

The role of native birds in weed invasion, species decline, revegetation and reinvasion: consequences for lantana management

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Summary The threat posed by *Lantana camara* L. (lantana) to native biodiversity has recently been assessed nationally. Part of this assessment identified 113 native bird species associated with lantana infestations, with 24 directly threatened; 68 positively influenced (or benefited) by lantana invasions; and another 21 species threatened but also partially benefiting (e.g. from additional food resources) from lantana invasions. Of the bird species that benefit from lantana, 28 are reported to consume lantana fruits as well as the fruits and seeds of a range of native plants, some of which are also threatened by lantana.

Information on the fruits and seeds consumed by these 28 bird species can be used to determine the role of birds in native plant species declines, revegetation, and invasion processes. For example, 202 native plant species that produce fruits and seeds which are consumed by these birds are also threatened by lantana. Thus these birds may have indirectly contributed to native plant species decline through the dispersal of lantana into native communities. In addition, such actions could hamper restoration efforts with the birds continuing to disperse lantana as well as another 36 weed species, which have been observed to invade following the control of lantana.

Such information is critical for developing long-term weed management strategies for biodiversity conservation, as well as understanding the role and implications of bird dispersal. As native birds play a role in dispersing both native and alien plants, it will be important to encourage native plant recovery, while controlling weeds that will continue to invade over the long-term.

Keywords Conservation, dispersal, frugivores, *Lantana camara*, restoration, weed substitution.

INTRODUCTION

Despite lantana invading more than 5% of the Australian continent (Sinden *et al.* 2004), until recently little was known about the native biodiversity threatened (Turner *et al.* 2007). A recent national assessment of the threat posed by lantana, revealed 1246 native plant and 141 native animal species as being at risk from lantana invasion (DECC 2007, Turner *et al.* 2007). A further 142 native animal species were identified as

benefiting from invasion, including 89 birds which use lantana for habitat or as a food source (DECC 2007).

Whilst lantana is considered to provide a lower quality habitat than uninvaded native communities (see Crome *et al.* 1994, Smith *et al.* 1998), the birds that utilise lantana can cause a conflict between their conservation and the management of lantana (see discussions within Crome *et al.* 1994 and Gosper and Vivian-Smith 2006 on the conflicts that can arise). For example, lantana has become an important part of the diets of rainforest pigeons, (Recher *et al.* 1995). However, lantana fruits are in many ways similar to many native fruits (Gosper and Vivian-Smith 2006), thus birds may feed on lantana fruits as well as those of native species. This can result in the dispersal of viable lantana seeds (Liddy 1985) into native communities.

In the past, weed management strategies have often failed to acknowledge these animal-weed interactions (Lawrie 2002). Yet, to manage weeds effectively, such interactions, especially between weeds and their dispersers need to be known. However, each disperser may be simultaneously involved in interactions with multiple species (Buckley *et al.* 2006), including both weeds and native plants. In addition, there are a range of flow-on effects which are not well understood. Therefore, this study aimed to determine (i) which native bird species eat lantana fruit, (ii) which other native and alien plant species produce fruits/seeds that are consumed by these bird species, and (iii) the likely consequences of these interactions for weed management and revegetation. Information such as this is critical not only for determining revegetation and restoration targets, but also to determine possible reinvasion patterns in managed sites.

MATERIALS AND METHODS

The Weed Impact to Native Species (WINS) assessment process (see Downey 2006) was used to determine the biodiversity threatened (as well as benefited) by lantana invasion. These results, as well as information on other alien species that could invade or increase in abundance following lantana control, are presented in DECC (2007) and Turner *et al.* (2007).

A list of the native bird species that have been reported to consume lantana fruits was compiled from the

literature (e.g. using HANZAB Volumes 1-7, including Marchant and Higgins (1990); and Barker and Vestjens (1989), Food of Australian Birds). The full reference list is available from the authors. The fruits and seeds of other plant species that these birds also consumed (also determined from the above references) were compared with the plant species identified in the WINS process (see above). Only plant species that produced fruits and seeds that these particular birds consumed and were identified from the WINS process as being threatened by lantana were included. In addition, other major weed species associated with lantana (see DECC 2007), that produced fruits and seeds consumed by these birds were identified. It should be noted that it was assumed that the consumption of fruits and seeds by these birds could result in the dispersal of the plant, irrespective of its effectiveness. For example, some birds such as rosellas destroy most of the seeds as they feed.

RESULTS

Twenty eight native bird species were identified to consume the fruits of lantana. These birds have also been observed to feed on the fruits/seeds of 202 of the native plant species identified to be at risk from lantana invasion using the WINS process. On average, each of these bird species fed on the fruits/seeds of 24.7 ± 4.3 (SE) native plant species. Approximately 60% of these birds consumed the fruit/seed of the native plant, *Melia azedarach* L., highlighting a large degree in dietary overlap between them (Table 1 – the top nine species).

These 28 bird species also consume fruits/seeds of another 36 weed species, which can invade following lantana control. Again there was a high degree of dietary overlap, with approximately 60% consuming wild tobacco (*Solanum mauritianum* Scop.); and 54% camphor laurel (*Cinnamomum camphora* (L.) J.Presl) and ink weed (*Phytolacca octandra* L.) fruits.

Silvereyes (*Zosterops lateralis* Latham) disperse the greatest number of weed species (including lantana) as well as 23 native species at risk from lantana, while regent bowerbirds (*Sericulus chrysocephalus* Lewin) are responsible for dispersing 73 native species at risk from lantana invasion, as well as 11 weed species (Table 2).

DISCUSSION

Lantana poses a significant threat to native plants in Australia. Whilst seeds of many of these species are dispersed by birds, these vectors are also known to disperse lantana and other weeds. This relationship between birds and weeds has provided a significant insight into the role birds can play in weed management, some of which we have not clearly understood

previously as the data on these interactions has not been available.

The dispersal of lantana by birds while also foraging on native species, may have indirectly contributed to native plant declines (Figure 1), as some of these plant species are reported to be threatened by lantana invasions (DECC 2007, Turner *et al.* 2007).

Table 1. Native plant species at risk from lantana invasion and the number of native bird species that consume their fruits/seeds as well as lantana.

Native plants threatened by lantana	No. of bird species
<i>Melia azedarach</i> L.	16
<i>Ficus rubiginosa</i> Desf. ex Vent.	15
<i>Polyscias elegans</i> (C.Moore & F.Muell.) Harms	14
<i>Acmena smithii</i> (Poir.) Merr. & L.M.Perry	13
<i>Ficus macrophylla</i> Desf. ex Pers.	13
<i>Ficus obliqua</i> G.Forst.	13
<i>Ficus watkinsiana</i> F.M.Bailey	12
<i>Alphitonia excelsa</i> (Fenzl) Benth.	11
<i>Glochidion ferdinandi</i> (Mull.Arg.) F.M.Bailey	11

Table 2. The top seven bird species based on the number of weeds they consume; and the number of native plant species threatened by lantana that they also utilise.

Bird species that consume fruits/seeds	No. of alien plant species	No. of native plant species
Silvereye	19	23
Pied currawong (<i>Strepera graculina</i> Shaw)	13	37
Lewin's honeyeater (<i>Meliphaga lewinii</i> Swainson)	12	64
Figbird (<i>Sphecotheres viridis</i> Vieillot)	12	43
Olive-backed oriole (<i>Oriolus sagittatus</i> Latham)	11	32
Crimson rosella (<i>Platycercus elegans</i> Gmelin)	11	44
Regent bowerbird	11	73

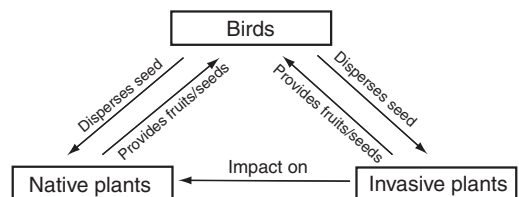


Figure 1. The role of birds in weed invasions, native species declines and restoration.

Compounding the problem is that as native plant species decline following lantana invasion, native birds may in turn consume more lantana fruits, thus increasing dispersal and invasion and decreasing the dispersal of native plants.

This bird-weed interaction has profound implications for revegetation and the long-term restoration of invaded sites, as it will be difficult to stop further dispersal of weeds into these managed sites. A gradual and staggered approach to lantana removal has been suggested as a way to minimise the impacts on native birds following lantana control (Recher *et al.* 1995). Currently there is also a trend to replace weeds with native plants having similar fruits (see Gosper and Vivian-Smith 2006). However, this approach may not be sufficient to prevent managed sites from returning to weed dominated communities in the long-term, since it does not address the continuous process of invasion and resultant species decline associated with bird dispersal of seed. By not accounting for the native species at risk, such recommendations may be of limited use in restoration. For example, 15 of 21 species identified by Gosper and Vivian-Smith (2006) are threatened by lantana.

This study has highlighted the potential role of birds in weed invasions, native species declines and restoration. However, a number of other factors need to be known to manage bird-dispersed weeds effectively, e.g. the distances and directions of weed dispersal (Buckley *et al.* 2006) and the impact of dispersal on the weed's recruitment. While Willson and Crome (1989) estimated that lantana could be dispersed up to 100 m into a rainforest patch by birds, the majority of seeds were dispersed <60 m, again highlighting the need for further research in this area. Irrespective, a significant investment of time and resources is needed to achieve the gradual removal of lantana over the distances required to ensure bird mediated re-infestation does not occur.

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