

Introduction to Taxonomy and Taxonomic Name Changes

Created by: Tiffany Doan, New College of Florida; Tanya Dewey, Colorado State University; John Carroll, Georgia Southern University; Liz Alter, California State University Monterey Bay

INTRODUCTION

This exercise serves as an introduction to the science of taxonomy and navigating taxonomic name changes. You will need this background to support your review of the literature and data associated with your chosen taxa. Before beginning the exercise below, determine which species you plan to use for your range changes project. At the end of this exercise, you should be able to:

- Explain the purpose of taxonomy and describe why taxonomic names may change.
- Explain what taxonomic synonyms are and which ones are preferred, based on the concept of priority.
- Navigate data on taxonomic names and synonyms in a variety of taxonomic databases (CoL, ITIS).
- Develop a strategy to search for museum collections data relevant to a particular taxon.

TAXONOMY

The science of taxonomy is the classification of organisms into a system that indicates natural relationships (evolutionary relationships), or the theory and practice of describing, naming, and classifying organisms. In other words, the goal of taxonomy is to understand biodiversity by creating an organizational system of unique names that represents the evolutionary history of a taxon.

A taxon is any natural (biological) group at any level of the hierarchy. A taxon can be a species, a genus, a family, an order, a phylum, a kingdom, a domain, or anything in between!

Go to the Animal Diversity Web page on organismal classification and read these two essays:

- Organismal classification- Evolutionary relationships and ranks
- What is in a Scientific Name?

After reading those brief explanations of the complex field of classification and the purpose of scientific names, respond to the following questions:

- 1. What is the relationship between a system of nomenclature (names) and taxonomy? How are they alike and how are they different?
- 2. Describe how new kinds of data, such as DNA sequence data, change our understanding of evolutionary relationships and why names must change to reflect that.
- 3. Explain how a system of unique names, i.e. the system of binomial nomenclature, helps clarify communication about biodiversity.
- 4. In your own words, what is a synonym in taxonomy?

SYNONYMS

To make sure that we are discussing the *same taxonomic entity*, we must be able to track what names are associated with what taxonomic entity. This is the function of **synonyms**.

As scientific understanding of evolutionary relationships and taxonomic entities changes, the scientific names associated with those entities may change as well. One of those names will be regarded as valid, but all the other names that have been used for a taxon will be recorded as synonyms.

Small cats as an example:

Cat species were once lumped into two broad categories: big, roaring cats in the genus *Panthera* and small, non-roaring cats in the genus *Felis*. As scientists learned more about the diversity of cat species, it became clear that their names should reflect that diversity. In other words, we needed MORE cat names to reflect the recognized evolutionary relationships and evolutionary differences among cats. In the small cats, the approximately 31 species around the world that were previously squeezed into the genus *Felis* are now split amongst 8 genera. The genus *Felis* is now restricted to small, Old World cats, such as the ancestors of domesticated cats (*Felis silvestris*) and other small cats of Asia and Africa. In North America, bobcats and lynx were previously recognized under the genus *Felis* as *Felis rufus* and *Felis canadensis*. They are now recognized as being in their own, unique genus, *Lynx*. Those same two species are now recognized as *Lynx rufus* and *Lynx canadensis*. *Lynx rufus* and *Lynx canadensis* are the **valid** names for those species and *Felis rufus* and *Felis canadensis* are **synonyms**.

What does this mean for you? If you were to try to find any literature or data (such as collections data) relevant to *Lynx rufus*, you should know what the synonyms of that name are so that you can find ALL of the available data on that species. Literature from before the name change would refer to the species as *Felis rufus* and museum records would use that name as well. Most museums lack the resources to change names associated with the millions of specimens in their collections, so the burden is on the researcher (you!) to know the taxon well enough to know what names may be associated with it.

Another reason to pay attention to synonyms is that not only do names change, but our definitions of taxa change. A common example is species that were previously considered to be one species, but are now recognized as multiple species. African elephants were once considered all the same species, *Loxodonta africana*. Based on genetic data, along with morphological, habitat, and other differences, two species are now recognized: *Loxodonta africana* and *Loxodonta cyclotis*. Of course, all individuals of *Loxodonta* would have been identified as *L. africana* until recently, so you will have to be alert to the distributional differences recognized in the two species to decide whether a literature reference or a museum record is *L. africana* or *L. cyclotis*.

The brief exercise on the following page gives you practice finding and interpreting synonyms.



Squirrel synonyms

- 5. Visit the Mammal Species of the World website, and find the squirrel genus Spermophilus.
 - a. What is the type species that this genus was based on? (A type species is typically the specimen, or individual animal, that was originally used to describe the species.)
 - b. Who was the author of that name?
 - c. What is the current name of the type species that this genus was based on?
 - d. How many synonyms are there at the generic (genus) level for Spermophilus?

Fun fact! Do any of those synonyms look like simple misspellings? That's often the way that synonyms accumulate- by simple carelessness! If a name is in the scientific literature, even if it's an obvious misspelling, it must be catalogued as a synonym.

TAXONOMIC DATABASES

There are many taxonomic databases available for a wide variety of taxa globally <u>The Catalogue of Life (CoL)</u> is currently regarded as the umbrella database that organizes and shares information on taxonomy of all life on Earth. It does this largely by gathering and collating taxonomic data collected from taxon specific databases (i.e. mammals, spiders, mollusks, etc., see below).

Each year CoL publishes a "checklist," which can be accessed and searched from their website. By searching for a taxon there, you can access its recognized position in a taxonomic (i.e. phylogenetic) hierarchy and any information on recognized synonyms.

- 6. Use CoL to answer the following questions about human taxonomy:
 - a. How many synonyms of *Homo sapiens* are there?
 - b. Who (which author) is responsible for most of those synonyms?

Taxon-specific databases

The taxon-specific databases that are collated through CoL are updated on a more regular basis, so it is worth checking for information in the database relevant to the taxa you are interested in. Some taxa have more experts and resources available to update this information, while others do not. You can imagine that it might be easier to find all available information on synonyms for a species of North American bird than for a species of Brazilian nematode!

- 7. Use the taxon name that you will use for your research project, and track down all its synonyms:
 - a. Using CoL, what are the synonyms of this name?
 - b. Use a different taxonomic database, identify the database, and list the synonyms represented there.



Identifying relevant data

- 8. Now that you have identified synonyms of your taxon name, articulate the strategy that you will use when searching for museum collections records. What name(s) will you use and how will you organize the results?
- 9. Try this out go to GBIF and search for your taxon name, how many results do you obtain?
- 10. Use the same database and search for a synonym, how many results do you get then? Are some of them the same? (In other words, perhaps the museum record has been identified as associated with BOTH the valid name and the synonym.)

REFERENCES

Bánki, O., Roskov, Y., Döring, M., Ower, G., Vandepitte, L., Hobern, D., Remsen, D., Schalk, P., DeWalt, R. E., Keping, M., Miller, J., Orrell, T., Aalbu, R., Adlard, R., Adriaenssens, E. M., Aedo, C., Aescht, E., Akkari, N., Alfenas-Zerbini, P., et al. (2022). *Catalogue of life checklist (Version 2022-07-12)*. Catalogue of Life. https://doi.org/10.48580/dfpz

Browse animalia. (2020). The Animal Diversity Web. https://animaldiversity.org/

Global Biodiversity Information Facility. (2022). GBIF home page. https://www.gbif.org

Myers, P., Espinosa, R., Parr, C. S., Jones, T., Hammond, G. S., & Dewey, T. A. (2022). *Organismal classification: Evolutionary relationships and ranks*. The Animal Diversity Web. https://animaldiversity.org/animal_names/phylogeny_ranks/

Myers, P., Espinosa, R., Parr, C. S., Jones, T., Hammond, G. S., & Dewey, T. A. (2022). *What is in a scientific name?* The Animal Diversity Web. https://animaldiversity.org/animal_names/scientific_name/

Wilson, D. E. & Reeder, D. M. (editors). (2005). *Mammal Species of the World. A Taxonomic and Geographic Reference* (3rd ed), Johns Hopkins University Press. https://www.departments.bucknell.edu/biology/resources/msw3/

