

Invertebrate collections policy of the Finnish Museum of Natural History

Risto Väinölä[‡], Lauri Kaila[‡], Jaakko Mattila[‡], Pasi Sihvonen[‡], Marko-Tapio Hyvärinen[§],
Leif Schulman[!], Aino Juslén[‡]

[‡] Zoology Unit, Finnish Museum of Natural History, University of Helsinki, Finland
[§] Botany Unit, Finnish Museum of Natural History, University of Helsinki, Finland
[!] Finnish Museum of Natural History, University of Helsinki, Finland

Corresponding author: Risto Väinölä (risto.vainola@helsinki.fi)

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Abstract

The collection policy of the Finnish Museum of Natural History Luomus is hierarchically structured. General principles and guidelines are defined in the General Collections Policy. Subordinate to it, the collection policies for the individual sub-collections implement and specify these guidelines and instructions, considering the special nature of each sub-collection. The invertebrate collections policy in 2017 was the first sub-collection policy to observe this hierarchical structure, and was guided by the standards set by the European SYNTHESYS collections management self-assessment procedure. The invertebrate collections policy directs all activities related to the Luomus invertebrate collections (apart from DNA and tissue samples), which comprise the separately managed entomological collections (ca. 9 million specimens) and collections of other invertebrates (0.4 million). The policy defines the purpose of the collections, outlines the objectives and content of procedures and activities related to them, the division of responsibilities for the administration and care of the collections within the organisation, and the principles and practices for the acquisition, preservation, accessibility and use of the collections.

Keywords

natural history collections, policy, collectionmanagement, collection care, accessioning, deaccessioning, biodiversity, zoology, entomology

1. Status, purpose and implementation of the Invertebrate Collections Policy at the Finnish Museum of Natural History

Status and implementation

The Collection Policy of the Finnish Museum of Natural History Luomus is hierarchically structured. General principles and guidelines are defined in the General Collections Policy (Hyvärinen et al. 2020). Subordinate to that are the collection policies for the individual collections, also known as “separate collection policy documents”. They adhere to and implement the General Collections Policy, and specify its guidelines and instructions, taking the special nature of the individual collection into account. The Invertebrate Collections Policy is one of these separate policy documents and it directs all activities related to invertebrate collections, excluding DNA and tissue samples which are governed by the separate Genomic Resources Collections Policy (Ståhls-Mäkelä et al. 2020).

This policy document has been prepared in the Zoology Unit, reviewed by the Collections Steering Group, and approved by the Luomus management group on 29 May 2017*1.

The invertebrate collections policy is implemented and executed by the teams that manage the invertebrate collections of the Zoology Unit - the Entomology Team and the Metazoa Team - as well as by every team member and visiting researcher that use the collections while working on behalf of Luomus and with its collections.

Goals of the collections policy

The goal of the collections policy is to ensure the high scientific quality of the collections and the data associated with them, and to enable optimal physical and digital access to the collections for the purposes of scientific research.

The policy document defines the purpose of the collections, the objectives and content of the procedures and activities related to them, the division of responsibilities for the administration and care of the collections within the Luomus organisation, and the principles of collection acquisition, preservation, accessibility and of use on a general level. Related specific practices and processes are separately documented in the operational instructions of each team (Museum wiki or equivalent).

Definition of a collection

A collection is a compilation of systematically organised scientific specimens and their metadata, from which the specimens can be retrieved on the basis of either collection data

files or of the physical location of the specimens. Specimens which have not yet been thus organised are not considered to be part of the collection.

Datasets included in the collections (e.g., specimen databases) may also be stored and organised together with data that do not make up part of the collection (e.g., observation data). The Luomus Digital Data Policy applies to all these kinds of data. Collection databases are thus governed by two data policies, those for collections and for digital datasets.

Purpose of the collections

The primary mission of the collections is to accrue and preserve scientific specimens representing biodiversity for the purposes of research and academic teaching. Specimens are also used at the Luomus public attractions for the educational needs of the general public and of higher education. Collection specimens document the structural and genetic diversity of animal taxa, as well as their geographical distribution and intra-specific variation. The collections promote the knowledge of zoological species in Finland and across the world, and appreciation for biodiversity. They make part of a global network of natural history collections that is a key resource for biodiversity research, a common infrastructure that has been built up over centuries by the international and Finnish research communities.

The legislation, general principles and strategies pertaining to the Luomus collections are discussed in the General Collections Policy. The invertebrate specimen collections make a part of the Luomus national natural history collections, as referred to in the Universities Act of 2009. For their part, the collections implement the mission of Luomus to be “responsible for the preservation, accumulation and exhibition of the national natural history collections and for research and education relating to them”.

Collection responsibilities in the Zoology Unit

The director of the Zoology Unit carries the primary responsibility for the zoological collections of Luomus, including their preservation, expansion, documentation and use. Responsibilities have been further divided between the Metazoa and Entomology Teams, which are led by their respective team leaders. Within the teams, responsibility for the collections is distributed among the scientific staff (curators and senior curators) so that each collection sector has an appointed scientific collection manager and a deputy (second in charge). Team leaders have the overall responsibility for the collections governed by their team. The distribution of responsibilities related to practical collection management and the supervision of work are agreed upon within the teams. This division of duties will be documented in the guidelines for the care of the collections.

2. Principles of collection acquisitions

Material to be added into the collections

New material to the collection is added systematically based on the objectives specified in the collection and research policies, rather than amassed arbitrarily. Acquisitions shall focus on the designated strengths of the collections and on collections that support those strengths, on threatened or rare species, and on type specimens. The scientific value of the strength areas is enhanced by expanding and supplementing the collections, and by complementing and replacing deficient materials.

The growth of the collection is guided by the potential information content of the new materials and by their utility for research. Specifically, this may be related to the documentation of species diversity (systematics and taxonomy), of variation within individual species (e.g., dispersal history) or of species distribution.

The primary means of collection growth is active, high-quality collection-oriented research. Material is acquired through specimens obtained by Luomus staff as part of their work as well as through material donated by other researchers, students, authorities and private individuals. In addition, specimens may be acquired by exchange between organisations or through purchases. As a rule, all material relating to research, theses or dissertations completed at Luomus must be documented and submitted for inclusion in the relevant collection. Final decisions on whether or not a specimen will be added to a collection are, however, made by the scientific collection manager.

At the general level, specimens to be accessioned are prioritised as follows:

1. Scientifically valuable and technically high-quality specimens, which support the strengths of Luomus and are important for current or future research
2. Specimens which supplement existing scientifically valuable collections and add to their coverage (e.g., represent missing developmental stages, expand time series or broaden the geographical or taxonomic scope of the collection)
3. Specimens with no immediate research value, but which may serve other societal interests such as environmental education or the public outreach in presentation of biodiversity

Specimens may also be added to the collection if they together with collections of other museums form a consistent resource.

When specimens are acquired through collecting activity in connection with other collection-related research or research that supports other Luomus collections, their incorporation can be justified by the synergy created between collections, and accessioning can be partly opportunistic. Documenting changes in the composition of biological communities is not an objective of the collections.

Collection strengths and responsibilities

The following focus areas or strengths guide the expansion of the invertebrate collections:

- Taxa that belong to active focus areas at Luomus. In the 2010s, these research-related focus areas are Coleoptera (beetles), Lepidoptera (butterflies), Diptera (flies), Hymenoptera (wasps, bees), aphids, Araneae (spiders), and Palearctic freshwater crustaceans.
- The fauna of Eastern Fennoscandia and of the boreal zone in general
- Sub-Saharan Africa (University of Helsinki research focus area)
- Materials that document intra-specific population variation

Further areas of responsibility guiding the expansion of collections are:

- Type specimens
- Threatened and rare species in Finland
- Documenting the distribution of fauna in Finland and adjacent regions

Quality criteria for specimens

Development of the collections is guided by the quality criteria for specimens and related metadata listed in the General Collections Policy. These criteria are applied when expanding and pruning (deaccessioning) the collections, to enhance the quality of the content of the collection. The quality criteria for the invertebrate collection areas:

- Reliability and accuracy of specimen collecting data
- Technical quality of specimens
- Accessibility of specimens
- The status of specimens as part of a larger collection or research entity, particularly in relation to Luomus' focus areas
- Special historical values
- Ethics criteria related to specimen collection

Ethics and legality

The collections are expanded in line with the principles and practices for protecting and promoting biodiversity. Specimens must be collected and imported in accordance with the laws and provisions of Finland and the countries of origin, as well as with international conventions ratified by Finland (e.g., CITES 1973). When accessioning new specimens, the required information on the legitimacy of the specimens and on their terms of use is entered into the collection management system. Those providing specimens may be required to supply written documentation on the origin of the specimens and their terms of use.

National division of responsibility

The zoological collections of Luomus are part of the national network of natural history collections. Knowing and recognising the focus areas of collections from other institutions is intertwined with designation of the strengths of the Luomus collections. This knowledge will help in directing the expansion of various collections in a way that will enhance the value of individual collections while at the same time responsibilities are distributed in a rational manner. The designated strengths of the invertebrate collections of the University of Turku, different from those of Luomus, include centipedes and millipedes as well as tropical parasitoid wasps. As a rule, natural history collections at other universities and provincial institutions have a regional focus related to their own geographical location.

3. Receipt and accessioning of specimens

Accessioning and cataloguing

New specimens become part of the collection only when formally accessioned. When a new specimen is accessioned into the collection, its data are entered into the collection management system and it is assigned a unique identifier. Material previously organized in the collection belongs to the collection even if it is not yet digitally registered. Cataloguing or digitising this type of existing material does not constitute expansion of collections.

New sample lots or private collections offered to and received by the museum will nevertheless be registered into the collection management system as separate larger entities (donations) already before the potential accessioning of the specimens. This enables the monitoring of incoming material from donations. Metadata on sample lots expected to be acquired in the future can also be registered in the collection management system.

Decision-making

The inclusion or accessioning of specimens to the collection requires a decision by the scientific collection manager (curator) of the relevant collection sector, or by their deputy or superior in the case of absences. These decisions are made in accordance with the principles of the General Collections Policy and of this document. Curators may delegate decisions on individual specimens to other collection staff, on the basis of written instructions. Decisions of accepting extensive collections are made by the director of Luomus on a proposal by the unit director.

When accessioning new collection materials, the following points related to the general quality criteria must be considered:

- Scientific significance and documentary value
- Whether the specimens genuinely expand the content and coverage of the collection, or duplicate existing materials

- The manner in which the specimens promote Luomus' strengths and the goals specified in its collection and research policies
- Reliability and sufficiency of specimen data

The following must also be considered in relation to storage resources:

- The amount of specimens and their space requirements
- In the case of large entities requiring extensive space, the additional criteria defined in the General Collections Policy

Terms attached to the receipt of specimens

As a rule, no such specimens or collections will be accepted whose release is subject to terms or conditions other than those related to the collecting permit practices. If the material is exceptionally valuable, Luomus and the donor may agree on an embargo period of up to two years before accessioning the material into the collection and opening it for use. Such agreements are approved by the director of Luomus on the proposal by the unit director.

Preparation of collection specimens

Collection specimens are prepared following recognized practices that guarantee a high quality and the best possible level of preservation. Invertebrate collection specimens are primarily pinned or glued to preparation cards, stored in alcohol, mounted on a microscope slide or stored in dry form (e.g., mollusc shells). Pinned insects will be accessioned as individual specimens; other specimens may be incorporated as lots of several individuals of the same population.

Microscope slides and DNA extracts prepared from collection specimens will be registered as separate specimens [preparations] with an identifier of their own, and clearly linked in the collection management system with the corresponding voucher specimen in the collection, if such a specimen exists.

The procedures of preparing various specimen types are recorded in the operational instructions of the teams. Fluid-preserved specimens are stored in ethanol. Specimens initially fixed in formalin will also be kept in ethanol for long-term storage. The regular ethanol concentration is 80%. In view of DNA research, specimens are also stored in 96% alcohol.

4. Collection management

The accessibility and actual utility of a collection depends on the systematic organising of the specimens and of the data that document the collection, as well as on familiarity of the staff with this organisational structure. Collection management refers to this process of organising and documenting the collections. Compliance with the principles of collection management is monitored, and the practices of management are developed in the teams

under the supervision of the team leaders and scientific collection managers and in cooperation with the Biodiversity Informatics Unit.

Metadata

Metadata about the structure of the invertebrate collections, documenting the subdivision of the collections into subcollections as well as the composition, size and location of the collections, is specified on a general level in the common collection management system "Kotka" of Luomus (Heikkinen et al. 2019). The persons in charge of individual subcollections are also registered in the system. This metadata is openly available to all.

Historical documents related to a collection are part of the collection, and the responsibility for such material is carried by the team managing that collection. Decisions on access to these materials will be based on practicality.

Specimen data and the collection database

Data related to individual museum specimens can be recorded on specimen labels, in field collecting documents and/or in collection databases and catalogues. Detailed data on the collecting and origin of all newly accessioned specimens are entered into the common Kotka collection management system (CMS) of Luomus. An objective of collection management is to register the entire Luomus collection into this single CMS. The history of specimen use and the potential physical consequences of it, such as damage caused by the preparation of DNA or microscopic preparations, are also recorded in the CMS.

Specimens will be unambiguously marked with labels that contain the most essential information on their origin along with a standard identifier that links them to the CMS. When replacing labels, all original labels and those with information that differs from the current information will be kept.

Recording specimen-specific data

The most important information required for museum specimens are the collecting locality and time. Specimens with no locality data should generally not be incorporated to a collection.

The following data are the minimum requirement for new specimens to be accessioned (quality criteria):

- Location of discovery (country, locality, coordinates with accuracy of no less than 1 km²)
- Collecting date (exact date or time period)
- Collector
- Number of individual organisms comprising the batch (or estimate)
- Type specimen status, if any, and the original publication reference

Recommended additional information includes:

- Detailed description of the collection location
- Habitat (macro- and microhabitat), substrate, potential host organism or accompanying species
- Developmental stage, sex and phenotype of the organism
- Collecting method
- Reference to the collecting event (e.g., research project, excursion, expedition) and its metadata; time of day
- Taxonomic determination and determiner
- References to publications where the specimen has been used as material

Physical organisation of the collections

The invertebrate collections are administratively and physically divided into the entomological collections and the collections of other invertebrates. These have been further organised variously according to taxonomy, geography and the method of preservation. In addition, certain historical entities are stored separate from others (separate collections). The organisation of the collections and specimens aims at ease of access. The principle of organisation of each individual collection is described in its metadata.

Entomological collections

Entomological collections that are kept dry have been organised in a single large collection hall where they are divided into six subcollections based on taxonomic orders: Lepidoptera, Coleoptera, Hymenoptera, Diptera, Hemiptera, and the Ordines minores collection comprised of other, smaller insect orders. In addition there is the bite mark and gall collection. The collections have been further subdivided into domestic (eastern Fennoscandia) and exotic collections, each with their own internal systematic organisation. Some collections that are of historical value and comprise a large amount of type specimens have been kept as separate entities. These include the Mannerheim Collection (Coleoptera), the Frey Collection (Diptera) and the Nylander Collection (Hymenoptera). Fluid-preserved insect collections are located in a collection hall of their own and their organisation primarily follows that of the dry collections.

Other invertebrates

The collection of other invertebrates is divided into four subcollections: Arachnida and Myriapoda, Mollusca, Worms, and *Invertebrata varia* (crustaceans and others). Physically, the collection is divided primarily into domestic (eastern Fennoscandia) and exotic (rest of the world) collections, which in the collection management system are identified by their own dataset identifiers.

Domestic and exotic collections are taxonomically organised by phyla and by classes, and further, depending on the group, by orders or families. Genera and species are in

alphabetical order. As a rule, microscope slides have been placed and organised at the end of their own group (e.g., an order). Type specimens are kept separate from the rest of the collection. Dry specimens (shells) in the mollusc collection are separate from the fluid-preserved samples in closed cabinets, and are further organised by geography, as well as into bivalves and to marine, freshwater and terrestrial gastropods.

Tissue and DNA sample collections

The tissue sample collection is an independent physical subcollection which for the part of invertebrates mainly comprises frozen lots of specimens. Tissue samples are administered together with DNA samples in accordance with the separate Genomic Resources Collections Policy.

5. Collection maintenance

Collection maintenance is conducted following the international standards of collection care in scientific collections. The aim is to ensure the preservation of specimens for the use by the scientific community for centuries to come. This requires specialised methods for storage, pest control, specimen handling and the security of the collection facilities.

Collection facilities

Ambient conditions in the facilities are adjusted for the optimal preservation of the collections. District cooling is available to keep the temperature to approximately +16 degrees Celsius, and humidity is kept at approximately 40–50%, in order to minimise pest risks. Specimens are protected from light and dust. Fire safety in the collections facilities is observed while minimising the risk of damages caused by humidity.

Practical and, when available, standardised storage systems and containers are implemented. Various storage systems and their development needs have been specified in the instructions for collection care.

Procedures for preparing material to be transferred to a collection are also described in the instructions for collection care (Museum wiki or equivalent). Dry specimens are processed at individual staff workstations or at laboratory facilities appointed for the task. A separate laboratory facility equipped with a fume hood and intended for processing fluid-preserved specimens is available in connection of the invertebrate collections.

Current state of collection maintenance

The state of organization of the entomological collections varies with the taxonomical orders. Some subcollections are very extensive and have grown rapidly. The electronic documentation of species location in the collection is the most advanced for the domestic Hymenoptera. For the rest of the entomological collection this work is only in the early stages.

Nearly all the collections of other invertebrates are properly organized physically, but a majority of samples remain undigitized. In practice, there are large materials waiting to be accessioned or to be otherwise processed. Incorporation of newly incoming material is prioritized, while material waiting for processing and old collection specimens are digitised following the digitising strategy (see below).

Collection care routines

The permanent technical collections staff monitor, manage and care for the collection specimens and regularly control the ambient conditions in the collection facilities. Specimen conservation and collection care are carried out following practices agreed upon with the scientific collection managers and coordinators.

Potential occurrence of pest insects in the collection facilities is regularly monitored and controlled. The condition of fluid-preserved samples is monitored regularly. A record of maintenance events and needs will be kept on the subcollection level for the purposes of operational development. Changes in the condition of specimens and events that have affected these changes are recorded in the collections management system.

Safety

A safety coordinator has been designated for the collection facilities. The staff receive orientation on the emergency plan, which is also readily available in written form. The University's occupational health and safety organisation monitors general occupational safety.

There are dedicated coordinators responsible for acquiring hazardous chemicals and controlling their storage in each team, and they will ensure that safety data sheets for chemicals and instructions for laboratory work are accessible to all. Hazardous volatile substances are handled in fume hoods or in facilities equipped with local exhaust ventilation. The coordinators will also ensure the availability of personal protective equipment and clothing.

Visitors working with the collections will also receive orientation relating to key safety instructions and working practices. Occupational ergonomics and safety are developed in cooperation with other parties at the University in accordance with relevant general instructions.

Taxonomic identification and scientific evaluation of the collections

Continued scientific evaluation of the collections by Luomus staff themselves, and support for the work of visiting researchers by making the facilities available, are key for high quality collection maintenance. The staff will organise collections primarily to a level at which they are readily accessible for use by specialist researchers.

Digitisation strategy

The digital availability of collection data (section 6) and, increasingly, the photographic documenting of actual specimens are central to the accessibility of the collections. Digitisation is currently one of the most important processes in collections management.

As a general guideline, priority is given to the digitisation of type specimens, historically or scientifically significant subcollections, and entities related to collection strengths (focus areas). The digitisation of specimens actually in use (particularly those that are submitted for loan) is the highest priority. To promote the collection objectives in an efficient manner, the teams will draft digitisation plans that prioritise digitisation needs for the invertebrate collections.

6. Accessibility and use of the collections

The collections are used primarily for scientific research and university teaching, and secondarily for other types of teaching and environmental education.

The collections can be studied on site in Luomus facilities, and collection material may be loaned outside Luomus for research purposes free of charge or in exchange for handling fees, in accordance with international museum practices. Digital accessibility to collection specimens in photographic form is an important trend that which will decrease the need for travel and for physical mailing of specimens.

Accessibility and access rights

The accessibility or availability of the collections is their key quality criterion and value indicator. The objectives of the collections policy include making the collections available for efficient use by the scientific community.

The use of the physical collections requires permission. Decisions on use are made by the scientific collection manager of each subcollection in the first place, or, in their absence, by the deputy manager, team leader or unit director. The person granting access to a collection shall evaluate on a case-to-case basis the scientific relevance of the intended use, the user's qualifications and the risks involved.

Openness of data

Metadata related to the collections and, as a rule, the digitised specimen data in the collection management system Kotka, are open data according to the Luomus Digital Data Policy. They are available to the scientific community and the public through the Finnish Biodiversity Information Facility (as a rule, [CC Attribution 4.0 licence](#) or newer).

Access to collections facilities

Access to the collections facilities requires authorisation (access control). Access is granted by the collection team leader or the scientific collection manager of the relevant facility. Luomus staff and persons with a working agreement with the museum usually have free access to the collection facilities. Others will use the collections under supervision of the collections staff of the relevant team. Assistance of visitors is one of the core duties of the collection teams.

A record is kept on visitors working with the collections. Persons overseeing the visit must also ensure that the visitor is familiar with both the appropriate procedures of handling scientific specimens and with related health and safety matters.

Requests of access to the collection are processed and reviewed without delay. When needed, visits to the collection shall be facilitated promptly; visits lasting up to one working day with no more than two weeks' notice, longer visits with no more than a month's notice.

Specimen loans

Specimens in the collections are available for loan to other collection units and research institutions subject to a decision of the scientific collection manager, in accordance with international practice. A written agreement on the loan and its terms must always be concluded. The parties to such agreements are the relevant institutions: the loanee that signs the agreement must have a permanent affiliation with the receiving organisation (unlike, for example, a postgraduate or postdoctoral student). Collection specimens are usually not lent directly to private individuals, neither are specimens received on loan from them. If specimens are handed over to a private individual, the unit director is technically lending the specimens to the scientific collection manager, who will be personally responsible for the loan.

Data about all incoming and outgoing loans is permanently entered into the collection management system. Loaned specimens must be handled carefully, as with any collection specimens. The loan period is always defined by the agreement. By default, the period is 12 months, or 6 months for type specimens. The extension of loans must be made in writing similarly to the original agreement. Collection managers will send regular reminders of overdue loans.

General and case-specific restrictions may be imposed on loans of type specimens or other particularly valuable specimens. Sending of digital images instead of actual specimens is recommendable. As a rule, material to be loaned out shall be digitised by photographing. This is particularly important for the valuable materials discussed above.

Destructive sampling

Museum specimens lent out are usually expected to be returned in their original condition. Any breakage of a specimen, such as for mounting a microscope slide, must be separately

agreed on in connection with the loan agreement, and both the original specimen and the preparations made must, as a rule, be returned.

Actual destructive sampling takes place, for example, when extracting DNA from museum specimens. The scientific collection managers can give permission for destructive sampling on a case-to-case basis, based on authorisation granted by the unit director. Decisions are based on the assessment of the scientific significance of the sampling in relation to the scientific value of the undamaged specimen. The damage to specimens caused by the sampling must be minimised. One should strive to sample one of paired appendages so that the other one remains intact. Samples extracted from individual organisms will be documented so that information on their individual identity is not lost.

Tissue samples extracted from collection specimens and handed over will be formally treated as loan transactions, similarly to the loans based on the separate Genomic Resources Collection Policy. The ownership and right of use of tissue samples and DNA preparations extracted from them remain with Luomus, unless otherwise agreed. The loanee must report on specimen use. The loanee is responsible for ensuring or obtaining the right of use for purposes referred to in the Nagoya Protocol 2010, and this is stated in the loan document.

Other use

The use of collection specimens in exhibitions or lending them out to parties other than scientific research or collections organisations is based on the guidelines of the General Collections Policy.

7. Deaccessioning

The collections policy aims to ensure that any specimen to be incorporated is potentially significant for promoting the objectives of the collection, as a relevant and useful document of biodiversity. This is not always the case with all material currently held in the collection. The quality of the collection and the efficient use of facilities can sometimes be improved by removing, or deaccessioning, specimens from the collection. As an alternative solution, exchange, donating or selling of specimens to another scientific collection unit can be considered.

According to the General Collections Policy, deaccessioning will be made basing on guidelines given by the unit director. Decisions on deaccessioning individual specimens are made by the scientific collection manager together with the unit director or other supervisor.

Deaccessioning shall be considered if

- The data on the origin of a specimen is missing, most likely permanently. In exceptional cases, individual specimens in good condition that represent a taxon otherwise missing from the collection can be kept in the collection.

- The specimen is in poor condition (defective diagnostic characters), and the collection includes a sufficient amount of equivalent material from the same area and period.
- There are many specimens from the same location, but the documentation is insufficient to justify considering them a population sample.

When deaccessioning specimens, any reliable collecting and observation data on them are retained. This also applies to deaccessioned specimens that are in poor condition. When possible, deaccessioned material will also be documented by digital photography.

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Endnotes

*1 The original document is in Finnish; this is a translation.