Environmental Protection Authority
Te Mana Rauhī Taiao

Staff Assessment Report

Application APP202262: to release privet lace bug

March 2015

Purpose	To release privet lace bug (*Leptophya hospita*) as a biological control agent for the weed privet (*Ligustrum* spp.).
Application number	APP202262
Application type	Notified, Full Release
Applicant	Waikato Regional Council
Date formally received	16 January 2015

Executive Summary and Recommendation

In January 2015, the Waikato Regional Council made an application to the Environmental Protection Authority (EPA) seeking to introduce the privet lace bug (*Leptophya hospita*) as a biological control agent for the weed privet (*Ligustrum* spp.).

Host range testing showed that no native, valued and/or taonga plants will be adversely affected by this agent, and we recommend that it be approved for release.

Table of Contents

1. Purpose of this document

1.1 On 16 January 2015, Waikato Regional Council applied to the Environmental Protection Authority (EPA) to introduce the privet lace bug (*Leptophya hospita*) as a biological control agent (BCA) for the weed privet (*Ligustrum* spp.).

1.2 This document has been prepared by EPA staff to advise the Decision-making Committee on our risk assessment for the release of *Leptophya hospita*. The document discusses the information provided in the application and information readily available in scientific literature.

2. Application process

2.1 Waikato Regional Council lodged an application with the EPA seeking approval to release *Leptophya hospita* under section 34 of the Hazardous Substances and New Organisms (HSNO) Act (the Act).

2.2 The application was publicly notified, and open for submissions for 30 working days as required by section 53(1)(b) of the Act.

3. Submissions

3.1 The EPA received submissions from Ngāi Tahu, Greater Wellington Regional Council, Bay of Plenty Regional Council, Liam John Mackay Griffin, Pakitai Raharuhi, Huakina Development Trust, and Clinton Care. The submissions are summarised in Appendix 1. All submitters supported the release of the privet lace bug to control privet infestations in New Zealand, except for Huakina Development Trust and Clinton Care who neither supported nor opposed the application.

3.2 Ngāi Tahu initially indicated that they would like to be heard in support of their submission but waived that right on 14 March 2015. Consequently, no public hearing will be held for this application.

4. Submissions from DOC and MPI

4.1 As required by the Act and the Hazardous Substances and New Organisms (Methodology) Order 1998, the Ministry for Primary Industries (MPI) and the Department of Conservation (DOC) were notified of the application and provided with the opportunity to comment.

4.2 MPI did not make any comments on the application.

4.3 DOC strongly support the application and noted that the benefits of reducing the impact of *Ligustrum* through privet lace bug is likely to be much larger than minor leaf damage to New Zealand maire species that are closely related to *Ligustrum* spp. DOC's full submission is provided in Appendix 2.

5. Background

Privet (*Ligustrum* species) inhabits natural and modified environments where it inhibits native seedlings and reduces plant and animal biodiversity

Ligustrum in New Zealand

5.1 There are at least nine species of *Ligustrum* (family: Oleaceae, tribe: Oleeae) in New Zealand. Five species occur on public conservation land and two are classified as weedy by DOC (Havell, D Technical Advisor Threats in a submission from DOC; Landcare Research 2014b). *Ligustrum sinense* Lour. (Chinese privet) and *Ligustrum lucidum* W.T. Aiton (tree privet) have DOC weediness scores[1] of 25 and 32 (out of 36) respectively. The other three species that occur on conservation land have either not been assessed to determine their weediness score or have a low score (23 out of 36). *Ligustrum* species are known to occur in at least 30 national priority ecological management units and in 70 other areas within public conservation estates including reserves and national parks (Landcare Research 2014b). *Ligustrum lucidum* is also listed on the Unwanted Organisms Register (MPI).

5.2 *Ligustrum* species occur in national biodiversity priority sites including wetlands, sand dunes, restoration planting areas and naturally uncommon ecosystems where several nationally critical threatened or nationally vulnerable plants occur, including *Pseudowintera insperata, Parahebe jovellanoides* and *Pimelea tomentosa* (de Lange, Rolfe et aL. 2013, Landcare Research 2014b). *Ligustrum* plants are also found near human habitation where ornamental plantings and hedges exist.

5.3 DOC noted that it is not uncommon for forest patches in the north of the North Island to be transformed into *L. lucidum* thickets which results in the loss of native biodiversity.

5.4 In a study on the prevalence of *L. sinense* in the Waikato, it was found that this privet species has naturalised across the region, persisting in a variety of environmental conditions (including wetlands and dry lower slopes of ranges) (Grove and Clarkson 2005). *L. sinense* seedling and saplings were also found in secondary kanuka forest, mature podocarp forest and mature pine plantations in the study (Grove and Clarkson 2005). An abundance of *L. sinense* seedlings was found at two podocarp sites at Waingaro. Livestock grazing no longer occurred at these sites suggesting that *L. sinense* rapidly established where it no longer faced control from being grazed by stock, and outcompeted and suppressed native species from establishing. The study also found that *L. sinense* seedlings and saplings occurred at greater densities than other species, were found where native seedlings were both sparse and common, and were present in high shade or light areas.

[1] Calculated from the 'biological success' score which considers the biological characteristics of a species and the 'effects on the system' score which considers the ability of the species to persist and supress native plants

5.5 A survey of 234 reserves located across eight low land regions, including East Taranaki, Wairarapa, Taumarunui and Auckland, conducted between 1981 and 1989 identified *Ligustrum* spp. to be problematic weeds (Timmins and Williams 1991).

Ligustrum is also a problem in other countries

5.6 *Ligustrum* spp. are widely distributed in the southeastern United States and considered an invasive species in many states (Greene and Blossey 2012). They have invaded riparian habitats and are well suited to invade floodplain forests. It is estimated that they have invaded 1.09 million hectares of forested land. *Ligustrum* spp. were found to suppress herbaceous understory, lower native species richness, abundance and cover, and reduce native seedling survival and growth in forest habitats.

5.7 In a study of the Upper Oconee River floodplain in Georgia in 1999, *Ligustrum sinense* was found to cover 59% of the floodplain which was an 8% increase from a 1951 aerial survey (Ward 2002). In another survey, abundance and richness of native plants were reduced in high *Ligustrum*-density plots compared to more species richness in low density plots in a forest preserve in the southeastern USA (Wilcox and Beck 2007).

5.8 A survey of forests in central Argentina considered the distribution and impact of *L. lucidum* found that *Ligustrum* dominated stands occupied 12% of the surveyed forest land area (Hoyos, Gavier-Pizarro et al. 2010). It was also found that forest regeneration was dominated by *L. lucidum* in native forest stands adjacent to *Ligustrum* dominated stands.

Biological characteristics that make *Ligustrum* species superior weeds

5.9 *Ligustrum sinense* and *L. lucidum* are tolerant of flooding and low light levels, and are evergreen. *Ligustrum* plants can establish in shaded areas such as forests which enable them to become invasive in habitats where other weeds may not grow. Mature plants produce abundant fruit that birds eat and then disperse the seeds (Greene and Blossey 2012). Flowering takes place in mid-late January to early February, and seeds are ripe in May to August. Seeds have been found to float for up to 2 weeks (BT Greene, pers. obs.).

5.10 *Ligustrum* spp. have the ability to suppress seed germination or growth of other plants. Allelopathy, which is the chemical suppression of other plants, was found to play a role in inhibiting root and stem lengths of radish (Grove and Clarkson 2005) and tomato (Pokswinski 2008) seedlings in laboratory studies as a result of extracts made from *L. sinsense* leaves and roots. Allelopathy allows *L. sinense* to inhibit the establishment and growth of other plants species which promotes the invasion of privet (Greene and Blossey 2012).

5.11 Metsulfuron or glyphosate herbicide applications and physical control are the only prescribed management methods for *Ligustrum* spp. (Waikato Regional Council 2011).

6. The biology of *Leptophya hospita* makes it a preferred BCA for *Ligustrum* spp.

6.1 The applicant is seeking to release *Leptophya hospita* (Drake and Poor, 1937) (Hemiptera: Tingidae), also called the privet lace bug, a native of China, Penang Island, and Malaysia (Zhang, Hanula et al. 2011). *Leptophya hospita* adults and nymphs feed on *Ligustrum* mesophyll[2] cells of leaves that lead to a bleached appearance of leaves and premature defoliation.

6.2 Females lay an average of 240 eggs that are inserted at an angle into both the dorsal and ventral surfaces of *Ligustrum* leaves and petioles (see Figure 1 for a photo of a female *L. hospita*).

6.3 A systemic survey was undertaken between 2005 and 2006 to identify insect communities in China associated with *Ligustrum sinense* foliage (Zhang, Hanula et al. 2008). *Leptophya hospita*, a flea beetle, *Argopistes teskooni*, and an unidentified sawfly were identified as potential biocontrol agents in the survey. The authors suggested that *L. hospita* was a promising biological control agent (BCA) as it often occurred in high numbers on *L. sinense* plants and has limited host range in the family Oleaceae. The recorded host range of *L. hospita* are restricted to the genus *Ligustrum* in China (Li 2001).

6.4 *Leptophya hospita* has a short immature developmental period of *circa* 25 days and has shown multiple overlapping generations in rearing colonies in quarantine which is presumed to also be the case in the field (Zhang, Hanula et al. 2011).

6.5 There are no known inseparable organisms associated with *L. hospita*.

Figure 1: Dorsal view of a female Leptophya hospita *(courtesy Landcare Research)*

[2] Photosynthetic cells that lie between the upper and lower epidermis layers of a leaf.

7. Risk assessment

7.1 The benefits and risks associated with the release of *L. hospita* to control *Ligustrum* spp. were assessed with the following assumption in mind:

Leptophya hospita successfully establishes in the environment and develops self-sustaining populations

7.2 We note that *L. hospita* may take some time to establish and build self-sustaining populations in New Zealand; therefore, the effects of the organism on *Ligustrum* will be gradual at first.

7.3 The likelihood of the benefits outweighing the risks or *vice versa* is determined in light of the information provided by the applicant, scientific evidence that was collected during a literature review, and additional information provided by submitters.

8. Assessment of benefits and positive effects

8.1 The applicant identified potential beneficial effects on the environment, human health, the market economy, society and communities, and Māori culture and traditions that can be associated with the release of *L. hospita* to control *Ligustrum* in New Zealand. We have assessed all benefits and discuss those elements that we considered to be non-speculative or that we consider will have a significant result.

Environmental benefits

Herbivory of *Ligustrum* species

8.2 A number of environmental benefits that may accrue from the release of *L. hospita* to combat *Ligustrum* species are discussed in the application. They include:

- Feeding on, and defoliation of, Ligustrum plants.
- Minimising the dispersal and establishment of Ligustrum plants in new environments by reducing the quantities of berries that birds feed on.
- Increasing the establishment, growth and diversity of native seedlings and animals where Ligustrum species used to grow before control by L. hospita.

8.3 Zhang and co-authors assessed the efficacy of *L. hospita* to cause damage to *Ligustrum* sinense (Zhang, Hanula et al. 2013). The authors found that significant defoliation and reductions in photosynthetic activity of damaged leaves from feeding larvae and adults resulted from releasing *L. hospita* on potted plants in the laboratory. The study showed that the density of *L. hospita* bugs on *Ligustrum* leaves played an important role in the level of damage to the plants. They noted that continuous and long term feeding by privet lace bug could result in suppression of *L. sinense* populations in the environment and, as a result, act as a feasible biological control agent to reduce *Ligustrum* species down to desirable levels.

8.4 Clinton Care submitted that he found *Aenetus virescens* (native puriri moth caterpillars) in branches and trunks of *Ligustrum lucidum* which he considered to be a good biological control agent for

Ligustrum spp. Chris Winks and co-authors undertook a survey of invertebrate fauna that are associated with *Ligustrum* spp. in New Zealand (Winks, Than et al. 2012). The survey found that although *Ligustrum* spp are attacked by a variety of native and exotic invertebrates in New Zealand overall damage appears to be minimal. Therefore it was recommended that a suitable BCA will need to be introduced to reduce *Ligustrum* infestation in New Zealand.

8.5 The Huakina Development Trust questioned the need for a BCA to combat *Ligustrum* in addition to other control methods that the submitter considers are not clearly outlined in the application. The current methodologies that are employed to control *Ligsutrum* spp. in New Zealand are outlined in 5.11. The applicant noted that knowledge of, and access to, *Ligustrum* infestations in addition to resource constraints limit the efficacy of these physical-chemical control methods. Huakina Development Trust further considered the lack of concerted efforts to mount a uniform attack on *Ligustrum* infestations. We considered the pre-application consultation that the applicant conducted with a number of unitary/regional councils, the QEII National Trust, DOC and other environmental organisations and we note that there is not a uniform approach to *Ligustrum* control across all organisations or regions. We consider this to be a result of temporal and spatial dissimilarity in *Ligustrum* abundances between different areas, resource availability and differences in the terms of reference for land management departments and organisations. We consider that a BCA such as *L. hospita* that will not be constrained by territorial boundaries and contrasting weed management practices, and has the potential to be an effective tool to control *Ligustrum* in the presence or absence of other control methods.

8.6 We consider *L. hospita* to be a suitable organism to control *Ligustrum* spp. that is **likely** to reduce *Ligustrum* biomass, and diminish dispersal and establishment of new *Ligustrum* plants. We note that the establishment of self-sustaining populations of *L. hospita* may not lead to dramatic reductions in *Ligustrum* populations since the principles of successful biological control is more likely to lead to gradual reduction in the number of *Ligustrum* plants to desirable levels. We also note that it may take time before *L. hospita* establishes in the environment and develops self-sustaining populations that can lead to suppression of *Ligustrum*.

Biodiversity and conservation values

8.7 The applicant discussed the impact that removing *Ligustrum* spp. may have on native plant and tree communities and suggested that reduction in *Ligustrum* plants will lead to improvements in biodiversity.

8.8 A number of studies assessed the impact that removal of *L. sinense* had on native plant and animal communities in riparian forests in the southeastern United States. Although most of these studies document the use of physical methods (mulching and hand felling) and herbicide application to remove *Ligustrum* plants, the observations regarding biodiversity values is of relevance in our assessment of the proposed beneficial effects of biological control of *Ligustrum spp.* The return and establishment of Lepidoptera to riparian forests that previously were overgrown with *L. sinense* was shown in a study of butterfly abundance and diversity in these forests (Hanula and Horn 2011). The authors concluded that by removing an invasive species cover that dominates the landscape improves forest habitats for butterfly communities to flourish.

8.9 In other studies the impact of removing *L. sinense* had a beneficial impact on bee and butterfly habitat and non-privet herbaceous plant communities after five years of removal of *Ligustrum* plants studied in riparian forest experimental plots (Hudson, Hanula et al. 2013, Hudson, Hanula et al. 2014). The return of pollinator communities and diverse plant communities to the plots was as a result of the removal of *Ligustrum* plants. Native North American earthworm communities established in flood plain forests once *L. sinense* plants were removed (Lobe, Callaham Jr et al. 2014). Exotic earthworms prevailed under *Ligustrum* trees which the authors concluded is a result of soil pH modification mediated by *L. sinense* which supported introduced earthworm communities.

8.10 *Ligustrum* has been shown to invade native plant communities and then degrades them by replacing other species such as shrubs and mid-canopy trees in native forests, shrublands and habitats at the interface of modified or developed environments (e.g. road verges, fence lines and drains) (McGregor 2000).

8.11 We consider it a **likely** outcome that the control and reduction of *Ligustrum* plants in the environment will support increases in biodiversity values in native plant and animal communities. The consequence of releasing *L. hospita* to control *Ligustrum* spp. will have **minor to moderate** impact on growth and diversity of native communities in these habitats.

Human health

8.12 The applicant considered that the biological control of *Ligustrum* plants would benefit human health by reducing flowering and therefore the incidence of hay fever, sinusitis and other respiratory health problems.

8.13 The applicant considered *Ligustrum* pollen to contribute to elevated allergen sensitisation in people that have hay fever and asthma conditions during the flowering season. The applicant consulted with a number of clinical and allergy experts in New Zealand regarding the impact of *Ligustrum* on allergic responses (Jorgenson 2014). There was consensus between the experts that privet pollen has strongly perceived effects on respiratory health in urban environments during the flowering season by members of the public. However, there is agreement amongst the clinical experts that *Ligustrum* pollen is not considered to be the primary cause of allergies in flowering seasons, or considered a bigger factor than grass pollens or dust mites. We note the tenuous link between *Ligustrum* pollen and respiratory ill health after reviewing the evidence presented in the application.

8.14 A number of clinical and botanical studies documented the effects of *Ligustrum* pollen on human health. In a study of 100 children that presented allergy and immunology conditions at a clinic in Argentina, *Ligustrum lucidum* presented the most allergenic pollen of the plant species in the study (Pendino, Agüero et al. 2011). The researchers found that *Ligustrum* pollen was responsible for 61.5%

positive skin prick tests of only 13 of the 100 patients that were sensitive to pollen. The majority of children (58%) were sensitive to dust mites.

8.15 *Ligustrum* plants were identified as the potential causative agent of allergic responses in Cordoba, south west Spain (Cariñanos, Alcázar et al. 2002). However it was found that privet pollen has a short dispersal range and periods of optimum pollinosis coincided with the flowering of *Olea europaea* (olive) trees, a close relative of *Ligustrum*, which is regarded as an important cause of hay fever and asthma in the Mediterranean (McGregor 2000, Cariñanos, Alcázar et al. 2002). Cross reactivity between pollens from trees in the Oleaceae family including *Faxinus excelsior* and *Ligustrum vulgare* was found, in addition to the fact that the main pollen allergen protein of *Olea europeae* is similar to proteins produced by the other species of the Oleaceae family (Obispo, Melero et al. 1993). This, the authors suggested, indicates that *Ligustrum* species may not be the sole cause of respiratory health issues where it is present in proximity to other tree species in the Oleaceae family.

8.16 Following a review of the literature on *Ligustrum* allergenics, we consider that biological control of *Ligustrum* plants is **unlikely** to have real benefits given the equivocal evidence of *Ligustrum's* effects on respiratory health. We therefore consider the release of *L. hospita* to have **minimal** consequences on human health.

Market economy

8.17 The applicant considered the successful biological control of *Ligustrum* species will benefit the market economy by reducing costs to land and conservation managers if *L. hospita* reduces the vigour and abundance of the weed.

8.18 The applicant consulted with a number of organisations with respect to the financial costs of controlling *Ligustrum* species. The organisations include:

- Department of Conservation. The costs to control *Ligustrum* species within DOC's weed management programmes very from $1,000 to $33,000 per year. The cost of managing *L. lucidum* in the Auckland Domain is $10,000 to 20,000 annually.
- Waikato Regional CounciL. The council historically has spent around $15,000 per year to control *Ligustrum* species. The cost to control *Ligustrum* in the Te Hikuwai reserve (Hamilton) will be $6,500 using mechanical means with up to $5,000 spend each year for a number of years to manage any regrowth.
- Pukemokemoke Bush Reserve Trust. The cost is $35,000 for mechanical removal of 4-5 acres of solid *Ligustrum* plants.
- Hawke's Bay Regional CounciL. It costs over $120,000 per annum in contractor's time and staff time to control *Ligustrum* plants.

- Bay of Plenty (BoP) Regional CounciL. In a cost-benefit analysis to support the BoP Regional Management Plant, the net present value of impacts of *Ligustrum* is estimated at $6M (minimum $1.4M, maximum $25M) over 50 years.

8.19 A number of the unitary and regional councils that were consulted did not have cost information or the data available to reliably estimate the costs pertaining to control of *Ligustrum* infestations in their regions. The applicant noted that from the cost information obtained through consultation, ongoing costs of at least $150,000 per year can be expected to control *Ligustrum* species in the environment.

8.20 We consider it **likely** that economic benefits to land management budgets may follow the release of *L. hospita* to control *Ligustrum* spp., but that the economic benefits will be **minimal** as weed control programmes will continue however the focus of these programmes will shift to other weeds that have become problematic.

9. Assessment of risks and costs

9.1 The applicant has identified potential adverse effects that may be associated with the release of *L. hospita*. These include effects on the environment, human health, the market economy and potential negative effects on Māori and their relationship with the environment.

Environmental effects

9.2 The applicant considered that the release and establishment of *L. hospita* would have adverse effects on the environment if feeding by adult and nymphs:

- attack and reduce populations of native plants
- interfered with trophic webs.

Host range testing shows that native New Zealand plants fall outside the ecological host range of *L. hospita*

9.3 The applicant discussed data from host range tests that were conducted in the United States and New Zealand and reported on in two unpublished reports (Zhang, Hanula et al. 2012, Landcare Research 2014a). The applicant considered that the host range tests show that New Zealand native plants are not preferred hosts for feeding or reproduction by *L. hospita*.

9.4 Host range testing is considered to be the gold standard approach to establish the specificity and safety of an organism as a biological control agent. The original and widely accepted method to determine host range was developed by Wapshere and published in 1974 (Wapshere 1974). The primary method to identify plant species to be used in host range tests according to Wapshere is to assess phylogenetic relationships between the weed and other plant species to determine which species are successively more distantly related for inclusion in a testing protocoL. Wapshere also proposed a number of additional criteria by which test species may be selected in case the centrifugal phylogenetic method fails.

9.5 The rapid development of molecular tools has led to new understandings of phylogenetic relationships between plant species. This has created new levels of certainty to establish strict relations beyond using taxonomic restrictions alone. This has meant that as many test plants from as many related taxa were included in testing protocols previously rather than considering the true degree of relatedness between target and non-target species (Briese 2005).

9.6 The host range testing undertaken in the USA was to determine the fundamental host range[3] of *L. hospita* (Zhang, Hanula et al. 2012).The tests were conducted in quarantine before the authors petitioned the relevant regulator to release *L. hospita* to supress *L. sinense* in the environment. The test plants were selected on the basis of true phylogenetic relationships modified from the centrifugal phylogenetic method. No-choice (*L. sinense* absent) and multiple choice (*L. sinense* present) tests were conducted on 45 and 13 plant species respectively to determine feeding damage, oviposition (egg laying) and egg numbers that successfully develop to adult. *Ligustrum sinense* belongs to the order Limiales, family Oleaceae, tribe Oleeae and subtribe Ligustrinae. The results from no-choice tests showed that the host range of *L. hospita* was restricted to plants in the tribe Oleeae. *Leptophya hospita* did cause minor damage to some plant species outside of the Oleeae however none of these plants could support development to adults where *L. hospita* successfully oviposited on plant material to lay its eggs. The authors reported that out of 45 test species in no-choice trials, *L. hospita* oviposited on three native North American species and three non-native species to the same level as they did on *L. sinense*. However, only one of the native species, *Forestiera neomexicana*, and one species belonging to the same genus as the target, *L. vulgare*, was comparable to *L. sinense* in terms of the number of nymphs that developed to adults.

9.7 The results of their choice tests show that *L. hospita* display a preference for feeding and ovipositing on *L. sinense* over any other species. When the researchers compared non-target plant species relative to *L. sinense* in no-choice and choice tests, they found that feeding and ovipositing rates dropped significantly. The authors considered that the results suggest that if *L. hospita* is faced with a number of options to feed and oviposit on, it will prefer *L. sinense* above any non-target species including the native North American species that are in the same family as the target weed and other *Ligustrum* species. This, the authors considered to be the ecological[4] host range or also called the realised host range of *L. hospita*, which is often smaller than the fundamental host range as determined in no-choice tests.

9.8 The applicant considered that no New Zealand native plants outside the tribe Oleeae would be a risk of attack from *L. hospita* in the field from the host range tests performed in the USA.

---

[3] Defines the absolute limits of a species host range. It includes all hosts that are used by the test organism where no alternative is offered. Fundamental host range does not represent field conditions.

[4] Comprises the plant species that are actually utilised in the field

9.9 No-choice host range testing was performed on the four native New Zealand maire species in the Oleeae: *Nestegis cumminghamii*, *N. lanceolata*, *N. montana* and *N. apetala* (Landcare Research 2014a).

9.10 None of the *Nestegis* species were preferred by *L. hospita* as hosts. There were a number of feeding marks on *Nestegis* leaves but the maximum mean number of counted feeding marks was 49% less the mean number of feeding marks on *L. sinense* plants. The largest number of marks was counted on *N. apetala* or coastal maire. As a result, the applicant considered that none of the *Nestegis* species are preferred food for the *L. hospita*. There were no eggs laid on any of the *Nestegis* species and none of the *Nestegis* species supported the rearing of *L. hospita* adults. Therefore *L. hospita* cannot complete a life cycle on *Nestegis* speices.

9.11 The applicant considered that damage to *Nestegis* leaves will be incidental where populations of *Nestegis* and Ligstrum grow in close proximity to one another as *Nestegis* spp. are not considered to be fundamental hosts of *L. hospita*. The applicant noted that *Ligustrum* and *Nestegis* species are not considered to be growing in close range to one other. David Havell, Technical Advisor for DOC, submitted that spreading of *L. hospita* from *Ligustrum* to *Nestegis* species will most likely occur in high density *Ligustrum* areas such as urban fringe and agricultural landscapes where *Ligustrum* patches and bush occur together in metropolitan bush fragments and margins. Mr Havell noted that *Nestegis* species are rarely found in relatively young secondary regeneration forests which is found in bush fragments, margin and canopy gaps. He went on to say: "*Nestegis species rarely dominate forest patches and usually occur as scattered individuals within older forests*". We therefore note that *Ligustrum* affected areas will generally have little or no *Nestegis* species.

9.12 The host range testing was reviewed by two independent scientists: Drs Simon Fowler (Research Leader, Biological Control, Landcare Research) and Jim Hanula (US Department of Agriculture, Forest Service). The reviewers were in agreement that the testing methodology was sound and the conclusions drawn correct. Simon Fowler commented that the choice of New Zealand native test plants is appropriate and that there is very low risk of minor spillover damage by *L. hospita* on *Nestegis* spp. in New Zealand. Dr Fowler considered the consequences of occasional and incidental damage to *Nestegis* as a result of *L. hospita* feeding to be negligible.

9.13 The Huakina Development Trust submitted that they consider *L. hospita* to be host specific, but noted the importance and need for long-term monitoring following the release of a new organism for biological control. The applicant noted that the National Biocontrol Collective is committed to the evaluation of target and non-target effects of agents post release. The applicant Waikato Regional Council will be overseeing the release of *L. hospita*, and evaluate establishment of the BCA and its effect on *Ligustrum* plants. The applicant further noted that monitoring of this release and other future BCA will be key to improve on the practice of biological control of weeds in New Zealand.

9.14 We consider it **highly improbable** for *L. hospita* to use native New Zealand *Nestegis* spp. as a host for development since the host range testing conclusively showed that the organism cannot complete development on *Nestegis* and is thus not a fundamental host. Hence native species are not able to act as an ecological host to *L. hospita*. The potential adverse effects of releasing *L. hospita* to control *Ligustrum* spp. on native New Zealand plant species is considered to be **minimal.**

Privet lace bug will not cause interference with trophic webs

9.15 We consider it important to take a holistic approach in assessing the potential adverse environmental effects that may be associated with the release of *L. hospita*. It is assumed that *L. hospita* will effectively establish in the environment and our assessment shows it is **likely** to reduce the occurrence and abundance of *Ligustrum* spp. It is therefore expected that control of *Ligustrum* will have effects at landscape and trophic web levels given that *Ligustrum* infestations reduce canopy tree abundance and native plant species richness (Greene and Blossey 2012).

9.16 Fiona McTavish of Bay of Plenty Regional Council submitted that the removal of *Ligustrum* infestations is unlikely to lead to re-invasion by worse weeds. Ms McTavish further stated that this is so because *Ligustrum* is "*almost unique in its ability to invade and displace established shrubland and forests by its ability to invade and displace dense canopy and eventually overtop established canopy species*".

9.17 Trophic or food webs are a succession of organisms in an ecological community that are linked to each other through the transfer of energy and nutrients. We consider new interactions between *L. hospita* and predators and parasitoids that may attack the organism as important effects that may follow the release and establishment of *L. hospita*. The impact that control of *Ligustrum* plants will have on habitats for native and specialised insects and food availability for birds are also important effects on trophic webs that we consider in our assessment.

9.18 The applicant noted that 'apparent competition' between two species occurs when both are predated upon by the same natural enemy. Thus when populations of parasites or parasitoids build to large numbers on a newly established organism, it may lead to elevated attacks on native organisms that fall within their host range.

9.19 The applicant lists *Tanybyrsa cumberi* Drake as the only native lace bug in the family Tingidae (subfamily Tinginae) known in New Zealand (Larivière and Larochelle 2004). In the updated list of New Zealand Hemiptera published in 2012, *Carldrakeana socia* Drake and Ruhoff is listed as a native tinged and *Cyperobia carectorum* Bergroth as an endemic tinged in the family Tingidae, subfamily Cantacaderinae (Larivière and Larochelle 2012).

9.20 *Tanybyrsa cumberi* is associated with its host plant *Astelia banksii* although it may sometimes occur on vegetation close to *Astelia* plants (Larivière and Larochelle 2012). *Astelia banksii* is primarily found in coastal regions in New Zealand and therefore we consider that *Astelia banksii* will not normally be growing in or near *Ligustrum* plants. The applicant noted that a small parasitic wasp has been recorded from the eggs of *Tanybyrsa cumberi* (May 1977). This, the applicant suggests could cause 'apparent competition' from the establishment of *L. hospita* in the environment if the wasp builds to unnaturally large populations on the privet lace bug which may lead to higher pressures on *Tanybyrsa cumberi* populations.

9.21 We consider it **unlikely** for *L. hospita* populations to convey unnaturally high pressures on *Tanybyrsa cumberi* populations. This may only occur where *Astelia banksii* and *Ligustrum* spp. grow near each other which is limited by the exclusive natural geographical location of these plant species.

9.22 The other two tingids have been found in locations where *Ligustrum* plants do not normally occur. *Carldrakeana socia* has been found in moss samples from the southeastern part of the North Island and *Cyperobia carectorum* on flowering plants comprising of the Compositae family from Marlborough to Central Otago (May 1977).

9.23 The applicant noted that there are low levels of general predators associated with *Ligustrum* spp. and none of these were restricted to *Ligustrum* plants only (Winks, Than et aL. 2012). These predators may attack *L. hospita* when it establishes in the environment however the pressures from generalist predators on a *Ligustrum* biocontrol agent are not considered to be over and above typically expected levels of predation.

9.24 There were no specialised invertebrates that are associated with *Ligustrum* spp. found in a survey of 39 sites throughout New Zealand except for the moth *Trichophysetis cretacea* whose host range is unknown and yet to be determined (Winks, Than et al. 2012). Therefore we consider it **very unlikely** that reduction in *Ligustrum* abundance will impact native and specialised invertebrate species as there are no invertebrate species that are exclusively associated with *Ligustrum* spp. Incidental disturbances are expected to be overcome by migration to nearby or suitable host plants in the absence of *Ligustrum*.

9.25 The applicant considered whether decline in *Ligustrum* populations may reduce the availability of food to birds. One study monitored the diet of birds in the forest remnants of the Nelson region (Williams and Karl 1996). None of the observed bird species fed exclusively on *Ligustrum* berries or were dependent on the fruiting season of *Ligustrum* spp. In addition, Bay of Plenty Regional Council submitted that "*frugivorous native birds are adaptable enough to source other food to replace the small dietary component privet fruit may have filled".*

9.26 No substantial differences in abundance and diversity of songbirds were found in forest plots that differed in *Ligustrum* densities (low, medium and high numbers of *Ligustrum* plants) (Wilcox and Beck 2007).

9.27 We consider it **highly improbable** that biological control of *Ligustrum* populations will negatively impact the diet of fruit eating birds since other fruiting plants are usually present where *Ligustrum* plants grow.

9.28 Overall, we consider it **very unlikely** that the release of *L. hospita* will disturb trophic webs or upset ecological relationships, and that any adverse effects on trophic webs will be **minimal.**

Effects on the market economy

Adverse effects on ornamental plants that are related to *Ligustrum*

9.29 The applicant identified potential adverse effects on New Zealand's nursery and garden industry once *L. hospita* establishes since a number of plant species that have economic and ornamental value may fall within the organism's host range.

9.30 We note that the fundamental host range of *L. hospita* is restricted to the tribe Oleeae (Zhang, Hanula et al. 2012). Within the tribe Oleeae, there are a number of genera of plants that are native to New Zealand (*Nestegis* spp. – see 9.9 – 9.11) or are sold in New Zealand at nurseries. The applicant considered that development of *L. hospita* to adult stage occurred in three genera of the Oleeae that are of relevance due to their ornamental value in New Zealand: *Fraxinus*, *Chionathus* and *Syringa*.

9.31 Host range testing conducted on six *Fraxinus* (ash) species showed that *F. nigra* was the only species that *L. hospita* laid eggs on and nymphs developed successfully in no-choice tests (Zhang, Hanula et al. 2012). In choice tests, feeding damage, number of eggs laid and numbers of adults reared were significantly lower on the *Fraxinus* species compared to *Ligustrum sinense*. It has also been noted that none of the 22 *Fraxinus* spp. that occur in China has been reported to be a host of *L. hospita* (Landcare Research 2014a).

9.32 Similarly, *Chionanthus* spp. (fringetrees) supported the life cycle of *L. hospita,* though the number of eggs laid and number of newly emerged adults were significantly lower than *L. sinense* in no-choice tests. Very few eggs were laid on *C. virginicus* in choice tests (0.8 % of the number of eggs laid on *L. sinense* in the test) indicating that this species does not fall within the ecological host range of the lace bug. We also note that none of the seven *Chionanthus* species that occur in China has been reported to be a host of *L. hospita*.

9.33 *Syringa* (lilacs) are the closest relative to *Ligustrum*. Therefore this genus was identified as being at the greatest risk of non-target attacks by *L. hospita*. No-choice host range testing was performed on seven *Syringa* spp: *Syringa patula*, *S. meyeri*, *S. oblata*, *S. vulgaris* (including six cultivars sold in New Zealand), *S. x josiflexa*, *S. x laciniata*, and *S. hyacinthiflora* (including three cultivars sold in New Zealand) (Zhang, Hanula et al. 2012, Landcare Research 2014a). The results indicate that although *L. hospita* laid its eggs on *Syringa* species, survival of *L. hospita* nymphs were poor compared to survival on *Ligustrum* controls, and few adults reared successfully. Even fewer adults were reared when *L. hospita* adults that were reared in the first test were placed back on *Syringa* plants for a second generation (<2% adults were reared compared to *L. sinense* control plants in a second generation).

9.34 The applicant considered that it is highly unlikely that *L. hospita* could colonise isolated *Syringa* plants and establish viable populations though minor spill over attack from nearby *Ligustrum* plants may occur. Jim Hanula (USDA, Forest Service) considered that the testing provided the necessary evidence to show that *L. hospita* is unlikely to be successful in the environment in the absence of *Ligustrum* sinense.

9.35 The applicant noted that the Nursery and Garden Industry Association of New Zealand (NGINZ) estimate that potential trade value of *Syringa* to the nursery industry is less than $100,000. The NGINZ also considers *Syringa* to be highly prized by gardeners.

9.36 We consider that it is **very unlikely** that *L. hospita* will pose any significant threat to ornamental plants that are related to *Ligustrum* spp. and that may have economic value to the nursery industry or have emotional enjoyment to gardeners. We consider that spill over attack on especially some of the *Syrina* cultivars that are sold in New Zealand may occur where these plants are grown in close proximity to *Ligustrum* plants. We also consider that it is unlikely for *Ligustrum* infestations to occur close to where Syringa is grown in gardens or parks therefore any spill over effects and related damage is expected to be **minimal.**

Adverse effects on plants that have agro-economic value

9.37 *Olea europaeus* or the olive tree is another plant in the Oleeae tribe that have economic value in New Zealand. Results from no-choice host range testing showed that there was minimal feeding by *L. hospita* on *O. europaeus* plants (only 3.8% of the damage caused to *L. sinense* leaves by *L. hospita*). No eggs were laid on *O. europaeus* leaves (Zhang, Hanula et aL. 2012).

9.38 Therefore we consider it **highly improbable** that *L. hospita* will cause any significant damage to *O. europaeus* and any spill over effects from *Ligustrum* plants close to olive groves will be **minimal**.

9.39 In conclusion, we consider it **very unlikely** for the establishment of *L.hospita* in the field to have detrimental effects on plant species that have ornamental and/or economic value. We consider that any negative effects will be **minimal** and that the risks can be mitigated by removing *Ligustrum* plants where they grow in gardens and parks or close to olive groves.

Relationship of Māori to the environment

9.40 The potential effects on the relationship of Māori to the environment have been assessed in accordance with section 6(d) and 8 of the Act. Under these sections all persons exercising functions, powers and duties under this Act shall take into account the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, valued flora and fauna and other taonga, and the Treaty of Waitangi.

9.41 The applicant engaged with Māori via the EPA's national Te Herenga[5] network and a Maori Reference Group (MRG). The MRG is made up of four members with expertise and experience relevant to biological control applications. The MRG was established to facilitate consultation with Māori interests

[5] Te Herenga is made up of Māori resource and environmental managers, practitioners, or experts who represent their iwi, hapū, or Māori organisation on matters of relevance to the activities and decision making of the EPA.

that may be impacted by the release of new biocontrol agents. The MRG noted that they neither represent their individual iwi or hapū nor represent a unifying voice for Māori interests. The MRG also noted that they will not comment on every application for a new pest control agent but consider the principle level impacts of new biocontrols and provide guidance that should be covered in individual applications.

9.42 The MRG noted that the broad cultural principles that apply to considerations on the introduction of new biological control agents, pest management and environmental protection are Kaitiakitanga[6] and Manaakitanga[7]. The MRG considered that new biocontrol agents pose the potential to both have a positive impact by aiding in the restoration of balance and reduction in environmental degradation, and a negative impact by leading to further disturbance. This, the MRG considered, influence iwi or hapū's ability to 'manaaki' for their whanau and visitors.

9.43 The applicant noted that with reference to the cultural principles, the MRG recognised that proposed introduction of *L. hospita* may have significant direct beneficial effects on taonga, and indirectly on the wider ecosystem. The applicant also noted that the MRG considered the host range testing to provide a degree of assurance that risk to non-target native organisms is likely to be minimal. The applicant further noted that the MRG recognised the specific biophysical characteristics of *Ligustrum* that disturbs native plants and the wider ecosystem.

9.44 The EPA furnished Te Herenga with information about the seven biocontrol release applications that the National Biocontrol Collective intend to submit to the EPA in 2015 and 2016, including the current application to release *L. hospita*. The applicant noted that no responses have been received concerning the introduction of *L. hospita* in particular, apart from a submission from Ngāti Hei that identified *Ligustrum* management as a financial burden to control in the Hikuai Ti Touka Reserve which has significance to Ngāti Hei.

9.45 We consider that the applicant provided sufficient information to show that the release of *L. hospita* will not pose significant risk to native or taonga species, ecosystems and traditional Māori values, practices, health and well-being. As noted above, we consider it highly improbable that *L. hospita* will use native *Nestegis* spp. as a host and very unlikely the organism will attack plants that are of ornamental and economic value, including *Syringa* and *O. europaeus*.

9.46 Te Rūnanga o Ngāi Tahu submitted that they "*consider the wholly negative impact of privet infestations on the integrity of taonga ecosystems and the risk of spread of the weed in the takiwā of*

---

[6] The responsibility of Māori to manage the natural resources within and beyond their hapū and iwi boundaries for the benefit of future generations.

[7] The ability of iwi, hapū or whanau to 'manaaki' (support and provide for) their people and visitors, which is central to the maintenance and enhancement of 'mana'. It is noted as a key cultural principle and practice, and extends to physical, spiritual and economic wellbeing.

Ngāi tahu, make it imperative that steps are taken now to tackle the weed." Ngāi Tahu also considered that biological control is the only feasible option to restore ecosystems, and that the introduction of a BCA to combat *Ligustrum* spp. aligns with the 'active protection' principle of The Treaty of Waitangi since it may restore and protect native forests and other taonga ecosystems.

9.47 We consider the applicant has taken positive steps to ensure Māori are consulted thereby participating with Māori during the application process.

10. Conclusion on benefits and risks assessment

10.1 After completing our risk assessment and reviewing the available information (Table 1), we consider that the adverse effects of releasing *L. hospita* to control *Ligustrum* spp. are negligible and the benefits are significant. Therefore, our assessment is that the benefits from the release of *L. hospita* outweigh the risks.

Table 1: Summary of our assessment of the benefits, risks and costs associated with the release of L. hospita to control Ligustrum spp.

Potential outcomes	Likelihood	Consequence	Conclusion
Beneficial effects on the environment			
Biodiversity and conservation values	Likely	Minor to moderate	Significant
Beneficial effects on human health			
Reduce respiratory ailments	Unlikely	Minimal	Negligible
Beneficial effects on market economy			
Reduce weed management costs	Likely	Minimal	Significant
Adverse effects on the environment			
Attack on native plants	Highly improbable	Minimal	Negligible
Disturb trophic webs	Very unlikely	Minimal	Negligible
Adverse effects on market economy			
Threats to the nursery industry or agro-economic market	Very unlikely	Minimal	Negligible

11. Minimum Standards

11.1 Prior to approving the release of new organisms, the EPA is required to determine whether the organisms meet the minimum standards set out in section 36 of the Act.

Can *L. hospita* cause any significant displacement of any native species within its natural habitat?

11.2 The applicant provided evidence that *L. hospita* will not attack native *Nestegis* spp. that may be at risk of attack since the four *Nestegis* species found in New Zealand are in the Oleeae tribe. Host range testing however showed that they are outside the fundamental host range of *L. hospita* (see 9.9 to 9.11).

11.3 There are no native invertebrate or bird species that are associated with *Ligustrum* plants only (see 9.24 to 9.27). Therefore we consider that feeding on, and defoliation of, *Ligustrum* spp. by *L. hospita* will not displace native species since invertebrates and birds can use other plant species for food, shelter and reproduction.

Can *L. hospita* cause any significant deterioration of natural habitats?

11.4 We consider that the effects on *Ligustrum* plants will be gradual and on-going since it will take time before populations of *L. hospita* build to large enough numbers to suppress *Ligustrum* infestations. We also consider that suppression of *Ligustrum* will lead to the re-establishment of non-weedy native and valued plants and lead to increases in plant and animal biodiversity.

Can *L. hospita* cause any significant adverse effects on human health and safety?

11.5 *L. hospita* is not known to cause any adverse effects on human health and safety.

Can *L. hospita* cause any significant adverse effect to New Zealand's inherent genetic diversity?

11.6 It is not expected that control of Ligstrum spp. by *L. hospita* will change New Zealand's genetic diversity as there are no native species that are known to be exclusively associated with *Ligustrum* plants (see 9.24). The only native or endemic lace bug species in the Family Tingidae belong to separate genera (9.19) therefore there is minimal opportunity of hybridisation or adverse effects to New Zealand's genetic diversity of its native tingids.

Can *L. hospita* cause disease, be parasitic, or become a vector for human, animal or plant disease?

11.7 Lace bugs or Tingidae typically feed on phloem and mesophyll and leave feeding scars on leaves and petioles which may allow accidental entry of other organisms that may be pathogenic. Tingidae are generally considered unlikely disease vectors (Mitchell 2004). We therefore consider that *L. hospita* is not known as a possible vector of disease causing organisms.

Conclusion on the minimum standards

11.8 We consider that *L. hospita* meets the minimum standards as stated in the HSNO Act.

12. Can *L. hospita* establish undesirable self-sustaining populations?

12.1 Section 37 of the Act requires EPA staff to have regard to the ability of the organism to establish an undesirable self-sustaining population and the ease with which the organism could be eradicated if it established such a population.

12.2 We note that the purpose of the application is to release *L. hospita* and to allow for the organism to establish, develop self-sustaining populations and disperse to locate its host, *Ligustrum* spp, in our environment. This is the foundation of a classical biological control strategy and therefore we consider that a population of *L. hospita* will not be undesirable.

13. Recommendation

13.1 Our assessment has found that the benefits of releasing *L. hospita* outweigh any identified risks or costs. We therefore recommend that the application be approved.

References

Briese, D. (2005). "Translating host-specificity test results into the real world: the need to harmonize the yin and yang of current testing procedures." Biological Control **35**(3): 208-214.

Cariñanos, P., P. Alcázar, C. Galán and E. Domínguez (2002). "Privet pollen (Ligustrum sp.) as potential cause of pollinosis in the city of Cordoba, south-west Spain." Allergy **57**(2): 92-97.

de Lange, P. J., J. R. Rolfe, P. D. Champion, S. P. Courtney, P. B. Heenan, J. W. Barkla, E. K. Cameron, D. A. Norton and R. A. Hitchmough (2013). Conservation status of New Zealand indigenous vascular plants, 2012. Wellington, Department of Conservation.

Greene, B. T. and B. Blossey (2012). "Lost in the weeds: Ligustrum sinense reduces native plant growth and survival." Biological invasions **14**(1): 139-150.

Grove, E. and B. D. Clarkson (2005). "An ecological study of Chinese privet (Ligustrum sinense Lour.) in the Waikato region."

Hanula, J. L. and S. Horn (2011). "Removing an exotic shrub from riparian forests increases butterfly abundance and diversity." Forest Ecology and Management **262**(4): 674-680.

Hoyos, L. E., G. I. Gavier-Pizarro, T. Kuemmerle, E. H. Bucher, V. C. Radeloff and P. A. Tecco (2010). "Invasion of glossy privet (Ligustrum lucidum) and native forest loss in the Sierras Chicas of Córdoba, Argentina." Biological invasions **12**(9): 3261-3275.

Hudson, J. R., J. L. Hanula and S. Horn (2013). "Removing Chinese privet from riparian forests still benefits pollinators five years later." Biological Conservation **167**(0): 355-362.

Hudson, J. R., J. L. Hanula and S. Horn (2014). "Impacts of removing Chinese privet from riparian forests on plant communities and tree growth five years later." Forest Ecology and Management **324**(0): 101-108.

Jorgenson, P. (2014). "Response to request for general consultation on APP202262." Retrieved 9 February 2015, from http://www.landcareresearch.co.nz/__data/assets/pdf_file/0007/82879/Summary_of_responses_Privet_2015.pdf.

Larivière, M.-C. and A. Larochelle (2004). "Heteroptera (Insecta: Hemiptera): catalogue." Fauna of New Zealand **50**.

Landcare Research (2014a). "Host range testing Leptophya hospita: a candidate biological control agent for privet (Ligustrum spp.) in New Zealand." Retrieved 21 March 2015, from http://www.landcareresearch.co.nz/__data/assets/pdf_file/0006/77658/Host_range_testing_Leptophya_hospita_v3.pdf.

Landcare Research (2014b). "Response to request for general consultation on APP202262 (Summary of responses)." Retrieved 18 March 2015, from http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol/approvals/current-applications/privet.

Larivière, M.-C. and A. Larochelle. (2012). "Checklist of New Zealand Heteroptera (Insecta: Hemiptera)." Retrieved 3 March, 2015, from http://www.nzhemiptera.com/home/Heteroptera/Heteroptera-Checklist.

Li, C. R. (2001). A revision of Chinese Tingidae with studies on some morphological characters (Insecta:Hemiptera) Ph.D., Nankai University.

Lobe, J. W., M. A. Callaham Jr, P. F. Hendrix and J. L. Hanula (2014). "Removal of an invasive shrub (Chinese privet: Ligustrum sinense Lour) reduces exotic earthworm abundance and promotes recovery of native North American earthworms." Applied Soil Ecology **83**(0): 133-139.

May, B. M. (1977). "The immature stages and biology of the lacebug Tanybyrsa cumberi Drake (Heteroptera: Tingidae)." Journal of the Royal Society of New Zealand **7**(3): 303-312.

McGregor, P. (2000). Prospects for Biological Control of Privet (*Ligustrum* spp.) (Oleaceae). Landcare Research Contract Report LC9900/127. Palmerston North, Landcare Research**:** 16.

Mitchell, P. L. (2004). "Heteroptera as vectors of plant pathogens." Neotropical Entomology **33**(5): 519-545.

Obispo, T., J. Melero, J. Carpizo, J. ARREIRA and M. Lombardero (1993). "The main allergen of Olea europaea (Ole e I) is also present in other species of the Oleaceae family." Clinical & Experimental Allergy **23**(4): 311-316.

Pendino, P., C. Agüero, P. Cavagnero, K. Lopez, I. Kriunis and J. Molinas (2011). "Aeroallergen Sensitization in Wheezing Children From Rosario, Argentina." The World Allergy Organization journal **4**(10): 159.

Pokswinski, S. (2008). Invasive characteristics of Chinese privet (Ligustrum sinense Lour.) in a bay swamp in the fall line hills of East-Central Alabama.

Timmins, S. M. and P. A. Williams (1991). "Weed numbers in New Zealand's forest and scrub reserves." New Zealand journal of ecology **15**(2): 153-162.

Waikato Regional Council (2011). Privet, all privet (Ligustrum spp.). Biosecurity Series **-** pest plant factsheet 8**:** 2p.

Wapshere, A. (1974). "A strategy for evaluating the safety of organisms for biological weed control." Annals of Applied Biology **77**(2): 201-211.

Ward, R. W. (2002). "Extent and dispersal rates of Chinese privet (Ligustrum sinense) invasion on the upper Oconee River floodplain, North Georgia." Southeastern Geographer **42**(1): 29-48.

Wilcox, J. and C. W. Beck (2007). "Effects of Ligustrum sinense Lour.(Chinese privet) on abundance and diversity of songbirds and native plants in a southeastern nature preserve." Southeastern Naturalist **6**(3): 535-550.

Williams, P. A. and B. J. Karl (1996). "Fleshy fruits of indigenous and adventive plants in the diet of birds in forest remnants, Nelson, New Zealand." New Zealand Journal of Ecology **20**(2): 127-145.

Winks, C., D. Than, S. Bellgard and R. Toft (2012). Invertebrates and fungi associated with privet, *Ligustrum* spp. (Oleaceae), in New Zealand., Landcare Research New Zealand Ltd.

Zhang, Y.-Z., J. Hanula, S. Horn, J.-H. Sun and S. Braman (2012). Fundamental host range of Leptophya hospita (Hemiptera: Tingidae), a potential biological control agent of Chinese privet. Unpublished report.**:** 25 p.

Zhang, Y.-Z., J. L. Hanula and J.-H. Sun (2008). "Survey for potential insect biological control agents of Ligustrum sinense (Scrophulariales: Oleaceae) in China." Florida Entomologist: 372-382.

Zhang, Y., J. L. Hanula, S. Horn, S. K. Braman and J. Sun (2011). "Biology of Leptoypha hospita (Hemiptera: Tingidae), a potential biological control agent of Chinese Privet." Annals of the Entomological Society of America **104**(6): 1327-1333.

Zhang, Y., J. L. Hanula, J. O'Brien, S. Horn, K. Braman and J. Sun (2013). "Evaluation of the impacts of herbivory by lace bugs on Chinese privet (< i> Ligustrum sinense</i>) survival and physiology." Biological Control **64**(3): 299-304.

Appendix 1: Summary of submissions

Submission	Submitter	Support/ Oppose	Summary of submission
111475	Ngāi Tahu	Support	• Considers the negative impact of privet infestations on the integrity of taonga ecosystems and the risk of spread of the weed into the takiwā of Ngāi tahu making it imperative that steps are taken to control the weed • Control of privet aligns with active protection principle of Te Tiri o Waitangi in that it may restore and protect forest and other taonga ecosystems
110693	Pakita Raharuhi	Support	• The submitter supports the decision of the relevant hapu or iwi on the application submission
111476	Greater Wellington Regional Council (Davor Bejakovich)	Support	• The release of privet lace bug will both reduce the plant's ability to spread through seed and its ability to outshade regenerating native plants • With finite resources to control an ever-growing number of problem species, and growing expense and resistance to chemical control, biocontrol is a cost effective and publically acceptable technique
111477	Bay of Plenty Regional Council (Fiona McTavish)	Support	• The Bay of Plenty has one of the highest percentages of Māori land in the country. Privet is a considerable problem on a lot of this land. The biological control of privet has the potential in the Bay of Plenty to restore culturally important resources and values derived from the ngahere • Environmental restoration resources will be better allocated to further restore and maintain existing native ecosystems if privet lace bug establishes in the environment
110671	Liam John Mackay Griffin	Support	• Privet species are nothing but trouble and provide little in the way of benefits. Privet strangles and develops an impenetrable canopy preventing the development of young natives • Privet lace bug poses little in the way of threat to native species and what threat is poses to cultivated exotics is far outweighed by potential benefits

Submission	Submitter	Support/ Oppose	Summary of submission
110670	Clinton Care	Neither support nor oppose	• Suggests using puriri moths to control privet instead
110683	Huakina Development Trust	Neither support nor oppose	• Suggests privet lace bug appears to be host specific • Concerted effort to educate the community would assist in identification of privet and would lead to removal in urban areas

Appendix 2: Submission from Department of Conservation

David Havell, Technical Advisor (Threats)

Under various acts to manage for conservation purposes, all land, and all other natural and historic resources that it holds or manages for others. For example under the Reserves Act, the Department of Conservation is to ensure, as far as possible the survival of all indigenous species of flora and fauna, both rare and common place, in their natural communities and habitats, and preserve representative samples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character. Under the National Parks Act, national parks are to be preserved as far as possible in their natural state; native plants and animals of the parks shall as far as possible be preserved and the introduced plants and animals shall as far as possible be exterminated:

In addition, the Department Of Conservation is required to be a good neighbour under Regional Pest Management Plans, which require the management of environmentally damaging plants where sucjh plants, including *Ligustrum* spp, have an impact on neighbours and a cost benefit analysis has been undertaken.

(2) Privet Impact. Weedy privet species (*Ligustrum* spp), compromise the the abilty of the department to carry out it's function and responsibilities listed above, by directly threatening at risk and threatened species, modifying natural ecosystems and landscape, and by making management to achieve conservation outcomes more difficult. It is not uncommon for forest patches in the northern North Island to be transformed into tree privet thickets with resulting in the loss of native biodiversity. In several areas privet is too widespread to be effectively managed without damaging native biodiversity values, and control is too expensive. In lowland areas of the North Island, native ecosystems are often threatened, these ecosystems tend to be commonly impacted by weedy privets much than the more protected ,less threatened upland ecosystems.

Privet management is sometimes unpleasant for staff, and dense privet patches and associated privet frumes are thought to have caused illness in staff. With increasing financial pressures on the Department and the wide spread distribution of privets within New Zealand, it is getting harder to conventionally control this weed at the number of sites DOC manages

(3) Membership of the Biocontrol Collective. As part of developing and improving weed management outcomes, the Department of Conservation is a member of the National Biocontrol Collective, and as such has assisted in prioritising weeds for biocontrol, including privets, and assessing biocontrol agents for impact on native plant species.

(4) Impact of the Privet Lace bug on native flora. Given that there is the potential for bio control agents to damage non target native species related to the original host, we oppose the introduction of biocontrol agent which have not been adequately tested on native plants, and which testing has shown to significantly damage native plants.

The privet genus, *Ligustrum*, is distantly related to New Zealand plant species in the genus Nestegis, (white maire, black maire, mountain maire and coastal maire). While these species are not threatened, they are not abundant and can have restricted distributions or be naturally uncommon.

We accept that the Privet lace bug, *Leptophya hospita* has been adequately tested and that the results of testing showed that the Privet Lace bug caused some minor leaf damage to maire leaves, but that the biocontrol agent did not reproduce on *Nestegis* plants. Given that the damage caused by *Leptophya hospita* was comparable to natural damage, and unlikely to be significant, it is our view that the benefits of reducing the impact of privet through Privet Lace Bug is likely to much larger than minor leaf damage to occasional maire, and therefore strongly support the release of Privet Lacebug, *Leptophya hospita* as a Privet biocontrol agent.