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Establishment of the green lacewing *Mallada basalis* (Walker, 1853) (Neuroptera: Chrysopidae) on mainland New Zealand

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Abstract
The chrysopid lacewing *Mallada basalis* has recently established in the north of the North Island of New Zealand. Information on its life cycle, distribution and seasonality is presented.

Keywords
Chrysopidae; *Mallada basalis*; introduced species; citizen science

INTRODUCTION

The endemic New Zealand mainland neuropteran fauna is small with only seven species in the families Berothidae (1), Hemerobiidae (1), Myrmeleontidae (1) and Osmylidae (4). This is augmented by seven adventive species in Coniopterygidae (2), Hemerobiidae (4) and Sisyridae (1) (Wise 1991, 1998). Chrysopidae, the largest family of Neuroptera with 1,300–2,000 species worldwide (Strange 2004; New 1991), has hitherto been absent from mainland New Zealand although the species reported here has long been known from Raoul I of the Kermadec Is (Wise 1972, 1977, specimens in Auckland Museum). Many attempts to introduce various chrysopid species for biological control of aphids (Thomas 1989) and mealybugs (Charles 1989) have failed. The only temporary establishment of a chrysopa [*sic*] was reported by Broun (1898) from observations in Auckland and Whangarei, but Wise (1995) gave good reasons to conclude that this was most likely a misidentification of the common hemerobiid *Micromus tasmaniae* (Walker, 1860).

A single specimen of *M. basalis* (Walker, 1853) was found in 1976 on Moturoa I (off Cape Karikari, Northland) (MacDonald 1977). This was probably a natural occurrence, but no further specimens were found despite searching for it by Keith Wise in Northland in the 1970s and 1980s, so it seems that it didn't establish. Wise (1988) recorded the inadvertent advent of a single *Chrysopa* specimen (later identified as *Mallada* sp. near *M. alcestes* (Banks, 1911) (Wise, 1991) on an imported pineapple, and even if others have escaped border inspection it is clear that they have not established. The purpose of this note is to record the recent establishment of *Mallada basalis*, the only chrysopid, in New Zealand.

OBSERVATIONS

Recent records

The first recent record of *M. basalis* that I am aware of is a specimen photographed by Trevor Crosby in March 2010 on Tiritiri Matangi in the Hauraki Gulf. In 2016 a second photographic record from the same place was made by Olivier Ball (Fig. 1), and the first specimen from Auckland City was reported (https://inaturalist.nz/observations/3160897). In April 2017 I found a final instar larva on *Ficus rubiginosa* in Albert Park, Auckland, and reared it through to adult. The 2018–19 summer saw many observations of all life cycle stages being posted on iNaturalistNZ (https://inaturalist.nz/) which, along with verbal reports from other experienced observers (N.A. Martin, G. Hill pers. comms), indicate that it clearly is now a well-established member of the New Zealand insect fauna. The proliferation of observations prompted the Ministry for Primary Industries (MPI) to seek confirmation of its identity and this was provided by Dr Shaun Winterton (California Department of Food and Agriculture) based on specimens collected from the Auckland Domain.

Recognition and life history stages

Adult *M. basalis* are 10–15 mm long from head to tip of the wings. Their shape and colour are typical for many species of the family; their beautiful pale green colour fades in museum specimens as sometimes does the mid-dorsal golden yellow stripe running the length of the body, from the back of the head to tip of the abdomen (Fig. 1). The delicate wings with characteristic network of green veins are held in a flattened tent-like manner over the slender abdomen and are considerably longer than it. They sparkle in sunlight and when the insect is in flight. The eyes have a brilliant irridescent copper to green colour in life but this fades within hours of death.

Figure 1. *Mallada basalis* female, Tiritiri Matangi, May 2016. Photo: O. Ball.

Males are readily distinguished by the presence of a strong green pterostigma on the hind wing (Fig. 2). In the female the pterostigma may be absent or pale brown but never as strong as in the male (Fig. 3). New (1980) provided illustrations of the apex of the abdomen which also help identification of the sexes.

The pale green oval eggs are laid on long stalks attached to leaves (see https://inaturalist.nz/observations/21340459). Larvae are very similar in appearance to those of the common hemerobiid *Micromus tasmaniae* which is readily found on aphid-infested garden plants. They differ, however, by their habit of festooning the body with small pieces of detritus and the bodies of prey which they attach to tufts of setae on the dorsal thoracic and abdominal surface as in Fig. 4. This is a common behaviour in many Chrysopidae species and has earned them the moniker 'trash-carriers'. It provides camouflage as they live their lives exposed on leaves. The final instar larva spins a white silk cocoon, incorporating the larval detrital decoration (Fig. 5). Pupation occurs within the cocoon and the adult emerges after 13–14 days in the lab at 21°C. On some occasions the pupa leaves the cocoon and its exuviae can be found beside it on the leaf.

Diet

Larvae are generalist predators of small invertebrates and probably take anything they encounter. For this reason, *M. basalis* is not associated with any particular plant species. I have reared them in the lab on

- acacia psyllid *Acizzia acaciae* (Maskell, 1894) adults
- hellebore aphid *Macrosiphon hellebori* (Theobald & Walton, 1923)
- green peach aphid *Myzus persicae* (Sulzer, 1776)
- citrophilous mealybug *Pseudococcus calceolariae* (Maskell, 1879)
- greenhouse thrips *Heliothrips haemorrhoidalis* (Bouché, 1833) adults and immatures
- bottlebrush thrips *Teuchothrips disjunctus* (Hood, 1918) immatures

Other observers have found them associated with oleander aphid *Aphis nerii* Boyer de Fonscolombe, 1841 on swan plant (Sophie Potter, pers. comm.), and with whitefly and psyllids on ash (S.E. Thorpe, pers. comm.).

Distribution, seasonality and abundance

Mallada basalis has a wide geographic distribution including Australia (Queensland, New South Wales, Victoria), Philippines, Taiwan, Ryukyu Is, Micronesia and Polynesia to Easter I (Adams 1959; New 1980; Winterton 1995; Wise 1991). The population closest to mainland New Zealand is on the Kermadec Is (Wise 1977), some 1,100 km north-east from the northern tip of the North I. In New Zealand they have been found from the top of Northland (Spirits Bay, Auckland Museum voucher specimen AMNZ135369) to south Auckland with most of the records from the greater Auckland area. The current distribution based on records from iNaturalistNZ and the Auckland Museum collection is shown in Fig. 6.

Figure 2. *Mallada basalis* male.

Figure 3. *Mallada basalis* female.

Figure 4. *Mallada basalis* larva.

Figure 5. *Mallada basalis* cocoon.

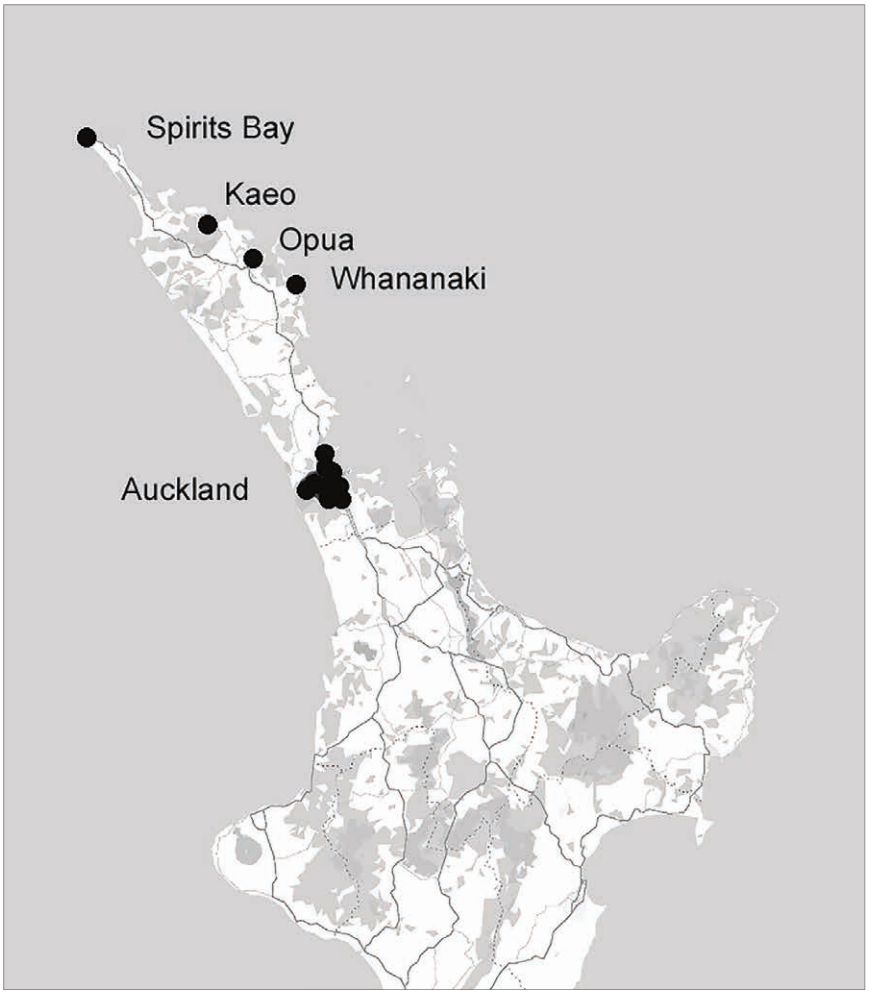

Figure 6. Distribution of *M. basalis* in the North Island.

Adults have been found from December to late July, but most records are from late summer to autumn (February–April). This probably reflects a build-up of populations by late season and increases the likelihood that they are observed. There is one record from September.

Natural enemies

One cocoon collected from the Auckland Domain on 26 March 2019 failed to emerge. It was dissected on 18 June and found to contain a well-formed but mouldy pupa of an ichneumonid which could not be identified further.

Other potential hymenopteran parasitoids are the figitids *Anacharis zealandica*, a common and widespread parasitoid of *Micromus tasmaniae* (Hemerobiidae) cocoons, and *Xyalaspis* sp., host unknown but possibly *Wesmaelius subnebulosus* (Hemerobiidae). Rearing of field collected cocoons is needed to obtain more information.

Friend or foe?

Most of specimens recorded here were seen and/or collected in modified habitats, mostly urban and suburban parks and gardens. *Mallada basalis* may prove to be beneficial for controlling pests like aphids and mealybugs in such environments and in horticultural crops. However, the two records from Tiritiri Matangi, where it was found on restoration plantings of endemic flora, indicate that it will colonise native habitats. Nicholas Martin (pers. comm) has also found it in native bush remnants around Auckland. It remains to be seen how far it will invade natural habitats and the extent to which it will feed on indigenous insects. Wise (1995) cautioned that introduced Neuroptera, all non-specific predators, ought to be considered as pests because of the risk they pose to the endemic insect fauna.

Material examined

45 records on https://inaturalist.nz/observations?place_id=6803&taxon_id=511376 (accessed 9 Oct 2019).

24 specimens in the Auckland Museum collection with the following accession numbers prefixed by AMNZ:

Kermadec Is: AMNZ75839-75861, 75864, 76463, 76464, 80178

Northland: AMNZ75863, 135369

Auckland: AMNZ118899, 135320-135324, 135352, 135368,135558-135563, 148177.

Specimen details can be obtained by searching for *Mallada basalis* at http://www.aucklandmuseum.com/collections-research/collections

DISCUSSION

It is not clear when this species arrived and naturalised, where the founders came from, nor whether this is a natural or human-aided introduction. Given the natural geographical distribution of this species and patterns of establishment of other insects, it seems that Australia or the Pacific islands are the most likely places of origin. If this was around 2010, when the first recent sighting occurred, then they will have been slowly building up population numbers until being recorded more frequently from 2016. The 2018–19 summer in Auckland was mild and long and this may have contributed to a population expansion and a surge of observations posted online on iNaturalistNZ. The current distribution from Auckland to the top of the North Island might also indicate that they have been present for some time, building up numbers and spreading. It remains to be seen how far south they will spread within New Zealand.

This study has relied heavily on observations and photographs on the online social media platform of iNaturalistNZ, demonstrating the importance of citizen science and the role that interested observers can play in documenting the fauna and monitoring the establishment of new species.

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