Type specimen

According to a precise set of rules laid down in the International Code of Zoological Nomenclature (ICZN) and the International Code of Nomenclature for algae, fungi, and plants (ICN), the scientific name of every taxon is almost always based on one particular *specimen*, or in some cases specimens. Types are of great significance to biologists, especially to taxonomists. Types are usually physical specimens that are kept in a museum or herbarium research collection, but failing that, an image of an individual of that taxon has sometimes been designated as a type.[3] Describing species and appointing type specimens is part of scientific nomenclature and alpha taxonomy.

When identifying material, a scientist attempts to apply a taxon name to a specimen or group of specimens based on his or her understanding of the relevant taxa, based on (at least) having read the type description(s), preferably based on an examination of all the type material of all of the relevant taxa. If there is more than one named type that all appear to be the same taxon, then the oldest name takes precedence, and is considered to be the correct name of the material in hand. If on the other hand the taxon appears never to have been named at all, then the scientist or another qualified expert picks a type specimen and publishes a new name and an official description.

This process is crucial to the science of biological taxonomy. People's ideas of how living things should be grouped change and shift over time. How do we know that what we call "*Canis lupus*" is the same thing, or approximately the same thing, as what they will be calling "*Canis lupus*" in 200 years' time? It is possible to check this because there is a particular wolf specimen preserved in Sweden[4] and everyone who uses that name – no matter what else they may mean by it – will include that particular specimen.

Depending on the nomenclature code applied to the organism in question, a type can be a specimen, a culture, an illustration, or (under the bacteriological code) a description. Some codes consider a subordinate taxon to be the type, but under the botanical code the type is always a specimen or illustration.

For example, in the research collection of the Natural History Museum in London, there is a bird specimen numbered 1886.6.24.20. This is a specimen of a kind of bird commonly known as the spotted harrier, which currently bears the scientific name *Circus assimilis*. This particular specimen is the holotype for that species; the name *Circus assimilis* refers, by definition, to the species of that particular specimen. That species was named and described by Jardine and Selby in 1828, and the holotype was placed in the museum collection so that other scientists might refer to it as necessary.

Note that at least for type specimens there is no requirement for a "typical" individual to be used. Genera and families, particularly those established by early taxonomists, tend to be named after species that are more "typical" for them, but here too this is not always the case and due to changes in systematics *cannot* be. Hence, the term name-bearing type or onomatophore is sometimes used, to denote the fact that biological types do not define "typical" individuals or taxa, but rather fix a scientific name to a specific operational taxonomic unit. Type specimens are theoretically even allowed to be aberrant or deformed individuals or colour variations, though this is rarely chosen to be the case, as it makes it hard to determine to which population the individual belonged.

The usage of the term *type* is somewhat complicated by slightly different uses in botany and zoology.

In botany

In botanical nomenclature, a *type* (*typus*, *nomenclatural type*), "is that element to which the name of a taxon is permanently attached." (article 7.1)[9] In botany a type is either a specimen or an illustration. A specimen is a real plant (or one or more parts of a plant or a lot of small plants), dead and kept safe, "curated", in a herbarium (or the equivalent for fungi). Examples of where an illustration may serve as a type include:

- A detailed drawing, painting, etc., depicting the plant, from the early days of plant taxonomy. A dried plant was difficult to transport and hard to keep safe for the future; many specimens from the early days of botany have since been lost or damaged. Highly skilled botanical artists were sometimes employed by a botanist to make a faithful and detailed illustration. Some such illustrations have become the best record and have been chosen to serve as the type of a taxon.
- A detailed picture of something that can be seen only through a microscope. A tiny "plant" on a microscope slide makes for a poor type: the microscope slide may be lost or damaged, or it may be very difficult to find the "plant" in question among whatever else is on the microscope slide. An illustration makes for a much more reliable type (Art 37.5 of the *Vienna Code*, 2006).

Note that a type does not determine the circumscription of the taxon. For example, the common dandelion is a controversial taxon: some botanists consider it to consist of over a hundred species, and others regard it as a single species. The type of the name *Taraxacum officinale* is the same whether the circumscription of the species includes all those small species (*Taraxacum officinale* is a "big" species) or whether the circumscription is limited to only one small species among the other hundred (*Taraxacum officinale* is a "small" species). The name *Taraxacum officinale* is the same and the type of the name is the same, but the extent of what the name actually applies to varies greatly. Setting the circumscription of a taxon is done by a taxonomist in a publication.

Miscellaneous notes:

1. Only a species or an infraspecific taxon can have a type of its own. For most new taxa (published on or after 1 January 2007, article 37) at these ranks a type should not be an illustration.
2. A genus has the same type as that of one of its species (article 10).
3. A family has the same type as that of one of its genera (article 10).

The *ICN* provides a listing of the various kinds of type (article 9),[9] the most important of which is the holotype. These are

- holotype
- lectotype
- isotype
- syntype
- paratype
- neotype
- epitype

Note that the word "type" appears in botanical literature as a part of some older terms that have no status under the *ICN*: for example a clonotype.

Although in reality biologists may examine many specimens (when available) of a new taxon before writing an official published species description, nonetheless, under the formal rules for naming species (the International Code of Zoological Nomenclature), a single type must be designated, as part of the published description.

A type description must include a diagnosis (typically, a discussion of similarities to and differences from closely related species), and an indication of where the type specimen or specimens are deposited for examination. The geographical location where a type specimen was originally found is known as its **type locality**. In the case of parasites, the term **type host** (or symbiotype) is used to indicate the host organism from which the type specimen was obtained.

Zoological collections are maintained by universities and museums. Ensuring that types are kept in good condition and made available for examination by taxonomists are two important functions of such collections. And, while there is only one *holotype* designated, there can be other "type" specimens, the following of which are formally defined:

Holotype

Main article: Holotype

When a single specimen is clearly designated in the original description, this specimen is known as the *holotype* of that species. The holotype is typically placed in a major museum, or similar well-known public collection, so that it is freely available for later examination by other biologists.

Paratype

Main article: Paratype

When the original description designated a holotype, there may still be additional specimens listed in the type series and those are termed paratypes. These are not name-bearing types.

Allotype

An allotype is a specimen of the opposite sex to the holotype, designated from among paratypes. It was also formerly used for a specimen that shows features not seen in the holotype of a fossil. The term is not regulated by the ICZN.

Neotype

A neotype is a specimen later selected to serve as the single type specimen when an original holotype has been lost or destroyed or where the original author never cited a specimen.

Syntype

Main article: Syntype

A syntype is any one of two or more specimens that is listed in a species description where no holotype was designated; historically, syntypes were often explicitly designated as such, and under the present ICZN this is a requirement, but modern attempts to publish species description based on syntypes are generally frowned upon by practicing taxonomists, and most are gradually being replaced by lectotypes. Those that still exist are still considered name-bearing types.

Lectotype

A lectotype is a specimen later selected to serve as the single type specimen for species originally described from a set of syntypes. In zoology, a lectotype is a kind of name-bearing type. When a species was originally described on the basis of a name-bearing type consisting of multiple specimens, one of those may be designated as the lectotype. Having a single name-bearing type reduces the potential for confusion, especially considering that it is not uncommon for a series of syntypes to contain specimens of more than one species.

A notable example is that Carl Linnaeus is the lectotype for the species *Homo sapiens*.

Paralectotype

A paralectotype is any additional specimen from among a set of syntypes, after a lectotype has been designated from among them. These are not name-bearing types.

Hapantotype

A special case in Protistans where the type consists of two or more specimens of "directly related individuals representing distinct stages in the life cycle"; these are collectively treated as a single entity, and lectotypes cannot be designated from among them.

Ergatotype

An ergatotype is a specimen selected to represent a worker member in hymenopterans which have polymorphic castes.