

# Queensland Herbarium

—documenting nature





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Front cover top: *Acacia wickhami*, Petford area in the Einasleigh Uplands |

© Photo KR McDonald

Front cover bottom: Snappy gum woodland in the Lawn Hill area of the Northwest Highlands | Photo Dan Kelman, Queensland Herbarium © State of Queensland

Inside front cover: *Sesbania sp.* fringing flood plain, Lake Constance, Diamantina National Park, Central Western Queensland | Photo Bruce Wilson

© State of Queensland

Inside back cover: *Diporiphora nobbi*, Nobbi Dragon, Desert Uplands, Central Western Queensland | Photo Annie Kelly, Queensland Herbarium © State of Queensland

Back cover top: A common bluetail damselfly, *Ischnura heterosticta*, Lake Nuga Nuga National Park, Arcadia Valley, western Queensland | Photo Dan Ferguson, Queensland Herbarium © State of Queensland

Back cover bottom: Palustrine wetland near South Yaamba (Rockhampton) in the Brigalow Belt bioregion | Photo Christopher Pennay, Queensland Herbarium © State of Queensland

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# Contents

<b>About the Queensland Herbarium</b> .....	<b>4</b>
Our science .....	6
Our highpoints 2014 .....	10
Our priorities .....	12
<b>Customers first</b> .....	<b>14</b>
Partnerships for outcomes .....	15
Providing information and expertise: Botanical Information and Advisory Services .....	17
<b>Advancing our collection</b> .....	<b>20</b>
Our partners .....	23
<b>Discovering new species</b> .....	<b>25</b>
Our partners .....	27
Fungi: the unexplored kingdom .....	28
<b>Understanding the ecological processes</b> .....	<b>29</b>
Our partners .....	32
Is it possible to restore an endangered ecosystem? .....	33
<b>Surveying and mapping our ecosystems</b> .....	<b>35</b>
Our partners .....	37
<b>Protecting our plants, animals and their habitats</b> .....	<b>41</b>
Our partners .....	44
Profile of a threatened species .....	45
<b>Publications 2013 and 2014</b> .....	<b>46</b>



## About the Queensland Herbarium

The Queensland Herbarium was established in 1859 and is the state's first and oldest scientific institution.

As part of the Queensland Department of Science Information Technology and Innovation (DSITI) the Herbarium is central to the research, identification and dissemination of information on Queensland's plants, fungi, algae and animals, and the ecosystems they inhabit.

*Grevillea robusta*, silky oak, South-East Queensland  
Photo Gordon Guymier  
Queensland Herbarium  
© State of Queensland



Queensland Herbarium  
Mount Coot-tha, Brisbane  
Photo John Neldner  
Queensland Herbarium  
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Queensland Herbarium scientists study the state's flora, fauna, ecosystems, and ecological processes and provide scientific knowledge to governments, businesses and individuals. Botanists and members of the public contribute thousands of plant specimens to the Herbarium collection each year, identifying new species and adding new distribution records of both native and naturalised plant species.

Ecological and biogeographical research provides essential information needed for the conservation assessment and management of Queensland's species and ecosystems. Research into a variety of vegetation communities is helping us to better understand ecological processes and the environmental services provided by ecosystems and wildlife.

The Queensland Herbarium is located at the Brisbane Botanic Gardens Mt Coot-tha and also is a partner in the Australian Tropical Herbarium in Cairns.



## Our science

The Herbarium's research is vital for:

- discovering, improving and disseminating Queensland's botanical, faunal and ecosystem knowledge
- actively monitoring the extent and condition of Queensland's species and ecosystems for regional planning and conservation management
- documenting and assessing vegetation and wildlife, including ecological processes and threats.

Our science supports a wide range of biodiversity services essential to planning, land management, biosecurity, agriculture, health, mining, and forensic science. The Herbarium's specimen collection of plants, algae and fungi is a core data source used for species discovery, and knowledge of species for conservation planning, weed control, agriculture, ethnobotany, ecology, evolutionary studies, education and forensics.





In addition to managing our collection, discovering new flora, and evaluating species and populations, a key part of the Queensland Government's responsibilities is surveying and mapping Queensland's regional ecosystems. This detailed work contributes to local, regional and national conservation and land use assessments, planning, and the application of Queensland legislation.

As well as mapping regional ecosystems the Herbarium is also Queensland's lead agency for mapping wetlands and, most recently, groundwater dependent ecosystems. The identification and mapping of groundwater dependent ecosystems is providing scientific information to assist Australian governments assess the impacts of coal and coal seam gas (CSG) mining on groundwater dependent ecosystems.

Pandanus Station waterhole in Far North Queensland, part of the Gulf Plains Bioregion, one of Queensland's 13 bioregions being mapped by the Queensland Herbarium  
Photo Chris Appelman  
Queensland Herbarium  
© State of Queensland

Our partnerships ensure that our vision of a Queensland where everyone values biodiversity and the environment is supported by scientific excellence and research that delivers outcomes. The expertise and collaboration through these relationships is helping conserve and enhance the flora and fauna of Queensland's environment.

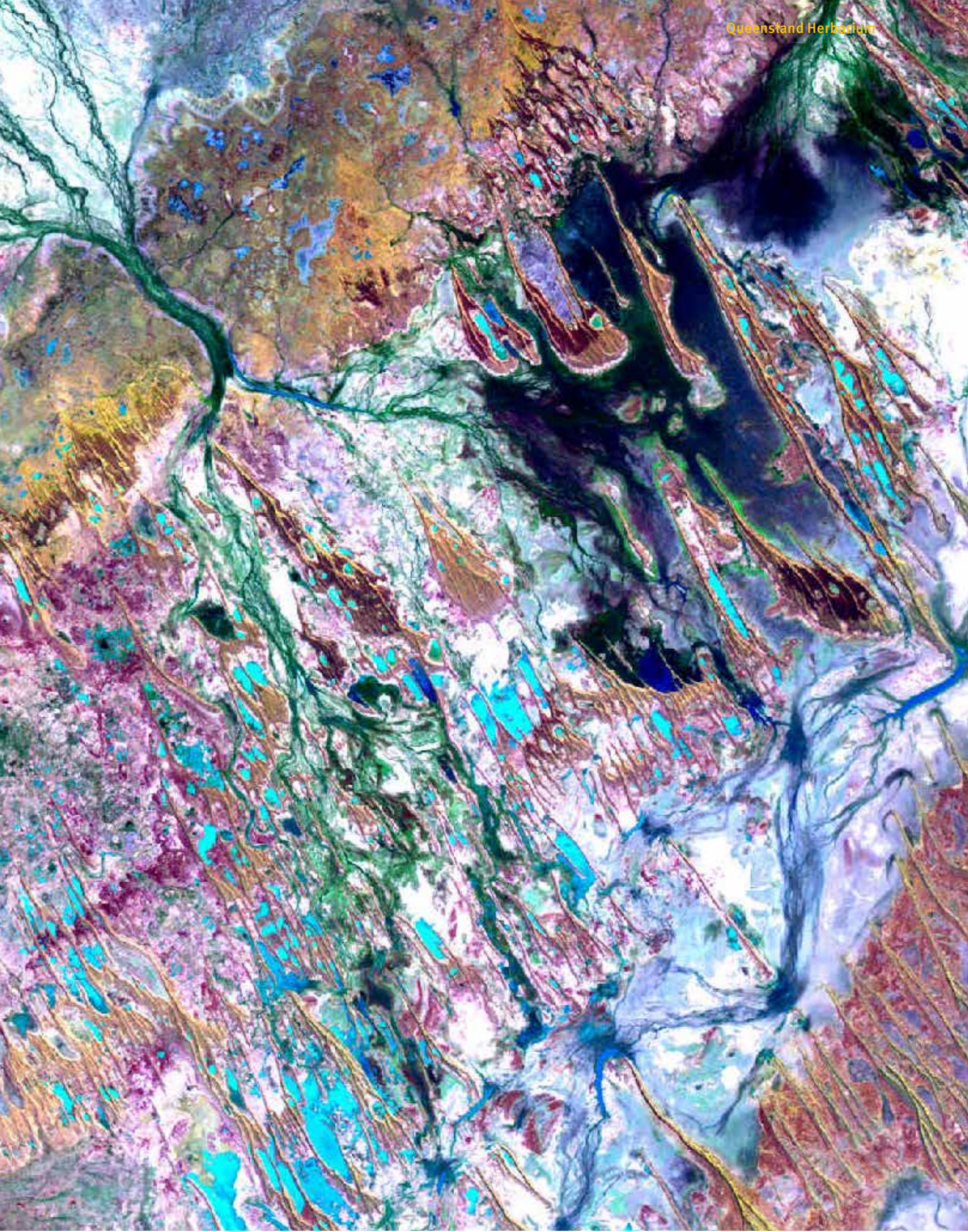
Applying science to meet real business needs is ensuring that our research is delivering on-the-ground benefits. For example our collaboration with the University of the Sunshine Coast contributed to the creation of DNA barcodes for the 870 species of south-east Queensland's rainforest trees, shrubs, vines and herbs which will help discriminate between closely-related species of plants. This study highlights the uniqueness of these rainforests, and how they are related to other areas of rainforest, along with providing a library of barcodes for rapid identification.

DNA barcodes will help quarantine officers, forensic investigators, land owners and others who need to quickly and accurately identify unknown plants and plant parts that may be poisonous, prohibited or legally protected.

Right: Landsat TM image  
Diamantina National Park, Channel  
Country. Palustrine wetlands and  
isolated dunes on the outer edges of the  
Diamantina River flood plain  
South-West Queensland  
Image Queensland Herbarium  
© State of Queensland

Below: Eroded dune on Cooper Creek  
flood plain, south of Windorah, Channel  
Country, South-West Queensland. This  
landscape is located in the general area  
of the top corner of the Landsat image  
(opposite)  
Photo Bruce Wilson  
© State of Queensland





## Our highpoints 2014




- 25 plant species new to science were formally described in the 2014 issue of Queensland Herbarium journal *Austrobaileya*
- 8,000 additional specimens and associated data of priority species incorporated into the collections and databases
- 58 new Queensland weed incursions detected and reported
- 47 new fungi species recorded for Queensland
- 20 plant species were assessed for their conservation status
- 4 fauna species were assessed for environmental protection
- *Census of the Queensland Flora 2014* was published on Queensland's Open Data Portal
- 7,500 plant identifications made for customers
- over 3000 information enquiries

*Opuntia* flower, prickly pear,  
Central Queensland  
Photo Paul Forster,  
Queensland Herbarium  
© State of Queensland



- over 50,000 maps provided to online clients
- 50 publications and reports published
- 41 peer-reviewed journal articles published
- 93 regional ecosystem benchmark documents were published for the assessment of vegetation condition in the Desert Uplands and Northern Brigalow Belt bioregions
- publication of the landmark *Vegetation of Queensland* by the Queensland Herbarium. Complimenting Queensland's regional ecosystem framework, this publication provides the first comprehensive overview of the vegetation in the state
- online access from the Biota Globe to Queensland's broad vegetation groups down to the property scale (pre-clearing and remnant)
- 8,317 type specimen images posted and available on JSTOR
- release of the *Native Forest Regrowth Benefit Information System* on the Queensland Government website. This calculator provides information on site suitability for regrowing native forest and the potential for carbon credits
- publication of six regrowth management guidelines to assist land managers undertaking carbon abatement projects involving native forest regrowth
- publication of the *Terrestrial Vertebrate Fauna Survey Guidelines* and datasheets for a select number of species of conservation concern
- commenced groundwater dependent ecosystem assessments for the Galilee and Cooper sub-basins of the Lake Eyre Basin to input to the Commonwealth's Bioregional Assessment Programme
- hosted the 41<sup>st</sup> meeting of the Council of Heads of Australasian Herbaria



Restoration planting with fauna boxes on poles, Netherleigh, Central Queensland.  
Photo Queensland Herbarium  
© State of Queensland



## Our priorities

The Queensland Herbarium's scientific research and information provision focuses on flora, fauna, and vegetation communities.



Top: Helicopter-based surveys were conducted 2010–13 in remote habitats of the Hann Tablelands, including ephemeral flush wetlands  
North Queensland  
Photo Mike Mathieson  
Queensland Herbarium  
© State of Queensland



Middle: A tropical pitcher plant, *Nepenthes mirabilis*, from the coastal wet tropics, Queensland  
Photo Mike Mathieson  
Queensland Herbarium  
© State of Queensland

*Rufous bettong*, a species found present in habitat restoration plots of Netherleigh, part of the Awoonga Dam rehabilitation zone, south of Gladstone, South-East Queensland  
Photo Luke Hogan  
Queensland Herbarium  
© State of Queensland

## Customers first

Understanding and engaging with our stakeholders about their needs for botanical and ecological services ensures that we retain a customer focus and are pursuing the desired environmental outcomes for Queensland in a collaborative and innovative way.

## Advancing our collections

The Queensland Herbarium specimen collections and associated data are the principal resource for knowledge and information about the flora of the state. Herbarium botanists, collaborators, volunteers, and other stakeholders are improving the comprehensiveness, adequacy and representativeness of our collections.

## Discovering new species

Queensland has the most diverse flora and fauna of any state in Australia. Herbarium scientists are discovering and documenting dozens of new species each year.

## Understanding ecological processes

Research into the ecology of Queensland's landscapes helps us understand the impacts of factors such as fire, grazing, drought, development and climate variability to help us better manage our environment.

## Surveying, mapping and monitoring ecosystems

Ecosystem survey, mapping and monitoring is fundamental to knowledge of our state's environment, planning for sustainable development, and conservation of our biodiversity.

## Protecting our plants, animals and their habitats

Researching, assessing and monitoring our flora, fauna, and ecosystems is essential to determine their conservation status and to address threatening processes, such as weeds, pests and land clearing. This allows for development of conservation strategies to safeguard our biodiversity.



## Customers first

Understanding and engaging with our stakeholders about their needs for botanical and ecological services ensures that we retain a customer focus and are pursuing the desired environmental outcomes for Queensland in a collaborative and innovative way.

Broad-leaved hickory, *Acacia falciformis*,  
Lonesome National Park—part of the  
Central Queensland sandstone belt  
Photo Melanie Venz  
Queensland Herbarium  
© State of Queensland



## Partnerships for outcomes

The Queensland Herbarium is committed to providing the best available information to businesses, government and the public. Our partnerships and volunteers provide valuable support in assisting us to achieve this goal.

The Queensland Herbarium has successfully collaborated, over many decades, with universities, international organisations, natural resource management organisations, and government and non-government bodies to achieve biodiversity discovery, innovation and improved environmental outcomes.

Our current research partners include:

- Queensland Department of Environment and Heritage Protection
- Queensland Department of Agriculture and Fisheries
- Queensland Department of Natural Resources and Mines
- Queensland Department of National Parks, Sport and Racing
- Queensland Museum
- Australian Tropical Herbarium
- Queensland Natural Resource Management Regional Bodies
- State and Commonwealth scientific advisory committees
- Other Herbaria, Australian and international
- Australian universities
- Queensland businesses
- Community groups and other non-government organisations
- Local governments
- Australian Government
- CSIRO
- Council of Heads of Australian Herbaria
- New York Botanical Gardens
- Chinese Academy of Sciences
- Atlas of Living Australia

New collaborative projects include how species vary across the landscape, how they are related to other species, how they reproduce, the effect of fragmentation, fire and weeds on ecosystems, mapping and assessment of groundwater dependent ecosystems, and carbon stores in native vegetation.

Our achievements have been made possible through the dedication, passion and commitment of our staff, volunteers, research associates and students. Their contribution is gratefully acknowledged.

The Northwest Highlands is a bioregion characterised by the spectacular exposure of ancient rock. This escarpment is at the edge of a sandstone plateau that is 1.5 billion years old. (There are 13 bioregions in Queensland—see p 35.)

Photo Dan Kelman  
Queensland Herbarium  
© State of Queensland





Hudson Pear, *Cylindropuntia rosea*, is an invasive cactus and is classified as a B Class 1 declared species in Queensland and is a weed of national significance (WONS)  
Photo Department of Agriculture and Fisheries  
© State of Queensland

## Providing information and expertise: Botanical Information and Advisory Services

The Queensland Herbarium is committed to disseminating knowledge of Queensland's flora, fauna and ecosystems. A comprehensive information and advisory service is provided for customers, including plant identification. Detailed plant specimen, species information and vegetation data are available from the Herbarium's databases and online sources, including information on species distribution, ecology, toxicity, weeds, and conservation status.

Botanical information is used by:

- governments, landowners and businesses to help with planning, management and conservation
- legal investigators for use in compliance cases including forensic evidence
- researchers to find out about local native flora species and ecosystems that support wildlife
- individuals to find out about what plants are poisonous, native, weedy or threatened.



Freehand traverse section of fresh leaf of *Panicum pygmaeum* showing unique vascular bundle configuration  
© Photo John Thompson

Demand for biodiversity services by governments, business, universities and the community is high. The Queensland Herbarium supports over 4,000 clients per year. This covers identification of specimens (~8,000 specimens for the public, business and government), regional ecosystem maps (~50,000 per year) and information through the Queensland Government's Open Data portal and Queensland's Biota Globe. Information and statistics on our most threatened species and their habitats is also available through Queensland Government's Wildlife Online, Australia's Virtual Herbarium, and Atlas of Living Australia.

In addition the Queensland Herbarium plays a vital role in providing expert witness services in legal cases involving government compliance or forensic identification such as the high-profile Baden–Clay murder investigation in 2014. The Herbarium is also a key contact for information and advice about poisonous plants.

As a centre dedicated to botanical and ecosystem research the Herbarium is an active partner in state, national and global research, with over 50 papers published each year.

Technical manuals, management guidelines, reports and datasets for species, ecosystems, vegetation and fauna, are also available through the Queensland Herbarium website, Queensland Government's Publication Portal, Open Data, and the Biota Globe.

The Biota Globe [data.qld.gov.au/maps-geospatial/qld-globe](http://data.qld.gov.au/maps-geospatial/qld-globe) is one of several category globes of the Queensland Globe which displays Queensland Herbarium spatial datasets relating to bioregions, vegetation and ecosystems, and other biodiversity datasets.

Weeds endanger biodiversity, impact agriculture and in some cases, human and animal health. The cost of weeds to Australian agriculture alone now exceeds \$4 billion per year.

The Queensland Herbarium in collaboration with Biosecurity Queensland (Department of Agriculture and Fisheries) has established the Weed Spotters' Network Queensland. The network focuses on early detection of new and emerging weeds through harnessing and fostering community interest and knowledge of invasive plants. For example, species like rubber vine in North Queensland have the potential to substantially alter entire native ecosystems by threatening native animals as well as plant species.

There are currently 1304 non-native plant species (13.5 per cent of the flora) in Queensland, increasing at a rate of around 10 new weeds becoming established each year. More than 80 of these are already declared weeds and many more have potential to become serious pests. Preventing new weeds from becoming established in the first place is our best defence against invasive species.

Weed spotters collect and identify new weeds in their local region with assistance from their regional coordinators and the Queensland Herbarium. Network members also provide location data on where weeds occur, leading to a better understanding of how far and how quickly they are spreading. This information is crucial for developing early response strategies and for the ongoing control and containment of weeds.

The Weed Spotters' Network trains and supports over 1000 members and 21 regional coordinators. In 2014, the network reported 58 new records of declared weeds.



Limnocharis (*Limnocharis flava*) is a class 1 pest plant. Infestations have been detected in backyard ponds, ornamental lakes, farm drains and natural waterways. Photo Department of Agriculture and Fisheries ©State of Queensland

Kudzu vine (*Pueraria montana* var. *lobata*) is a class 2 pest plant. Kudzu grows rapidly—reaching 20–30 m in length. Kudzu runners can grow 30 cm a day in summer. Photo Department of Agriculture and Fisheries ©State of Queensland



## Advancing our collection

The Queensland Herbarium specimen collections are the principal knowledge and information resource for the state's flora and comprise over 830,000 specimens.

*Commersonia* sp. A new species of  
*Commersonia* from open eucalypt forest  
in the Burnett District  
Photo Gordon Guymmer  
Queensland Herbarium  
© State of Queensland



The Queensland Herbarium specimen collections and associated data form the basis for research and knowledge on the state's flora. The specimen collections are a unique record of the state's changing flora and comprise over 830,000 individual specimens, each with their own location and habitat information. The Herbarium's collection contains historically important specimens, such as the first Queensland plant specimens collected by Sir Joseph Banks and Dr Daniel Solander, the botanists who accompanied Captain James Cook in 1770.

This world class repository of specimens is actively used by staff, volunteers and researchers and thousands of quality specimens are added to the collection each year.

The Queensland Herbarium's research collaborations extend nationally and internationally. Recently, a world-wide study on the brake ferns (*Pteris*) was completed, with specimens sourced from every continent in the world except Antarctica. The study resulted in 15 distinct lineages identified, with the related endemic *Platyzoma* embedded amongst the *Pteris* in the resulting classification.

Clarabelle flame tree, *Brachychiton x vinicolor*, a beautiful tree that occurs as a natural hybrid between *B. acerifolius* and *B. discolor* in north eastern New South Wales and south eastern Queensland. It is now being grown as an ornamental  
Photo Gordon Guymier  
Queensland Herbarium  
© State of Queensland



Public access to this essential botanical resource is continuously improving. For example, specimen label data of all plant specimens held by the Herbarium are recorded on the HERBRECS database. HERBRECS data is accessible through Australia's Virtual Herbarium, the Atlas of Living Australia, and the Global Biodiversity Information Facility.

The annual Census of the Queensland Flora provides an authoritative published list of all known Queensland species of plants, algae, fungi and lichens, and is available on Queensland's Open Data Portal. Images of our representative (Type) specimens have been scanned for inclusion in the Global Plant Initiative, available on JSTOR. Type specimens govern the application of scientific names under the International Code of Nomenclature for algae, fungi and plants.

Left: A specimen of *Lomandra banksii* collected by Banks and Solander from the Endeavour River area during Cook's voyage, 1770  
Photo scan Queensland Herbarium  
© State of Queensland

Right: A Type specimen of *Homoranthus tricolor*, a new species collected near Mundubbera, Burnett district of Queensland  
Photo Queensland Herbarium  
© State of Queensland







## Our partners

The Queensland Herbarium is the state's principal repository for flora specimens and information and works in partnership with other state and national herbaria through the Council of Heads of Australasian Herbaria, and with other recognised international herbaria that are contributing to our knowledge of Queensland's biodiversity.

Many cooperative projects exist, including Australia's Virtual Herbarium, the Atlas of Living Australia, and the Australian Plant Census which provides common nomenclatural information through the Australian Plant Name Index.

Identification keys to the Queensland flora are hosted by KeyBase, an national online portal linked to the Atlas of Living Australia.

The Global Plants Initiative captures images of representative (type) specimens from herbaria around the world, greatly facilitating taxonomic work and the correct application of names.

The Queensland Herbarium is a partner in this project along with other state herbaria. The Queensland Herbarium is joint partner in the Australian Tropical Herbarium (ATH) in Cairns, along with James Cook University and CSIRO.

The Tropical Indigenous Ethnobotany Centre is an exciting new project capturing Aboriginal and Torres Strait Islander plant knowledge, and coordinated by Queensland Herbarium staff as part of the ATH partnership.



*Boletellus deceptivus* is a woodland fungus photographed at Ravensbourne National Park, South-East Queensland  
© Photo Roy Halling

Other partnerships include collaborations with the New York Botanic Garden for fungi discovery in Queensland and others researching Queensland's cycads, ferns, grasses and legumes.

Areas of the state that are remote or difficult to access are priority targets for enhancing our specimen collections and improving our knowledge of Queensland's flora. In May 2014, collaboration between the Queensland Herbarium and the Queensland Department of Aboriginal and Torres Strait Islander Partnerships enabled a helicopter expedition to the remote Orchid Creek Station on Cape York Peninsula. The purpose of the expedition was to document the flora of several previously unsurveyed sandstone and granite ranges and assess the area for its natural values.

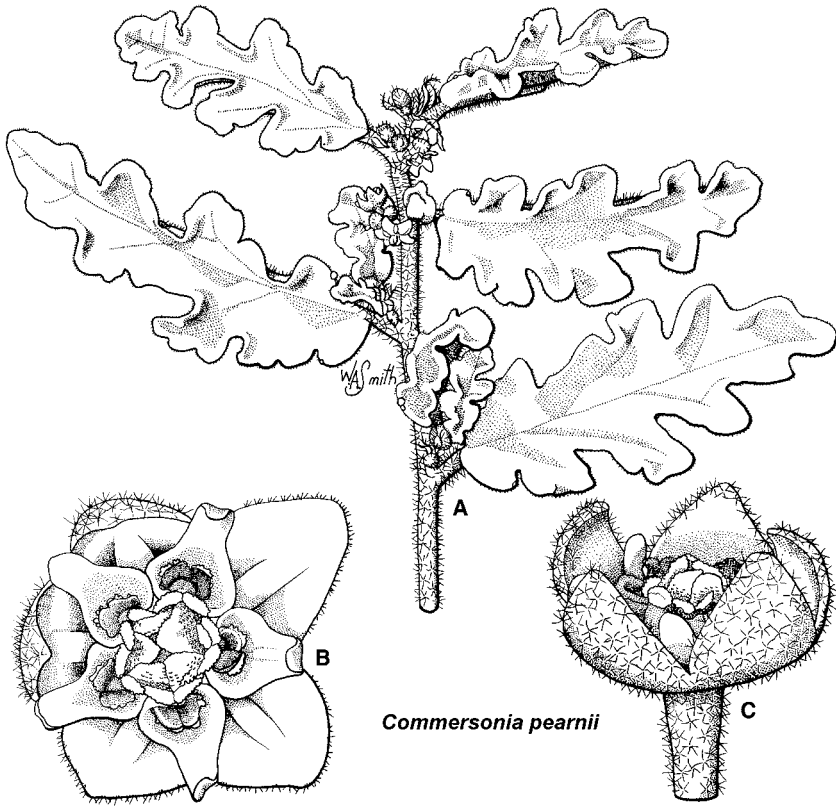
The sandstones of this area are characterised by steep hill faces and cliffs and have a distinctive flora. The granite ranges contain diverse areas of rainforest related to those found in the Iron and McIlwraith Ranges of Cape York Peninsula. More than 400 plant specimens were collected on the expedition, including new collections of five plant species currently listed as *Vulnerable* under the Queensland *Nature Conservation Act 1992*. A significant find for the expedition included the first record for this area of the Cooktown orchid, *Dendrobium bigibbum*, Queensland's state floral emblem.



## Discovering new species

New plant species are being discovered by Queensland Herbarium scientists and enthusiasts at a rate of around 50 species every year. In 2014, botanists formally described 25 new plant species for Queensland.

*Plectranthus geminatus* is a new species of cocksbur (family *Lamiaceae*) recently discovered in Lamington National Park, South-East Queensland. It was first described by Paul Forster, Queensland Herbarium, in 2014  
© Photo Glenn Leiper



Left: *Commersonia pearnii*.  
 A. flowering branchlet x 1.5  
 B. flower x 16  
 C. opening bud x 16  
 Illustration Will Smith  
 Queensland Herbarium  
 © State of Queensland

Below: *Commersonia pearnii* occurs  
 in open-forest and grows to a metre in  
 height. It grows on sandstone tablelands  
 only in Blackdown Tableland National  
 Park, Central Queensland  
 Photo Paul Forster  
 Queensland Herbarium  
 © State of Queensland.



Key's boronia, *Boronia keysii*, is listed as vulnerable and is only known to occur in a small area east of Gympie, South-East Queensland. It flowers primarily from May to November  
 Painting Will Smith  
 Queensland Herbarium  
 © State of Queensland



Botanical illustration merges the two disciplines of art and science. It does this by providing detailed and scientifically accurate illustrations of new and revised plant, algae and fungi species to complement their scientific classifications, descriptions and identification tools (taxonomy).

Scientific illustration through a range of media is an important part of scientific communication and engagement. The Queensland Herbarium is helping to make sure that research findings are accessible to wider audiences.

## Our partners

The Queensland flora is the most diverse in Australia, with more than 14,000 native species already described, and many more yet to discover. Thirty per cent of the state's flowering plant species are endemic, known to occur only in Queensland.

In 2014, botanists formally described 25 new plant species for Queensland. These included wild tomatoes (*Solanum*), cockspurs (*Plectranthus*) and native ebonies (*Diospyros*). Many of the newly discovered species were published in the Queensland Herbarium's flagship journal *Austrobaileya*. Previous volumes of the journal are available from JSTOR.

The New York Botanic Gardens has been a major collaborator, with the Fraser Island (National Geographic) and Queensland Bolete (National Science Foundation) surveys aimed at discovering the wealth of macrofungi occurring in Queensland. This project has generated global interest in our fungi flora and an estimated 100 new species will be described as a result.



Yellow-footed polypore, *Microporus xanthopus*, Buderim Forest, South-East Queensland. This species occurs in wet sclerophyll forest and rainforest. Photo Megan Prance Queensland Herbarium © State of Queensland

## Fungi: the unexplored kingdom

Fungi are essential to life, occurring everywhere in large numbers, but are still poorly understood. Recent research into fungi has focused on their potential for bioremediation (use of biological organisms to solve an environmental problem) and as new sources of food, medicine and even fuel. Many ecosystem functions are reliant upon fungi: they are essential for breaking down organic materials, recycling nutrients and sequestering carbon. The majority of plant species in Australia rely on *mycorrhizal* associations (relationship with fungi) to survive in a low nutrient environment, and some animals, such as bettongs, utilise fungi for food.

Queensland's macrofungi remain largely undiscovered with only one tenth of estimated species documented. Discovery starts with finding the fruiting bodies (e.g. mushrooms) and collecting specimens, photographs and DNA samples, which are all linked through the Herbarium's specimen database HERBRECS.

Once the specimen is identified to genus and the DNA is sequenced, new species of fungi and new records for the state are then documented.

## Understanding ecological processes

The Queensland Herbarium is working with state and local organisations to monitor and protect our valuable ecosystems.

Chookie's waterhole, Doomadgee, Gulf Plains Bioregion, Gulf of Carpentaria, Queensland  
Photo Chris Appelman  
Queensland Herbarium  
© State of Queensland





Squirrel glider, *Petaurus norfolcensis*, is an arboreal mammal frequently encountered in both wet and dry sclerophyl woodlands and forests  
Photo Mike Mathieson  
Queensland Herbarium  
© State of Queensland

Scientific research is conducted across the state by the Herbarium to assess and monitor the condition and trend of ecosystems and biodiversity, including listed threatened ecological communities. In some cases this involves establishing permanent sites to monitor and analyse long term change. Detailed vegetation surveys, monitoring and assessment are undertaken by the Herbarium on:

- national parks and state forests
- vegetation offsets
- mangroves of South-East Queensland
- groundwater dependent ecosystems including wetlands (e.g. springs)
- grasslands
- grazing lands
- mining lands and tenements
- military reserves.

*BioCondition* (developed by the Queensland Herbarium) is a vegetation condition assessment tool which measures how well a terrestrial ecosystem is functioning for the maintenance of biodiversity values at a local or property scale. *BioCondition* is used by local governments, land managers, natural resource management groups and the Department of Defence, and in the state's offset policy.

Critical to the use of this *BioCondition* tool is the use of benchmarks. Benchmarks are specific to regional ecosystems (the state's mapped vegetation communities) and are the most practical method of objectively comparing condition for biodiversity within and between ecosystems.

Benchmarks are quantitative values for each attribute and are based on data from mature and long undisturbed 'reference' sites, or from best-on-offer sites. Benchmarks act as a 'yardstick' against which users can compare an assessment site, and describe features of the vegetation critical for wildlife.



In 2014, the Queensland Herbarium researched and published 93 Benchmarks for communities, largely in the Desert Uplands and Northern Brigalow Belt bioregions. The Galilee basin ecosystem benchmarking project was conducted as a joint initiative between the Queensland Herbarium, the Department of Environment and Heritage, and a collective of Galilee basin mining proponents who required benchmarks for ecological equivalency offset work. Projects such as this are critical in documenting our ecosystems in their natural state and providing understanding of the diversity and characteristics of the state's vegetation. Conservation objectives that aim to enhance vegetation in good condition are vital to the preservation of our varied and unique wildlife.

This information is used by landholders, industry, natural resource management groups, local authorities and state government for planning and land management.

Research into a variety of vegetation communities is helping us to understand ecological processes and the environmental roles provided by vegetation and wildlife.

Monitoring changes in ecosystems associated with natural and human induced changes, such as fire, clearing, development, grazing, weed invasion, and changes to our climate helps us to track changes in the condition of plant and animal communities. For example, the Queensland Herbarium is monitoring mangroves and related communities in Moreton Bay, documenting change in mangrove extent over the last 50 years. This project will assess the impacts of anthropogenic influence on the health of mangrove and inter-tidal communities.

Regrowing native vegetation can play an important role in the provision of habitat for biodiversity, salinity management and carbon accumulation.

In 2014, the Department of Environment and Heritage Protection released the Native Forest Regrowth Benefit Information System which was developed by DSITI scientists including the Queensland Herbarium. This system includes a mapping tool which provides



Mangrove site, Short Island  
Photo Megan Prace  
Queensland Herbarium  
© State of Queensland

site-specific advice for Queensland landholders about regrowth management, carbon sequestration potential and biodiversity co-benefits from forest regrowth. Six management guidelines have been developed to assist land managers undertake carbon abatement projects involving native forest regrowth.

## Our partners

The Queensland Herbarium works closely with other state government agencies, industry, councils and community organisations in modelling and monitoring the condition of various plant and animal communities. For example the Herbarium is working with the Department of Agriculture and Fisheries monitoring mangroves and related communities in Moreton Bay, as well as assessing the flora and fauna values of the offset areas near Awoonga Dam, south west of Gladstone.

All recreational activities, including horse riding, can generate impacts on national parks and must therefore be managed.

The impact of horse riders through protected areas in South-East Queensland is being assessed by the Herbarium in conjunction with Queensland National Parks, Sport and Racing, through the South-East Queensland Horsetrail Monitoring Program that includes more than 500 kilometres of trails within 29 reserves between Gympie and the state's southern border.

The Queensland Government has committed to a detailed scientific monitoring program that will operate over a 20-year period with regular points of review to monitor any potential impacts that result from horse riding on these areas.

Mine rehabilitation aims to minimise and mitigate the environmental effects of mining. CSIRO, Stanwell Corporation and the Herbarium have been monitoring and modelling the vegetation rehabilitation on the Meandu open-cut coal mine near Nanango. This project has involved monitoring the re-establishment of native vegetation across an area that has previously been mined and re-vegetated.

## Is it possible to restore an endangered ecosystem?

The Awoonga Dam is built across the Boyne River south west of Gladstone and in 2002 its wall was raised flooding an extra 150 hectares of endangered regional ecosystems. A revegetation project was initiated on the land adjacent to the dam, managed by the Gladstone Area Water Board.

The project involved revegetation at two sites (Netherleigh and Futter Creek) an area of 300 hectares. This work, conducted between 2002 and 2004 involved planting a mix of local provenance trees in areas that had been extensively cleared; and protecting and enhancing natural regeneration in areas where some mature trees remained.

After 10 years, 70 and 66 per cent of the total vertebrate species found in remnant vegetation had been recorded in plantings and in natural regeneration respectively.

The Queensland Herbarium is now in a position to assess which actual revegetated areas have, and have not, reached remnant status.



Awoonga Dam revegetation 2004–11. Before regeneration (above) and after (below)  
Photo Scott Swift, Department of Agriculture and Fisheries © State of Queensland

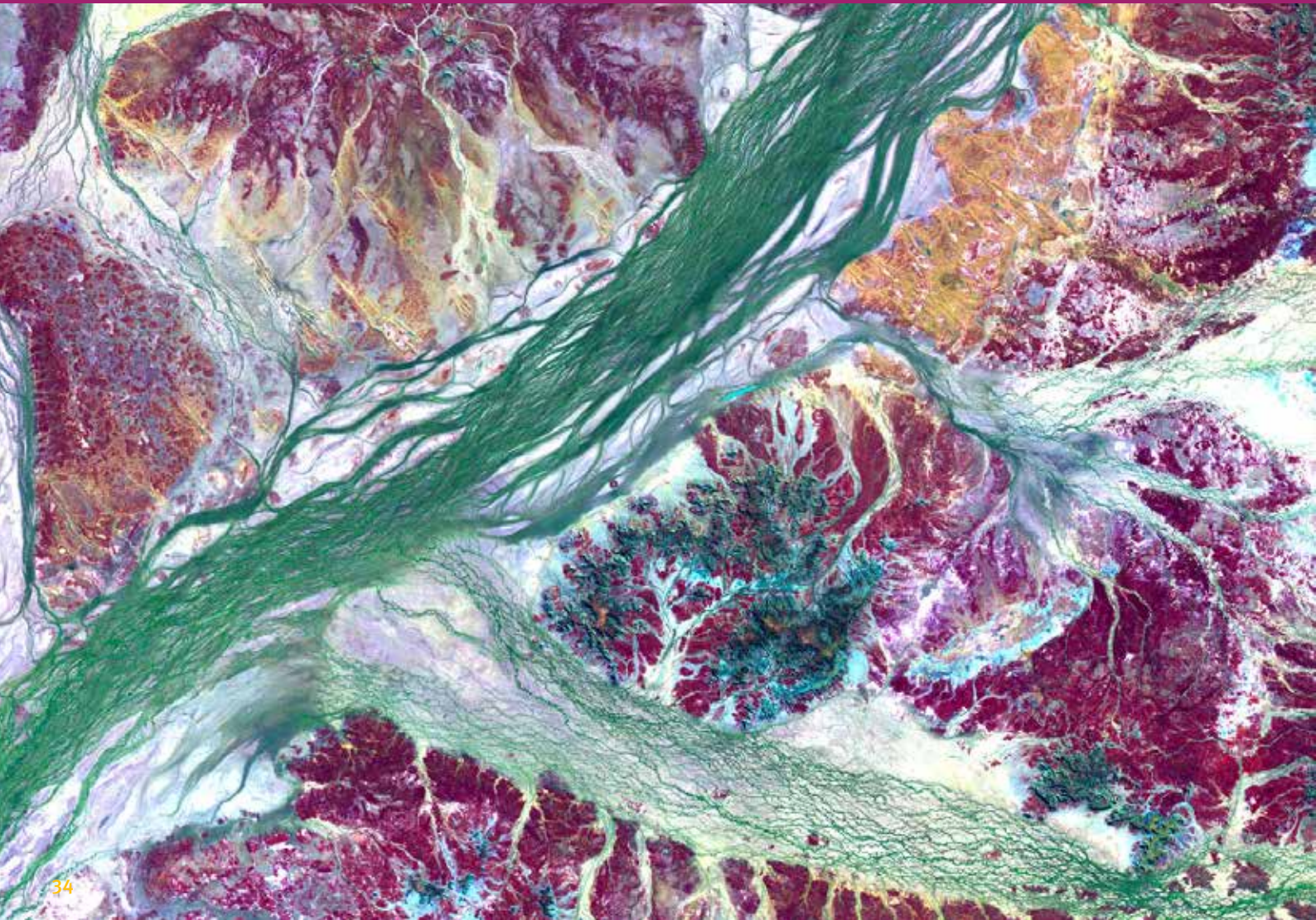


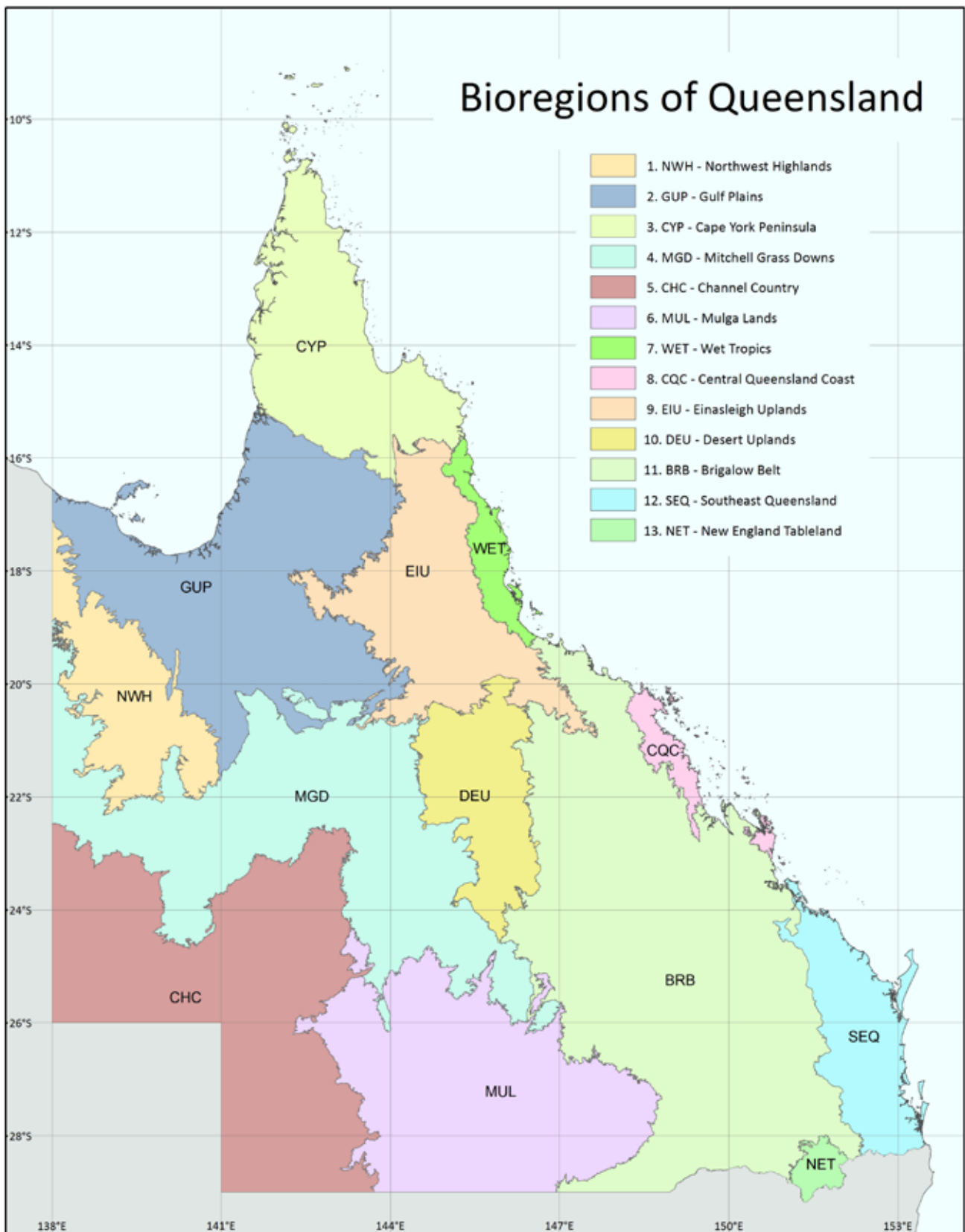
## Surveying and mapping our ecosystems

Approximately 95 per cent of our state (164 million hectares) has been mapped for regional ecosystems by the Queensland Herbarium.

This is a manipulated satellite image of the Diamantina River flowing through a lateritic landscape. These landscapes are characterised by red residual soil formed by the leaching of silica and by the enrichment with aluminium and iron oxides, similar to those found in the North West Highlands bioregion

Image Dan Kelman  
Queensland Herbarium  
© State of Queensland





### Bioregions of Queensland

Queensland has 13 bioregions supporting over 1300 different ecosystems.



Queensland is Australia's most naturally diverse state. It has 13 terrestrial bioregions supporting more than 1300 ecosystem types, including rainforests, savannas, eucalypt forests, wetlands and mangroves.

Queensland's regional ecosystem maps provide a foundation for Queensland's biodiversity conservation and sustainable landscape management. Regional ecosystems (REs) are an ecosystem classification system that results from the division of the state into biogeographic regions, geomorphological categories (i.e. land forms and soils) and vegetation communities. REs are a surrogate for biodiversity in a wide variety of conservation applications from legislation to community conservation groups, and form the base line for conservation-planning across the state.

The Queensland Herbarium is the lead agency for managing the classification and description of regional ecosystems and for mapping their extent both pre-clearing and in remnant condition. There are currently 1386 regional ecosystems recognised in Queensland and the Queensland Herbarium provides information on these for the *Vegetation Management Act 1999* (VMA). The Queensland Herbarium's current world leading program has 95 per cent of the state surveyed and mapped at 1:100,000 or larger scale for both pre-clearing and remnant vegetation.

In 2016 the first seamless coverage of regional ecosystems across the whole of Queensland's 173 million hectares is planned for release. The RE mapping process is based on field survey and interpretation of aerial photographs and satellite imagery. The mapping and RE classification framework is a living dataset, constantly being improved by new mapping and updated to capture changes in remnant regional ecosystem extent through time. This results in regular releases of updated spatial data every two years, improved regional ecosystem descriptions and an assessment of the biodiversity status of regional ecosystems.

Clay pans in reticulated dune fields,  
Channel Country, South-West  
Queensland, part of the Channel  
Country bioregion  
Photo Nick Cuff  
Queensland Herbarium  
© State of Queensland



Mitchell Grass, Headingly Station, Barkly Tableland, part of the Mitchell Grass Downs bioregion, North-West Queensland  
Photo Bruce Wilson  
© State of Queensland

Mitchell Grass Downs are rolling plains, mostly treeless, extending from central west Queensland into the Barkly Tableland in the Northern Territory.

## Our partners

Vegetation communities are amalgamated into broad vegetation groups (BVGs). Released in 2014, *Vegetation of Queensland* provides the first comprehensive overview of the vegetation in the state classified into 98 broad vegetation groups.

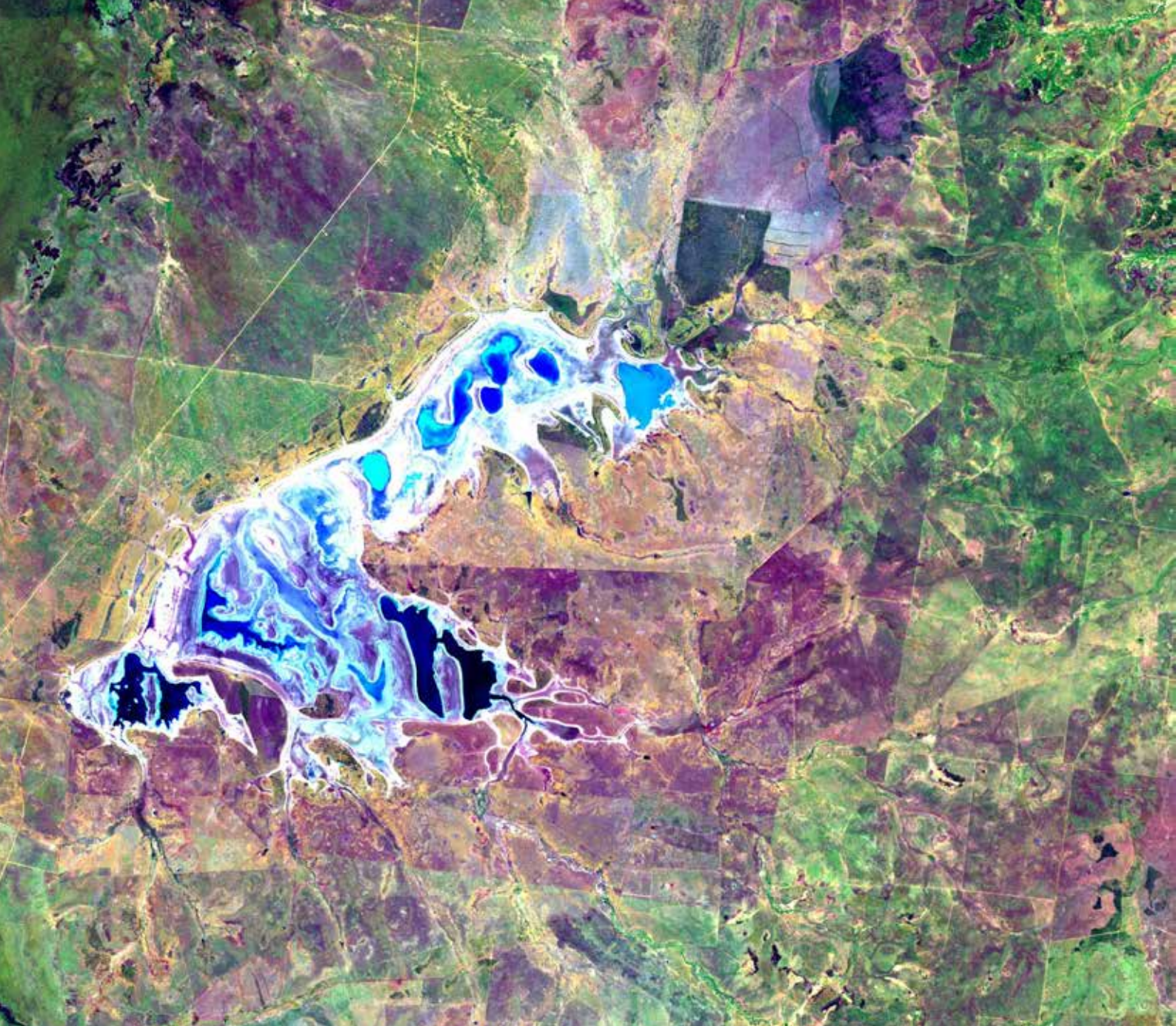
Maps of these broad vegetation groups (pre-clearing and remnant) down to the property scale are available online from the Biota Globe (Queensland Globe).

The Queensland Herbarium is also working with the Commonwealth under their Bioregional Assessment (BA) Programme to identify ground water dependent ecosystems (GDEs). The BA programme is assessing water-related impacts of coal seam gas and coal mining in key regions.

Queensland's ecosystems are the subject of ecological research, condition assessment and monitoring. To undertake this work the Queensland Herbarium has surveyed, mapped and classified 1,386 unique regional ecosystems across the state.

The Herbarium's ecosystem survey and mapping team relies on partnerships and collaboration to produce high-quality mapping and technical products in order to achieve beneficial outcomes for Queensland's regional ecosystems.

Core projects, including mapping regional ecosystems, wetlands and groundwater dependent ecosystems, are integral in supporting development and implementation of the state's environmental plans and regulations. This work involves close partnerships with other teams across the Queensland Department of Science, Information Technology and Innovation, especially the Queensland Remote Sensing Centre, and other state government agencies including the Department of Environment and Heritage Protection and the Department of Natural Resources and Mines.



Landsat image of the Galilee Basin,  
Desert Uplands Bioregion, central  
western Queensland  
Image Queensland Herbarium  
© State of Queensland

Partnerships are critical to our research on ecosystems. For example, in 2014 the Queensland Herbarium worked closely with CSIRO on a project to improve the understanding of biomass in native forests and regrowth, and collaborated with several universities, CSIRO and the NSW Office of the Environment to support regional natural resource management bodies in their planning for climate adaptation.

Our work with the South Australian Government in the identification of ground water dependent ecosystems (such as springs) that exist in the Lake Eyre Basin will promote better management and understanding of the ground water dependent ecosystems of the Lake Eyre Basin (LEB).



## Lake Eyre Basin Springs Assessment Project

The Lake Eyre Basin Springs Assessment Project (LEBSA) is funded under the Australian Government's Bioregional Assessment Programme to support the analysis of the impacts of coal seam gas and large coal mining development on water resources, such as ecosystems dependent on ground water (i.e. ground water dependent ecosystems or GDEs).

LEBSA is being undertaken by the Queensland and South Australian Governments and involves the mapping of GDEs for the Lake Eyre Basin. For Queensland this includes springs of the Galilee and Cooper Basins.

GDEs are natural ecosystems that require access to groundwater. 'Spring wetlands' are unique groundwater dependent ecosystems where the groundwater comes to the land surface.

Springs wetlands are extremely rare and have significant environmental, economic and social values. Many springs have become extinct, or at least dormant, over the past 100 years and are under threat of degradation.

Elizabeth Springs (Galilee Basin) like all Great Artesian Basin springs, are threatened by water extraction and feral animals. Elizabeth Springs is in the heart of the Desert Uplands bioregion  
Photo © Adam Kereszy





Many aquatic invertebrates (e.g. snails), fish, and rare plants are restricted to springs and often many have very localised distributions. The Red-finned Blue Eye is Australia's smallest freshwater fish, reaching a length of 30 mm and is restricted to the Edgbaston springs in the Barcaldine supergroup, Lake Eyre Basin. The Red-finned Blue is listed as endangered under both Australian and Queensland environmental legislation  
Photo © Adam Kerezsy

In the Queensland portion of the Great Artesian Basin the number of active artesian springs has declined by almost 40 percent since 1900. Springs and their source of water are valued by both agriculturalists and ecologists. Many aquatic invertebrates (e.g. snails), fish, and rare plants are restricted to springs and often have very localised distributions.

Both the Queensland and South Australian Governments will produce a range of technical products that will feed into the LEB Bioregional Assessment, including:

- aligned springs database
- spatial products showing the location of groundwater dependent ecosystems
- models that depict their hydrogeological and ecological interactions.

The LEB is an area targeted under the Federal Government's Bioregional Assessment Programme because it is underlain by significant coal basins in Queensland (Galilee, Cooper), and South Australia (Pedirka and Arckaringa).

## Protecting our plants, animals and their habitats

The Queensland Herbarium provides information and advice on the 981 plant species, 245 fauna species, 793 endangered and of concern regional ecosystems are currently listed as needing protection.

The golden-tailed gecko (*Strophurus taenicauda*) (Brigalow Research Station, Moura, southern Queensland) is under threat from habitat degradation and loss—as well as from feral cats, cane toads and foxes.

Photo Mike Mathieson  
Queensland Herbarium  
© State of Queensland



Green tree snake or common tree snake,  
*Dendrelaphis punctulatus*, sunbaking metres  
from tourists at Lake Eacham (Crater Lakes  
National Park)  
Photo Dan Ferguson  
Queensland Herbarium  
© State of Queensland



Herbarium scientists are actively researching and monitoring Queensland's most threatened species and ecosystems. This includes investigating threats and the means for ameliorating impacts to our flora, fauna and vegetation from grazing, fire, weed invasion, climate, management practices and development.

The Queensland Herbarium provides information and advice on protection and management of the state's flora and fauna species, including 981 plant species and 245 animals listed as endangered, vulnerable, near threatened or extinct under the Queensland *Nature Conservation Act 1992*.

Assessments and compilation of inventory data by the Herbarium on flora and fauna underpin key legislation (*Nature Conservation Act 1992* (Qld)) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (the EBPC Act) aimed at the protection of our natural assets.

Much of Queensland's environmental legislation relies on risk-based assessment, where it is assumed that the distribution of fauna and flora species in Queensland is well known. Recent analysis and mapping of fauna surveys across Queensland shows that further research is needed via systematic vertebrate fauna surveys in particular for the Mitchell Grass Downs, Gulf Plains and Channel Country.

To inform biodiversity decision-making it is important that adequate data across Queensland's bioregions are available. To do this zoologists at the Queensland Herbarium have developed a 'where to' and a 'how to' of fauna surveying to improve our knowledge of the distribution of fauna in Queensland.

The Herbarium's *Vertebrate Survey Effort Across Queensland Report* and the *Terrestrial Vertebrate Fauna Survey Guidelines* help fill the gaps in our knowledge of the distribution of fauna in Queensland. These documents are useful for zoologists, natural resource management groups and consultants who undertake fauna surveys.

Knowledge of the distribution, population size, ecology and habitat needs of plant and animal species and their ecosystems is essential to enable effective conservation assessment and management.

Queensland Herbarium botanists and zoologists actively research and monitor the populations of some of Queensland's most threatened species. Accurate assessments of conservation status of species ensures our vulnerable flora and fauna are appropriately listed for protection through state environmental regulation.

Below: Azure kingfisher, *Ceyx azureus*, found roosting on the upper reaches of Stanley River  
Photo Dan Ferguson  
Queensland Herbarium  
© State of Queensland

Right: Narrow-leaved gum, *Eucalyptus seeana*, grows to 40 m with smooth white or grey bark which sheds in large flakes and is a koala food tree. This tree was photographed in the Tingalpa Bushland Reserve  
© Photo Glenn Leiper



## Our partners

Mooloolah River, Mooloolah National Park, Maroochydore, South-East Queensland, 2009  
Photo Queensland National Parks, Sport and Racing  
© State of Queensland



The Queensland Herbarium works in collaborative partnerships aimed at the conservation of the state's biodiversity in particular researching the natural and human induced impacts that can threaten plant and animal populations and their habitats.

For example the Herbarium in conjunction with CSIRO are researching the impacts of fire on biodiversity in fragmented poplar box woodlands of Queensland's brigalow bioregion, and contributing to a national trial on the surveillance of rangeland biodiversity.

The Australian rangelands contain vast tracts of relatively unmodified ecosystems, a wide diversity of native species and are home to a large number of rare and endangered species. Knowledge of these ecosystems and species is limited and the ability to report change in biodiversity is restricted by patchy and inadequate data. Interpretation of change is also complicated by extreme climatic variation.

The primary objective of a national rangeland biodiversity monitoring program is to track changes in biodiversity of the rangelands at the national scale with the ultimate goal of protecting and managing rangeland biodiversity.

Detailed monitoring on species that are threatened or declining helps contribute to the development of better solutions for restoration and recovery. The Queensland Herbarium collaborates on a number of projects that are helping to increase this understanding.

The Herbarium together with Department of Environment and Heritage Protection and Queensland Museum are modelling the potential habitat of 143 threatened and priority flora; and 221 threatened and priority fauna. This research tracks the condition and distribution of key plant and animal communities, and informs planning and management strategies.

Together with the three tiers of government, industry, universities and non-government organisations the Queensland Herbarium is delivering projects that contribute to the knowledge and management of plants, animals and their habitats.

## Profile of a threatened species

The Nangur spiny skink (*Nangura spinosa*) is listed as endangered under Queensland legislation and as critically endangered by the Commonwealth. The Nangur spiny skink was formally described in 1993. At the time there was significant academic excitement that a skink so morphologically unique had remained undiscovered for so long in South East Queensland. Only known from two sites, one in Nangur National Park, the second in the Oakview National Park/State Forest area SEQ, the total extent of its habitat area is estimated at less than 900 hectares.

The two populations of the skink are genetically distinct and differ in extent, numbers and threats. A recovery plan for research and management actions of the skink was released in 2010 by the Queensland Government. Threats listed in the plan include roadside maintenance, hoop pine plantation maintenance, and control of feral animals and weed species. The skink is naturally restricted to semi-evergreen vine thicket, and vine forest.

Estimated adult population size is only around 30–40 at the Nangur National Park site and the low thousands for the Oakview site. Surveys for new populations are continuing.

Nangur spiny skink is listed as endangered under Queensland legislation  
Photo Mike Mathieson  
Queensland Herbarium  
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