

# The basics of ZOOLOGICAL NOMENCLATURE

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C. Linnaeus – father of nomenclature

## History of scientific nomenclature

Taxa have always been named and classified (*e.g.* Greek and Roman naturalists; medieval herbalists; folk taxonomists)

- Names used by Pre-Linnaean naturalists:

- ✓ Latin
- ✓ *nomina specifica*; binominal, trinominal or even polynominal names (*e.g.* *Iris perpusilla saxatilis Norbonensis acaulis ferme*)
- ✓ names inconsistent and often paragraphs long serving as diagnosis, description and as key to identification
- ✓ constantly changing names

- Linnaeus' 18th century taxonomic system [cf. *Species plantarum* (1753) and *Systema naturae* (1758)]

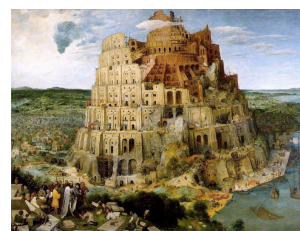
- ✓ Latin
- ✓ *nomina trivialia*; always binominal in structure
- ✓ name divorced from diagnosis and description



- 1758** Formal starting point = 10<sup>th</sup> Edition of Linnaeus's Systema Naturae (also Clerck's Aranei Svecici)
- 1842 Strickland Code (botany and zoology)
- 1889 First ICZ meeting (Paris); tentative adoption of a set of rules
- 1901 Fifth ICZ meeting (Berlin); "Rules of Zoological Nomenclature"; published as Règles Internationales de la Nomenclature Zoologique (French, English & German)
- 1961** First edition of the Code of Zoological Nomenclature
- 1964** Second edition
- 1985** Third edition (glossary added; French = English)
- 1988 Launch of fourth edition project
- 1995 Draft of fourth edition released by Secretariat  
Distribution of hard copies; Discussion forum on internet; New concepts and provisions published in Bull. Zool. Nomenclature
- 1999** Fourth edition (current edition)  
Takes effect from 1 January 2000
- 2005 Launch of fifth edition project (foreseen for **2012**)

## WHY nomenclature? NAMES!

*Scientific names are the unique and unambiguous identifiers of a taxon and ensure that we are talking about the same organism regardless of our geographic location or language*



bad taxonomy



# Will the edible stone fish stand up?



Want to know? Ask  
the scientific name  
to a taxonomist



## HOW are scientific names formed? Codes!

The 4 codes hold universally  
accepted rules for assigning  
scientific names



Greuter, W., et al. (eds), 2000. *International Code of Botanical Nomenclature (St Louis Code)*. Regnum Vegetabile 138. Koeltz Scientific Books, Königstein.



Treharne, P., et al. (eds). 1995. *International Code of Nomenclature for Cultivated Plants*. Adapted by the International Committee for the Nomenclature of Cultivated Plants of the I.U.B.S. Regn. Veget. 133.



Sneath, P.H.A., et al. (eds), 1992. *International Code of Nomenclature of Bacteria*. Washington (+ : Skerman, V.D.B. et al., 1980. *Approved Lists of Bacterial Names*).



International Commission on Zoological Nomenclature, 1999. *International Code of Zoological Nomenclature*, 4th edition. Adopted by the I.U.B.S. The International Trust for Zoological Nomenclature, London.



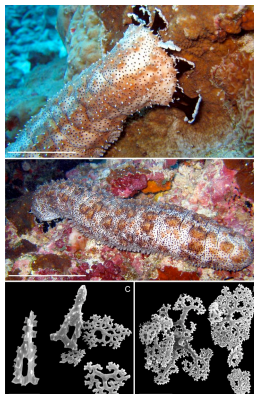
“The objects of the Code are to promote stability and universability in the scientific names of animals and to ensure that the name of each taxon is unique and distinct.

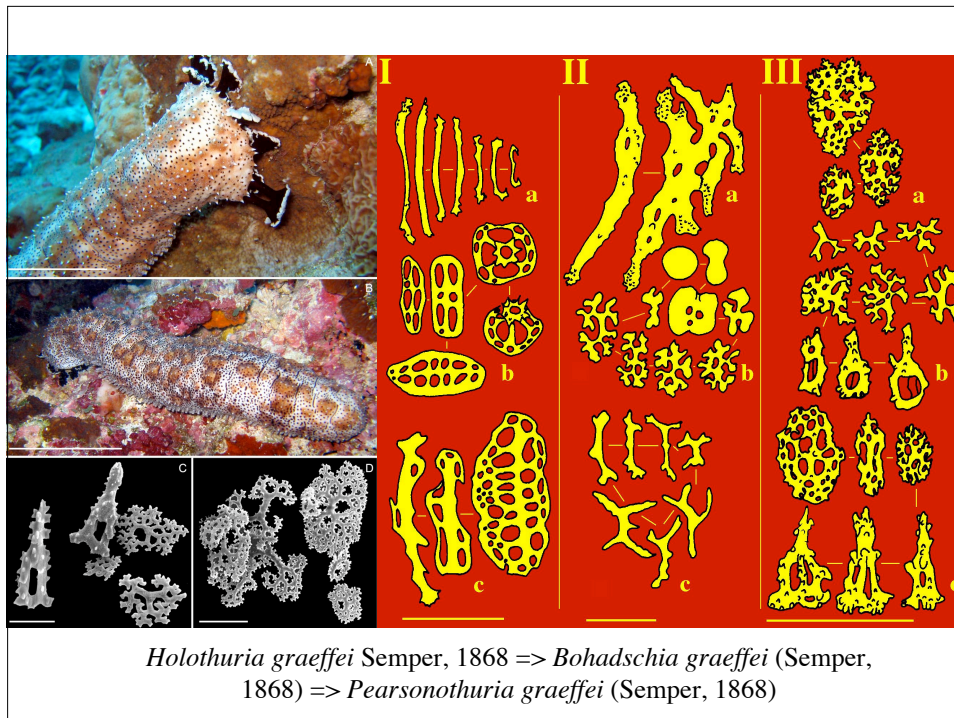
All its provisions and recommendations are subservient to those ends and none restricts the freedom of taxonomic thought or actions”

(ICZN 1999: 2)

## WHY do names change anyway?!

1. Scientific research leads to improvement in the understanding of relationships (*e.g.* transfer of species to the more correct genus)





## WHY do names change anyway?

*S. monotuberculatus* (Quoy & Gaimard, 1833)



*S. variegatus* Semper, 1868 = *S. horrens* Selenka, 1867



*S. variegatus* Herrmanni Semper, 1868 = *S. herrmanni* Semper, 1868



**Fig.** The *Stichopus variegatus* problem. Valid names are underlined. a. *S. monotuberculatus*; b. *S. horrens*; c. *S. herrmanni*. Photo's (a) & (c) Y. Samyn; (b); from Guille *et al.*, 1986.

## WHY do names change anyway?

1. Scientific research leads to improvement in the understanding of relationships (*e.g.* transfer of species to the more correct genus)

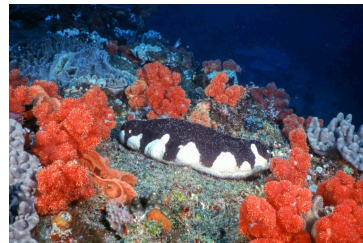
*Holothuria graeffei* Semper, 1868

*Bohadschia graeffei* (Semper, 1868)

*Pearsonothuria graeffei* (Semper, 1868)

2. Application and use of nomenclatural rules (*e.g.* correction of spelling errors, homonym discovery)

## Formation & treatment



### *Vernacular name*

*Black teatfish*

### *Original name*

*Mülleria nobilis* Selenka, 1867

→ Only the generic name commences with an upper-case letter

### *Name corrected to*

*Muelleria nobilis* Selenka, 1867

→ 'ü' is not a Latin letter; it's replaced by 'ue' (similarly 'ñ' is replaced by 'n', 'æ' by 'oe')

### *Species transferred to other genus*

*Holothuria nobilis* (Selenka, 1867)

→ Name of author and date are enclosed in parentheses

### *Subgenus recognised in genus*

*Holothuria (Microthele) nobilis* (Selenka, 1867)

→ Subgeneric name is interpolated in parentheses between generic and specific names. Like the generic name it is capitalized



## Ruling PRINCIPLES of nomenclature

### Only a tool! Not science!!



Taxonomy = science	Nomenclature = tool
The taxonomist decides on the utilised principles (e.g. cladistics or phenetics); science knows no authority	Taxonomists artificially produce names; no science involved, so rules can be imposed on this process



Nomenclature only follows taxonomy

## Ruling PRINCIPLES of nomenclature

**Principle of binominal nomenclature** ('two' words)

**Principle of Typification** (identity of a name relies on its type, not on its description)

**Principle of Priority** ("the oldest fool is always right")

**Principle of the First Reviser** ('the fastest is right')

**Principle of Synonymy** (1 taxon can only have one name)

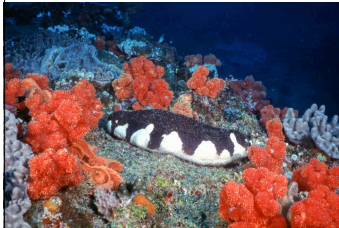
**Principle of Homonymy** [1 name can apply to only 1 taxon (but see independance of codes)]

**Principle of Coordination** (name established for one rank simultaneously establishes names for other ranks in the same group)

**But!**

- Interpretation and administration
- No "case-laws"

## PRINCIPLE of binominal nomenclature



### Binomens

*Mülleria nobilis* Selenka, 1867

*Muelleria nobilis* Selenka, 1867

*Holothuria nobilis* (Selenka, 1867)

*Holothuria (Thymiosycia) nobilis* (Selenka, 1867)



### Trinomens

[*Holothuria impatiens* var *bicolor* H.L. Clark, 1938]

*Holothuria impatiens bicolor* H.L. Clark, 1938

*Holothuria (Thymiosycia) impatiens bicolor*  
H.L. Clark, 1938

## PRINCIPLE of typification

Art. 61.1. Each nominal taxon in the family, genus or species groups has actually or potentially a name-bearing type. The fixation of the name bearing type of a nominal taxon provides the objective standard of reference for the application of the name it bears.

61.1.1. The valid name from a taxon is determined only from the name-bearing type(s)

61.1.2. Objectivity through typification is continuous through the hierarchy of names, from species to family group

61.1.3. Once fixed name-bearing types are stable and provide objective continuity in the application of names



## PRINCIPLE of typification

- ⇒ Types are international standards for scientific names
- ⇒ Identity of a name relies only on its type, not on its description or diagnosis

Note: The principle of typification has nothing to do with typological thinking!

## Types of TYPES

### Original designation

(=fixed in original publication)

**Holotype:** the single specimen upon which a new species-group taxon is based in the original publication

**Paratypes:** remaining specimens of the original type series (see also allotype, isotype)

**Syntypes:** specimens of a type series that collectively constitute the name-bearing type

### Subsequent designation

(=fixed in subsequent publication)

**Lectotype:** a syntype designated as the single-name bearing type specimen, after the establishment of a nominal species or subspecies

**Paralectotypes:** each specimen of the former syntype series remaining after lectotype designation

**Neotype:** the single specimen designated as the name-bearing type when no name-bearing type specimen is believed to be extant.

## Types of TYPES

### Terms not regulated or recognised by the Code

**Allotype:** a designated specimen of opposite sex of the holotype

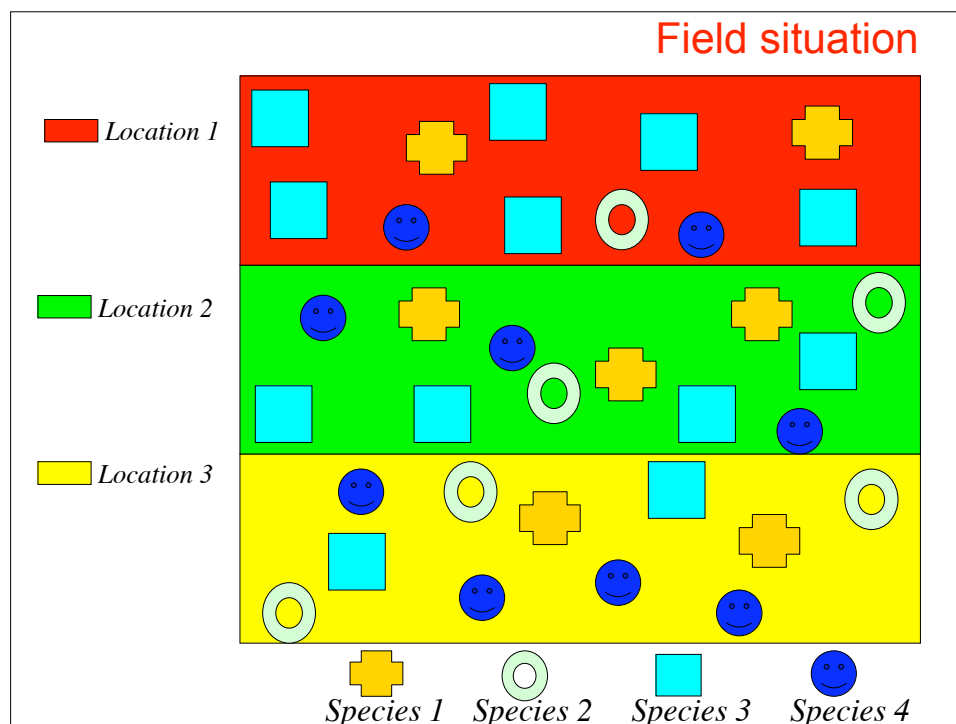
**Cotype:** a term formerly used for either syntype or paratype

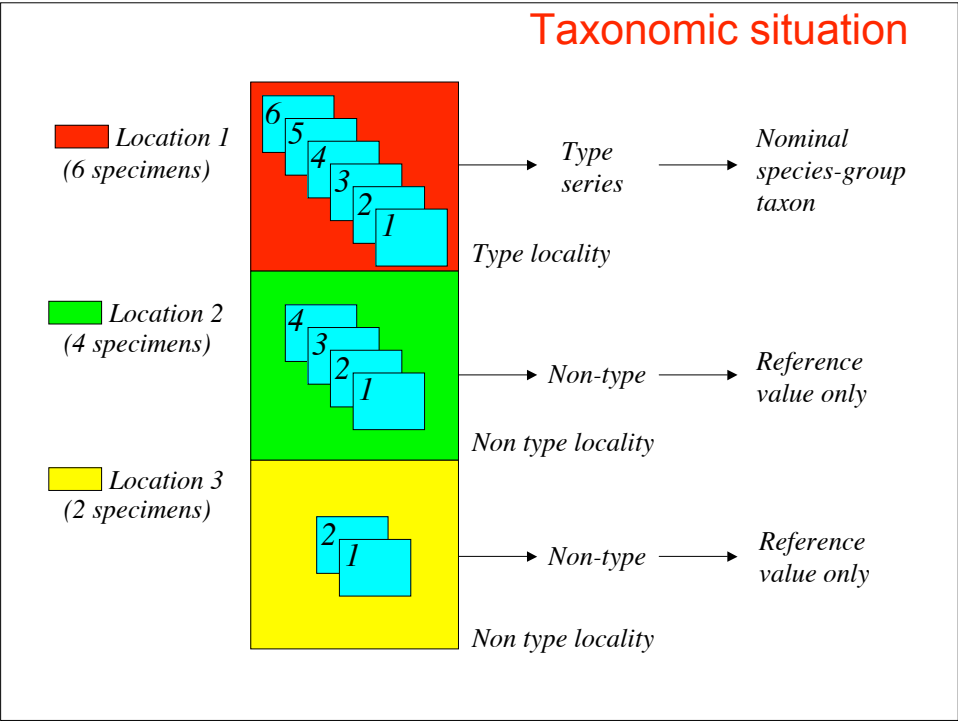
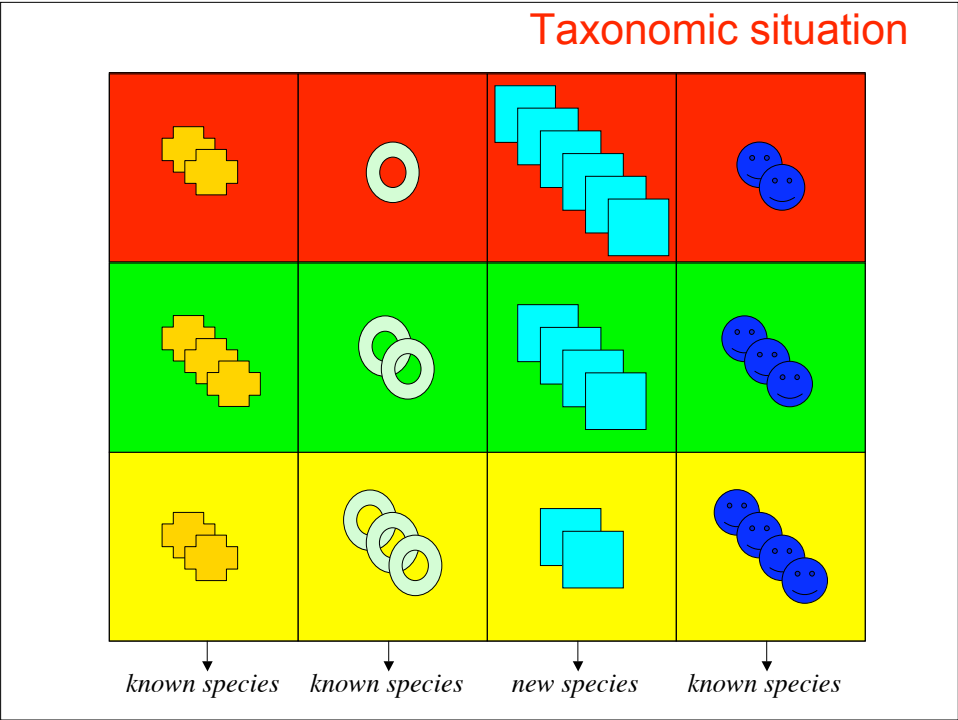
**Genotype:** a term formerly used to designate the holotype

**Topotype:** a term formerly utilised for a specimen originating from the type locality (the geographical place of capture, collection or observation of the name-bearing type of a nominal species or subspecies) of the species or subspecies to which it is thought to belong, whether or not the specimen is part of the type series

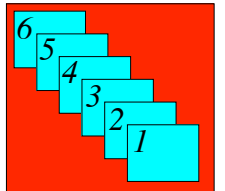
**Isotype:** duplicate material of the holotype, collected at the same time and place by the same collector (botany)

For typification in the family group (see chapter 14 ICZN)  
 For typification in the genus group (see chapter 15 ICZN)  
 For typification in the species group (see chapter 16 ICZN)

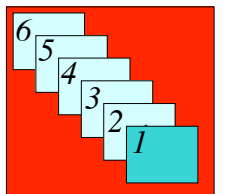




## Nomenclatural situation original designation



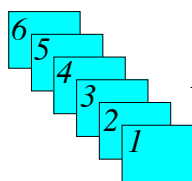
**Syntypes**: all the specimens in the type series that collectively constitute the name-bearing type.



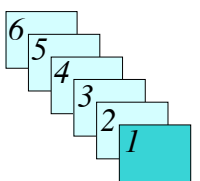
**Paratypes**: remaining specimens of the original type series

**Holotype**: the single specimen upon which a new species-group taxon is based

## Nomenclatural situation Subsequent designation



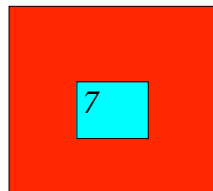
**syntypes**



**Paralectotypes**: each specimen of the former syntype series remaining after lectotype designation

**Lectotype**: one of the syntypes designated as the single-name bearing type specimen

**all name-bearing types lost**



**Neotype**: the single specimen designated as the name-bearing type when no name-bearing type specimen (i.e. holotype, lectotype, syntype or prior neotype) remains. Specimen must come as near as possible from the type locality.

## PRINCIPLE of typification by example

Genus *Pinus* Linnaeus, 1753 (pine trees)

Taxonomy: five distinct genera

Genus 1 : *P. cedrus*

Genus 2 : *P. larix*

Genus 3 : *P. picea*, *P. balsamea*

Genus 4 : *P. abies*

Genus 5 : *P. sylvestris*, *P. pinea*, *P. cembra*, *P. strobus*, *P. taeda*

Q: Who's the real *Pinus*?

Type of *Pinus* = *P. sylvestris*; hence Genus 5

Others: new genus names (*Cedrus*, *Larix*, *Picea* and *Abies*, respectively)

## PRINCIPLE of priority

Basic aim of zoological nomenclature is to get stable and universal scientific names

Availability & Validity

Name to be used = valid name

Valid name is chosen from available names

THUS:

- Available name can be valid or not
- Unavailable name can never valid

Availability exists under (*all*) strict conditions (cf. Chapter 4: Criteria of availability):

e.g.

- Date of publication
- Format of name
- Format of description

Principle  
of  
Priority  
(or usage)

## PRINCIPLE of priority

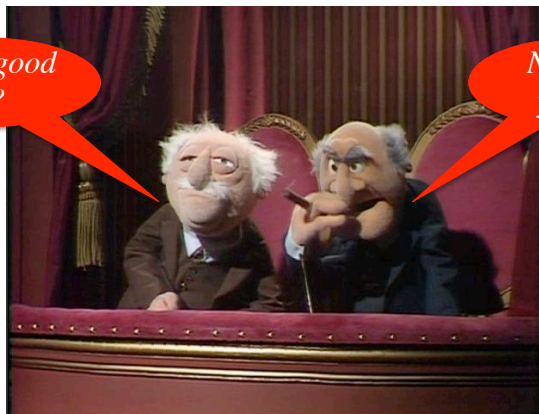
Art. 23.1. The valid name of a taxon is the oldest available name applied to it, unless that name has been invalidated or another name is given precedence by any provision of the Code or by any ruling of the Commission

- Validity of synonyms
- Relative precedence of homonyms
- Correctness of spellings
- Validity of nomenclatural acts
  - Principle of first reviser
  - Fixation of name-bearing types

But with recognition of the purpose of the Code, *i.e.* **STABILITY**

*"The Oldest Fool is Always Right"*

*Looks good  
no?*



*Nah, too  
young!*



## PRINCIPLE of priority an example

Taxonomists recognise two distinct species are recognised; how to name them?



Name given:  
*Holothuria scabra* var. *versicolor* Conand, 1986  
Later raised to  
*Holothuria scabra versicolor* Conand, 1986



Name given:  
*Holothuria scabra* Jaeger 1833

The name *versicolor* is however not available (art 15.2) and cannot be made available by subsequent action (art 45.5.1)

## PRINCIPLE of priority an example



*Holothuria scabra* var. *versicolor* Conand, 1986 is a *nomen nudum*

Which name to use?

The first available (=oldest or senior) synonym:  
*Holothuria timama* Lesson, 1830  
But this name has been suppressed by the ICZN  
(Opinion 762)

Which name then?

The next available subjective synonym  
*Holothuria tigris* Brandt, 1835 harms stability  
*Holothuria aculeata* Semper, 1868?



## PRINCIPLE of priority an example

*Holothuria aculeata* Semper, 1868?



*Holothuria aculeata* Semper, 1868



*Holothuria* sp. nov.

*More:* Massin Cl. et al. 2009. Taxonomy of the heavily exploited Indo-Pacific sandfish complex. ZJLS 155: 40-59

## PRINCIPLE of synonymy

Synonym: each of two or more names of the same rank used to denote the same taxonomic taxon  
(2 or more names = 1 taxon)

- *Nomenclatural* (= *objective, homotypic*) synonyms
- *Taxonomic* (= *subjective, heterotypic*) synonyms (most common)
- Junior synonym: the latter of the synonyms established
- Senior synonym: the earlier of the synonyms established

## PRINCIPLE of synonymy subjective synonyms



Each of two or more names whose synonymy is only a matter of individual opinion

“Oldest fool” →

*Holothuria decorata* Marenzeller, 1882  
*Holothuria fasciola* Quoy & Gaimard, 1833  
*Holothuria flammea* Quoy & Gaimard, 1833  
*Stichopus flammeus* Brandt, 1835  
*Holothuria fuscopunctata* Quoy & Gaimard, 1833  
*Stichopus gyrifer* Selenka, 1867  
*Holothuria hilla* Lesson, 1830  
*Labidodemas leucopus* Haacke, 1880  
*Holothuria macleari* Bell, 1884  
*Holothuria minax* Théel, 1886  
*Labidodemas neglectum* Haacke, 1880  
*Holothuria ondatjei* Bell, 1887  
*Holothuria zihuatanensis* Caso, 1964

## PRINCIPLE of synonymy objective synonyms



Each of two or more different names applied to one and the same taxon based on the same type

“Objective synonym” →

*Penaeus setifer* (Linnaeus, 1767)

*Cancer setiferus* Linnaeus, 1767  
*Astacus setiferus* (Linnaeus, 1767)  
*Cancer (Gammarellus) setiferus* Linnaeus, 1767  
*Penaeus fluviatilis* Say, 1818 (an objective synonym of *Cancer setiferus* L., 1767, through the type selection by Holthuis, 1964, Bull. zool. Nomencl., 21(3):233).

## PRINCIPLE of homonymy

**Homonym (in the species group):** each of two or more available specific or subspecific names having the same spelling which were established for different nominal taxa (1 name = 2 or more taxa)

- Originally combined with the same generic name (Primary homonym)
- Subsequently combined with the same generic name (Secondary homonym)

## PRINCIPLE of homonymy an example in the genus group

***Argus*** Bohadsch, 1761 (gastropod);  
***Argus*** Scopoli, 1763 (butterfly);  
***Argus*** Scopoli, 1777 (butterfly);  
***Argus*** Poli, 1791 (mollusk);  
***Argus*** Temminck, 1807 (bird);  
***Argus*** Lamarck, 1817 (hesperid);  
***Argus*** Boisduval, 1832 (lycaenid);  
***Argus*** Walckenaer, 1836 (arachnid);  
***Argus*** Gray, 1847 (mollusk);  
***Argus*** Gerhard, 1850 (lycaenid)

Only the oldest name is valid,  
all the rest are junior homonyms

How to find these? *Nomenclator zoologicus*

# PRINCIPLE of homonymy an example in the species group

***Holothuria lamperti* Ludwig, 1886**  
***Holothuria lamperti* Sluiter, 1889**

***Holothuria kurti* Ludwig, 1891**  
**As replacement name for Sluiter's taxon**

*How to find these? Zoobank*

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nature

COMMENTARY

 *Zootaxa* 1550: 39–50 (2008)  
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**ZOOTAXA**  
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## A universal register for animal names

Andrew Polaszek and colleagues propose an open-access web-register for animal names, which they believe is vital to move taxonomy into the twenty-first century.

**H**ow can we maintain and continue to benefit from our planet's biodiversity? A first step, the effective exchange of information about biodiversity needs an efficient and stable means of naming species. For animals, this is achieved with the Linnaean system of binominal nomenclature, introduced in 1758, and a comprehensive set of

exists for bacteria, and was considered and rejected by the plant taxonomy community who decided that with fewer taxa (and some excellent existing databases) it was not needed.

We believe that Zoobank could have huge benefits for taxonomists and for biologists in general. First, many names currently pub-

lished and provide the definitive naming authority.

**Joining forces**

Through its website ([www.iczn.org](http://www.iczn.org)), the ICZN is initiating a year-long period of consultation on the merits of mandatory registration and the details of Zoobank's creation. Using existing

**Zoobank: Developing a nomenclatural tool for unifying 250 years of biological information\***

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\* In: Minelli, A., Bonato, L. & Fusco, G. (EDS) *Updating the Linnaean Heritage: Names as Tools for Thinking about Animals and Plants*, *Zootaxa*, 1550, 1–163.

## Criteria of AVAILABILITY

- Name or nomenclatural act must be *Published*;
- Scientific names must be spelled using the 26 letters of the *Latin Alphabet*;
- Consistent application of *binominal nomenclature* in the work in which the new name or nomenclatural act is published;
- *Derivation*: a name may be derived from any language, or even an arbitrary combination of letters if this is formed to be used as a word (not cbafdg);

## Criteria of AVAILABILITY

- Names to be used as valid when proposed
- Publication of a name as a synonym does not thereby make the name available;
- New requirements for species-group names published after 1999:**
  - Explicit indication of name as intentionally new**  
(n.sp., gen. nov., nom. nov.,...)
  - Fixation of name-bearing types explicit**  
designation & deposition

### Article 10. Provisions conferring availability

- [10.1.](#) General conditions to be met
- [10.2.](#) Availability of infrasubspecific names
- [10.3.](#) Availability of names proposed for collective groups and ichnotaxa
- [10.4.](#) Availability of names for divisions of genera
- [10.5.](#) Availability of names of taxa later but not at first classified as animals
- [10.6.](#) Effect of invalidity upon availability
- [10.7.](#) Availability of names not listed in a relevant adopted Part of the List of Available Names in Zoology

### Article 11. Requirements

- [11.1.](#) Publication
- [11.2.](#) Mandatory use of Latin alphabet
- [11.3.](#) Derivation
- [11.4.](#) Consistent application of binominal nomenclature
- [11.5.](#) Names to be used as valid when proposed
- [11.6.](#) Publication as a synonym
- [11.7.](#) Family-group names
- [11.8.](#) Genus-group names
- [11.9.](#) Species-group names
- [11.10.](#) Deliberate employment of misidentifications

### Article 12. Names published before 1931

- [12.1.](#) Requirements
- [12.2.](#) Indications
- [12.3.](#) Exclusions

### Article 13. Names published after 1930

- [13.1.](#) Requirements
- [13.2.](#) Family-group names
- [13.3.](#) Genus-group names
- [13.4.](#) Combined description of new genus-group taxon and new species.
- [13.5.](#) Combined description of new family-group taxon and new genus.
- [13.6.](#) Exclusions

### Article 14. Anonymous authorship of names and nomenclatural acts

### Article 15. Names and nomenclatural acts published after 1960

- [15.1.](#) Conditional proposal
- [15.2.](#) Names published after 1960 with the term "variety" or "form" excluded

### Article 16. Names published after 1999

- [16.1.](#) All names: intention of authors to establish new nominal taxa to be explicit.
- [16.2.](#) Family-group names: type genus to be cited
- [16.3.](#) Genus-group names: ichnotaxa and collective groups
- [16.4.](#) Species-group names: fixation of name-bearing types to be explicit

### Article 17. Names found to denote more than one taxon, or taxa of hybrid origin, or based on parts or stages of animals or on unusual specimens

### Article 19. Status of emendations, incorrect spellings, and mandatory changes

- [19.1.](#) Unjustified emendations and incorrect spellings
- [19.2.](#) Justified emendations
- [19.3.](#) Multiple original spellings
- [19.4.](#) Mandatory changes

### Article 20. Genus-group names ending in -ites, -ytes, or -ithes given to fossils



## What's in a name? Nomenclature as a metalanguage

Scientific names are Latin

Rules of Latin linguistics apply:

e.g. agreement in gender

*Thyonidium magnum* Ludwig, 1882

*Phyllophorus magnus*; Ludwig 1889-92

*Neothyonidium magnum*; Heding & Panning 1954

*Massinium magnum*; Samyn & Thandar 2003



## Formation of species names

Rules of Latin linguistics apply:

e.g. agreement in gender

*Thyonidium magnum* Ludwig, 1882

*Phyllophorus magnus*; Ludwig 1889-92

*Neothyonidium magnum*; Heding & Panning 1954

*Massinium magnum*; Samyn & Thandar 2003



When named:

After **features**: adjectives

After **other species**: noun in apposition, adjective

After **people**: noun in genitive case

After **places**: adjectival toponym

## Formation of species names

### **One-letter difference:**

Genus ***Eucosma*** (Moths, Northern Mexico:  
Kearfoot, 1907)

<i>E. fandana</i>	<i>E. sandana</i>
<i>E. gandana</i>	<i>E. tandana</i>
<i>E. handana</i>	<i>E. vandana</i>
<i>E. kandana</i>	<i>E. wandana</i>
<i>E. mandana</i>	<i>E. xandana</i>
<i>E. nandana</i>	<i>E. yandana</i>
<i>E. pandana</i>	<i>E. zandana</i>
<i>E. randana</i>	



*Eucosma obumbratana* - Finland, EK: Kotka 9.VIII.1991, Leg: S. Siikonen

## Formation of species names

### *Can be long*

*Gammaracanthuskytodermogammarus loricatobaicalensis*  
Dybowski, 1927 (an amphipod)

### *Can be short*

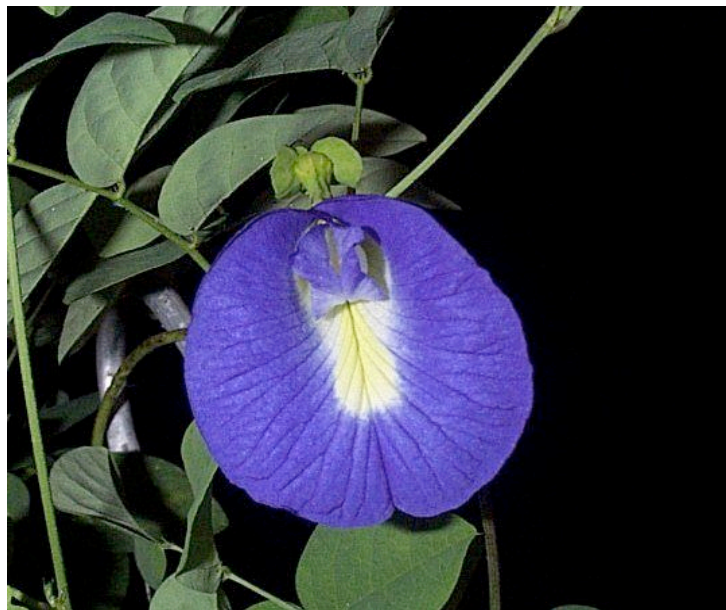
*Ia io* Thomas, 1902 (a bat)

### *Can be a lot of fun*

*Ytu brutus* Spangler, 1980 (a waterbug)



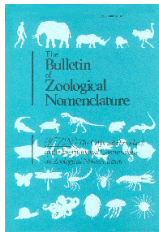
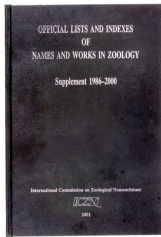
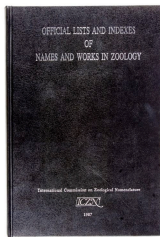
*Phallus impudicus* Linnaeus, 1753



*Clitoria ternatea* Linnaeus, 1753

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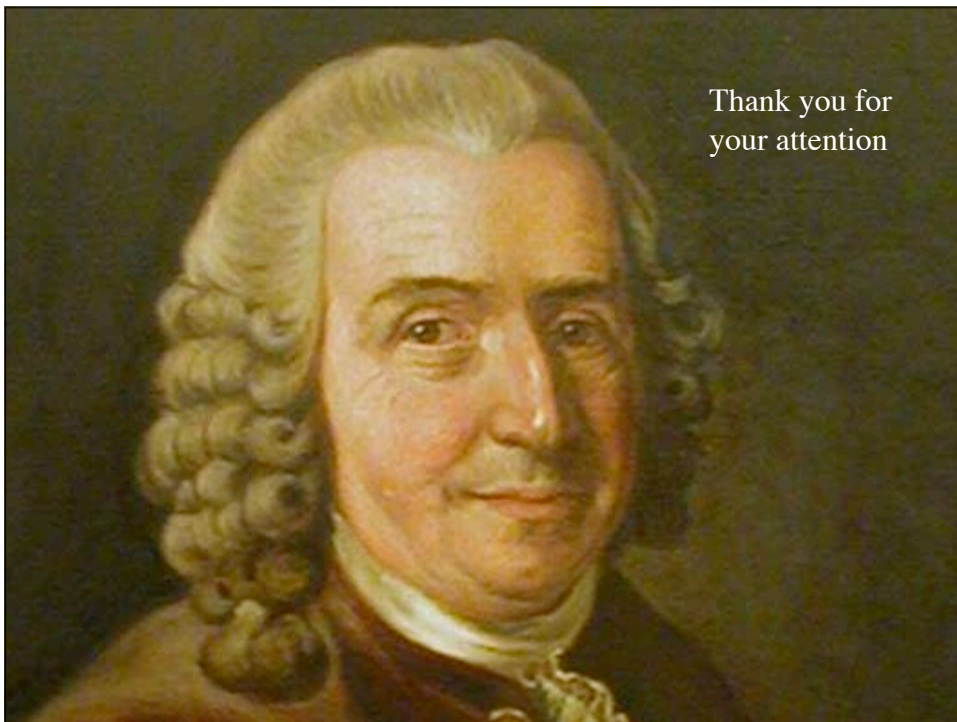


### Using sea cucumbers to illustrate the basics of zoological nomenclature

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#### Abstract

In addition to a brief account of the need to have unique and unambiguous scientific names for taxa, this paper, annotated with examples of sea cucumbers, explains the basics of zoological nomenclature. In doing so, it aims to reduce the confusion that exists among various breeds of end-users of taxonomists who may not fully understand the seemingly arbitrary and often volatile nature of scientific names. This paper also aims to provide teachers and students with a comprehensible account of the basic principles of zoological nomenclature.



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