

# Metodologie didattiche nella Biologia Animale



SAPIENZA  
UNIVERSITÀ DI ROMA

Percorso 24 Cfu – Master formazione insegnanti

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*Dipartimento di Biologia e Biotecnologie*  
*«Charles Darwin»*

# ***Le dimensioni della Biodiversità***

La Biodiversità animale

cenni essenziali sui principali phyla di protozoi e metazoi

**Inventari della Biodiversità  
i numeri della biodiversità animale:  
specie note vs specie esistenti**

Classificazione della Biodiversità

storia dei metodi di classificazione;

*Systema Naturae*;

evoluzione della tassonomia come linguaggio scientifico

comune dei naturalisti

*Le dimensioni della Biodiversità*

*2, 10 o 30 milioni di specie?*

Numero di specie **catalogate**

Numero di specie **esistenti**



## ... il mestiere più antico del mondo

*“Allora il Signore Dio plasmò dal suolo ogni sorta di bestie selvatiche e tutti gli uccelli del cielo e li condusse all'uomo, per vedere come li avrebbe chiamati: in qualunque modo l'uomo avesse chiamato ognuno di tutti gli uccelli del cielo e a tutte le bestie selvatiche*



# *Le dimensioni della Biodiversità*

## Numero di specie catalogate

<b>ANIMALS</b>	<b>1 527 319</b>	<b>PLANTS</b>	<b>312 000</b>
of which: Porifera	8 346	of which : Bryophytes	16 000
Cnidaria	10 105	« Algae »	12 000
Platyhelmintha	29 285	Pteridophytes	9 000
Nematoda	24 783	Spermatophytes	275 000
Arthropoda	1 235 848	<b>FUNGI</b>	<b>99 000</b>
of which: Crustacea	66 914	<b>OTHER ORGANISMS</b>	<b>65 000</b>
Arachnida	112 201	of which : Procaryotes	7 643
Insecta	1 020 007	Cyanophyceaea	2 664
of which: Coleoptera	387 100	Diatoms	20 000
Diptera	159 294	Protoctista	29 000
Hymenoptera	115 000		
Lepidoptera	157 424		
Mollusca	85 000	<b>GRAND TOTAL</b>	<b>2 003 000</b>
Annelida	17 210		
Echinodermata	7 509		
Vertebrata	65 158		
of which: Fishes	31 958		
Amphibians	7 694		
Reptiles	9 766		
Birds	9 990		
Mammals	5 750		

Sources:

Chapman 2009, Numbers of living species, ed. 2

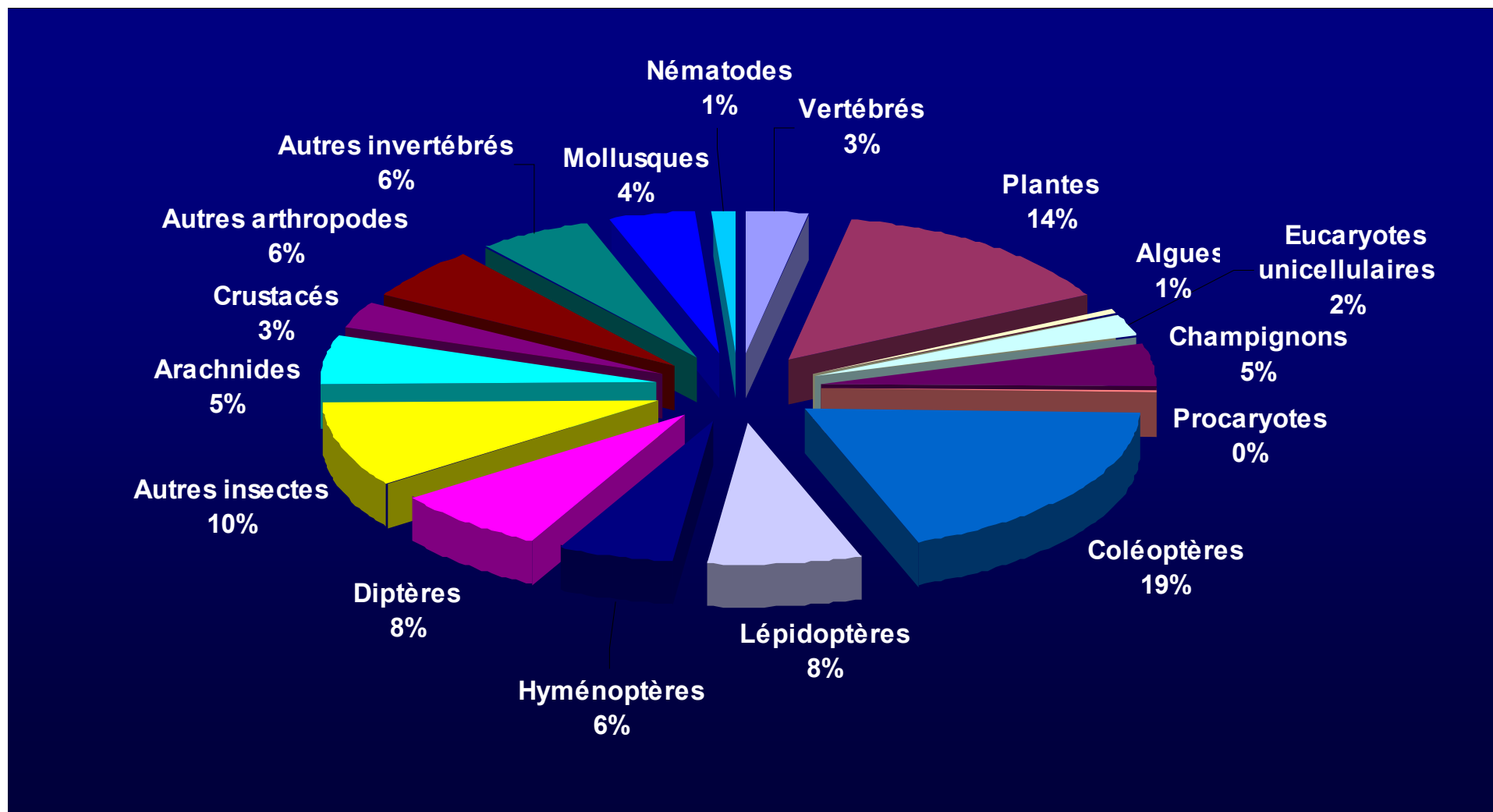
[www.environment.gov.au/biodiversity/abrs/publications/species-numbers/2009/index.htm](http://www.environment.gov.au/biodiversity/abrs/publications/species-numbers/2009/index.htm)

The Plant List [www.theplantlist.org](http://www.theplantlist.org)

Zhang 2011, Zootaxa 3148: 7-12

# Le dimensioni della Biodiversità

## Specie catalogate





# *Le dimensioni della Biodiversità*

## Numero di specie catalogate

### Fonti di incertezza

- Specie valide vs sinonimi

*Facelina bostoniensis*  
(Couthouy, 1838)

Western Atlantic



*Facelina curta*  
(Alder & Hancock, 1843)

Eastern Atlantic

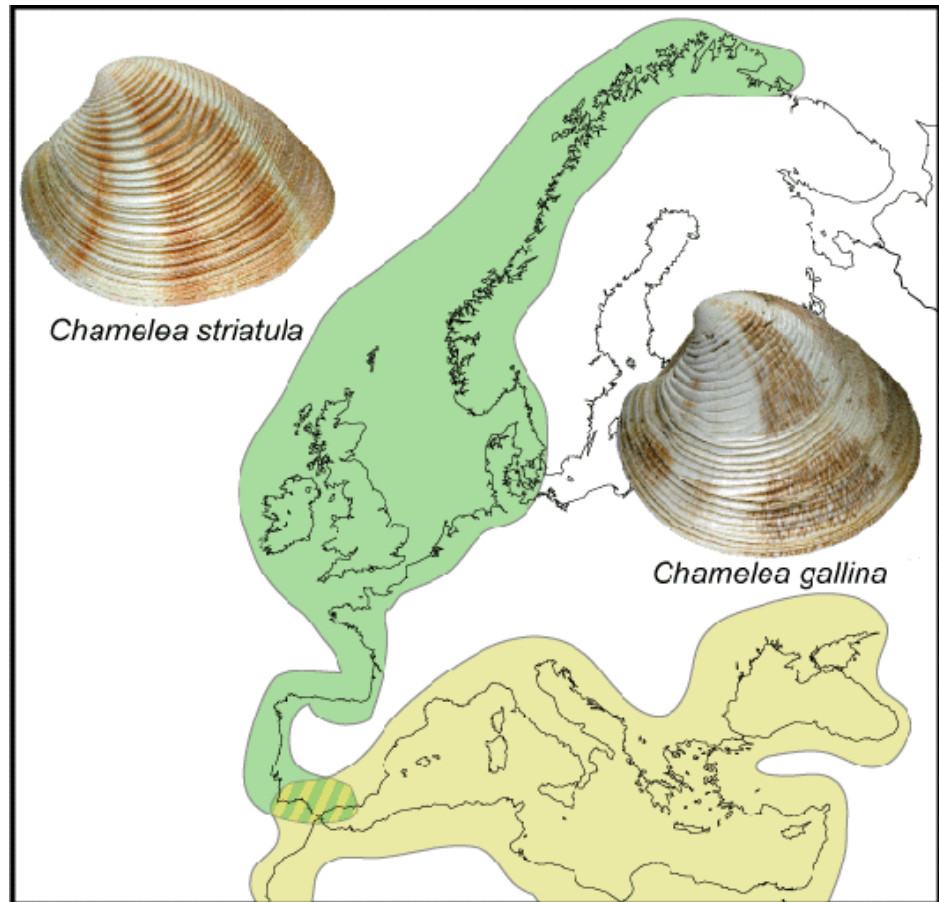
# Le dimensioni della Biodiversità

## Numero di specie catalogate

### Fonti di incertezza

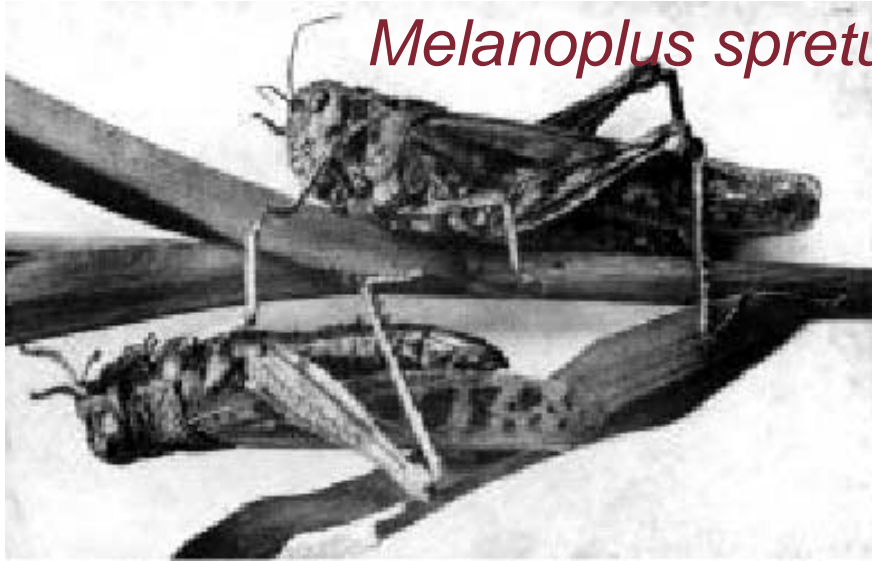
- Specie valide vs sinonimi

**Backeljau, T.; Bouchet, P.; Gofas, S.; De Bruyn, L. (1994). Genetic variation, systematics and distribution of the venerid clam *Chamelea gallina*. *J. Mar. Biol. Ass. U.K.* 74: 211-223**





*Melanoplus spretus*



The best known destructive migratory insect in the United States. Between 1873 and 1877 it caused more than \$200 million in crop damages in Colorado, Nebraska, and other states. (Ryckman, 1999)



*Melanoplus sanguinipes*

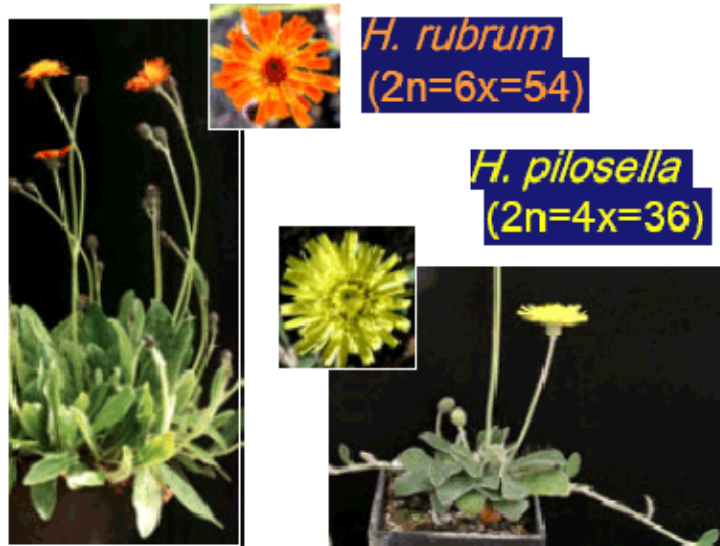
Ryckman, L. 06-22-99. The Great Locust Mystery Grasshoppers That Ate The West Became Extinct. *Denver Rocky Mountain News*.

# Le dimensioni della Biodiversità

## Numero di specie catalogate

### Fonti di incertezza

- Specie valide vs sinonimi
- **Diversi concetti di specie**



Gen. *Hieracium* (sparvieri)

Allogamic species: 25



## *Le dimensioni della Biodiversità*

*2, 10 o 30 milioni di specie?*

**Numero di specie catalogate**

**ca. 2.000.000**

**Numero di specie esistenti ?**

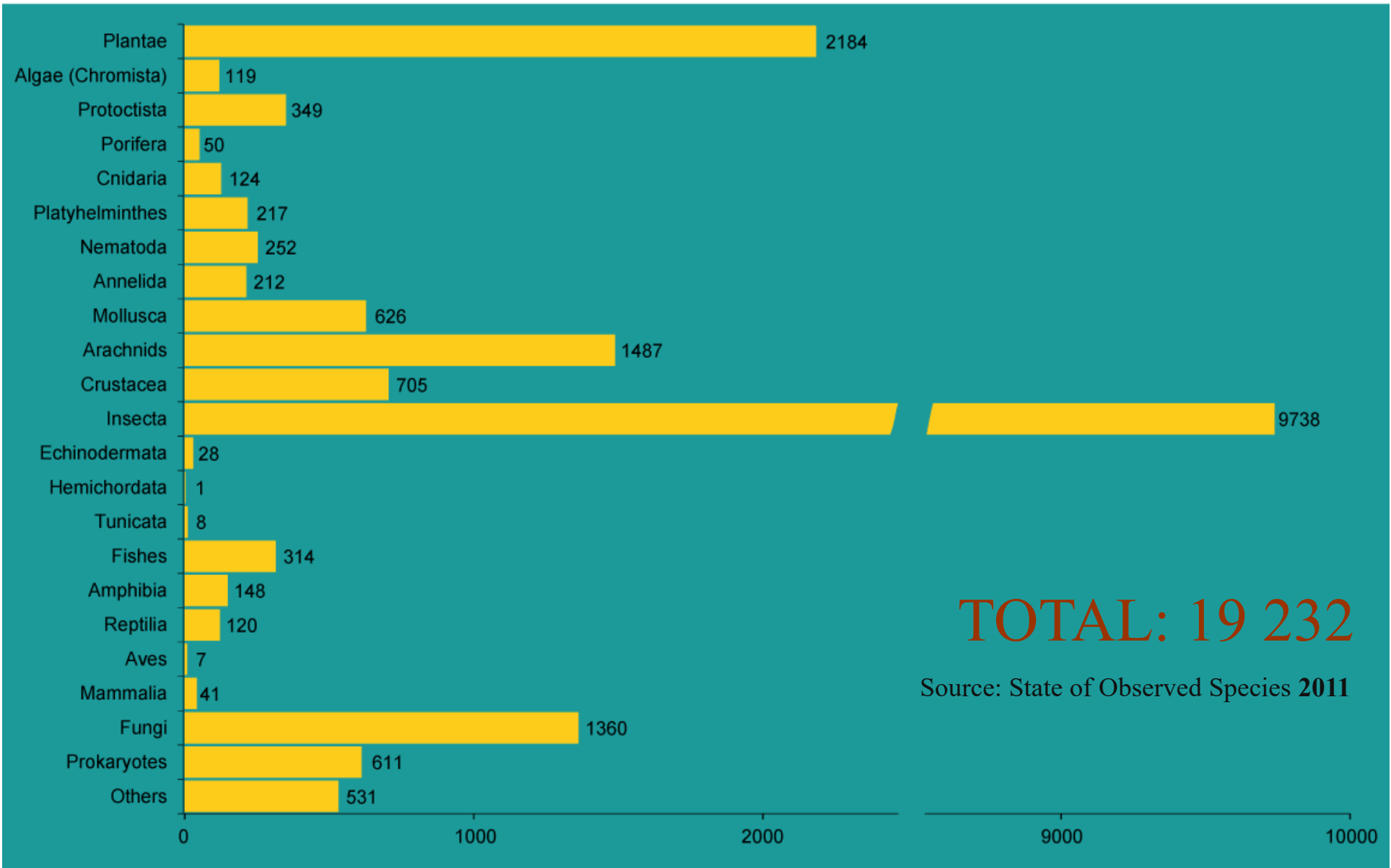
## ***Le dimensioni della Biodiversità***

### **Numero di specie esistenti**

### **Media nuove specie per anno**

Land and freshwater vertebrates	560
Insects	7000
Other land animals	2500
Plants	2300
Other land organisms	1800
Marine fishes	140
Marine Crustacea	440
Other marine organisms	1000
Marine algae	90

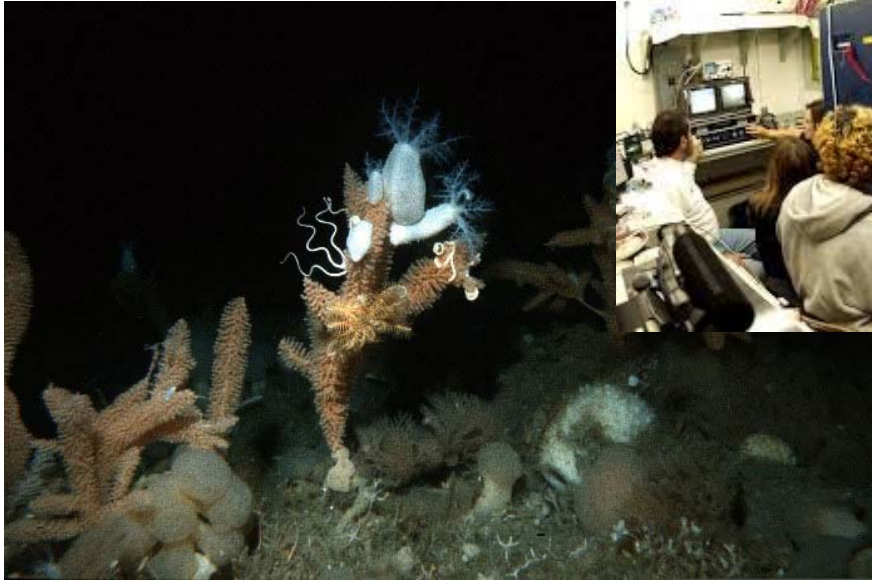
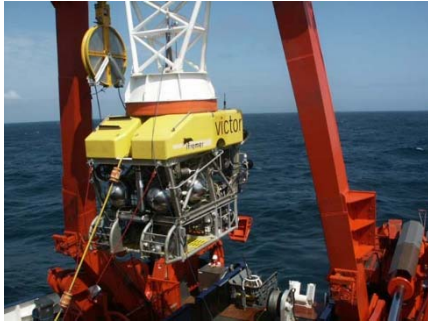
# New taxa





# *Le dimensioni della Biodiversità*

## Numero di specie esistenti



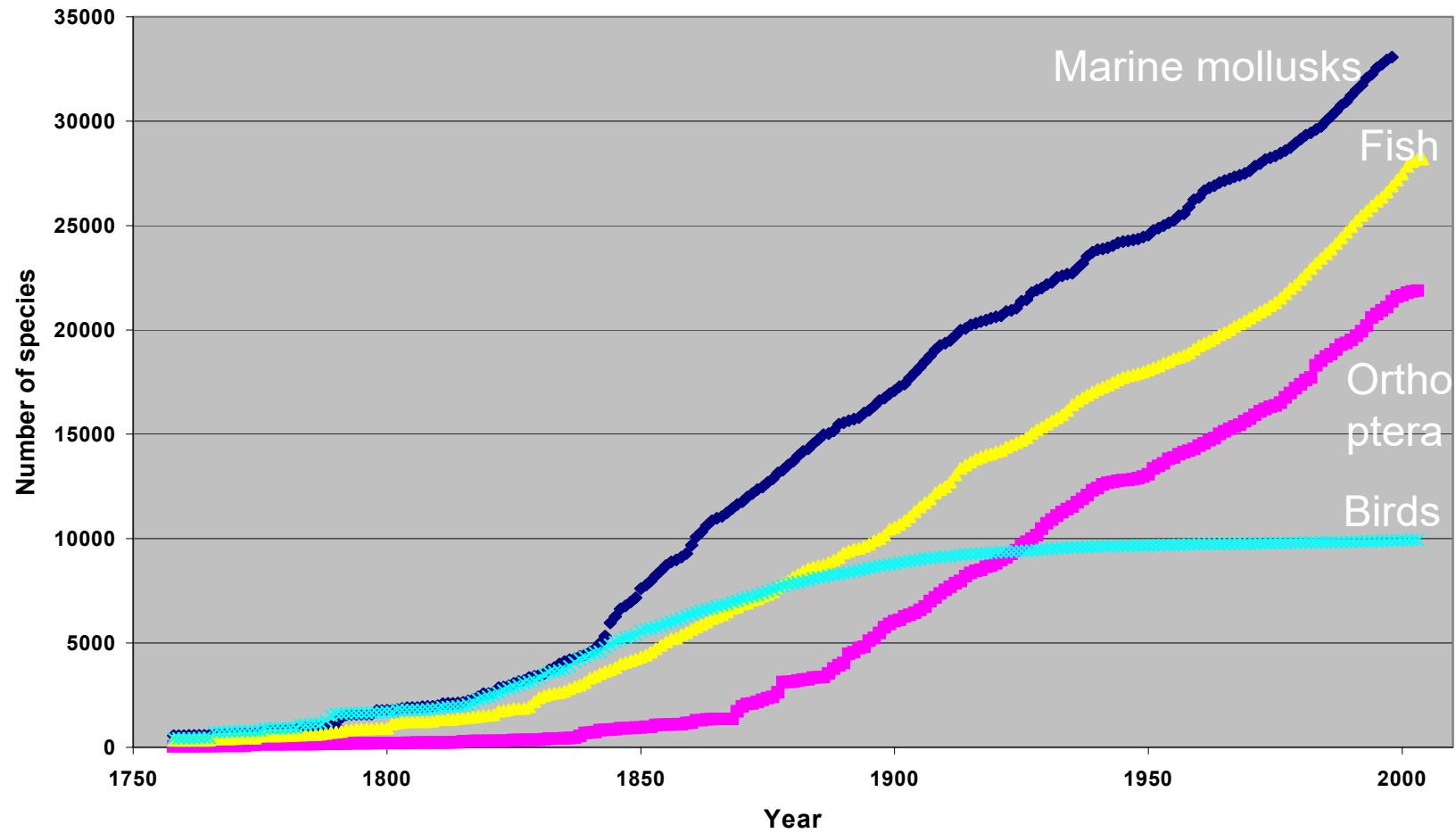




# *Le dimensioni della Biodiversità*

## Numero di specie esistenti

Species naming curves for various taxa



# Le dimensioni della Biodiversità

## Numero di specie esistenti



30 000 000  
Tropical arthropods !!

The Coleopterists Bulletin, 36(1):74-75. 1982.

### TROPICAL FORESTS: THEIR RICHNESS IN COLEOPTERA AND OTHER ARTHROPOD SPECIES

TERRY L. ERWIN

National Museum of Natural History, Smithsonian Institution,  
Washington, DC 20560

#### ABSTRACT

Extrapolation from data about canopy insects collected by fogging methods together with estimates of tropical plant host specificity indicate that one hectare of unrich seasonal forest in Panama may have in excess of 41,000 species of arthropods. Further extrapolation of available data based on known relative richness of insect Orders and canopy richness leads to the conclusion that current estimates of Arthropod species numbers are grossly underestimated; that there could be as many as 30 million species extant globally, not 1.5 million as usually estimated.

Since the early days of naturalists, there has been the question of how many species there were in the forests of the tropics. Bates (1892) wrote of collecting more than 700 species of butterflies within an hour's walk of his home in Para, Brazil. Many have guessed that the arthropod fauna of the world today contains between 1.5 to 10 million species. No hard data are available however, and these estimates are less than reliable and as a result misleading. In a recent paper, Erwin and Scott (1980) provided the first hard data with regard to the Coleoptera fauna of a single species of tree in the tropical seasonal forest of Panama. Also recently, Peter Raven of the Missouri Botanical Gardens wrote me with the same inquiry that Bates had pondered—"How many species are there in one acre of rich tropical forest?" With the hard data available from the Panama study, I set out to give as close an estimate as possible and was shocked by my conclusions.

The tropical tree *Luehea seemannii* is a medium-sized seasonal forest evergreen tree with open canopy, large and wide-spaced leaves. The trees sampled ( $n = 19$ ) had few epiphytes or lianas generally, certainly not the epiphytic load normally thought of as being rich. These 19 trees over a three season sampling regime produced 955+ species of beetles, excluding weevils. In other samples now being processed from Brazil, there are as many weevils as leaf-beetles, usually more, so I added 206 (weevils) to the *Luehea* count and rounded to 1,200 for convenience. There can be as many as 245 species of trees in one hectare of rich forest in the tropics, often some of these in the same genus. Usually there are between 40 to 100 species and/or genera, so I used 70 as an average number of genus-group trees where host-specificity might play a role with regard to arthropods. No data are available with which to judge the proportion of host-specific arthropods per trophic group anywhere, let alone the tropics. So conservatively, I allowed 20% of the *Luehea* herbivorous beetles to be host-specific (i.e., must use this tree species in some way for successful reproduction), 5% of the predators (i.e., are tied to one or more of the host-specific herbivores), 10% of the fungivores (i.e., are tied to fungus associated only with this tree), and 5% of the scavengers (i.e., are associated in some way with only the tree or with the other three trophic groups) (Table 1).

74

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- **Education:**

*Cicindis horni* Bruch,  
The Fairy Shrimp Hunting  
Beetle

Research  
Collections





**7 300 000 – 81 400 000  
forest arthropods**



**Vojtech Novotny**

**Estimates of the global diversity of  
tropical arthropods (Novotny et al., 2002)**

*Biodiversity and Conservation* 2, 215–232 (1993)

## **How many species are there?**

**NIGEL E. STORK**

*Biodiversity Division, Entomology Department, The Natural History Museum, Cromwell Road, London SW7 5BD, UK*

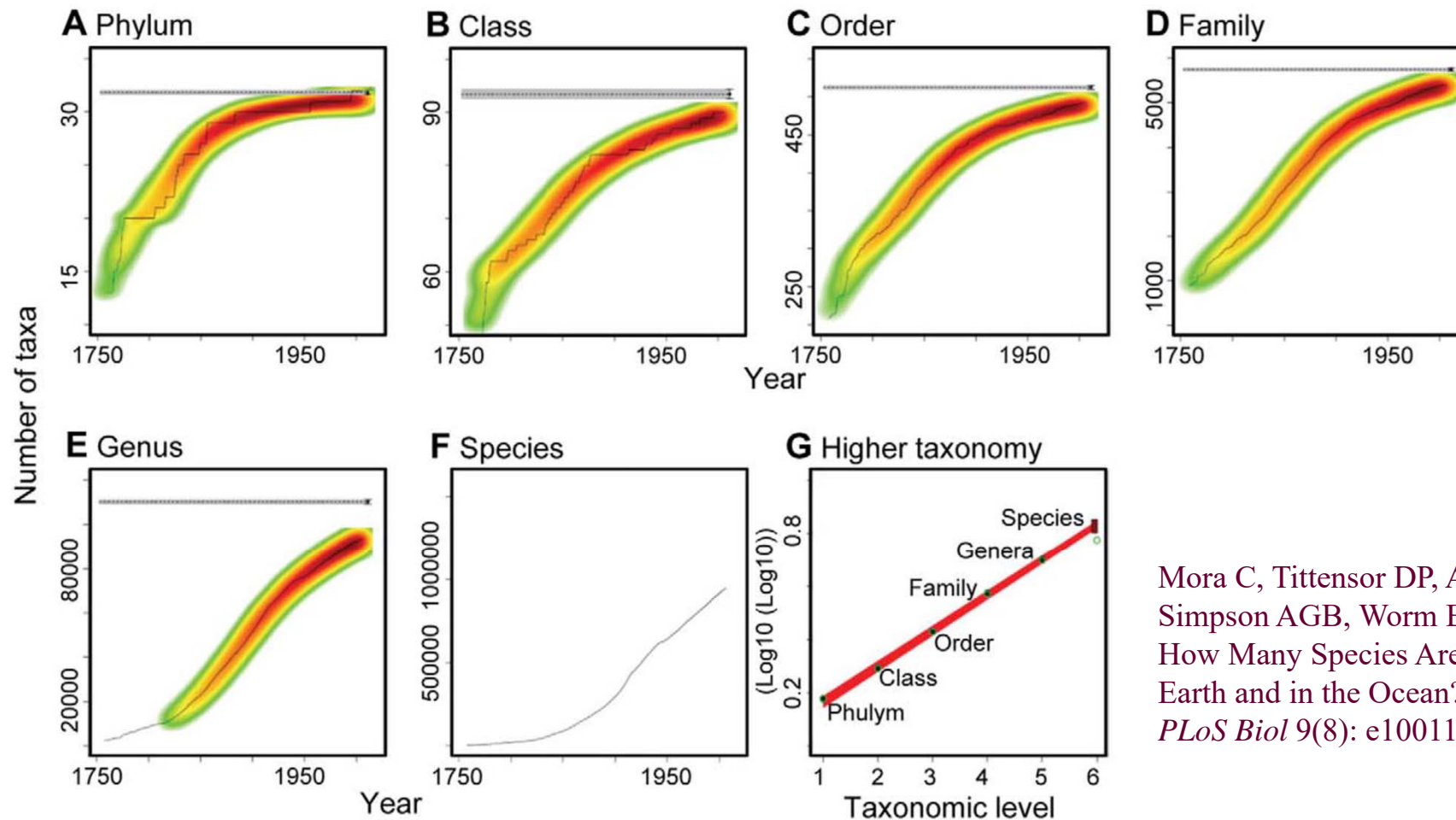
Received 8 December 1992; revised and accepted 8 February 1993

'How many species are there' is a question receiving more attention from biologists and reasons for this are suggested. Different methods of answering this question are examined and include: counting all species; extrapolations from known faunas and regions; extrapolations from samples; methods using ecological models; censusing taxonomists' views. Most of these methods indicate that global totals of 5 to 15 million species are reasonable. The implications of much higher estimates of 30 million species or more are examined, particularly the question of where these millions of species might be found.

**3 700 000 - 5 800 000  
tropical arthropods**

# Le dimensioni della Biodiversità

## Numero di specie esistenti



Mora C, Tittensor DP, Adl S, Simpson AGB, Worm B (2011) How Many Species Are There on Earth and in the Ocean? *PLoS Biol* 9(8): e1001127.

# Le dimensioni della Biodiversità

## Numero di specie esistenti

**Table 2.** Currently cataloged and predicted total number of species on Earth and in the ocean.

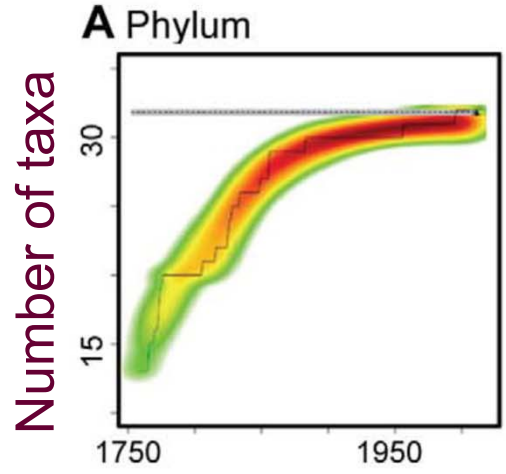
Species	Earth			Ocean		
	Catalogued	Predicted	±SE	Catalogued	Predicted	±SE
<b>Eukaryotes</b>						
Animalia	953,434	7,770,000	958,000	171,082	2,150,000	145,000
Chromista	13,033	27,500	30,500	4,859	7,400	9,640
Fungi	43,271	611,000	297,000	1,097	5,320	11,100
Plantae	215,644	298,000	8,200	8,600	16,600	9,130
Protozoa	8,118	36,400	6,690	8,118	36,400	6,690
<i>Total</i>	1,233,500	8,740,000	1,300,000	193,756	2,210,000	182,000
<b>Prokaryotes</b>						
Archaea	502	455	160	1	1	0
Bacteria	10,358	9,680	3,470	652	1,320	436
<i>Total</i>	10,860	10,100	3,630	653	1,320	436
<b>Grand Total</b>	<b>1,244,360</b>	<b>8,750,000</b>	<b>1,300,000</b>	<b>194,409</b>	<b>2,210,000</b>	<b>182,000</b>

Predictions for prokaryotes represent a lower bound because they do not consider undescribed higher taxa. For protozoa, the ocean database was substantially more complete than the database for the entire Earth so we only used the former to estimate the total number of species in this taxon. All predictions were rounded to three significant digits.

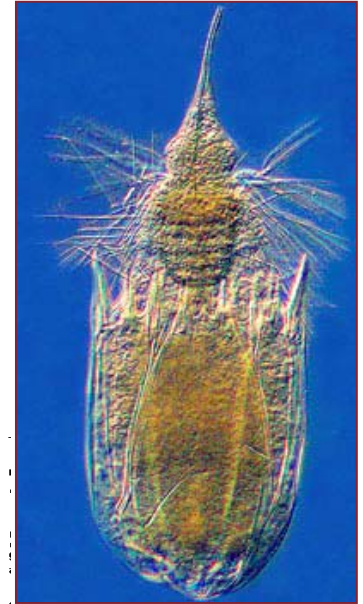
doi:10.1371/journal.pbio.1001127.t002

Mora et al. 2011, PLoSBiology 9(8): e1001127

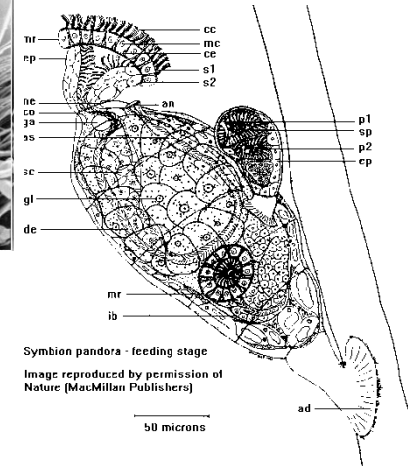
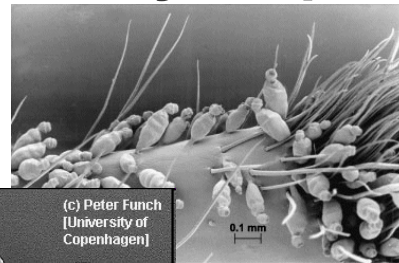




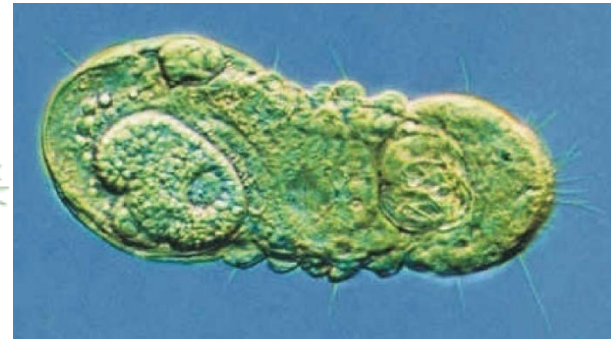
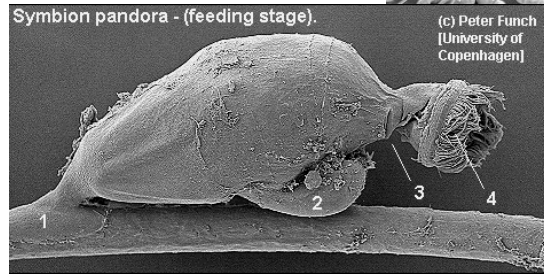
# 1983 - Loricifera



# 1995 - Cycliophora



Year



# 2000 - Micrognathozoa



## **Some general properties**

Most species are small  
and (naturally) rare

## Most species are small

*Biological Journal of the Linnean Society*, 2002, **75**, 421–436. With 7 figures

### Assessing the magnitude of species richness in tropical marine environments: exceptionally high numbers of molluscs at a New Caledonia site

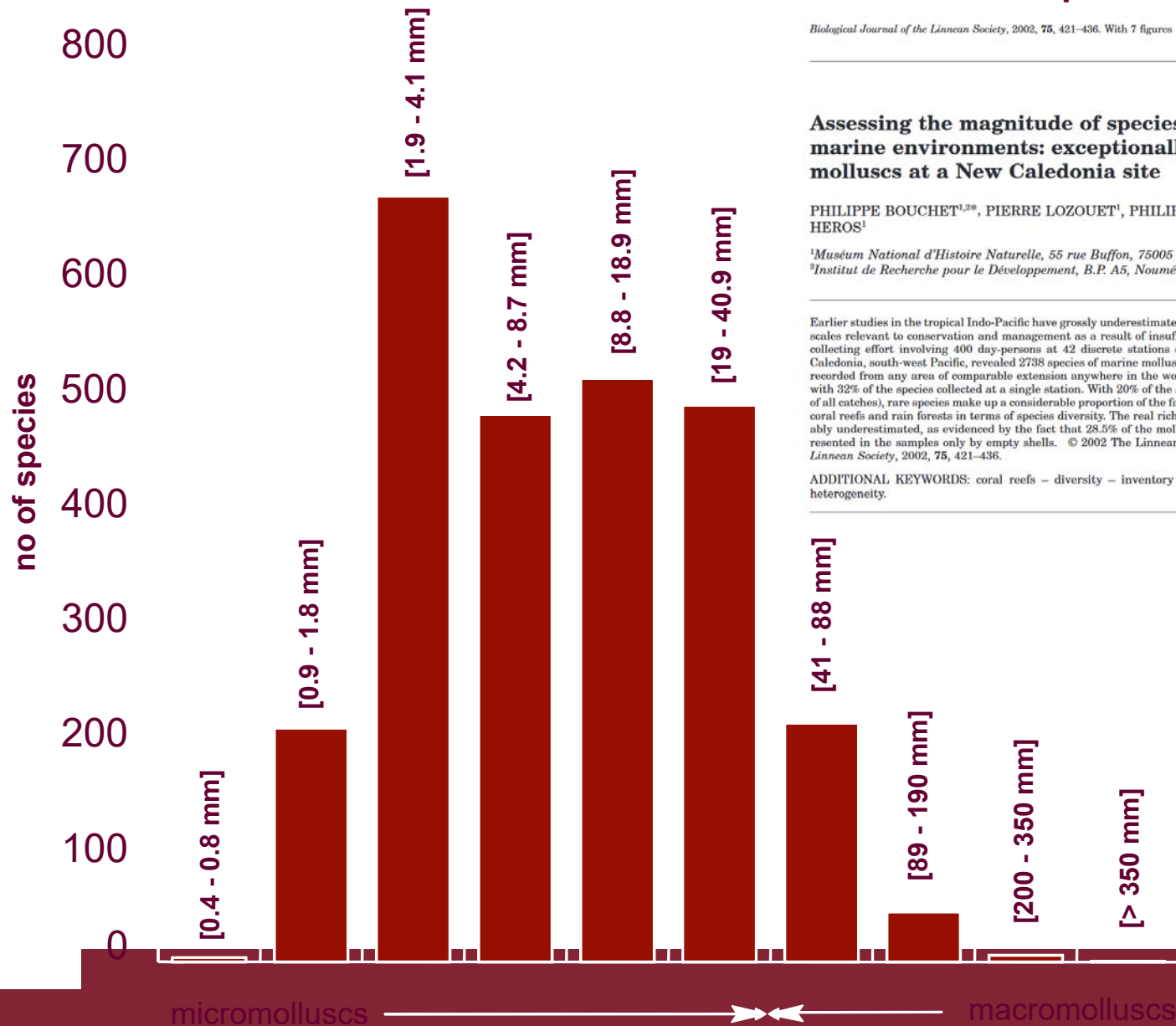
PHILIPPE BOUCHET<sup>1,2\*</sup>, PIERRE LOZOUET<sup>1</sup>, PHILIPPE MAESTRATI<sup>1</sup> and VIRGINIE HEROS<sup>1</sup>

<sup>1</sup>Muséum National d'Histoire Naturelle, 55 rue Buffon, 75005 Paris, France

<sup>2</sup>Institut de Recherche pour le Développement, B.P. A5, Nouméa, New Caledonia

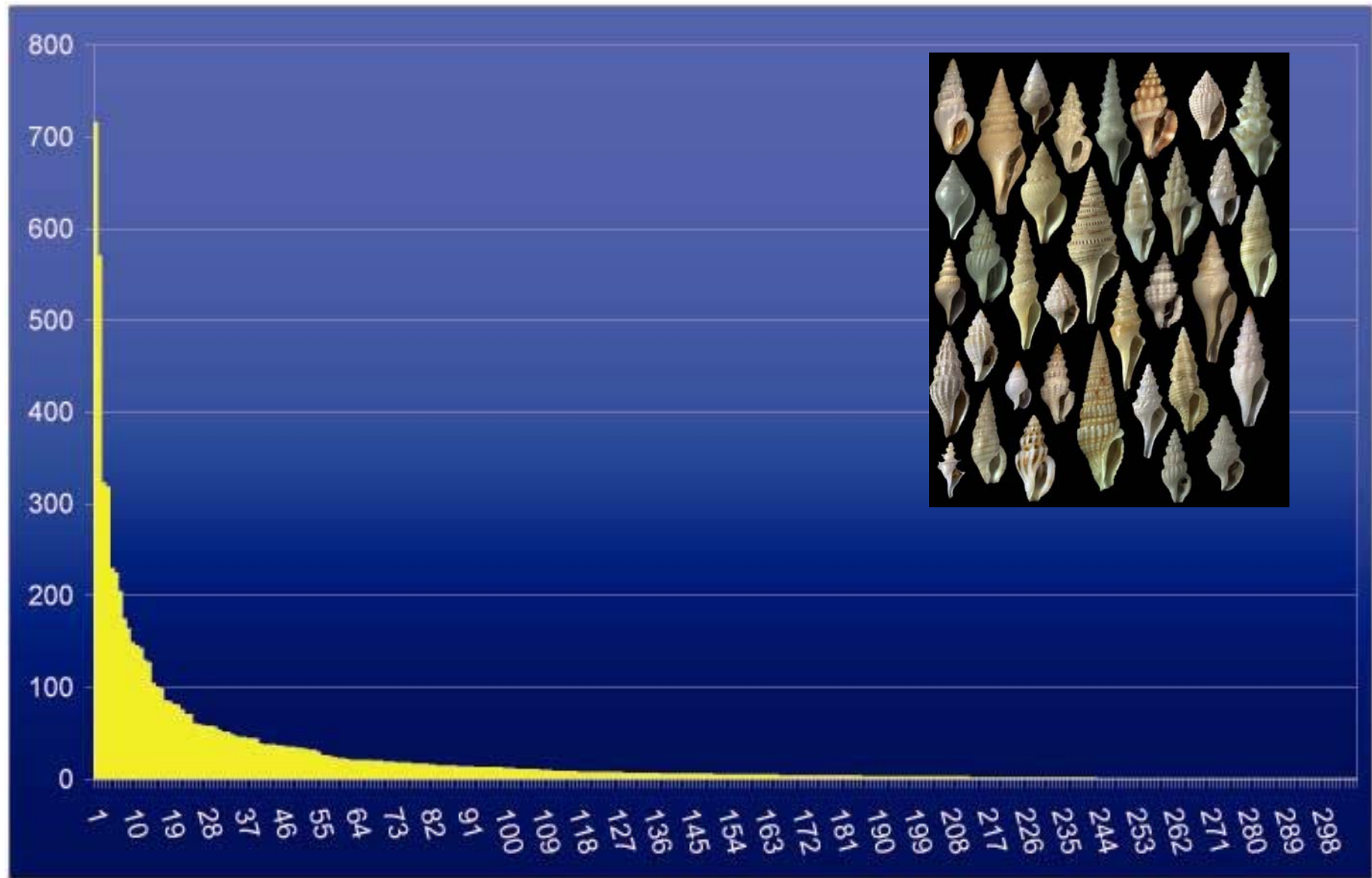
Earlier studies in the tropical Indo-Pacific have grossly underestimated the richness of macrofauna species at spatial scales relevant to conservation and management as a result of insufficient collecting and sorting effort. A massive collecting effort involving 400 day-persons at 42 discrete stations on a 295-km<sup>2</sup> site on the west coast of New Caledonia, south-west Pacific, revealed 2738 species of marine molluscs. This is several times the number of species recorded from any area of comparable extension anywhere in the world. Spatial and habitat heterogeneity is high with 32% of the species collected at a single station. With 20% of the species represented by single specimens (0.4% of all catches), rare species make up a considerable proportion of the fauna. This justifies the parallel drawn between coral reefs and rain forests in terms of species diversity. The real richness of many soft-bodied marine taxa is probably underestimated, as evidenced by the fact that 28.5% of the mollusc species present at the study site are represented in the samples only by empty shells. © 2002 The Linnean Society of London, *Biological Journal of the Linnean Society*, 2002, **75**, 421–436.

ADDITIONAL KEYWORDS: coral reefs – diversity – inventory – *post mortem* remains – rarity – spatial heterogeneity.



# Biodiversity

Abundance



Demographic rarity (turrid conoideans from Lifou)

Rank

# Estimating Biodiversity

**empty shells only**

**living  
specimens**



# Estimating Biodiversity

1 living spm

**1036**  
species represented by  
empty shells only

**373**

species  
represented by  
living specimens





# Estimating Biodiversity

**1036**  
species represented by  
empty shells only

1 living spm

2 living spms



**373**

**270**



# Estimating Biodiversity

**1036**  
species represented by  
empty shells only

1 living spm

2 living spms

3 living spms



**373**

**270**

**220**



# Estimating Biodiversity

**1036**  
species represented by  
empty shells only

1 living spm

2 living spms

3 living spms

30  
living spms

**373**

**270**

**300**



## BIODIVERSITÀ

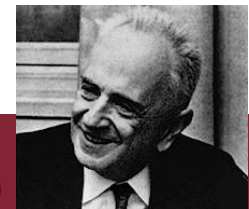
- 2.000.000 di specie viventi note
- 10-30 milioni di specie esistenti

**Come sono distribuite**  
**Come sono venute all'esistenza**



*“Nothing in Biology Makes Sense  
Except in the Light of Evolution”*

Theodosius Dobzhansky (1900-1975)



# Biodiversity

