

The rise of trait-based approaches in Ecology and Evolution

J. N. Am. Benthol. Soc., 1997, 16(2):391–409
© 1997 by The North American Benthological Society

Landscape filters and species traits: towards mechanistic understanding and prediction in stream ecology

N. LeROY POFF¹

Department of Zoology, University of Maryland, College Park, Maryland 20742 USA

Abstract. A heuristic framework for understanding and predicting the distribution of species in stream communities is presented. The framework requires that species be described in terms of their functional relationships to habitat selective forces or the

Annals of Botany 91: 455–463, 2003

doi:10.1093/aob/mcg041, available online at www.aob.oupjournals.org

REVIEW

Effects of Plant Traits on Ecosystem and Regional Processes: a Conceptual Framework for Predicting the Consequences of Global Change

F. STUART CHAPIN, III*

Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99775, USA

Functional Ecology 1992
6, 621–626

ESSAY REVIEW

A pragmatic approach to functional ecology

P. A. KEDDY

Department of Biology, University of Ottawa, Ottawa, Ontario K1N 6N5, Canada

Introduction

As ecology matures and as the world's environmental problems continue to multiply, the need for general predictive models also grows. However, it is one thing to assert that such models are needed, and quite

parative ecology is by itself not a new discipline (Grime 1965; Rorison *et al.* 1987), the use of screening for comparison is. In its most general sense, the screening involves measuring one trait on a large number of species simultaneously. This could include traits such as size, reproductive output



Review

TRENDS in Ecology and Evolution Vol. 21 No. 5 May 2006

SCIENCE @ DIRECT®

Land-plant ecology on the basis of functional traits

Mark Westoby and Ian J. Wright

Department of Biological Sciences, Macquarie University, Sydney, NSW 2109, Australia

The tissue traits and architectures of plant species are important for land-plant ecology in two ways. First, they control ecosystem processes and define habitat and resources for other taxa; thus, they are a high priority for understanding the ecosystem at a site. Second, knowledge of trait costs and benefits offers the most promising path to understanding how vegetation

leaves, but also position and nitrogen. Thus, addressing traits and architecture the most important land-ecosystem obvious point,

VOL. 170, NO. 2 THE AMERICAN NATURALIST AUGUST 2007

Trait Evolution, Community Assembly, and the Phylogenetic Structure of Ecological Communities

Nathan J. B. Kraft,^{1,*} William K. Cornwell,^{2,†} Campbell D. Webb,^{3,‡} and David D. Ackerly^{1,§}



ANIMAL BEHAVIOUR, 2006, 71, 389–399
doi:10.1016/j.anbehav.2005.05.010

Available online at www.sciencedirect.com

SCIENCE @ DIRECT®



Developing an evolutionary ecology of fear: how life history and natural history traits affect disturbance tolerance in birds

DANIEL T. BLUMSTEIN

Department of Ecology and Evolutionary Biology, University of California Los Angeles

(Received 5 December 2004; initial acceptance 1 April 2005;

final acceptance 24 May 2005; published online 9 January 2006; MS. number: A10057R)

Global Change Biology (2007) 13, 1672–1684, doi: 10.1111/j.1365-2486.2007.01386.x

Climate envelope, life history traits and the resilience of birds facing global change

FRÉDÉRIC JIGUET^{*,†}, ANNE-SOPHIE GADOT^{*}, ROMAIN JULLIARD^{*}, STUART E. NEWSON^{†,‡} and DENIS COUVET^{*}

Just a small sample...

Functional Ecology 2002
16, 545–556

ESSAY REVIEW

Predicting changes in community composition and ecosystem functioning from plant traits: revisiting the Holy Grail

S. LAVOREL* and E. GARNIER

Centre d'Ecologie Fonctionnelle et Evolutive, CNRS UPR 9056, 1919 route de Mende, 34293 Montpellier C France

Trait-Based Community Ecology of Phytoplankton

Elena Litchman¹ and Christopher A. Klausmeier²

Kellogg Biological Station, ¹Department of Zoology, and ²Department of Plant Biology, Michigan State University, Hickory Corners, Michigan 49060; email: litchman@msu.edu, klausmeier@msu.edu

Evolution, 53(3), 1999, pp. 732–744

PHYLOGENETIC ANALYSIS OF TRAIT EVOLUTION AND SPECIES DIVERSITY VARIATION AMONG ANGIOSPERM FAMILIES

MICHAEL E. DODD,¹ JONATHAN SILVERTOWN,^{1,2} AND MARK W. CHASE³

¹Ecology and Conservation Research Group, Biology Department, Open University, Milton Keynes MK7 6AA, United Kingdom

²Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3DS, United Kingdom

Ecology, 81(5), 2000, pp. 1450–1461
© 2000 by the Ecological Society of America

WHICH TRAITS OF SPECIES PREDICT POPULATION DECLINES IN EXPERIMENTAL FOREST FRAGMENTS?

KENDI F. DAVIES,^{1,4} CHRIS R. MARGULES,² AND JOHN F. LAWRENCE³

¹Division of Botany and Zoology, Australian National University, Canberra ACT 0200, Australia

²CSIRO Wildlife and Ecology, PO Box 84, Lyneham ACT 2602, Australia

³CSIRO Australian National Insect Collection, Entomology, Box 1700, Canberra ACT 2601, Australia

Abstract. Theory suggests that species with particular traits are at greater risk of extinction than others. We assumed that a decline in abundance in forest fragments, compared to continuous forest, equated to an increase in extinction risk. We then tested the relationships between five traits of species and decline in abundance for 69 beetle species in an experimentally fragmented forest landscape at Mt. Woorwo in southeastern Australia.

Annu. Rev. Ecol. Syst. 2008. 39:615–39

First published online as a Review in Advance on September 10, 2008

Key Words

marine, freshwater, resources, trade-offs, functional groups

Why Trait-based Ecology?

- **Frustrations with the limitations of ‘traditional’ metrics**
 - Organismal/species classification (functional groupings)
 - Life history groupings (*r* vs. *K* strategist, etc.)
 - Diversity metrics (e.g. Species diversity)
- **More closely captures variation in organismal ‘performance’**
- **More quantitative (move from discrete to continuous measures)**
- **Thought to offer more insight and predictive power**
- **Can better link evolutionary questions (bridges phenotype and genotype)**
- **Can better link biodiversity and ecosystem function**
- **A basis to scale from organisms to ecosystems and evolutionary dynamics**

Why Trait-based Science?

Trait-based approaches are rapidly becoming the basis of much ecology, physiology, comparative evolutionary studies, and global change biology.

Patterns in organismal and species functional traits are increasingly being used to understand

- evolutionary dynamics
- the mechanisms of community assembly,
- ecosystem functioning,
- how the biosphere matters in global change biology.

Why Trait-based Science?

Well, we seem to just be using the word 'trait' more

brianjenquist@gmail.com | [Sign out](#)

Google Trends

Tip: Use commas to compare multiple search terms.

Searches [Websites](#)

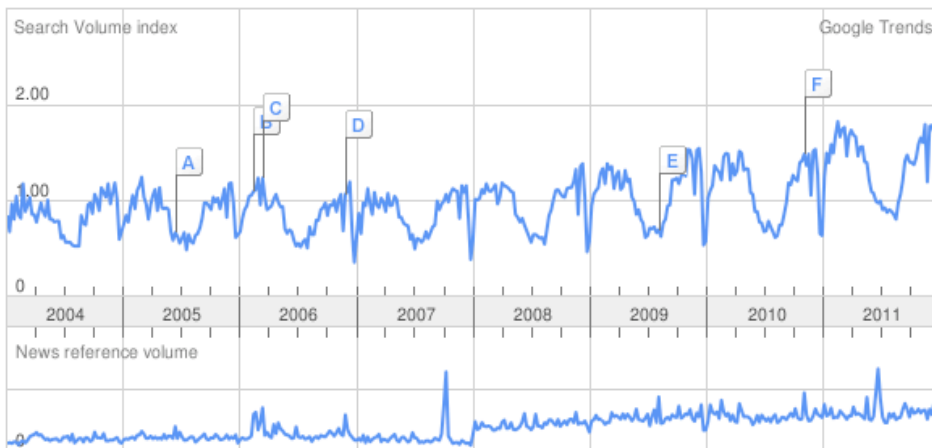
United States

All subregions

All years

- Scale is based on the average traffic of [trait](#) from United States in all years. [Learn more](#)
- An improvement to our geographical assignment was applied retroactively from 1/1/2011. [Learn more](#)

[trait](#) 1.00



Rank by

- [A 'I enjoy people' -- Methodist Oaks CEO uses role as minister, director to exhibit character trait of fairness](#)
The Times and Democrat - Jun 17 2005
 - [B A Golden Touch Is a Trait of Any Mogul](#)
Los Angeles Times - Feb 17 2006
 - [C Teen Did Not Die From Sickle Cell Trait, Doctor Says](#)
NBC6.net - Mar 14 2006
 - [D DuPont Achieves Regulatory Milestone for Optimum\(TM\) GAT\(TM\) Trait in Soybeans](#)
PR Newswire (press release) - Nov 28 2006
 - [E Rare athlete deaths spur sickle cell trait testing](#)
msnbc.com - Aug 3 2009
 - [F Changing A Nation's Mindset One Trait At A Time](#)
Jamaica Observer - Oct 31 2010
- [More news results »](#)

Why Trait-based Science?

... and seem to just be using the word 'ecology' less.

brianjenquist

Google Trends

Tip: Use commas to compare multiple search terms.

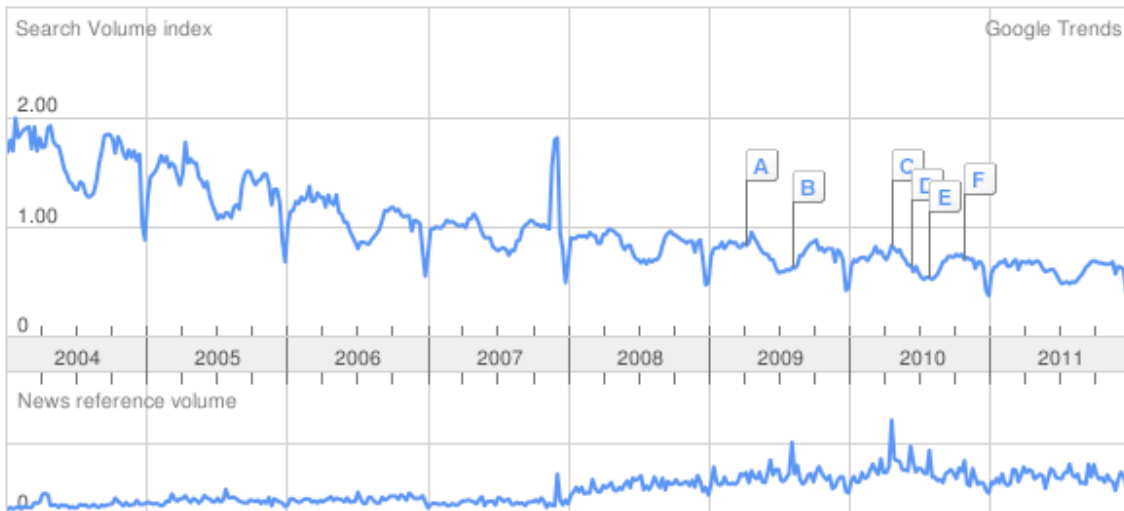
Searches [Websites](#)

All regions

- Scale is based on the average worldwide traffic of **ecology** in all years. [Learn more](#)
- An improvement to our geographical assignment was applied retroactively from 1/1/2011. [Learn more](#)

ecology

1.00



Rank by

- [A Tax practices that hurt ecology: Shourie](#)
Times of India - Apr 8 2009
- [B Florida Bay's ecology on the brink of collapse](#)
SFGate.com - Aug 5 2009
- [C Call for damage control to save ecology](#)
Times of India - Apr 22 2010
- [D Ongoing Gulf oil spill wreaking havoc for marine ecology](#)
Sify - Jun 9 2010
- [E Beyond The Science-Religion Debate: A Spiritual Ecology?](#)
NPR - Jul 29 2010
- [F US Ecology Reports Improved 3Q Results](#)
Toronto Star - Oct 26 2010

[More news results »](#)

Do trait based approaches really reveal more?

Improve our science?

Provide more insight?

How much of the current focus on traits
is just hype versus real insight?

What is a Trait?

There has been confusion in the use, not only of the term “trait” itself, but also in the underlying concept(s) it refers to.

To start . . .

A trait is any quantifiable characteristic of a phenotype (organism) which is presumably is governed by a specific gene(s)

Several uses of the term 'Trait'

What is a trait versus a functional trait?

What is a Functional Trait?

A trait that impacts fitness indirectly via their effects on growth, reproduction and survival,

What is a 'Response Trait'?

What is an 'Effect Trait'?

More on these later – but terms used in community and ecosystem ecology

**An overview of *some* of the focal areas of
current trait based research**

Integrated phenotypes

Measuring one trait often reflects other traits and whole organism function

Some traits are more 'central and important'

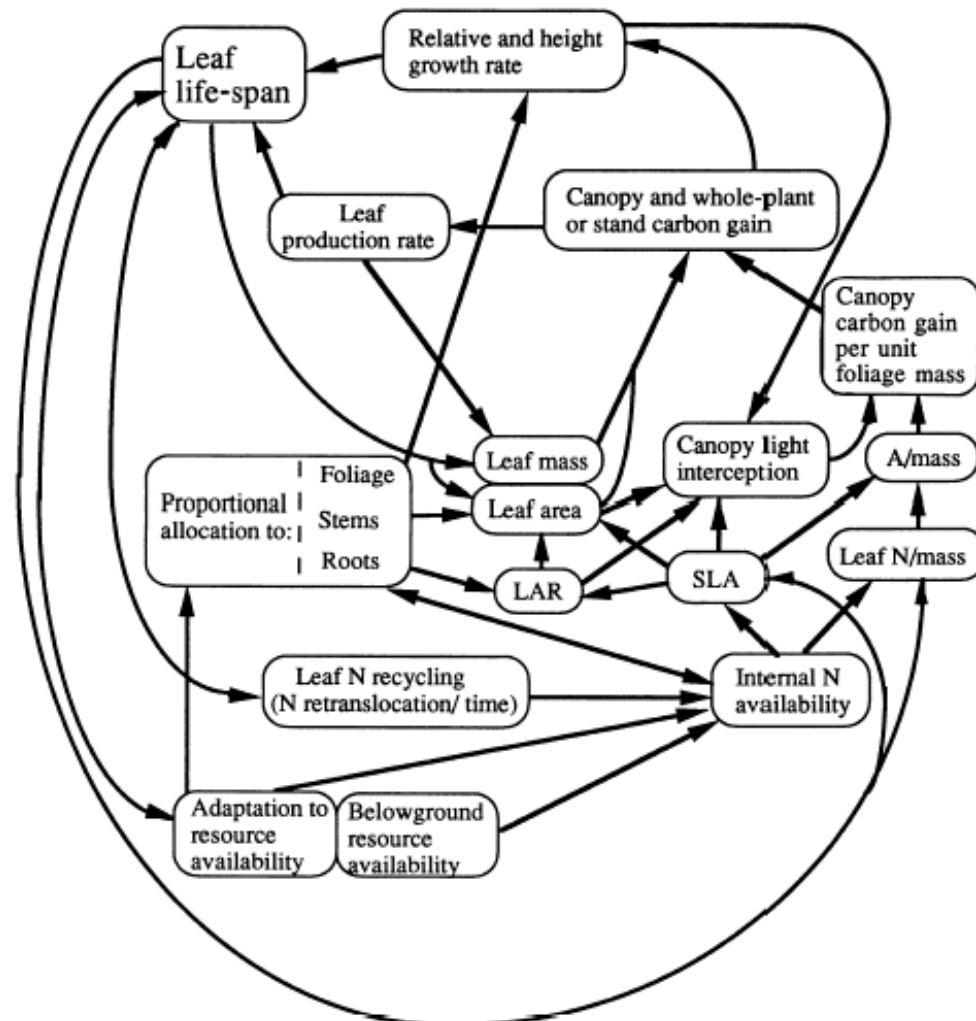


FIG. 9. Conceptual model of the interrelationships between allocation, metabolism, and patterns of carbon assimilation and distribution as affected by and affecting leaf life-span. For simplicity, and to be consistent with topics covered in this paper, the model focuses on N and does not consider the influence of other nutrients or water. However, the model is applicable to other resources such as these and their interactions would follow generally the pathways shown, as well as requiring additional ones. Influences of both adaptation and acclimation are addressed in the model. The model is applicable to young, individual, open-grown plants, and to forest stands. For instance, in young plants of species with short leaf life-span, high SLA and N_{mass} lead to high A_{mass} and LAR, resulting in high plant carbon gain and growth that "feed back" to result in higher leaf area and mass, further accelerating carbon gain, growth rate, and leaf turnover rate. Young plants with long leaf life-span show opposite traits (e.g., low SLA, A_{mass}) that interact to result in low carbon gain and growth. However, as young plants grow into large trees and form closed-canopy forest stands, extended leaf life-span leads to the accumulation of high leaf mass and leaf area, that act to partially compensate for the traits that otherwise lead to low productivity.

From tropics to tundra: Global convergence in plant functioning

PETER B. REICH^{*†}, MICHAEL B. WALTERS[‡], AND DAVID S. ELLSWORTH[§]

^{*}Department of Forest Resources, University of Minnesota, St. Paul, MN 55108; [‡]Faculty of Natural Resources and Environmental Studies, University of Northern British Columbia, Prince George, British Columbia, Canada V2N 4Z9; and [§]Department of Applied Science, Brookhaven National Laboratory, Upton, NY 11973

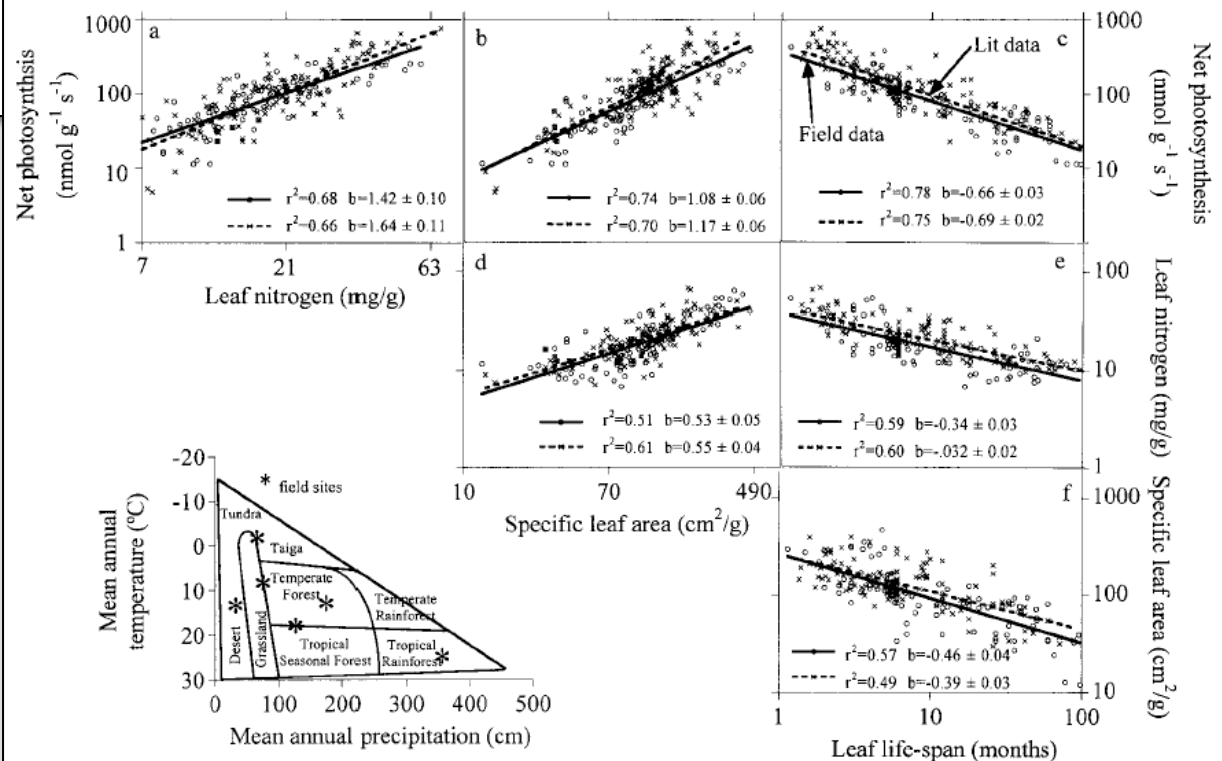
Communicated by Harold Alfred Mooney, Stanford University, Stanford, CA, September 12, 1997 (received for review May 21, 1997)

ABSTRACT Despite striking differences in climate, soils, and evolutionary history among diverse biomes ranging from tropical and temperate forests to alpine tundra and desert, we found similar interspecific relationships among leaf structure and function and plant growth in all biomes. Our results thus demonstrate convergent evolution and global generality in plant functioning, despite the enormous diversity of plant species and biomes. For 280 plant species from two global data

species, light-saturated net photosynthetic capacity (A_{\max}) and leaf diffusive conductance were measured in the field (7–9)

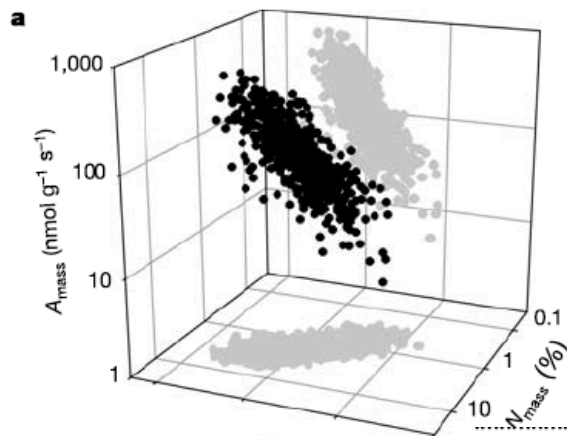
Ecology: Reich *et al.*

Proc. Natl. Acad. Sci. USA 94 (1997)

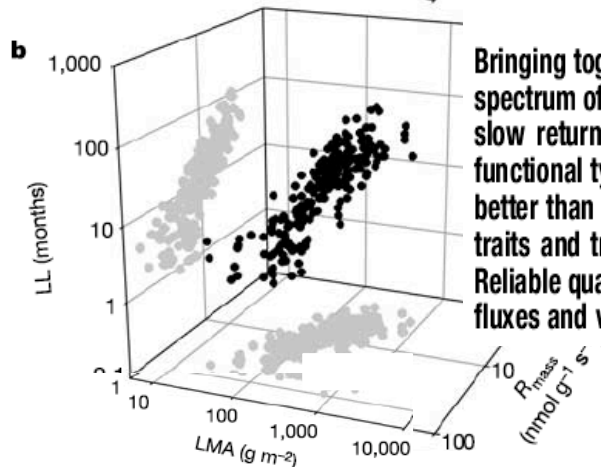


The worldwide leaf economics spectrum

Ian J. Wright¹, Peter B. Reich², Mark Westoby¹, David D. Ackerly³, Zdravko Baruch⁴, Frans Bongers⁵, Jeannine Cavender-Bares⁶, Terry Chapin⁷, Johannes H. C. Cornelissen⁸, Matthias Diemer⁹, Jaume Flexas¹⁰, Eric Garnier¹¹, Phillip K. Groom¹², Javier Gullas¹⁰, Kouki Hikosaka¹³, Byron B. Lamont¹², Tall Lee¹⁴, William Lee¹⁵, Christopher Lusk¹⁶, Jeremy J. Midgley¹⁷, Marie-Laure Navas¹¹, Ülo Niinemets¹⁸, Jacek Oleksyn^{2,19}, Noriyuki Osada²⁰, Hendrik Poorter²¹, Pieter Poort²², Lynda Prior²³, Vladimir I. Pyankov²⁴, Catherine Roumet¹¹, Sean C. Thomas²⁵, Mark G. Tjoelker²⁶, Erik J. Veneklaas²² & Rafael Villar²⁷



Wright et al. (2004) *Nature*



Bringing together leaf trait data spanning 2,548 species and 175 sites we describe, for the first time at global scale, a universal spectrum of leaf economics consisting of key chemical, structural and physiological properties. The spectrum runs from quick to slow return on investments of nutrients and dry mass in leaves, and operates largely independently of growth form, plant functional type or biome. Categories along the spectrum would, in general, describe leaf economic variation at the global scale better than plant functional types, because functional types overlap substantially in their leaf traits. Overall, modulation of leaf traits and trait relationships by climate is surprisingly modest, although some striking and significant patterns can be seen. Reliable quantification of the leaf economics spectrum and its interaction with climate will prove valuable for modelling nutrient fluxes and vegetation boundaries under changing land-use and climate.

**Quantifying the diversity of strategies:
life histories & new insights to diversity**

EVIDENCE FOR THE EXISTENCE OF THREE
PRIMARY STRATEGIES IN PLANTS AND ITS RELEVANCE
TO ECOLOGICAL AND EVOLUTIONARY THEORY

J. P. GRIME

Unit of Comparative Plant Ecology (NERC), Department of Botany, The University,
Sheffield S10 2TN, England

The external factors limiting plant biomass in any habitat may be classified into two categories. The first, which henceforth will be described as stress, consists of conditions that restrict production, e.g., shortages of light, water, or mineral nutrients and suboptimal temperatures. The second, referred to here as disturbance, is associated with the partial or total destruction of the plant biomass and arises from the activities of herbivores, pathogens, man (trampling, mowing, and plowing), and from phenomena such as wind damage, frosts, desiccation, soil erosion, and fire.

Grime 1977 *American Naturalist*

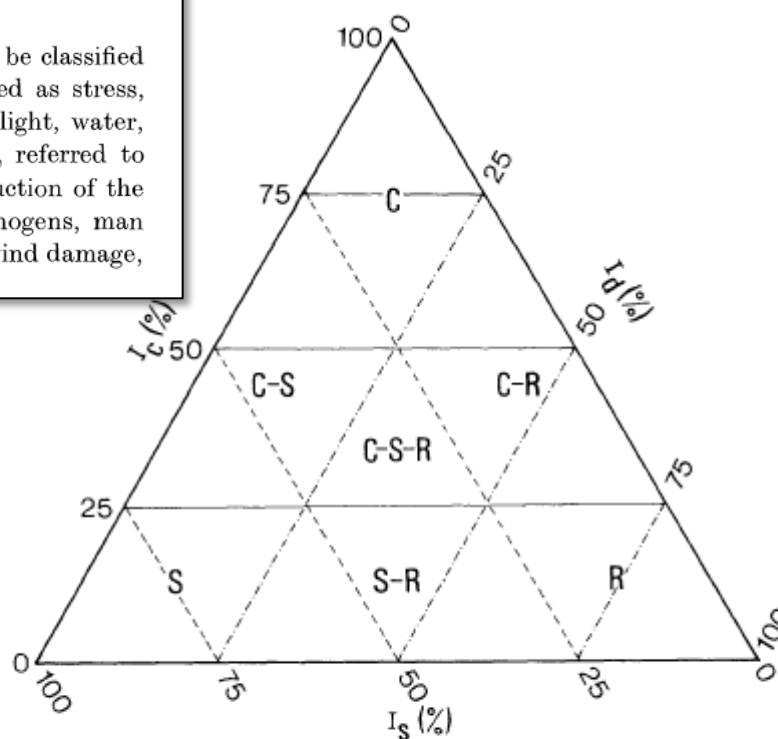


FIG. 2.—Model describing the various equilibria between competition, stress, and disturbance in vegetation and the location of primary and secondary strategies. I_c —relative importance of competition (—), I_s —relative importance of stress (---), I_d —relative importance of disturbance (· · · ·). A key to the symbols for the strategies is included in the text.



A leaf-height-seed (LHS) plant ecology strategy scheme

Mark Westoby

*School of Biological Sciences, Macquarie University, NSW 2109, Australia**

Received 27 August 1997. Accepted in revised form 15 December 1997

Key words: height of species canopy, meta-analysis, plant ecological strategy, plant functional types, seed mass, specific leaf area

Annu. Rev. Ecol. Syst. 2002. 33:125–59

doi: 10.1146/annurev.ecolsys.33.010802.150452

Copyright © 2002 by Annual Reviews. All rights reserved

First published online as a Review in Advance on August 6, 2002

PLANT ECOLOGICAL STRATEGIES: Some Leading Dimensions of Variation Between Species

Mark Westoby, Daniel S. Falster, Angela T. Moles,
Peter A. Vesk, and Ian J. Wright

*Department of Biological Sciences, Macquarie University, Sydney, New South Wales
2109, Australia; email: mwestoby@rna.bio.mq.edu.au*

Key Words seed mass, leaf mass per area, foliage height, leaf size, leaf lifespan,
twig size

Functional richness, functional evenness and functional divergence: the primary components of functional diversity

Norman W. H. Mason, David Mouillot, William G. Lee and J. Bastow Wilson

January 2010

NOTES

299

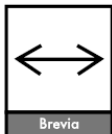
Ecology, 91(1), 2010, pp. 299–305
© 2010 by the Ecological Society of America

A distance-based framework for measuring functional diversity from multiple traits

ETIENNE LALIBERTÉ^{1,3} AND PIERRE LEGENDRE²

¹*School of Forestry, University of Canterbury, Private Bag 4800, Christchurch 8140 New Zealand*

²*Département de Sciences Biologiques, Université de Montréal, C.P. 6128, Succursale Centre-Ville, Montréal H3C 3J7 Canada*



Oikos 116: 1422–1426, 2007

doi: 10.1111/j.2007.0030-1299.15894.x,

Copyright © Oikos 2007, ISSN 0030-1299

Subject Editor: Nick Gotelli, Accepted 19 March 2007

Dendrograms and measuring functional diversity

Owen L. Petchey and Kevin J. Gaston

O. L. Petchey (o.petchey@shef.ac.uk) and K. J. Gaston, Dept of Animal and Plant Sciences, Univ. of Sheffield, Sheffield, UK, S10 2TN.

Measure traits to measure Ecosystem function

Emerging out of the Biodiversity/Ecosystem Functioning Debate....

Proc. Natl. Acad. Sci. USA
Vol. 94, pp. 1857–1861, March 1997
Ecology

Plant diversity and ecosystem productivity: Theoretical considerations

(biodiversity/resource competition/soil fertility/nutrient use/retention)

DAVID TILMAN[†], CLARENCE L. LEHMAN[†], AND KENDALL T. THOMSON[‡]

[†]Department of Ecology, Evolution and Behavior, 1987 Upper Buford Circle, University of Minnesota, St. Paul, MN 55108; and [‡]Department of Chemical Engineering and Materials Science, 421 Washington Avenue SE, University of Minnesota, Minneapolis, MN 55455



ECOLOGY

Biodiversity and Ecosystem Function: The Debate Deepens

J. P. Grime



Proc. Natl. Acad. Sci. USA
Vol. 94, pp. 1857–1861, March 1997
Ecology

Plant diversity and ecosystem productivity: Theoretical considerations

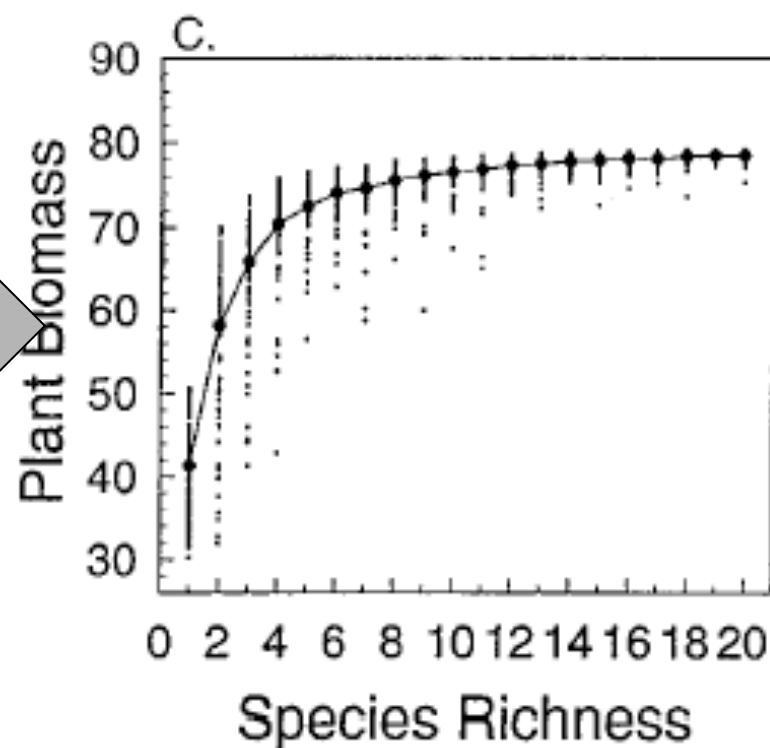
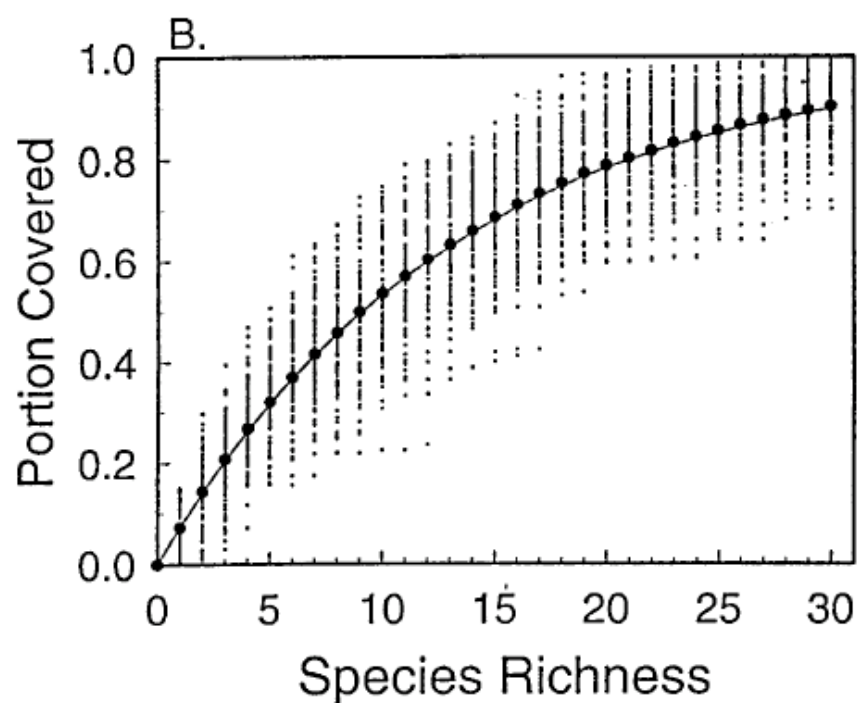
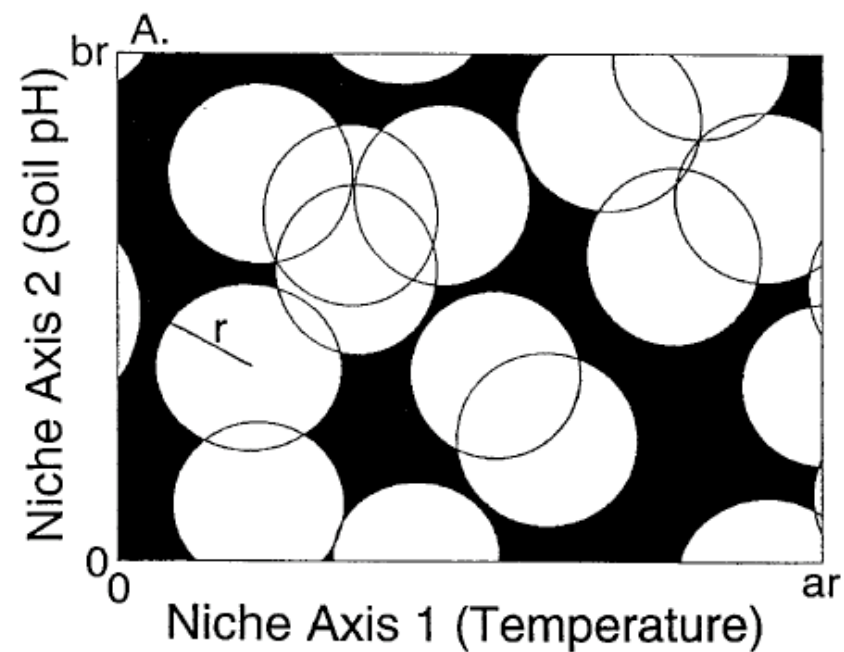
(biodiversity/resource competition/soil fertility/nutrient use/retention)

DAVID TILMAN[†], CLARENCE L. LEHMAN[†], AND KENDALL T. THOMSON[‡]

[†]Department of Ecology, Evolution and Behavior, 1987 Upper Buford Circle, University of Minnesota, St. Paul, MN 55108; and [‡]Department of Chemical Engineering and Materials Science, 421 Washington Avenue SE, University of Minnesota, Minneapolis, MN 55455

Communicated by Peter Vitousek, Stanford University, Stanford, CA, December 23, 1996 (received for review September 1, 1996)

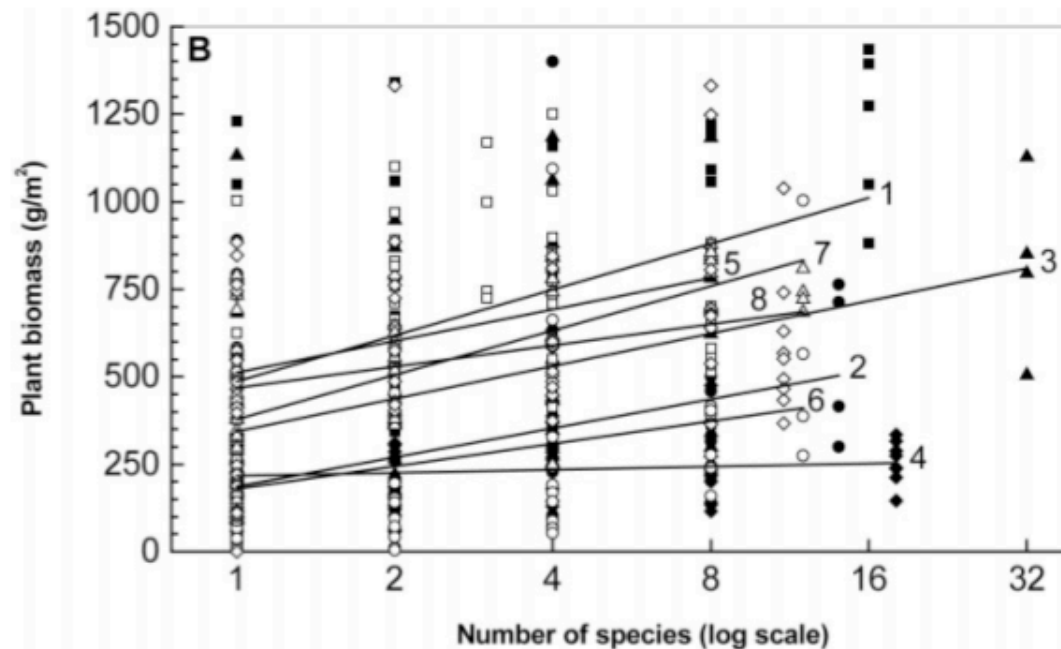






Biodiversity and Ecosystem Functioning: Current Knowledge and Future Challenges

M. Loreau,^{1*} S. Naeem,² P. Inchausti,¹ J. Bengtsson,³ J. P. Grime,⁴ A. Hector,⁵ D. U. Hooper,⁶ M. A. Huston,⁷ D. Raffaelli,⁸
B. Schmid,⁹ D. Tilman,¹⁰ D. A. Wardle⁴



“The . . . consequences of biodiversity . . . has aroused considerable interest and controversy. . . there is however, uncertainty as to how (these findings). . . generalize across ecosystems”

Trait diversity is more important than species richness to ecosystem functioning

Vive la différence: plant functional diversity matters to ecosystem processes

Sandra Díaz and Marcelo Cabido

The links between plant diversity and ecosystem functioning remain highly controversial. There is a growing consensus, however, that functional diversity, or the value and range of species traits, rather than species numbers *per se*, strongly determines ecosystem functioning. Despite its importance, and the fact that species diversity is often an inadequate surrogate, functional diversity has been studied in relatively few cases.

Approaches based on species richness on the one hand, and on functional traits and types on the other, have been extremely productive in recent years, but attempts to connect their findings have been rare. Crossfertilization between these two approaches is a promising way of gaining mechanistic insight into the links between plant diversity and ecosystem processes and contributing to practical management for the ecosystem services.

ecosystem processes and the ECOSYSTEM SERVICES (see Glossary) that humans derive from them¹. The issue of whether plant diversity influences ecosystem processes has received increasing attention in the past five years, as a consequence of the publication of several groundbreaking theoretical developments and experiments^{2–13}.

There is now general agreement that diversity (a synonym of biodiversity and biological diversity) includes both number and composition of the genotypes, species, functional types and landscape

Functional Ecology 2002
16, 545–556

ESSAY REVIEW

Predicting changes in community composition and ecosystem functioning from plant traits: revisiting the Holy Grail

S. LAVOREL* and E. GARNIER

Centre d' Ecologie Fonctionnelle et Evolutive, CNRS UPR 9056, 1919 route de Mende, 34293 Montpellier Cedex 5, France

Revitalization of Community Ecology?

“Community ecology appears to have few if any useful generalizations . . . ”

VOL. 163, NO. 6 THE AMERICAN NATURALIST JUNE 2004

Community Ecology: Is It Time to Move On?

(An American Society of Naturalists Presidential Address)

Daniel Simberloff[†]

Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996

*Submitted August 29, 2003; Accepted January 9, 2004;
Electronically published April 21, 2004*



There are three separate issues here. First, does community ecology really not have general laws? Second, is the worth of community ecology as a science determined by the degree to which communities adhere to general laws? Third, whether community ecology has or will ever have general laws, we must study communities because understanding them is crucial to dealing with many key conservation and environmental issues.

Functional Traits and Niche-Based Tree Community Assembly in an Amazonian Forest

Nathan J. B. Kraft,¹ Renato Valencia,² David D. Ackerly¹

It is debated whether species-level differences in ecological strategy, which play a key role in much of coexistence theory, are important in structuring highly diverse communities. We examined the co-occurrence patterns of over 1100 tree species in a 25-hectare Amazonian forest plot in relation to field-measured functional traits. Using a null model approach, we show that co-occurring trees are often less ecologically similar than a niche-free (neutral) model predicts. Furthermore, we find evidence for processes that simultaneously drive convergence and divergence in key aspects of plant strategy, suggesting that at least two distinct niche-based processes are occurring. Our results show that strategy differentiation among species contributes to the maintenance of diversity in one of the most diverse tropical forests in the world.

Explaining the high species diversity of moist tropical forests has proved an enduring challenge to ecologists and has inspired many theories of species coexistence and much debate (1–3). Current coexistence theories can be divided into two categories: those that invoke a role for meaningful differences in the ecological strategy (niche) of co-occurring species (2–5), and those that rely on dispersal and stochastic demographic processes that explicitly assume the equivalent per capita fitness of species (1). The latter, termed neutral theory, was initially developed to explain coexistence in diverse tropical forests (1), where it seemed implausible that each tree species occupied a unique niche, although it can be applied to a range of communities.

Few large-scale tests of coexistence theories in tropical forests have explicitly examined the ecological strategy of co-occurring species, in part because of difficulties in identifying more than a few discrete plant strategies (such as shade-tolerant, light-demanding pioneer, etc.) (6). Recent advances in functional ecology now permit a more precise quantification of woody plant strategy along a number of continuous, often orthogonal, axes of variation related to resource acquisition strategy, regeneration niche, environmental tolerance, and life history (7–10), opening the door for previously intractable analyses.

Here we present a critical test of neutral and niche-based coexistence theories in one of the most diverse tropical forest plots in the world. The stochastic processes associated with neutral theory assume the equivalence of all individuals, and therefore species, with the result that species co-occurrence patterns should be random with respect to ecological strategy (1, 11). We tested

for two niche-based alternatives: (i) that co-occurring species converge in strategy because of establishment and/or survival barriers imposed by the abiotic environment (“environmental filtering”) (4, 12, 13); and (ii) that co-occurring species diverge in strategy as predicted by classic coexistence theory (“niche differentiation”) (5, 14). The latter pattern may occur as a result of competition or of enemy-mediated density dependence (15) if plant susceptibility (16) and overall plant strategy are phylogenetically conserved. A strength of our approach is that we are able to test for both processes (17), because environmental filtering should limit the range of strategies found in a community (12, 17), whereas niche differentiation should spread individuals evenly along strategy axes (14, 17). These two features of community-trait distributions can be assessed sequentially.

We tested these predictions in the Yasuni Forest Dynamics Plot (FDP) in eastern Ecuador, a 25-ha plot containing over 150,000 mapped trees ≥ 1 cm in diameter at breast height (dbh) from over 1100 species (18). The ecological strategy for each species was quantified with field-measured estimates of specific leaf area (SLA, leaf area divided by dry mass), leaf nitrogen concentration, leaf size, seed mass, and maximum dbh (used here as a proxy for maximum height), as well as published estimates of wood density (19, 20). We combined this trait information with species co-occurrence data to develop estimates of the community-trait distribution at the 20-by-20-m (“quadrat”) scale. Metrics of community-trait structure sensitive to environmental filtering and niche differentiation were compared to a null expectation. We generated our null expectation by creating random communities of equal richness by drawing species from the entire plot weighted by their plot-wide occurrence, irrespective of trait values (20).

We predict that if habitat filtering is occurring at the quadrat scale, the range of observed trait

¹Department of Integrative Biology, University of California, Berkeley, CA 94720, USA. ²Laboratorio de Ecología de Plantas, Escuela de Ciencias Biológicas, Pontificia Universidad Católica del Ecuador, Aptado, 17-01-2184, Quito, Ecuador.

New & Interesting Approaches and Methods

- New measures of diversity (Functional diversity)
- New measures of functional similarity and differences
 - null models & simulations*
- Hierarchical analysis of variation
- Regression techniques (OLS, RMA etc.)
- Phylogenetic methods for trait evolution
 - measures of trait conservatism*
 - measures of rates of trait divergence*
- Units, dimensional analysis, and Log transformation of traits
- Several others too! ...

Phylocom

Software for the Analysis of Phylogenetic Community Structure and Character Evolution, with Phylomatic

Current version: 4.2 (released 2011-08-06)

© 2011 Campbell Webb, David Ackerly, Steven Kembel



Features (Current version: 4.2)

- Calculate phylogenetic community structure metrics (Webb's NRI, NTI, Faith's PD, Rao's entropy) and compare observed patterns to those expected under various null models of community assembly and phylogeny structure (`comstruct`). Now, many metrics incorporate variation in taxon abundance.
- Calculate inter-sample phylogenetic distance for phylogenetic ordination and classification (`comdist` and `comdistnt`). Now incorporates null model testing of observed patterns.
- Comparative methods for the analysis of character evolution (`aot`; conservatism metrics, independent contrasts, lineages through time).
- Calculate trait distribution metrics within sample communities and compare to metrics for random community assembly (`comtrait`).
- Simulate phylogeny and trait evolution under various evolutionary models (`ecovolve`).
- Manipulate phylogenetic trees and ecological community data: convert Newick to Nexus format, prune and merge phylogenetic trees, add branch lengths to your supertrees, community data randomization using one of several null models, and much more...
- Turn species lists into phylogenies (with or without branch lengths) using the included standalone version of `phylomatic` and `phylocom`'s `bladj` function.
- Handles large data sets (tested with >10,000 samples/taxa), polytomies, continuous and categorical characters. NEW: detects UNIX/Windows/Mac line-endings in your input files.

(Difference from version 4.1 to 4.2: minor bug fixes, and new options: `new2fy` and `nodesigl`)

Picante: R tools for integrating phylogenies and ecology

About Picante

The Picante package provides tools for **Phylocom** integration, **community analyses**, **null-models**, **traits** and **evolution** in R.

The package includes functions for analyzing the phylogenetic and trait diversity of ecological communities, comparative analyses, and the display and manipulation of phenotypic and phylogenetic data.

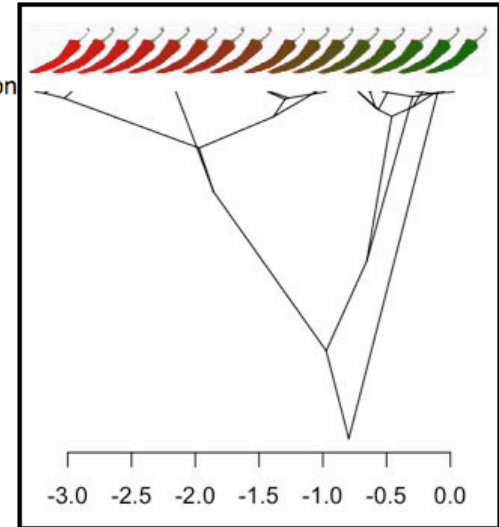
Package maintainer: Steven Kembel

Developers: Peter Cowan, Matthew Helmus, Steven Kembel

Contributors: David Ackerly, Simon Blomberg, Will Cornwell, Peter Cowan, Matthew Helmus, Steven Kembel, Helene Morlon, Cam Webb

Development of picante has been supported by **NSERC**, **NESCent**, the **Google Summer of Code**, and the **Gordon and Betty Moore Foundation**.

Thanks to Kyle Dexter, Catherine Graham, Nathaniel Hallinan, Nick Matzke, Alain Paquette, Emmanuel Paradis, Juan Parra, Dan Rabosky, and Marten Winter for feedback and bug reports. Thanks to **R-Forge** for hosting the project.



News

- A manuscript describing Picante has been published in Bioinformatics.
- Picante 1.3 has been released
 - The phylogenetic community dissimilarity (PCD) of Ives and Helmus (2010) is now included in function `pcd`
- Lots of changes and new features in version 1.0
 - Calculate Rao's quadratic entropy (alpha and beta diversity taking phylogenetic distinctiveness into account)
 - Added more phylobeta diversity measures (UniFrac, Rao's quadratic entropy)
 - Changed name of `randomizeSample` to `randomizeMatrix` for consistency with other functions
 - Added automatic checks to ensure taxa labels in phylogeny and other data sets match

[R-pkgs] FD: R package to measure functional diversity indices

Etienne Laliberté etiennelaliberte@gmail.com

Thu Apr 16 23:44:57 CEST 2009

- Previous message: [\[R-pkgs\] Major bigmemory revision released.](#)
- Next message: [\[R-pkgs\] igraph 0.5.2](#)
- Messages sorted by: [\[date \]](#) [\[thread \]](#) [\[subject \]](#) [\[author \]](#)

Dear useRs,

The FD package is intended for ecologists interested in functional diversity (FD). It measures different functional diversity indices from multiple traits (any type of traits). The first version of FD (1.0-0) is now available on CRAN:

<http://cran.r-project.org/web/packages/FD/>

The main functions of FD are:

dbFD: Compute different multidimensional FD indices

gowdis: Gower dissimilarity, including options for variable asymmetric binary variables, and implementing Podani's (1999) to ordinal variables

fdis: Functional dispersion

functcomp: Functional composition (community-weighted means values, or CWM)

Journal of Vegetation Science 14: 927-930, 2003
© IAVS: Opulus Press Uppsala.

927

Computer program review

VEGAN, a package of R functions for community ecology

Dixon, Philip

*Department of Statistics, Iowa State University, Ames, IA 50011-1210, USA;
Fax +15152944040; E-mail pdixon@iastate.edu*

Abstract. VEGAN adds vegetation analysis functions to the general-purpose statistical program R. Both R and VEGAN can be downloaded for free. VEGAN implements several ordination methods, including Canonical Correspondence Analysis and Non-metric Multidimensional Scaling, vector fitting of environmental variables, randomization tests, and various other analyses of vegetation data. It can be used for large data. Graphical output can be customized using the R language's extensive graphics capabilities. VEGAN is appropriate for routine and research use, if you are willing to learn some R.

Keywords: ANOSIM; Mantel test; Multidimensional scaling; Ordination; Procrustes rotation.

Addition results include Procrustes rotations, vector and surface fitting to relate environmental information to ordination plots, and various randomization tests. VEGAN also includes functions for working with distance matrices, including a choice of vegetation distance measures, Mantel tests, and ANOSIM using Clarke's R. Finally, VEGAN provides various utility functions to read data files in Cornell Ecology Program (CANOCO) format, standardize data, write compact species \times site tables, and compute diversity measures.

R is an object-oriented language, so most functions in the VEGAN package do not produce output directly; instead, they produce a data structure that stores the

 [Home](#)[About TRY](#)[Participants](#)[Database](#)[Data Explorer](#)[Contribute Data](#)[Request Data](#)[Projects](#)[Workshops](#)[References](#)[Internal](#)[Contact](#)

Welcome to the TRY Initiative on Plant Traits

Quantifying and scaling global plant trait diversity

A network of vegetation scientists jointly headed by
DIVERSITAS, IGBP and the Max Planck Institute for Biogeochemistry

Main objectives

- Construction of a global database of plant functional traits
- Make the data available for the ecological community
- Support the design of a new generation of global vegetation models

Current state of database and network

- 3 million trait records for about 69000 plant species
- 206 participants from 106 scientific institutes worldwide
- 50 scientific projects using plant trait data via TRY

PhotosyntheticPathway
Respiration LeafArea NfixationCapacity
SLA RegenerationCapacity PlantLifespan
WoodDensity GrowthForm
PhenologyType LeafN
LeafP LeafLongevity PhotosyntheticCapacity
MaxPlantHeight SeedMass

News

TRY Data Explorer

Now including maps and
downloads ([link](#))

TRY highlighted in FLUXNET newsletter

October 2011 Vol 4 No 2

*TRY – a global database of plant
traits – meets FLUXNET* ([link](#))

Paper published

Kattge et al.: *TRY – a global
database of plant traits*, Global
Change Biology, doi:
10.1111/j.1365-
2486.2011.02451.x ([link](#))

TRY in the media

*A new global database of plant
traits – TRY*,
Resilience Science ([link](#))

Paper published

Kattge et al.: *A generic
structure for plant trait
databases*, Methods in Ecology
and Evolution, doi:
10.1111/j.2041-
210X.2010.00067.x ([link](#))

Class Overview

To focus on how trait-based approaches can better link ecological, biogeochemical, and evolutionary mechanisms that have shaped patterns of diversity.

Cover both theoretical, empirical and applied cases of trait-based research

In sum, the goals of the course are –

- (i) To provide detailed introduction and critique of original literature (historical overview)
- (ii) To cover the primary trait-based focal points and debates in the current literature
- (iii) To provide overview of tools, methodology, and issues of trait-based studies
- (iv) To conduct original trait-based research via learning to use new and existing analyses in R