
Executive summary of *National Taxonomic Collections in New Zealand* (2015) Royal Society of New Zealand²

Biological collections, supported by world-class taxonomic expertise and research, provide the evidence base for New Zealand to respond effectively to present and future challenges.

The knowledge enshrined in the collections is needed in many spheres of New Zealand life, delivering essential information and valuable benefits, for example:

- The primary production sector requires accurate and authoritative information to provide proof that products are pest- or disease-free for export markets and ongoing access. The identification of pests, pathogens, and biological contaminants is critical for maintaining market reputation especially in relation to food safety. In addition, taxonomy is essential for the identification of species that may have economic potential or attributes that, for example, would be valuable under changed climate conditions. Also of economic value is the development of innovative products on the basis of biodiscovery from native biota; species identification and distribution information are crucial for such activities.
- Biosecurity, an important part of risk management for New Zealand's economy, environment, and human health, depends on accurate, authoritative and rapid identifications of invasive organisms such as weeds, pests, toxin producers, and pathogens. Collections and knowledgeable research taxonomists provide the primary material and vouchers needed. Without such capacity, response to biosecurity threats would be based on little more than guesswork.
- New Zealand has a clear international responsibility to identify, classify and protect its species, and meet international treaty obligations (e.g. Convention on Biological Diversity, Intergovernmental Platform on Biodiversity and Ecosystem Services, environmental reporting in the OECD). This includes the obligation to implement the agreed-upon New Zealand Biodiversity Strategy, which calls for the protection of natural ecosystems, flora, and fauna.
- Monitoring and managing changes in biodiversity

and the environment are entirely dependent upon authoritative taxonomic data and expertise. These are prerequisites if New Zealand is to meet its obligations relating to environmental monitoring under the new Environmental Reporting Act.

- There are legislated requirements for accurate and timely information about species, their distributions, and their interrelationships (e.g. Resource Management Act, Hazardous Substances and New Organisms Act, Environmental Impact Assessments as part of regulations such as the Extended Economic Zone and Continental Shelf Environmental Effects Act). Further, New Zealand's ability to provide certainty about the effects of resource use and management in the primary sector (agriculture, horticulture, forestry, aquaculture, wild fisheries, and mining) is heavily dependent on biological collections and taxonomic expertise.
- Human health outcomes are directly influenced by proactive provision of critical identifications of and information about poisonous plants, toxic algal blooms, and other pathogens that could have serious health and economic consequences.
- The quality of New Zealand's research output in many areas of biological science and ecology depends on the ability to accurately identify the organisms being studied.

All of this relies on the interplay between taxonomists and physical specimens. It is an active process, involving research, and reference to scientifically validated reference collections, databases and literature. The evidence base must be authoritative, well documented, accessible, comparable over time, and supported by world-class taxonomic expertise.

Given the wide benefits that this research infrastructure enables, to what extent is strategic guidance being provided over its directions, standards and investment; is the funding and capacity of New Zealand's specialist taxonomic research optimal; and is sufficient taxonomic training being undertaken to meet New Zealand's needs in this area?

² www.royalsociety.org.nz/national-taxonomic-collections-in-new-zealand

The Royal Society of New Zealand convened a Panel of experts to investigate these questions and to provide recommendations on the current support, development, and management of New Zealand's taxonomic collections and their future needs, including the taxonomic research, information systems, and expertise vital to make them useful.

The Panel gathered evidence from 29 taxonomic collections housed in Crown Research Institutes (CRIs), the Cawthron Institute, museums and universities. These represent the majority of New Zealand's biological collections that are actively supported with taxonomic research. They contain over 12 million specimen lots* of vertebrates, invertebrates, plants, fungi, micro-organisms, and fossils. The Panel also undertook surveys of the taxonomic workforce, and taxonomy stakeholders, and referred to reports and publications from New Zealand and overseas.

Summary of findings

This investigation identifies inadequate and overall declining support for this nationally important resource. Erosion of investment, particularly evident in the CRI sector, has seen loss of national capability in specialised expertise in taxonomy and curation through redundancies, reduced hours, and non-replacement of retiring staff. In addition it has led to collections being closed or having limits put on access, and reduced ability to protect specimens and deliver services.

Continued decline in support for the collections is a real risk for New Zealand, especially if it continues to occur largely out of sight and incrementally until a major event in the future highlights deficiencies. It also means that New Zealand is limiting its opportunities to adopt new technologies and provide best-practice interoperability of data and information systems, both domestically and internationally.

The investment in collections and taxonomic research in New Zealand is fragmented. The key sources of investment are the Ministry for Business, Innovation and Employment (for CRIs and Cawthron Institute); the Ministry for Culture and Heritage (Museum of New Zealand Te Papa Tongarewa); City Councils (metropolitan and regional museums); Tertiary Education Commission (Performance Based Research Fund) and Universities (assorted research funds).

The biological collections' infrastructure (physical specimens, taxonomic research, tools and information systems, and associated activities) is largely invisible to the final beneficiaries as many services that rely on and access the collections' infrastructure are delivered through government agencies or other intermediaries. Even where services are provided directly, these are often provided through tools and information systems alongside the advice of taxonomy experts, with the physical collections and their curation and management needs largely unseen. The Panel has noted that Treasury guidelines for financial reporting of heritage and cultural assets do not cater well for the types of collections being considered here.

The Panel notes that there is a disconnect between the funding and delivery of services. There is no apparent strategic alignment between the setting of short-term output priorities of departments and agencies, and the long-term input investment priorities of those providing the main funding to the collections' infrastructure.

Despite their uniqueness and value, legal protection for collections exists only under the Museum of New Zealand

Te Papa Tongarewa Act 1992, the Auckland War Memorial Museum Act, and Trust Board Acts of some metropolitan museums. In addition, the Protected Objects Act 1975 is now dated and provides protection for natural history specimens mainly in the area of sale and export outside of New Zealand.

There is no coordinated national process for assessing whether collections' research activities, and the collection development policies of individual institutions, meet national and stakeholder needs. Nor, in the absence of national scale oversight, are collections' infrastructure safe from individual institutional policy changes and priorities. The combination of eroding support, lack of formal protection, and reliance on individual organisations' prioritisation processes, poses a risk of unintentional consequences if not addressed. The Panel has observed several examples where decisions have been made or are being considered by individual organisations to stop or reduce activities to respond to their own budgetary constraints, and not necessarily acting in the country's long-term interests.

Demands on the biological collections' infrastructure and services are increasing both in New Zealand and overseas. For example, growing international trade increases biosecurity risk; increasing human and animal health risks driven by population, climate and immigration pressures; growing international demand for certified pest- and toxin-free food; global efforts to advance knowledge of ecosystem services and to contribute to regional biodiversity assessment; initiatives to identify and protect vulnerable marine ecosystems; and increasing research efforts to investigate the world's evolutionary biology. There is also increasing demand from communities, such as iwi resource managers, citizen science, and the natural resource sector to mobilise data about the distribution and abundance of species.

The specific requirements for access to the collections' infrastructure (both collection material and taxonomic expertise) are generally frequent but unpredictable. This means that significant numbers of biological specimens need to be proactively collected, stored, documented and kept useable, possibly for very long periods of time, to be available when needed. When they are required, speed of access to both information and taxonomic expertise is often paramount.

New Zealand's publicly funded taxonomic workforce is only funded to spend a small proportion of their time on taxonomic research, far below the standards of Australia and Canada. In our survey of 97 publicly funded taxonomists, 77% are funded to spend less than 25% of their time on taxonomic research and only 16% of the workforce is in the 20–40 age bracket. This situation poses a real risk for New Zealand, for example in terms of succession planning. This is compounded by concerns over whether graduates in biology are sufficiently equipped with an understanding of basic taxonomic principles.

The involvement of iwi Māori and scholars of Mātauranga Māori, in the care, development, and use of collections is minimal at present, and there is considerable potential for the collections to be used to further the integration of Māori cultural concepts in New Zealand society, and to allow for iwi development. In addition, there is an opportunity to build Māori and Pasifika capability and contributions to the contemporary science of taxonomy including the importance of traditional knowledge systems to complement that which has been collected in currently established collections.

*A "lot" is a group of specimens of one species or taxon that are from the same collection locality and collected at the same time.

Continuing declines in investment are limiting the ability of institutions to respond to existing demands, let alone meet new demands and opportunities. This means that New Zealand is not obtaining full benefit offered by emerging digital and analytical techniques, and molecular technologies. High priority has to be given to securing the current infrastructure, both physical assets and expertise.

The biological collections' infrastructure requires a long-term commitment and stable investment to work effectively. The annual cost of this is a very small fraction of the benefits that the collections enable. For example, an effective biological collections' infrastructure is critical in the defence of the economy, environment and society against pests, diseases, and weeds which currently cost New Zealand \$2.45 billion annually, and in ensuring market access for New Zealand's \$1.5 billion seafood exports.

The Panel's analysis of other countries' taxonomic infrastructure shows that New Zealand is not alone in the issues raised here. However, as a small and relatively well connected country, we should be able to do much better than we are.

Currently, New Zealand is not meeting its international obligations with respect to mobilisation of data and information sharing, nor is it leveraging opportunities that the international community provides. The Panel believes that central and local government have the major responsibilities for addressing the investment requirements, coordination, and protection for the collections. The majority of investment needs to come from the public as there is limited appetite for the private sector to pay beyond the cost of immediate service delivery, especially given that the collections require long-term investment and need to be accessible by a wide variety of public and private users. It is much more efficient for government to do this collectively on behalf of all users. The government also has a role to mitigate coordination failure that is a consequence of the fragmented system of collections' ownership, use, and investment. This includes both coordination within government and support for stronger national coordination. The government has a role to provide legislative protection to ensure that the evidence base provided by the collections is maintained and remains available for the long-term benefit of New Zealand.

Recommendations

The Panel is convinced that a whole-of-systems approach must be taken to interconnect providers, custodians, practitioners, stakeholders, and end-users. Thus the following recommendations need to be implemented as an integrated package to ensure the most effective and efficient use of existing and future resources, addressing coordination, investment, stewardship, protection, and training.

The collections should be recognised as national heritage assets and essential components of the New Zealand science system, underpinning a wide range of public and private benefits. The biological collections' infrastructure needs to be nurtured, protected, and accessible for current and future generations of New Zealanders, within an investment framework that recognises the intergenerational values of these assets.

The Panel recommends that:

System performance

1. New Zealand should retain a decentralised and geographically spread network of national taxonomic collections that enables integrated and close collaborative links with end-users.
2. New Zealand's taxonomic collections should be located in establishments that have clear commitment to stewardship to ensure long-term protection and ongoing curation.
3. New Zealand's taxonomic collections should be accessible for the benefit of New Zealand, reflecting their use across multiple public-benefit domains, while also meeting collection standards, policies, and protocols. Where charges are made (such as for specific access, or under commercial contract to specialist users and service providers), this should not limit access by others.
4. Government resource a mechanism that enables coordination and oversight of New Zealand's taxonomic collections by collection holders, to improve practices relating to standards, taxonomic research, training, biodiversity information systems, and to provide a source of advice to government and stakeholders.
5. A single point of responsibility within government is established to coordinate a coherent approach to policy and investment in the biological collections' infrastructure. This would also provide a channel for interaction and information exchange between the Government and collection holders.
6. Strong protection is provided for the collections that form part of our national biological collections' infrastructure.

Investment

7. The evidence and findings of this review are incorporated into the 2015 review of Core Purpose Funding for CRIs, reflecting the significance of the CRIs in managing these collections.
8. Government urgently address the immediate investment needs of the national taxonomic collections and research staff so that critical taxonomic expertise is restored, and that services and quality are not put at further risk.
9. Government adopt a strategic and more tailored approach to investment based on a set of principles set out in this report, which would provide greater certainty for collection holders in planning for both short and long term demands.
10. Substantial new investment is made to meet the growing demands on the taxonomic collections. This should address: i) the large backlog of curation and digitisation of existing collections' information; and ii) application of new technologies (e.g. for specimen and data analysis, integration and mobilisation of data, and development of appropriate informatics tools).
11. New investment is made to support training, such as internships, scholarships and fellowships, to attract high-calibre researchers into New Zealand taxonomy and collection management, and to ensure New Zealand has a strong and expert taxonomic workforce.