Principles of Taxonomy

- **Interesting tool, need to understand concept and meaning of :**

☻ **Taxonomy**

☻ **Systematics**

☻ **International code of nomenclature**

TAXONOMY

(Greek, taxis= arranged; nomos= law)

- **Making and maintaining collection**
- **Differentiating species**
- **Identification (Keys) and diagnosis of species and genera**
- **Naming and describing species and genera**

Taxonomy: DINC

Description

Identification

Nomenclature

Classification

Description

= assign features

Character = a feature (e.g., “Fin color”)

Character states = two or more forms of a character (e.g., “red,” “Blue”).

Identification

= associate an unknown with a known

How? One way:

Taxonomic Key, e.g.,

Finfish

Scale cycloid ..... Species *A*

Scales placoid ..... Species *B*

Prawn (Shellfish)

Rostral teeth 7/5..... Species *C*

Rostral teeth 6/4..... Species *D*

Nomenclature

Naming, according to a formal system.

Binomial: Species are two names (Linnaeus):

E.g., ***Labeo rohita***

Labeo = genus name

rohita = specific epithet

Labeo rohita= species name

NOMENCLATURE & TYPES

Guiding principles of the ICZN:

- Availability
- Validity
- Priority: First published name is the correct one to use
- Typification: Data in the label, put in collection somewhere, Type specimen

Classification

- Placing objects, e.g., life, into some type of order.

- Taxon = a taxonomic group (plural = taxa).

CLASSIFICATION

- **Arrangement of organisms into taxonomic groups**
- **Natural classifications are objective Monophyletic vs Polyphyletic**
- **Artificial classifications are subjective** (The characters are not considered in relation to their Phylogeny)

Taxonomic hierarchy

Domain

Kingdom

Phylum

Class

Order

Family

Genus

Species

How to classify life?

- **Phenetic classification**
  - Based on overall similarity
  - Those organisms most similar are classified more "closely" together.

Example: Phenetic Tree

Consider, as a trivial example, leopards, lions, wolves and coyotes: all are mammals, all are carnivores, but no one would have any difficulty recognizing the basic similarity between leopards and lions and between wolves and coyotes.

Here, the similarity tree, reflects the true relationships of these 4 taxa.

Leopard

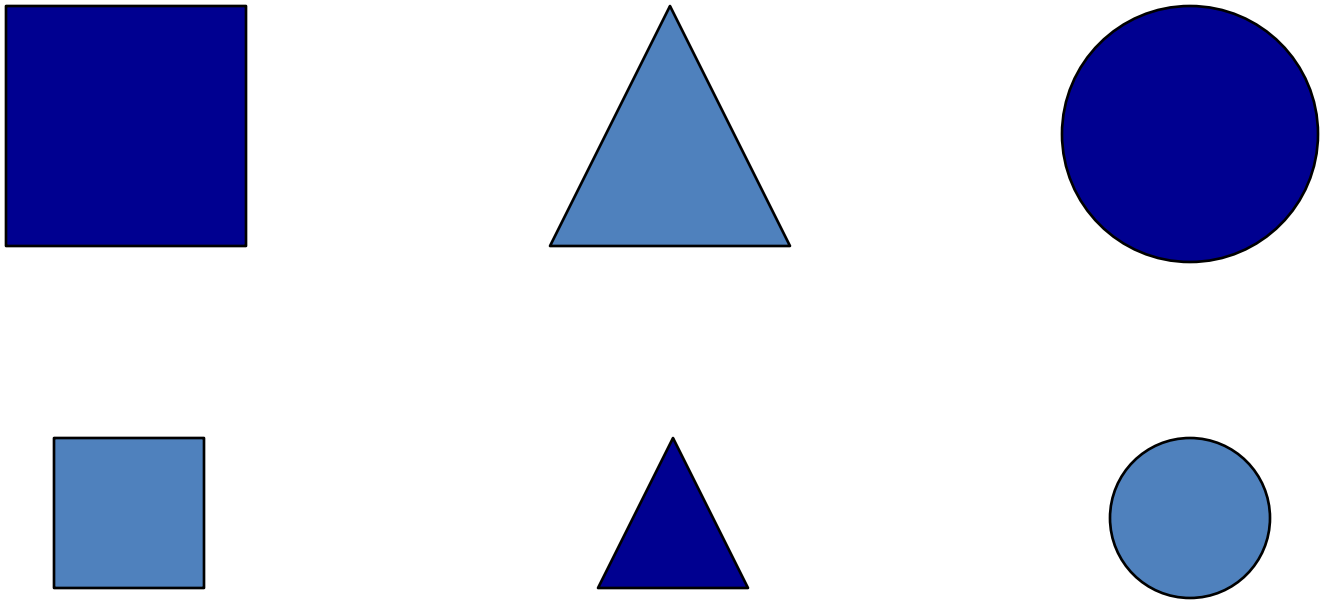
Lion

Wolf

Coyote/Jackal

Problem with phenetic classification:

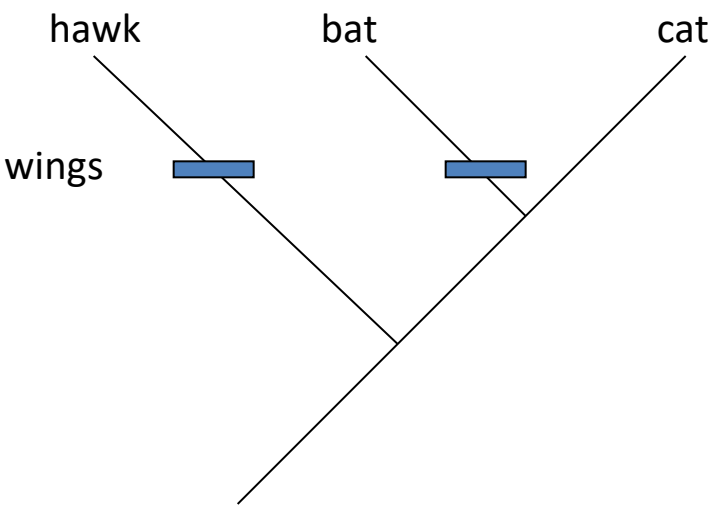
- **Can be arbitrary,**
  e.g., classify these:



Homoplasy (analogy)

- Similarity not due to common ancestry
- **Reversal** – loss of new (apomorphic) feature, resembles ancestral (old) feature.
- **Convergence** (parallelism) – gain of new, similar features independently.

Homoplasy



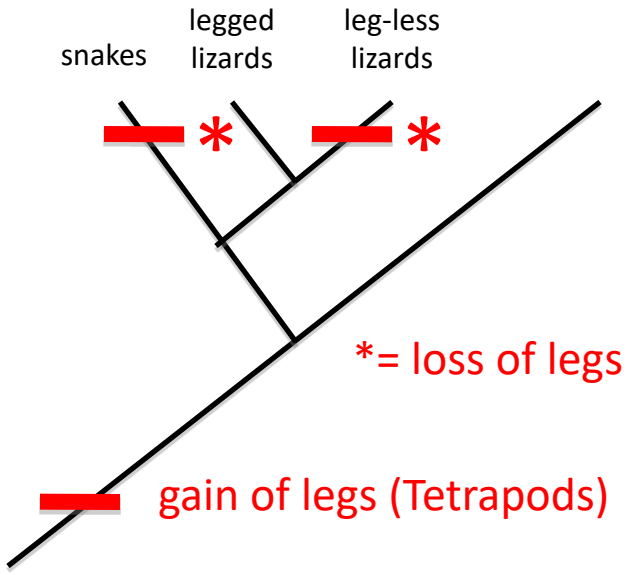
- In this diagram, wings are a homoplasy in hawks and bats because their common ancestor was an un-winged tetrapod reptile. Bird wings and bat wings evolved independently.

Leg-less lizards

Snake

Both examples of **reversal** within Tetrapods:
loss of a derived feature – forelimbs.

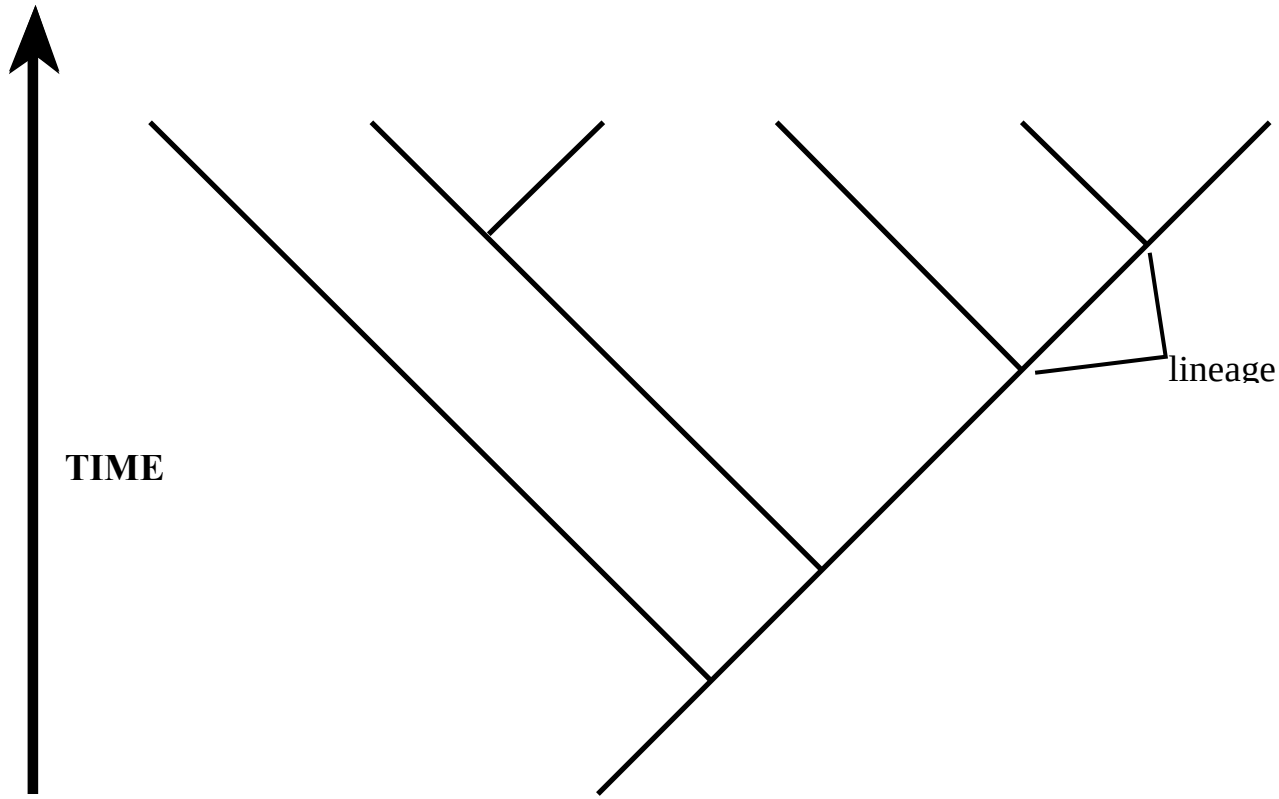
Example of **convergence** relative to one another!
Independently evolved.



Phylogenetic/Cladistic classification

- Based on known (inferred) evolutionary history.

- Advantage:
  - Classification reflects pattern of evolution
  - Classification not ambiguous



Cladogram or Phylogenetic Tree

= Representation of the history of life

Systematics

- **Field of biology dealing with diversity and evolutionary history of life**

(Greek, systema = a whole made of several parts)

- Develops the classification of organisms
- Species comparison and grouping into higher categories
- Organisms are arranged in definite, hierarchical order
- The order of the system is based on hypothesis of common descend

("Study of the kinds and diversity of organisms and the relationships between them")

Systematics includes taxonomy

Goal: Determine Evolutionary History (Phylogeny) of Life

Importance of systematics & evolution

1) Foundation of biology - study of biodiversity

2) Basis for classification of life

3) Gives insight into biological processes:
   speciation processes
   adaptation to environment

4) Can be aesthetically/intellectually pleasing!

Systems of Nomenclature

- The term nomenclature is derived from the latin words nomen=name and cadre =to call i.e. to call by name.
- Nomenclature thus means a system of names. It is to provide labels for various taxonomic categories to facilitate easy communication and recognition.

Binomial System of Nomenclature

- The system of naming species by two words is called the binary of **binomial system of nomenclature.**
- Binomial system of nomenclature was given by **Carolus Linnaeaus**.
- In this system, the first word in the name is the genus name and the first letter of genus name is capital whereas the second word is the species name and is cited with small letters.

Rules of Nomenclature

- The **International Commission on Zoological Nomenclature (ICZN)** is an authoritative body empowered to set the rules of nomenclature.
- It is also empowered to interpret, amend or suspend provisions of the rules of nomenclature by a collective decision after an elaborated procedure of the publication of name.
- The commission has plenary power to set aside the rules of uniformity and stability.
- The **Code of Zoological Nomenclature** is a published document on rules and regulation of nomenclature of animals.
- The head office of ICZN is in London

Some Important Regulations of ICZN

- **Law of priority**: this law stipulates that the valid name of a taxon is the oldest available name applied to it provided that the name is not invalidated by any provisions of the code or has not been suppressed by the ICZN.
- This is one of the basic principles of Zoological nomenclature.
- The priority is the date of publication, even page (page priority) or even line (line priority) over the two names.

Eschmeyer's Catalog of Fishes

- A compendium of all fish names, their type species, year and date of publication and validity is published by the California Academy of Sciences (CAS) under the title "Catalog of Fishes".

- Catalog of fishes is a comprehensive on-line database and reference work on the scientific names of fish species and genera.

- It is global in its scope and has been updated by the curator emeritus of the CAS fish collection, **William Eschmeyer.**

- **The taxonomy maintained by the Catalog of Fishes is considered authoritative**

Synonyms

The term synonym is important and is often used in fish taxonomy

- Synonyms are different names given to same taxon. There are two types in this : subjective or **nomenclatural synonym** and objective or **zoological synonym.**

- Nomenclatural synonym is on the basis of the opinion of the taxonomist or reviser who in the light of his studies decides that two taxa should be merged

- Zoological synonym is effected after studying material of the two species and not on the basis of simple inference or facts from literature.

Homonyms

The term homonym is also important and is often used in fish taxonomy

- Homonyms are one name given to different taxa. There are two types in this : **Primary homonym** and Secondary **homonym.**

- **Primary homonym: When same scientific name (combination of generic and scientific name)** is given to different species at the time of first description. The first published name gets the priority.

- **Secondary homonym:** When two species at the time of first/original description are given same specific name but placed in different genera and later the species are placed under the same genus, each of them are secondary homonym, but the earlier proposal gets the priority.