

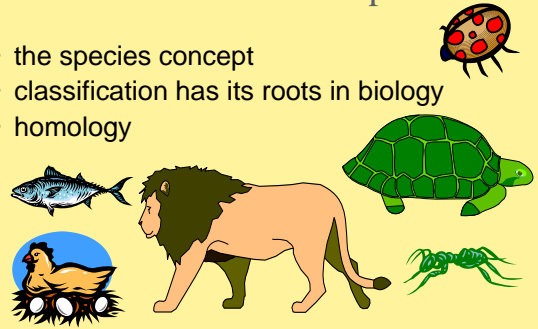
Bioinformatics CSM17 Week2: Biological Classification

- Fundamental concepts
- Traditional methods
- Nomenclature (naming)
- Taxonomy & systematics
- Overview of main 'systems'
- Cluster analysis / Numerical Taxonomy

JYC: CSM17

Fundamental concepts

- the species concept
- classification has its roots in biology
- homology



JYC: CSM17

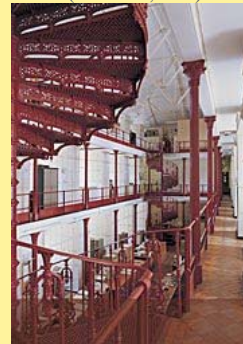
Traditional/classical methods

- Floras & monographs
- New species
- Herbaria & museums
- Mostly phenotypic characters



JYC: CSM17

Herbarium of the Royal Botanic Gardens, Kew
(London, UK)



Nomenclature (Naming)

- the *type* concept
- the *binomial* system
 - Carolus Linnaeus, *Species Plantarum* (1753)
- *type descriptions* (Latin) and authorities
- *Index Kewensis*
- IPNI (International Plant Names Index)
- 'version control'
- ICBN & ICZN



JYC: CSM17

How to interpret IPNI search

- *Aizoaceae Lithops karasmontana subsp. bella* (N.E.Br.) D.T.Cole -- Lithops Flowering Stones: 217 (1988):. (IK)
- Aizoaceae is the FAMILY
- Lithops is the GENUS
- karasmontana is the SPECIES
- bella is the SUBSPECIES (subsp.)
- N.E. Brown is the AUTHOR of
Lithops bella N.E.Brown
- D.T. Cole decided that *L. bella* was a subsp. of *L. karasmontana*

JYC: CSM17

Lithops karasmontana subsp. *bella*
(N.E.Br.) D.T.Cole



JYC: CSM17

Taxonomy and systematics

- **Taxonomy**
 - putting things into classes...
 - a 'taxonomy' is a classification system
 - 'taxonomy' is the theory, principles & practice of classification
- **Systematics**
 - the scientific study of the variation of living organisms and the relationships between them

JYC: CSM17

Overview of Life

- viruses
- bacteria
- algae
- protista - e.g. *Amoeba*, *Paramecium*
- mosses & liverworts
- higher plants
- animals



JYC: CSM17

What is a species?

- the biological species concept
- the 'practical' species concept
- about 1.7 million known
 - about 300K green plants
 - about 1.05M animals
- approximately 5-100 million yet to be discovered

JYC: CSM17

Biological variation

- helps ensure survival
- phenotypic plasticity
 - environmental conditions
- genotypic variation
 - the 'real' (encoded) variation

JYC: CSM17

Rosa canina var. *lutetiana* f. *lasiostylus*

- | | |
|---------------------|--------------------|
| • Kingdom | Plantae |
| • Division (Phylum) | Tracheophyta |
| • Class | Angiospermopsida |
| • Order | Rosales |
| • Family | Rosaceae |
| • Genus | <i>Rosa</i> |
| • Species | <i>canina</i> |
| • Subspecies | |
| • Variety (var.) | <i>lutetiana</i> |
| • Form (f.) | <i>lasiostylus</i> |



JYC: CSM17

Numerical taxonomy

- Multivariate analysis
- Cluster analysis / clustering
- using a computer...
- Sneath & Sokal 1960s, 1970s



JYC: CSM17

Distance Measures (Metrics)

- Similarity / Dissimilarity...
- Euclidean distance
 - Standardisation & Normalisation
- Sneath's simple matching coefficient
- Gower's similarity coefficient

JYC: CSM17

Dendrograms

- Tree diagrams
- Phenograms



JYC: CSM17

Linkage methods

- Nearest Neighbour (single link)
- Furthest Neighbour
- Group Average Link (complete link e.g. UPGMA)



JYC: CSM17

DELTA

- DDescriptive Language for TAXonomy
- a suite of programs and tools
- a database format
- uses text-based files

JYC: CSM17

PCLASS

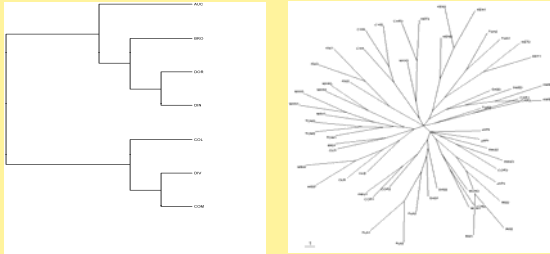
- a cluster analysis tool bundled with DELTA
- an example treefile...

```
((((((DAS3:0.07322,AME1:0.07322):0.02505,(AME3:0.06559,AME2:0.06559):0.03269):0.02093,(HET2:0.08696,HET1:0.08696):0.03225):0.01429,(TUA2:0.06325,TUA1:0.06325)
```

JYC: CSM17

TREEVIEW

- a dendrogram (tree diagram) generator



JYC: CSM17

Useful Websites & Journals

- *Taxon* - the journal for botanical taxonomists
www.botanik.univie.ac.at/iapt/
- IPNI: www.ipni.org
- Kew Gardens: www.kew.org
- TREEVIEW:
<http://taxonomy.zoology.gla.ac.uk/rod/treeview.html>
- DELTA: <http://delta-intkey.com/>

JYC: CSM17

References & Bibliography

- Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (1997). *User's guide to the DELTA system - a general system for processing taxonomic descriptions*, Edition 4.07, CSIRO Division of Entomology: Canberra, Australia.
- Dunn, G. & Everitt, B.S. (1982). *An introduction to mathematical taxonomy*. Cambridge University Press, UK.
- Everitt, B.S. (1993). *Cluster Analysis*. John Wiley & Sons, New York, USA.
- Page, R. D. M. (1996). TREEVIEW: An application to display phylogenetic trees on personal computers. *Computer Applications in the Biosciences* 12: 357-358.
- Pankhurst, R.J. (1991). *Practical Taxonomic Computing*. University of Cambridge Press: UK.
- Sneath, P.H.A. & Sokal, R.R. (1973). *Numerical Taxonomy*. W.H. Freeman, San Francisco, USA.
- Stace, C.A. (1980). *Plant Taxonomy & Biosystematics*. Edward Arnold, London

JYC: CSM17