Is the New Zealand endemic gall mite *Aceria clianthi* endangered?

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ABSTRACT

The monophagous gall mite *Aceria clianthi* Lamb (Acari: Eriophyidae) lives on the endangered New Zealand endemic shrub kaka beak *Clianthus puniceus* (G. Don) Lindley (Fabaceae). This report assesses the impact of other invertebrates and plant pathogens on the plant and the gall mite. Three mite herbivores, five insect herbivores, a snail and six fungal pathogens have been recorded from kaka beak. In urban Auckland, the invertebrates causing most damage to plants are the introduced brown garden snail *Cantareus aspersus* (Muller) (Gastropoda: Helicidae), and the endemic leaf mining fly *Liriomyza clianthi* (Watt) (Diptera: Agromyzidae). Both species can severely damage plants and shorten their life. The fly breeds all year and is attacked by a complex of introduced and endemic parasitoids. The gall mite, *Aceria clianthi*, is associated with distorted new leaves and shoots and "witches' broom" symptoms (shoot proliferation) which can develop on kaka beak shrubs. The mite does not appear to limit plant growth. A predatory bug and predatory mite have been observed in mite colonies. To assess the level of risk to *Aceria clianthi* and whether any special steps are needed to ensure its survival, more information is needed about the range and distribution of invertebrates associated with kaka beak in its natural environment, including the gall mite, the other herbivores such as the leaf mining fly, and their natural enemies.

Keywords: Kaka beak, *Clianthus puniceus,* Fabaceae, Acari, gall mite, Eriophyidae, *Aceria clianthi*, herbivores, Diptera, Agromyzidae, *Liriomyza clianthi,* Tortricidae, Lepidoptera, *Sejanus albisignatus,* Hemiptera, Miridae, predators, *Agistemus collyerae,* Stigmaidae, parasitoids, Hymenoptera, fungal pathogens, annual cycle, plant phenology.

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1. Introduction

Kaka beak, *Clianthus puniceus* (G. Don) Lindley (Fabaceae), is an endangered endemic New Zealand shrub (Wilson & Given 1989). It follows that any monophagous herbivore dependent upon kaka beak is also endangered. This report provides information about the endemic monophagous gall mite, *Aceria clianthi* Lamb, 1952 (Acari: Eriophyidae), and the risks to it posed by other invertebrates associated with kaka beak.

Information has been obtained from the literature and from observing kaka beak planted in the Christchurch City Botanic Gardens, in Auckland at the Mount Albert Research Centre, in the author's garden (New Lynn, Auckland) and elsewhere in New Zealand.

2. Sources of information

Spiller & Wise (1982), in a publication cataloguing entomological literature up to 1960, list four plant-feeding insects associated with kaka beak. These are an endemic leaf roller moth *Ctenopseustis obliquana* (Walker) (Lepidoptera: Tortricidae); an endemic mealy bug *Pseudococcus glaucus* (Maskell) (Hemiptera: Pseudococcidae); an introduced psyllid *Psylla albizziae* Ferris & Klyver (Hemiptera: Psyllidae); and an endemic leaf mining fly *Liriomyza clianthi* (Watt 1923) (Diptera: Agromyzidae).

In 1994, John Dugdale (formerly of Landcare Research) collated the information on totricid moths associated with plants in a database. The database lists two endemic polyphagous leaf rollers, *Ctenopseustis obliquana* (Walker) and *Pyrgotis plagiatana* Walker, that were each reared once from *Clianthus puniceus.*

The endemic mite, *Aceria clianthi* (Acari: Eriophyidae), which causes "witches' broom" galls on kaka beak, was described by Lamb in 1952.

Other introduced mites associated with *Clianthus* are *Bryobia repensi* and *Tetranychus urticae* (Tetranychidae) (Manson 1987).

My observations have shown that in addition to the species listed above, feeding by the following introduced invertebrates can damage kaka beak in Auckland: green vegetable bug *Nezara viridulus* (Hemiptera: Pentatomidae); an Australian crop mirid *Sidnia kinbergi* (Stal) (Hemiptera: Miridae); and the brown garden snail *Cantareus aspersus* (Muller) (Gastropoda: Helicidae).

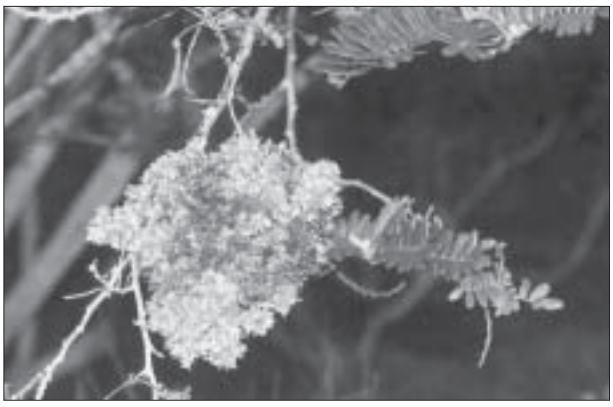
3. Invertebrates and fungal pathogens recorded from kaka beak and their impact on plants

3.1 ACARI (MITES)

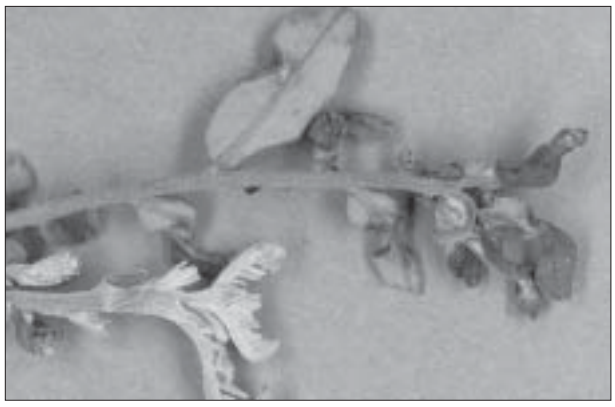
Aceria clianthi Lamb, 1952 (Acari: Eriophyidae)

This endemic eriophyid mite causes kaka beak plants to produce deformed growths, which can develop into clusters of deformed shoots that are commonly called "witches' brooms" (Fig. 1). At early stages of infestation, the mite causes leaflets to remain small and folded and to become hairy on the surface where the mites are feeding. Often only a single leaflet of a leaf may be affected. There appears to be a shortening of the leaf where a leaflet is attacked. The mites attack young expanding shoots, leaves and flower racemes. High numbers of mites cause the growths to shorten and become distorted. This is accompanied by a proliferation of shoots or racemes that form the "witches' broom" galls. The mite can only attack the plant when the plant is producing new growth. The mite is regarded as monophagous, i.e. reliant on one plant—kaka beak—although it was found once on *Lotus cornculatus* (Fabaceae), near where kaka beak plants had recently been growing (Manson 1984). The mite is probably primarily distributed by wind. New colonies probably establish only on actively growing kaka beak plants.

Manson (1984) records the mite from Auckland, Napier, Palmerston North, Wellington, Christchurch, near Port Chalmers and Invercargill. During the last 10 years I have seen mites and the damage caused by them on plants in the Christchurch Botanic Gardens, a garden in Palmerston North and at the Mount Albert Research Centre, Auckland. The latter infestation showed up 12 months after the kaka beak shrubs were planted. No signs of mite damage have been seen on plants at the author's garden (New Lynn, Auckland) or in the Auckland Botanic Gardens.



A.



B.

Figure 1. A. 'Witches' broom' gall. B. Distorted leaves resulting from mite damage.

Alan Eyles (pers. comm.) reports two predators associated with the *Aceria clianthi* mite. He observed the native (they are found also in Australia) bugs *Sejanus albisignatus* (Hemiptera: Miridae) probing and apparently feeding among the distorted leaves where the mites were present. Also observed with the mites was a commonly found (probably introduced) yellow predatory mite species, *Agistemus collyerae* Gonzalez (Stigmaidae).

Other mites

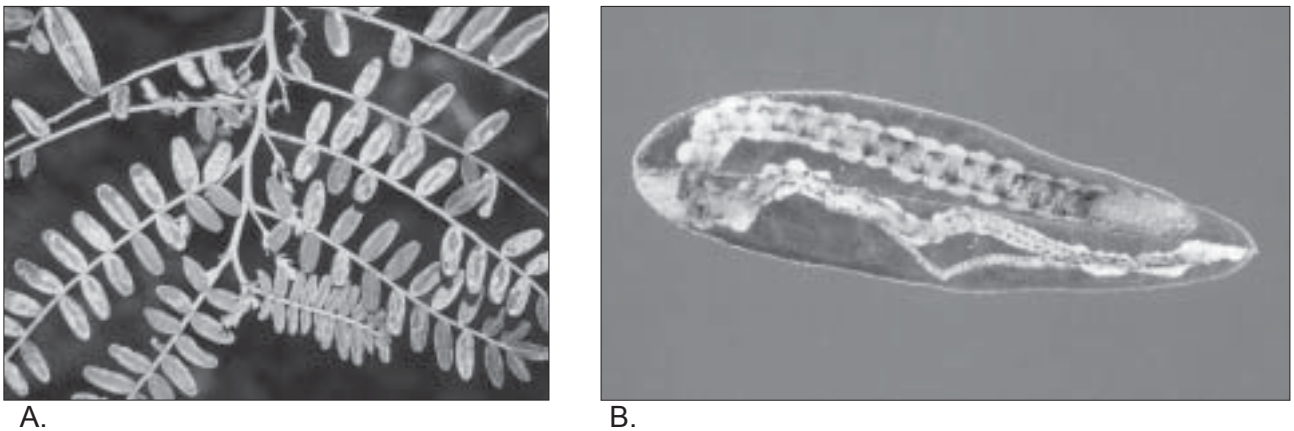
Although two common introduced plant-feeding mites (*Bryobia repensi* and *Tetranychus urticae*, see Section 2 above) have been recorded from kaka beak. I have not seen these non-native mites on plants in Auckland or Christchurch and Zhang Z. Q. (Landcare Research, pers. comm.), in a review of the Tetranychidae specimens in New Zealand, found no specimens collected from *Clianthus*.

3.2 INSECTA

Liriomyza cliathi (Watt, 1923) (Diptera: Agromyzidae)

This endemic leaf mining fly can cause severe damage to kaka beak plants. Adult female flies make holes with their ovipositor in young expanding leaves. They feed on the plant fluids exuding from the damaged tissue. They lay a single egg in some of the holes. On hatching from the egg, the larvae burrow into the tissue of the leaf. They feed on the leaf tissue as they tunnel through the leaf, creating a distinctive mine (Fig. 2). When larvae reach full size they cut a slit in the epidermis of the leaf and drop to the ground where they pupate in the leaf litter or soil. Mines with actively feeding larvae are found in expanding or recently fully expanded leaves.

Liriomyza cliathi appears to be able to breed all year round in Auckland, although numbers of flies are lowest in late summer and early autumn. This may be due to the effects of parasites and other natural enemies, dry soil conditions for pupae or a summer resting stage. New mines are seen in autumn when plants produce new leaves in response to autumn rain. Populations of flies can build up during the winter so that by spring there may be such high numbers



A. B.

Figure 2. A. Fly leaf mines on kaka beak. B. Fly leaf mine in kaka beak leaflet.

that feeding by adult female flies kills all new leaves before they can fully expand. At slightly lower fly populations, any new leaves are killed by larvae trying to mine them. In Auckland suburbs, the plants are likely to be killed by the flies after two growing seasons and only one spring flowering from kaka beak plants can be expected. Wise (1953) reported that the severity of leaf-mining damage to kaka beak plants in gardens could be such that the plant was very difficult to grow in certain areas.

Observations in Christchurch indicate that *Liriomyza cliathi* populations are much lower there than in Auckland. It appears that the flies breed more slowly over winter and that parasitism rates of their larvae are relatively high in late spring and early summer. Kaka beak plants in Christchurch appear to be able to live for several years and to flower for several seasons.

The adult *Liriomyza cliathi* appear to have a good ability to find host plants, which include several *Carmichaelia* (native broom) species (Spenser 1976) as well as kaka beak.

Several parasitoids have bean reared from kaka beak plants growing in suburban gardens:
Opius sp. (Braconidae), pupal parasite,
Chrysocharis pubicornis (Zetterstedt) (Eulophidae), introduced, polyphagous mainly pupal parasite,
Chrysonotomyia spp. (Eulophidae), polyphagous larval parasite,
Diglyphus isaea (Walker) (Eulophidae), introduced, polyphagous larval parasite, kills small larvae,
Hemitarsenus sp. (Eulophidae), polyphagous larval parasite,
Proacrias n. sp. (Eulophidae), polyphagous larval parasite, probably a New Zealand species.

Most of these parasitoids are not active during the winter. In indigenous ecosystems, indigenous Agromyzidae are attacked by parasitoids (presumably indigenous species) that are active during the winter.

Sidnia kinbergi (Stal) (= *Eurystylus australis* Poppius) (Hemiptera: Miridae), Australian crop mirid

Like the endemic *Liriomyza cliathi*, this introduced (Australian) sucking insect also tends to feed on young growths such as shoot tips. Adults have only been observed on plants in New Lynn, Auckland. Plants do not appear to be attacked by this insect every year.

Nezara viridula (Hemiptera: Pentatomidae), green vegetable bug

In an area such as the author's New Lynn garden where the introduced green vegetable bug is breeding on other plants, the bugs will also breed on kaka beak. All stages can be present. Both adults and juveniles feed on the young shoot tips, causing growth to be deformed or stunted. This can be particularly damaging in the late summer when the plant is trying to form new shoots and leaves after a period of no growth associated with dry weather.

All stages, including first instar nymphs, have been found on kaka beak, suggesting that it is a host of green vegetable bug and not a casual association of stray nymphs and adults.

Mealy bugs (Hemiptera: Pseudococcidae)

A major study of New Zealand mealy bugs (Cox 1987) did not record any mealy bugs from kaka beak. This and my own observations suggest that kaka beak plants are not normally susceptible to mealy bugs.

Psyllidae (Hemiptera)

An introduced psyllid, *Psylla* (*Acizzia*) *albizziae* Ferris & Klyver, is recorded as associated with kaka beak. Pam Dale (pers. comm.) reports that this is based on a comment in Tuthill (1952) that gave the hosts of *P. albizziae* as *Acacia decurens* 'and possibly *Clianthus puniceus*' since Tuthill only had adults from the latter. The hosts (plants where nymphs and adults are present) of *Acizzia albizziae* are all *Acaia* species and do not include *Clianthus*.

Leaf roller caterpillars (Lepidoptera: Totricidae)

Two endemic polyphagous leaf roller species, *Ctenopseustis obliquana* (Walker) and *Pyrgotis plagiatana* (Walker), have been reared from kaka beak. Leaf rollers do not appear to be common on kaka beak.

3.3 MOLLUSCA

Cantareus aspersus (Muller, 1774) (= *Helix aspersa* Muller) (Gastropoda: Helicidae), brown garden snail

It is common knowledge in Auckland that the introduced brown garden snail feeds on kaka beak and can defoliate and kill plants. My observations confirm that brown garden snails feed on kaka beak. They appear to feed preferentially on young growths and, if uncontrolled, will prevent plants from producing new leaves and shoots. The snails 'roost' in the bush.

3.4 FUNGI

Six introduced species of fungi have been recorded from kaka beak plants:
Cylindrocladium scoparium (PDD herbarium database)
Odium (powdery mildew) (PDD herbarium database)
Sclerotinia minor. One record (Landcare Research fungal literature database)
Sclerotinia sclerotiorum (PDD herbarium database)
Verticillium dahliae (PDD herbarium database)

Five of the six fungi associated with kaka beak cause root rots. The sixth, *Odium*, damages leaves. It has also been observed on kaka beak in an Auckland garden where it did not appear to cause significant leaf damage or leaf loss.

4. Discussion

There appears to be no published information on the status of the endemic monophagous gall mite *Aceria clianthi* in its natural environment. Populations of the mite are dependent upon the host plant, the environment in which the host plant lives, and upon natural enemies of the mite. Observations to date show that healthy, actively growing kaka beak plants are required to support good populations of *Aceria clianthi.* There is no information on the direct impact of the environment on the mite and very little information on its natural enemies.

The health and vigour of kaka beak plants can be affected by fungal pathogens and invertebrate herbivores, but surprisingly few species of fungi and invertebrates have been recorded from kaka beak. Fungal pathogens do not seem to be a limiting factor in the establishment and growth of the plants. However, one introduced mollusc (the brown garden snail) and one endemic insect (the leaf-mining fly *Liriomyza cliathi*) can severely damage plants and even kill them, thus endangering the host-specific endemic eriophyid mite *Aceria clianthi*.

The impact of the introduced brown garden snail and the native leaf-mining fly can be localised, though there is little information on the environmental factors influencing the distribution and abundance of both invertebrates. While the snail may be present in disturbed indigenous forest (Barker 1999), it is commonly abundant in urban gardens.

The impact of the endemic leaf-mining fly *Liriomyza cliathi* on kaka beak plants appears to be affected by conditions during the winter that affect plant and insect growth, and parasitoid activity. The Christchurch winter climate is much less suitable for the fly than the Auckland climate, perhaps because in Christchurch the fly grows only slowly during winter. In Auckland, kaka beak plants can grow vigorously throughout the winter and the flies breed on the new growth. However, in Auckland suburban gardens there appear to be few parasitoids of the leaf-mining fly active during winter. In New Zealand indigenous ecosystems, parasitoids of native leaf-mining flies breed throughout the winter, but it is not known if native parasitoids attack *Liriomyza clianthi* when it grows in its native habitat, i.e. in the wild as opposed to suburban gardens.

In order to assess the level of risk to the kaka beak gall mite *Aceria clianthi* and whether any special steps are needed to ensure its survival, it is desirable to know more about the range and distribution of invertebrates associated with kaka beak in its natural environment, including the gall mite, the other herbivores such as the leaf-mining fly *Liriomyza cliathi* and their natural enemies.

5. Recommendations

On the basis of the observations made and discussion presented, the author recommends that, in order to protect *Aceria clianthi*:

1. The distribution of indigenous invertebrates on kaka beak should be determined. This would require all wild populations of kaka beak to be surveyed for signs of the gall mite *Aceria clianthi*, the leaf-mining fly *Liriomyza cliathi* and other insects, and the relative abundance of each invertebrate at each site be recorded. Photographs of symptons could be provided.
2. The level of parasitism and parasitoids of the kaka beak leaf-mining fly *Liriomyza cliathi* should be determined. To do this, collections of leaf-mining flies should be made four times a year from wild populations of kaka beak so that the parasitoid species present and the times of year when they are active can be identified.
3. The effects of the kaka beak leaf-mining fly *Liriomyza cliathi* on urban kaka beak plants should be determined. Observations should be made throughout the country to determine the times of year that kaka beak plants put on new growth and the times of year when new leaf mines are seen.
4. To protect the native kaka beak gall mite *Aceria clianthi* in the Auckland area, suppression of the kaka beak leaf-miner *Liriomyza cliathi* may be required. Insecticides for control of the leaf mining fly should be assessed to find products that will suppress populations in the spring and that are least harmful to parasitoids.

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