

- Sullivan JJ, Meurk CD, Dawson MI, Hutchison M. 2019. Crowdsourcing the discovery of new plant naturalisations in Canterbury using iNaturalist NZ. See this volume.
- Wilson HD. 1994. Regeneration of native forest on Hinewai Reserve, Banks Peninsula. *New Zealand Journal of Botany* 9(3): 41–55.
- Wotton DM, McAlpine KG. 2013. Predicting native plant succession through woody weeds in New Zealand. NZ Department of Conservation Research and Development Series 336.
-

Crowdsourcing the discovery of new plant naturalisations in Canterbury using iNaturalist NZ

Jon J Sullivan¹, Colin D Meurk², Murray I Dawson², and Melissa AS Hutchison³

¹ Department of Pest-Management and Conservation, PO Box 84, Lincoln University, Lincoln, New Zealand, jon.sullivan@lincoln.ac.nz

² Manaaki Whenua – Landcare Research, Lincoln, New Zealand

³ Wildland Consultants Ltd, Christchurch, New Zealand

Introduction

“The new flora and vegetation are in their making. The future of glorious New Zealand plants and the beautiful primitive vegetation lies not in the lap of the gods but in the good sense of us New Zealanders and in our love for beautiful New Zealand.” Cockayne (1967, p. 201)

Weeds are on the march in New Zealand and their impacts on New Zealand’s indigenous vegetation will be felt over centuries to come (e.g., Williams and Braithwaite 2003; Williams and Cameron 2006). New plant species continue to naturalise from New Zealanders’ gardens and spread across the country (Gatehouse 2008). The much older human history in Europe indicates that this invasion will take millennia to complete; it can take more than a century before woody garden plants are first discovered in the wild (Kowarik 1995), and naturalised plants that have “only” been in Europe for a thousand years are on average less widespread than those that naturalised earlier (Pýsek and Jarůsík 2005). The weed invasion of New Zealand has just begun, and our actions today have the potential to make a big difference to New Zealand’s future vegetation.

Climate change may accelerate this process. It’s likely to make southern regions like Canterbury suitable for weeds of more northern parts of NZ (Williams and

Braithwaite 2003). It's also likely to put locally adapted native plant populations at a disadvantage in competition with some of the newcomers. If we're not careful, human responses to the threat of climate change, like the One Billion Trees programme, may also provide opportunities for weeds to spread, depending on what species and genotypes are planted and how well these plantings are maintained. Regardless, with or without climate change, our diverse gardens ensure that the plant invasion of wild New Zealand will continue well beyond our lifetimes.

Rolling back widespread Canterbury weeds like gorse, Scotch broom, and wilding pines is expensive and suitable for site-led and landscape-scale weed management and biological control programmes. Many other weeds, like boneseed, hawthorn, rowan, and sycamore maple, are still on the move but are already entrenched enough in many places to be expensive to push back. All of Canterbury's institutional weed control budgets could be spent on these established weeds. That would be a mistake, as there are many more new weeds waiting in gardens to naturalise or that have recently jumped the garden fence (e.g., Hulme 2014).

Getting ahead of the invasion curve by stopping newcomers in their tracks is much less costly than dealing with established weeds, when combined with dedication and persistence. The essential ingredients are early detection and swift, sustained action. Modern technologies like smart phones, combined with apps and websites for reporting weeds, and online weed identification tools, all make it easier than ever for the wider public to play a prominent role in weed surveillance and the early detection of new naturalisations.

One such tool for the early detection of new weeds is iNaturalist NZ – Mātaiki Taiao (previously NatureWatch NZ). iNaturalist NZ combines a social network of nature watchers, an online database of observations and photos, and a species identification engine. By encouraging people to report new and unusual species, the iNaturalist NZ community can help discover new plant naturalisations. Those discoveries can be new naturalisations to New Zealand, new to Canterbury, or new to their local district. All such early reports of incipient weed populations are useful when combined with prompt control.

In this article, we introduce iNaturalist NZ – Mātaiki Taiao and explore some of the important naturalised plant discoveries in Canterbury that have been made so far by the iNaturalist NZ community.

iNaturalist NZ: a brief history

iNaturalist NZ – Mātaiki Taiao (<https://inaturalist.nz>) is the New Zealand chapter of the global iNaturalist Network (<https://www.inaturalist.org/pages/network>). iNaturalist is a free website and mobile app for sharing and identifying observations of species. iNaturalist is operated from the California Academy of Sciences and is co-owned by the Academy and the US National Geographic. iNaturalist began in 2008 as an open-source masters project at UC Berkeley's School of Information. It became

part of the California Academy of Sciences in 2014, and became a joint initiative with National Geographic in 2017.

The New Zealand Bio-Recording Network Trust (a NZ charitable trust) launched a New Zealand optimised version of the iNaturalist codebase in August 2012, with major funding from the NZ Government's Terrestrial and Freshwater Biodiversity Information System (TFBIS). This system was pre-loaded with NZ species and places, along with the observations and users from the Trust's older NZBRN species recording website. After consultation with NZBRN users, some of whom expressed confusion between "naturalist" and "naturist", NZBRN launched its iNaturalist-based system under a different brand name, NatureWatch NZ.

In 2014, NZBRN joined the incipient iNaturalist Network after iNaturalist built the features to allow Mexico to operate a regional site (NaturaLista, <https://www.naturalista.mx/>) within the global iNaturalist system. This integration maintained the New Zealand focus and vibrant and growing New Zealand community, while contributing to the global iNaturalist database, and it allowed New Zealanders to obtain species identifications from all iNaturalist users worldwide. The NatureWatch NZ brand was retired in June 2018 and replaced with iNaturalist NZ – Mātaiki Taiao.

When you use <https://inaturalist.nz>, you see the New Zealand observations, species, users, and projects, but the whole world of iNaturalist is accessible from any search. By 6 June 2019, 13,669 users had made 743,646 New Zealand observations of 16,336 species and lower taxa, identified by 4,471 users. In the Canterbury region, 3,444 users had made 167,604 New Zealand observations of 7,490 species, identified by 2,059 users. (See below for a closer look at just the Canterbury plant observations.)

All of iNaturalist NZ's wild observations with confirmed identifications ("research grade") are shared weekly with the Global Biodiversity Information Facility (GBIF, <https://www.gbif.org>), and iNaturalist NZ is now the fifth largest overall contributor of NZ species observations to GBIF. iNaturalist NZ is the second largest GBIF contributor of observations made this century (after eBird) and has contributed 81.5% of NZ's GBIF plant observations made this century.

If you have not used iNaturalist NZ yet, we encourage you to join and share your botanical expertise with other users, and upload your most interesting and important observations. Also, if you are promoting botany with community groups, be sure to mention iNaturalist NZ – Mātaiki Taiao as a great way for budding botanists and naturalists to build their knowledge of NZ species and share their observations.

Plant naturalisations in Canterbury

Since European settlement of Canterbury, there has been an ongoing accumulation of naturalised plants, one that shows no sign of slowing. From the PhD research of the late Hazel Gatehouse (Gatehouse 2008) there were 1,312 seed plant species known to have been naturalised in Canterbury by 2010 (Fig. 1, p. 57). The dates of discovery in

Canterbury are not readily available for these species so Dr Gatehouse's national dates of discovery for each species have been used (Fig. 1).

Gatehouse (2008), and independently Mahon (2007), have been one-off efforts to collate all available publication and collection data on wild exotic plants in Canterbury. For her PhD research, Gatehouse (2008) collated an annotated list of all seed plant species naturalised nationally by the end of 2000, including the regions in which each was known, based on all available published sources (e.g., Heenan et al. 2002). She updated this up to the end of 2010 after graduating (H.A.W. Gatehouse, unpublished data), bringing the total to 1,312 full species of naturalised seed plants in Canterbury.

Mahon (2007) collated all naturalised vascular plants in Canterbury prior to December 2005, based primarily on the national list of Howell and Sawyer (2006). Mahon listed 1,367 taxa (species and subspecies) of vascular naturalised plants in Canterbury, including 1,319 full species.

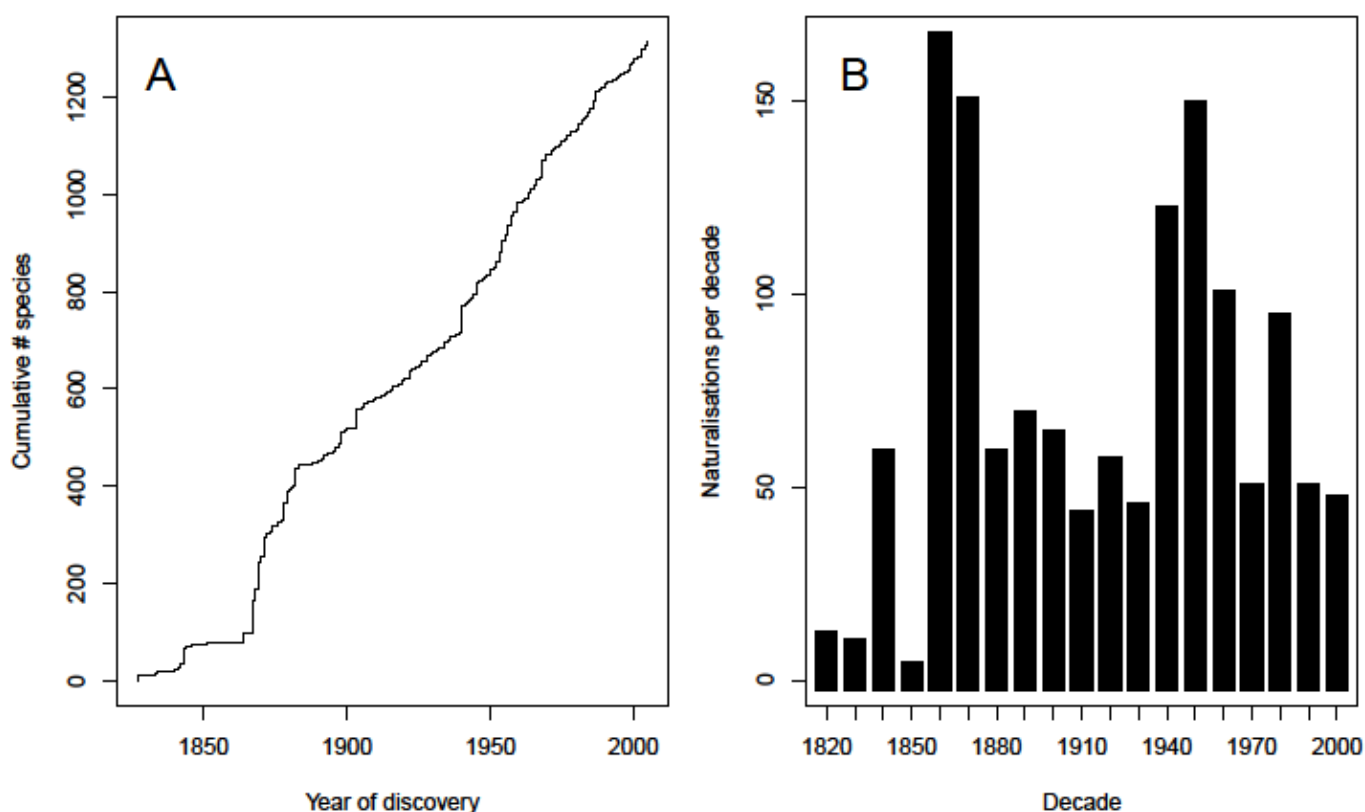


Figure 1. The accumulation of naturalised seed plants (conifers and angiosperms) in Canterbury, plotted against the national date of discovery for each species (based on Gatehouse (2008) and H.A.W. Gatehouse, unpublished data, for naturalisations up to 2010). **A** shows the cumulative naturalisation in Canterbury and **B** shows the same data by naturalisations per decade. Varying collecting effort likely explains most of the between-decade variation in naturalisations in recent decades in **B**, such as the 1980s spike in naturalisations coinciding with the writing of Flora IV (Webb et al. 1988).

The New Zealand Plant Conservation Network (NZPCN) website (<http://www.nzpcn.org.nz>) also maintains a searchable list of exotic (and native) plant

species in New Zealand, which can be filtered by district. It currently includes 805 wild exotic taxa from all Canterbury districts combined, including 797 species (accessed 5 August 2019).

For plant observations from Canterbury made by users on iNaturalist NZ as at 6 June 2019, a total of 1,834 users had made 80,008 Canterbury plant observations of 3,392 species and lower taxa (Fig. 2). The prominent uptick in species in April 2019 (Fig. 2) is the result of the Christchurch District’s participation in the global City Nature Challenge (Australasia’s first entry into this global competition). This recent uptick, and the continuing upward trajectory of all observations (Fig. 2), indicate that more Canterbury plant species, of all biostatus categories, have yet to be documented by the iNaturalist NZ community, and likely will be observed over the coming months and years.

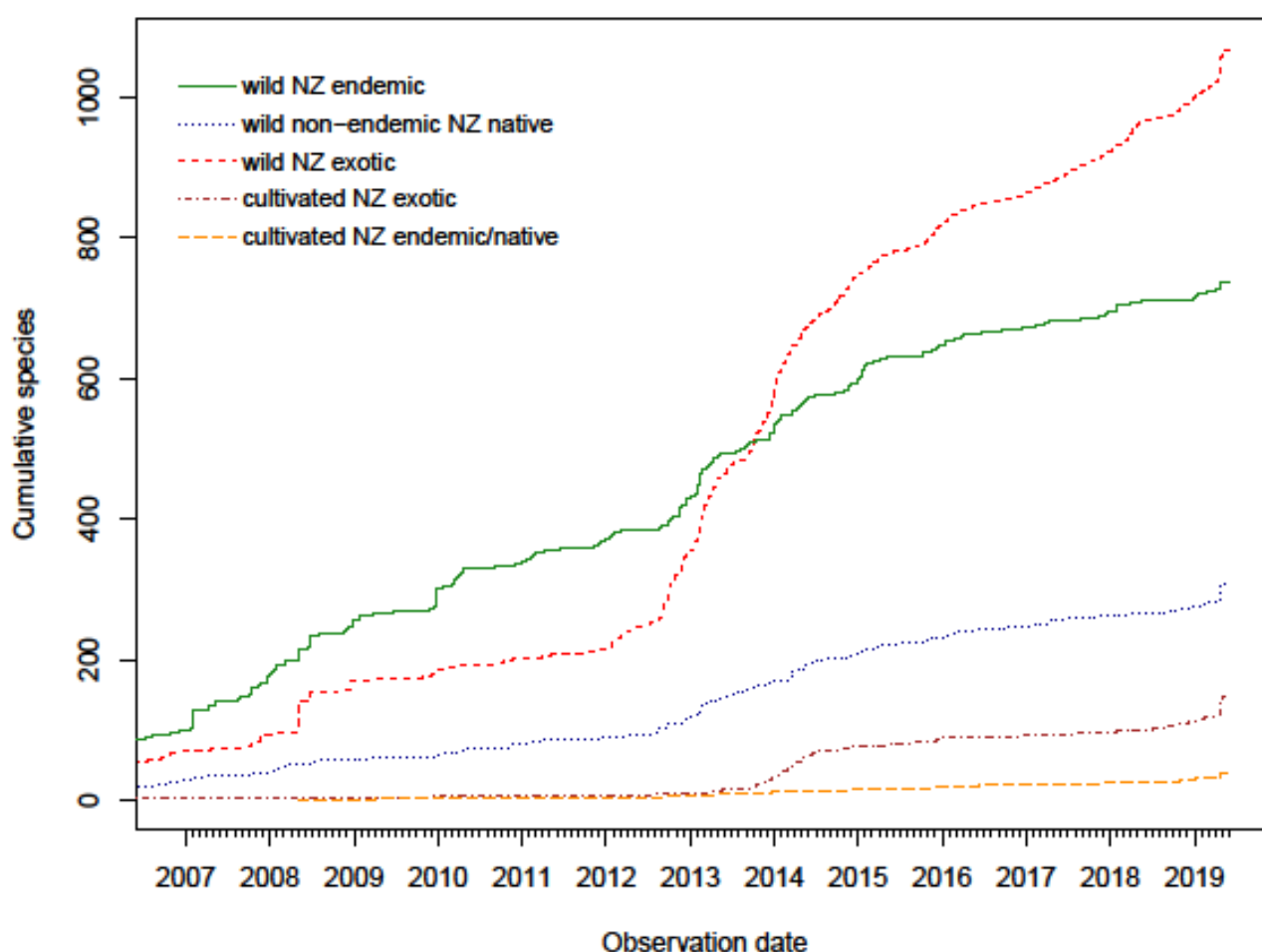


Figure 2. The accumulation of plant species (full species, lumping together subspecies and varieties) observed by users of iNaturalist NZ – Mātaiki Taiao, as at 6 June 2019. Species are separated by their national biostatus, based on iNaturalist NZ’s edited checklist of biostatus sourced from the NZ Organisms Register (<http://www.nzor.org.nz/>). Species are additionally separated by whether or not each species has been observed in the wild.

As at 6 June 2019, approximately 1,070 wild, exotic plant species had been observed by iNaturalist NZ users. We say “approximate” due to the ambiguity around whether

some of the species recorded from Canterbury's cities and towns were really wild. Some iNaturalist NZ users have not consistently recorded whether their observed plants are wild or not, and some of these observations have yet to be annotated as such by other users. In an attempt to weed out these observations of cultivated plants, we have applied a 5% threshold, whereby we consider all species with $\geq 95\%$ of observations noted as cultivated to be only cultivated unless they are also on one of the Canterbury naturalised plant lists, and all species with $< 95\%$ of observations cultivated we considered to be present in the wild.

We have manually inspected the iNaturalist NZ species lists and our threshold seems to be functioning as expected. However, we have not (yet) carefully looked through all of the observations of all species that have been reported only in Canterbury via iNaturalist NZ. It therefore remains possible that a few cultivated-only species have slipped through.

What proportion of Canterbury's known naturalised plants have been observed by iNaturalist NZ users, and how many first records of naturalised plant species have they documented? Answering these questions proved to be much more complicated than we expected, due to differences in taxonomy and synonymy in the three available lists of Canterbury's naturalised plants. After careful editing of each list to account for (at least some of) the differences in synonyms and formatting, we combined the species lists from Mahon (2007), Gatehouse (2008), and the NZPCN. This produced a total list of 1,545 species.

While this warrants a more in-depth taxonomic look, one thing is immediately apparent: the three existing lists of Canterbury naturalised plants are quite different, both in their lengths and the species they contain. Of the 1,545 species, only 633 (41%) are shared by all three lists, even after our attempt to clean up synonymy. 77.3% are shared by Mahon (2007) and Gatehouse (2008).

Given this taxonomic uncertainty, it is a testament to the tenacity and skills of the iNaturalist NZ community that, in just seven years, observations have been made of 782 (50.6%) of Canterbury's naturalised plant species, as listed on at least one of these three other source lists (Table 1, p. 60). Furthermore, 285 plant species have been observed that were not listed on any of these other lists.

A more detailed exploration and analysis of the iNaturalist NZ exotic plant observations from Canterbury (and New Zealand) would be beneficial. Our preliminary look underscores the importance of iNaturalist NZ, and citizen botanists, as an engine for discovering new naturalisations. It also highlights how difficult it currently is to promptly and accurately determine which Canterbury observations are of plants not previously recorded in the region.

Table 1. Lists of naturalised plants of Canterbury and how many were observed and identified by users of iNaturalist NZ – Mātaki Taiao, as at 6 June 2019.

Source	Total species	Only on this list	Observed on iNat NZ
Mahon (2007)	1,317	59	710
Gatehouse (2008)	1,311	86	678
NZPCN	795	65	550
iNat NZ	1,067	285	

Notable new naturalisations

While there remains uncertainty around exactly how many new-to-Canterbury plant naturalisations have been detected so far on iNaturalist NZ – Mātaki Taiao, there are many, as can be illustrated through examples. The following is an annotated list of examples of some of the new Canterbury naturalisations, or prominent range expansions, detected by users of iNaturalist NZ. This is sorted alphabetically (by Latinised binomial) and is not intended to be comprehensive.

Kiwifruit *Actinidia chinensis* var. *deliciosa* (Mike Lusk, 28 Apr. 2017, Lake Tekapo, <https://inaturalist.nz/observations/7303478>, Mark Bloomberg, 11 Mar. 2018, Lake Pukaki, <https://inaturalist.nz/observations/10300330>)

While wild kiwifruit as an abundant weed is an issue only in more northern parts of New Zealand, it is impressive how cold-hardy it can be. Well-established plants were found growing on the shores of Lakes Tekapo and Pukaki, presumably germinated from discarded fruit.

Madeira vine *Anredera cordifolia* (Jon Sullivan, 10 May 2016, Lincoln, <https://inaturalist.nz/observations/3148973>, <https://inaturalist.nz/observations/3363469>)

Madeira vine is a well-established and problematic weed of the North Island but few observations of it have been made from Canterbury (there are five records on the Australasian Virtual Herbarium, all from Christchurch city). Here it was found aggressively spreading through Lincoln's Mahoe Reserve. How it got there remains unknown, and an attempt is being made to eradicate it from the area.

Cow parsley *Anthriscus sylvestris* (James Mortimer, 26 Jan. 2013, Christchurch, <https://inaturalist.nz/observations/949961>)

James Mortimer made repeat visits to this plant, wild in the Christchurch Botanic Gardens, to confirm its identification. It was one of few records of this species from NZ, but Trevor Partridge (pers. comm.) notes that it is now well established at three sites around Christchurch and he expects to see more of it in the future.

Great masterwort *Astrantia major* (Trevor Partridge, 14 Nov. 2015, Christchurch, <https://inaturalist.nz/observations/2394683>)

This is a potential first record for New Zealand of this species, here found spreading in the Christchurch Residential Red Zone.

Berberis congestiflora (Jon Sullivan, 20 Apr. 2012, Geraldine, <https://inaturalist.nz/observations/940126> CHR 616308)

This unusual barberry in Geraldine's Talbot Bush was noticed while on a university field trip. It is the first New Zealand record for this species. It has been removed and has not been seen since.

Candy flower *Claytonia sibirica* (William Reinders, 4 April 2018, Christchurch, <https://inaturalist.nz/observations/10653937>)

This was the first record of this species on iNaturalist NZ and, according to the Australasian Virtual Herbarium, there have been eight prior herbarium collections from Canterbury, all from the past 20 years. This is native to Siberia and North America and may be one to watch given how widespread its congener miner's lettuce is becoming, and how widespread this species is reported to be in the UK.

Smokebush *Cotinus coggygria* (David Beukes, 5 May 2017, Lincoln, <https://inaturalist.nz/observations/6243578>)

Three wild seedlings have been found in Christchurch of this long-time garden plant, and there are no records of it wild from Canterbury on the Australasian Virtual Herbarium. Time will tell whether this remains casual in the wild or naturalises fully.

Chilean glory creeper *Eccremocarpus scaber* (various observers, https://inaturalist.nz/observations?place_id=8479&taxon_id=401602)

Chilean glory creeper is worthy of mention because it is still very rare in and around the Christchurch District but is being reported by iNaturalist NZ users. It is spreading and is a known weed. Time is running out to control it.

Red Mount Teide bugloss *Echium wildpretii* (William Reinders, 11 Aug. 2017, Tai Tapu, <https://inaturalist.nz/observations/7444566>)

The Australasian Virtual Herbarium lists three previous collections of this species in Canterbury, the earliest from 1998. This could be another one to watch, and potentially stop, given how abundant *Echium vulgare* now is, and how quickly *Echium candicans* and *Echium pininana* are spreading.

Long-flowered veldt grass *Ehrharta longiflora* (Alice Shanks, 9 & 11 Sept. 2018, Christchurch, <https://inaturalist.nz/observations/16372106>
<https://inaturalist.nz/observations/16413917>)

This is a relative of veldt grass (*Ehrharta erecta*), which was voted New Zealand's worst environmental weed in 2014 by the NZ Plant Conservation Network (Ward 2015). *Ehrharta longiflora* is already naturalised in Australia, and this was the first

South Island record of the species, growing along a fence line in Christchurch city. It has since been eradicated.

Rough horsetail *Equisetum hyemale* (Sonny Whitelaw, 16 Jul. 2015, Oxford, <https://inaturalist.nz/observations/1767761>, James Ranstead, 12 Nov. 2016, Lincoln, <https://inaturalist.nz/observations/4533604>)

The Australasian Virtual Herbarium lists 12 earlier herbarium collections of this species, all but one from Christchurch city. These iNaturalist NZ observations appear to be the first observations of this species from Lincoln and Oxford. Environment Canterbury was alerted in both cases.

Great willowherb *Epilobium hirsutum* (Jason Butt, 15 May 2018, Pegasus, <https://inaturalist.nz/observations/10247701> CHR646066, Colin Meurk, 2 Feb. 2019, Christchurch, <https://inaturalist.nz/observations/20037942>)

This was a new-to-New Zealand discovery of a serious wetland weed that triggered a national incursion response from Biosecurity NZ.

Blue eryngo *Eryngium planum* (William Reinders, 19 Mar. 2017, Christchurch, <https://inaturalist.nz/observations/5886642> CHR644048)

This was the first wild observation of this species in Canterbury and resulted in a vouchered specimen lodged in the Allan Herbarium.

Tussock hawkweed *Hieracium lepidulum* (Jon Sullivan, 12 Apr. 2018, Christchurch Port Hills, <https://inaturalist.nz/observations/10849005>)

Herbarium collections on the Australasian Virtual Herbarium of this hieracium are from the Canterbury high country and (two) from high elevation sites on Banks Peninsula. This was the first observation from the Christchurch Port Hills, and may signal an ongoing expansion of this species through the Christchurch District.

Himalayan balsam *Impatiens glandulifera* (Wie Quan, 18 Mar. 2016, Christchurch, <https://inaturalist.nz/observations/2807511>, Joe Potter Butler, 21 Feb. 2018, Christchurch, <https://inaturalist.nz/observations/9942039>)

This is a notorious riparian weed in the United Kingdom and Europe, which took several centuries to reach its current distribution and abundance (Phil Hulme, pers. comm.). It is known in Canterbury, and already abundant around parts of Hanmer Springs. Several new sites of this species have been observed on iNaturalist NZ across Christchurch city, as well as Temuka, Little River, Rangiora, and Waikuku, indicating its continued spread.

Limonium companyonis (Steve Attwood, 14 Jan. 2014, Christchurch, <https://inaturalist.nz/observations/983490>)

This saltmarsh weed has been observed in Ferrymead, Christchurch, and in Akaroa harbour, complementing the four herbarium collections made in these areas on the Australasian Virtual Herbarium. Attempts are being made to stop this weed.

Garden honeysuckle *Lonicera* × *americana* (Mark Parker, 24 Jan. 2017, Kaikoura, <https://inaturalist.nz/observations/4996371> CHR644108)

This was a first record of this species for Kowhai Bush in Kaikoura.

Yellow lupin *Lupinus luteus* (Trevor Partridge, 16 Dec. 2017, Christchurch, <https://inaturalist.nz/observations/9181701>)

Webb et al. (1988) regarded *Lupinus luteus* as a casual escape of fodder crops that “seems never to have established except in Northland and on Great Barrier Id”. It remains a mystery where this patch in Christchurch came from, and whether or not it was wild.

Gypsywort *Lycopus europaeus* (William Reinders, 28 Dec. 2018, Christchurch, <https://inaturalist.nz/observations/19265182>)

The Australasian Virtual Herbarium lists two previous collections of this species in Canterbury, one in Lincoln and one north of Lake Ohau. This observation is the first for Christchurch city.

Nemesia floribunda (Jon Sullivan, 19 Mar. 2014, Lincoln, <https://inaturalist.nz/observations/990325>, William Reinders, 4 Jul. 2017, Christchurch, <https://inaturalist.nz/observations/6913608>)

This widespread weed of Dunedin was previously not recorded from Canterbury. The single plant found at Lincoln was removed before it seeded and none have been seen since. However, since then it has been detected at several locations in Christchurch city, including a dense patch on the Main South Road railway bridge. Port Hills rangers of the Christchurch City Council are eager to keep this from establishing on the Port Hills as it is a potential rock outcrop weed.

Nemesia fruticans (Trevor Partridge, 4 Oct. 2015, <https://inaturalist.nz/observations/2077698>)

This was the first record of this species in Canterbury, and William Reinders has since observed it wild at four other sites in the city.

Apple-of-Peru *Nicandra physalodes* (Sue McGaw, 11 May 2014, Kaiapoi, <https://inaturalist.nz/observations/1000019>)

There are nine Canterbury Allan Herbarium collections of this species on the Australasian Virtual Herbarium, eight from Christchurch and one from Ashburton, dating back to the 1960s. However, reports are increasing on iNaturalist NZ of this species in and around Christchurch city.

Antarctic beech *Nothofagus antarctica* (Dave Evans, 23 Apr, 2011, Mount Oxford, <https://inaturalist.nz/observations/944640>)

This unusual beech was spotted growing wild part way up Mount Oxford and turned out to be *Nothofagus antarctica*, which is known wild in just a few places in the Canterbury mountains. This iNaturalist NZ observation was pre-dated by four

herbarium collections on the Australasian Virtual Herbarium, from other areas of Canterbury.

Australian fireweed *Senecio bipinnatisectus* (William Reinders, 10 Sept. 2017, Christchurch, <https://inaturalist.nz/observations/7913770>)

This was the first observation of this Australian naturalised *Senecio* in Canterbury, and there are now eight observations all around the Wigram area and Christchurch city. It is widespread and abundant further north in New Zealand. It is not known whether its arrival in Christchurch is a result of the warming climate or the ongoing southward expansion of this species. Regardless, it appears to be persisting.

Arsenic bush *Senna septemtrionalis* (Murray Dawson, 1 Oct. 2015, Diamond Harbour, <https://inaturalist.nz/observations/2621906>)

This species had been collected twice wild around Lincoln according to the Australasian Virtual Herbarium. It is a forest weed in New South Wales and Queensland.

Flowering inch plant *Tradescantia cerinthoides* (William Reinders, 22 Jul. 2017, Christchurch, <https://inaturalist.nz/observations/7185974>)

This wild seedling of *Tradescantia cerinthoides* appears to be a first record for Canterbury. It has been recorded wild in the North Island before but there are no herbarium records of it on the Australasian Virtual Herbarium.

Discussion

We see iNaturalist NZ – Mātaiki Taiao as a valuable complement to the professional botanical services of the Allan Herbarium. iNaturalist NZ has resulted in many more people in Canterbury making many more plant observations than have traditionally be made by professional botanists. As we have shown, some of those observations have been important, and several of these have resulted in vouchered herbarium specimens and weed control efforts. It is encouraging that many botanists are active identifiers on iNaturalist NZ and are encouraging users to collect the most important finds and send them to the Allan Herbarium.

As well as new naturalisations, iNaturalist NZ users are also reporting the ongoing spread of known naturalised plants in Canterbury. Species like *Eccremocarpus scaber*, *Equisetum hyemale*, *Heracleum mantegazzianum*, and *Impatiens glandulifera*, are well known weeds and iNaturalist NZ users are showing that they are on the move in Canterbury. More can, and should, be done to ensure that detections of such weeds in new areas of Canterbury are dealt with swiftly.

Prompt alerts to new naturalisations have so far been *ad hoc* based on knowledgeable iNaturalist NZ users noticing unusual plant observations and alerting staff at the Allan Herbarium or the appropriate agencies, i.e. regional and local Councils and/or the Department of Conservation. This process could be automated if there was an up-to-date list of known naturalised plants of Canterbury, preferably with names

matching those on the NZ Organisms Register (<http://www.nzor.org.nz/>), or Kew Gardens' Plants of the World online. There is much to be gained from better streamlining Canterbury's processes for weed detection and follow-up action.

It is important that agencies monitor iNaturalist NZ observations. They can subscribe to get automated emails of all observations of selected taxa from selected places. Decisions can then be promptly made, and actions against new naturalisations are more likely to be both affordable and successful. The eradication of long-flowered veldt grass is an excellent example of early detection leading to successful eradication of a bad weed. However, this discovery triggered no official agency process and its eradication was the result of the right people being told. Canterbury – and indeed all of New Zealand – stands to save a huge amount in weeding expense and ecological and economic impacts if we get better at pouncing on new naturalisations as they are discovered. The clock is ticking.

Acknowledgments

We are grateful to all of those people who have taken the time to upload observations to iNaturalist NZ – Mātaiki Taiao. We would like to particularly acknowledge the many important Canterbury plant observations made by Grahame Bell, Joe Potter Butler, Alex Fergus, Kate McCombs, Sue McGaw, Nathan Odgers, Trevor Partridge, William Reinders, Jenny Saito, Alice Shanks, Greg Stanley, Gail Timmerman-Vaughan, and Wei Quan. We would also like to acknowledge Ken-ichi Ueda, Scott Loarie, and the whole team at iNaturalist central for developing and maintaining the iNaturalist platform globally. We also thank the New Zealand institutions (DOC, MPI, MBIE, Brian Mason Trust) that have provided financial support to NZBRN to maintain and grow iNaturalist NZ – Mātaiki Taiao.

References

- Cockayne L. 1967. New Zealand plants and their story. 4th ed. (Godley EJ, editor). Government Printery, Wellington, New Zealand.
- Gatehouse HAW. 2008. Ecology of the naturalisation and geographic distribution of the non-indigenous seed plant species of New Zealand. PhD thesis, Lincoln University, New Zealand.
- Heenan PB, de Lange PJ, Cameron EK, Champion PD. 2002. Checklist of dicotyledons, gymnosperms, and pteridophytes naturalised or casual in New Zealand: additional records 1999–2000. *New Zealand Journal of Botany* 40: 155–174.
- Howell C, Sawyer JWD. 2006. New Zealand naturalised vascular plant checklist. New Zealand Plant Conservation Network, Wellington, New Zealand.
- Hulme P. 2014. An introduction to plant biosecurity: past, present and future. In: Gordh G, McKirdy S, editors. *The handbook of plant biosecurity: principles and practices for the identification, containment and control of organisms that*

threaten agriculture and the environment globally, Dordrecht: Springer Netherlands; p. 1–25.

- Kowarik I. 1995. Time lags in biological invasions with regard to the success and failure of alien species. In: Pysek P, Prach K, Rejmánek M, Wade M, editors. Plant invasions: general aspects and special problems. Workshop held at Kostelec nad Černými lesy, Czech Republic, 16–19 September 1993. Amsterdam: SPB Academic Publishing; p. 15–38.
- Mahon DJ. 2007. Canterbury naturalised vascular plant checklist. Canterbury Conservancy, Department of Conservation, Christchurch, New Zealand.
- Pýsek P, Jarošík V. 2005. Residence time determines the distribution of alien plants. In: Inderjit S, editor. Invasive plants: ecological and agricultural aspects. Basel: Birkhäuser; p. 77–96.
- Ward M. 2015. Magnificent and invasive; Favourite Plant and Worst Weed 2015: have your say!! *Trilepidea* – Newsletter of the New Zealand Plant Conservation Network 143: 1.
- Webb CJ, Sykes WR, Garnock-Jones PJ. 1988. Flora of New Zealand. Vol. IV, Naturalised pteridophytes, gymnosperms, dicotyledons. Christchurch: Botany Division, Department of Scientific and Industrial Research.
- Williams PA, Braithwaite H. 2003. The future of weeds in Canterbury landscapes. *Canterbury Botanical Society Journal* 37: 73–86.
- Williams PA, Cameron EK. 2006. Creating gardens: the diversity and progression of European plant introductions. In: Allen RB, Lee WG, editors. Biological invasions in New Zealand. Ecological Studies Series Volume 186. Berlin: Springer Verlag, p. 33–48.
-

Chilean mayten – an increasingly invasive tree in Canterbury

Murray I Dawson

Manaaki Whenua – Landcare Research, PO Box 69040, Lincoln 7640, New Zealand
dawsonm@landcareresearch.co.nz

Introduction

Maytenus boaria (also known as Chilean mayten, mayten or maiten) is a woody South American species becoming increasingly more invasive, especially in the Canterbury region. This tree has real potential to become yet another major environmental weed in New Zealand.