Manaaki Whenua
Landcare Research

NVS Annual Report for the 2018/19 year

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NVS Annual Report for the 2018/19 year

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Manaaki Whenua – Landcare Research

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Contents

1 Overview

The National Vegetation Survey (NVS) databank continues its major focus on primary data acquisition, curation and provision, to ensure ongoing, up-to-date delivery of New Zealand (NZ)'s vegetation plot data to enhance fundamental understanding of our biota and ecosystems and to meet conservation and biosecurity priorities and sector needs. The NVS databank now holds data from over 109,000 vegetation survey plots – including data from over 25,000 permanent plots. These span all major ecosystems and a diverse range of naturally uncommon ecosystems – recent acquisitions have extended coverage of kauri forests in Northland, islands (Rona Island in Lake Manapouri) and have reflected long-term efforts to document the impact of fire in shrublands and the impacts of browsing mammals via fenced exclosure plots. The NVS databank continues to support national initiatives for reporting and monitoring on NZ's biodiversity by serving as the repository for national scale monitoring programme of the Department of Conservation (DOC) for biodiversity (referred to as 'Tier 1' from here) and the Ministry for the Environment (MfE) concerning land use and carbon storage and sequestration (LUCAS). This year NVS archived data from 323 new or remeasured plots for these programs and these data supported NZ's sixth national report to the United Nations Convention on Biological Diversity. This year, data sourced from NVS have supported 57 peer-reviewed research publications, 12 contract reports, and three theses. New knowledge gains encompassing NZ focussed themes were many and varied; examples include i) that even at low abundance alien plants can be associated with reduced native species diversity; ii) predicting how climate change will shift the distribution of specific exotic weeds in NZ; iii) developing new quantitative methods to disentangle the reasons different species occur together; and iv) demonstrating that woody debris cans protect regenerating native trees from browsing by introduced deer.

2 New plot records archived in NVS

Twenty new projects[1] and their associated electronic data were added to NVS in 2018/19 (year to 30 June 2019; Fig. 1 & Appendix 1) with a total of 639 plots added. This brings the total number of projects with electronic data in NVS to 1,669, comprising 109,122 individual plots. Data additions since 2007/08 are shown in Figure 1, broken down by major provider.

Major sources of new data this year include the ongoing plot measurement to support a NZ national scale monitoring programme (the Tier 1 programme) undertaken by the DOC, (323 plots, most with their associated bird count and exterior plots).

Reconnaissance plot description (Recce) data from a further 98 plots from Warawara forest, Northland were deposited in NVS this year, adding to the 107 plots measured in 2016 (see the 2016 NVS Annual Report). Warawara is a mixed broadleaf forest just north

[1] A project is a defined sampling event undertaken over a specific period. A project may have many methods and many plot observations (visits).

of the Hokianga Harbour and is dominated by tawa, tōwai, rimu. and large tracts of intact and logged kauri.

The Greater Wellington Regional Council continues to be a valuable contributor to the NVS database, depositing data from four projects (51 plot observations) in the 2018/19 year. These data include two measurements of the Wairarapa wetland exclosures, remeasures of forest plots established throughout the Greater Wellington region and remeasures of exclosure plots set up in East Harbour Regional Park in 2001 to monitor impacts of browsing mammals.

On the browsing mammal theme, three exclosure plots and their associated control plots set up in Woodhill forest in 1983 were remeasured for the third time in 2018 by Manaaki Whenua – Landcare Research (Manaaki Whenua) staff in partnership with Ngati Whatua o Kaipara. The study was set up to assess the influence of ungulate browsing on forest regeneration.

The Pomona Island Charitable Trust deposited data in NVS from two vegetation plots set up on Rona Island, Lake Manapouri set up in 2005 and remeasured in 2016. The plots were established to study the effects of a planned poison drop and trapping regime on the vegetation of the island.

Plots set up by Manaaki Whenua on Birdlings Flat, Banks Peninsula soon after a fire swept through a large stand of native-dominated scrub vegetation in 2014 were measured for the fourth time in 2018. The study was set up to study the reassembly of burned shrubland communities in the presence and absence (fenced-off plots) of grazing animals.

NVS Express software facilitated the addition of data for seven projects (39 plots) to NVS during 2018/19.

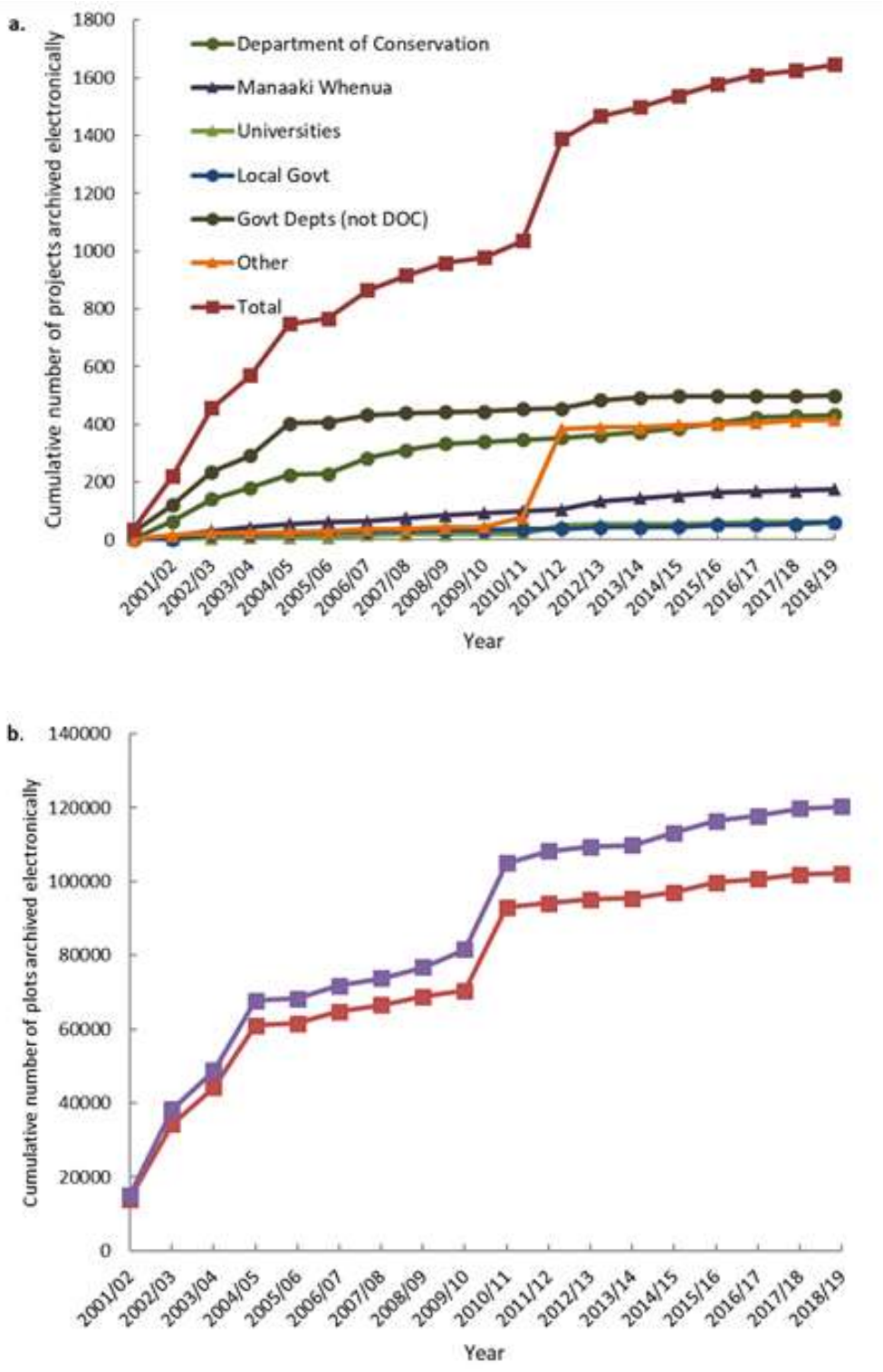

Figure 1. a. Cumulative number of projects archived in the National Vegetation Survey (NVS) databank, total and from five major contributors, per financial year since the SQL relational database was developed in 2000. These figures include projects migrated over time from 'legacy' data management systems in use in previous years. b. Cumulative number of plots archived in the NVS databank per financial year since the SQL relational database was developed in 2000. The red line represents new plots archived; the purple line represents plot measurements archived, so illustrates plots that have been remeasured. These figures include projects migrated over time from 'legacy' data management systems (e.g. data stored as text files compatible with FORTRAN-based analytical tools) or non-NVS formats (e.g. EXCEL).

3 Improving archival of physical records

Electronic data are only one part of the NVS databank. Of critical importance is the physical archive, maintained under climate-controlled conditions, that contains irreplaceable field plot sheets, annotated maps and aerial photographs, photography of plots themselves and other invaluable documentation. Many of these ancillary records are vital for relocating plots for future re-measurement and providing details that allow correct interpretation of electronic data. The archive also houses original paper records of irreplaceable historic datasets that have yet to be digitised. The redevelopment of the Lincoln site provided the opportunity for the materials in the former archive, which at 65 m^2 floor space was filled to capacity, to be moved to a new space with floor space of 116 m^2, almost doubling the floor area. The new NVS archive, opened on 13 March 2019, will allow for the anticipated storage needs over the coming decades. In addition to a large increase in shelving, and four additional compactor units, the facility includes more file cabinets, well-lit work surfaces, and a computer workstation. Importantly, this allowed us accession into the NVS backlog of 79 new boxes of plot records that were stored in offices that were vacated as part of the Lincoln site redevelopment. Now, the entire backlog of 205 boxes is readily visible, providing the NVS team a concrete idea of the effort required to accession and digitise these data.

4 Technological improvements

4.1 New NVS search tool released

In October 2018, the search functionality on the NVS Website (https://nvs.landcareresearch.co.nz/) was replaced with a new search interface that provides the user with a more intuitive approach to search, reducing the barrier to finding information and accessing data. This tool is a major advance over the current NVS search tool in providing:

- a more intuitive search syntax
- advanced search capability with extensive online help
- a faceted project result list that allows users to quickly and easily refine their results and identify data suitable for their needs
- a map-based spatial search to identify data sets within user-defined geographical areas.

As part of the enhanced search, the ability to capture search history has been implemented. This enables better monitoring of the search functionality, allowing the development team to quickly isolate and resolve problems when they arise. It also provides a rich source of information that will be used to inform future improvements to the search experience.

4.2 Excel data entry template online

The NVS team created a template (Microsoft EXCEL spreadsheet) for entering data into a format that can be readily migrated into the NVS back-end database. Although the NVS team still recommends the use of NVS Express for data entry to achieve the highest level of data validation and integrity, this spreadsheet template meets the needs of those stakeholders that prefer to use EXCEL to such a degree that without it they would not archive their data in NVS.

4.3 Improvements to NVS website

Work has been undertaken this year to resolve several long-standing issues in the NVS website. This has included:

- Streamlining the request process making it easier to submit requests and allowing data owners to process requests more effectively. Where they were previously required to approve large requests in one step, they can now partially process a request and return at a later stage to complete processing where necessary.
- Improving the display of dataset metadata.
- Improving how the dataset upload process functions in response to user feedback.
- Implementing more comprehensive logging of actions and errors occurring on the website. This enables better monitoring of the site and faster resolution of any issues that arise.
- Updating the underlying technology to the latest software versions to keep it current.

4.4 Improvements to the linkage between the web-based metadata entry system and the backend NVS metadatabase

Work has been done this year to improve the process that takes metadata uploaded via the website and enters it into the NVS repository. The process has been further automated to reduce the risk of human error being introduced through manual copying of data. The process now requires the NVS manager to review the metadata that has been uploaded via the website, correct any errors and approve the submission. At this point the metadata is automatically uploaded into the NVS databank.

5 Significant revisions of data

5.1 Enhancing quality of existing datasets

This year we continued to devote resources to addressing much needed data corrections and revisions across historic data held in the NVS databank. Consistency and high-quality data are especially important when we develop new collaborations in NZ and when we engage in national and international data synthesis efforts.

We made a major effort on improving the quality of the historic data from NZ's largest (2.5 ha) forest plot at the Orongorongo field station where the spatial locations of all trees (>4,000) are mapped. Being first established in 1961, this stand also has the longest measurement history of any mapped stand in NZ. Efforts included ensuring that all trees depicted on hand-drawn maps were included in electronic dataset, that unique tags for each tree were consistent over time and matched those in the field, and that trees included in electronic data but not on maps were known. These efforts allowed a complete remeasurement, including updated mapping, to be done by research stakeholders to underpin fine-scale integration of ground-based and remotely sensed data.

Other corrections and revisions included:

Project data

- projects renamed where the habitat type in name was misleading

Temporal consistency in long-term datasets

- corrections discovered in later measurements of some permanent plots applied to previous measurements

Plot attributes and site data

- misspecifications of the ParentPlotObsID corrected
- misspecifications of georeferences corrected
- misspecifications of tier definitions corrected

Plant names

- linkages between species codes and the intended plant name were resolved for instances where the original plant name was misapplied in NZ, and the NZ Plant Names database were overridden to prevent incorrect designation of indigenous versus exotic biostatus [*Geniostoma rupestre* versus *G. ligustrifolium*]
- new tag names were created for taxa that have been subject to nomenclatural treatments that changed the meaning of the name used in the past (e.g. *Nothofagus* species replaced with *Fuscospora/Lophozonia* species)
- clearly misspelled species codes were corrected [SCHDIC versus SCHDIG for records where it was clear that it pertained to a small tree, not a small fern]

6 Assessing user needs to guide future planning

In July/August 2018 we ran a detailed survey of users of the NVS databank (Appendix 2). We sought to understand the types of users (e.g. are they data providers, consumers or both; what kind of organisation do they represent), how they use vegetation plot data, which tools associated with the NVS databank do they use (e.g. data entry software, website, request, and approval) and their satisfaction with these tools and their ideas for future priorities for the NVS databank. Eighty-nine people responded to the survey.

Respondents were from a wide range of organisations including research institutes, universities, central and local governments, and NGOs. NVS data were primarily used to support research and biodiversity reporting and to guide biodiversity management. The number of data consumers slightly exceeds the number of data providers and 2/3 of respondents viewed NVS as very or extremely important to their work. The processes and tools that support data deposit, discovery and retrieval data were viewed as satisfactory or better. Users were highly satisfied that the NVS website allows them to access the NVS species name list, download field manuals and readily search the NVS plot data holdings.

Areas for future work were made evident from the survey were:

- increase the familiarity of users with wide variety of NVS data holdings and their complexity and the range of services and data base linkages that NVS provides
- increase the familiarity of users with the NVS data-use protocol
- enable more machine-to-machine access to data in NVS
- the desirability of ready linkage to pertinent data in other databases (e.g. herbarium records, soils data, wetland monitoring data)
- enable retrieval of scans of original data sheets.

Suggested improvements to the metadata capture system, the search system and the MyNVS section of the NVS website were either implemented in our technological improvements this year or used to set future short-term development priorities.

7 Increasing end-user awareness and capability

7.1 Increasing access and end-user capability

Regional and District Councils and Territorial Authorities maintain internal GIS systems that bring together a range of different types of spatially explicit data pertaining to the area they administer. These organisations have responsibilities in planning and resource consenting processes that require knowledge of biodiversity in their region. Some are also creating plot-based monitoring systems. This year NVS staff negotiated MOUs with the Waikato and Bay of Plenty Regional Councils to provide shape files delivering two types of biodiversity data sourced from plots archived in NVS that occur in these regions. The first is public domains species occurrence records. The second is plot location and associated metadata from both public domain plot records and those requiring permission from data owners to be released. This will allow these Councils to easily determine if plot records exist that may provide biodiversity information to meet specific needs and if permanent plots exist that can be incorporated into planned monitoring systems. These two efforts are providing initial 'case studies' that can be rolled out to all interested Councils in the coming years. This will broaden the stakeholder-base of the NVS databank beyond the limited proportion of Councils that currently have strong linkages with it.

NVS provides the primary indigenous forest data repository and user interfaces for the DOC Tier 1 and MfE Land Use Carbon Analysis System (LUCAS) programmes. Regular engagement and collaboration between the parties ensure the services provided by NVS

are always being optimised to meet the needs of these two programmes and support data quality.

During the 2018–19 year, two new capabilities were designed and implemented:

- On occasion, methods may be adopted for quantifying aspects of the biota that are later superseded by new methods deemed to be more accurate. Temporal continuity may be able to be achieved by evaluating the correlation between the measure of the same biotic property (e.g. tree height) derived from the old and new methods. The Tier 1/LUCAS user-interface and back-end database was enhanced to allow for such a transition of methods used to assess shrub biomass.
- Measurements of trees are made in two different methods: that used to assess living trees and that used to assess coarse woody debris. The user-interface and back-end database was enhanced to allow the same individual to be linked across different measurement methods. This maintains data integrity and ensures different carbon pools are accurately quantified.

7.2 New NVS users

There is currently a total of 500 registered NVS users, with 62 new users registering between 1 July 2018 and 30 June 2019.

8 Data-sharing agreements, data exchange, journal repositories

We collaborate with numerous domestic and international initiatives to broaden the impact of data held in the NVS databank. These collaborations facilitate the use of NVS data by a wider range of users who otherwise may have remained unaware of these data and their potential. Internationally, NVS contributes data to the i) sPlot initiative (https://www.idiv.de/?id=176&L=0), the largest repository for plant community data in the world with the goal of understanding global patterns in plant diversity across facets, biomes and scales; ii) Global Forest Biodiversity Initiative (http://www.gfbinitiative.org/ that supports cutting-edge research and policy making in forest science and related initiatives)); iii) the Global Biodiversity Information Facility (GBIF; (https://www.gbif.org/)), aimed at providing anyone, anywhere, open access to data about all types of life on Earth. Access to these data have been vastly accelerated by the development of an R package (rgbif), released in September 2017 (Fig. 2). NVS data also continue to be used in numerous one-off global collaborations.

The dataset provided to GFBI was changed from LUCAS to a dataset of 'public domain' data comprising 205,413 individual trees occurring on 3433 forest plots. Originally, we had provided data from the representative plot network from the LUCAS Program (MfE) for a specific set of analyses. Since then the goal of GFBI has expanded to create a database for multiple use. With this shift in emphasis, NVS staff did not feel able to constrain the ongoing use of these data to meet the data use protocol of MfE and felt it more appropriate to supply public domain data, as we do to GBIF and sPlot

8.1 Use of NVS data through the GBIF Portal

An updated set of 1,579,141 species occurrence records for NVS public domain (Open Access) data were uploaded to the GBIF Portal in June 2019, an increase of >48,000 occurrence records over June 2018. These can be viewed here http://www.gbif.org/dataset/788439f0-3b56-11dc-8c19-b8a03c50a862. NVS provides a refreshed dataset to GBIF every month. Between 1 July 2018 and 30 June 2019 there were 3,366 downloads of species occurrence data, incorporating 858,942,416 records, accessed via the GBIF website (Fig. 2). The 2014/15 year showed an order of magnitude increase in the rate of species occurrence downloads and this trend has continued since then.

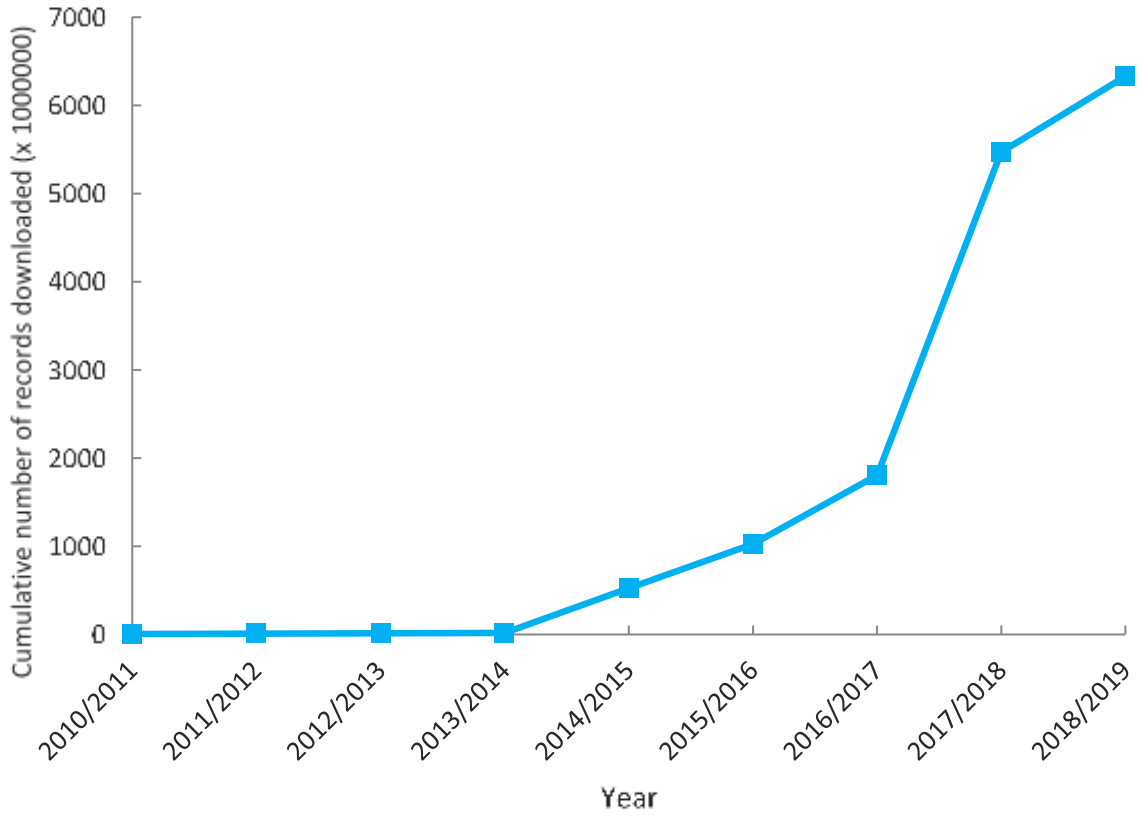

Figure 2. Cumulative number of species occurrence records supplied by the NVS databank that have been downloaded from the GBIF Portal since 2010.

8.2 NVS collaboration with sPlot

Data from a further 17,071 public domain 'Recce' plots spanning forests, shrubland, grasslands and other ecosystems were provided to the sPlot initiative in November 2019. This provides a substantially more comprehensive dataset than our original contribution of 1,947 public domain transect data from montane and alpine grasslands provided in 2014 and ensure that interpretations of NZ vegetation patterns in a global context are based on a dataset that better represents the major vegetation gradients. Manaaki Whenua staff are currently collaborating with other members of the sPlot consortium on fifteen different research projects using these data.

8.3 Use of NVS data via the Manaaki Whenua – Landcare Research DataStore

The NVS databank has joined with the Manaaki Whenua Research Datastore (https://datastore.landcareresearch.co.nz/) to provide a means for authors of scientific publications to meet journal open access requirements. NVS data are provided in the cleaned and aggregated form that transparently links to publication results. These datasets are resolved via DOIs provided with the original publication or by searching.

To provide an indication of use, between 1 July 2018 and 30 June 2019 the 12 data sets associated with the NVS databank were viewed 795 times.

Over the last year, the Waitutu dataset was again the most visited in the NVS collection, followed by the Root Trait dataset.

9 Conservation and management outcomes

Data sourced from NVS were used to support the resource consent process for the NZ Transport Agency's proposed Mt Messenger Bypass Project. This required assessing ecological effects, including impacts on native vegetation, evaluating proposed mitigation, offset and monitoring measures and identifying and calculating suitable biodiversity offsets. Data from forest plots were one of the information sources used to define pre-existing ecological values of the site.

The Pomona Island Charitable Trust is restoring NZ's largest inland island as a sanctuary for native birds, including many threatened species. Since 2005, major efforts have been made to eradicate mammal pests. Located within Lake Manapouri, Fiordland, Pomona Island is relatively easily accessible and is a place where visitors will be able to imagine Fiordland as it was before introduced predators became established. Data archived in NVS demonstrates the substantial recovery (between 2005 and 2016) in sapling populations of palatable woody species following deer and possum removal.

10 Meeting emerging policy and management needs

After the incursion of myrtle rust, an immediate priority was to better understand the distribution (or range) of all native species from the plant family Myrtaceae that are potentially susceptible to the disease. Following on from preliminary analyses done in 2017–18, the NVS Databank provided a large volume of data on the presence and absence of all native taxa of the Myrtaceae, which together with herbarium records and citizen science records were used to build statistical models that find relationships between these occurrences and environmental gradients of climate, soil and topography. Maps of the distribution for all species were then produced for the entire country. These distribution maps provide information about where myrtle rust might spread in the future and can also be used to guide conservation, management, disease monitoring, and seed banking efforts. MPI provided feedback that these models will be extremely useful for end

users including land managers, and they are already being used to plan restoration options under various scenarios of disease spread.

Compositional data from plots distributed nationally were used to predict forest and shrubland composition at a national scale. These predictions have been integrated alongside flowering phenology data to predict the monthly availability of nectar and pollen resources for honeybees to support the Māori honey industry.

Data archived in NVS collected under the auspices of the LUCAS (MfE) and the DOC Tier 1 supported NZ's sixth national report to the United Nations Convention on Biological Diversity. Specifically, these data support the Indicator 'Enhance understanding of the contribution of indigenous biodiversity to carbon stocks' via Implementation Measure 1 Quantifying the contribution of indigenous biodiversity to carbon stocks.

11 International collaborations

Susan Wiser (Manaaki Whenua) continues to serve as a scientific advisor to the New South Wales Office of Environment and Heritage Vegetation Information and Mapping Programme and on the Steering Committee of the International Association for Vegetation Science Working Group for Ecoinformatics. She was invited to serve in these positions in recognition of her expertise with the NVS databank and other scientific expertise.

NVS staff have collaborated with Dr Sebastian Schmidtlein, Karlsruhe Institute of Technology, Germany who has developed the smartphone app 'Vegapp' for collecting relevé (i.e. "Recce") plot data in the field. The entry of plant species is facilitated by checklists that can be loaded from a web repository, which includes a list for NZ, or hand-crafted by users. Ad hoc species entries are possible as well. The spatial position of a plot can be retrieved from the Android device and visualized on a map. Settings profiles allow the user to pick relevant data entry fields, set default values to avoid repetitive inputs and to define vegetation layers. Supported export formats include generic text for R or spreadsheets etc., Turboveg-xml and VegX-xml, which can be imported in the NVS databank. Vegapp can be used at no cost for non-commercial use.

The app is available in English and German. See https://play.google.com/store/apps/details?id=edu.kit.ifgg.vegapp&hl=en_US.

12 Use of the NVS website

12.1 Web statistics

From 1 July 2018 to 30 June 2019, the NVS website was visited 4,164 times, down 11% from the 2017/18 year (4,667 visits), and there were 14,591-page views, down 35%.

There were 2,221 unique visitors to the site over this period. Of the current year's hits that could be traced to origin, most visits were from NZ (51%), followed by the USA/Canada

(15%), France (5%), the UK (4%), South Korea (4%), Australia (3%), Germany (2%), India (2%), and Russia (1%). The website was also visited by people from another 70 countries.

The data discovery and request component of the website continues to prove popular, accounting for 32% of page views. The Index page received 22% of all page views and resources (downloadable content of NVS codes for plant names, field techniques, manuals, and field forms) were also popular (12% of page visits). Apart from the number of website visits, total page views and visits to the resources (up from 9%), these numbers are similar to last year. That the NVS website has become the go to source for retrieving field manuals and abbreviated codes, now considered the 'standard' in NZ is evidenced by citation of the website in peer-reviewed publications

Access via search engines remains the most frequent pathway to the NVS website (37%): 30% of the navigation to the NVS website was direct traffic, indicating that frequent users bookmark the website.

Referrals from other sites accounted for 33% of page views. Apart from the Manaaki Whenua website, the NVS website receives the most referrals from the NZPCN (NZ Plant Conservation Network), MfE, and DOC websites.

12.2 Document and software downloads

Various documents and software are available to download from the NVS website and during 2018/19, a total of 890 documents were downloaded, the most popular of which are listed in Table 1.

Table 1. Number of document downloads from the NVS website during 2018/19 (compiled using Google Analytics)

Item	Number of downloads (Google Analytics)
NVS Plant Names List	365
Forest Plot – pro forma data sheets (Recce, Stem Diameter and Sapling etc)	264
Grassland survey manual and pro forma data sheets	141
DOC Tier 1 – manuals and pro forma data sheets	80
Reconnaissance plot manual*	79
Forest permanent plot manual*	62
FBI manual, plot-sheets and foliar cover scale	59
NVS Express software package	33
NVS Express Data Entry Manual	17
Using VegX with NVS	17

*Combined totals for previous and updated (2007, expanded and field-guide) manuals.

The most popular items downloaded from the website were the NVS Plant Names List, which includes six-letter NVS codes, blank data sheets associated with forest plot measurement, grassland survey manuals & associated blank data sheets, and items associated with the DOC Tier 1 surveys.

13 Access to NVS data

13.1 Direct requests for NVS data

This year the NVS databank provided 2,294 data sets to meet requests from 55 different users (Fig. 3a & b). This reflects the continuing trend of users, particularly in the NZ research community, to conduct data syntheses at both NZ and international scales. 36% of data sets requested were supplied via the NVS website, and 64% were custom requests with data manually extracted from NVS.

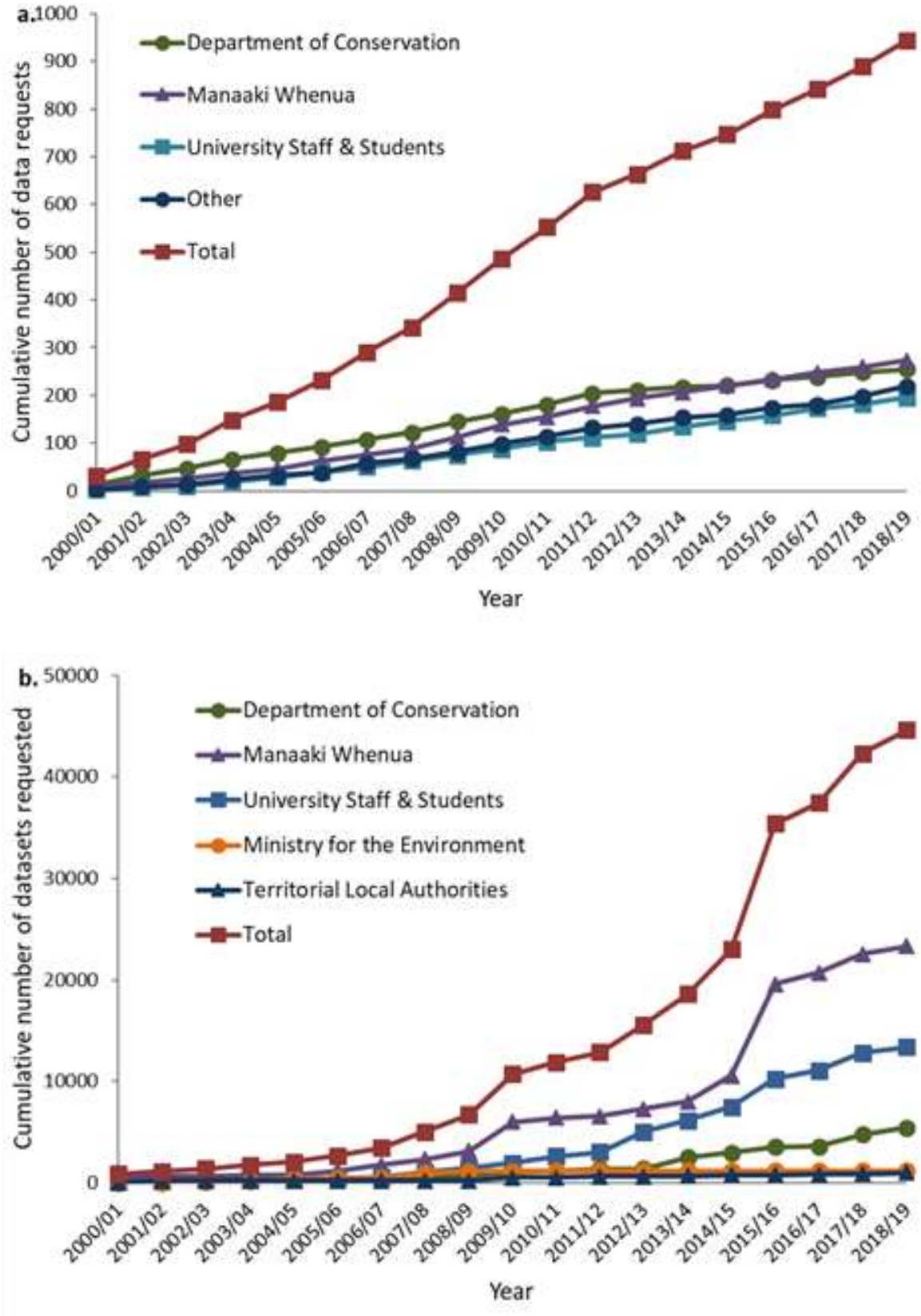

Figure 3. Trends in number of requests for NVS data since 2000, broken down by end-user type. a) cumulative number of requests; b) cumulative number of datasets requested (and delivered).

Some examples of intended uses of these data are:

- A researcher working with the Nelson City Council requested plot data, including exclosure data, from the Nelson region to inform the Councils own vegetation/pest animal management and monitoring activities.
- A researcher from SCION (NZ Forest Research Institute) requested data for a project evaluating the growth of naturally regenerated totara (*Podocarpus totara*) in the northern part of the North island.
- A researcher from NIWA (National Institute of Water and Atmospheric Research) was interested in data for a study commissioned by Meridian Energy of riverbed vegetation in the Waitaki catchment.
- A researcher from Manaaki Whenua requested NVS data to map radiata pine (*Pinus radiata*) invasions nationally and to assign the plots in which radiata pine occurred to national plot classifications.
- A researcher from Manaaki Whenua requested data for a project to assess the relationships between functional traits of trees and understory invasions in NZ forests
- Data requested from NVS by students were used to understand the regeneration of indigenous vegetation after possum control, describe vegetation in the Mackenzie Basin and to model species distributions.
- Manaaki Whenua staff requested NZ-wide plant community map species-specific nectar and pollen production measures as a function of land cover and environment. The goal is to enable landscape-level predictions of hive carrying capacities and potential honey production.
- A private contractor for Environment Southland requested data to ground-truth a preliminary map of the potential vegetation cover of Southland, including beech forest ecosystem types that can be difficult to map using aerial photo interpretation traditional methods.
- The arrival of myrtle rust in NZ has resulted in requests for Myrtaceae species distribution data to, for example, monitor the impacts of myrtle rust, calculate recruitment and mortality for NZ native Myrtaceae species and locate individuals of unevenly distributed Myrtaceae species for seed collection from around the Coromandel Peninsula.
- A large request of level 1 (public datasets) was made as part of a project to map global forest diversity. The goal is to calculate alpha-, beta-, and gamma-diversity of tree species, based on forest inventory data, and extrapolate the point data to map these characteristics across forested regions of the world.
- An environmental group in Kaikoura were interested in looking through vegetation plot data of the area to inform a revegetation program near Oaro. They were particularly interested in how matai (*Prumnopitys taxifolia*) fit in the landscape.

14 Building internal capability

This year NVS staff took two recently hired, highly experienced programmers into the field to provide them a direct experience in the collection of field vegetation plot data. Direct experience is invaluable to help them develop informatics tools that are suitable to meet both data management and data use needs. A new early-career plant ecologist completed development of a data pipeline to allow direct access to the backend NVS databank using the universally adopted R package for data management, summary and statistical analysis. This will facilitate direct access for synthetic research using from 10s to 100s to even 1,000 individual data sets. This represents an important component of our succession planning, as a high level of expertise is required to navigate the complexities of the back-end database and ensure data extracts are suitable for the intended applications. Finally, we have begun the internal process for succession of the NVS director and training of a staff member to share the duties of the NVS administrator.

15 Publications associated with the NVS Databank

15.1 Publications and conference presentations funded by the NVS programme

Arnst E, Wiser S, Abozeid M, Watts M 2018. [Poster] A new search tool to aid discovery of data from the National Vegetation Survey Databank. New Zealand Ecological Society Conference, Wellington, 25–29 November 2018.

15.2 Published papers

The following 57 2018/19 publications used data archived in the NVS Databank. This list includes earlier publications that were not reported in previous annual reports. GBIF now provides reports of publications that have incorporated data sourced from the NVS Databank via GBIF. This has greatly enhanced our ability to identify such publications.

Antonelli A, Hettling H, Condamine FL, Vos K, Nilsson RH, Sanderson MJ, Sauquet H, Scharn R, Silvestro D, Töpel M and others 2016. Toward a self-updating platform for estimating rates of speciation and migration, ages, and relationships of taxa. Systematic Biology 66(2): 152–166. [Data sourced from GBIF]

Bacon CD, Velásquez-Puentes FJ, Hinojosa LF, Schwartz T, Oxelman B, Pfeil B, Arroyo MT, Wanntorp L, Antonelli A 2018. Evolutionary persistence in *Gunnera* and the contribution of southern plant groups to the tropical Andes biodiversity hotspot. PeerJ. 16;6:e4388 [Data sourced from GBIF]

Bernard-Verdier M, Hulme PE 2019. Alien plants can be associated with a decrease in local and regional native richness even when at low abundance. Journal of Ecology. 107: 1343–54.

Bombaci S, Pejchar L, Innes J 2018. Fenced sanctuaries deliver conservation benefits for most common and threatened native island birds in New Zealand. Ecosphere 9(11): e02497.

Brock JMR, Perry GLW, Lee WG, Burns BR 2016. Tree fern ecology in New Zealand: A model for southern temperate rainforests. Forest Ecology and Management 375: 112–126. [Data sourced from GBIF]

Brock JM, Perry GL, Lee WG, Schwendenmann L, Burns BR 2018. Pioneer tree ferns influence community assembly in northern New Zealand forests. New Zealand Journal of Ecology 42(1): 18–30.

Bruelheide H, Dengler J, Purschke O, Lenoir J, Jiménez-Alfaro B, Hennekens SM…..Orwin K..2018. Global trait–environment relationships of plant communities. Nature Ecology and Evolution. Jul 31.

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Zörner J, Dymond JR, Shepherd JD, Wiser SK, Bunting P, Jolly B 2018. Lidar-based regional inventory of tall trees - Wellington, New Zealand. Forests 9: 702–71.

15.3 Contract reports

The following 12 2018/19 contract reports used data archived in the NVS Databank.

Bellingham P, Wiser S, Burge O, Easdale T, Richardson S 2018. Potential of Tier One and alternative monitoring networks to assess the ecological integrity of alpine vegetation exposed to tahr grazing. MWLR Contract Report LC3328 for the Department of Conservation.

Easdale T, Burrows L, Bellingham P, Carswell F 2019. Rates of carbon sequestration in naturally regenerating indigenous forests. Manaaki Whenua – Landcare Research Contract Report LC3530 for SCION.

Fitzgerald NB, Mason, Mason NWH, Smale MC 2019. Changes in Bay of Plenty frost flat heathland, 2012–2018. Manaaki Whenua – Landcare Research Contract Report LC3411 for Bay of Plenty Regional Council.

Husheer S 2018. Molesworth evgetation 1952–2016. Contract report by New Zealand Forest Surveys prepared for the Department of Conservation. 65 p.

Husheer S 2018. Kaweka Forest Park Mountain Beech Project Culling and Monitoring Review. Contract report by New Zealand Forest Surveys prepared for the Department of Conservation. 58 p.

Mason NWH 2019. Thornton kānuka plot remeasurements: analyses of change in native dominance. Manaaki Whenua – Landcare Research Contract Report LC3496 for Bay of Plenty Regional Council.

Mason NWH, Price RJ 2019. Trends in the health of Bay of Plenty forest communities. Manaaki Whenua – Landcare Research Contract Report LC3433 for Bay of Plenty Regional Council.

Maule H 2019. Final Report: 406036 Botanical Survey of Apiary Sites. Manaaki Whenua – Landcare Research Contract Report LC3473 for Ministry for Primary Industries.

McCarthy JK, Richardson SJ, Cooper JA, Bellingham PJ, Wiser SK 2019. Species distribution models of the native New Zealand Myrtaceae. Manaaki Whenua – Landcare Research Contract Report LC3458 for Scion.

Wilmshurst J, Wood J, Fergus A, Scheele S, Walls G, Richardson S 2018. He Kainga Taurikura – A Treasured Environment. Manaaki Whenua – Landcare Research Contract Report LC3365 for Maungaharuru-Tangitū Trust.

Wilmshurst JM, Wood JR, Fergus AJ, Scheele S, Richardson SJ 2018. Whakapapa o te Taiao. Manaaki Whenua – Landcare Research Contract Report LC3364 for Te Kopere O Te Iwi O Hineuru Trust.

15.4 Conference presentations

The following six 2018/19 conference presentations (or earlier conferences not reported) used data archived in the NVS Databank. Note that this is unlikely to be a comprehensive list, as it is very challenging to track such presentations.

Burge O, Burrows L, Richardson S, Bellingham P, Wiser S, Arnst E, Morse C, Wilmshurst J, Ford K, Robinson M, Maule H, Buxton R, Boot K 2018. Reviving the Cockayne plots: 130 years of post-fire succession records in Arthurs Pass, NZ. New Zealand Ecological Society Conference, Wellington, 25–29 November 2018.

De Bello F, Gotzenberger L, Valencia E, Lepš J 2018. Accounting for directional trends in species synchrony through time: problems and solutions. 61st Annual Symposium for the International Association of Vegetation Science, Bozeman, Montana, USA, 22–27 July 2018.

McCarthy J, Richardson S, Wiser S 2018. Mapping the distributions of Aotearoa's native Myrtaceae. Presentation to the 2018 New Zealand Ecological Society Conference, Wellington, 28 November 2018.

Wiser S, Affeld K, DeCáceres M 2018. Using classification assignment rules to assess land use change impacts on national and regional forest biodiversity: a case study using the Mokihinui dam proposal. 2018 Conference of the New Zealand Ecological Society, Victoria University, Wellington, 25–29 November 2018.

Zörner J, Dymond JR, Wiser SK, Shepherd JD, Jolly B 2018. Using airborne LiDAR to study the spatial distribution of tall trees in Greater Wellington, New Zealand. European Geosciences Union (EGU) General assembly, 7–12 April 2019.

Zörner J, Dymond JR, Shepherd JD, Wiser SK, Pairman D, Sabetizade M. 2019. Joint use of space-borne SAR, optical imagery and air-borne LiDAR for improved mapping of forest structural types in New Zealand. GeoComp.

15.5 Theses

The following three 2018/19 theses used data archived in the NVS Databank:

Bellve A 2018. The distribution of epiphytic *Astelia* and their role in habitat formation. MSc thesis in Biological Sciences, the University of Auckland, New Zealand.

Beckmann M 2018. in search of similarities in invasive plant species – comparing native and invasive populations of six clonal plant species in Germany and New Zealand. Doctoral dissertation, Christian-Albrechts Universität, Kiel, Germany.

Nkuna KV 2018. Risk analysis of alien grasses occurring in South Africa. MSc thesis, Stellenbosch University, South Africa. [Data sourced from GBIF]

Appendix 1 – New electronic datasets in NVS 2018/19

Datasets digitised by Manaaki Whenua – Landcare Research/DOC Tier One programme

Banks Peninsula Birdlings Flat Stony Beach Ridges 2018

Botanical Survey of Apiary Sites 2019

DOC Tier 1 2017

MOLESWORTH-JOLLIES WILDING PINES 2018

MT BARKER WILDING PINES 2018

ORONGORONGO BEECH STUDY AREA 1972

WAIKARE FOREST MONITORING 2005

WARAWARA FOREST 2018

WELLINGTON LAND DISTRICT 2013

WELLINGTON LAND DISTRICT 2011

WOODHILL 2019

Datasets entered using NVS Express and migrated into the NVS Databank

East Harbour 2018

GREATER WELLINGTON FOREST MONITORING 2017

Lake Okataina Exclosures 2007

POMONA ISLAND 2016

Rona Island 2005

Rona Island 2016

WAIRARAPA WETLAND EXCLOSURES 2017

WAIRARAPA WETLAND EXCLOSURES 2018

Datasets migrated from other formats into the NVS Databank

TAWHARANUI REGIONAL PARK 2005

Hard-copy plot sheets accessioned and archived:

ARTHURS PASS TRANSECTS 1890 - 2000

BANKS PENINSULA BIRDLINGS FLAT STONY BEACH RIDGES 2018

Botanical Survey of Apiary Sites 2019

EAST HARBOUR 2018

GRANVILLE FOREST SMALL COUPE HARVESTING TRIALS 1995

GRANVILLE FOREST SMALL COUPE HARVESTING TRIALS 1996

GRANVILLE FOREST SMALL COUPE HARVESTING TRIALS 1997

GRANVILLE FOREST SMALL COUPE HARVESTING TRIALS 1998

GRANVILLE FOREST SMALL COUPE HARVESTING TRIALS Post-harvest 1994

GREATER WELLINGTON TIER 2 FOREST MONITORING 2017-2022

KOKATAHI PERMANENT FOREST PLOTS 2018

MOLESWORTH-JOLLIES WILDING PINES 2018

MT BARKER WILDING PINES 2018 - 2019

OHOPE SCENIC RESERVE FOREST HEALTH ASSESSMENT 2018

OMIHI SOUTHERN RATA 2018

Orongorongo 2019

ORONGORONGO BEECH STUDY AREA 1972

Pomona Island 2005

Pomona Island 2005

POMONA ISLAND 2016

PUKETI FOREST 2017

PUKETI FOREST SEEDLING PLOTS 2017

Rona Island 2005

Rona Island 2016

SLOPEDOWN FOREST PLANTING TRIAL 1976

SLOPEDOWN FOREST PLANTING TRIAL 1978

SLOPEDOWN FOREST PLANTING TRIAL 1980

SLOPEDOWN FOREST PLANTING TRIAL 1982

STAFFORD 2018

TARAMAKAU- DECEPTION 1972

TARAMAKAU- DECEPTION 1973

WAIRARAPA WETLAND EXCLOSURES 2017

WAIRARAPA WETLAND EXCLOSURES 2018

WANGANUI STATE FOREST LOGGED TERRACE RIMU 1966

WARAWARA FOREST 2018

WELLINGTON LAND DISTRICT 2011

WELLINGTON LAND DISTRICT 2013

WOODHILL 2019

Appendix 2 – User needs survey

Questionnaire

The National Vegetation Survey (NVS) Databank is a nationally significant database administered by Manaaki Whenua – Landcare Research. It is a physical archive and computer databank containing records from over 104,000 vegetation survey plots – including data from over 24,000 permanent plots. These data can be explored online as well as requested for download. See http://nvs.landcareresearch.co.nz for further information.

We are conducting this survey to help us plan our future activities to maximally benefit the NVS Databank user community.

A. Some background about you

1 What type of organisation are you associated with?

	Landcare Research
	Other Crown Research Institute
	Department of Conservation
	Ministry for the Environment
	Ministry for Primary Industries
	Other NZ Government Department or Ministry
	NZ Regional, District, or City Council or Territorial Authority
	NZ University
	University outside of NZ
	NZ Consulting firm
	Māori organisation
	NGO
	Other (specify)

2 How do you currently use plot-based vegetation data?

(X as many as apply to you)

	For research purposes
	For managing biodiversity
	For reporting on biodiversity status and trends
	On behalf of a community group
	On behalf of a Māori organisation
	For developing databases and computer applications for use within my organisation
	For developing policy
	For training that I am undertaking
	For training that I am providing
	For personal interest
	On behalf of private landowners
	Other (specify)

3 What future uses do you think you might have for NVS data?

4 How long have you been involved in collecting or using plot-based vegetation data?

	< 1 year
	1–5 years
	> 5 years
	Other (specify)

B. Basic use of NVS

5 How do you rate your awareness of the NVS databank?

X the one that best applies to you

	I know something about it but have never used it
	I have been to the NVS website but have never deposited to or retrieved data from the databank
	I have deposited data into the NVS databank
	I have retrieved data from the NVS databank
	I have BOTH deposited and retrieved data from it
	Other comments:

6 How important is the NVS Databank and associated tools to you or your work? [1 to 5, not important to very important]

7 How frequently do you use the NVS Databank?

	Monthly
	Quarterly
	Yearly
	Irregularly

If you HAVE used NVS to deposit or retrieve data, then please go to Question 14

If you have NOT used NVS:

8 Do you currently enter plot-based vegetation data to an electronic form?

	Yes
	No

9 How do you currently store and archive your vegetation plot data?

10 Do you consider NVS to be a suitable repository for your vegetation plot data storage and archive needs?

- ☐ Yes
- ☐ No

Please explain your response.

11 Do you currently use pre-existing vegetation plot data?

- ☐ Yes
- ☐ No

12 What do you think are the main impediments to you making use of the NVS databank?

If you have NOT used NVS and have answered the above questions, then please go to Question 56

If you HAVE used the NVS database:

13 If you need help, what is the most common way you contact NVS staff?

- ☐ Phone call
- ☐ Email
- ☐ Contact via the NVS website
- ☐ Have not required assistance
- ☐ Other (please specify)

14 How would you rate the quality of service provided by NVS staff?
[1 to 5, very poor to very good]

Very good

Good

Neither good nor poor

Poor

Very poor

Please explain your response.

C. The NVS protocol

15 Are you familiar with the current NVS data-use protocol?

- [ ] Yes
- [ ] No

16 Does the data-use protocol meet your needs for security and access?

- [ ] Yes
- [ ] No

17 Are there any services that NVS could provide that would encourage you to make your data open access (Level 1)?

D. Depositing data into NVS

18 How do you digitise your own data (choose all answers that apply)?

- [ ] a. Using NVS data entry staff
- [ ] b. Using NVS-Express (available from the NVS website)
- [ ] c. Using the NVS Excel tool (available from the NVS website)
- [ ] d. Using electronic field data capture tools
- [ ] d. Using the NVS database user interface (Landcare Research and DOC staff only)
- [ ] e. Using other software

If e. what software?

19 how would you rate the ease of use of NVS Express for data entry?
[1 to 5, very difficult to use to very easy to use]

20 Do you find the data entry instruction manual helpful?

- [ ] Yes
- [ ] No

21 Are you aware there is an inbuilt validation tool for checking your data after entry?

- [ ] Yes, I use it
- [ ] Yes, but I do not use it
- [ ] No

22 Do you upload your data to the NVS databank after entering it?

- [ ] Yes
- [ ] No

23 Do you have any suggestions for improving NVS Express for data entry?

24 Would you attend a workshop for training in using this tool?

- [ ] Yes
- [ ] No

25 Where would be your preferred location or venue?

26 Have you used the online system for uploading metadata or data into the NVS databank?

- [ ] Yes
- [ ] No

27 How would you rate the ease of use?
[1 to 5, very difficult to use to very easy to use]

28 Do you have any suggestions for improvements?

29 When you have deposited data into NVS, how would you rate the process?
[1 to 5, very hard to very easy]

30 Please explain your response

31 What would make the data deposit process work better for you?

32 How do you rate the process whereby other users request your data?
[1 to 5, very poor to very good]

33 Please explain your response

E. Requesting, retrieving and analysing data from NVS

34 Have you used data from the NVS Databank during the last 2 years?

- ☐ Yes
- ☐ No

35 How would you rate the quality of the data in the NVS Databank?
[1 to 5, very poor to very good]

36 Please explain your response

37 When you have requested data from the NVS databank, how would you rate the process?
[1 to 5, very hard to very easy]

38 Please explain your response

39 In what form or format do you most prefer to receive data?

- [ ] NVS-Express
- [ ] .csv / .txt
- [ ] Excel
- [ ] MS-Access
- [ ] CANOCO
- [ ] PC-Ord
- [ ] Pre-printed plot sheets
- [ ] Veg-X exchange standard (XML)
- [ ] Other (specify)

40 How important would dynamic Internet access (live, real-time, interactive, web-service, API) be to you when requesting and receiving data from NVS?

- [ ] Not useful
- [ ] Useful
  Provide detail here:

41 How important is access via (rank these options: 1=most important);

- [ ] A GIS interface
- [ ] A database query interface
- [ ] A statistical interface
- [ ] Other - describe

42 Would you like to see integration data held by Manaaki Whenua - Landcare Research? Please describe

43 If you have any further comments about the data requesting and retrieval process, please put them here.

44 Have you found errors in data you have retrieved?

- [ ] Yes
- [ ] No

45 did you report these errors back to NVS?

- [ ] Yes
- [ ] No

46 Could anything be done to make it easier for you to report errors back to NVS?

47 Do you analyse vegetation plot data sourced from NVS?

- [ ] Yes
- [ ] No

48 What software packages do you use to analyse/summarise quantitative vegetation data? (X the one(s) that applies)

- [ ] NVS-Analysis software (downloadable from NVS website)
- [ ] R
- [ ] Vegetation data analysis software (e.g. CANOCO, PC-ORD)
- [ ] Generic spreadsheets or databases (e.g. MS-Excel, MS-Access)
- [ ] Other statistical packages
- [ ] GIS
- [ ] Other – describe

49 How would you rate the ease of use of the NVS-Analysis software?
[1 to 5, very difficult to use to very easy to use]

50 What measurement methods do you analyse using NVS-Analysis? (e.g. recce, understorey, stem diameter, site variables etc)

51 What analytical tools do you use (e.g. tabular summaries, graphs, cross-tabulations, classification, other?)

52 Do you find the NVS-Analysis instruction manual helpful?

- [ ] Yes
- [ ] No

53 Do you have any suggestions for improvements?

54 Would you attend a workshop for training in the NVS-Analysis software?

- [ ] Yes
- [ ] No

55 Where would be your preferred location or venue?

F. The NVS website

56 When did you most recently visit the NVS website?

- [ ] Within the last month
- [ ] Within the last year
- [ ] More than a year ago
- [ ] Never

57 What did you use or download? (check all that apply)

- [ ] Information in the website text
- [ ] The data search capability
- [ ] The data contribution capability
- [ ] The NVS plant names and code list
- [ ] The field manuals
- [ ] The field data sheet templates
- [ ] The MyNVS facility
- [ ] NVS software (NVS-Express, NVS-Analysis, NVS Excel template
- [ ] Other (specify)

58 What did you find were the most, and least, useful features of the website?

Most useful: Least useful:

59 What other new features would you like to see in the NVS website?

G. Database integration within and between organisations

This section asks you to consider options that you might use for archiving data in future, and what your preferences for database integration within and between organisations might be.

60 Does your organisation receive vegetation data from other organisations? If so, can you give examples?

61 Does your organisation give vegetation data to other organisations? If so, can you give examples?

62 Does your organisation have a strategy for, or conform to e-government standards on:

a The E-government Interoperability Framework (NZ e-GIF)

b Inter-agency secure transfer of data?

c New Zealand Geographic Locator Service (NZGLS) and general metadata standards?

d Has your organisation any plans for investing in web service mediated data exchange?

e Does your organisation contain skills necessary to deal with XML formatted information?

63 In 10 years', time, how do you think New Zealand should store vegetation data on behalf of agencies and groups, and how should data interchange work?

And finally:

64 Are there any other topics you wish to discuss or comments that you wish to make that have not been covered above?

65 What is the best means for us to provide you and your organisation with information about any updates and developments associated with the NVS Databank and website?

	Direct contact by email
	News item on the NVS website
	Workshop
	Conference presentations (if yes indicate where) Which conferences:
	Other (specify):

66 If you would like us to get in touch regarding anything above, please provide your name and contact details

Thank you.