

Invertebrates associated with *Acacia longifoliae* Andr. (Willd.) (Leguminosae) in Northland and Horowhenua

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Summary

Project and Client

- A low-key survey of the invertebrate fauna associated with the foliage and seed pods of *Acacia longifolia* in Northland was carried out from December 2018 to August 2019 for the Northland Regional Council. The research was supported by Envirolink Medium Advice Grant 1931-NLRC213.

Objectives

- To survey the invertebrate fauna associated with the foliage and reproductive structures of *A. longifolia* in Northland and comment on the herbivores and their associated predators and parasitoids.
- To determine whether two candidate biocontrol agents, a gall wasp *Trichilogaster acaciaelongifoliae* and a seed weevil *Melanterius ventralis* are already present in New Zealand.
- To determine whether native ecological analogues of the two candidate biocontrol agents that would potentially be sources of natural enemies that could interfere with biocontrol success are present in New Zealand.

Methods

- The invertebrate fauna associated with foliage, flower buds and mature pods of *A. longifolia* was surveyed at five Northland sites, ranging from Henderson Bay in the north to Coopers Beach from December 2018 to July 2019.
- Seeds were sampled at the same five sites and in two sites in Horowhenua, and the invertebrate fauna inhabiting the seeds was determined.

Results

- 36 herbivorous invertebrate species, or groups of taxonomically related herbivorous species, were recorded from *A. longifolia*. Most belonged to self-introduced species of Australian origin that specialise in feeding on *Acacia* species
- The most abundant species collected was an unknown species of ?*Austroporus* that may be new to New Zealand. This group is known to feed on fungi.
- Lepidoptera larvae caused significant damage to phyllodes and growing points in early summer and fed on dormant flower buds.
- No native species that are closely related to the candidate biocontrol agents were found attacking *A. longifolia*.
- A weevil thought to be *Storeus albosignatus* destroyed an average 36.5% of seed over seven sites. The weevil is of Australian origin.

Conclusions

- There is no evidence that SGW supports significant populations of native herbivorous insects in New Zealand
- *Trichilogaster acaciaelongifoliae* is unlikely to meet with any significant competition from resident herbivores because no significant damage to flower buds was observed
- An absence of native analogues indicates that *T. acaciaelongifoliae* is unlikely to be attacked by parasitoids in New Zealand.
- Predation of SGW flower buds by lepidopterous larvae may limit the effectiveness of the gall wasp
- The introduction of *Melanterius ventralis* will not be necessary if *S. albosignatus* destroys a high proportion of seeds even should pods become rare because of flower suppression by the gall wasp.
- The generalist predators found are unlikely to inhibit the effectiveness of the potential invertebrate biocontrol agents for *A. longifolia*.

Recommendations

- *T. acaciaelongifoliae* should be introduced to New Zealand. The release of *M. ventralis* should be delayed until the role of *S. albosignatus* in seed predation in the presence of *T. acaciaelongifoliae* is clarified.

1 Introduction

A survey of the invertebrate fauna associated with Sydney Golden Wattle (SGW), *Acacia longifolia* Andr. (Willd.) (Leguminosae), in New Zealand was carried out from December 2018 to August 2019.

2 Background

SGW is a fast-growing shrub or small tree that is native to south-eastern Australia. It can grow in a range of habitats but flourishes in coastal areas, riparian zones, scrub, grassland and woodland. It has been introduced to many parts of the world as an ornamental or for soil stabilisation and has established widely. SWG can form dense thickets in naturally open habitats (Figure 1). The presence of SGW thickets increases the risk and intensity of fires, and the long-live seedbank and high growth



Figure 1. *Acacia longifolia* invading dunes in Portugal

hinders regeneration of native flora after fire. The development of thickets in naturally open habitats can result in severe habitat modification and consequent ecosystem changes. There have been many studies of the adverse environmental effects of SGW in South Africa, New Zealand, Portugal, and even in areas of Australia where SGW grows outside its native range. These effects include:

- modification of shade regimes in riparian areas resulting in habitat loss
- simplification of vegetation structure and changes in the structure of plant communities
- reduction in biodiversity of plants and invertebrates
- Increased flammability of vegetation
- modification of substrates

- modification of soil microbiota and soil chemistry

Management interventions to reduce the occurrence of SGW to mitigate these effects tend to fail because of regeneration from the large seedbank.

SGW was introduced to New Zealand before 1897. It has established widely, especially in coastal North Island (Figure 2). It is locally abundant in Northland, especially near Kaitaia, the Horowhenua coast, and the Bay of Plenty coast (Figure 2). In the South Island it is established at Motueka Inlet and has been recorded growing wild in Christchurch. SGW is not generally regarded as a weed of national importance but can be locally important.

The Kaimaumau gumlands stretch 11 km north of the Rangaunu harbor mouth and comprise a series of flats and ridges. The flats have impeded drainage leading to wetland formation. This the only remaining freshwater wetland in Northland exceeding 1,000ha. An area of 955ha has been designated as a scientific reserve because of its outstanding conservation values (McQueen & Forester, 2000). A further 2,312 ha is designated as a conservation area. The native vegetation of Kaimaumau is adapted to grow in low pH, nutrient-poor, waterlogged conditions. Eleven species of plants growing in the conserved area are listed as threatened, including four that are critically endangered (Hicks et al., 2001). The rest are range- or habitat-restricted. SGW and gorse are the most important weeds that have invaded the dry ridges and then spread into seasonally wet areas, establishing huge long-lived seedbanks (McQueen & Forester, 2000). Both fix nitrogen which increases soil nutrient status and changes the soil characteristics vital to the native plants that grow there. McQueen & Forester (2000) monitored the recovery of vegetation following a major fire in Kaimaumau in 1988. They found that the native vegetation recovered to pre-disturbance character over time in plots without weeds. However, observations on weed-infested plots led them to conclude that the abundance of weeds was likely to increase over time with future disturbance. The large seedbank allowed SGW increase dramatically in one plot after fire, forming a monocultural stand with few species in the understory. The absence of understory species and the huge amounts of wattle seed present suggest that these stands will regrow following disturbance. Mixed gorse/kanuka stands suggested that gorse may act as a nurse crop in this area and eventually give rise to kanuka and manuka stands. However, wattle outcompetes gorse on dry sites and is likely to become increasingly dominant with successive disturbances.

McQueen and Forester (2000) also noted that

- wattle and gorse produce high fuel loads that increase fire risk and have fire adaptations that are superior to the natives present.
- Aesthetic values of the area are degraded because wattle is taller than the native vegetation.

The Kaimaumau area is drying, and the incursion of SGW into the wetland is likely to accelerate. Unless the invasion of SGW is stopped, the effects of SGW measured at Kaimaumau are likely to increase, and be repeated in other important dune wetland/lake systems within Northland, in areas like Bay of Plenty, in Horowhenua, where SGW is already abundant (Figure 2), and in areas of New Zealand where SGW is not yet widely established.

The Department of Conservation has assigned SGW a 'weediness score' of 26 and a 'biological success rating' of 12 (<https://www.doc.govt.nz/documents/science-and-technical/Sfc199.pdf>).



Figure 2. Distribution of *Acacia longifolia* (red dots) *A. sophorae* (green) and *A. floribunda* (open) populations as recorded in the Australasian Virtual Herbarium and in Department of Conservation records (D. Havell, DOC, pers. comm.)

Two biological control agents have successfully controlled the weed in South Africa. The small pteromalid wasp *Trichilogaster acaciaelongifoliae* (Ta) induces galls in flower buds. These prevent flower production, and heavy galling can kill plants. The larvae of the weevil *Melanterius ventralis* (Mv) feed inside and destroy the seeds in those few pods that develop following gall wasp attack on the buds. The case for introducing biocontrol of SGW to New Zealand is made by Hill (2005).

Before a new organism is introduced to New Zealand for the biological control of a weed it is desirable to assess whether:

- the proposed control agent, or a native or exotic species fulfilling the same role as the proposed agent, is already present in New Zealand
- native analogues of the two candidate biocontrol agents are present in New Zealand that would potentially be sources of natural enemies capable of interfering with biocontrol success (Paynter et al., 2010).

3 Objectives

A low-key survey of the arthropod fauna associated with the foliage of *A. longifolia* was undertaken at five sites north of Coopers Beach from late spring 2018 until August 2019. Seed pods were collected in those sites as well as at two sites in coastal Horowhenua. The aims of the survey were to:

- assess the invertebrate fauna associated with *A. longifolia* in New Zealand and identify any key native herbivores and their associated predators and parasitoids.
- determine the rate of infestation of seeds by resident seed feeders.
- determine whether two candidate biocontrol agents, Ta and Mv, are already present in New Zealand.

4 Methods

The invertebrate fauna associated with the foliage of *A. longifolia* was surveyed at five sites in Northland (Table 1). The collection sites ranged from Henderson Bay south to Rangiputa. Sites were sampled on 11 December 2018. At each site 10 collection locations were selected. A collecting tray, 80 × 80 cm, was placed under suitable parts of selected plants, and the foliage above the tray was hit five times with a solid stick. Invertebrates that fell onto the tray were collected with an aspirator and preserved in 75% alcohol.

The invertebrates collected were only identified to species or genus level where this was feasible. Expert taxonomic expertise was not sought generally. Instead, most invertebrates were placed into functional groups of related species (e.g. 'spiders').

A rapid visual inspection (generally less than a minute for each of the 10 collection locations at each site) was made of foliage and stems for signs of invertebrates such as gall-formers, leaf miners, and scale insects. Invertebrates found during the visual inspections were collected live, along with the plant material they were on, for identification. At each site, a visual estimate was made of the amount of herbivore-related damage, and the likely cause of the damage was noted (e.g., adult beetles, lepidopteran larvae). A further survey was conducted in July 2019 to look for galls on plants.

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At least 100 seed pods were collected from each site and from two sites in Horowhenua in December 2018. The seeds were removed from the pods and a subsample of 100 seeds was dissected to check if there were larvae inside the seeds.

Table 1. *Acacia longifolia* survey site details (New Zealand 2018), and the rate of infestation of seed by *Storeus albosignatus* at those sites.

Site no.	Site name	Collection date	GPS Coordinates (NZTM)	% infestation of seeds
1	Henderson Bay	11.12.18	-34.742431, 173.110002	0
2	Far North Rd nr Trig Rd	11.12.18	-34.780835, 173.095250	-
3	Big Flat Rd	11.12.18	-34.917449, 173.182336	24
4	Waiharara	11.12.18	-34.934735, 173.209867	20
5	Rangiputa	11.12.18	-34.875892, 173.321102	22
6	Coopers Beach	12.12.18	-34.990443, 173.520800	60
7	Hokio Beach		-40.598756, 175.200628	34
8	Castlecliff		-39.941734, 174.982846	59

5 Results

Invertebrates associated with foliage

This was a survey of the functional role that species play in the *A. longifolia* environment rather than a taxonomic survey. Most individuals were not identified to species. 1299 specimens were collected at 6 Northland sites in late spring.

The fauna was dominated by species that do not feed on the foliage or flowers of SGW. Spiders and predatory mites made up 15.2% of all individuals collected, and ants another 15.2%. Argentine ant, *Linepithema humile*, was present at one site at least. Detritus feeding collembola and psocidae made up 17.1% of the individuals collected, and at least some of the beetle species collected were likely to also be associated with this process.

Over 29% all invertebrates collected were adult or larval beetles of a species probably of the genus *Austroporus* (Phalacridae) (R. Leschen, MWLR, pers. comm.; M. Gimmel, Santa Barbara Museum of Natural History, pers. comm.). Further research is required in spring to confirm the identity of this species. Its role in the ecology of *A. longifolia* is uncertain, but it is not herbivorous and may well feed on fungi. This was the single most abundant species in collections and was present at all five Northland sites sampled. It is almost certainly an Australian immigrant and an *Acacia* specialist. It is likely to be new to New Zealand. The species is distributed over at least 78km and must have been present in New Zealand for many years.

Species that could potentially feed on the foliage or flowers of SGW made up less than 15% of the insects collected. Six percent of the total could be ascribed to two specialist lepidoptera (see below) and two *Acacia* psyllids, *Acizzia uncatoides*, and *Acizzia conspicua* (Psyllidae). All four species are of Australian origin. A further 2.8% appear to be larvae of the generalist light brown apple moth,

Epiphyas postvittana (Tortricidae), a native species well-known from many habitats, and a known orchard pest.

The residual herbivorous fauna totalled less than 10% of the individuals collected, and most of these were represented by 19 weevil and beetle species, present as adults, and nine further hemipteran species. The abundance of only three species exceeded 1% of the specimens collected, one beetle, one weevil and once bug. In each case the species was only abundant at one of six sites, which may indicate association with neighbouring vegetation rather than SGW. Incidence of all other species was low, suggesting these were itinerant on SGW.

Visual assessment of foliage

Visual assessment of foliage did not reveal any significant infestation by sedentary insects such as mealybugs or scale insects. Foliage observed in December was heavily damaged by the larvae of a leaf mining moth later identified as *Acrocercops alysidota* (Gracilariidae) and the leaf tying *Holocola* sp. nr *triangulana* (Tortricidae) (Robert Hoare, MWLR, pers. comm.). Both species are relatively recent self-introduced species well known to attack SGW. The leaf miner causes blotch mines and older larvae abrade the surface of phyllodes. This species was abundant on phyllodes. *Holocola* sp. larvae web phyllodes together and commonly cause heavy damage to the growing points and new growth. In January approximately 90% of growing points were compromised or destroyed by *Holocola* sp. By March further feeding by lepidoptera larvae had destroyed many flower buds which and new flower buds (5-8mm in length) were forming in compensation (J. Dymock, Northland Regional Council, pers. observations.).

Infestation of seeds

Seeds were collected in November/December 2018 at seven sites, five in Northland and two in Wanganui and Horowhenua (Table 1). These seeds were frozen in April 2019 and dissected in May. Weevil larvae were present in seeds at five of the seven sites. Infestation could not be confirmed at Henderson Bay the northernmost site. The identity of the weevil was not confirmed, but life history strongly suggests this was *Storeus albosignatus*, a species known to infest SGW seeds. The presence of the weevil in seeds from Northland and from Horowhenua suggests that it is likely to infest seeds wherever SGW grows in the North Island. Where it was present the rate of seed destruction ranged from 20-60% with a mean of 36.5% (Table 1).

Visual assessment of flower buds

Sites were revisited in July 2019. Heavy flowering was observed and there was no evidence of significant flower bud damage. There appear to be no insects reducing flowering intensity and no galled flower buds were present. There is no evidence that *T. acaciaelongifoliae* is present in Northland (J. Dymock, Northland Regional Council, pers. observations.).

6 Conclusions

Although only five sites were surveyed, and few species were fully identified, it is clear that only a limited range of native invertebrates are associated with SGW in New Zealand. There was no indication that SGW hosted significant populations of any key native herbivore species. It seems unlikely that the reduction in abundance of SGW through biological control could significantly displace any native species.

There is no indication that Ta or Mv are already present in Northland.

The most abundant species in the survey was an unrecognized Phalacrid beetle. The identity of this beetle and its role in the ecology of SGW should be resolved.

Six species of Australian origin specialising on *Acacia* spp. were abundant in this survey and several caused significant damage to foliage and to seed production. None fed predominantly on flower buds and no competing gall-forming species were observed. However, *Holocola* sp. larvae were observed feeding on the dormant flower buds of SGW in January. These are the flower buds on which Ta would lay eggs over a very short period in late spring. Feeding by larvae in January would therefore consume the eggs of Ta along with the buds. As the buds were destroyed by grazing, the net effect to flower production could be insignificant. However, SGW was observed to compensate for the loss by developing fresh buds in January. These buds would not be susceptible to attack by Ta which is only lays eggs in late spring. The extent of bud destruction by *Holocola* sp. larvae and the importance of compensatory bud development on seed production is unknown at present but could potentially reduce the overall effectiveness of Ta as a biological control agent.

This is the first systematic assessment of the impact of *Storeus albosignatus* on seed production in *A. longifolia*. It appears that this species destroys a moderate proportion of the seeds produced in New Zealand. It therefore plays a similar role to that of Mv in South Africa. Mv is said to have a high search capacity destroys a high proportion of SGW seed in South Africa, even when galling of flower buds by Ta makes pods rare. It is possible that *S. albosignatus* will have a similar high search efficiency if pods become rare. If so, the introduction of Mv to New Zealand would be unnecessary and possibly counterproductive. The value of *S. albosignatus* as a control agent will only become clear once the gall wasp has become well established. The introduction of Mv should be delayed until the effect of *S. albosignatus* on seed production in the presence of Ta can be assessed.

It is not known whether *S. albosignatus* has parasitoids in New Zealand that could transfer to Mv if it were introduced.

7 Recommendations

We conclude that the candidate biocontrol agents have the potential to greatly decrease the potential range and abundance of SGW in New Zealand. It is highly unlikely that introduction would lead to significant displacement of native species. Moreover, an absence of native analogues indicates that

the candidate agents are unlikely to be attacked by native parasitoids in New Zealand (see Paynter et al. 2010). Ta should be introduced to attack SGW. *S. albosignatus* destroys a significant amount of SGW seed. Release of Mv should be delayed until the efficacy of *S. albosignatus* in the presence of Ta can be assessed.

8 References

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