Many eyes on the prize: the role of citizen scientists in active weed surveillance

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Summary   Engaging and training citizen scientists to detect incursions of new and emerging weed species through active surveillance has proven an effective plant biosecurity strategy in Queensland. Between 2013 and 2015, approximately 550 community members attended Weed Spotter training sessions across Queensland where they were trained to detect declared pest plants in the field and submit specimens for formal identification. During the same three year period, more than 3000 weed specimens were submitted to the Queensland Herbarium for identification, 45% of which were subsequently incorporated into the Herbarium's collection and databases including Australia's Virtual Herbarium. Data from both specimen backed and non-specimen backed data are also accessible via the Atlas of Living Australia.

Submission of weed specimens by the community between 2013 and 2015 has allowed 383 incursions of 88 priority weed species to be notified to Biosecurity Queensland and local government officers, as well as other weed and land management organisations. In addition to priority weeds, members of the Weed Spotters Network have assisted in detecting newly naturalised and doubtfully naturalised species for Queensland and for Australia. Since 2013, 25 new naturalisations and 31 new 'doubtful naturalisations' have been detected including six species with no previous record in Queensland and eight species not previously known to occur in Australia. By detecting emerging and priority weeds through active surveillance, Weed Spotters are making a valuable contribution to biosecurity in Queensland.

Keywords   Active surveillance, citizen science, early detection, Weed Spotters Network Queensland.

INTRODUCTION

Queensland is a large state (1.7 M km^2) with a significant weed problem, costing the economy in excess of $600 million a year in control and lost productivity costs (Biosecurity Queensland 2016). Addressing new weed threats quickly ensures that the control and management of weeds is targeted and cost effective. Discovering and correctly identifying new weed occurrences are vital first steps. Plant identification services are provided to Queenslanders by the Queensland Herbarium, however the size of the state and the scale of the weed threat mean that plant scientists, botanists and biosecurity staff need the help of the community to spot and identify new and emerging weeds. The Weed Spotters Network Queensland project aims to establish and support a weed incursion detection capability focused on the early detection of new and emerging weeds through harnessing and fostering community interest and skills in collecting and identifying weeds.

The Weed Spotters Network Queensland is a citizen science collaboration between the Queensland Herbarium, Biosecurity Queensland and the community. Local government support for the network is provided via the Land Protection Fund. The Queensland Herbarium, part of the Department of Science, Information Technology and Innovation (DSITI) is the Queensland Government's centre for research and information on Queensland plants, animals, fungi, algae and ecosystems. Herbarium botanists, ecologists and taxonomists identify and verify weed specimens submitted for identification and provide data to scientists, government agencies and the public. Where new naturalisations (species detected as becoming weeds for the first time), new occurrences of declared weeds or potential new weed species are detected, the Queensland Herbarium notifies Biosecurity Queensland and local government agencies. Biosecurity Queensland, part of the Department of Agriculture and Fisheries (DAF), provides leadership and support for invasive plants and animal management in Queensland through the development of policy, legislation, pest risk assessments, research, state-wide coordination of pest programs, communication, education and awareness programs. Biosecurity Queensland works directly with local governments and the community to manage new naturalisations, new occurrences of declared weeds, and potential new weed species where they are identified through a risk assessment process.

The Weed Spotters Network Queensland project coordinator is based at the Queensland Herbarium and manages communication across the state, provides training and educational resources and raises awareness of weed issues through the network's monthly

bulletin, media releases, website and publications. Training is delivered to participants at the regional level and covers weed ecology, plant identification and plant collecting techniques to assist Weed Spotters to locate, identify and collect weed specimens. The Network coordinator is also the regional coordinator for Brisbane. Other volunteer regional coordinators are located in 21 regions around the state and provide assistance to Weed Spotters in their local area with the collection, identification and sending of specimens to the Queensland Herbarium. They also provide feedback to local Weed Spotters about new and emerging weeds found locally and assist with accessing government information.

Participants in the Weed Spotters Network come from diverse sectors of the community but share a common interest in weeds for either scientific, economic, or environmental reasons. The current membership includes landholders, industry representatives, regional natural resource management groups, Landcare, Bushcare, scientists, slasher drivers, weed contractors, gardeners, biosecurity and local government officers. Once trained, Weed Spotters send specimens of potential, new and emerging weeds and accompanying data to the Queensland Herbarium for identification, data capture and mapping. Analysis of this data leads to a better understanding of new weed incursions in Queensland and tracks how far and how quickly weeds are spreading. This information is crucial for developing early response strategies for new weeds, and for the ongoing control and containment of established weeds, a key objective of the project.

RESULTS

The Weed Spotters Network has been engaging and training citizen scientists to detect incursions of new and emerging weed species through active surveillance since 2008. Network membership has continually grown and now exceeds 1000 members (Figure 1). Between 2013 and 2015, 550 participants attended Weed Spotter training sessions on weed ecology, plant identification and plant collecting techniques to assist them to locate, identify and collect weeds across Queensland. To support this training, Weed Spotters have received over 30 editions of the Weed Spotters bulletin via email, providing them with information on weed spread pathways, biosecurity legislation changes and identification training for over 100 declared weed species.

Between 2013 and 2015, more than 3000 weed specimens were submitted to the Queensland Herbarium for identification. Almost half of these specimens (45%) and their associated data were subsequently incorporated into the Queensland Herbarium specimen collection and associated Herbrecs database. Data from weed specimens not incorporated into the collection is captured in Queensland's Wildnet (Wildlife Online) database. As a result, data on weed species, distribution and spread is accessible to the public, governments and scientists via tools such as Australia's Virtual Herbarium, the Atlas of Living Australia and Queensland's Wildlife online. Specimens are also extensively used for plant molecular and taxonomic studies by botanists and university researchers from around the world.
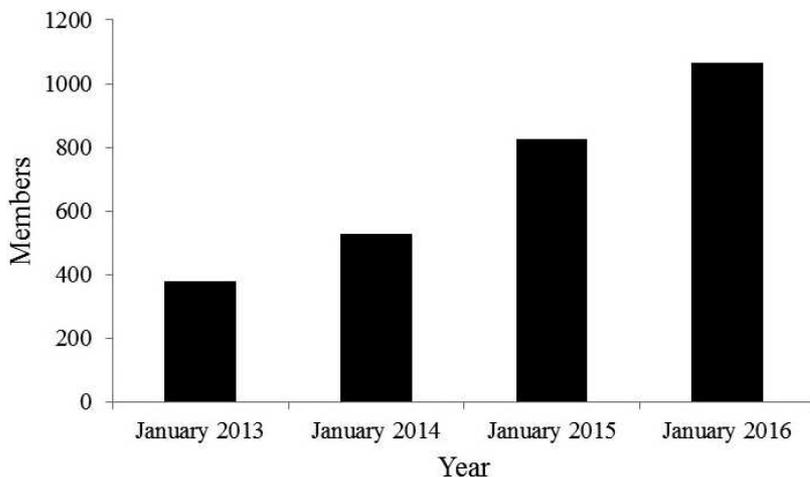

Figure 1. Weed Spotters Network Queensland membership 2013–2016.

Between 2013 and 2015, 383 incursions of 88 priority weed species were reported to Biosecurity Queensland and other weed management agencies as a result of specimens submitted to the Herbarium for identification (Table 1). These included 109 specimens of 28 Class 1 and 89 specimens of 27 Class 2 species declared under Queensland's *Land Protection (Pest and Stock Route Management) Act 2002*, including 98 specimens of 27 species also listed as Weeds of National Significance (WONS). These declared species are prioritised as targets because of their potential to cause economic, environmental and social impacts in Queensland. These incursions were notified to management agencies including Biosecurity Queensland and local governments for management. In addition, since 2013, 25 species have been detected as new naturalisations and a further 31 species have been detected as new 'doubtful naturalisations'. Six of these species were not previously known to occur in Queensland and eight species were not previously known to occur anywhere in Australia.

DISCUSSION

Weed Spotters are trained individuals and groups with the knowledge, skills, contacts and support to obtain accurate and timely weed identifications. Correct identification empowers actions in the community including weed control and management programs, the issuing of local government weed control notices and the pursuit of community project funding opportunities. The provision of advice, data and resources assists communities wishing to prepare funding applications, educational publications and programs aimed at increasing community knowledge and changing local attitudes towards weeds. The support of scientists, botanists and other weed specialists allows Weed Spotters to become informed biosecurity advocates within their communities. An online survey of Weed Spotters Network members in July 2015 asked Weed Spotters what they felt were the benefits of being part of the network:

- 93% of respondents told us that as a result of participation in the network, they know how to collect and submit a weed specimen to the Queensland Herbarium for identification
- 94% know who to contact to report a declared or potential weed in their region
- 100% of respondents felt that being a part of the Weed Spotters Network helped them learn more about weeds in their region and across the state
- 97% told us they were now actively looking out for new and emerging weeds in their region.
- 89% said they talk to their community, friends and/or family about the importance of early weed detection and
- 97% said that participation in Weed Spotters made them feel they contribute to keeping Queensland free of some of the world's worst weeds.

Weed Spotters have an increased understanding of invasion ecology. They understand that the time lag between when a weed species first invades and when it begins to have serious impacts can be exploited to save on weed control costs and lost production, as well as to protect our native ecosystems. They also appreciate the value of accurate identifications, data and mapping in supporting on ground actions. Weed Spotters understand the important role of herbaria and biological collections, the value of plant and biodiversity science and the applied benefits to our biosecurity of understanding our state's alien flora. As a result, the Weed Spotters Network has proven to be an effective aid to both plant science and biosecurity in Queensland and Australia.

REFERENCES

Biosecurity Queensland (2016). Impacts of weeds. [accessed 20 June 2016] https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants/weeds/impacts-of-weeds.

Table 1. Weed incursions notified by the Queensland Herbarium 2013–2015.

Weed category	Number of notifications				Number of species			
	2013	2014	2015	Total	2013	2014	2015	Total
Class 1	34	37	38	**109**	17	15	20	**28**
Class 2	33	15	41	**89**	16	7	20	**27**
Class 3	6	1	0	**7**	3	1	0	**3**
Weeds of National Significance (WONS)	22	22	54	**98**	11	8	25	**29**
Northern Australian Quarantine Strategy (NAQS)	16	4	8	**28**	8	3	5	**13**
National Environmental Alert List (NEAL)	13	8	6	**27**	5	4	3	**6**