050
- Osborne, CP. Wythe, EJ. Ibrahim, DG. **Gilbert, ME.** Ripley, BS. (2008) Low temperature effects on leaf physiology and survivorship in the C<sub>3</sub> and C<sub>4</sub> subspecies of *Alloteropsis semialata*. *Journal of Experimental Botany* 59(7): 1743-1754
- Ripley, BS. **Gilbert, ME.** Ibrahim, D. Osborne, CP. (2007) Drought constraints on C<sub>4</sub> photosynthesis: stomatal limitation and electron sinks in C<sub>3</sub> and C<sub>4</sub> subspecies of *Alloteropsis semialata*. *Journal of Experimental Botany* 58(6): 1351-1363
- Barker, NP. Galley, C. Verboom, AG. Mafa, P. **Gilbert, M.** Linder, HP. (2007) The phylogeny of the austral grass subfamily Danthonioidae: evidence from multiple data sets. *Plant Systematics and Evolution* 264(3-4):135-156
- Gilbert, ME.** Ripley, BS. (2002) The effect of smoke on the photosynthetic gas exchange of *Chrysanthemoides monilifera*. *South African Journal of Botany* 68(4): 525-531

## PRESENTATIONS

**Gilbert, ME.** Zwieniecki, M. and Holbrook, NM. (2009) Rapid variation in leaf water status results in large reductions in photosynthesis due to reduced liquid phase diffusion of CO<sub>2</sub> in the mesophyll. Ecological Society of America Conference, Albuquerque, NM

**Gilbert, ME.** Ripley, B. Pammenter, N. (2006) Contrasting growth, allocation and photosynthetic responses of four coastal-dune plant species are related to the rates of natural sand-burial and nutrient limitations. British Ecological Society Annual Meeting, University of Oxford, UK

**Gilbert, ME.** Engelbrecht, B. Kursar, T. (2003) The survival of tropical rainforest seedlings along a gradient of soil-drought in Panama. Smithsonian Tropical Research Institute Workshop on “Soil Dynamics in Panama”, Panama City, Panama

Presented seven oral presentations at the annual South African Botanical Society Conference, between 2002 and 2008, including: Could the trade-off between plant burial responses and light-competition result in the zonation of dune vegetation? (2007)

Collaborators have presented various presentations and posters on my behalf, including:

Buckley, T.N. Sack, L. **Gilbert, M.E.** (2011) The role of bundle sheath extensions and life form in stomatal responses to leaf water status. American Society of Plant Biologists Annual Meeting, Minneapolis, MN

Green, W.A. **Gilbert, M.** Arthurs, A. Holbrook, N.M. Knoll, A.H. (2011). Axial transport of CO<sub>2</sub> in Lycopods: implications for carbon cycling in Paleozoic coal swamps. Poster at the Plant Biology Symposium, Harvard University

Secchi, F. **Gilbert, M.** and Zwieniecki, M. (2011). Comparative analysis of the transcriptome response of xylem parenchyma cells to embolism and osmotic stress in stems of *Populus trichocarpa*. Poster at the Plant Biology Symposium, Harvard University

Osborne, C.P. Ibrahim, D.G. **Gilbert, M.E.** Haasbroek, A. Ripley, B.S. (2004). The origin of a C<sub>4</sub> species? Evolution and atmospheric interactions in C<sub>3</sub> and C<sub>4</sub> subtypes of *Alloteropsis semialata*. Geological Society of America annual meeting, Denver, CO

## RESEARCH

2011 – Ongoing collaboration with W. A. Green (Harvard University) on photosynthetic measurements of *Selaginella* spp. and whether photosynthesized CO<sub>2</sub> is derived in part from the soil, resulting in poster presentation of Green *et al.* (2011)

2011-2010 – Collaboration with T. Buckley and L. Sack on the influence of heterobaric and homobaric leaf anatomy on stomatal functioning and hydraulic integration of leaves; resulted in Buckley, Sack and Gilbert (2011)

2011-2010 – Collaboration with F. Secchi and M. Zwieniecki on the transcriptome response of *Populus* plants affected by air-injection embolism or apoplastic sucrose in the xylem – and the subsequent xylem refilling response; provided gas-exchange measurement expertise; resulted in poster presentation, and submitted manuscript (Secchi *et al.*, 2011)

2011-2010 – Agro-ecological modeling and GIS exercise in how the resilience of rain-fed subsistence farmers is affected by crop/plant ecology in the former Ciskei and Transkei;

specifically whether crop functional types and plant functional types influence how farmers may be able to diversify agriculture so as to reduce the risks of rainfall variation.

Manuscript in preparation

2011-08 – Ongoing investigation of the hydraulically mediated mechanisms whereby plants respond to wounding; elucidating a critical piece of the long-standing puzzle as to how signals are transmitted from sites of wounding to leaves

2010-2009 – Evaluated the most common method of measuring mesophyll conductance to CO<sub>2</sub> (a vital photosynthetic parameter that has major ecological and crop breeding implications); Gilbert *et al.* (under revision), where we critically review this method and resolve discrepancies between results using this method and independent techniques

2010-2008 – Investigated the mechanisms whereby soybean genotypes vary in transpiration – a trait that can be used to conserve soil water and avoid mild droughts, buffering yield in response to rainfall variability; proposed a technique of breeding for this trait consistent with photosynthetic tradeoffs; resulted in Gilbert *et al.* (2011a, c)

2008-2004 – Investigated numerous aspects of coastal dune plant ecology, including the following published thesis chapters:

1) Investigation of the theoretical optimal geometry of dune plant growth, and the extent to which dune plants achieve this, and by what mechanisms; resulted in Gilbert *et al.* (2011b),

2) Provided a synthesis of the many disparate burial experiments performed by dune plant researchers, providing a unifying reason for the unresolved differences between the experiments – that the degree of plant response to burial is determined by the depth of burial, the plant's ability to shift biomass from root to shoot, and scale at which the response is measured; resulted in Gilbert & Ripley (2009),

3) Studied the responses of dune plants to burial, the interaction of this with nutrient limitation and how these patterns corresponded to the typical species position on dune zonations; resulted in Gilbert *et al.* (2008),

4) Researched and experimentally compared the ecophysiological mechanisms that enable dune plants to respond to burial – determining the sources of nutrients and carbon, and the costs of newly produced structures; resulted in Gilbert & Ripley (2008).

2006-2003 – Research assistant work at Rhodes University included the following projects:

1) Gas exchange and plant phenology on C<sub>3</sub> and C<sub>4</sub> *Alloteropsis semialata* (Gramineae); resulting in Ibrahim *et al.* (2008), Osborne *et al.* (2008), Ripley *et al.* (2007),

2) Gas exchange and water use of C<sub>3</sub> and C<sub>4</sub> Panicoid grasses with K. Frole; resulting in Ripley *et al.* (2010),

3) Performed HPLC analyses to extend data collected by A. White; resulting in: White *et al.* (2008) Measuring and optimising umckalin concentration in wild-harvested and cultivated *Pelargonium sidoides* (Geraniaceae). *South African Journal of Botany* 74(2): 260-267.

2003-2002 – Research assistant work at the Smithsonian Tropical Research Institute in Panama included: ecological measurements on 40+ species of tropical forest trees, with phenological and physiological measurements of plants at three sites of differing rainfall in a reciprocal transplant experiment; resulting in publications: Engelbrecht *et al.* (2007) Drought sensitivity shapes species distribution patterns in tropical forests. *Nature* 447: 80-82 and Kursar *et al.* (2005) A comparison of methods for determining soil water availability in two

sites in Panama with similar rainfall but distinct tree communities. *Journal of Tropical Ecology* 21: 297-305

2003-2002 – Measured leaf decomposition experiments; resulting in Powers *et al.* (2009)

2001 – Conducted two Honours research projects, Rhodes University, South Africa, with advisors Brad Ripley and Nigel Barker:

- 1) Investigated the effects of smoke on photosynthesis; resulting in Gilbert & Ripley (2002),
- 2) Generated a molecular and trait-based phylogeny of a large genus of Danthonioid grasses; resulting in Barker *et al.* (2007).