

Collections Procedure

DAF Plant Pathology Herbarium and Insect Collection

Version: 2.3

1 Procedure statement

The Plant Pathology Herbarium and Insect Collection are recognised as State Significant Collections by the Office of the Queensland Chief Scientist. This procedure provides standards and guidelines for curation and maintenance of the collections, while balancing protection and access to specimens. This procedure considers past and current collection practices, data standards for specimen records, curatorial issues and planning for the future.

2 Background and context

The Plant Pathology Herbarium and Insect Collection hold authoritatively identified specimens that represent virtually all of the known plant pathogens and insect pests that occur in Queensland. The collections include irreplaceable specimens that are essential for diagnostics and identification, taxonomic and phylogenetic research, continued market access for agricultural products, State legislation (*Biosecurity Act 2014*), plant health management and education.

The Insect Collection and Plant Pathology Herbarium were established in 1894 and 1901, respectively. Biosecurity Queensland is the custodian of both collections and is responsible for managing the collections and making them accessible to Queensland and the Australian community.

3 Scope

This procedure applies to Department of Agriculture and Fisheries (DAF) staff working in the Plant Pathology Herbarium and Insect Collection, as well as research associates, volunteers and visitors to the collections.

4 Abbreviations, acronyms and definitions

Accessioning is the process of assigning specimens a unique number, labelling and entering record information into a Collection Management System.

The **Australian Plant Pest Database (APPD)** is a national, online repository of specimen records of insect pests and plant diseases of Australia's economically and ecologically important plants. The database has over 1.28 million records, with data being sourced from 18 separate plant pest collections. This information supports market access, emergency plant pest management and plant protection research.

The **Atlas of Living Australia (ALA)** is a data aggregator that brings together biodiversity data from many sources and makes it publicly accessible online. The Atlas has over 67 million specimen occurrence records.

The **Biosecurity Act 2014** commenced on 1 July 2016. It replaced a number of separate pieces of legislation that were previously used to manage biosecurity. It provides a consistent, modern, risk-based approach to safeguard our economy and agricultural industries.

Biosecurity Queensland is a business group within the Queensland Government Department of Agriculture and Fisheries that manages and coordinates the Queensland Government's efforts to

prevent, respond to, and recover from pests and diseases that threaten the economy, agricultural and tourism industries, environment and way of life.

The **Collection Management System** is the database used to manage and report information about specimens held in the collections. Specimen records are managed by the KE EMu® database.

The **Collections** encompasses the Plant Pathology Herbarium and Insect Collection. Both collections are co-located at the Ecosciences Precinct, Dutton Park, Brisbane, and are managed by Biosecurity Queensland.

Comma Separated Values (CSV) is a commonly used computer file format often used to exchange tabulated data stored in collection databases.

Curation is the process whereby specimens are processed (i.e. pinned, slide mounted, dried and packaged) and organised according to discipline-specific taxonomic and nomenclatural rules.

Deaccessioning is the process of removing specimens permanently from the Collections if no longer relevant, lost or deteriorated to a point where the specimen is no longer useful scientifically.

Deaccessioning requires prior approval by the Collection Managers or Curator.

The **Department of Agriculture and Fisheries (DAF)** is a Queensland Government department that aims to develop productive and profitable agriculture, fisheries and forestry, while protecting our valuable natural resources.

Loans are temporary transfers of specimens either to or from the Collections to another institution/organisation for the purposes of research, education or display.

A **Specimen** is an individual insect (or group of insects), diseased plant part, living culture, or genomic DNA extracted from an organism.

5 Key principles

The mission of the Collections is to acquire and disseminate knowledge about the diversity and systematics of plant pests and diseases for the benefit of the Queensland, Australian and international scientific community. The application of this knowledge and expertise supports sustainable primary industries by providing solutions for market access, biotechnology, production research, extension services and natural resources.

5.1 Significance of the collection

The Insect Collection and Plant Pathology Herbarium were established by Henry Tryon in 1894 and 1901, respectively, to support the identification of agricultural pests and plant diseases in Queensland. Over the next 100 years these two biological collections grew into internationally recognised reference collections of agriculturally important plant pests and diseases in Australia. Specimens are regularly cited by their accession numbers in most of the leading scientific journals. The collections are uniquely valuable for their representation of tropical and subtropical plant pests and diseases in Australia.

Biological collections play an invaluable role in DAF. The Plant Pathology Herbarium and Insect Collection hold authoratively identified reference specimens that represent virtually all of the known plant pathogens and insect pests that occur in Queensland. The specimens are preserved as either living cultures, dried plant and fungal material, pinned insects, ethanol preserves, slide mounts or DNA extracts.

The Collections underpin the reliable and accurate identification of plant diseases and pests in Queensland. The Collections are especially valuable as a resource for maintaining Queensland's biosecurity through the early detection of new and emerging plant diseases and pests. Exotic plant pathogens and insect pests pose a huge economic threat to Queensland's crop production industries, which are worth approximately \$3.5 billion annually. The Collections support Biosecurity Queensland's Plant Biosecurity program which coordinates DAF efforts to prevent and respond to pests and diseases that threaten the economy and environment as well as to ensure continued market access. The Collections also support legislation, e.g. prohibited and restricted matter, under the Queensland *Biosecurity Act 2014*, and the Commonwealth *Biosecurity Act 2015*

5.1.1 Plant Pathology Herbarium (BRIP)

The Plant Pathology Herbarium maintains a reference collection of over 89,000 specimens, of which 80,000 represent fungal pathogens. The specimens comprise dried plant and fungal tissue, dried fungal cultures, microscope slides and other materials. The collection includes specimens of plant pathogenic fungi, bacteria, viruses and viroids.

Culture collection and DNA bank

In addition to dried plant and fungal tissue, many specimens also include living cultures. There are over 20,000 isolates representing more than 1,500 unique species of microorganisms (primarily fungi). The collection also stores over 7,000 genomic DNA samples that represent about 1,200 unique species of plant pathogens.

5.1.2 Insect Collection (QDPC)

The Insect Collection is unique in Queensland in that it is closely aligned to an identification service and is principally oriented towards insect pests of agricultural importance. The collection consists of three elements, specifically, a pinned collection, slide collection and alcohol collection.

Pinned collection

The pinned collection presently contains about 1.6 million insect specimens and is the largest reference collection of economically important species in the Southern Hemisphere. All specimens with a hardened exoskeleton are mounted on stainless steel pins and accommodated in either timber or metal insect cabinets. Within the pinned collection there are several smaller associated collections, Alan Fletcher Research Station Biocontrol Collection as well as the Queensland Forestry Insect Collection.

Slide collection

Many small insects, e.g. thrips, aphids and scale, must be preserved by slide mounts using a semi-permanent or permanent mounting medium such as Canada Balsam or Hoyer's mounting medium. This collection presently contains over 52,000 slides.

Alcohol collection

The alcohol collection consists of over 9,000 glass vials of specimens representing approximately 1,200 different species of insects. The alcohol (ethanol) collection contains soft-bodied specimens which are unable to be pinned.

5.1.3 Research and education values of the collection

The Plant Pathology Herbarium has Australia's largest collection of plant pathogens found in tropical and subtropical regions. Staff working in this collection identify and classify new and emerging plant pathogens, validate molecular methods used in nationally endorsed diagnostic protocols, develop multi-access interactive identification keys, develop training courses and run workshops for particular groups of plant pathogens.

The Insect Collection is a valuable resource of specimens for entomological research. Each year hundreds of specimens are lent to taxonomic experts in other institutions, both in Australia and overseas. As entomologists develop insect management systems for Queensland crops with reduced reliance on chemicals and increased use of alternative control measures, the importance of the collection has increased. In adopting Integrated Pest Management practices, all insects in crop systems must be studied and identified as either pest or beneficial. The taxonomist and the field entomologist work together to provide the answers.

5.1.4 Collection contact persons

The Plant Pathology Herbarium and Insect Collection are managed by Biosecurity Queensland, DAF. Staff working in the collections are aligned to the Plant Biosecurity and Product Integrity program. The Collections are co-located at the Ecosciences Precinct, 41 Boggo Road, Dutton Park, Brisbane. Key contact persons for the collections can be found on the DAF Biological Collections website (collections.daff.qld.gov.au/web/contact).

5.2 Standards for maintaining the collection

The Collections have specific standards for accessioning, curation and maintenance of specimens, environmental controls, pest management and auditing. The purpose of these standards is to minimise specimen deterioration, thereby ensuring the collections remain valuable in the future.

5.2.1 Accessioning

The Collections impose certain standards when accessioning new material. Specimens must be of suitable quality, preserved properly, free of dirt, insect pests and mould. Specimens must be accompanied by appropriate collection data and collection permits if required. Further details can be found in the [Accessioning Procedure](#).

5.2.2 Curation and preservation

The Collections have a responsibility to curate and maintain specimens indefinitely. To achieve this, collection staff have adopted best practice conservation methods from natural history museums and herbaria throughout Australia. Wherever possible, archival quality paper and card stocks are used for specimen packaging and labels. Other safe enclosures, such as polypropylene containers, are used to store larger specimens.

Plant Pathology Herbarium (BRIP)

The collection comprises two parts, the herbarium where dead, dried and pressed specimens are kept in packets, and a culture collection where living cultures are preserved

in a metabolically inactive state by a variety of methods including water, lyophilisation (freeze dried) and ultra-low temperature storage (-80°C).

Insect Collection (QDPC)

Pinned specimens are stored in unit trays, which are shallow cardboard boxes with a foam base to hold the pins. Each species has its own tray (or trays), separating it from other species. This system facilitates easier handling of specimens and greatly reduces the risk of damage to irreplaceable reference specimens. Depending on the mounting medium used for microscope slides, they may be stored either vertically or horizontally. Alcohol specimen tubes have been packed with cotton wool and bulked into large glass jars for ease of maintenance, as these specimens are rarely accessed.

5.2.3 Collection security and access

Collection managers and collection staff are responsible for maintaining access and security of the Insect Collection and Plant Pathology Herbarium. Collection staff have access to the collections 24 hours per day, 7 days per week. All other nominated staff including research associates, visitors and volunteers have access to the collections from 6 am to 6 pm Monday to Friday.

5.2.4 Environmental controls and fire protection system

Environmental control (low temperature and low humidity) is critical for the preservation of specimens in the collections. Monitoring of environmental conditions is carried out by DAF Facility Managers and collection staff.

Collection storage rooms at the Ecosciences Precinct are protected by a fire suppression system, that when activated, discharges an inert gas mixture consisting of an equal mix of argon and nitrogen. This gas displaces oxygen from the room to a level that will not support combustion. The use of an inert gas protects specimens against potential water damage that could occur with traditional sprinkler systems.

5.2.5 Pest management

In the past, pest management practices have involved the use of chemicals, e.g. naphthalene. Workplace health and safety concerns have led to a change in pest management practices. Pest management is now achieved via an integrated approach including exclusion, environmental controls, monitoring and temperature treatment. The main pest management issues for the Plant Pathology Herbarium and the Insect Collection are psocids, mites and carpet beetles, which are addressed in the [Pest Management Procedure](#).

5.2.6 Auditing and verification

Given the size of the Collections, traditional stocktake methods for auditing and verification are impractical. Random specimens are therefore selected from both the Plant Pathology Herbarium and the Insect Collection for verification of location and assessment of specimen condition. The accuracy of information recorded in the Collection Management System is also compared with label data attached to specimens. Specimen condition and location checks are conducted annually.

Valuations are not currently conducted by the Collections, though if required, it is likely the methodology used by the Queensland Museum would be followed, whereby the fair value of specimens is assessed as the cost of recollection, accessioning, identification, curation and storage.

5.3 Standards for information recorded about the collection

Information about the Insect Collection and Plant Pathology Herbarium are made available on the DAF Biological Collections website (collections.daff.qld.gov.au), including key contact persons, addresses for specimen submissions and loan returns. Other resources are also made available for research and educational purposes, including taxonomic keys.

Computerisation of plant disease records and insect specimens began in the early 1990s on two separate databases. Data capture and validation was enhanced during the early 2000s when both collections participated in the Australian Plant Pest Database (APPD) project. In 2009, all specimen record data was integrated into one Collection Management System.

5.3.1 Collection Management System

The Collections use KE EMu® (Electronic Museum) software for the capture and management of specimen records. This database is licenced and supported by Axiell ALM and is compliant with the following standards:

- Spectrum – standard procedures for documenting museum objects and the processes they undergo.
- Dublin Core – standard terms that can be used to describe web resources (video, images, web pages).
- Darwin Core – an extension of Dublin Core for biodiversity informatics.

The database currently holds over 280,000 catalogue records. Its functionality includes (but is not limited to) processes that assist with accessioning specimens, changes in taxonomy, managing incoming and outgoing loans, tracking internal and external movements and specimen locations, managing associated multimedia and references.

The catalogue is the main module of the database and has tailored to meet the specific needs of the Plant Pathology Herbarium and Insect Collection. The catalogue stores information about each specimen in the collection, including the pest or pathogen scientific name, host plant scientific name, date of collection, collector name, collection locality, determiner and date of identification.

Minimum and mandatory data record requirements are detailed in the [Accessioning Procedure](#).

5.4 Standards for improving public access

The Collections are committed to providing public access by digitising specimens and providing this information in real-time via the internet. Research associates and visitors are also welcome to access the physical specimens held in the Plant Pathology Herbarium and Insect Collection by prior arrangement with the Curator or relevant Collection Managers. Approvals for access to the collection and examination of specimens are coordinated and endorsed by the Curator or Collection Managers.

5.4.1 Volunteers, visitors and students

DAF encourages the temporary engagement of work experience students and volunteers. Visiting scientists and research associates are also welcomed. In all cases, approval must be sought from the appropriate human resources delegate for the business group. A contract template must be completed, i.e. Work Experience Agreement, Visitor Agreement or Volunteer Deed, and site inductions carried out. All relevant documentation can be located on the DAF Intranet.

5.4.2 Loans

Loans of specimens from the Plant Pathology Herbarium and Insect Collection are an integral part of providing public access to the collections. Loans are encouraged to provide broad taxon coverage to underpin research and diagnostics. All loans will be conducted according to the [Loans Procedure](#).

5.4.3 Cultures

The Plant Pathology Herbarium is able to provide living cultures for research and commercial purposes. Unlike loaned specimens, gifted cultures are classed as derivatives, with capacity for regeneration and renewal. As such, cultures are not expected to be returned.

Generally there will be no charge for the provision of cultures if they are requested by DAF staff or scientists/researchers from external agencies who are engaged in non-commercial activities. The purpose of the cultures must be consistent with the interests of the Plant Pathology Herbarium, and will be subject to DAF's capacity to resource the culture request. The Collections reserve the right not to provide cultures.

5.4.4 Intellectual property, confidentiality and rights

Generally, biological specimens and information about them are not bound by copyright, though associated images captured by persons other than DAF employees may be copyright. In these cases, collection managers will use due diligence to record information about the rights holder for imagery held by the Collections.

The confidentiality and privacy of persons and locality data in the Collection Management System is handled on a case by case basis. The Collection Management System also has mechanisms to prevent sensitive information from being released publicly. No specimen data is released publicly without validation by the curator or collection managers.

With respect to the *Biodiscovery Act 2014* and the Nagoya Protocol, which establishes procedures for the 'fair and equitable sharing of benefits' arising from the utilisation of genetic resources. The Collections require Material Transfer Agreements (MTAs) with collaborators and researchers wishing to access specimens in the Insect Collection and Plant Pathology Herbarium, particularly living cultures. The MTAs define the rights of the collection and the collaborator/researcher to the specimens.

5.4.5 Open and accessible data

The Collections provide free and open access to the public information relating to specimens collected in Queensland, where possible, and not limited by legislation, individual privacy, confidentiality or intellectual property. This also applies to images and associated documentation.

Specimen information for insect pests and plant diseases recorded in Queensland is currently made available to the public via the DAF Biological Collections website (collections.daff.qld.gov.au).

The Collections also share over 140,000 specimen records to the APPD portal (appd.ala.org.au) within the Atlas of Living Australia (ALA). As information in this database is sensitive, access is restricted and administered by Plant Health Australia (PHA). More details and access guidelines can be found on the PHA website (www.planthealthaustralia.com.au/resources/australian-plant-pest-database)

Information about living cultures in the Plant Pathology Herbarium are shared with the publically accessible Australian Microbial Resource Information Network (AMRIN) (amrin.ala.org.au) within the ALA.

The Collections also plan to share raw data in machine-readable open formats (e.g. CSV) with the Queensland Government Open Data Portal (data.qld.gov.au).

5.5 Curation and use of the collection

5.5.1 Staff associated with the collection

The Collections currently have 2.5 FTE (full-time equivalent) staff. The organisational structure currently comprises line management streams aligned to each discipline, entomology and plant pathology, with additional staff time allocations in molecular biology and information systems.

Collections staffing levels are as follows:

- Principal Plant Pathologist (Curator) – 1.0
- Senior Research Scientist – 0.5
- Molecular Biologist - 0.25
- Senior Entomologist – 0.5
- Technical Officer (Insect Collection) – 0.25

5.5.2 Users of the collection and linkages

The Collections respond to a variety of information requests. Internal requests are from research staff and extension officers in Plant Biosecurity & Product Integrity, Biosecurity Operations and Agri-Science Queensland. External requests are from universities, Cooperative Research Centres, industry, other state government agencies and international collaborators.

The Plant Pathology Herbarium and Insect Collection support university student (both undergraduate and PhD) research projects. Collections staff also collaborate with

scientists nationally and internationally on taxonomic projects. Research findings are published in Australian and international peer-reviewed scientific journals.

5.5.3 Application of modern techniques

Modern techniques such as DNA sequencing and molecular phylogenetic analyses are used to classify and identify specimens, e.g. resolution of the *Colletotrichum* and *Diaporthe* species complexes. Research also involves the investigation of new molecular techniques for the detection and diagnosis of plant pests and diseases.

5.5.4 Training and expertise

Collections staff working in the Plant Pathology Herbarium and Insect Collection provide training for DAF scientists and external clients. Areas of expertise in insect taxonomy include Coleoptera, Diptera and Thysanoptera. Similarly, the Plant Pathology Herbarium has run training courses in Ustilaginomycetes, Pucciniomycetes and plant pathogenic Ascomycetes. The Plant Pathology Herbarium was previously commissioned to produce a reference book for the management of plant pathogen collections in South-east Asia (Shivas and Beasley, 2005).

5.6 Processes for budgeting for curation

Budgeting for the Collections is managed through the Plant Biosecurity and Product Integrity subprogram within Biosecurity Queensland. Base funding is provided for 2.5 FTE staff, software licences, depreciation on capital equipment (including microscopes, centrifuges, PCR machines, ultra-low temperature freezers) and consumables. New or replacement scientific equipment is procured through the DAF capital funding programs as needed each financial year.

Building utilities including power, water and gas are predominately funded by DAF Research Infrastructure. However, power consumption by equipment such as ultra-low temperature freezers and autoclaves is monitored, and the associated costs are passed onto the collections.

The Collections have access to the following purpose built laboratories:

- Plant Pathology Herbarium (room 2.C.403, 39 m², specimen storage)
- Insect Collection (room 2.C.404, 140 m², specimen storage)
shared 80:10:5 with Biosecurity Queensland program Invasive Plants and Animals, and CSIRO Tropical Weeds Management Research Group
- Alcohol Collection (room 2.C.406, 22 m², specimen storage)
shared 50:50 with CSIRO Tropical Weeds Management Research Group
- Collections Laboratory (room 2.C.405, 65 m², curatorial workspace)
- Dry Store (room 2.C.427, 20 m², consumables storage)

5.7 Deaccessioning

Generally the Insect Collection and Plant Pathology Herbarium collect and maintain specimens in perpetuity. However, it is sometimes necessary to de-accession specimens to curate and manage the collections. In such cases the Deaccessioning Procedure determines the process. Deaccessioning requires prior approval by the Curator.

6 Responsibilities and accountabilities

The Minister for the Department of Agriculture and Fisheries is ultimately responsible for the Collections. The Chief Biosecurity Officer and the General Manager of Plant Biosecurity and Product Integrity, are responsible for ensuring that collection policies and procedures are developed and implemented. Collection managers are responsible for managing the collections and providing access, ensuring that anyone who works within the Plant Pathology Herbarium and Insect Collection are aware of collection policies and procedures. Staff and volunteers are required to follow these procedures in a consistent manner.

Curator	Manage the collections and disseminate research and knowledge about the collections. Ensure the accuracy of data captured into the Collection Management System Approve outgoing loans.
Collection managers	Manage and curate the collections through appropriate storage, handling and environmental conditions. Providing access to Collection staff, research associates, visitors and volunteers. Carry out routine maintenance and integrated pest management to protect collection specimens from deterioration.
Collection staff	Apply excellent science to the taxonomy and preservation of both living and dried specimens. Ensure that research associates, visitors and volunteers are made aware of collection procedures.
Research associates, visitors and volunteers	Follow collection procedures as directed by Collection managers and/or Collection staff.

7 Source documentation

Not applicable.

8 Related and reference documents

Shivas RG, Beasley DR (2005) Management of Plant Pathogen Collections. Australian Government Department of Agriculture, Fisheries and Forestry. Canberra ACT.

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