Arthropods in peril between taxonomy crisis and biodiversity loss

Feedback from OHMi Patagonia (Chile)

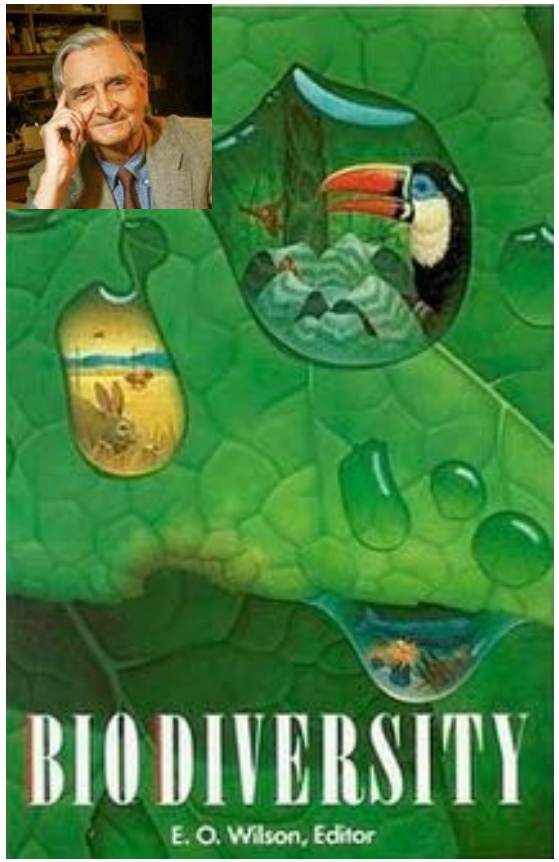
Amouroux P.,

Universidad Mayor, Huechuraba, Chile.

"Biodiversity" Session

International Symposium of LabEx DRIIHM
Inter-Disciplinary Research Facility on Human-Environment Interactions - ANR-11-LABX-0010
June 5th-7th, 2023 – Strasbourg (France)

Biodiversity: new concept, still abstract



First book, 1988

In the early 1980s, ‘biological diversity’ => Biodiversity

Are we understanding:

- What is biodiversity?
- What is the human impact on biodiversity and causing biodiversity loss?
- Why is it a concern?

(Grandcolas P., 2023)

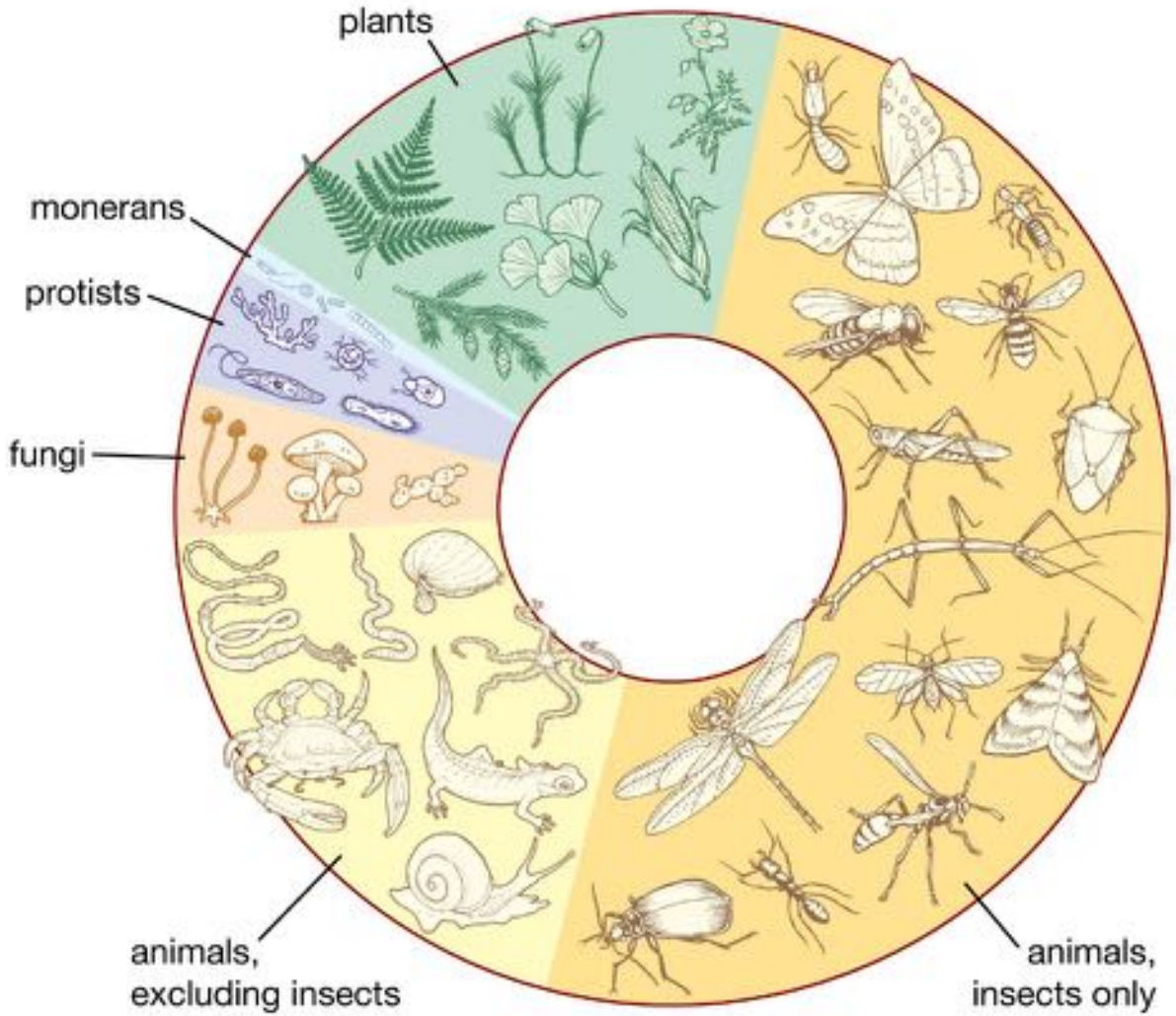
Biodiversity = limited to visible species

? Ecosystem diversity

? Genetic diversity

Insects? Maybe some pests and beautiful ones

Biodiversity = Insects



+ 1 million species described

⇒ 50% of all known species

⇒ 75% of the animals

But 4-7 millions species undescribed
(Stork, 2018)

- 40% of insect species in decline
- 8 times faster than vertebrates

Decline of Insect = Decline of ecosystem services

Insects at the base of food chain:
=> Trophic cascade effects

Farmland practices are driving bird population decline across Europe

Stanislas Rigal, Vasilis Dakos, Hany Alonso, +47, and Vincent Devictor Authors Info & Affiliations

Edited by Ivette Perfecto, University of Michigan, Ann Arbor, MI; received September 28, 2022; accepted March 6, 2023

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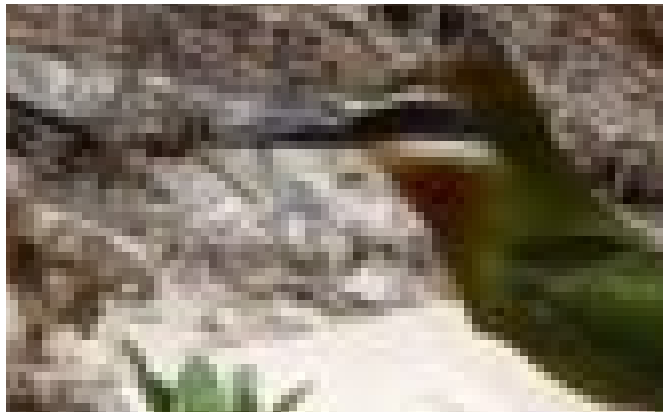
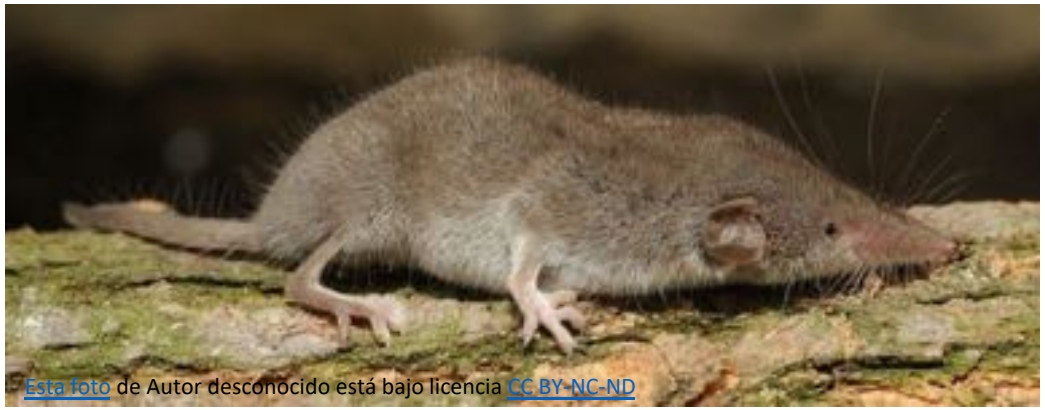
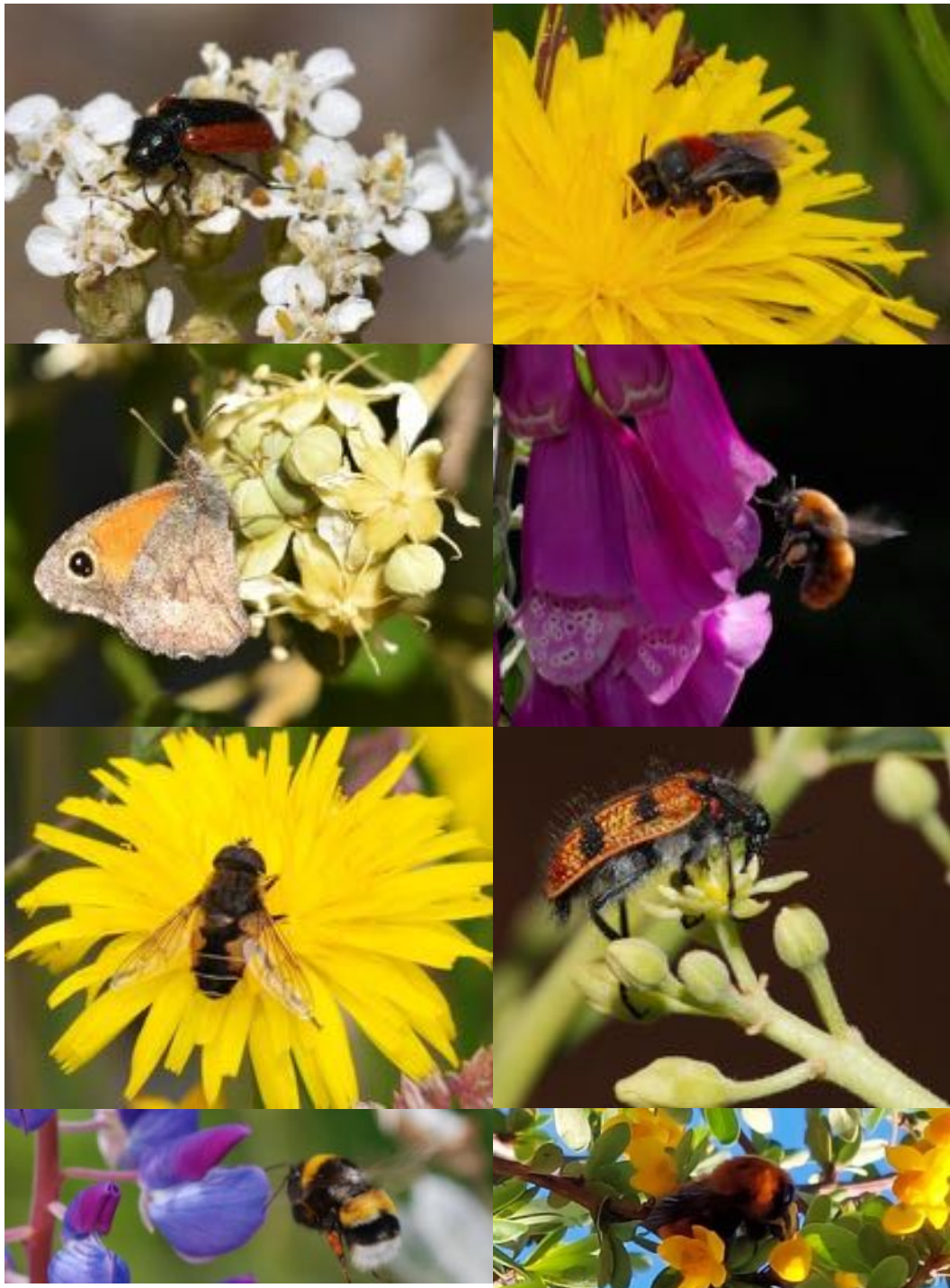




Decline of ecosystem services

- Insect pollination
  - 75 % of cultivated plants
  - Supporting plant biodiversity
  - Not only *Apis mellifera*



Decline of ecosystem services

- Organic matter recycling and nutrient cycles

Example:
Australia,
cow pads and
dung beetles

Lack of specific actions for insects conservation

Previously, lack on public sensibilization

Not enough considered by public policy

Specific actions: pesticides reduction

Almost all mammals, birds and reptiles, and 17 insects

PLOS ONE

More than 75 percent decline over 27 years in total flying insect biomass in protected areas

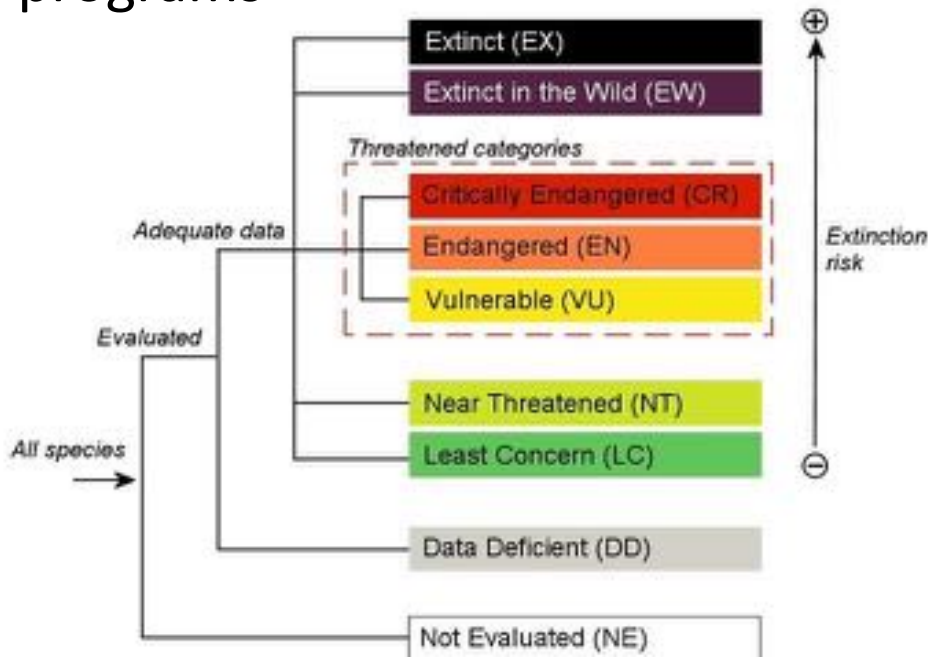
Caspar A. Hallmann, Martin Sorg, Eelke Jongejans, Henk Siepel, Nick Hofland, Heinz Schwan, Werner Stenmans, Andreas Müller, Hubert Sumser, Thomas Hörren, Dave Goulson, Hans de Kroon

Published: October 18, 2017 • https://doi.org/10.1371/journal.pone.0185809

Taxonomy Importance and species

- Keystone for biological and ecological studies

- Species is the taxon used to:
  - IUCN and National Red List
  - Management and conservation programs



- Species of economic importance:
  - Agricultural pests
  - Invasive species
  - Vector-borne diseases

Taxonomy Crisis

- Old-fashioned vision
- Funding:
  - for evolutive studies
  - from taxonomy to systematic
- Consequences:
  - Decline of taxonomists
  - Collection maintenance

- ***Aspidiotus perniciosus*** Comstock 1881a: 304. Type data: U.S.A.: California, Santa Clara County, on apple, pear, plum, and other trees.. Syntypes, female, Type depository: Washington: United States National Entomological Collection, U.S. National Museum of Natural History, District of Columbia, USA . accepted valid name Illustr.
- ***Aonidia fusca*** Maskell 1895b: 43. Type data: AUSTRALIA: New South Wales, Bulga, on peach, *Persica vulgaris*, sent by Mr. French.. Syntypes, female and first instar, Type depository: Auckland: New Zealand Arthropod Collection, Landcare Research, New Zealand . junior synonym (discovered by Maskel1896, 14). Notes: Illustr.
- ***Aspidiotus albopunctatus*** Cockerell 1896h: 20. Type data: JAPAN: on twigs of orange seedlings; collected Craw. . Syntypes, female, Type depository: Washington: United States National Entomological Collection, U.S. National Museum of Natural History, District of Columbia, USA . junior synonym (discovered by Danzig1993, 191).
- ***Aonidiella fusca*** (Maskell, 1895); Leonardi 1897: 286. change of combination
- ***Aspidiotus (Diaspidiotus) perniciosus*** Comstock, 1881; Cockerell 1897i: 30. change of combination
- ***Aspidiotus (Diaspidiotus) perniciosus albopunctatus*** Cockerell, 1896; Cockerell 1897i: 20. change of combination and rank
- ***Aonidiella perniciosa*** (Comstock, 1881); Leonardi 1897: 286. change of combination requiring emendation of specific epithet for agreement in gender
- ***Aspidiotus (Diaspidiotus) andromelas*** Cockerell 1897i: 20. Type data: JAPAN: on "Phaetenia glauca".. Syntypes, female, Type depository: Washington: United States National Entomological Collection, U.S. National Museum of Natural History, District of Columbia, USA . junior synonym (discovered by Danzig1993, 191).
- ***Diaspidiotus perniciosus*** (Comstock, 1881); Cockerell 1899a: 396. change of combination
- ***Diaspidiotus perniciosus andromelas*** (Cockerell, 1897); Cockerell 1899a: 376. change of combination and rank
- ***Aonidiella andromelas*** (Cockerell, 1897); Leonardi 1900: 341. change of combination
- ***Aspidiotus perniciosus albopunctatus*** Cockerell, 1896; Fernald 1903b: 275. change of combination
- ***Aspidiotus perniciosus andromelas*** Cockerell, 1897; Fernald 1903b: 276. change of combination and rank
- ***Aspidiotus (Diaspidiotus) perniciosus*** Comstock, 1881; Brain 1918: 125. change of combination
- ***Comstockaspis perniciosa*** (Comstock, 1881); MacGillivray 1921: 438. change of combination
- ***Aspidiotus (Hemiberlesiana) perniciosus*** Comstock, 1881; Thiem & Gerneck 1934a: 132. change of combination
- ***Aspidiotus (Comstockaspis) perniciosus*** Comstock, 1881; Borchsenius 1935a: 33. change of combination
- ***Quadraspidiotus perniciosus*** (Comstock, 1881); Ferris 1938a: 337. change of combination
- ***Aspidiotus fuscus*** (Maskell, 1895); Ferris 1941e: 43. change of combination requiring emendation of specific epithet for agreement in gender
- ***Aspidiotus (Quadraspidiotus) perniciosus*** Comstock, 1881; Merrill 1953: 25. change of combination
- ***Hemiberlesiana perniciosa*** (Comstock, 1881); Lindinger 1957: 549. change of combination
- ***Aspidiotus albopunctatus*** Cockerell, 1896; Borchsenius 1966: 368. revived combination (previously published)
- ***Aspidiotus andromelas*** Cockerell, 1897; Borchsenius 1966: 368. revived combination (previously published)
- ***Quadraspidiotus perniciosus*** (Comstock, 1881); Borchsenius 1966: 337. revived combination (previously published)
- ***Comstockaspis perniciosa*** (Comstock, 1881); Takagi 1974: 12-15. revived combin (previously published)
- ***Aspidiotus perniciasus*** Comstock, 1881; Chou 1985: 310. misspelling of species
- ***Diaspidiotus perniciosus*** (Comstock, 1881); Danzig 1993: 191-193. revived comb (previously published)
- ***Ceudraspidiotus perniciosus***; Liang, et al. 1999: 29. misspelling of genus name
- ***Comstockaspis perniciosa*** (Comstock, 1881); Normark, Morse, Krewinski & Okusu 2014: 45. revived combination (previously published)

Classical Taxonomy Criticism


Melanaspis sitreana

- Illustrated by *Comstockaspis perniciosa* (Comstock, 1881)
- Continuous name modification based on expert opinions
- How can you classify something without knowing the complete diversity?

Taxonomic identification = Long time process

Parc national de Mercantour

Accueil / Des connaissances / L'acquisition et le partage de la connaissance / L'Inventaire Biologique Généralisé

L'Inventaire Biologique Généralisé

(ATBI, All Taxa Biodiversity Inventory)

2450 km2, 14 years, 300 taxonomists
From 1,800 species of invertebrados to 7,000 (total 11,000 species)

Molecular Ecology Resources / Volume 22, Issue 2 / p. 803-822

RESOURCE ARTICLE | Open Access

A molecular-based identification resource for the arthropods of Finland

Tomas Roslin, Panu Somervuo, Mikko Pentinsaari, Paul D. N. Hebert, Jireh Agda, Petri Ahlroth, Perttu Anttonen, Jouni Aspi, Gergin Blagoev, Santiago Blanco, Dean Chan, Tom Clayhills ... See all

First published: 25 September 2021
https://doi.org/10.1111/1755-0998.13510

communications biology

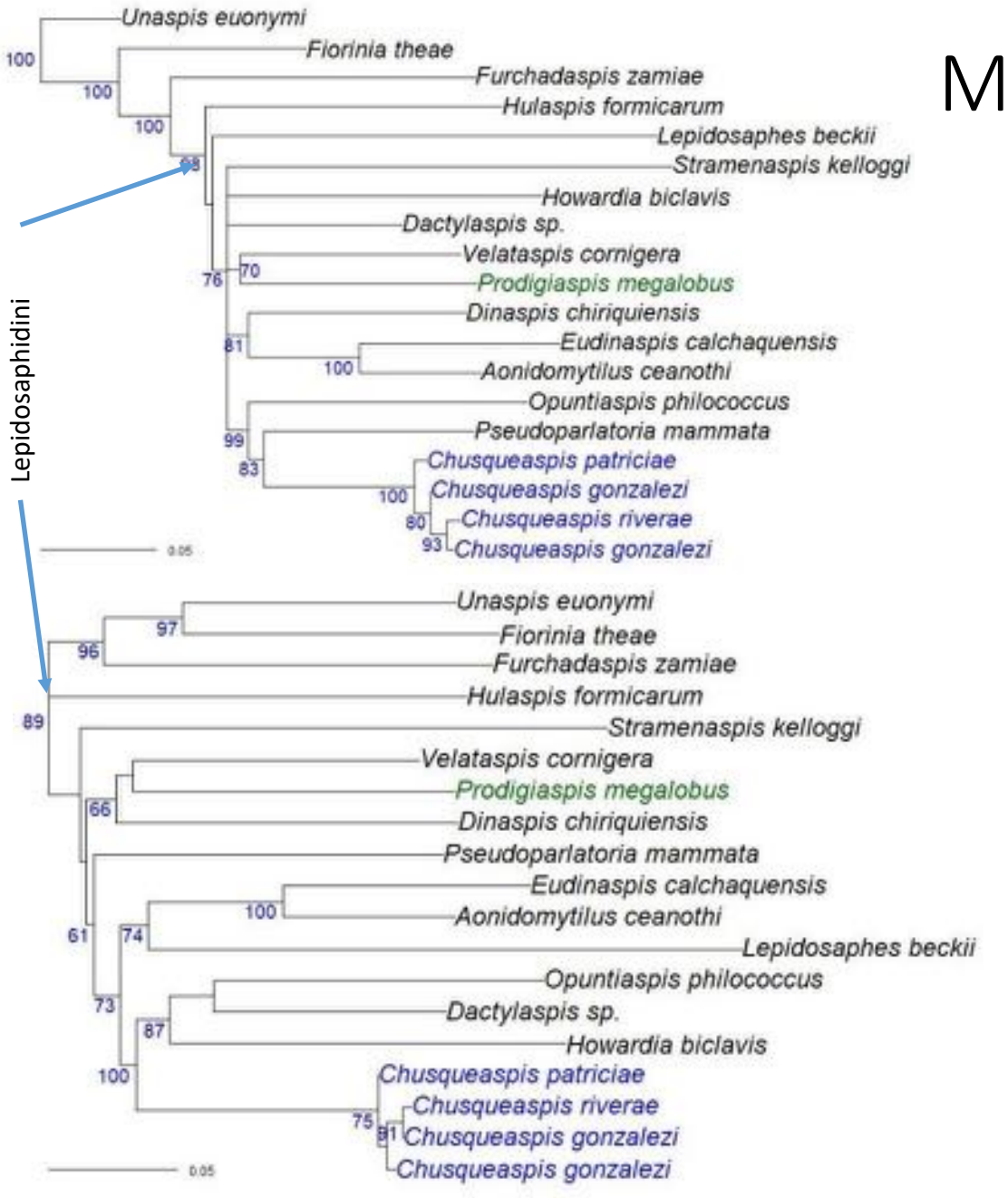
ARTICLE

OPEN

Climate-induced forest dieback drives compositional changes in insect communities -that are more pronounced for rare species

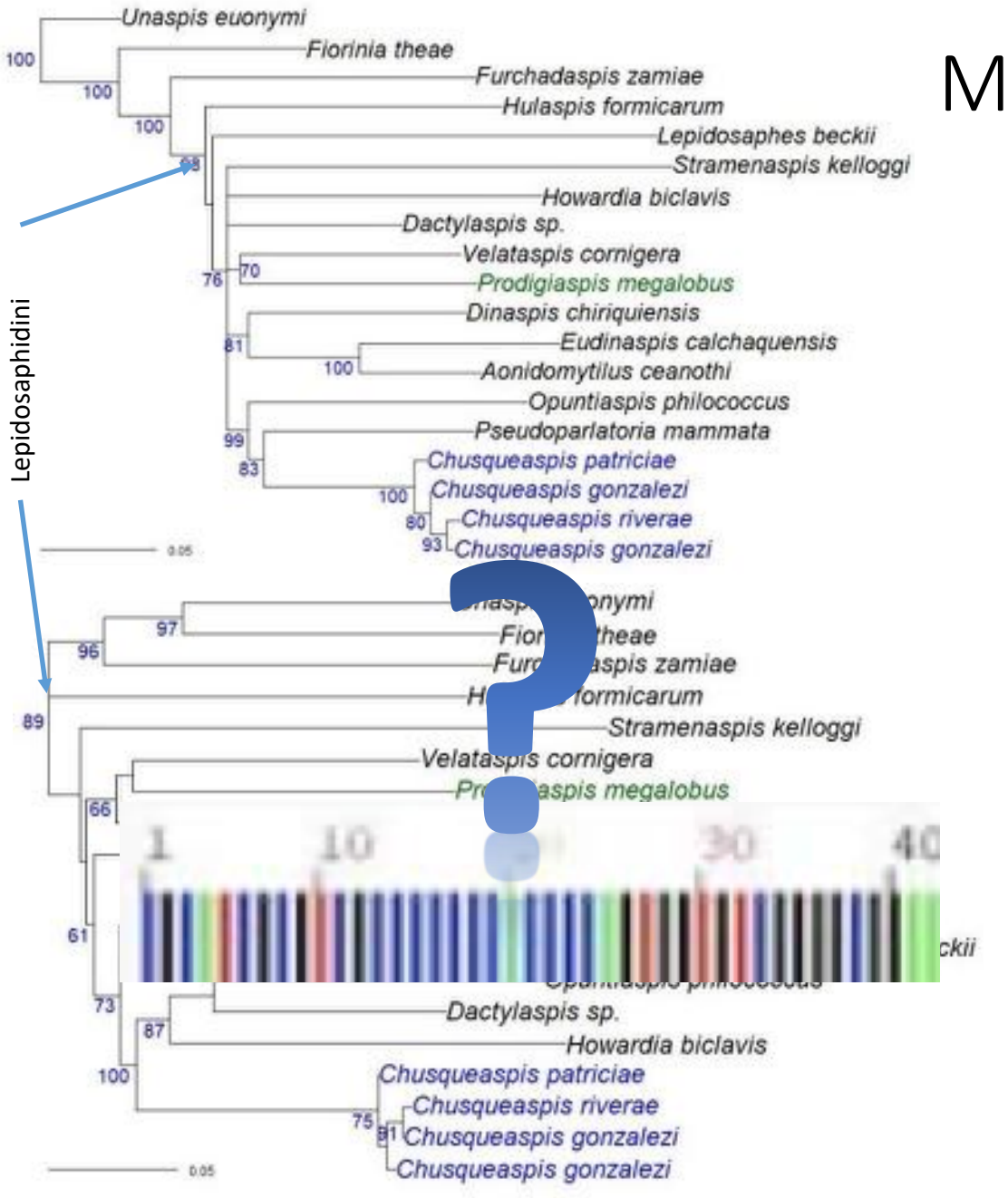
Lucas Sire, Paul Schmidt Yáñez, Cai Wang, Annie Bézier, Béatrice Courtial, Jérémy Cours, Diego Fontaneto, Laurent Larrieu, Christophe Bouget, Simon Thorn, Jörg Müller, Douglas W. Yu, Michael T. Monaghan, Elisabeth A. Herniou & Carlos Lopez-Vaamonde

- Taxonomy and Barcode Index Numbers (BINs) -



Molecular, not absolute techniques

- Phylogenetics also based on expert opinions
- But a useful tool to support morphological analysis



Molecular, not absolute techniques

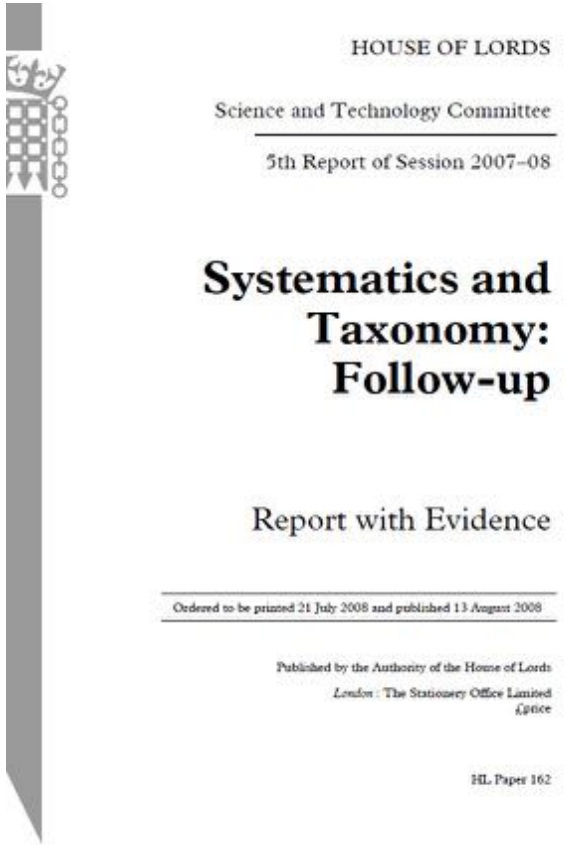
- Phylogenetics also based on expert opinions
- But a useful tool to support morphological analysis
- Barcoding still insufficient to describe new species

=> need morphological reference

Challenges for future taxonomy

- Increase the description of new species
  - Balance between morfopholgy and molecular (Browser, 2010)
  - But, morphological description still obligatory

- Tools modernization
  - DNA
  - Morphometry
  - New microscopy (electron, scanner…)
  - Digitalization (high resolution, 3D…)


HOUSE OF LORDS

Science and Technology Committee

5th Report of Session 2007–08

Systematics and Taxonomy: Follow-up

Report with Evidence

Ordered to be printed 21 July 2008 and published 13 August 2008

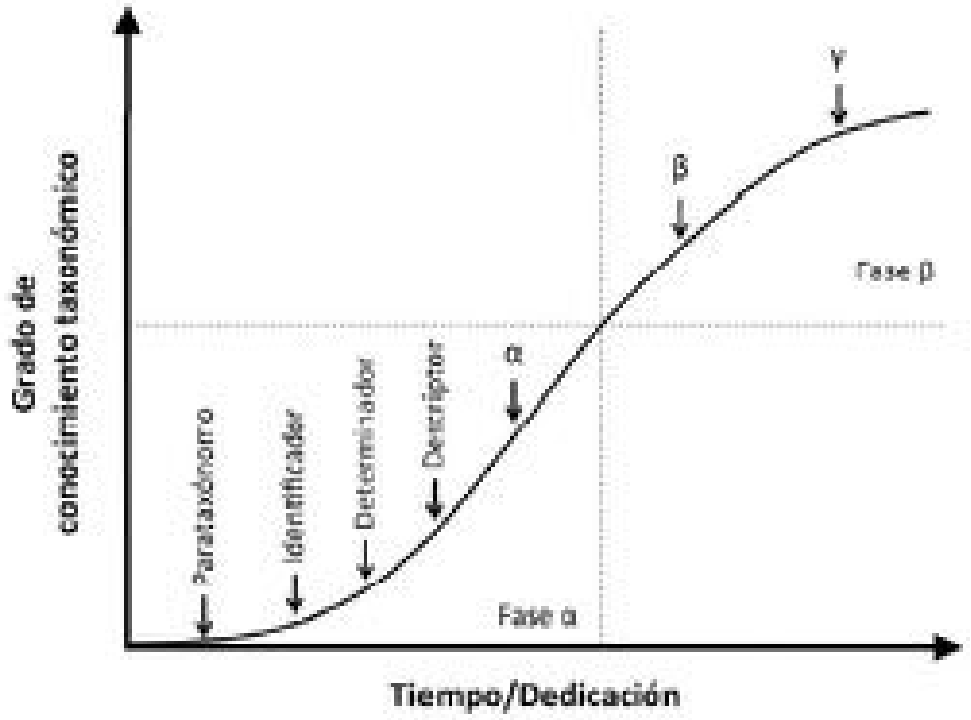
Published by the Authority of the House of Lords

London : The Stationery Office Limited

£price

HL Paper 162

Need for future taxonomy



Ari Noriega et al. 2015. Revista IDE@

- Valorization of taxonomy by funding agencies
- Capacitation of new generations
- Development of collection (physical, digital and ADN)

Aysén: out-focused / forgotten region

Myers et al. 2000

- Between the Central Chile Hotspot and the Magallanes Region
- In the South of Valdivian Rainforest ecoregion
- About 50% Nacional Protected Areas

Region with the one of the lowest presence in Museum National Collection

Classical approaches (2019-2021)

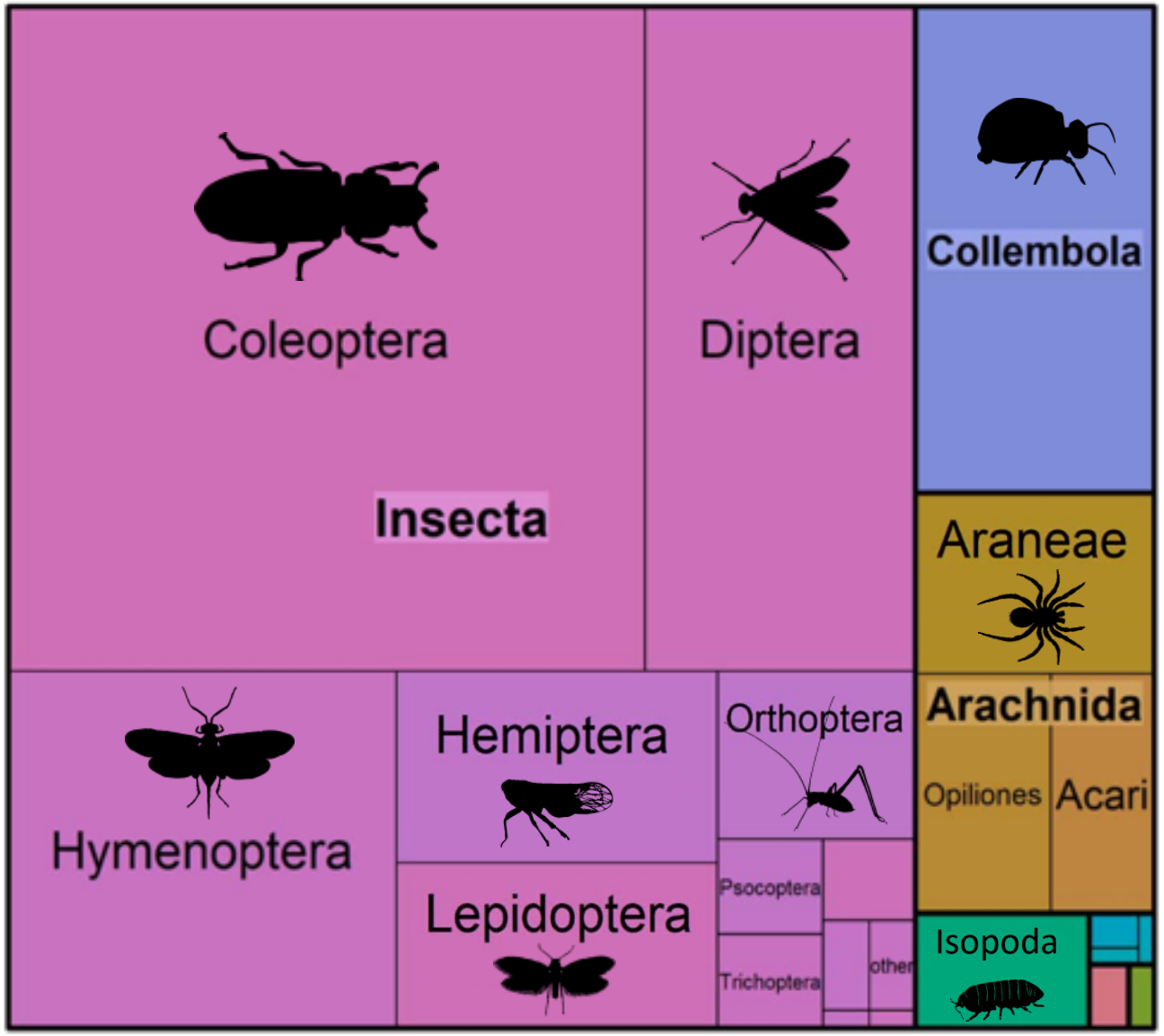
- Three week-long expeditions
- Diversity of traps and collecting techniques
- National collaborations

Sociedad Chilena de Entomología

UMCE

Museo Nacional de Historia Natural Chile

Classical approaches (2019-2021)



- About 1.000 individuals
  - 56 families in Coleoptera
  - 23 in Diptera
  - 13 in Lepidoptera
- Individuals in public collections

Museo Nacional de Historia Natural Chile

Updated distribution and unknown species

- 500 km southernmost than previous record
- New species

Udenus fasciatus Ander, 1938

Heteromallus spinipes Karny, 1930

Dolichochaeta sp.

New approaches: BioScan Program

- Global Malaise Trap Program

(University Guelph – Canada)

- Metabarcoding for flying insects, but vouchers available

Beetles as bioindicators of austral forests

- Taxonomic approaches on functional taxa
- Local collaboration for sampling

Protected areas

Anthropized areas

Native vs Invasive: the case of *Bombus*

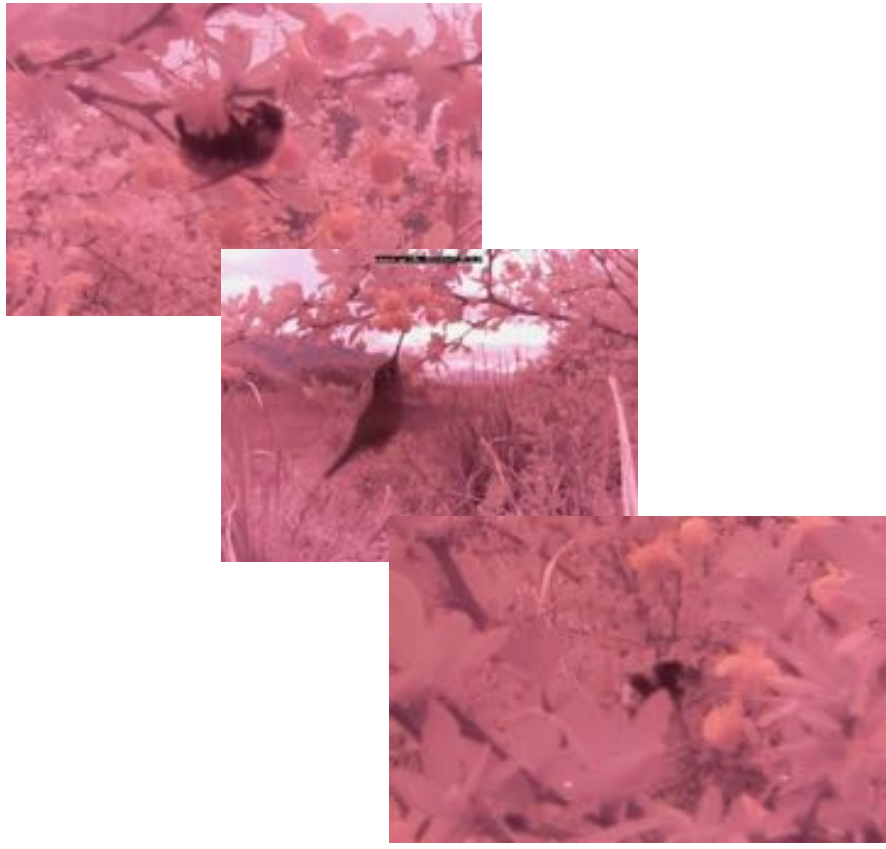
FACULTAD DE AGRONOMÍA
E INGENIERÍA FORESTAL
PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE

- Species interactions: Monitoring by camera-trap with image recognition by I.A. and pollen identification

Queens of *Bombus*

B. dahlbomi *B. terrestris*

Plant-Insect interaction camara trap



Citizen science project: iNaturalist

- ✓Sensibilization (night trip, local talks)
- ✓Collect temporal information

Conclusion

- Identify insect biodiversity need revalorisation of taxonomy

  => cite the publication of species description as the publication of software programme.

- Not only taxonomy, understand biology, ecology / species interactions

- Knowledge for future generations

Positive future…

¡Gracias!
Merci !
Thank you!

Insecta exists since 425 millions years,
survived to the 5 major extinctions.

They will survive (despite the disappearance of unique millions species)
they will be studied by future entomologists (maybe non-human)