Taxonomic Concept Schema

Complementary Documentation for Draft Standard

The schema was developed by the TDWG Name Standard Committee as a collaborative project funded by GBIF and SEEK at Napier University. Full documentation and contact information as well as a platform for discussion can be found at:

http://tdwg.napier.ac.uk/

1 Overwiew

This documentation should be read in conjunction with the Taxonomic Concept (Transfer) Schema (TCS) as submitted to TDWG for consideration as a standard. The version of the schema is v0.70.

This is the second 'official' version after v0.50 presented at the eScience Workshop in May 2004 in Edinburgh. We have taken on board the comments received there and either incorporated changes to accommodate requirements or discussed how the additionally requested information can be stored with the current structure.

The major change is the incorporation of a top-level structure called Assertions that is used to store relationships between Taxonomic Concepts as declared/established by Taxonomists who are not the authors of either of these concepts. Furthermore the definition of what a concept is has been widened and new types were introduced.

Here is a list of the main changes:

- Key ref instead of ID-REF
- ReferenceType refined to allow explicit notation of GUID reference
- Author added to Publication.
- Renaming of various fields to clarify their meaning
- Expanded enumeration list for concept types and relationships
- AccordingToType and RelationshipType separated out for re-use
- Status attribute for names

2 Definition of terms and their relation to Schema Elements

The terms listed here are to complement the inline documentation of the XSD file and give an indication under what circumstances the particular element is going to be used.

2.1 Data set

(also data source) – taxonomic data (e.g. a revision of a taxonomic group or a database of taxonomic names) that is transformed to conform to the Taxonomic Concept (Transfer) Schema. Depending on the kind of data, interpretation will be necessary to extract *concepts*.
Information about the (source) data set is stored in the ***MetaData*** element.

2.2 (Taxonomic) concept

Concepts arise from the classification of a group(s) of organisms by a person (taxonomist) at a certain time. They are given a name by the person, typically following the rules of nomenclature. The concept can be defined in many ways; by the organisms or other *concepts* which circumscribe it, one of which being its type (specimen); by reference to other concepts or by a set of characters which differentiate it from other concepts. Depending on the *data source* only a subset of the information might be available.

In short: a concept is composed of a name and some kind of definition.

The vagueness of this definition is intentional and reflected in the design of the ***TaxonConcept*** element, where only the name is compulsory (to give some sort of handle, to communicate about the concept) and all possible elements that can contribute to the definition of the concepts are optional. There are two possibilities why such elements would be missing: either the author did not use them in his definition or the data source that was used as the basis for the transfer didn't include the information. It might not be known for a particular data source which possibility applies.

A ***TaxonConcept*** can be designated as one of five concept types (below) via its ***type*** attribute. In addition it can be recorded as 'empty' for TaxonConcepts that hold no information other than a reference to an external concept record via a GUID. It should be noted that ***type*** is optional because often it cannot be determined from the data source.

Original	The first representation/original publication of a taxon concept/name use. In other words: concepts where a new name has been created. The definition of the taxon concept will be variable depending on where and when it was published. These concepts act as the foundation on which current taxonomic concepts are based.
Revision	A concept definition presented as part of a taxonomic revision. Usually the results of a re-classification (e.g. combining or splitting) of existing concepts where a previously used name is redefined in some way.
Incomplete	An incomplete record of a concept. This should be used if it is known (or suspected) that not all information about the concept is contained in the data source.
Aggregate	A collection of TaxonConcepts grouped together under a name of utility by a user/author. It needs to include links to all of the TaxonConcepts it covers explicitly stated.
Nomenclatural	A concept holding purely nomenclatural information, any relationships held will be to similar nomenclatural concepts. It (implicitly) covers all concepts that ever used the particular name. A special case of this is a vernacular concept.
Empty	No contents other than its ID (a GUID), which is to be used as a reference to an external **TaxonConcept** record.

The Schema does not prescribe which composite elements of a Taxon Concept must be represented for each of the given Taxon Concept types, rather it is envisaged that this would be determined by the business rules of applications that use and parse data exchanged via a TCS validated document.

The allowed components for each of the types might be as follows

Concept Components	**Original Concept**	**Revision Concept**	**Incomplete Concept**	**Aggregate Concept**	**Nomenclatural Concept**
Name	+	+	+	+	+
AccordingTo	+	+	**?**	+	-
Kingdom	**?**	**?**	**?**	**?**	**?**
Rank	**?**	**?**	**?**	**?**	**?**
Relationships to Concepts	**?**	**?**	**?**	+	**?**
Specimen Circumscription	**?**	**?**	**?**	-	- (1)
Character Circumscription	**?**	**?**	**?**	**?**	-

+ Required; **?** Optional; **-** Disallowed

(1) Nomenclatural Concepts might have type specimens recorded

2.3 Relationships between Taxonomic Concepts

Relationship (also Taxonomic Concept Relationship, Synonymy) – describes the documented association between two concepts as seen by the author of one of the two OR by a third party. Therefore the relationship can be considered as a directed link.

In the TCS the definition of a TaxonConcept can include ***Relationships*** to other taxon concepts, these are determined by the author of the concept. However we can also have relationships between two existing taxon concepts which we call ***Assertions***. Such Assertions are not part of the definition of a Taxon Concept and are often made by a third party.

A provisional list of the possible types of relationships (for relationships defined in the Taxon Concept and Assertions) is presented below, together with a brief descriptive definition. Most of the relationships that are not inherently bi-directional are represented by a pair of unidirectional relationships.

The various relationships can be grouped according to which variety of Taxon Concept that they may apply to (refer to separate discussion of TaxonConcept types). The group of set operations can only be asserted between full Taxon Concepts (i.e. it is not possible to express these opinions about concepts that are purely nomenclatural). Such relations will provide the richest means of relating concepts between separate taxonomic hierarchies, and as such can be classified as '*Horizontal Relationships*'. Parent Child (i.e. *Vertical*) relationships apply within a taxonomic hierarchy or classification, and may relate full Taxon Concepts or Nomenclatural Concepts. The majority of Relationships are Nomenclatural, and express the various 'traditional' relationships of taxonomy. All concepts are required to possess names, and can therefore be related by nomenclatural relationships.

SET OPERATIONS BETWEEN CONCEPTS

is congruent to	The extent of Concept 1 is (essentially) identical to Concept 2
is not congruent to	The extent of Concept 1 is not identical to Concept 2
includes	Concept 2 is a subset of Concept 1
does not include	Concept 2 is not a subset of Concept 1
excludes	Concept 1 does not overlap or include Concept 2
is included in	Concept 1 is a subset of Concept 2
is not included in	Concept 1 is not a subset of Concept 2
overlaps	Concepts 1 and 2 share members/children in common
does not overlap	Concepts 1 and 2 have no members/children in common

HIERARCHICAL RELATIONSHIPS BETWEEN CONCEPTS OR NAME CONCEPTS

is child of	Concept 1 is a member of lower taxonomic rank of Concept 2
is parent of	Taxon Concept 1 includes Concept 2 as a lower-ranked member.

NOMENCLATURAL RELATIONSHIPS (BETWEEN NAMES OF CONCEPTS

is type of	Concept 1 is the nominal taxon that is the name-bearing type member of Concept 2.
has type	Concept 2 is the nominal taxon that is the name-bearing type member of Concept 1.
is basionym for	The name for Concept 2 is provided by Concept 1, by the rules of priority
has basionym	The name for Concept 1 is provided by Concept 2, by the rules of priority
is vernacular for	The name of Concept 1 is a common usage name for Concept 2
has vernacular	The name of Concept 2 is a common usage name for Concept 1
is conserved against	An exception to the rules of nomenclature allows the name of Concept 1 to be maintained in preference to that of Concept 2
has conserved name	An exception to the rules of nomenclature allows the name of Concept 2 to be maintained in preference to that of Concept 1
has conserved type	An exception to the rules of nomenclature allows Concept 2 to be retained as the taxonomic type of Concept 1
is conserved type of	An exception to the rules of nomenclature allows Concept 1 to be retained as the taxonomic type of Concept 2
is heterotypic synonym of	The name applied to Concept 1 is an alternative name for Concept 2, and derives from a different type

is homotypic synonym of	The name applied to Concept 1 is an alternative name for Concept 2, and derives from the same type
is later homonym of	The name for Concept 1 is the same as that of the earlier Concept 2, but the concepts are not related
has later homonym	The name for Concept 2 is the same as that of the earlier Concept 1, but the concepts are not related
is treated as later homonym of	The name for Concept 1 is the same as that of Concept 2 and treated as of junior precedence, but the concepts are not related
has homonym treated as later	The name for Concept 2 is the same as that of Concept 1 and treated as of junior precedence, but the concepts are not related
is lectotypification of	Concept 1 has been selected as the lectotype of Concept 2 (in the absence of a holotype)
has lectotypification	Concept 2 has been selected as the lectotype of Concept 1 (in the absence of a holotype)
is neotypification of	Concept 1 has been selected as the neotype for Concept 2
has neotypification	Concept 2 has been selected as the neotype for Concept 1
is orthographic variant of	The name of Concept 1 is variant spelling of that of Concept 2
is misapplied name for	The name given for Concept 1 is misapplied, the correct name being that of Concept 2
has misapplied name	The name given for Concept 2 has been misapplied to Concept 1
is nomen novum for	The name of Concept 1 is established expressly to replace the established name of Concept 2 (retaining the name-bearing type)
has nomen novum	The name of Concept 2 is established expressly to replace the established name of Concept 1 (retaining the name-bearing type)
is not a synonym of	The name of Concept 1 is not an alternative name for Concept 2
is partial synonym of	The name applied to Concept 1 can be applied to some of the taxonomic concepts represented in Concept 2
is pro parte synonym of	The name applied to Concept 1 is a partial synonym (q.v) of Concept 2, generally not involving the type
is recombination of	The name for Concept 1 is a new combination of a generic name with the previously established species-group name in Concept 2.
has recombination	The name for Concept 2 is a new combination of a generic name with the previously established species-group name in Concept 1
is rejected in favour of	The name of Concept 1 is set aside in favour of the name of Concept 2
has rejected name	The name of Concept 2 is set aside in favour of the name of Concept 1
is rejected type of	Concept 1 is set aside as the type of Concept 2
has rejected type	Concept 2 is set aside as the type of Concept 1

is replaced synonym for	The name for Concept 1 has been replaced by the alternative name given for Concept 2
has replaced synonym	The name for Concept 2 has been replaced by the alternative name given for Concept 1
is synonym of	The name applied to Concept 1 is an alternative name for that applied to Concept 2
is validation of	The name for Concept 1 is the correct name for Concept 2 under the rules of the nomenclatural codes
has validation	The name for Concept 2 is the correct name for Concept 1 under the rules of the nomenclatural codes
is epitypification of	Concept 1 is designated the epitype for Concept 2
has epitypification	Concept 2 is designated the epitype for Concept 1
is anamorph of	Concept 1 is the asexual or mitotic reproductive stage in a pleomorphic life cycle in which Concept 2 is the teleomorph or meiotic reproductive stage
is teleomorph of	Concept 1 is the teleomorph or meiotic reproductive stage in a pleomorphic life cycle in which Concept 2 is the asexual or mitotic reproductive stage

HYBRIDIZATION RELATIONSHIPS

is second parent of	Concept 1 is genetic parent (2) of Concept 2 (a Hybrid)
is female parent of	Concept 1 is genetic mother of Concept 2 (a Hybrid)
is first parent of	Concept 1 is genetic parent (1) of Concept 2 (a Hybrid)
is male parent of	Concept 1 is genetic father of Concept 2 (a Hybrid)
is hybrid parent of	Concept 1 is genetic parent of Concept 2 (a Hybrid)
is hybrid child of	Concept 2 is a genetic parent of Concept 1 (a Hybrid)

GENERAL

doubtful	Uncertain relationship between Concepts 1 and 2

CONSIDERED BUT NOT USED

is taxonomically included in	equivalent to 'included in'?
have common elements	equivalent to 'overlaps'?
sanctioning (only fungi)	Unsure of use - does it refer to use of 'ex' Author?
is later validation of	equivalent to 'is validation of'?
is contradiction	Unsure of use
same citation as	Unsure of relevance to concept definitions
earlier publication of	Unsure of relevance to concept definitions
later publication of	Unsure of relevance to concept definitions
isonym of	Unsure of meaning
correction of	Unsure of relevance to concept definitions

corrected by	Unsure of relevance to concept definitions

2.4 Publication

The publication is the document where the author's opinion is recorded. Historically this would be a paper publication such as a journal article/monograph but databases are being used increasingly. There has been a lot of discussion about the adoption of a common format for publications for all TDWG schemata. We are much in favour of such a format, but not in a position to make a decision. Until then the basic format as introduced in the strawman schema is used which is based on the Endnote format. This has the advantage of being simple and compact. An explanation on how the different fields are used is provided in the appendix.

2.5 Author

(also Author Team) – person or group of people who publish taxonomic *concepts*. In addition to taxonomist/biologists this can include owners of taxonomic databases such as ITIS if the data stored there underwent taxonomic modification and interpretation (revision) and is not just a record of other *authors* concepts. (**Authority** should not be used because of its ambiguity)

2.6 Name

A name is a textual label for a concept. It can be

scientific – follows the rules of nomenclature and can be broken down into components

non-scientific – ad-hoc label, vernacular or any other type of identifier

2.7 Specimen

In the TaxonConceptSchema a Taxon Concept can be circumscribed by a (set of) ***Vouchers***, which are records of specimen objects. A voucher consists of two parts, the Institution or ***Repository***, where it is stored and a local Identifier of the actual ***Specimen***. It is anticipated to use records from ABCD or DiGR here, provided they can be accessed by a GUID.

Some of the specimen might be designated types for a concept. A ***type*** attribute can optionally be recorded for each voucher in the circumscription, to detail whether the specimen is a 'type specimen' for the given Taxon Concept, and the nature of the type according to the rules of nomenclature.

15 enumerated type of types are given here, representing the types controlled in the botanical and zoological codes of nomenclature (see appendices below).

epitype
holotype
isotype
lectotype
neotype
non-type
paratype
syntype

isosyntype
hapantotype
paralectotype
paratype
syntype
type
name-bearing type

3 Appendix

3.1 List of Parties consulted

1. VegBank and Taxonomer groups Santa Barbara, 22-25th January 2004
2. Berlin Model group, Berlin 26-27th Feb 2004
3. GBIF, Copenhagen 16-17th Feb 2004
4. Nomencurator, London 29th Mar 2004
5. Species 2000, London 30th Mar 2004
6. ITIS, Edinburgh 9th May 2004
7. IPNI, London 9th Jun 2004

Other valuable input was received on the Wiki page by

3.2 Additional Material

Wiki/Website for schema related discussion
http://tdwg.napier.ac.uk/

Previous versions of the TCS Schema:
http://cvs.ecoinformatics.org/cvs/cvsweb.cgi/seek/projects/taxon/schemas/seek_napier.xsd?only_with_tag=EdinburghMeeting (pre march'04)
http://www.soc.napier.ac.uk/tdwg/index.php?pagename=TheSchema (post march'04)

Case studies: conversion of existing databases to schema conformant XML
(actual data only available at request because of copyright issues):
http://tdwg.napier.ac.uk/data-sets/

Notes from meetings with taxonomic data user groups
(various formats; incomplete):
http://tdwg.napier.ac.uk/notes/

3.3 Glossary of terms

Here various taxonomic (or somehow related) terms and their definitions (from various sources) are listed. This reflects our understanding of their meaning if there are multiple meanings associated with them.

- **authorship** - author's name and date of publication are typically given after the scientific name. If a name is later changed (e.g., moved to a new genus), The original author is given in parentheses. Anonymous publication is invalid as of 1950, but was accepted before then.
- **autonym** - when an author names a new subspecies or variety, the species is given the same new rank, based on the original type of the species and

duplicating the epithet, e.g., when Pinus nigra ssp. larico was designated, Pinus nigra ssp. nigra came into being.

- **basionym** - specific or infraspecific name which has priority over other names later given to the same plant by different authors.
- **binomial** - genus name is one word. A species name is the genus plus a second word. Subspecies have a trinomial name. A subgenus is occasionally given in parentheses after the genus, thus:
- *Bison (Bison) bison bison* (Linne, 1758) Skinner & Kaisen, 1947
- **component** – parts of a string that still have a meaning.
- **description** - after 1930, new names must come with a description (or reference to one) telling what the name means.
- **element** – used in the XML sense; a node in the document tree.
- **homonym** - scientific name given two or more times to plants of the same taxonomic rank but which are quite distinct from each other. In botanical nomenclature, the authors are given in taxonomic monographs, and if a name is changed, both the original author (in parentheses) and the revising author are named.
- **original data source** – where the data stored in the transfer schema is coming from; typically a database, but can also be a piece of literature.
- **synonym** – any one of two or more names used for the same taxon rank; a rejected name due to misapplication or difference in taxonomic judgment.
- **tautonym** - illegitimate binomial in which the genus and species are the same word, such as Amoracia armoracia, later changed to Armoracia rusticana.
- **taxon** - taxonomic group; A group of organisms at any level of the taxonomic hierarchy. The major taxa are the species and genus and the higher taxa, including the family, order, class, phylum, and kingdom.
- **type specimen** - descriptions should refer to an actual specimen, available for examination in a museum or other collection. There are complicated rules for determining the type if the original is lost or if there was no type specimen with the original description.

3.4 Conventions (technical)

This section lists all conventions used in designing the Napier SEEK transfer schema.

3.4.1 Design

- The schema is designed to store about taxonomic concepts, assertions (relationships), specimen (vouchers) and publications. This is reflected in the three top-level elements.
- If a collection of items is stored, the individual items are encapsulated in a container element that takes the name of the individual item plus the letter ‘s’ to indicate plural (e.g. `<Items>`). Container elements are mandatory but can be empty.
- If an item is typically used as the concatenation of individual components, the schema provides a way to store the full text string as `<FullItem>` (mandatory) and broken down list of components as `<ItemAtomised>` (optional). The `<ItemAtomised>` can also contain information that is not part of `<FullItem>`.

3.4.2 Element Names

- Names of elements are written in lower case with an initial uppercase letter and (in the case of composite names) uppercase letters at the start of every component.
- Underscores (_) are not used.
- Attributes are all lower case (composite name are not used).

3.4.3 References

- If an element is not specified in place, but rather references a location either in the same file or at a globally accessible location, the element is stored as an empty element either with a ***ref*** attribute containing a local ID (LUID) or a ***gref*** attribute containing a global ID (GUID). As a result of comments received in Edinburgh, the reference Element doesn't carry the same name as the target.
- LUIDs are typically the identifiers from the original data source

3.4.4 Documentation

- Every element defined in the schema has an associated `<xs:annotation>` tag, containing annotations and documentation.
- Inside the `<xs:annotation>` tag a compulsory `<xs:documentation>` tag contains text describing the purpose of the element. This should be a single, concise sentence that doesn't contain any reasoning or discussion.
- If an element has attributes it is good form to use [A] in the documentation as they are often overlooked.

3.4.5 Included XSD

- Parts of the schema that are taken (nearly) verbatim from other sources are contained in a separate file and included via the `<xs:include>` tag as a single file.
- The filename indicates the source: ***Source***`Contents.XSD`.
- The original XSD is left untouched as far as possible.
- Modifications are documented inside and additional `<xs:annotation><xs:documentation>` tag

3.5 Use of fields for different publication types

(As used by EndNote 7 ;taken from Richard Pyle's Taxonomer paper)

ID 0	Generic	Year	Title	Secondary Title	Place Published	Publisher	Volume	No. of Volumes	Number	Pages
1	Journal Article	Year	Title	-	-	-	Volume	-	Issue	Pages
2	Book	Year	Title	Series Title	City	Publisher	Volume	No. Vols.	Number	Pages
3	Book Section	Year	Title	Book Title	City	Publisher	Volume	No. Vols.	Number	Pages
4	Manuscript	Year	Title	Collection Title	City	-	-	-	Number	Pages
5	Edited Book	Year	Title	Series Title	City	Publisher	Volume	No. Vols.	Number	Pages
6	Magazine Article	Year	Title	-	-	-	Volume	-	Issue	Pages
7	Newspaper Article	Year	Title	-	City	-	-	-	-	Pages
8	Conference Proceedings	Year	Title	Conf. Name	Conf. Loc.	Publisher	Volume	No. Vols.	-	Pages
9	Thesis	Year	Title	Academic Dept.	City	University	-	-	-	Pages
10	Report	Year	Title	-	City	Institution	-	-	-	Pages
11	Personal Communication	Year	Title	-	City	Publisher	-	-	-	-
12	Computer Program	Year	Title	-	City	Publisher	Version	-	-	-
13	Electronic Source	Year	Title	-	-	Publisher	Access Year	Extent	Acc. Date	-
14	Audiovisual Material	Year	Title	Collection Title	City	Publisher	-	-	Number	-
15	Film or Broadcast	Year	Title	Series Title	City	Distributor	-	-	-	Length
16	Artwork	Year	Title	-	City	Publisher	-	-	-	-
17	Map	Year	Title	-	City	Publisher	-	-	-	Scale
18	Patent	Year	Title	Published Source	Country	Assignee	Volume	No. Vols.	Issue	Pages
19	Hearing	Year	Title	Committee	City	Publisher	-	-	Doc. No.	Pages
20	Bill	Year	Title	Code	-	-	Code Volume	-	Bill No.	Pages
21	Statute	Year	Title	Code	-	-	Code Number	-	Law No.	1st Pg.
22	Case	Year	Title	-	-	Court	Reporter Vol.	-	-	-
23	Figure	Year	Title	Source Program	-	-	-	-	-	-
24	Chart or Table	Year	Title	Source Program	-	-	-	-	-	-
25	Equation	Year	Title	Source Program	-	-	Volume	-	Number	-
26	Book Series	Year	Title	-	City	Publisher	-	No. Vols.	-	Pages
27	Determination	Year	Title	-	-	Institution	-	-	-	-
28	Sub-Reference	Year	Title	-	-	-	-	-	-	Pages

ID 0	Generic	Section	Tertiary Title	Edition	Date	Type of Work	Short Title	Alternate Title	ISBN ISSN	Figures
1	Journal Article	-	-	-	Date	-	Short Title	Alt. Jour.	-	Figures
2	Book	-	-	Edition	Date	-	Short Title	-	ISBN	Figures
3	Book Section	-	Ser. Title	Edition	Date	-	Short Title	-	ISBN	Figures
4	Manuscript	-	-	Edition	Date	Type Work	Short Title	-	-	Figures
5	Edited Book	-	-	Edition	Date	-	Short Title	-	ISBN	Figures
6	Magazine Article	-	-	-	Date	-	Short Title	-	-	Figures
7	Newspaper Article	Section	-	Edition	Date	Type Art.	Short Title	-	-	Figures
8	Conference Proceedings	-	Ser. Title	Edition	Date	-	Short Title	-	ISBN	Figures
9	Thesis	-	-	-	Date	Thesis Type	Short Title	-	-	Figures
10	Report	-	-	-	Date	Type Work	Short Title	-	Rpt. No.	Figures
11	Personal Communication	-	-	-	Date	Type Work	Short Title	-	-	-
12	Computer Program	-	-	Platform	Date	Type Work	Short Title	-	-	-
13	Electronic Source	-	-	Edition	Date	Medium	Short Title	-	-	-
14	Audiovisual Material	-	-	-	Date	Type Work	Short Title	-	-	-
15	Film or Broadcast	-	-	-	Date	Medium	Short Title	-	ISBN	-
16	Artwork	-	-	-	Date	Type Work	Short Title	-	-	-
17	Map	-	-	Edition	Date	Type Work	Short Title	-	-	-
18	Patent	-	-	-	Date	-	Short Title	-	Pat. No.	Figures
19	Hearing	-	Leg. Body	Session	Date	-	Short Title	-	-	-
20	Bill	Section	Leg. Body	Session	Date	-	Short Title	-	-	-
21	Statute	Section	-	Session	Date	-	Short Title	-	-	-
22	Case	-	-	-	Date	-	Abb. Case	-	-	-
23	Figure	-	-	-	Date	-	-	-	-	-
24	Chart or Table	-	-	-	Date	-	-	-	-	-
25	Equation	-	-	-	Date		-	-	-	-
26	Book Series	-	-	Edition	Date	-	-	-	ISBN	Figures
27	Determination	-	-	-	Date	-	-	-	-	-
28	Sub-Reference	-	-	-	Date	-	-	-	-	Figures

3.6 Type Definitions

3.6.1 Type Definitions: (based on ICBN, Chapter II, Section 2, Article 9)

Included in TDWG TCS

- **epitype:** "a specimen or illustration selected to serve as an interpretative type when the holotype, lectotype, or previously designated neotype, or all original material associated with a validly published name, is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the name of a taxon." The holotype, lectotype, or neotype that the epitype supports must be explicitly cited when the epitype is designated.
- **holotype:** the one specimen or illustration used by the author, or designated by the author as the nomenclatural type.
- **isotype:** any duplicate specimen of the holotype.
- **lectotype:** a specimen or illustration designated as the type when no holotype was indicated at the time of publication. If possible, the lectotype should be selected from the syntypes or original material.
- **neotype:** a specimen or illustration selected as the type when all of the material on which the name of the taxon was based is missing.
- **non-types:** specimens which are erroneously labelled as types should be annotated as, "Not a Type."
- **paratype:** a specimen cited in the protologue that is neither the holotype, isotype, nor one of the syntypes. These are often listed as representative specimens in the original description.
- **syntype:** any one of two or more specimens cited in the protologue when no holotype was designated, or any one of two or more specimens simultaneously designated as types in the original description. Monographers are urged to select a lectotype from among the syntypes whenever possible.
- **isosyntype:** a duplicate specimen of a syntype.

Not in the Code, but in common usage (Not in TDWG TCS)

- **isolectotype:** any duplicate specimen of the lectotype.
- **isoneotype:** any duplicate specimen of the neotype.

3.6.2 Type Definitions: (based on *International Code of Zoological Nomenclature* (ICZN) 4th Edn.)

Included in TDWG TCS

- **hapantotype:** One or more preparations consisting of directly related individuals representing distinct stages in the life cycle, which together form the name-bearing type in an extant species of protistan. A hapantotype, while a series of individuals, is a holotype that must not be restricted by lectotype selection; however, if a hapantotype is found to contain individuals of more than one species, components may be excluded until it contains individuals of only one species.
- **holotype:** The single specimen (except in the case of a hapantotype, *q.v.*) designated or otherwise fixed as the name-bearing type of a nominal species or subspecies when the nominal taxon is established.
- **lectotype:** A syntype designated as the single name-bearing type specimen subsequent to the establishment of a nominal species or subspecies.
- **neotype:** The single specimen designated as the name-bearing type of a nominal species or subspecies when there is a need to define the nominal taxon

objectively and no name-bearing type is believed to be extant. If stability and universality are threatened, because an existing name-bearing type is either taxonomically inadequate or not in accord with the prevailing usage of a name, the Commission may use its plenary power to set aside that type and designate a neotype.

- **paralectotype:** Each specimen of a former syntype series remaining after the designation of a lectotype.
- **paratype:** Each specimen of a type series other than the holotype.
- **syntype:** Each specimen of a type series from which neither a holotype nor a lectotype has been designated. The syntypes collectively constitute the name-bearing type.
- **type:** A term used alone, or forming part of a compound term, to denote a particular kind of specimen or taxon.
- **name-bearing type:** The type genus, type species, holotype, lectotype, series of syntypes (which together constitute the name-bearing type) or neotype that provides the objective standard of reference whereby the application of the name of a nominal taxon can be determined.

Not in the Code, but in common usage (Not in TDWG TCS)

- **allotype:** A term, not regulated by the Code, for a designated specimen of opposite sex to the holotype.
- **cotype:** A term not recognized by the Code, formerly used for either syntype or paratype, but that should not now be used in zoological nomenclature.
- **genotype:** A term not recognized by the Code, formerly used for type species, but that should not now be used in zoological nomenclature.
- **topotype:** A term, not regulated by the Code, for a specimen originating from the type locality of the species or subspecies to which it is thought to belong, whether or not the specimen is part of the type series.

3.6.3 Codes of Nomenclature

- International Code of Botanical Nomenclature: Saint Louis Code in English (published by the IAPT - International Association for Plant Taxonomy)
- International Code of Nomenclature of Bacteria. The International Committee on Systematics of Prokaryotes (ICSP) (www.the-icsp.org). Unfortunately, the *Bacteriological Code* (1990 Revision) is not available on the Internet!
- International Code of Zoological Nomenclature (ICZN), also non available on the Internet www.iczn.org
- International Code of Virus Classification and Nomenclature (published by the ICTV - International Committee on Taxonomy of Viruses).
- BioCode (the) - Draft BioCode 1997
- *PhyloCode*