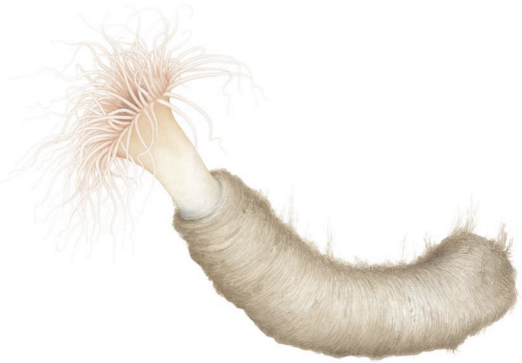
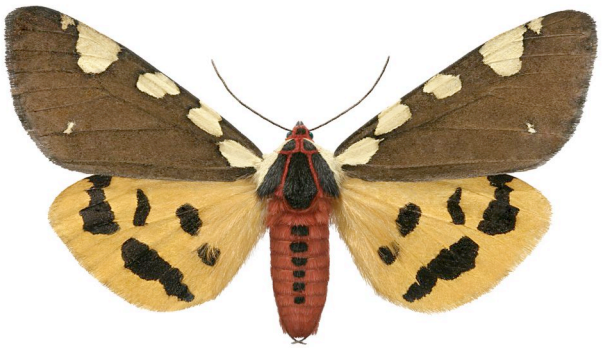
Why taxonomy matters



Johan Liljeblad

Ulf Gärdenfors

Swedish Species Information Centre



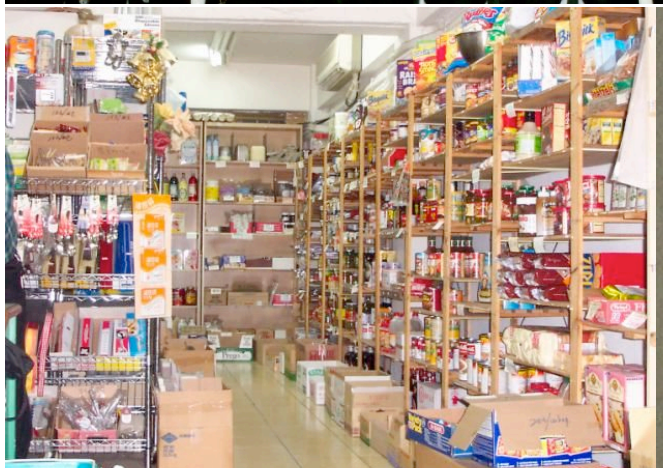
Why is taxonomy important?

Because taxonomy is

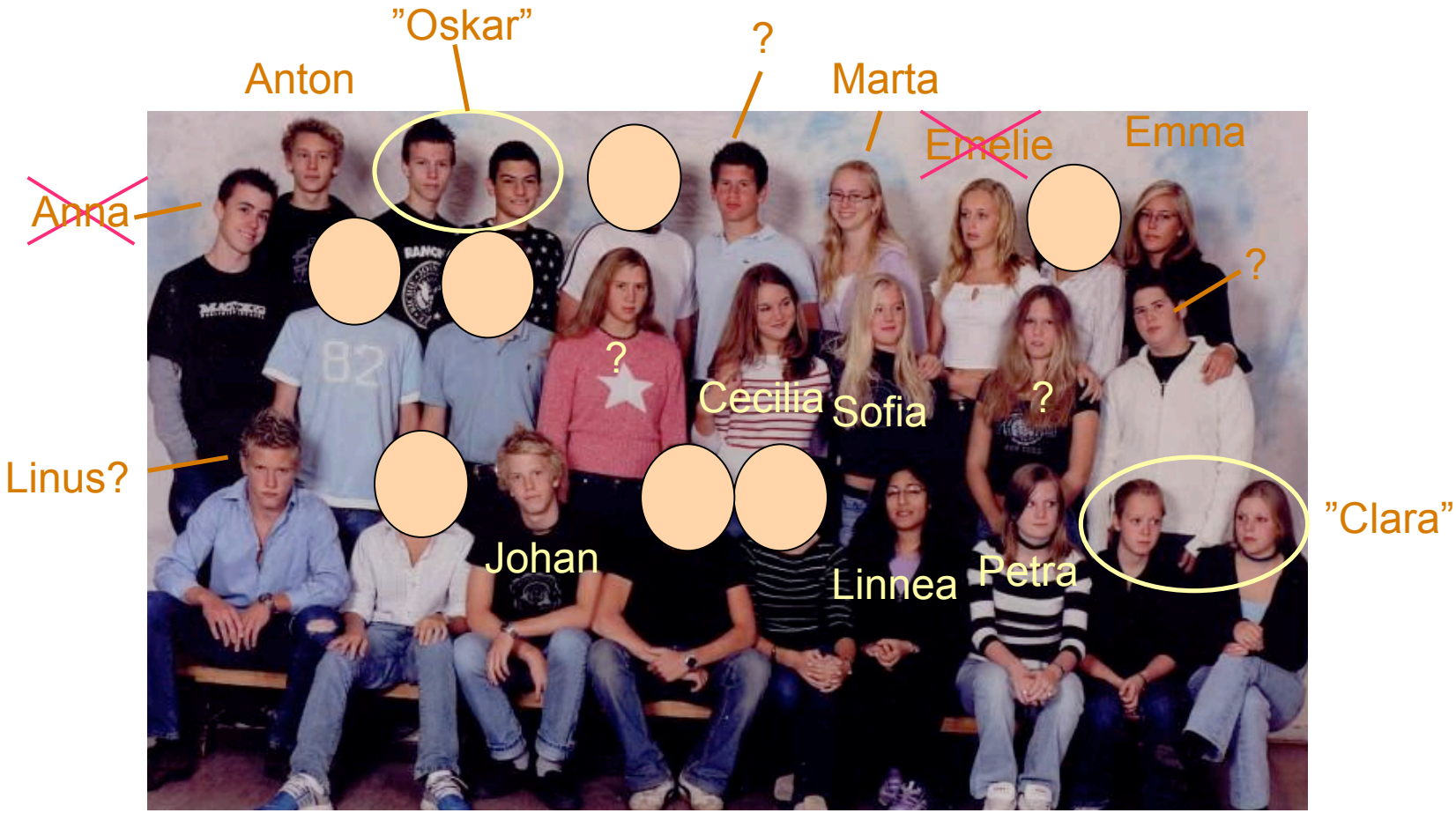
- a language for communication
- an essential infrastructure for other activities in society

Imagine if people and things didn't have a name…

?



… or if many names were wrong



A typical taxon in need of revision

Krtek a medicína (1987)
Zdeněk Miler

Matricaria recutita

Chamomilla recutita

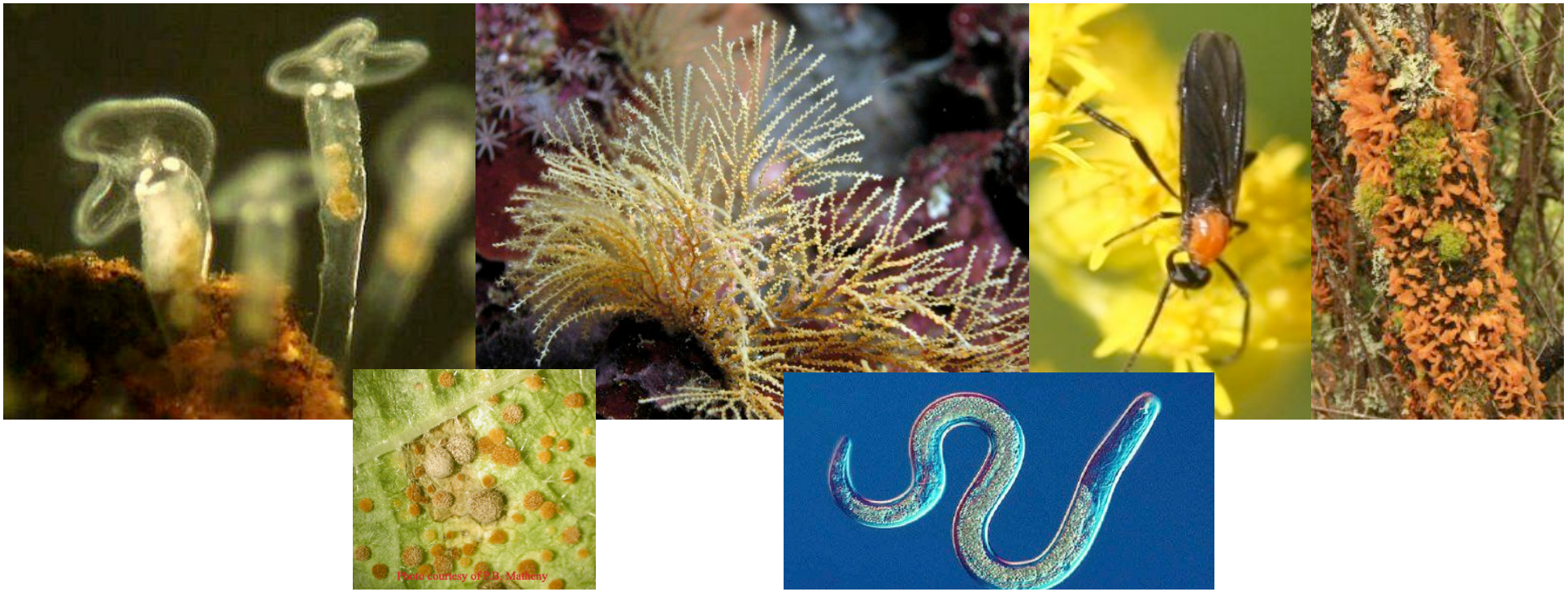
Matricaria chamomilla

Matricaria suaveolens

Chamomilla suaveolens

Taxonomy – an important language

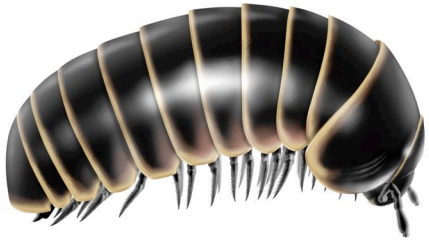
If a researcher doesn't have a reliable name on her study object, it is impossible to communicate and publish on the results



Taxonomy – an important language

Researcher A: "*Glomerus marginata* produces homoglomerin"

Researcher B: "*Glomerus marginata* produces acetoquinazolinone"



If the taxonomy is poor, studies may be conducted on different taxa but reported by the same name – creates confusion

Black Bug in the Philippines

One species -> 11 species + life history.
Only 3 act as pests, developing in stubble.
The use of insecticides could be reduced considerably.

Malaria mosquitoes in Europe

Malaria mosquito
Anopheles maculipennis
Entire Europe

North Europe	Possible vector
North- and Central Europe	No vector
European mountains	No vector
Mediterranean area	No vector
Mediterranean area	No vector
South Europe	Important vector
Eastern Mediterranean	Important vector

Cassava mealybug

Phenacoccus manihoti

Cassava (manioc or tapioca)

Anagyrus (Epidinocarsis) lopezi

Project cost $30 mil, revenue $8-20 billion, i.e. 200x

Taxonomy – an important language

Taxa with poor taxonomy may not even be possible to do research on.

Taxonomy – an important language

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The funding to biodiversity research from research councils is heavily dominated by support to vertebrates and vascular plants.

Taxonomy – an important language

Taxa with poor taxonomy may not even be possible to do research on.

The funding to biodiversity research from research councils is heavily dominated by support to vertebrates and vascular plants.

What interesting theories, processes and use of goods do we miss because of that?

Taxonomy – an essential infrastructure for other fields

Research

- Every field of basic biological research: ecology, physiology, biotechnology, genetics
- Pharmaceutical research
- Human and veterinary medicine

Taxonomy – an essential infrastructure for other fields

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Use of biodiversity (poor taxonomy may kill!)

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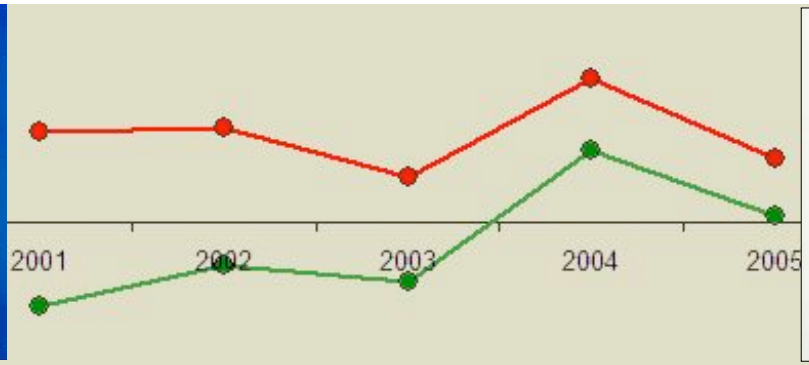
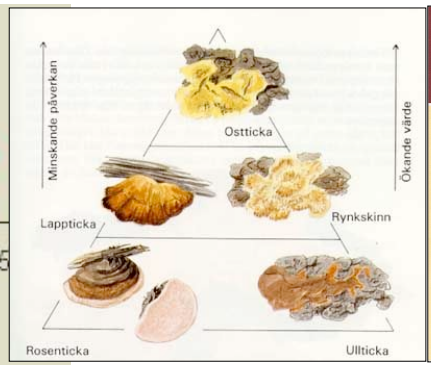
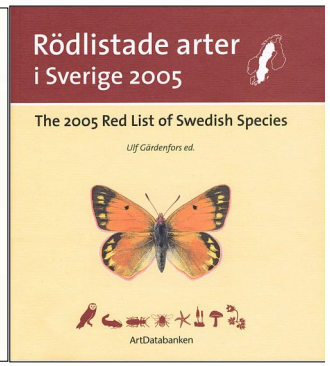
Use of biodiversity (poor taxonomy may kill!)

Monitoring & conservation of environment







Taxonomy – an essential infrastructure for other fields

Research

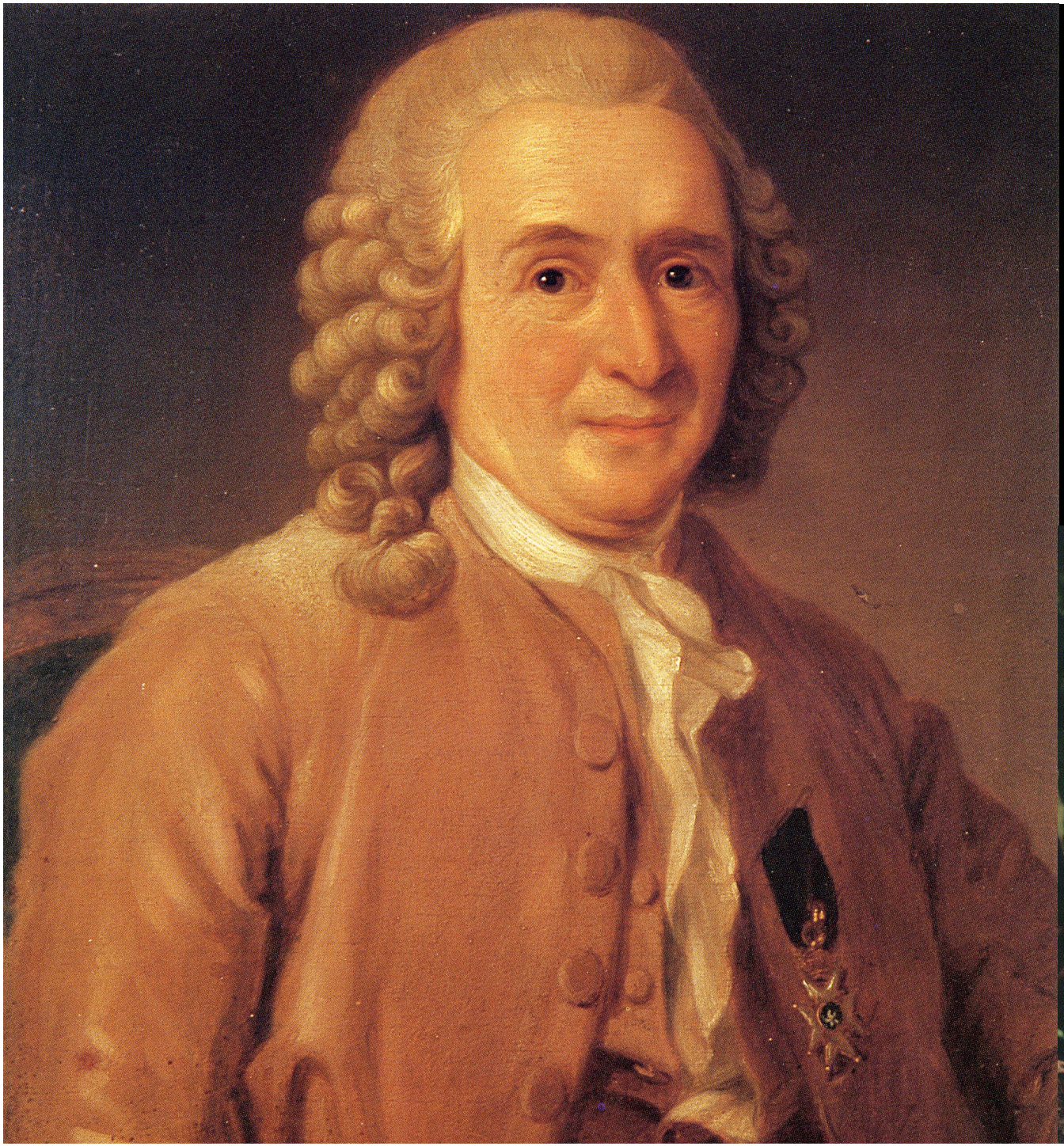
- Every field of basic biological research: ecology, physiology, biotechnology, genetics
- Pharmaceutical research
- Human and veterinary medicine

Use of biodiversity (poor taxonomy may kill!)

Monitoring & conservation of environment

Biological pest control

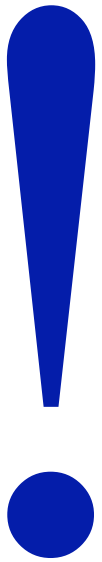
Control of invasive species



Linnaeus estimated that there are 26,500 species world-wide

Since the 18th century we have learned that...

- …the speed of light is 299,729,458 m/s
- …the average distance to the moon is 384,403 km
- …the sun weighs 1.989×10^{30} kg
- …the emission from caesium^{133} oscillates at 9,192,631,770 Hz during the transition between two particular energy levels



But…

…we still have no idea how many species there are on earth

- 2 million?
- 20 million?
- 200 million?

?

We don’t even know how many species we have found and described

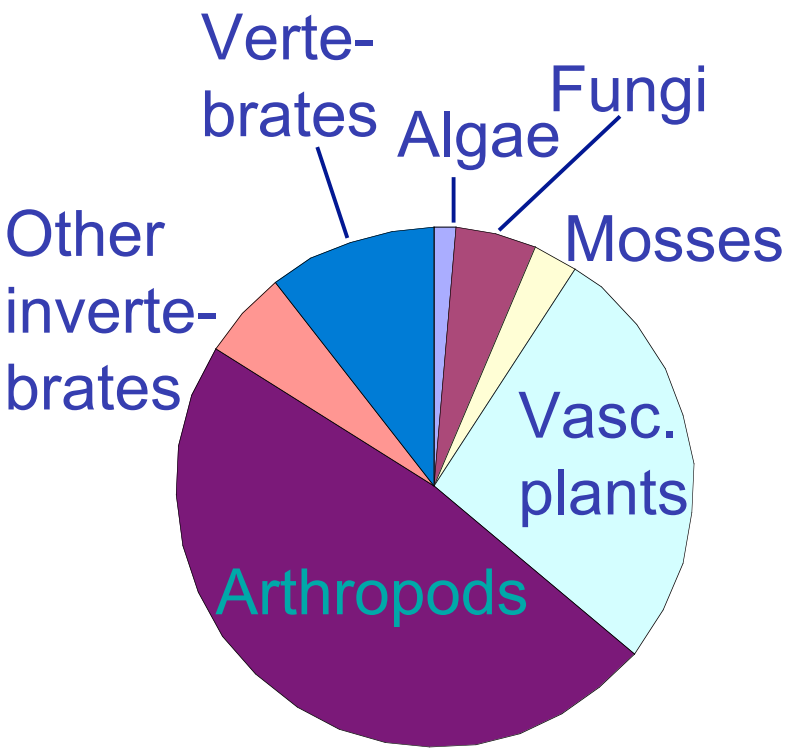
Global databases today contain 1,160,711 species

Species 2000

ITIS Integrated Taxonomic Information System

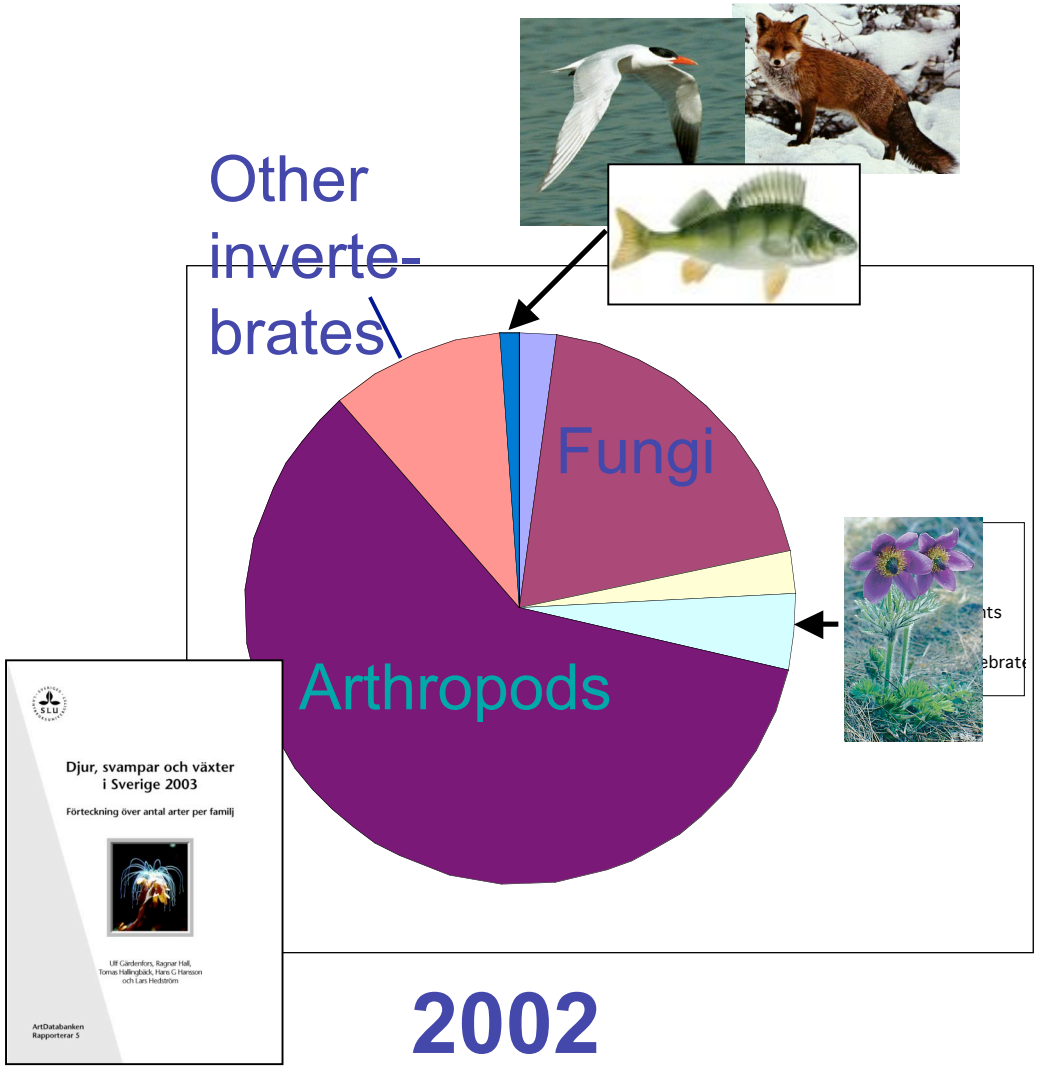
The probable answer lies between **1.5–2.0 million** described species

Known species in Sweden



Linnaeus

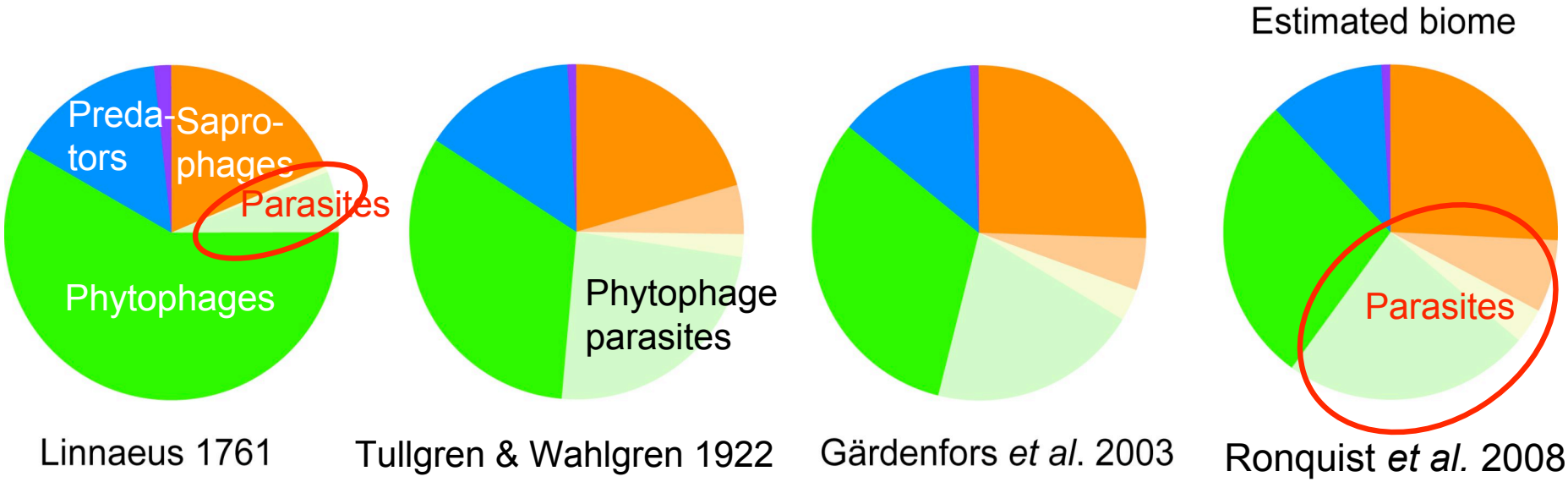
3,559 species



2002

50,200 (+13,000) species

Insects in Sweden



Predators

Phytophages

Other

Saprophages

Saprophage parasites

Unspecialized parasites

Phytophage parasites

From: F. Ronquist, M. Forshage, R. Hovmöller, D. Karlsson, K. Glemhorn & J. Liljeblad

Taxonomy Impediment

Lack of good taxonomy and skilled taxonomists is an impediment for society

Why an impediment?

Difficult to compete as a regular science within the university and research council systems of ranking



MISTRA

STIFTELSEN FÖR MILJÖSTRATEGISK FORSKNING

Vetenskapsrådet

formas

Forskningsrådet Formas

Knut och Alice Wallenbergs Stiftelse

New taxa in high-ranking journals

In Science and Nature only 4 arthropods n.sp. have been published during the last 20 years:

- A **new order** (*Mantophasmatodea*)
- A new **major pest** – a whitefly (demonstrated by a battery of **high tech**)
- An **unusual physiology** (on a Himalayan glacier)
- A **correction** for a ***nomen nudum*** in a report on a snail-eating caterpillar

Taxonomy Impediment

Lack of good taxonomy and taxonomists is an impediment for the society

We must transform the impediment to an **expedient**

Taxonomy Expedient

Taxonomists need to be more active towards the society

- Communicate to society the importance of taxonomy infrastructure

  Compare:
  Medical care
  Schools
  Roads and railways
  IT, *e.g.* telephone, broadband

Taxonomy Expedient

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- Promote taxonomy

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Taxonomists need to be more active towards society

- Communicate to the society the importance of taxonomy infrastructure
- Promote taxonomy
- Assist the society in it's need of taxonomic help – share your knowledge

Make taxonomic information accessible

- Publish open access
- Deposit gene sequences and illustrations in accessible databases
- Assist completing taxonomic databases
- Enter data about material in accessible databases
- Make older descriptions available in databases

Classic taxonomy still important

Morphological descriptions, type designations and identification keys are still needed

Convention on Biological Diversity (CBD)

Convention on Biological Diversity (CBD)

Article 7. Identification and Monitoring

Each Contracting Party shall:

(a) **Identify** components of biological diversity important for its conservation and sustainable use;

(b) **Monitor** the components of biological diversity identified pursuant to (a);

(c) **Identify processes** and categories of activities which have **significant adverse impacts** on the conservation and sustainable use of biological diversity, and monitor their effects; and

(d) **Maintain and organize data** derived from identification and monitoring activities pursuant to (a), (b) and (c).

Convention on Biological Diversity (CBD)

Article 8. In situ-conservation

Each Contracting Party shall:

c) Regulate or manage biological resources important for the conservation of biological diversity with a view to **ensuring their conservation** and sustainable use;

(h) Prevent the introduction of, and control or eradicate those **alien species** which threaten ecosystems, habitats or species

Convention on Biological Diversity (CBD)

Article 12. Research and training

Each Contracting Party shall:

(a) Establish programmes for scientific and technical **education and training** in measures for the identification, conservation and sustainable use of biological diversity;

(b) Promote **research** which contributes to the conservation and sustainable use of biological diversity

Taxonomy Initiatives

”Governments, through the **Convention on Biological Diversity**, have acknowledged a *taxonomic impediment* to the sound management of biodiversity, and have developed the **Global Taxonomy Initiative** to remove or reduce the impediment.”

GBIF

... free and open access to biodiversity data

GLOBAL BIODIVERSITY INFORMATION FACILITY

NSF

AToL
Assembling the Tree of Life

Partnerships for Enhancing Expertise in Taxonomy

Biodiversity Heritage Library

International Commission on Zoological Nomenclature

ICZN

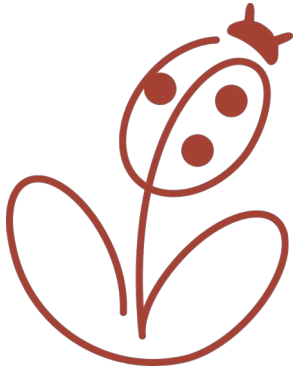
ZooBank

ITIS
Integrated Taxonomic Information System

atlas of LIVING AUSTRALIA

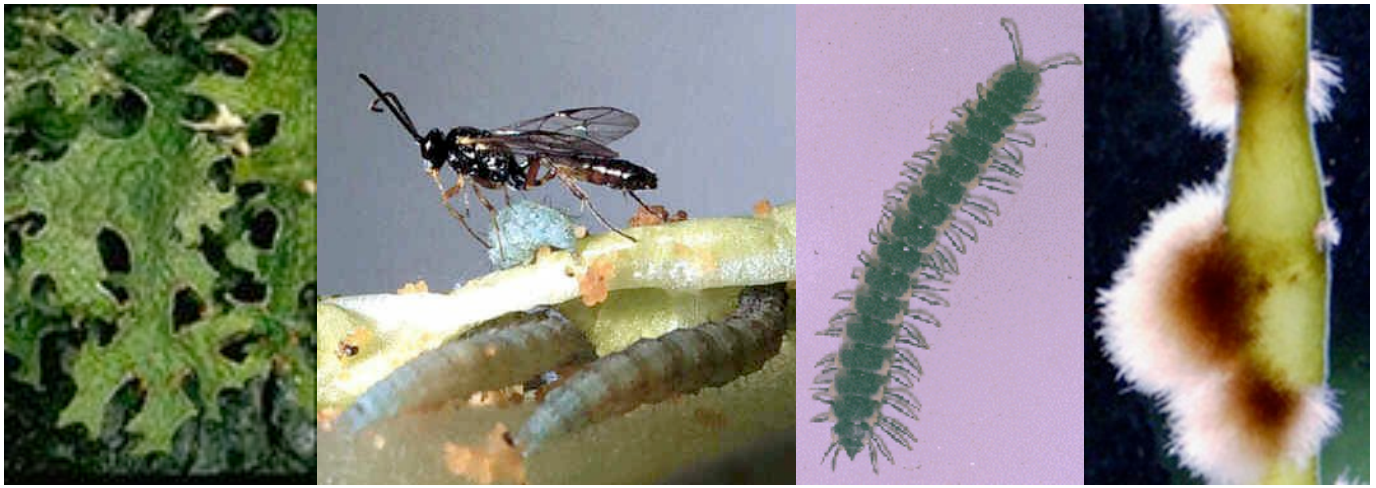
EDIT
European Distributed Institute of Taxonomy

Swedish Taxonomy Initiative



The Swedish Taxonomy Initiative (Svenska artprojektet)

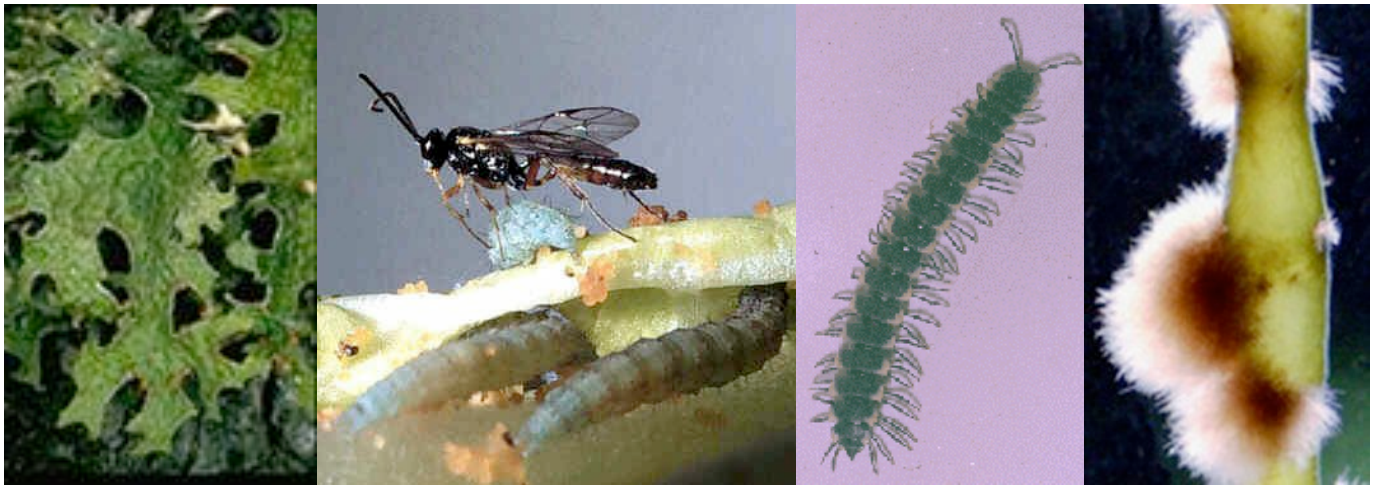
Aims at charting and describing the entire Swedish fauna and flora (>50,000 species) within 20 years, as well as describing them in a popular science encyclopedia (Nationalnyckeln)



The Swedish Taxonomy Initiative (Svenska artprojektet)

Commissioned by the Swedish Parliament 2002

Hosted and directed by The Swedish Species Information Centre (ArtDatabanken)



Swedish Taxonomy Initiative

Inventories

↓

Taxonomic revisions

↓

Popular science encylopedia

Taxonomic research

€6 million granted 2002–2008

Taxonomic research & inventories

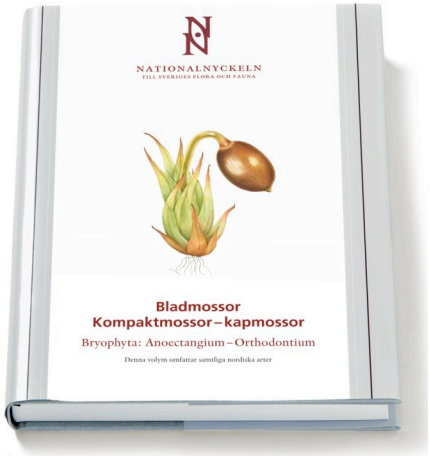
Has so far resulted in

- 2000 species new to Sweden
- out of which 750 are new to science!

The Encyclopedia of the Swedish Flora and Fauna

- Popular science presentation of multi-cellular species in Sweden/Nordic countries
- In Swedish, important facts and identification keys in English
- High-quality illustrations
- Ca. 100 volumes planned

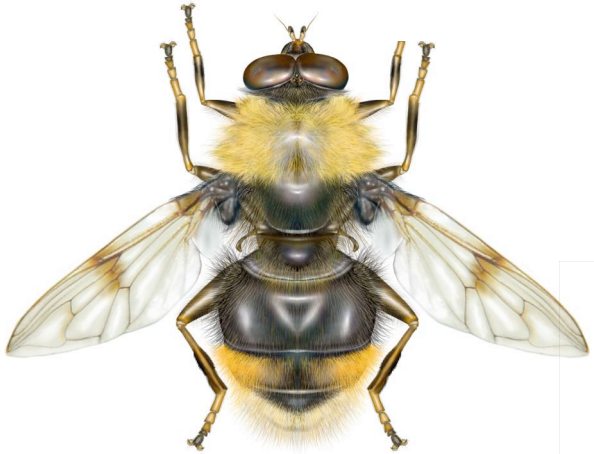
NATIONALNYCKELN
TILL SVERIGES FLORA OCH FAUNA



NATIONALNYCKELN

TILL SVERIGES FLORA OCH FAUNA

Next volume – Hoverflies Syrphidae



NATIONALNYCKELN
TILL SVERIGES FLORA OCH FAUNA

Ill: Elisabeth Binkiewicz

Why a Taxonomy Initiative?

- Builds taxonomy capacity
- Support for research, nature conservation and species monitoring
- Makes the entire flora and fauna accessible to everyone
- Enhances awareness and possibilities for schools and the general public
- Fulfillment of international obligations and a contribution towards charting the worlds flora and fauna

The deliverables of STI

- Complete taxonomic revisions
- Popular science handbooks: ca. 100 vol. of an Encyclopedia of the Swedish Flora and Fauna
- Taxonomic infrastructure
- Reinforced museums
- Better knowledge of species biology and conservation status

Norway has started a taxonomy initiative 2009

in close cooperation with Sweden

It could be done on a European level as well!

What must be done in the EU?

Research strategy recommendations:

- build-up of taxonomy as an essential *infrastructure* for society
- *taxonomy initiatives* to chart and describe entire flora and fauna
- support to taxonomy needs to be *targeted* since it can't compete in the traditional peer review system
- also support to and collaboration with *developing countries* outside of the EU

Research priority recommendations:

- *educate and employ* taxonomists, incl. research schools, with a focus on poorly known taxa
- support to natural history (research) *museums*
- support to *ICT* (Information and Communications Technology) systems for names, descriptions, observations/collections