Centre for Philosophy of Science   Applied Evolutionary Epistemology Lab

3-Day International Conference on Evolutionary Patterns

Horizontal and Vertical Transmission and Micro- and Macroevolutionary Patterns of Biological and Sociocultural Evolution

Calouste Gulbenkian Foundation, Lisbon, Portugal

May 27th-29th, 2013

Integration between ecological and genealogical patterns: Where are we?

Emanuele Serrelli

"Riccardo Massa" Department of Human Sciences - University of Milano Bicocca, ITALY
Lisbon Applied Evolutionary Epistemology Lab - Universidade de Lisboa, PORTUGAL

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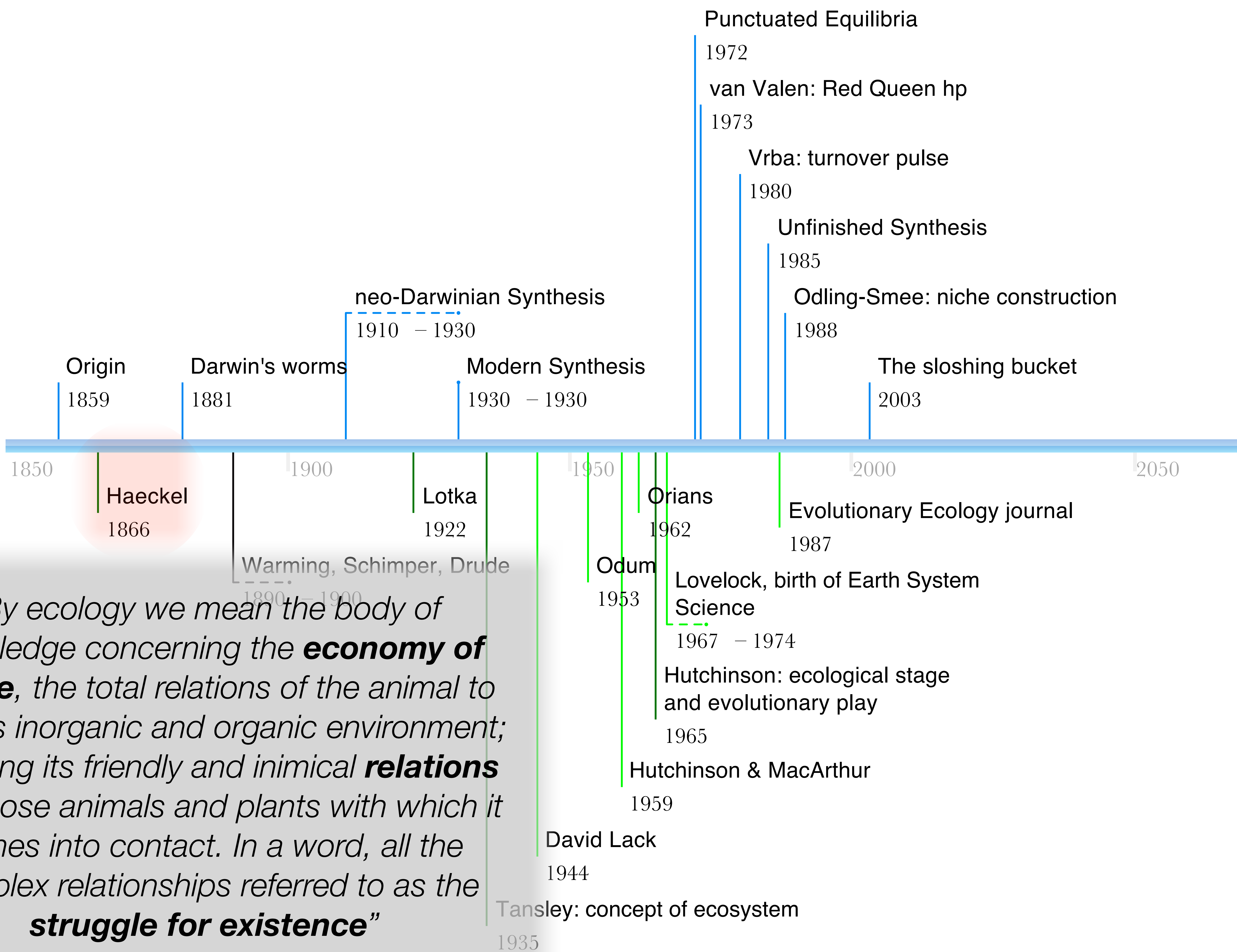
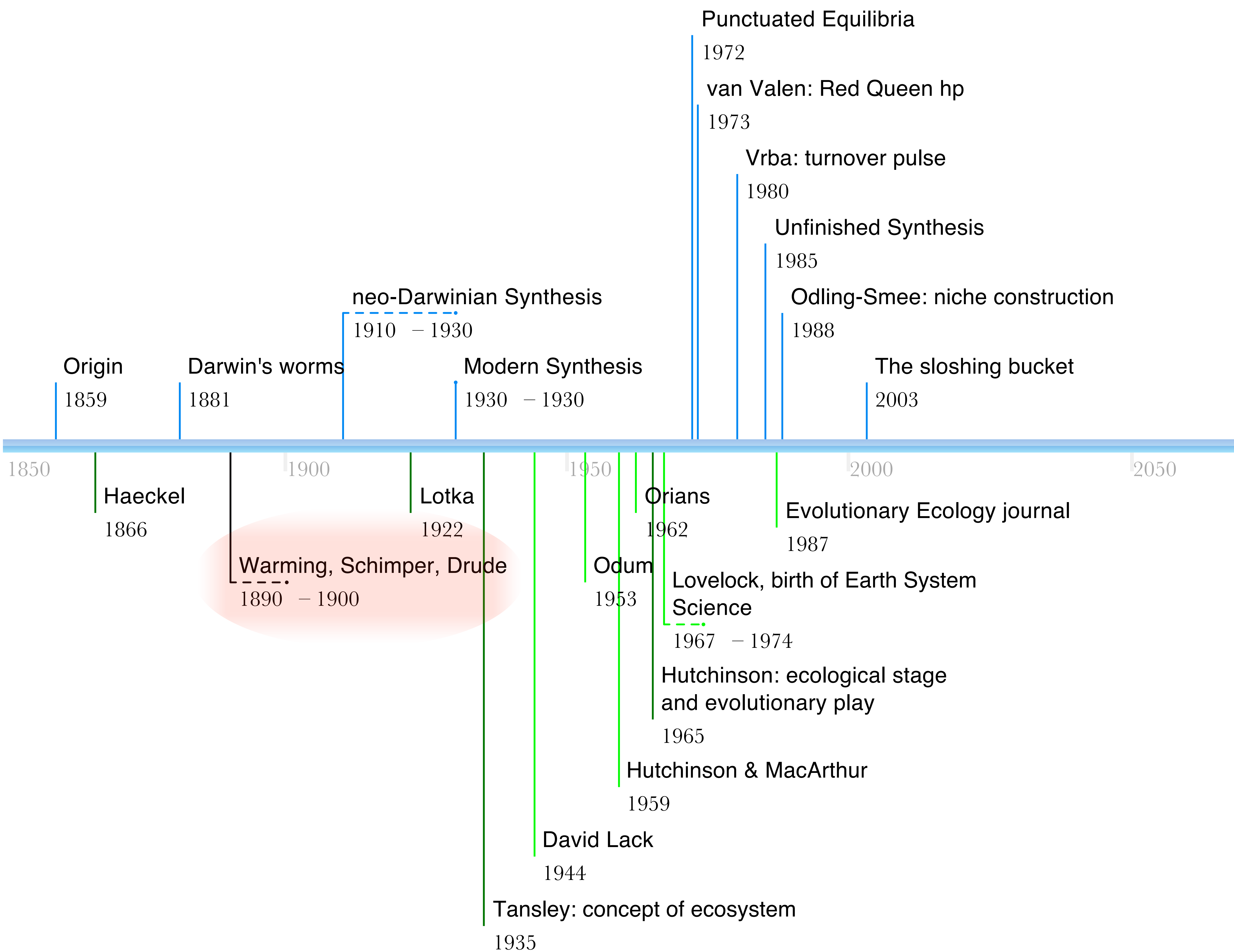


"By ecology we mean the body of knowledge concerning the ***economy of nature****, the total relations of the animal to both its inorganic and organic environment; including its friendly and inimical* ***relations*** *with those animals and plants with which it comes into contact. In a word, all the complex relationships referred to as the* ***struggle for existence****"*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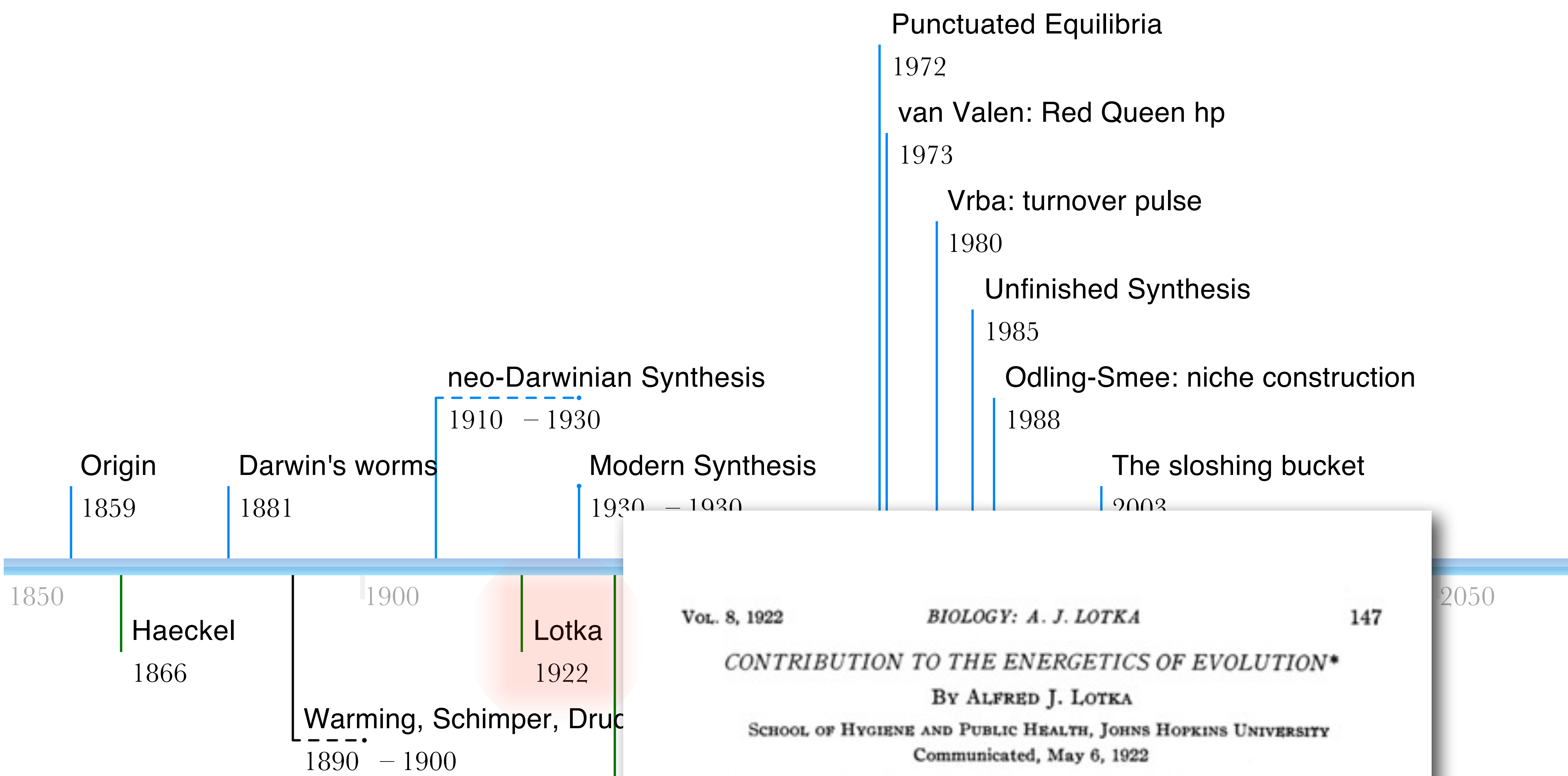
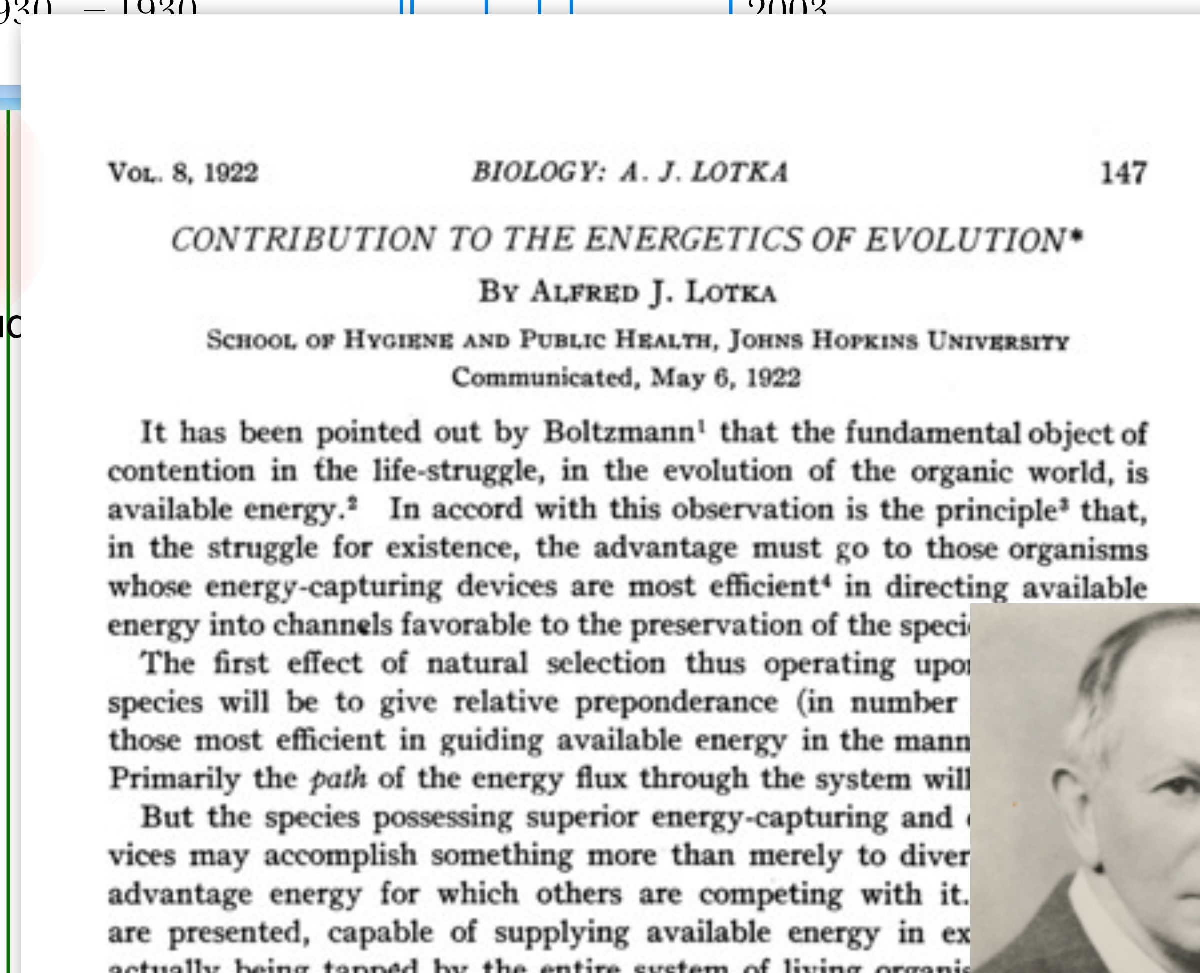




Vol. 8, 1922 *BIOLOGY: A. J. LOTKA* 147

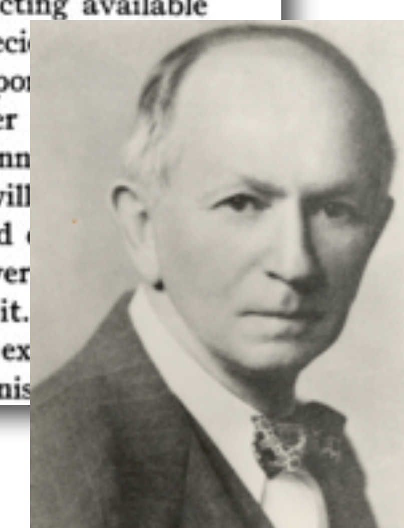
*CONTRIBUTION TO THE ENERGETICS OF EVOLUTION**

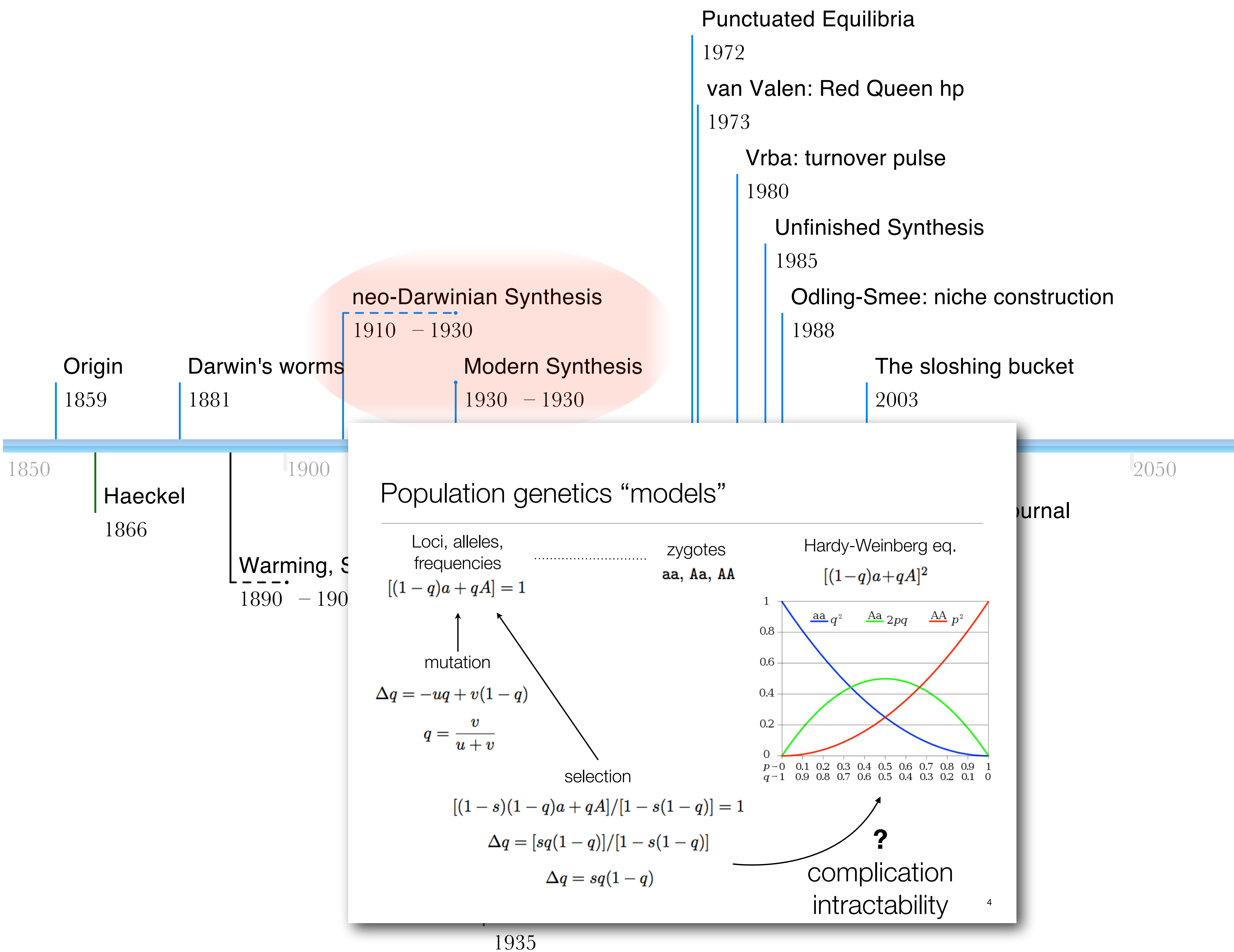
By Alfred J. Lotka

School of Hygiene and Public Health, Johns Hopkins University

Communicated, May 6, 1922

It has been pointed out by Boltzmann[1] that the fundamental object of contention in the life-struggle, in the evolution of the organic world, is available energy.[2] In accord with this observation is the principle[3] that, in the struggle for existence, the advantage must go to those organisms whose energy-capturing devices are most efficient[4] in directing available energy into channels favorable to the preservation of the speci
The first effect of natural selection thus operating upo species will be to give relative preponderance (in number those most efficient in guiding available energy in the mann Primarily the *path* of the energy flux through the system will
But the species possessing superior energy-capturing and vices may accomplish something more than merely to diver advantage energy for which others are competing with it. are presented, capable of supplying available energy in ex actually being tapped by the entire system of living organis

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Population genetics "models"
Loci, alleles, frequencies
$[(1-q)a+qA]=1$
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$[(1-q)a+qA]^2$
aa q^2
Aa $2pq$
AA p^2
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$\Delta q = -uq + v(1-q)$
$q = \frac{v}{u+v}$
selection
$[(1-s)(1-q)a+qA]/[1-s(1-q)]=1$
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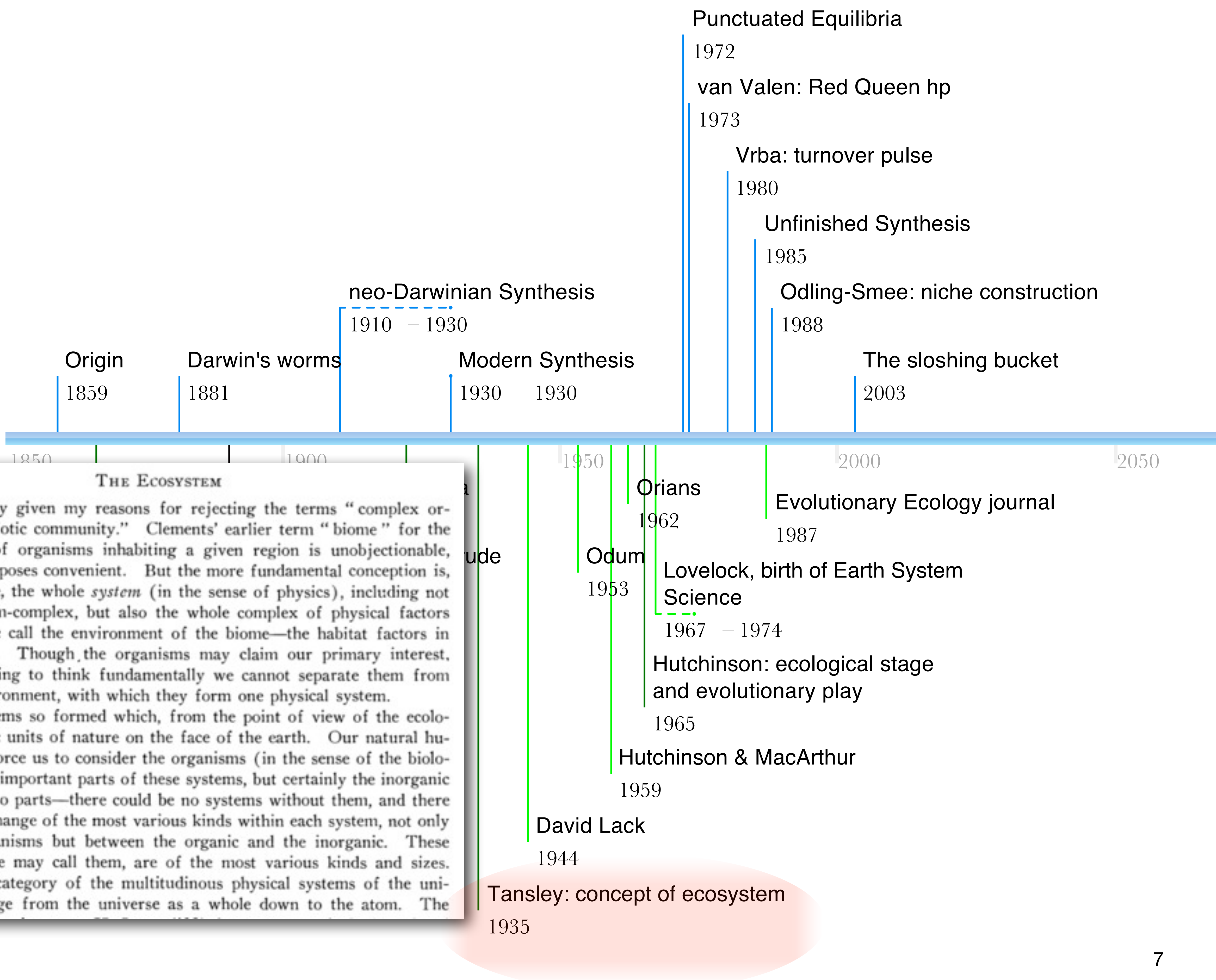
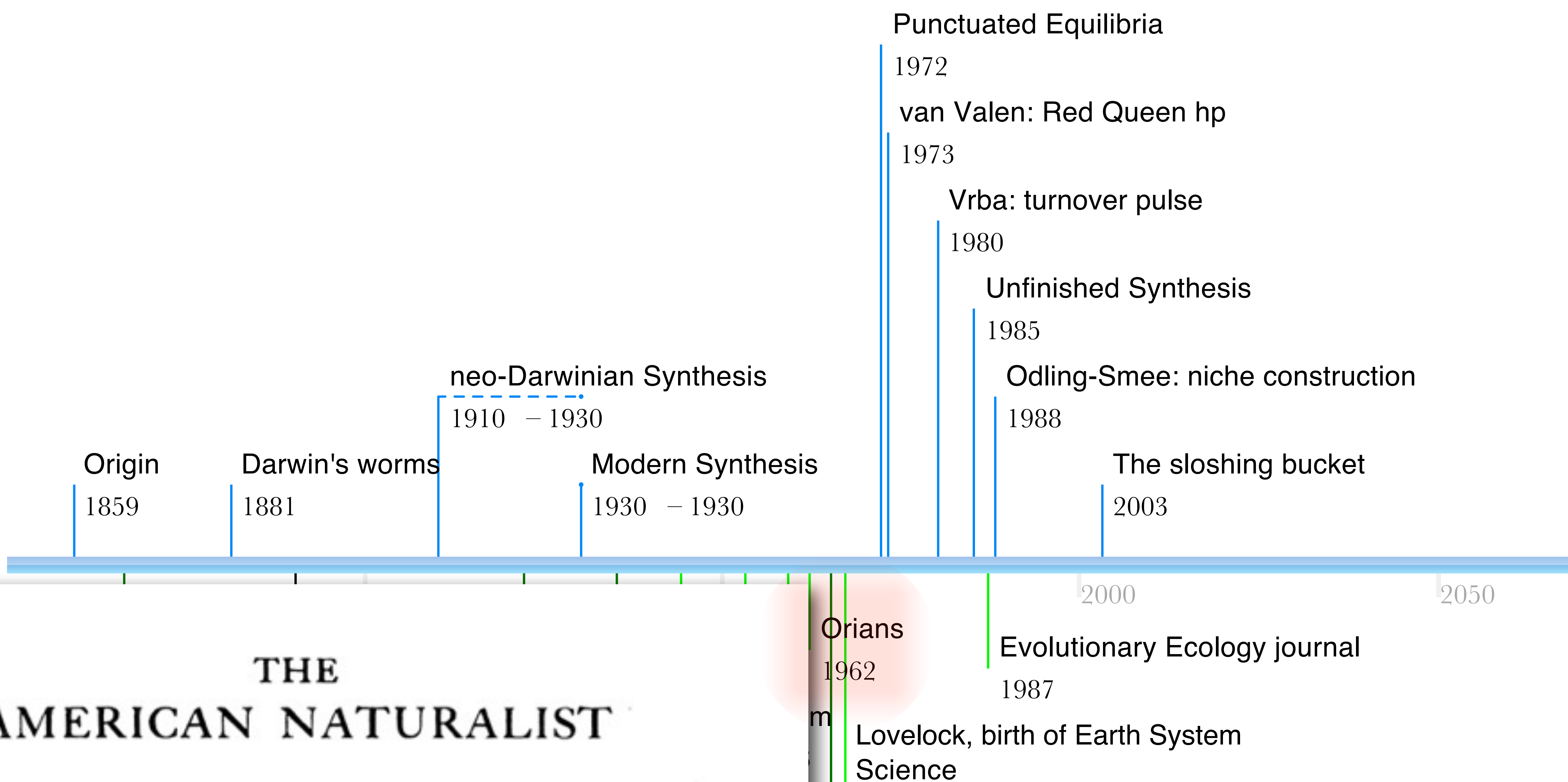
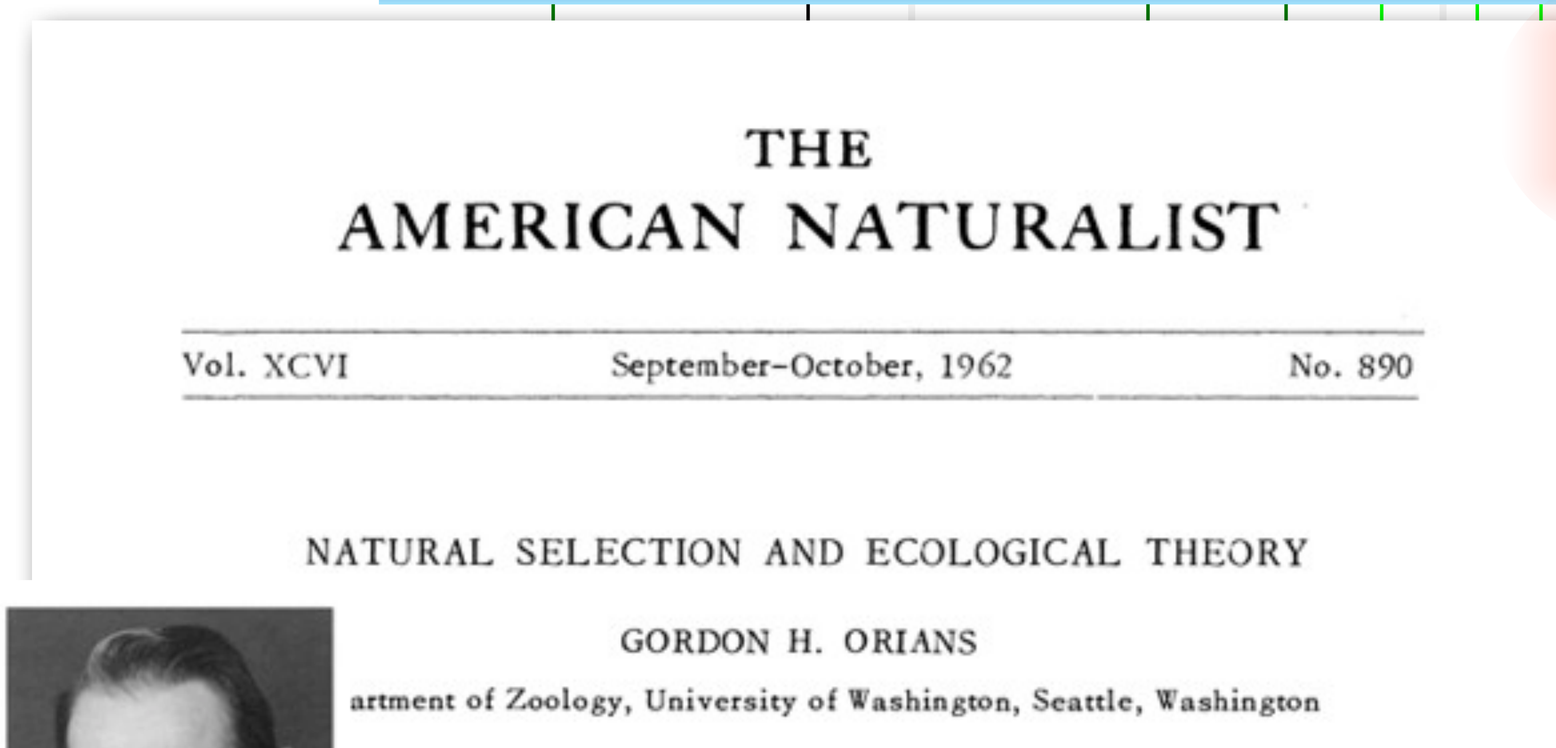


The Ecosystem

I have already given my reasons for rejecting the terms "complex organism" and "biotic community." Clements' earlier term "biome" for the whole complex of organisms inhabiting a given region is unobjectionable, and for some purposes convenient. But the more fundamental conception is, as it seems to me, the whole *system* (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome—the habitat factors in the widest sense. Though the organisms may claim our primary interest, when we are trying to think fundamentally we cannot separate them from their special environment, with which they form one physical system.

It is the systems so formed which, from the point of view of the ecologist, are the basic units of nature on the face of the earth. Our natural human prejudices force us to consider the organisms (in the sense of the biologist) as the most important parts of these systems, but certainly the inorganic "factors" are also parts—there could be no systems without them, and there is constant interchange of the most various kinds within each system, not only between the organisms but between the organic and the inorganic. These *ecosystems*, as we may call them, are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom. The





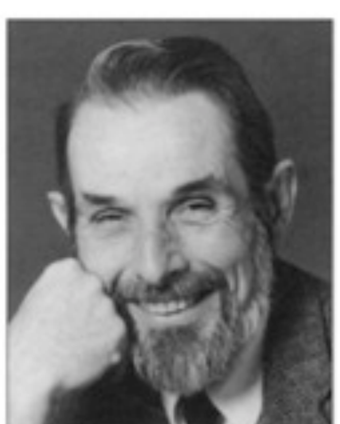
THE
AMERICAN NATURALIST

Vol. XCVI September–October, 1962 No. 890

NATURAL SELECTION AND ECOLOGICAL THEORY

GORDON H. ORIANS

artment of Zoology, University of Washington, Seattle, Washington



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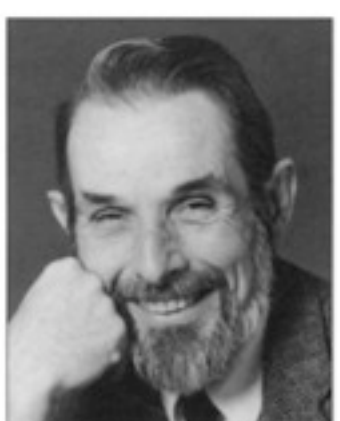

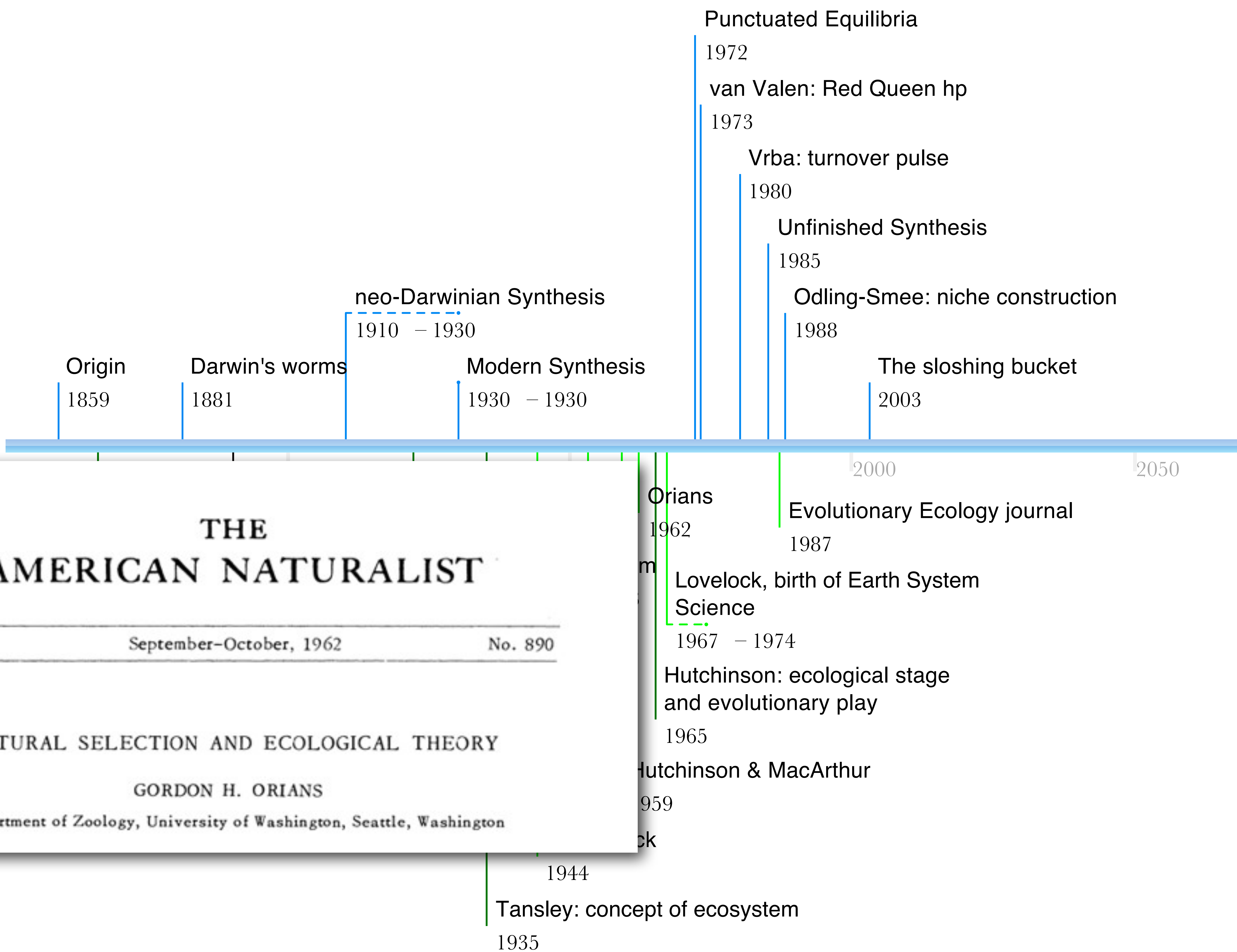

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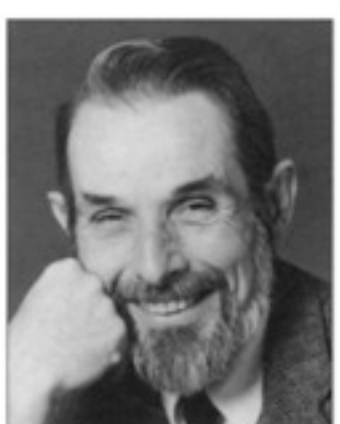

“It is becoming increasingly apparent that a complete answer to any question should deal with physiological, adaptational and evolutionary aspects of the problem. The evolutionary process of becoming yields the most profound understanding of biological systems at all levels of organization. The non-evolutionary answer to the question of why an animal is abundant in some parts of its range and rare in others is of necessity incomplete”

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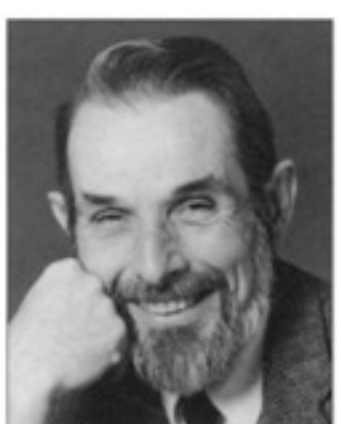

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neo-Darwinian Synthesis 1910 – 1930

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1985

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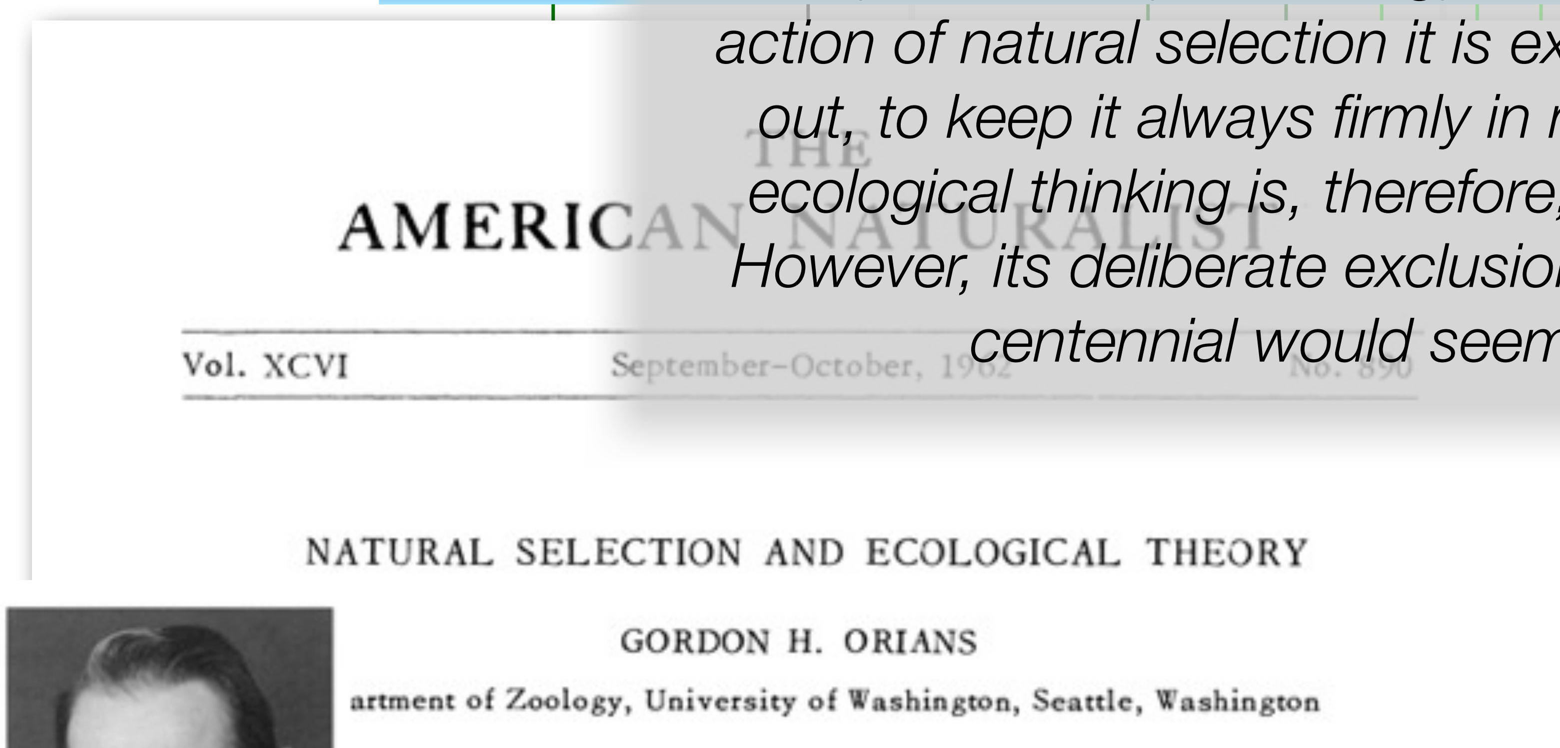
"Ecology [...] has its descriptive generalizations, such as the principle of competitive exclusion, but as in other fields, evolution would seem to be the only real theory of ecology today. Even if one strongly believes in the action of natural selection it is exceedingly difficult, as Darwin pointed out, to keep it always firmly in mind. Neglect of natural selection in ecological thinking is, therefore, understandable though regretable. However, its deliberate exclusion in these years following the Darwin centennial would seem to be exceedingly unwise"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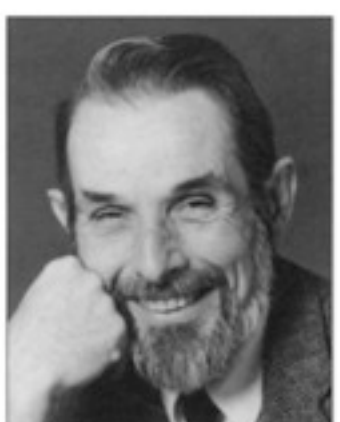

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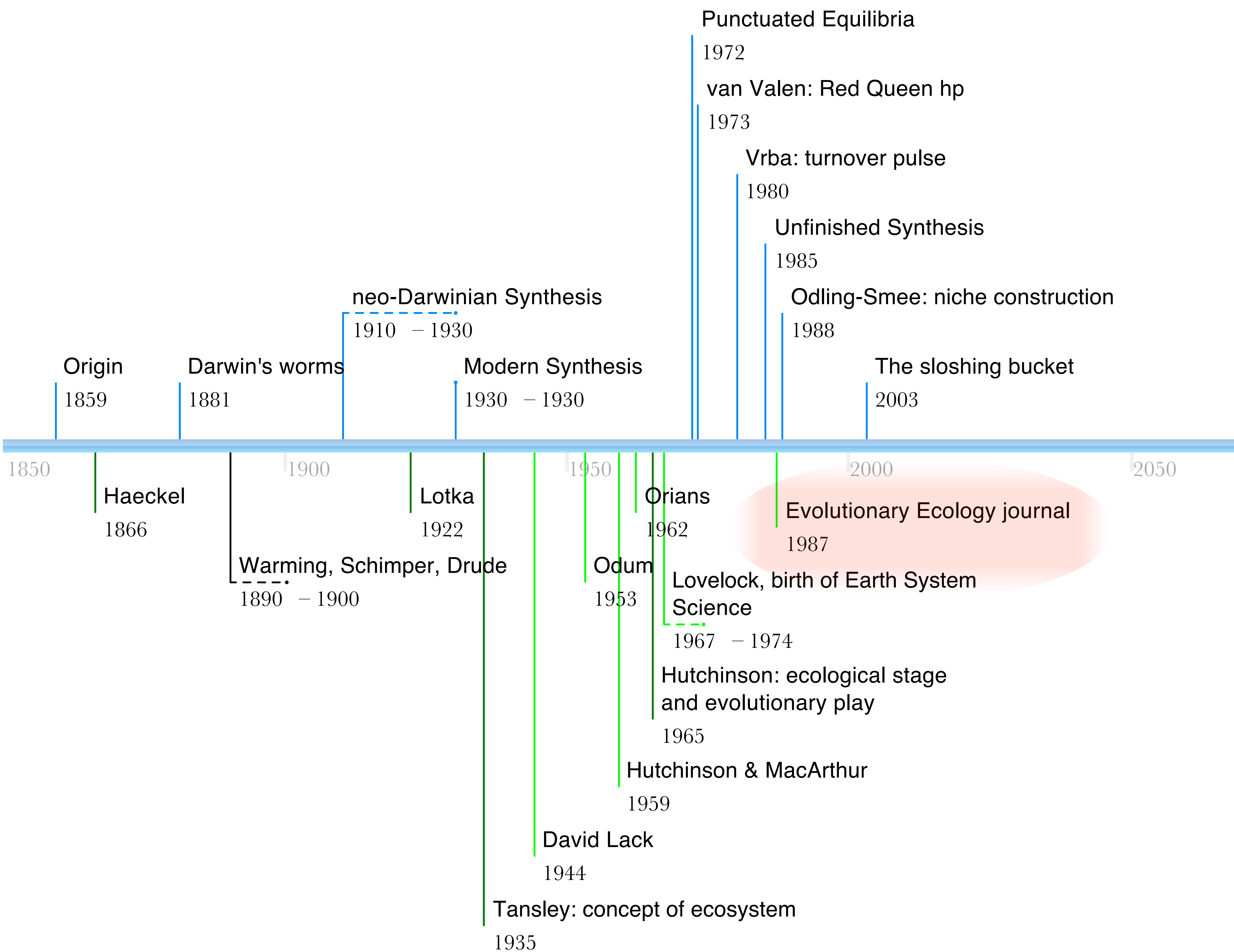
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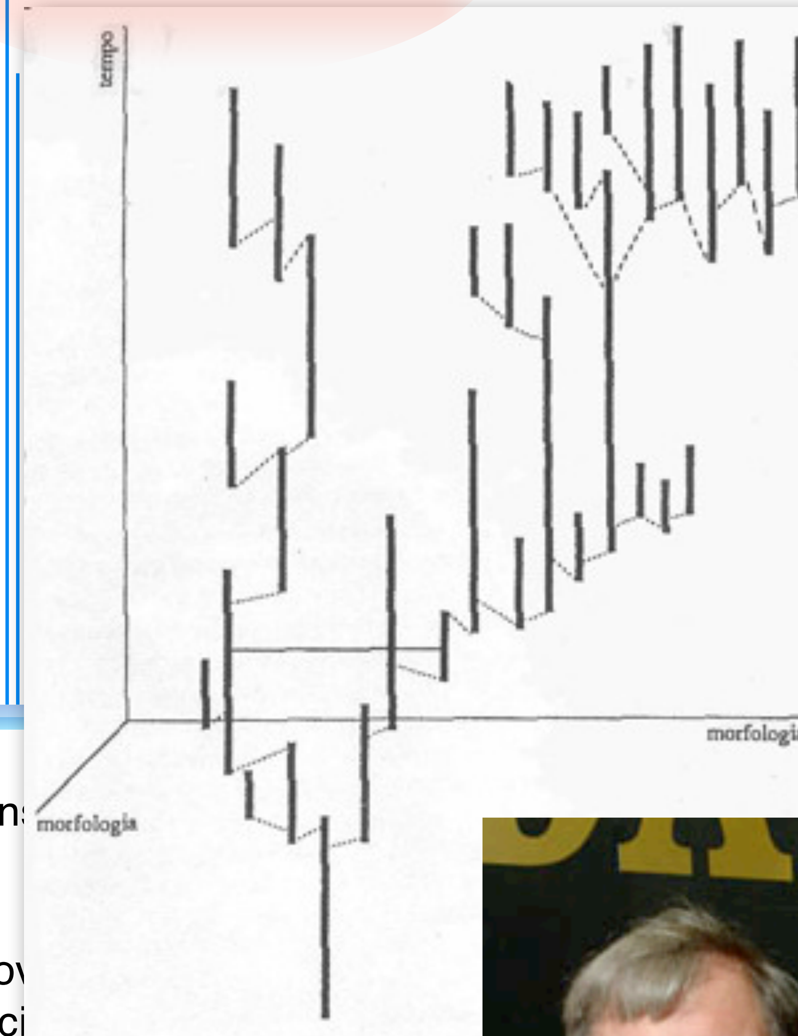

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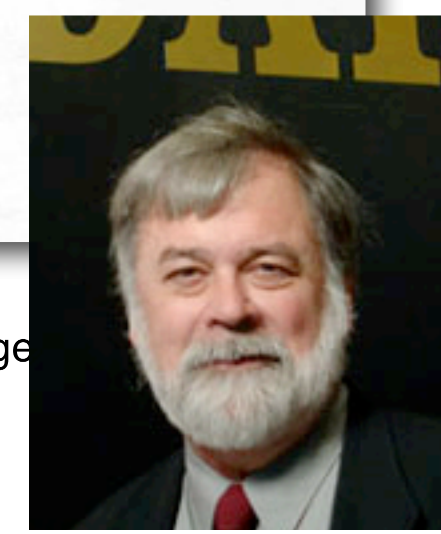

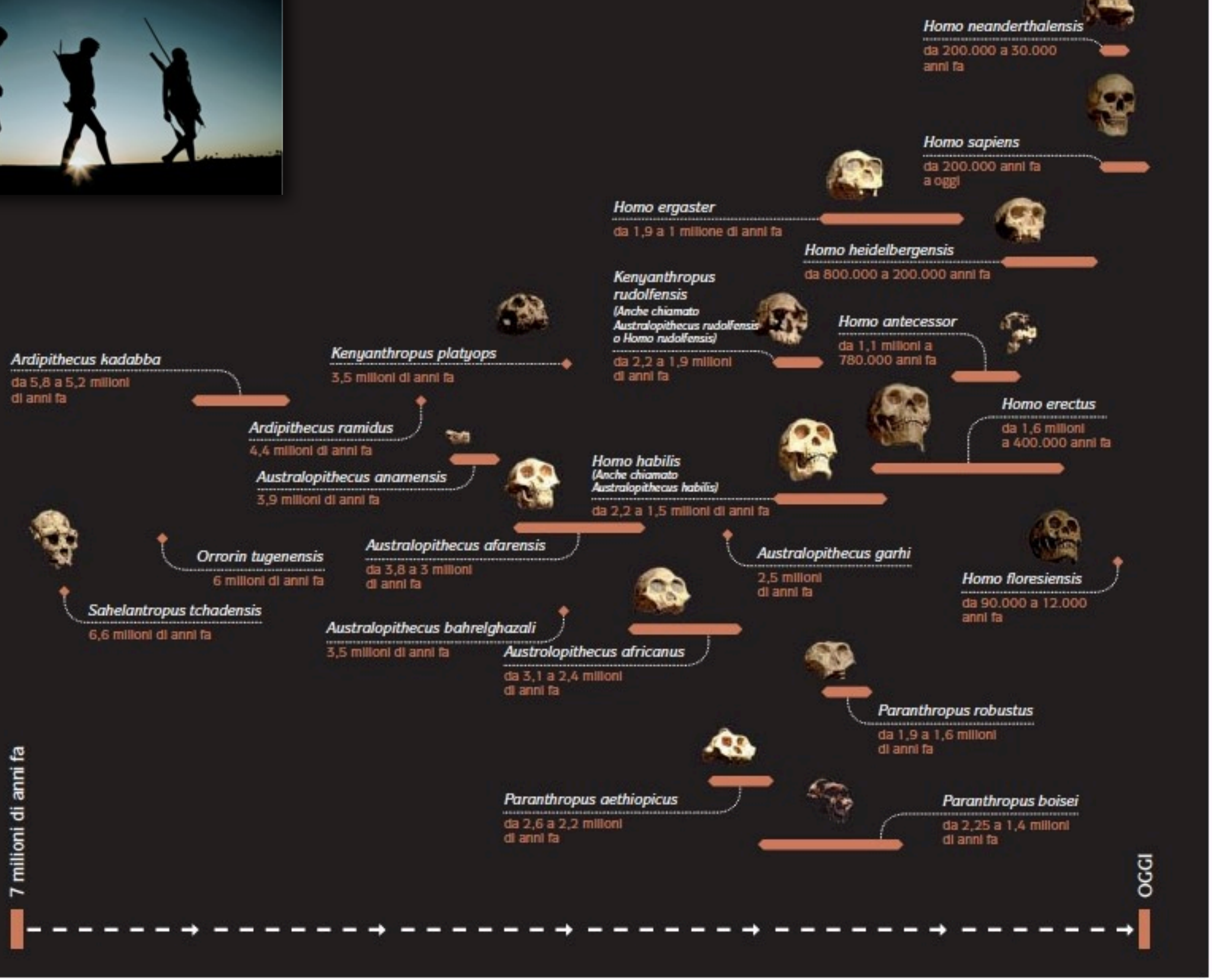

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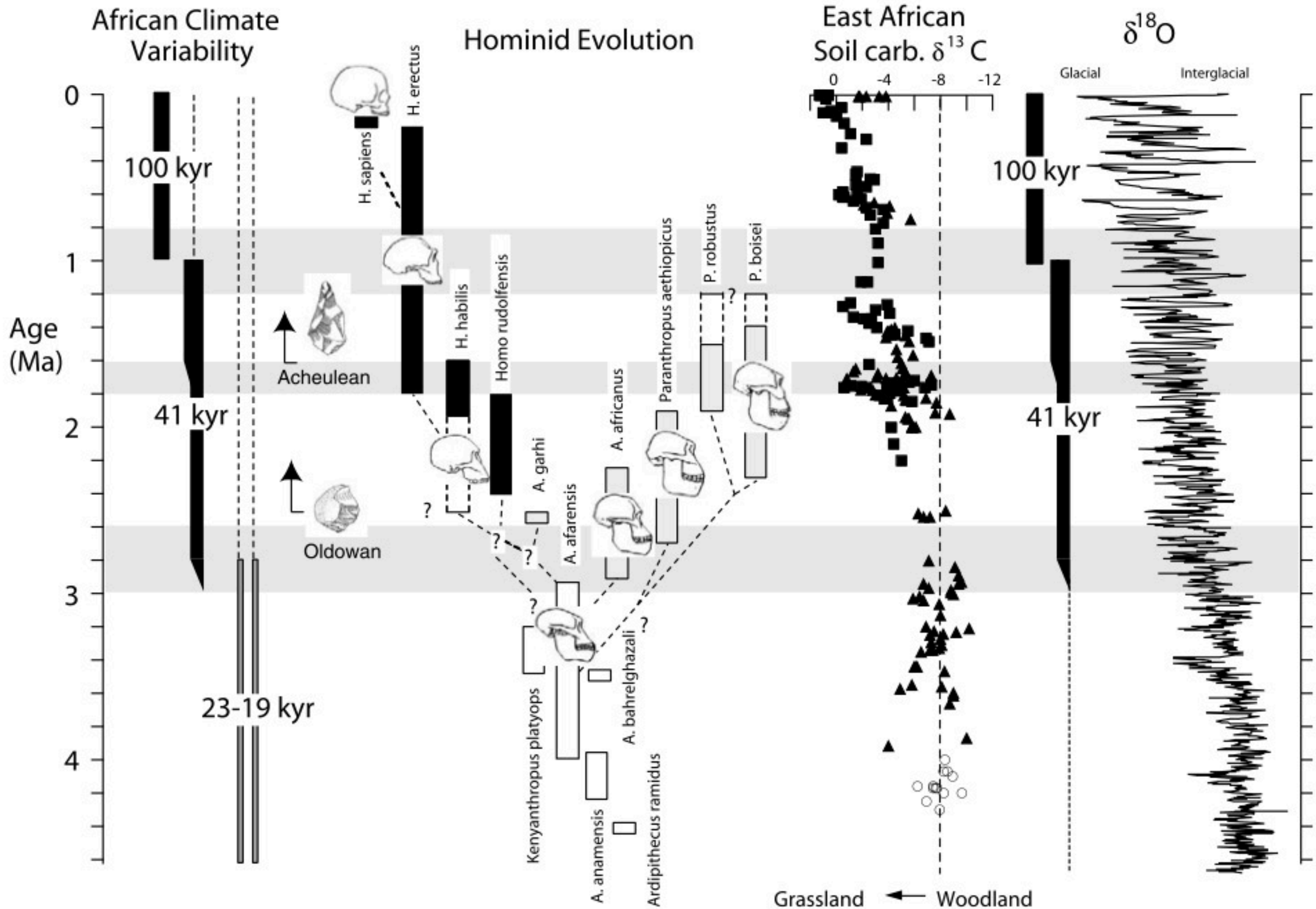

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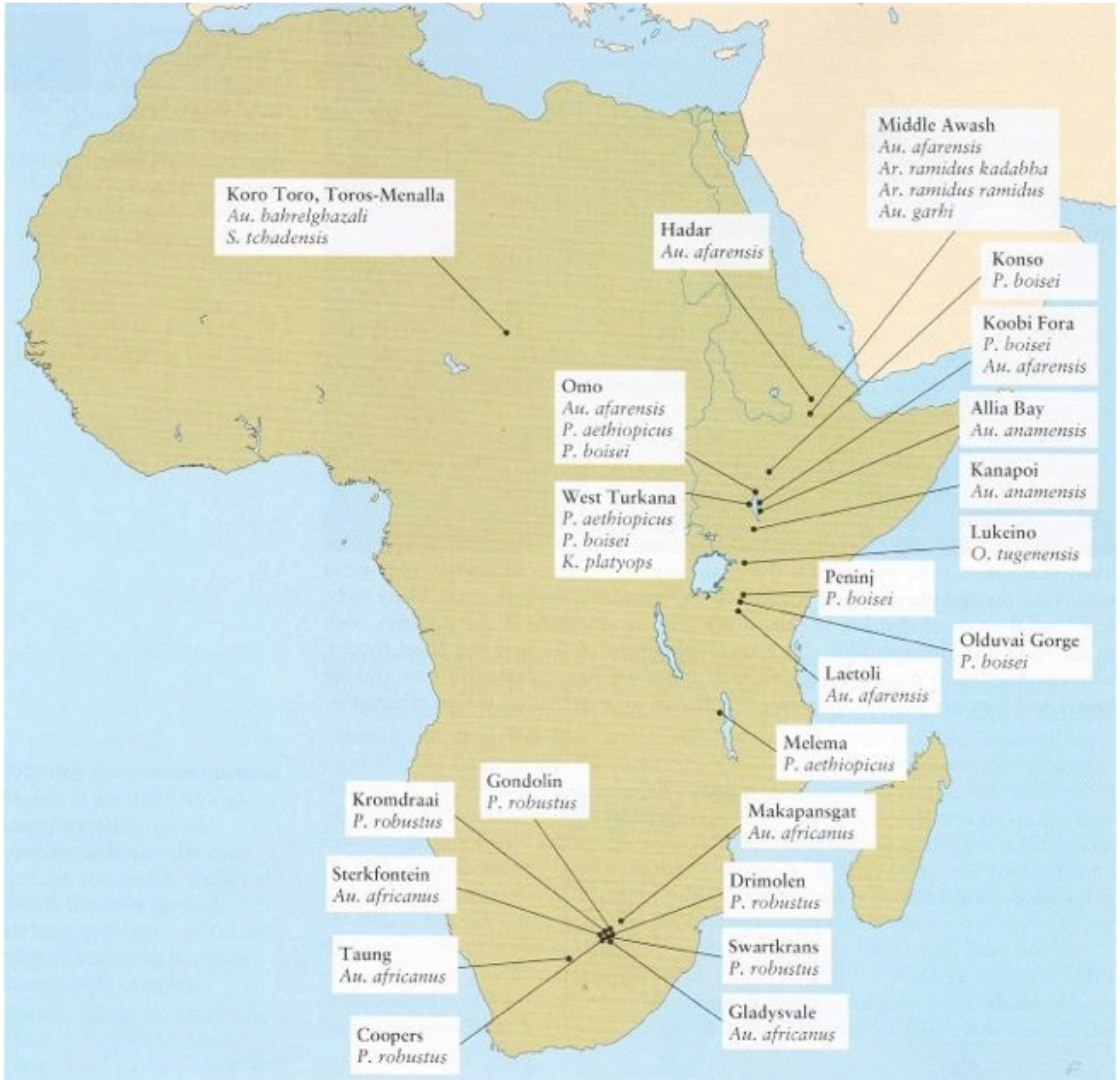

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Roger Lewin (1996), Le origini dell'uomo moderno, Zanichelli, p. 121 // Bernard Wood 2008

Hierarchy Theory of evolution


INFORMATION, ECONOMICS, AND EVOLUTION

Niles Eldredge

INTRODUCTION

Eldredge 1986

Table 1 The genealogical and ecological hierarchies

Genealogical hierarchy	Ecological hierarchy
Monophyletic taxa	Biosphere
Species	Ecosystems
Demes	Avatars
Organisms	Organisms
Germ line[a]	Soma[b]

[a]Composed of hierarchically nested chromosomes, genes, codons, and base pairs.
[b]Composed of hierarchically nested organ systems, organs, tissues, cells, and proteins.

*"organisms seem to be **both** energy conversion machines and reproducing 'packages' of genetic information. As such they are integrated **simultaneously into two** largely separate, but interacting kinds of general systems" (1986, p. 351)*


The Sloshing Bucket: How The Physical Realm Controls Evolution

Niles Eldredge

Eldredge 2003

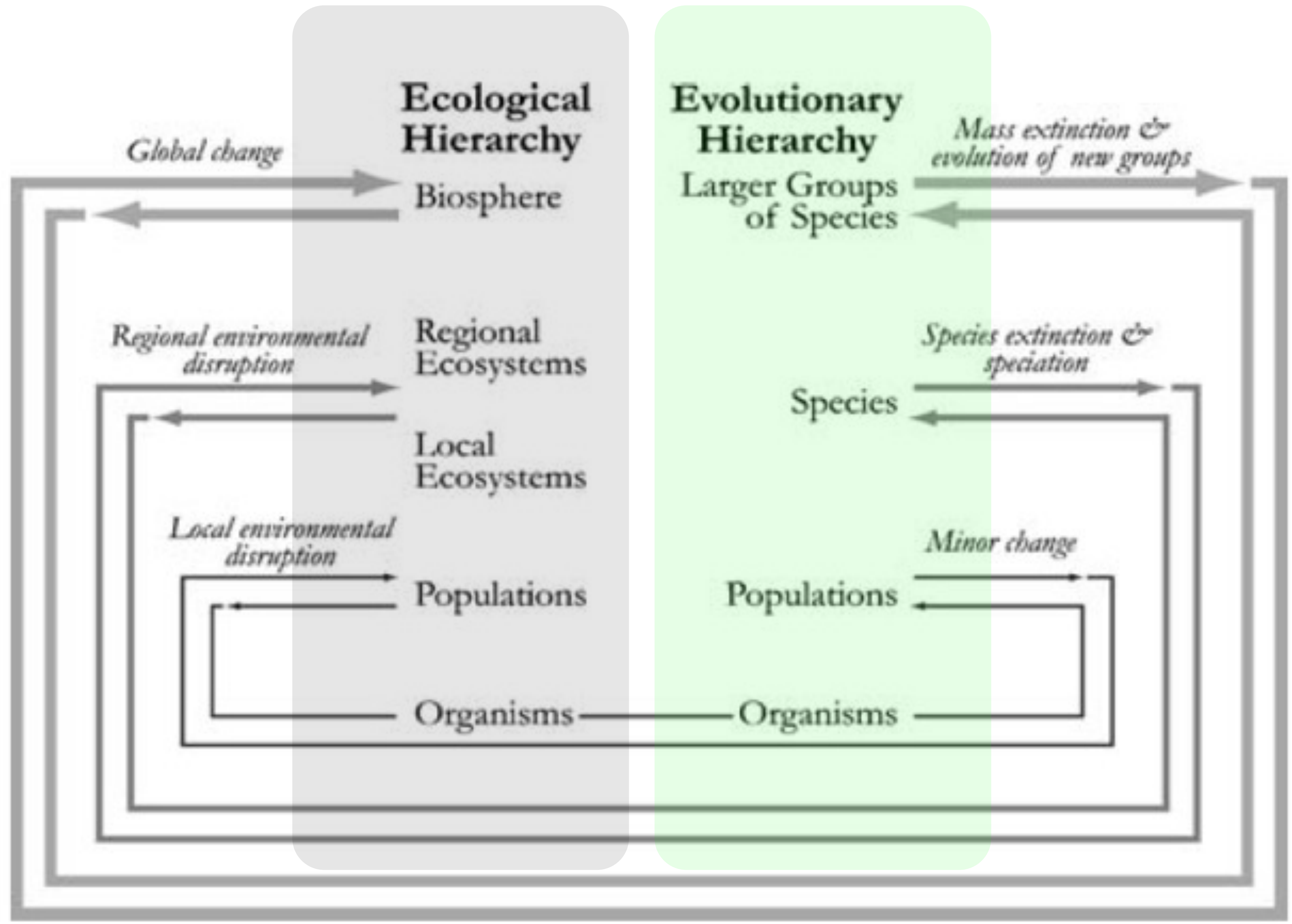

Fig. 4 The sloshing bucket theory of evolution

The Sloshing Bucket: How The Physical Realm Controls Evolution

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Niles Eldredge (2008) , “Hierarchies and the Sloshing Bucket: Toward the Unificati


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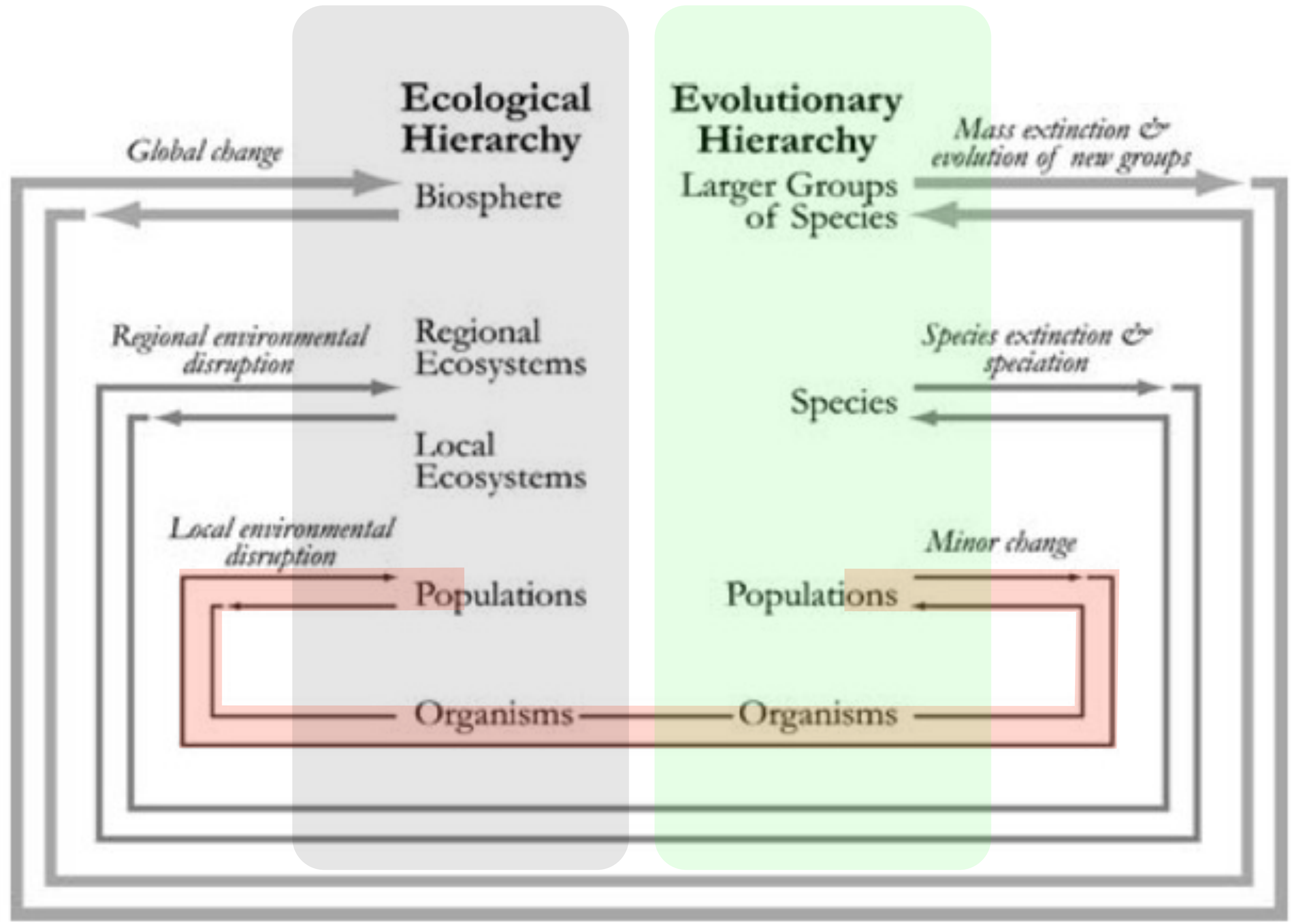

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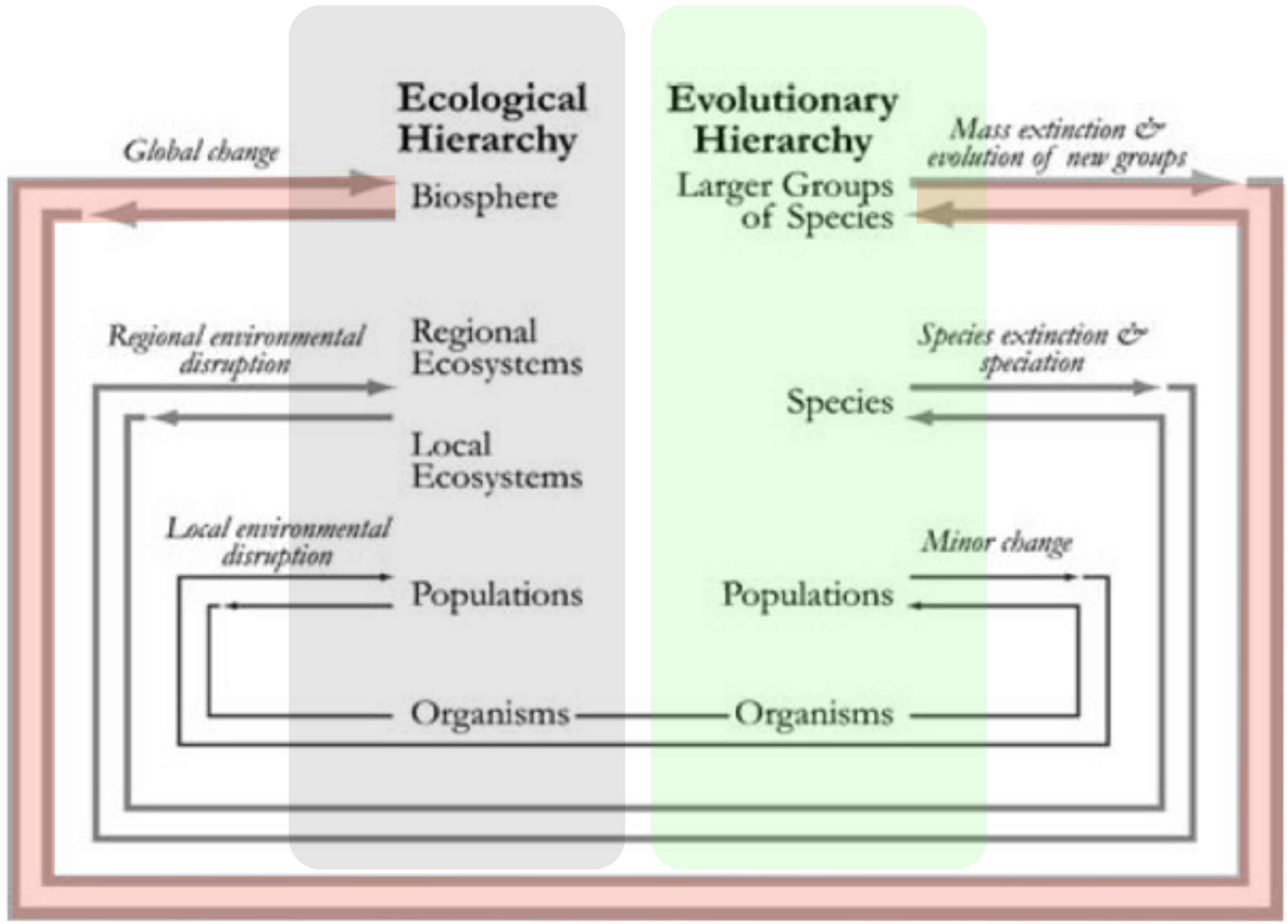

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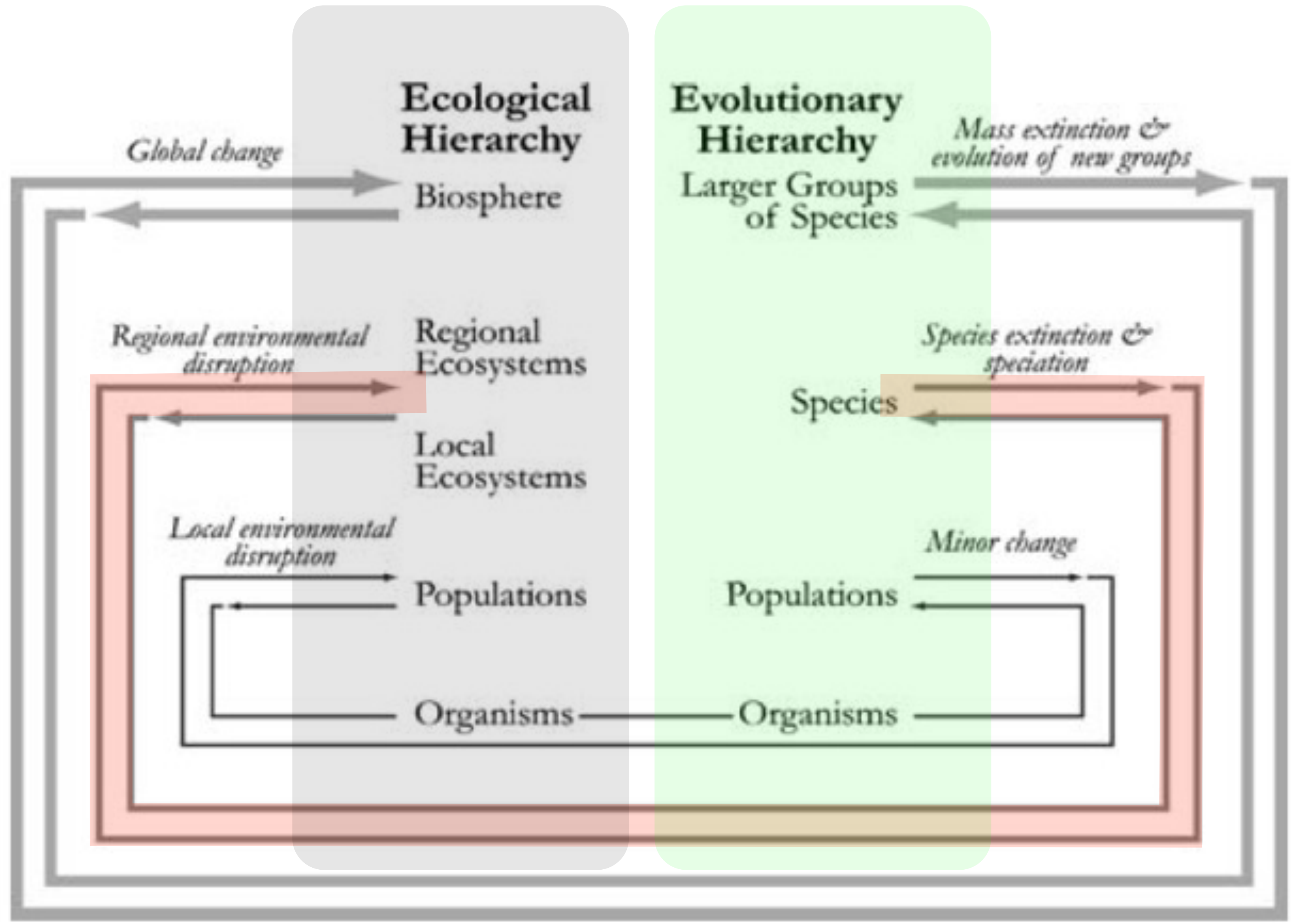

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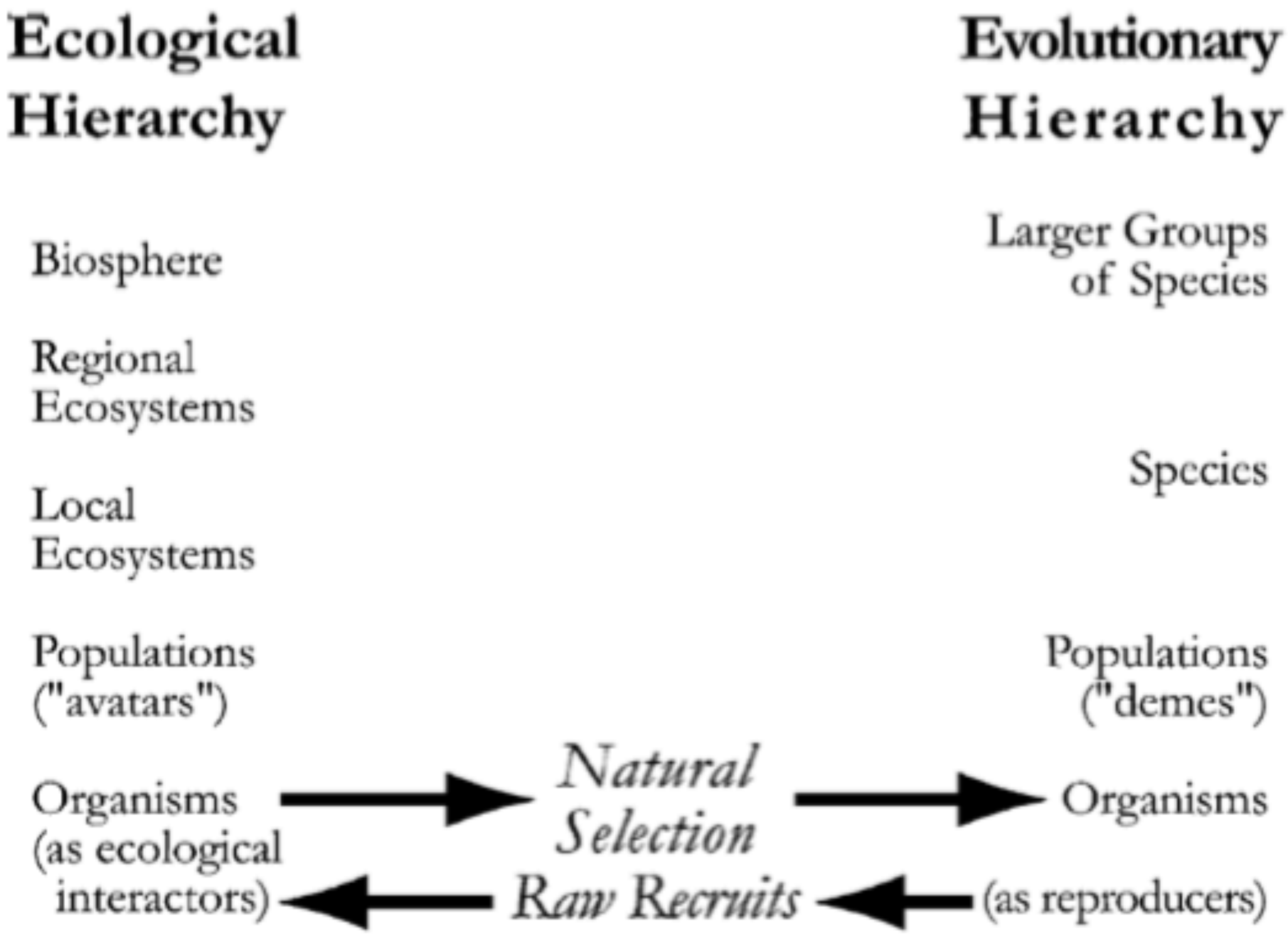

Fig. 3 The two hierarchies and natural selection

Niles Eldredge (2008) , "Hierarchies and the Sloshing Bucket: Toward the Unification of Evolutionary Biology", in Evo Edu Outreach 1 pp. 10–15.

J. Evol. Biol. 9: 293–316 (1996)
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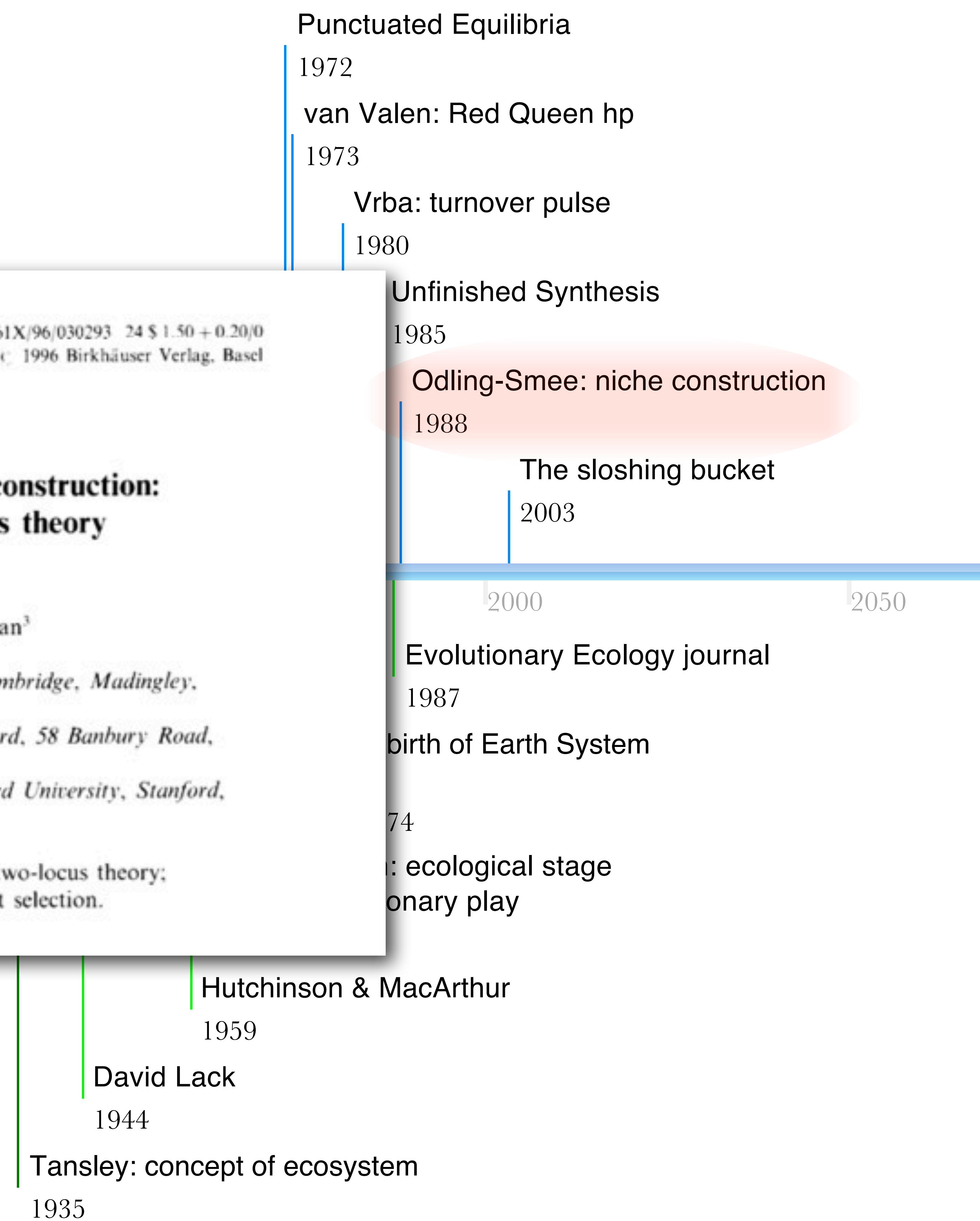
The evolutionary consequences of niche construction: a theoretical investigation using two-locus theory

K. N. Laland,[1,*] F. J. Odling-Smee[2] and M. W. Feldman[3]

[1]*Sub-Department of Animal Behaviour, University of Cambridge, Madingley, Cambridge CB3 8AA, UK*
[2]*Institute of Biological Anthropology, University of Oxford, 58 Banbury Road, Oxford OX2 6QS, UK*
[3]*Department of Biological Sciences, Herrin Hall, Stanford University, Stanford, CA 94305-5020, USA*

Key words: Evolution; niche construction; adaptation; two-locus theory; organism-environment coevolution; frequency-dependent selection.



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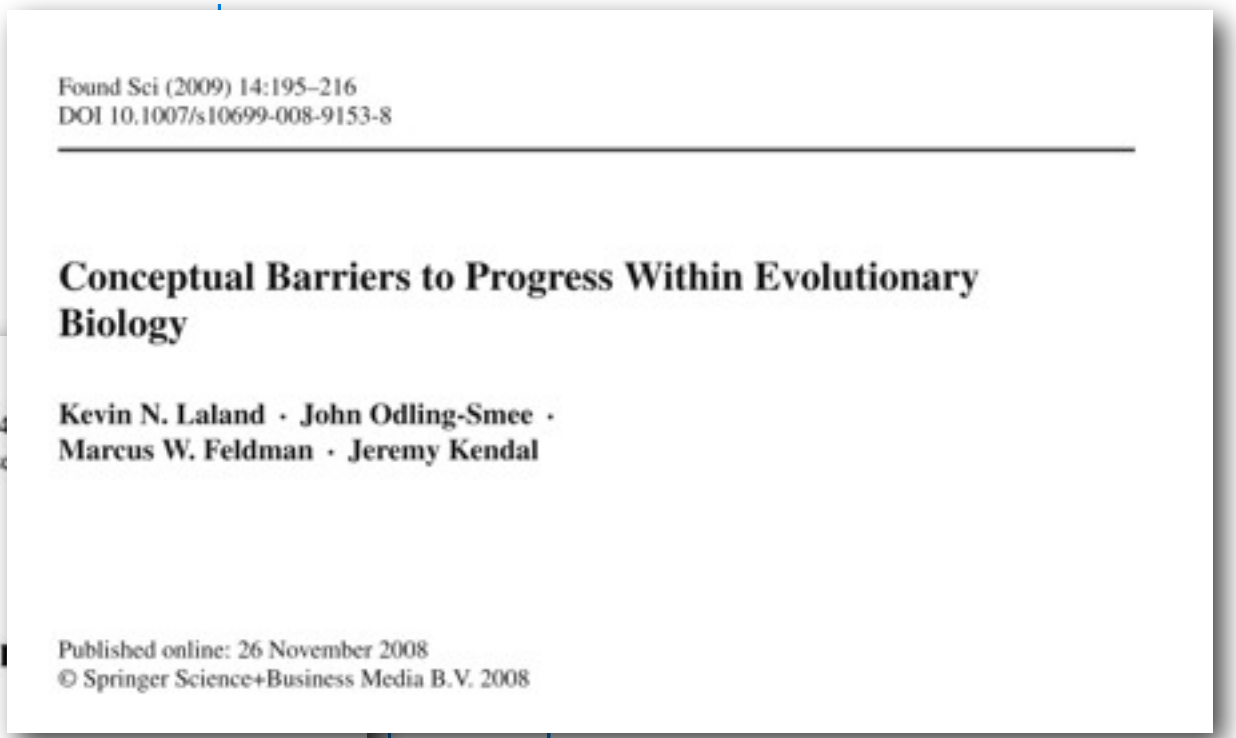
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DOI 10.1007/s10699-008-9153-8

Conceptual Barriers to Progress Within Evolutionary Biology

Kevin N. Laland · John Odling-Smee · Marcus W. Feldman · Jeremy Kendal

Published online: 26 November 2008
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J. Evol. Biol. 9: 293–316 (1996) 1010 061X/96/030293 24 © 1996 Birkhäus

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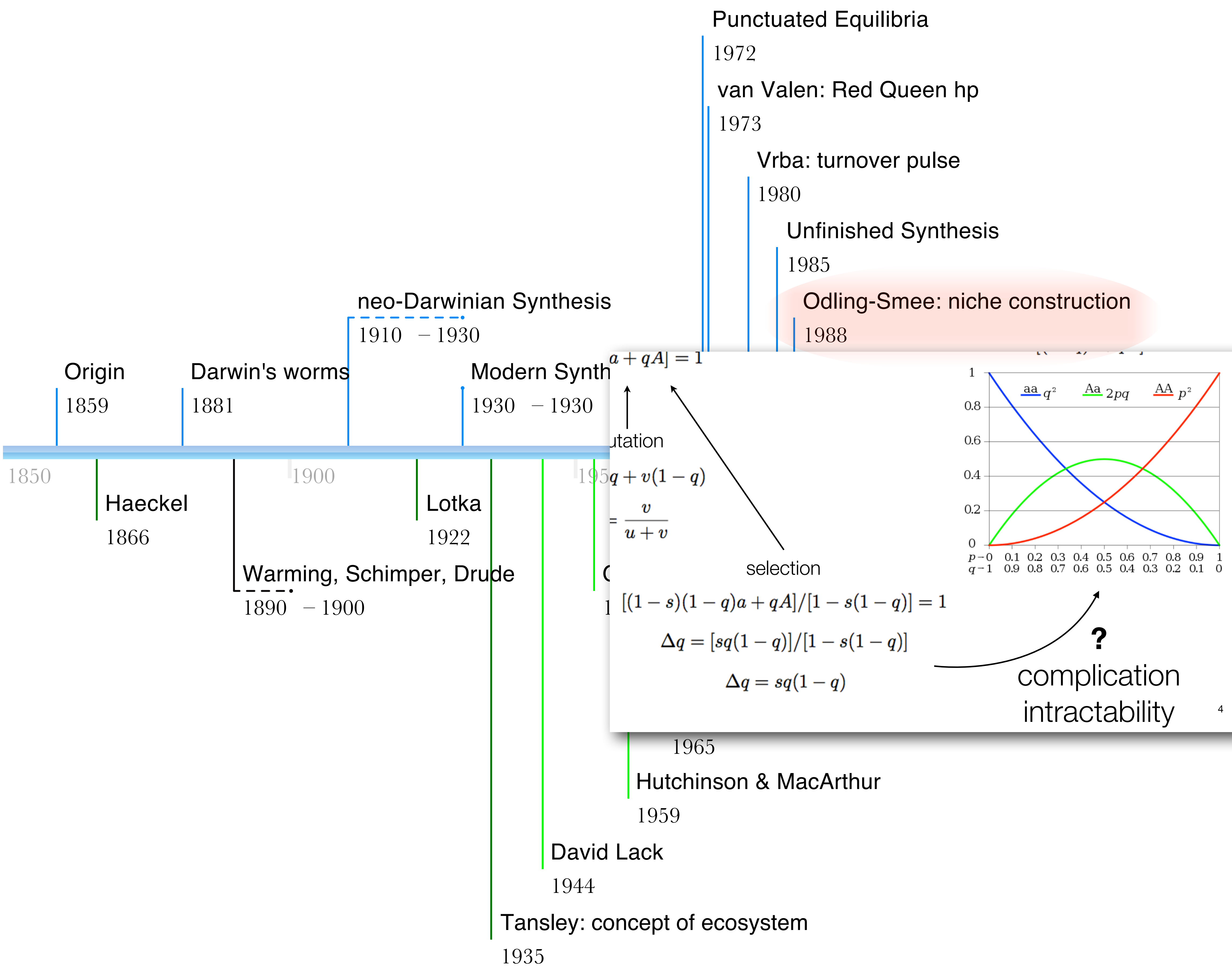
A Niche Construction Perspective on the Middle–Upper Paleolithic Transition in Italy

Julien Riel-Salvatore

Tansley: concept of ecosystem
1935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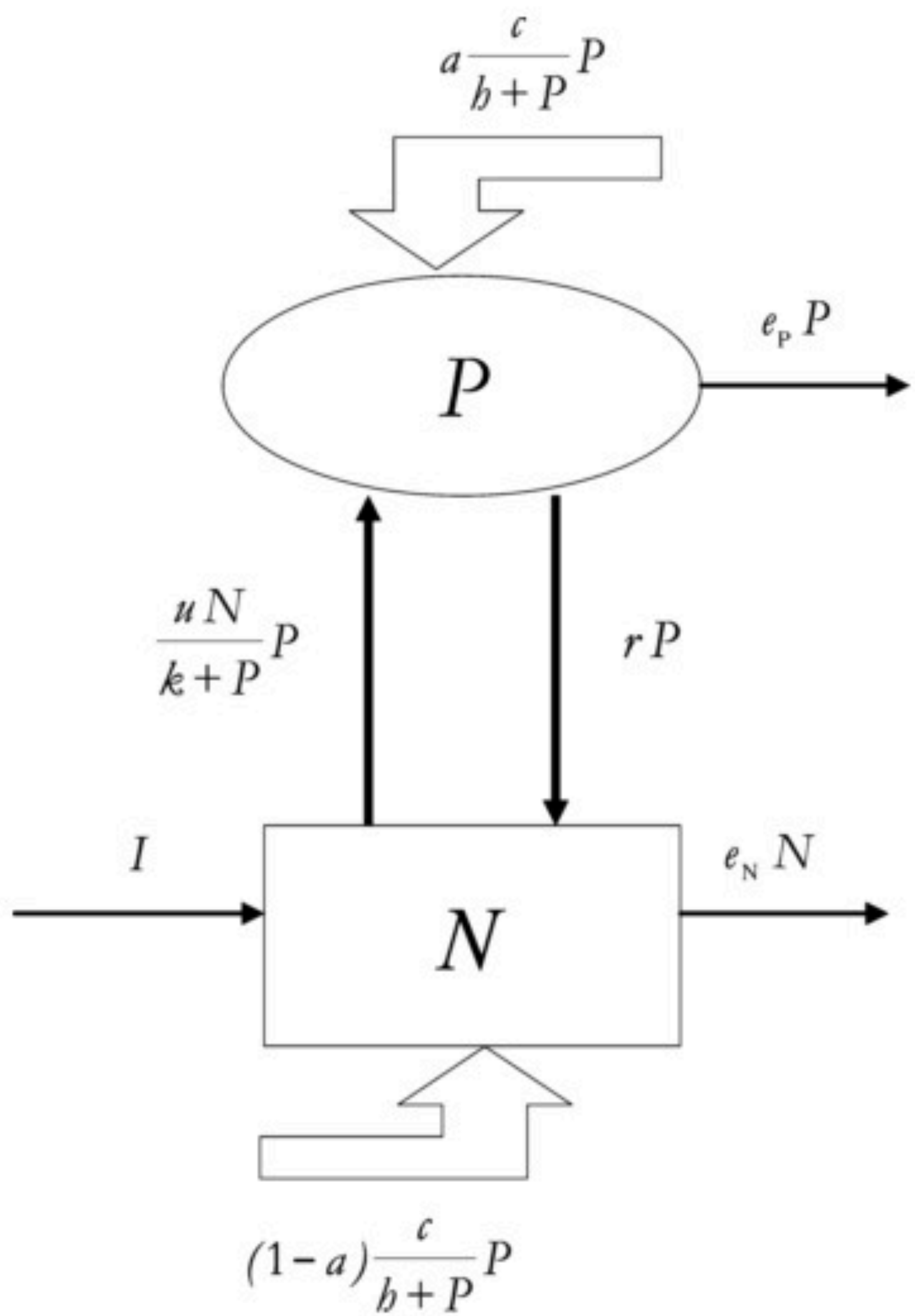

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PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2009) **364**, 1483–1489
doi:10.1098/rstb.2009.0027

Introduction

Eco-evolutionary dynamics

F. Pelletier[1,2,*], D. Garant[2] and A. P. Hendry[3]

[1]*NERC Centre for Population Biology, Division of Biology, Imperial College London, Silwood Park, Ascot, Berkshire SL5 7PY, UK*
[2]*Département de Biologie, Faculté des Sciences, Université de Sherbrooke, Sherbrooke, Quebec J1K 2R1, Canada*
[3]*Redpath Museum and Department of Biology, McGill University, 859 Sherbrooke Street West, Montreal, Quebec H3A 2K6, Canada*

Evolutionary ecologists and population biologists have recently considered that ecological and evolutionary changes are intimately linked and can occur on the same time-scale. Recent theoretical developments have shown how the feedback between ecological and evolutionary dynamics can be linked, and there are now empirical demonstrations showing that ecological change can lead to rapid evolutionary change. We also have evidence that microevolutionary change can leave an ecological signature. We are at a stage where the integration of ecology and evolution is a necessary step towards major advances in our understanding of the processes that shape and maintain biodiversity. This special feature about 'eco-evolutionary dynamics' brings together biologists from empirical and theoretical backgrounds to bridge the gap between ecology and evolution and provide a series of contributions aimed at quantifying the interactions between these fundamental processes.

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BIOINFORMATICS **APPLICATIONS NOTE**

Vol. 26 no. 11 2010, pages 1463–1464
doi:10.1093/bioinformatics/btq166

Phylogenetics

Advance Access publication April 15, 2010

Picante: R tools for integrating phylogenies and ecology

Steven W. Kembel[1,*], Peter D. Cowan[2], Matthew R. Helmus[3], William K. Cornwell[4], Helene Morlon[5], David D. Ackerly[2], Simon P. Blomberg[6] and Campbell O. Webb[7]

[1]Center for Ecology and Evolutionary Biology, University of Oregon, Eugene, OR, [2]Department of Integrative Biology, University of California, Berkeley, CA, USA, [3]Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Kunming, Yunnan, China, [4]Biodiversity Research Centre, University of British Columbia, Vancouver, BC, Canada, [5]Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA, USA, [6]Faculty of Biological and Chemical Sciences, University of Queensland, Brisbane, Australia and [7]Arnold Arboretum of Harvard University, Cambridge, MA, USA

Associate Editor: David Posada

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Popul Ecol (2011) 53:9–21
DOI 10.1007/s10144-010-0250-5

SPECIAL FEATURE: REVIEW

Linking Genome to Ecosystem

The contribution of evening primrose (*Oenothera biennis*) to a modern synthesis of evolutionary ecology

Marc T. J. Johnson

Received: 24 May 2010 / Accepted: 13 October 2010 / Published online: 16 November 2010

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ECOLOGY LETTERS

Ecology Letters, (2011) **14**: 690–701

doi: 10.1111/j.1461-0248.2011.01627.x

REVIEW AND SYNTHESIS

Toward an integration of evolutionary biology and ecosystem science

Blake Matthews,[1] Anita Narwani,[2] Stephen Hausch,[3] Etsuko Nonaka,[4] Hannes Peter,[5] Masato Yamamichi,[6] Karen E. Sullam,[7] Kali C. Bird,[8] Mridul K. Thomas,[8] Torrance C. Hanley[9] and Caroline B. Turner[10]

Abstract

At present, the disciplines of evolutionary biology and ecosystem science are weakly integrated. As a result, we have a poor understanding of how the ecological and evolutionary processes that create, maintain, and change biological diversity affect the flux of energy and materials in global biogeochemical cycles. The goal of this article was to review several research fields at the interfaces between ecosystem science, community ecology and evolutionary biology, and suggest new ways to integrate evolutionary biology and ecosystem science. In particular, we focus on how phenotypic evolution by natural selection can influence ecosystem functions by affecting processes at the environmental, population and community scale of ecosystem organization. We develop an eco-evolutionary model to illustrate linkages between evolutionary change (e.g. phenotypic evolution of producer), ecological interactions (e.g. consumer grazing) and ecosystem processes (e.g. nutrient cycling). We conclude by proposing experiments to test the ecosystem consequences of evolutionary changes.

Keywords

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biology letters
Evolutionary biology

Biol. Lett.
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Meeting report

Integrating ecology into macroevolutionary research

Lynsey McInnes[1,2,*], William J. Baker[3], Timothy G. Barraclough[1], Kanchon K. Dasmahapatra[4], Anjali Goswami[4,5], Luke J. Harmon[6], Hélène Morlon[7], Andy Purvis[1], James Rosindell[8], Gavin H. Thomas[9], Samuel T. Turvey[10] and Albert B. Phillimore[1]

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**Author for correspondence (lynsey.mcinnes01@imperial.ac.uk).*

REVIEW

The Newest Synthesis: Understanding the Interplay of Evolutionary and Ecological Dynamics

Thomas W. Schoener

The effect of ecological change on evolution has long been a focus of scientific research. The reverse—how evolutionary dynamics affect ecological traits—has only recently captured our attention, however, with the realization that evolution can occur over ecological time scales. This newly highlighted causal direction and the implied feedback loop—eco-evolutionary dynamics—is invigorating both ecologists and evolutionists and blurring the distinction between them. Despite some recent relevant studies, the importance of the evolution-to-ecology pathway across systems is still unknown. Only an extensive research effort involving multiple experimental approaches—particularly long-term field experiments—over a variety of ecological communities will provide the answer.

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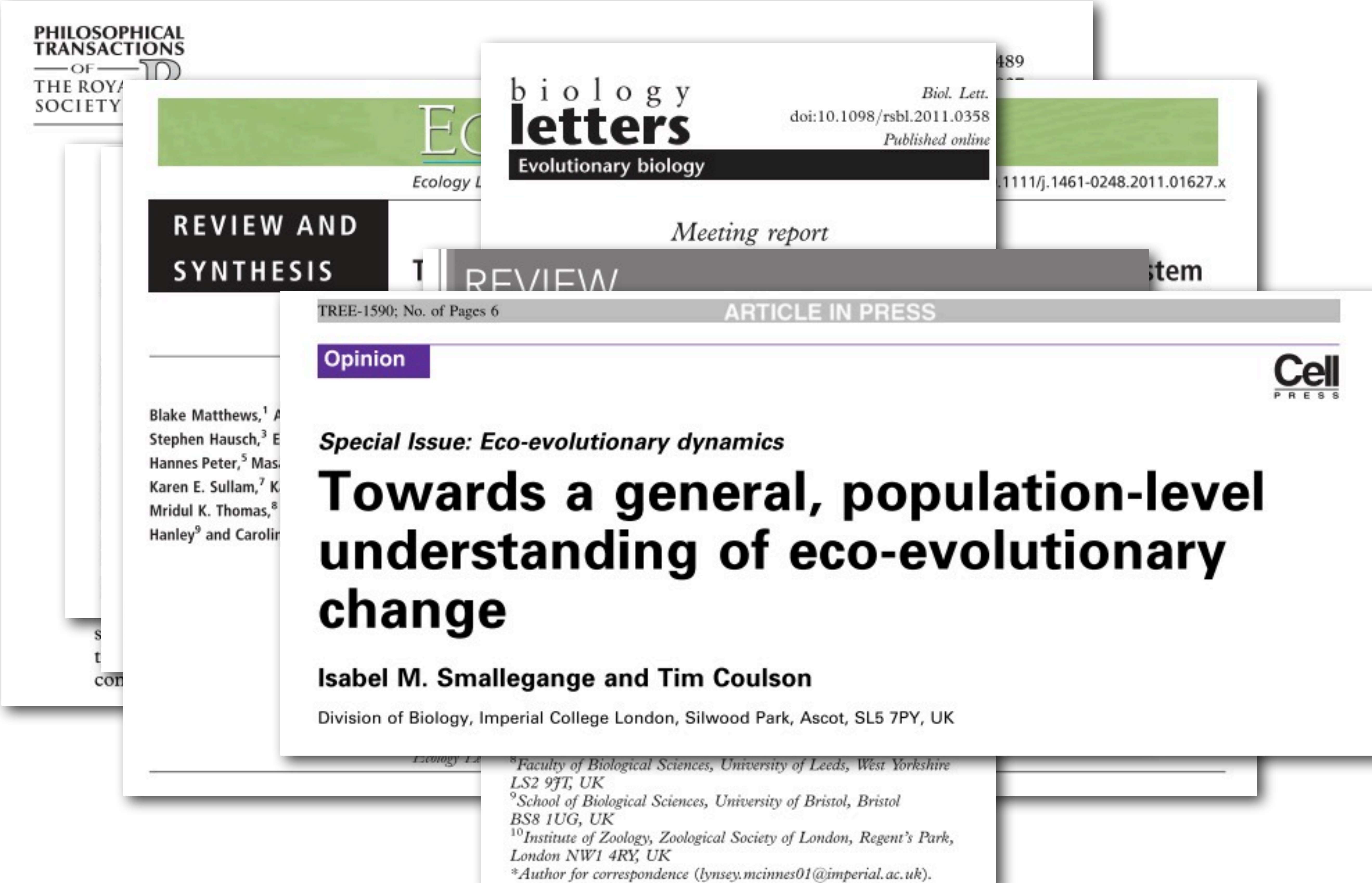

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REVIEW

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Special Issue: Eco-evolutionary dynamics

Towards a general, population-level understanding of eco-evolutionary change

Isabel M. Smallegange and Tim Coulson

Division of Biology, Imperial College London, Silwood Park, Ascot, SL5 7PY, UK

REVIEW

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Biology and Philosophy (2006) 21:25–40
DOI 10.1007/s10539-005-3181-3

Review article – A system for analysing features in studies integrating ecology, development, and evolution

J. R. STONE[1,2,*] and B. K. HALL[1,*]
*[1]Biology Department, Dalhousie University, Life Sciences Building, 1355 Oxford Street, Halifax NS B3H 4J1, Canada; [2]Department of Biology, McMaster University, Life Sciences Building, 1280 Main Street West, Hamilton ON, Canada L8S 4K1; *Author for correspondence(e-mail: jstoner@mcmaster.ca and bkh@dal.ca; phone: +905-525-9140; fax: +905-522-6066)*

Received 24 September 2003; accepted in revised form 4 March 2005

Key words: Adaptation, Development, Ecology, Evolution, Homology, Morphology, Ontogeny, Phylogeny

Abstract. Ecology is being introduced to Evolutionary Developmental Biology to enhance organism-, population-, species-, and higher-taxon-level studies. This exciting, bourgeoning troika will revolutionise how investigators consider relationships among environment, ontogeny, and phylogeny. Features are studied (and even defined) differently in ecology, development, and evolution. Form is central to development and evolution but peripheral to ecology. Congruence (i.e., homology) is applied at different hierarchical levels in the three disciplines. Function is central to ecology but peripheral to development. Herein, the supercategories form ('isomorphic' or 'allomorphic'), congruence ('homologous' or 'homoplastic'), and function ('adaptive' or 'nonadaptive') are combined with two developmental mode (i.e., growth) categories ('conformational' or 'nonconformational') to provide a 16-class system for analysing features in studies in which ecology, development, and evolution are integrated.

ECOLOGY LETTERS

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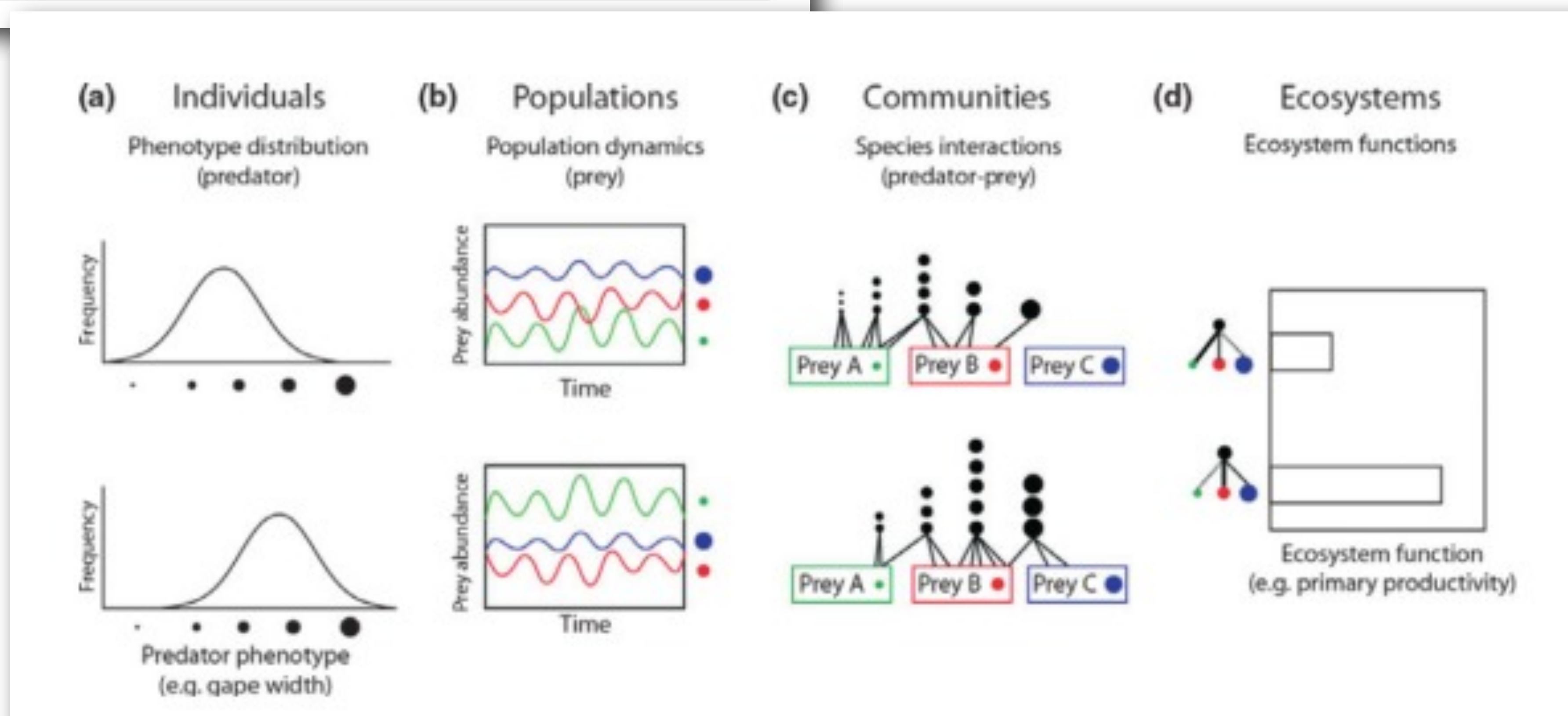

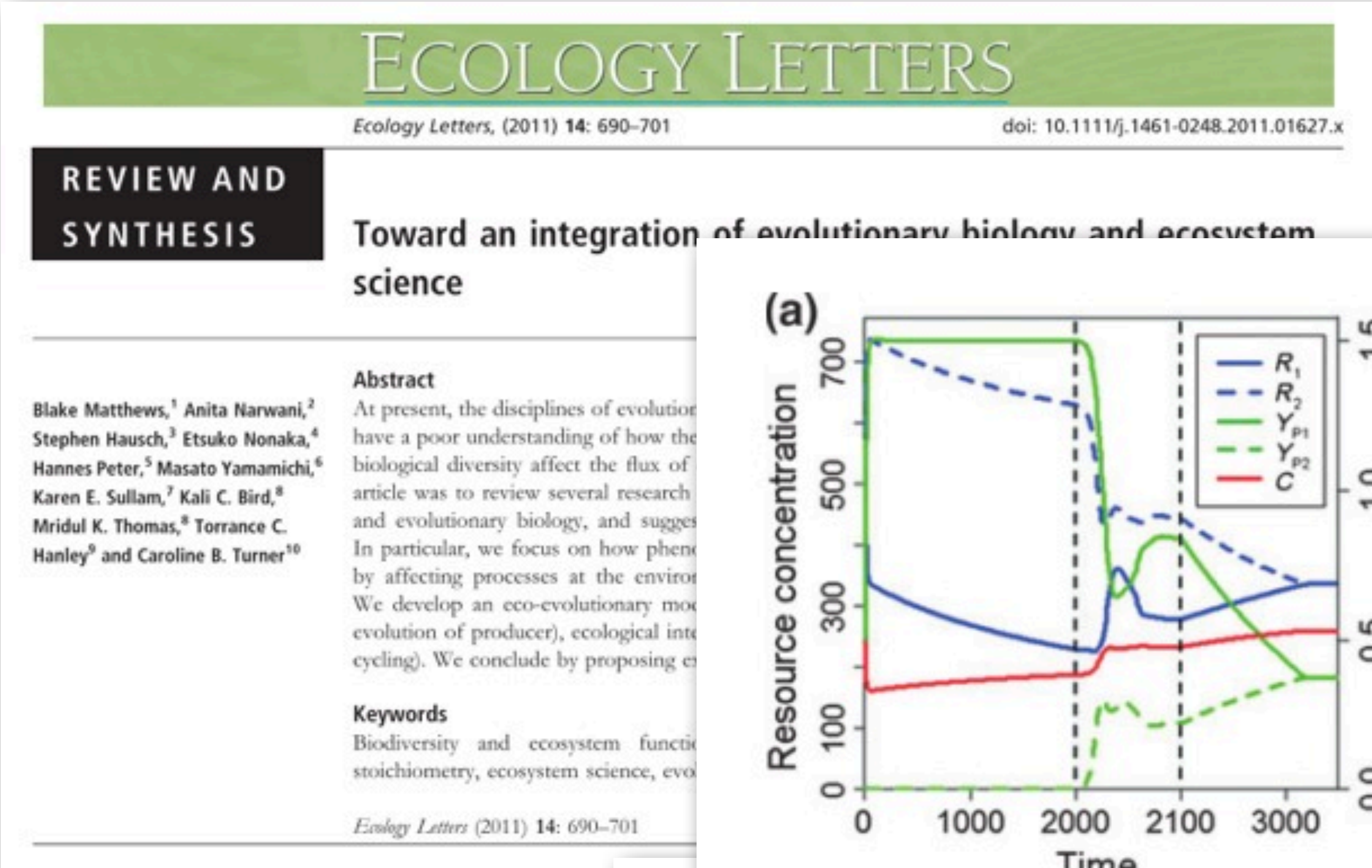

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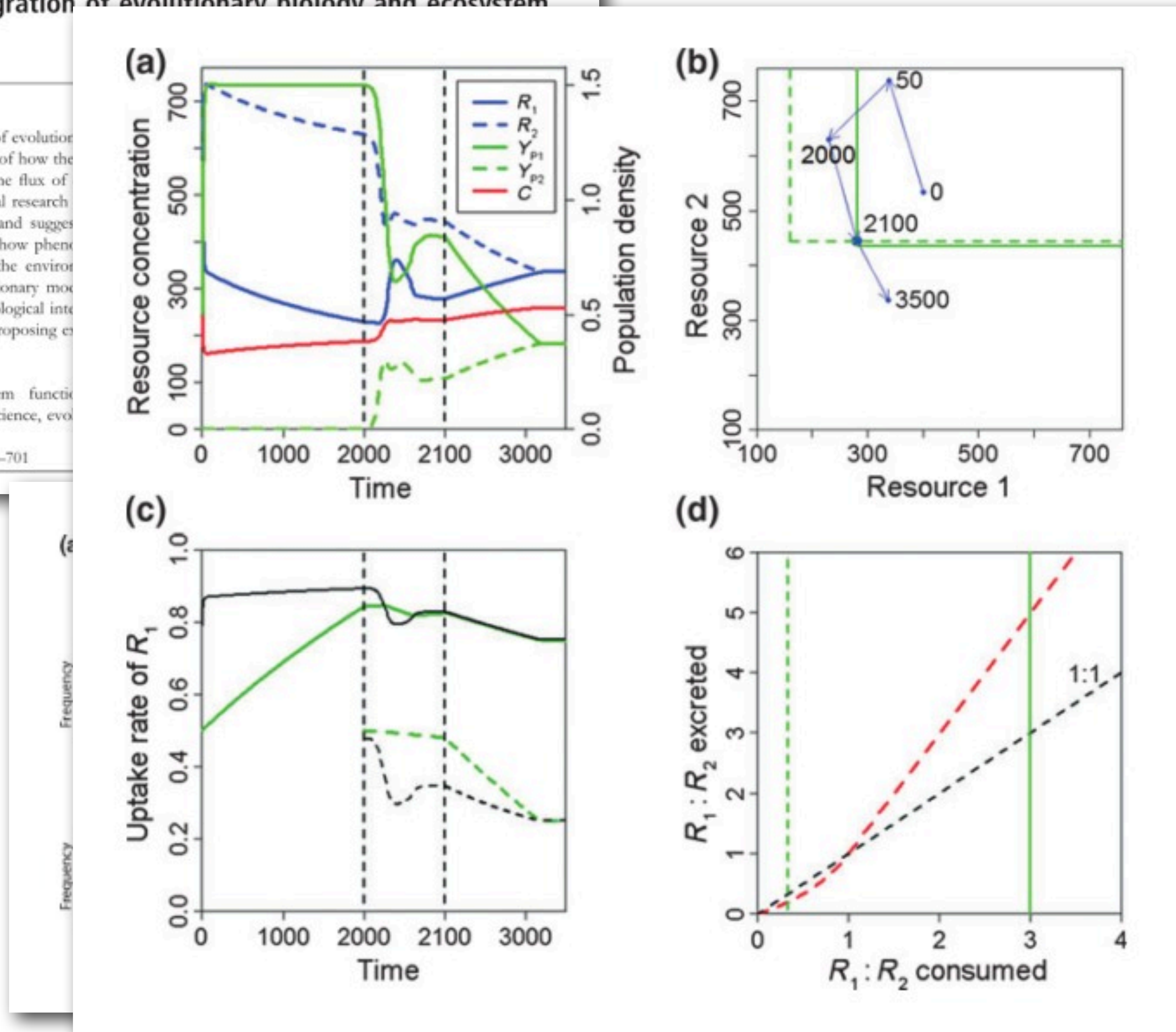

Integration between ecological and genealogical patterns: Where are we?

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Patterns in the natural world are extremely important. [...] They pose both the questions and the answers that scientists formulate as they seek to describe the world [...]. Science is a search for resonance between mind and natural pattern as we try to answer these questions. (Eldredge 1999, pp. 4-5)

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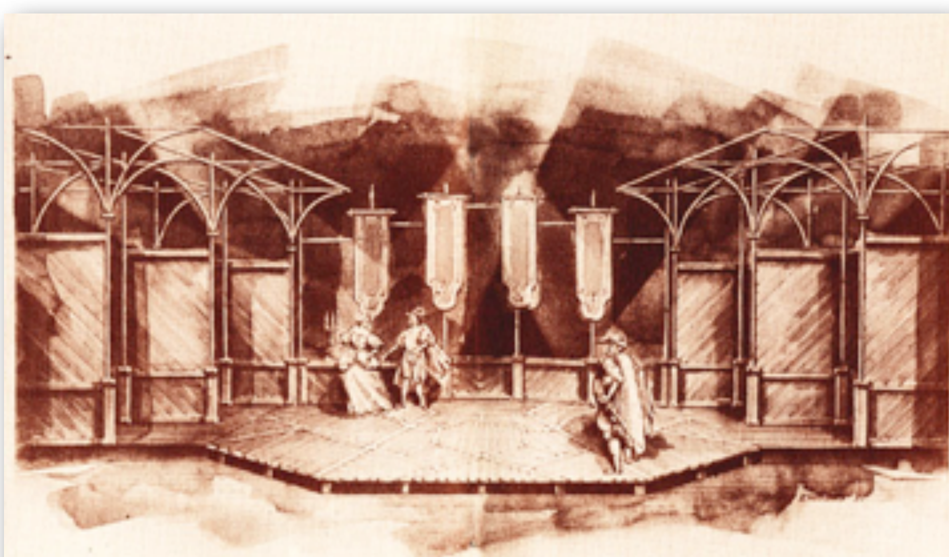

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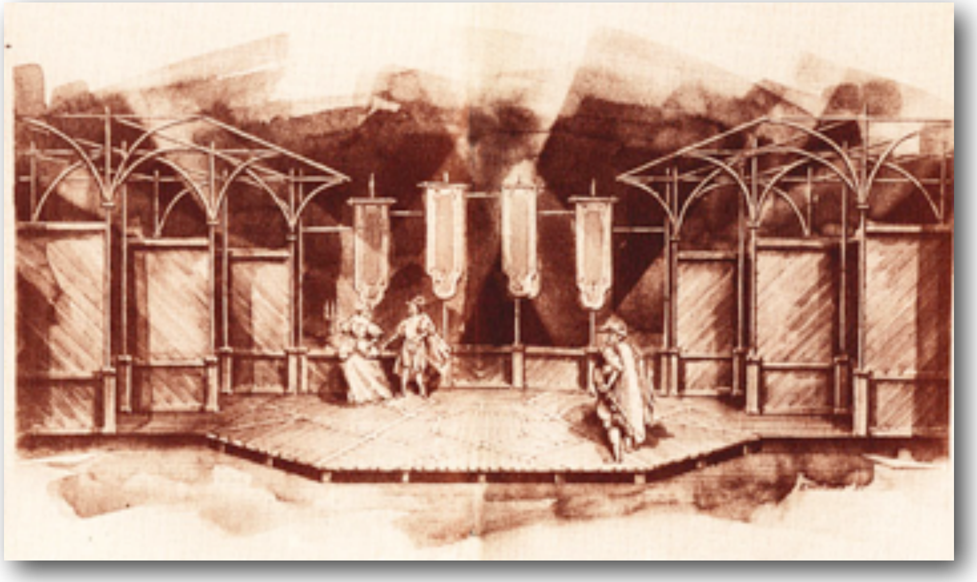

It is this two-way street [...] that together form the resonance between mind and material nature that is the heart and soul of science. The search for more accurate depictions and explanations of phenomena already perceived is where most of the serious day-to-day work of science lies. But it is in the learning of new ways to see phenomena that true novelty and creativity come in. Both are vital and in many ways themselves inseparable. Both involve wrestling with patterns in nature-the explanation of agreed-upon pattern, and the search for new ways of seeing new patterns (Eldredge, cit., p. 16).

Centre for Philosophy of Science — Applied Evolutionary Epistemology Lab

3-Day International Conference on Evolutionary Patterns

Horizontal and Vertical Transmission and Micro- and Macroevolutionary Patterns of Biological and Sociocultural Evolution

Calouste Gulbenkian Foundation, Lisbon, Portugal

May 27th-29th, 2013

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Emanuele Serrelli

“Riccardo Massa” Department of Human Sciences - University of Milano Bicocca, ITALY
Lisbon Applied Evolutionary Epistemology Lab - Universidade de Lisboa, PORTUGAL

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AppEEL Applied Evolutionary Epistemology Lab

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