

Evolutionary walks through a land plant morphospace

Karl J. Niklas

August 28, 2006

1 Introduction

Wright’s protocol has been successfully recast in terms of spatial domains containing all (or at least many) of the conceivable morphological variants (‘morphospaces’ *sensu* Thomas and Reif (1993)).

In this paper, I review the construction of a morphospace for early land plants (Niklas and Kerchner, 1984; Niklas, 1997a; 1997b) and show how it can be used

... horizontally cantilevered branches impose the largest bending moments on subtending branches (Niklas, 1992; 1994a).

... This definition removes the sharp dichotomy said to exist between ‘object’ and ‘process’ complexity (i.e. the number of different parts in an organic system versus the number of different interactions among them (McShea, 1996)).

... fossil record for Devonian and Carboniferous vascular land plants (Niklas et al., 1980; 1983; Gensel and Andrews, 1984).

References

- Farnsworth, K. D. and K. J. Niklas. 1995. *Theories of optimization, form and function in branching architectures in plants*, Functional Ecology **9**, 355–363.
- Gill, P. E., W. Murray, and M. H. Wright. 1981. *Practical optimization*, Academic Press, London.
- Gensel, P. G. and H. N. Andrews. 1984. *Plant life in the Devonian*, Praeger Press, New York.
- McShea, D. W. 1996. *Metazoan complexity and evolution: is there a trend*, Evolution **50**, 477–492.
- Meredith, D. D., K. W. Wong, R. W. Woodhead, and R. H. Wortman. 1973. *Design and planning of engineering systems*, Prentice-Hall, Englewood Cliffs, New Jersey.
- Niklas, K. J. 1992. *Plant biomechanics: an engineering approach to plant form and function*, University of Chicago Press, Illinois.
- . 1994a. *Plant allometry: the scaling of form and process*, University of Chicago Press, Illinois.
- . 1994b. *Simulation of organic shape: the roles of phenomenology and mechanism*, Journal of Morphology **219**, 243–246.
- . 1997a. *Adaptive walks through fitness landscapes for early vascular land plants*, American Journal of Botany **84**, 16–25.
- . 1997b. *Effects of hypothetical developmental barriers and abrupt environmental changes on adaptive walks in a computer-generated domain for early vascular land plants*, Paleobiology **23**, 63–76.

- Niklas, K. J. and V. Kerchner. 1984. *Mechanical and photosynthetic constraints on the evolution of plant shape*, Paleobiology **10**, 79–101.
- Niklas, K. J., B. H. Tiffney, and A. H. Knoll. 1980. *Apparent changes in the diversity of fossil plants: a preliminary assessment*, Evolutionary biology, pp. 1–89.
- . 1983. *Patterns in vascular land plant diversification*, Nature **303**, 614–616.
- Thomas, R. D. K. and W.-E. Reif. 1993. *The skeleton space: a finite set of organic designs*, Evolution **47**, 341–360.