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NVS Annual Report for the 2015/16 year

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Contents

1 Number of new records archived in NVS

A total of 40 new projects[1] were added electronically to NVS in 2015/16 (year to 30 June 2016; Figure 1 & Appendix 1) with a total of 2148 plots added. Of these, 1875 were new plots, the remainder were remeasurements of pre-existing plots. This brings the total number of projects in NVS to 1571 comprising 103,827 individual plots. Data additions since 2006/07 are shown in Figure 1, broken down by major provider.

New data over the past year have come from a remarkable variety of environments, including beaches, lakes, ephemeral wetlands, pine forest, gumlands, grasslands (high and low country), islands within lakes, and indigenous forest. A notable addition to our collection of data from the wider Pacific is the project Niue – Huvalu Forest Conservation Area 2015. This FAO-funded project was led by Larry Burrows of Landcare Research, Lincoln with the objective of implementing activities that will enable Niuean communities to conserve biodiversity, and sustainably manage their forest resources in protected areas. A second notable addition was data associated with the project Hapupu National Historic Reserve Kopi Monitoring 2012. The purpose of this project was to assess the overall health of kopi (*Corynocarpus laevigatus*) forest at Hapupu, Chatham Islands, including the health of kopi with Moriori dendroglyphs, after the canopy of the forest was damaged by a storm 10 years before.

Development and use of NVS Express software has facilitated the addition of data into NVS for some data providers; six projects (133 plots) deposited into NVS in 2015/16 were via NVS Express, the same number of projects as last year.

Again this year, we devoted a significant period of time to processing the 'backlog' of paper records housed in the NVS archive . The accession policy written in 2014/15, which includes clear criteria to guide decisions on whether or not the materials fit within the scope of the NVS databank, proved very useful.

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

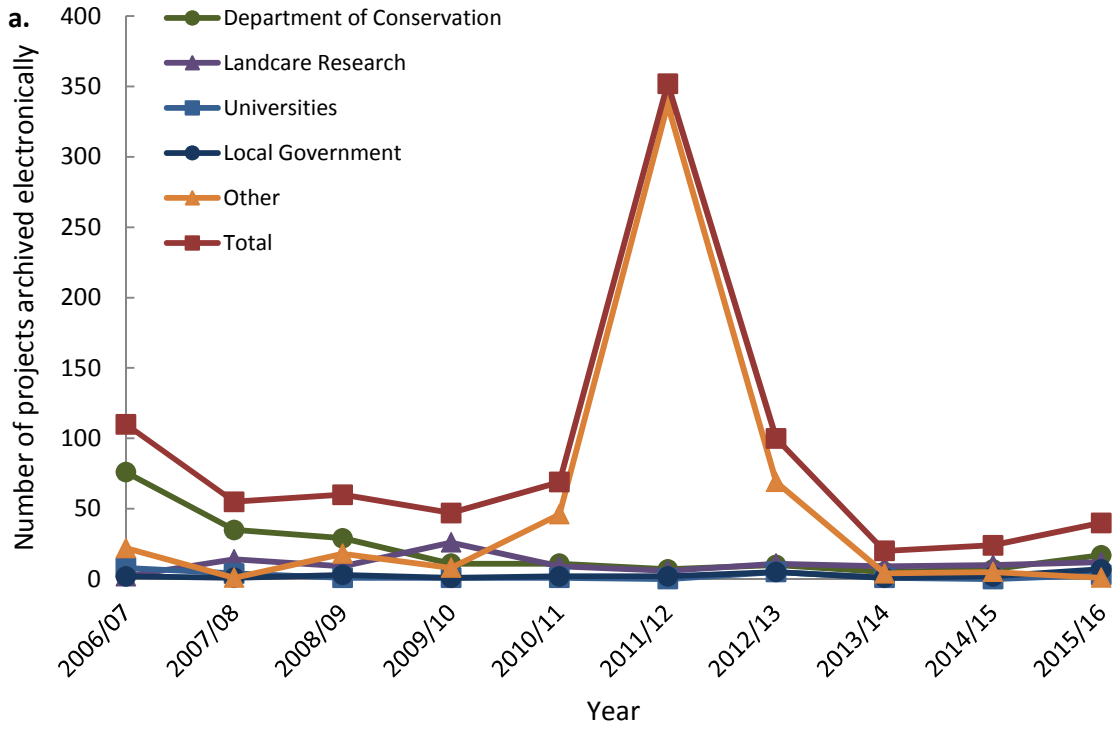

Figure 1 Number of projects archived in the National Vegetation Survey databank, total and from four major contributors, per financial year since 2006/7. The spike in 2011/12 was the product of the incorporation (funded by the Terrestrial and Freshwater Biodiversity Information System (TFBIS)) of the large DTZ vegetation monitoring dataset collection (see the NVS annual report for 2011/12).

2 Database development and integration

Developments were made both in the structure of the NVS backend database and in the user interface. For example:

- We have now implemented a process to allow the nature of a dataset request to be specified. While NVS tracks when individual datasets are provided to data users, in the past it was very cumbersome to record whether a dataset was requested as part of a larger request involving hundreds of datasets.

Specific improvements have been made to the module developed for the DOC Tier One monitoring program. These include:

- new data validations that allow for missing data and enable data quality issues across plot records to be identified and corrected, such as Plot Treatment being missing or different between different measurement years.
- new bulk load capability added between the NVS user interface tool and the backend database. This improved the both the speed of the NVS interface and reduced server impacts, thereby improving the overall performance of the NVS system for other users.

- modified form design on the site description and plot visit metadata screens to be more consistent with the Tier One paper record forms. This will make it easier for Tier One data entry teams to enter data from the paper-based plot sheets and ensure better accuracy and improved efficiency.

Developments have been made to improve the metadata system including:

- streamlined data storage to remove redundancy, which is when the same kind of metadata was stored in multiple places and in a confusing way. This has improved accuracy of the metadata records

3 Significant revisions of data

This year we continued to devote resources to addressing much needed data corrections and revisions across historic data held in the NVS databank. Corrections and revisions included:

- Metadata
  - Inconsistencies in project names between the NVS core database and the metadatabase were resolved
  - Correcting inconsistences in metadata project names and dataset titles were corrected
- Project integrity
  - Plots were reassigned to projects to maintain temporal consistency among the various projects measured as part of the long-term assessment of impacts of Himalayan thar
- Temporal consistency in long-term datasets
  - Across all projects, where dead stems and live stems were in separate datasets, these were merged into single datasets, as is now the standard NVS approach
  - Temporal inconsistencies in plot names in the Waitutu Fertiliser Experiment project were corrected to allow plots to be correctly matched to examine temporal change
- Plot locations
  - Inconsistencies between recorded map sheet and geolocations for c. 2900 plots were explored and corrected accordingly
- Plot attributes and site data
  - Plot shapes that had been incorrectly described as circular were corrected
  - Where method of plot placement (e.g. random, grid-based, subjective) was provided in a project's metadata, this was applied at the individual plot level in the NVS database
- Plant names
  - Incorrect linkages between the NVS taxon list and the NZ Plant Names Database were resolved to stop NVS codes being linked to the wrong taxonomic name

4 Increasing end-user awareness and capability

4.1 Training workshop in NVS Express

Elise Arnst and Hamish Maule ran a 1-day workshop for NVS Express at the start of the New Zealand Ecological Society Conference at the University of Canterbury. Six participants attended from the University of Canterbury, University of Otago, Taranaki Regional Council, and Department of Conservation. The workshop provided knowledge but also reinforced positive relationships with key organisations and will likely lead to ongoing positive interactions and increased use of NVS and NVS Express.

4.2 Presentations and workshops for end users

Landcare Research staff associated with the NVS databank delivered several presentations throughout the year to disseminate information to end users and other government agencies and to support reviews of Landcare Research. For example, in November 2015, Susan Wiser gave the presentation 'New Zealand's National Vegetation Survey databank and "big data"' to a group representing the French research sector. The goal is for Landcare Research to create stronger linkages with research institutions in France and associated territories in the Pacific (New Caledonia, French Polynesia). Susan highlighted opportunities for collaboration by combining data in NVS with data from France (or territories) and also to explore the establishment of a Pacific Island vegetation plot databank. Also in November, she gave a presentation and tour of the NVS archive to the Landcare Research Science Advisory Panel, Board and Senior Leadership team. Susan described a number of aspects of NVS including a) history and content, b) lessons we have learned in developing NVS, c) ongoing and future challenges, and d) exciting future prospects. In May 2016 Elise Arnst gave a tour of the NVS archive area to a delegation of policy analysts from MfE. She described the importance of archiving data and current and potential uses of data in the NVS databank. This highlighted the role NVS plays in handling nationally significant datasets, including those belonging to MfE.

Landcare Research Link is a series of short seminars and discussions for environmental policymakers in Wellington. These sessions provide an informal way for our scientists to deliver key research outcomes or share the challenges associated with our science with a broad-based policy audience. The peer-to-peer feedback and discussion is valuable to the Landcare Research team, and more discussions often follow. In April 2016, Susan Wiser gave a Link seminar titled 'Mobilising Vegetation Data: the National Vegetation Survey Databank'. Approximately 30 people attended representing a wide range of stakeholders including DOC, MfE, Greater Wellington Regional Council, MPI, Wellington City Council and independent consultants. In this seminar she introduced and described the NVS data resource, explained its potential to address a diverse array of needs and questions and how the data can be explored and used. She also introduced some of the informatics challenges and lessons learned in managing such a resource in the face of ever-changing technologies and expectations of the open-data movement.

4.3 NVS used in courses and training

To support journal requirements to archive data, we reported in 2014/15 how the NVS databank has teamed up with the Landcare Research DataStore to deliver on this requirement for data originally sourced from the NVS databank. One of the most comprehensive NVS datasets stored in the DataStore is from the Waitutu Forest Study conducted between 2001 and 2008. A teacher from St Paul's Collegiate in Hamilton set an assessment ('Investigating bivariate measurement data') for an NCEA level 3 Mathematics class that utilised data from our DataStore repository. As per our licence on DataStore, the assessment worksheet cited our data as the source, and also referenced some publications by Landcare Research staff. After being contacted by a student looking for additional information to help him with his analysis, we obtained further details and links to additional papers from the scientists involved who were very pleased to see their data being used in this way. We also contacted the teacher to congratulate him on his initiative of using real data and encouraging students to investigate. The teacher responded thanking Landcare Research and the scientists for "the wonderful dataset on the Waitutu Forest". He said "I chose Waitutu Forest Saplings data assessment as in my opinion it was the one that was the most interesting to NZ students". There are teams of volunteer teachers who get together during the summer holiday to write assessments (available for use by schools across the country). This is a nice example of our data being discoverable, accessible and well-documented. This has enabled its use in an unforeseen and very worthwhile way. Moreover, there is a high probability that Landcare Research and the Waitutu data are now well known to a whole set of secondary students across the country!

Shirley Vickers, the long-term NVS programmer, took the post-graduate course 'Practical Data Mining' at Massey University this year. To satisfy the course requirements she completed the project 'Evaluation of data mining classifiers for predicting presence of a fern from externally assessable site attributes including canopy species'. For this project she applied nine data mining classification methods to predict the presence or absence of fern *Leptopteris superba* at a site, based on attributes that could be assessed without actually visiting the site, from a dataset of 8500 NVS plots linked spatially with rainfall and temperature data. The most important predictors were rainfall and a small number of canopy species (including *Pseudowintera colorata*, *Cyathea smithii*, *Coprosma ciliata*, and *Raukaua simplex*). The classification performed best on 14 canopy species, with 74% precision (i.e. the species were predicted to occur where they actually do occur).

4.4 Increasing access and end-user capability

We have improved the efficiency and capabilities of diverse end-users to access NVS data by:

- creating a secure connection between NVS and the MfE LUCAS program so that the MfE LUCAS staff can review DOC Tier One data, which are collected from LUCAS plots, as they are being entered
- creating a complex data export pipeline to allow DOC Tier One data stored in NVS to be exported to the LUCAS Gateway system, MfE's internal data

management system. This pipeline both maps all data elements from the NVS system into the LUCAS formats and performs all the data validation that is required for data in the LUCAS Gateway

- completing data element mapping for exporting occurrence data to GBIF using the current GBIF tools. The tools we had been using were old and no longer supported by GBIF. This allows us to keep the data that we provide to GBIF up-to-date.

4.5 New NVS users

Between 1 July 2013 and 30 June 2014, 60 new people became registered NVS users.

5 Data-sharing agreements, data exchange, journal repositories

5.1 Use of NVS data through the GBIF Portal

The mechanism for providing data to be uploaded into the GBIF portal has changed. GBIF recently produced the Integrated Publishing Toolkit (IPT), a free, open source software tool written in Java that is used to publish and share biodiversity datasets through the GBIF network. This required us to revise our process for providing NVS data to ensure it was in the correct format for the IPT. This was completed in June and the NVS data were ready for publishing. The actual publication and consequent availability via GBIF was completed in October 2016.

Improvements in the process mean that now we:

- aggregate our species records so that only one occurrence is provided per project. We used to provide multiple records when records for the same taxon were collected using different methods on the same plot (e.g. a taxon was recorded in both sapling counts and among tagged trees). This makes our data easier to use
- provide all records using the currently preferred taxon name, according to the NZ Plant Names database. This reduces inconsistencies among names for individual taxa that may have changed over time.

Between 1 July 2015 and 30 June 2016 there were 1885 downloads of species occurrence data, incorporating 499,375,742 records, accessed via the GBIF website.

5.2 NVS collaboration with sPlot

In preparation for the launch of the sPlot global vegetation plot database, version 2.0, NVS is now listed (October 2015) on the sPlot website as a contributing database (https://www.idiv.de/en/sdiv/working_groups/wg_pool/splot/consortium_and_contributing_databases.html) and the locations of the 1946 permanent grassland transect records

provided by NVS in 2014/15 appear on maps on the sPlot website (https://www.idiv.de/en/sdiv/working_groups/wg_pool/splot/splot_database.html) .

5.3 Use of NVS data via the Landcare Research NZ DataStore

There are now nine datasets deposited in the Landcare Research NZ DataStore that are connected to the NVS Databank; of these seven are publically available. Between 1 July 2015 and 30 June 2016, two datasets connected to NVS were within the monthly top 10 of datasets located using their doi and archived in the DataStore. The 'Waitutu SORTIE-NZ 2001-2008' dataset page was the most highly visited, with 449 hits according to Google Analytics. The datasets 'Puketi Forest 2011 Trait variation along a toposequence' and 'New Zealand bark thickness 2015' were also popular.

6 International collaborations

Susan Wiser was invited by the International Association for Vegetation Science to deliver a plenary presentation at the 2015 annual symposium in Brno, Czech Republic. The presentation 'How can we meet "big data" aspirations in vegetation informatics?' formed the basis for the invited paper 'Achievements and outstanding challenges in integrating, reusing and synthesising vegetation plot data' published in the Journal of Vegetation Science (see publications list below). In this paper she reviewed the progress in enabling vegetation plot data to be discovered (i.e. via the Global Index of Vegetation-Plot Databases) and integrated to answer exciting, large-scale ecological questions. However, barriers to data integration, reuse and synthesis remain, particularly missing or incorrect geographic coordinates and inconsistencies in plant names. Geographic and taxonomic barriers to data integration confront all biodiversity data integration efforts, both internationally and in New Zealand. Issues associated with data attribution and acknowledgement confront all of those who create and use data. The latter is extremely topical and is being widely addressed in the scientific literature as our technical abilities allow large-scale data exchange. It is important that the ethical constructs surrounding data use are developed alongside. The message of this paper is not just relevant to scientists, but also to those developing policies around data.

Susan Wiser contributed NVS data to a global study that found there are more than three trillion trees in the world – about eight times higher than previous estimates (see Crowther et al. below). That equates to about 422 trees per person in the world, not 61 as originally thought. But it's not all good news. The study, published in the scientific journal Nature, also took into account the impact of human activity on forests. It estimates deforestation is currently responsible for removing over 15 billion trees each year and the global number of trees has dropped 46% since human civilisation. Researchers from 15 countries collaborated on the global project. They used satellite imagery, forest inventories and supercomputer technologies to generate a map of the world's forests. More than 420,000 ground-sourced measurements of tree density from every continent except Antarctica were used. These measurements were taken from more than 50 countries. Previous estimates relied solely on satellite imagery. The study also highlights the importance of national-scale forest monitoring efforts and the role our collections and databases play in providing access to

these data, not just in underpinning New Zealand policy but in helping understand global patterns and properties of forest. This study on global tree density enables us to understand how New Zealand fits into a global context. In terms of trees per capita and trees per area of land, NZ just squeaks into the 90th percentile of the countries for which data were available. NZ tree density is comparable to other countries in the temperate broadleaf forest biome.

The Botanical Information and Ecology Network (BIEN) is a network of ecologists, botanists, conservation scientists and other researchers (including Susan Wiser and Nick Spencer) interested in global patterns of plant diversity, function and distribution. (See previous NVS annual reports for more detail about this group.) We have continued to provide our technical expertise to support publication efforts by this group, resulting in two publications this year (see publications list below). The first study, led by K. Engemann, assessed existing theory linking functional group dominance patterns to their drivers by quantifying the spatial distribution of plant functional groups at a 100 km grid scale. We used a standardised plant species occurrence dataset of unprecedented size covering the entire New World. Seven plant functional groups were considered, describing major differences in structure and function: epiphytes, climbers, ferns, herbs, shrubs, coniferous trees and angiosperm trees. The functional groups showed distinct geographical patterns of dominance across the New World. Temperature seasonality and annual precipitation were most frequently selected, supporting existing hypotheses for the geographical dominance of each functional group. Human influence and topography were secondarily important. Our results support the prediction that future climate change and anthropogenic pressures could shift geographical patterns in dominance of plant functional groups, with probable consequences for ecosystem functioning. The second publication, led by G. Goldsmith, presented a new SmartPhone App called 'Plant-O-Matic'. This serves as a mobile catalogue of all of the plants of the Americas developed using species distribution models estimated from field observations of plant occurrences. The underlying data comprise over 3.5 million standardised observations of over 88,000 plant species. Plant-O-Matic, a free iOS application, combines the species distribution models with the location services built into a mobile device to provide users with a list of all plant species expected to occur in the 100 × 100 km geographic grid cell corresponding to the user's location. The application also provides ancillary information on species' attributes (when available), including growth form, reproductive mode, flower colour, and common name. Results can be searched and conditionally filtered based on these attributes. Links to externally sourced specimen images further aid in identification of species by the user. The application's ability to assemble on demand locally relevant lists of plant species and their attributes for anywhere in the Americas provides a powerful new tool for identifying, exploring, and understanding plant diversity. Mobile applications such as Plant-O-Matic can facilitate dynamic new approaches to science, conservation and science education.

Susan Wiser 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.

7 Web statistics

Over recent years an increasing number of organisations are providing links to the NVS website as a resource for vegetation data, a provider of information on vegetation monitoring, and a New Zealand Government conservation resource. On average, 30% of page views resulted from referrals from other sites, whereas access via search engines remains the most frequent pathway to the NVS website (38%). The remainder (32%) was direct traffic, indicating that frequent users bookmark the website.

There are some new and interesting links to the NVS website and database, for example:

- NIWA provides a link to and description of NVS as a data resource for its 'Framework for Interoperable Freshwater Models'. These pages summarise what data is available for freshwater models, standards for exchanging data, and initiatives to make data more organised, discoverable, and available.
- The Department of Conservation publication *Mapping the services and benefits of indigenous biodiversity and historic heritage in New Zealand: An exploration of spatial datasets* included the NVS databank in its summary of currently available GIS-based ecosystem service assessment tools and how they can be used to further conservation in New Zealand. See http://www.doc.govt.nz/Documents/science-and-technical/sap260.pdf

From 1 July 2015 to 30 June 2016, the NVS website was visited 3545 times, down 11% from the 2014/15 year (3993 visits), and there were 12,333 page views. There were 1911 visitors to the site. Of the current year's hits that could be traced to origin, the majority of visits were from New Zealand (77%), followed by the USA/Canada (8%), Australia (3%) and the UK (2%). The website was also visited by people from another 70 countries. The data discovery and request component of the website is proving popular, with 31% of page views, and the data search tool attracting around half of those. The Index page received 23% of all page views and details about field techniques, manuals, and field forms were also popular (18% of page visits). Apart from the number of visits, these numbers are similar to last year.

8 NVS data requests

A total of 51 requests for NVS data and metadata were made during 2015/16 and 12,452 datasets supplied (Figure 2a, b), an increase of 16 requesters and an increase of 7244 datasets over the 2014/15 year. As over last year, this is reflecting the trend for modelling using large amounts of data. The principal agencies requesting data and number of datasets supplied since 2006 are shown in Figure 2b. Most data requests this year have been made directly through the website's data request tool, which is proving popular and which frees up NVS data administrative staff to perform other tasks. However, more complex and unusual data requests are still handled manually.

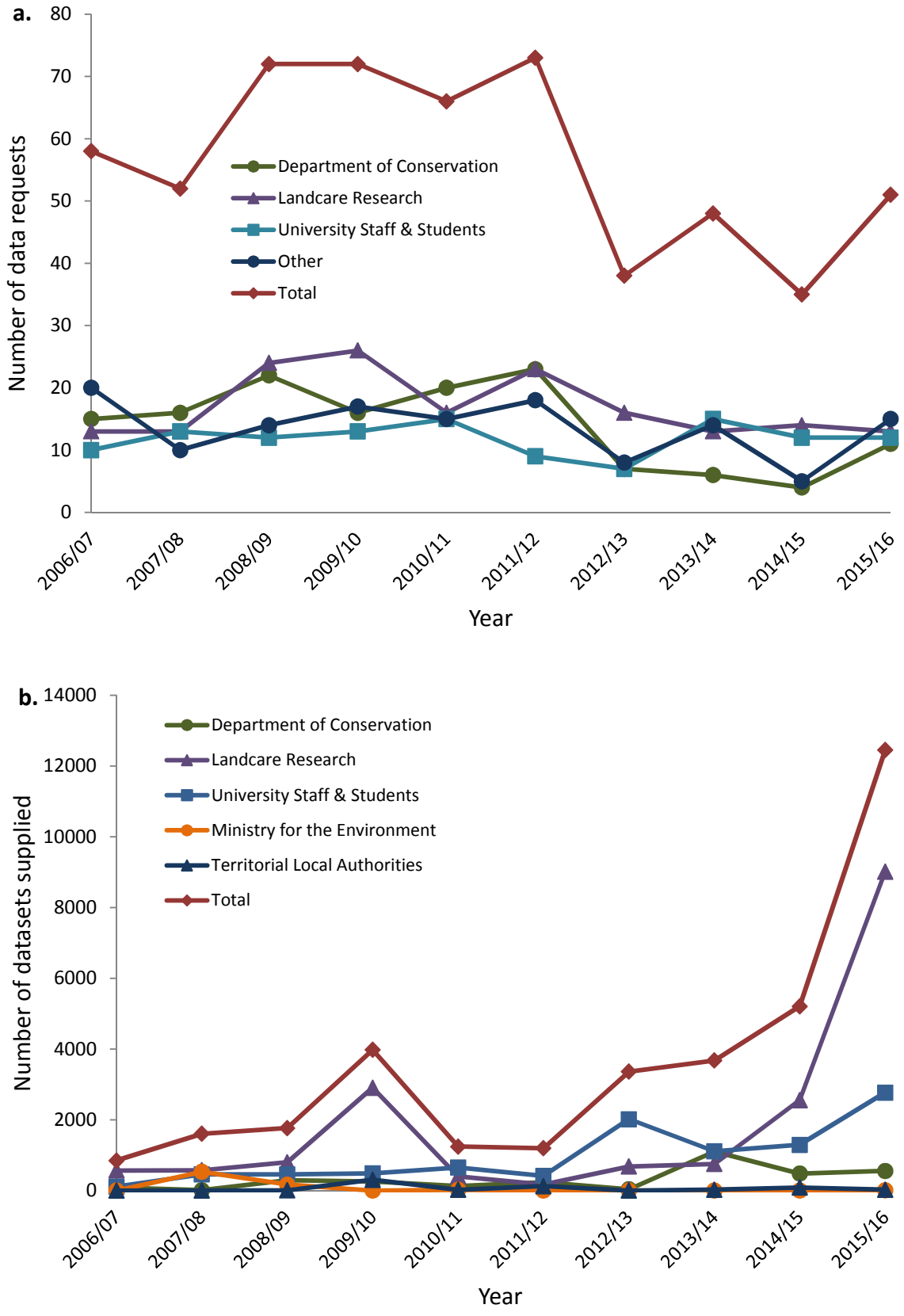

Figure 2. Requests for data from the National Vegetation Survey Databank per financial year since 2006: (a) total number of requests and from three major data users and (b) number of datasets supplied, total and from five major data users.

Some intended uses of these data are listed below.

- Modelling of current and future ranges for as many New Zealand plant species as possible under climate change scenarios and to test ecologically plausible plateau models.
- A group of Year 13 biology teachers from Cambridge (NZ) sought data on particular plant species to practice using Simpson's index of species diversity.
- Nelson Council and DOC requested vegetation data to use as part of a synthesis including animal pest data and vegetation data from local monitoring initiatives. These data are used for operational decision-making in setting up long-term monitoring sites for key management units in the Salisbury and Dun regions.
- Vegetation data were requested in an attempt to identify the provenance of some 1870s kakapo skins held at the Macleay Museum of Natural History, University of Sydney.
- South Island high country grassland data were requested to be used in a Masters thesis investigating factors controlling orchid distribution and their community functional traits.
- A study exploring functional trait differences between native and non-native tree communities by a consortium of invasion ecologists from the University of Vienna.
- Plot data were supplied to the Atuanui Restoration Project (a community undertaking pest control and restoration projects in the Kaipara Harbour area) who are intending to remeasure established plots and undertake forest monitoring to measure changes in ecosystem health.

9 Publications directly associated with the NVS Databank

Publications and conference presentations funded, at least in part, by the NVS program (8 total)

Wiser SK 2016. Achievements and outstanding challenges in integrating, reusing and synthesising vegetation plot data. Journal of Vegetation Science 27: 868–879. doi: 10.1111/jvs.12419.

Crowther TW, Glick HB, Covey KR, Bettigole C, Maynard DS, Thomas SM, Smith JR, Hintler G, Duguid MC, Amatulli G, Tuanmu MN, Jetz W, Salas C, Stam C, Piotto D, Tavani R, Green S, Bruce G, Williams SJ, Wiser SK, Huber MO, Hengeveld GM, Nabuurs GJ, Tikhonova E, Borchardt P, Li CF, Powrie LW, Fischer M, Hemp A, Homeier J, Cho P, Vibrans AC, Umunay PM, Piao SL, Rowe CW, Ashton MS, Crane PR, Bradford MA 2015. Mapping tree density at a global scale. Nature 525(7568): 201–205.

Goldsmith GR, Morueta-Holme N, Sandel B, Fitz ED, Fitz SD, Boyle B, Casler N, Condit R, Dolins S, Donoghue JC, Engemann K, Jørgensen PM, Kraft NJB, Marcuse-Kubitza A, McGill B, Peet RK, Piel W, Regetz J, Schildhauer M, Spencer N, Svenning J, Theirs BM, Violle C, Wiser SK, Enquist BJ 2016. A dynamic and mobile field guide to all plants of

the Americas. Methods in Ecology and Evolution 7(8): 960–965. http://doi.org/10.1111/2041-210X.12548

Engemann K, Sandel B, Enquist BJ, Jørgensen PM, Kraft N, Marcuse-Kubitza A, McGill B, Morueta-Holme N, Peet RK, Violle C, Wiser S, Svenning J-C 2016. Patterns and drivers of plant functional group dominance across the Western Hemisphere: a macroecological re-assessment based on a massive botanical dataset. Botanical Journal of the Linnean Society 180(2): 141–160. http://doi.org/10.1111/boj.12362.

Wiser SK 2015. How can we meet "big data" aspirations in vegetation informatics? Invited plenary presentation, 58th Annual symposium of the International Association for Vegetation Science, Brno, Czech Republic. 19-24 July.

De Cáceres M, Wiser SK, Martin-Alcón S, González-Olabarria JR, Coll L 2015. Classification of vegetation using both the structure and composition of plant communities. Oral presentation. 58th Annual symposium of the International Association for Vegetation Science, Brno, Czech Republic. 19-24 July.

De Cáceres M, Chytry M. Agrillo E, Attorre F, Botta-Dukát Z, Capelo J, Czúcz B, Dengler J, Ewald J, Faber-Langendoen D, Enrico F, Franklin S, Gavilán R, Gillet F, Jansen F, Jiménez-Alfaro B, Krestov P, Landucci F, Lengyel A, Loidi J, Mucina L, Peet R, Roberts D, Roleček J, Schaminée J, Schmidtlein S, Theurillat J, Tichý L, Walker D, Wildi O, Willner W, Wiser SK 2015. A comparative framework for broad-scale plot-based vegetation classification. Poster presentation. 58th Annual symposium of the International Association for Vegetation Science, Brno, Czech Republic. 19-24 July.

Enquist BJ, Boyle D, Sandel B, Donoghue II JC, Regetz J, Simova I, Svenning J, McGill BJ, Peet RK, Jorgensen P, Thiers B, Schildhauer M, Smith S, Hinchliff C, Violle C, Spencer N, Morueta-Holme N, Marcuse-Kubitza A, Kraft NJB, Ott JE, Narro M, Wiser SK 2015. [Abstract] The macroecology of botanical diversity: history, new insights and the central informatics barriers. Proceedings: Ecological Society of America Annual Meeting 2015: "Ecological Science at the Frontier: Celebrating ESA's Centennial", Baltimore, Maryland, USA, 9-14 August 2015. http://eco.confex.com/eco/2015/webprogram/Paper51648.html

Refereed publications

The following 22 2015/16 publications used data archived in the NVS Databank (excludes those listed above; includes earlier publications that were not reported in previous annual reports).

Bellingham PJ, Richardson SJ, Mason NWH, Veltman C, Allen RB, Allen WJ, Barker RJ, Forsyth DM, Nicol SJ, Ramsey DSL 2016. Introduced deer at low densities do not inhibit the regeneration of a dominant tree. Forest Ecology and Management 364: 70–76.

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

Cheng D, Xu L 2015. Predicting the potential distributions of Senecio vulgaris L. in China. PeerJ PrePrints 3: p.e1612v1. [Sourced from GBIF]

Coomes DA, Bentley WA, Tanentzap AJ, Burrows L 2013. Soil drainage and phosphorus depletion contribute to retrogressive succession along a New Zealand chronosequence. Plant and Soil 367(1-2): 77–91.

Cohen JE, Lai J, Coomes DA, Allen RB 2016. Taylor's law and related allometric power laws in New Zealand mountain beech forests: the roles of space, time, and environment. Oikos 125: 1342–1357.

Drummond AJ, Newcomb RD, Buckley TR, Xie D, Dopheide A, Potter BC, Heled J, Ross HA, Tooman L, Grosser S 2015. Evaluating a multigene environmental DNA approach for biodiversity assessment. GigaScience 4(1): 1–20.

Forsyth DM, Allen RB, Allen RKJ, Affeld K, MacKenzie DI 2016. Soil phosphorus predicts feral pig (Sus scrofa) occupancy, detection probability and feeding activity in a temperate montane rainforest. Wildlife Research 43(4): 277–287.

Gallien L, Saladin B, Boucher FC, Richardson DM, Zimmermann NE 2016. Does the legacy of historical biogeography shape current invasiveness in pines? New Phytologist 209: 1096–1105 [Sourced from GBIF]

Gormley AM, ForsythDM, Wright EF, Lyall J, Elliott M, Martini M, Kappers B, Perry M, McKay M 2015. Cost-effective large-scale occupancy–abundance monitoring of invasive brushtail possums (Trichosurus vulpecula) on New Zealand's Public Conservation Land. PloS one 10(6): p.e0127693.

Kramer-Walter KR, Bellingham PJ, Millar TR, Smissen RD, Richardson SJ, Laughlin DC 2016. Root traits are multidimensional: specific root length is independent from root tissue density and the plant economic spectrum. Journal of Ecology 104: 1299–1310.

Kunstler G, Falster D, Coomes DA, Hui F, Kooyman RM, Laughlin DC, (17 others), Richardson SJ et al. (12 others) 2016. Plant functional traits have globally consistent effects on competition. Nature 529: 204–207 (14 January 2016) doi:10.1038/nature16476

Lusk CH, McGlone MS, Overton JM 2016. Climate predicts the proportion of divaricate plant species in New Zealand arborescent assemblages. Journal of Biogeography 43(9): 1881–1892.

Jager MM, Clearwater MJ, Richardson SJ, Bellingham PJ, Laughlin DC 2015. Soil fertility induces coordinated responses of multiple independent functional traits. Journal of Ecology 103: 374–385. doi: 10.1111/1365-2745.12366

Laughlin DC, Richardson SJ, Wright EF, Bellingham PJ 2015. Environmental filtering and positive plant litter feedback simultaneously explain correlations between leaf traits and soil fertility. Ecosystems 18: 1269–1280. doi: 10.1007/s10021-015-9899-0.

Pertierra LR, Baker M, Howard C, Vega GC, Olalla-Tarraga MA, Scott J 2016. Assessing the invasive risk of two non-native Agrostis species on sub-Antarctic Macquarie Island. Polar Biology: 1–11. [Sourced from GBIF]

Richardson SJ, Laughlin DC, Lawes MJ, Holdaway RJ, Wilmshurst JM, Wright M, Curran T, Bellingham PJ, McGlone MS 2015. Functional and environmental determinants of bark thickness in a fire-free temperate rain forest flora. American Journal of Botany 102: 1590–1598. doi: 10.3732/ajb.1500157.

Simpson A, Richardson SJ, Laughlin, DC 2016. Ubiquitous soil-climate interactions drive functional trait distributions across temperate rainforests. Global Ecology and Biogeography 25: 964–978.

Sniderman J MK, Woodhead JD, Hellstrom J, Jordan GJ, Drysdale RN, Tyler JJ, Porch N 2016. Pliocene reversal of late Neogene aridification. Proceedings of the National Academy of Sciences 113: 1999–2004.

Syfert MM, Smith MJ, Coomes DA 2013. Correction: The effects of sampling bias and model complexity on the predictive performance of MaxEnt species distribution models. PLoS ONE 8(7): 10.1371/journal.pone.0055158

Velázquez J, Allen RB, Coomes DA, Eichhorn MP 2016. Asymmetric competition causes multimodal size distributions in spatially-structured populations. Proceedings of the Royal Society B-Biological Sciences 283 (20152404). doi: 10.1098/rspb.2015.2404 .

Wiser SK, Thomson FJ, DeCáceres M 2015. Expanding an existing classification of New Zealand vegetation to include non-forested vegetation. New Zealand Journal of Ecology 40(2): 160–178.

Wang JC, Pan BR, Albach DC 2016. Evolution of morphological and climatic adaptations in Veronica L. (Plantaginaceae). PeerJ 4: p.e2333. [Sourced from GBIF]

Contract reports

The following three 2015/16 contract reports used data archived in the NVS Databank.

Allen RB, Tahi B 2015. Opportunities and issues for tawa timber: a product-market review. Report prepared for the Tūhoe Tuawhenua Trust. 24 p.

Bellingham PJ, Cieraad E, Gormley AM, Richardson SJ 2015. Department of Conservation biodiversity indicators: 2015 assessment. Landcare Research Contract Report LC2343 for the Department of Conservation.

Mason NWH, Holdaway RJ, Richardson SJ 2015. Quantifying uncertainty in biodiversity data for monitoring and reporting indicators. Landcare Research contract report LC2190 for the Department of Conservation.

Conference presentations

The following six 2015/16 conference presentations (or earlier conferences not reported) used data archived in the NVS Databank.

Affeld K, Wiser S, Payton I, Mason N, De Cáceres M 2016. Using classification assignment rules to assess land use change impacts on national and regional biodiversity. 59th Annual symposium of the International Association for Vegetation Science, Pirenópolis, Brazil. 12-17 June.

Bellingham P, Wright E, Richardson S, Gormley A, MacLeod C, Husheer S, Monks A 2014. A national assessment of biodiversity throughout New Zealand's public conservation lands. Island Biology 2014 conference, University of Hawai'i at Mānoa, 7–11 July, 2014, Honolulu, USA.

Buitenwerf R 2015. The future of New Zealand vegetation: insights from physiologically-based species distribution modelling. NZES November 2015. University of Canterbury.

Crisp P 2015. Greater Wellington's Tier 1 monitoring programme. NZES November 2015. University of Canterbury.

Gormley A, Richardson S, Bellingham P, MacLeod C, Wright E, MacKay M 2015. Combining monitoring data: Towards a reliable and trustworthy aggregated index. Statistics in Ecology and Environmental Monitoring (SEEM) 2015 Conference, 22–26 June 2015, Queenstown, New Zealand.

Holdaway R 2015. Disentangling the drivers of New Zealand's natural forest carbon sink. NZES November 2015. University of Canterbury.

Theses

The following two 2015/16 thesis used data archived in the NVS Databank.

Lawrence G 2015. Using satellite imagery and novel low altitude aerial imagery to classify coastal wetland vegetation for change detection at Whatipu Scientific Reserve, Auckland, NZ. PhD thesis. Auckland University of Technology, Auckland.

Simpson AH 2015. Interactions between soil fertility and climate drive variation in functional traits in New Zealand forests. MSc thesis. University of Waikato, Hamilton.

Appendix 1 – New electronic datasets in NVS 2015/16

Banks Peninsula Birdlings Flat Stony Beach Ridges 2015

BOUNDARY STREAM SCENIC RESERVE 2009

EASTERN NEW ZEALAND DRY FORESTS 1998

Hapupu National Historic Reserve Kopi Monitoring 2012

HAUTURU (LITTLE BARRIER ISLAND) 2010

KAWEKA WILDING PINES 2014

Kettle hole ephemeral wetlands 2015

MANAWATU GORGE EXCLOSURES 2006

MANAWATU GORGE EXCLOSURES 2011

MT BARKER WILDING PINES 2013

NIUE - HUVALU FOREST CONSERVATION AREA 2015

NORTHERN GUMLAND HEATHS 2016

TE UREWERA-LAKE WAIKAREMOANA-WEST WAIKAREITI AND PUKETUKUTUKU PENINSULA 2014

THAR IMPACT SITE - TOWNSEND 1999

THAR IMPACT SITE - ZORA 1999

WITHER HILLS 2002

WITHER HILLS 2003

WITHER HILLS 2015

BIRDLINGS FLAT GRAVEL BEACH SURVEY 2012

CANTERBURY HIGH COUNTRY HIERACIUM 2009

CANTERBURY HIGH COUNTRY TUSSOCK GRASSLAND 2010

FIORDLAND LAKES 1991

Franz Josef Chronosequence 2002

LAKE PUKAKI ISOLEPIS MONITORING 2014

MANAWATU GORGE EXCLOSURES 2000

MOKAU RIVER - KAHIKATEA BEND EXCLOSURE 1993

MOKAU RIVER - KAHIKATEA BEND EXCLOSURE 2006

MURCHISON MOUNTAINS VEGETATION PLOTS 1980

OHAU DOWNS OUTWASH PLAIN SURVEY 2012

ORONGORONGO 2006

STAFFORD 2005

TARAMOUKOU 2006

In addition, the following datasets have been entered using *NVS Express* and incorporated into the NVS Databank

GREATER WELLINGTON STATE OF THE ENVIRONMENT MONITORING 2015

HEAPHY 2009

Hope River vegetation plot survey 2016

Mackay Downs 2015

Nelson Nature: Main 2015

Nelson Nature: Restricted 2015

TARARUA 2012

Whangamarino Wetland Monitoring 2015

Hard-copy plot sheets of these projects are either archived or in the process of being archived.

BANKS PENINSULA BIRDLINGS FLAT STONY BEACH RIDGES 2015

BIRDLINGS FLAT GRAVEL BEACH SURVEY 2012

Colac Bay - Lake George 2014

DENNISTON ESCARPMENTS 2008

EASTERN NEW ZEALAND DRY FORESTS 1998

EYRE MOUNTAINS FOREST 1962

FIORDLAND LAKES 1971

FIORDLAND LAKES 1974

FIORDLAND LAKES 1988

FIORDLAND LAKES 1991

FIORDLAND LAKES 1992

HAKARIMATA SCENIC RESERVE 2016

HEAPHY 2009-2010

Hope River vegetation plot survey 2016

HOROMANGA PHOTOPOINTS 1960-1986

KAWEKA WILDING PINES 2014

Kettle hole ephemeral wetlands 2015-2016

LAKE PUKAKI ISOLEPIS MONITORING 2014

MACKAY DOWNS 2015 -2016

MT BARKER WILDING PINES 2013

MURCHISON MOUNTAINS VEGETATION PLOTS 1980-1981

National Biodiversity Monitoring and Reporting System: Main 2013-2014

National Biodiversity Monitoring and Reporting System: Main 2013-2014 - Nested Recce 10x10

National Biodiversity Monitoring and Reporting System: Main 2013-2014 - Nested Recce 2x2

National Biodiversity Monitoring and Reporting System: Main 2013-2014 - Nested Recce 5x5

National Biodiversity Monitoring and Reporting System: Main 2014-2015

National Biodiversity Monitoring and Reporting System: Main 2014-2015 - Nested Recce 10x10

National Biodiversity Monitoring and Reporting System: Main 2014-2015 - Nested Recce 2x2

National Biodiversity Monitoring and Reporting System: Main 2014-2015 - Nested Recce 5x5

NELSON NATURE: Main 2015-2016

NIUE - HUVALU FOREST CONSERVATION AREA 2015

NORTHERN GUMLAND HEATHS 2016

NORTHERN GUMLAND HEATHS 2016 - Recce Inventory 10x10

NORTHERN GUMLAND HEATHS 2016 - Recce Inventory 20x20

NORTHERN GUMLAND HEATHS 2016 - Recce Inventory 2x2

NORTHERN GUMLAND HEATHS 2016 - Recce Inventory 5x5

OHAU CANOPY GAPS AND EXCLOSURES 2006 - 2007

TARARUA 2012

TE UREWERA-LAKE WAIKAREITI-SE PLOT 2012

TEKAPO SCIENTIFIC RESERVE SURVEY 2011

Whangamarino Wetland Monitoring 2015

WITHER HILLS 2015