

Short Communication

Maorigoeldia argyropus Walker (Diptera: Culicidae): is this another threatened endemic species?

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Abstract

Maorigoeldia argyropus Walker is a monotypic mosquito endemic to New Zealand. It has a limited and disjunct distribution the extent of which is unknown. The distribution may be a consequence of extensive anthropogenic environmental change in the 20th century, and in particular the fragmentation of lowland forests and isolation of fragments. We present some evidence that *M. argyropus* may be slowly disappearing from many sites throughout New Zealand, and that its long-term survival could be at risk.

Keywords: mosquito, New Zealand, monotypic, endemic, conservation, distribution

Taxonomic status & habitat

Maorigoeldia argyropus Walker (Fig. 1) is a distinctive monotypic mosquito (Diptera: Culicidae: Sabethini), endemic to New Zealand. The tribe Sabethini is a primitive group that is the most structurally and biologically diverse of all mosquitoes, and is primarily distributed in a band extending 30 degrees north and south of the Equator (Pillai 1965, Belkin 1968, Judd



Fig. 1. *Maorigoeldia argyropus* has distinctive silvery/bluish scaling on head and thorax, which makes it easily distinguishable from other New Zealand mosquito species. Photograph by Richard Toft (Landcare Research, Nelson).

1996). *Maorigoeldia argyropus* has primitive morphological characteristics (such as acrostichal setae on the thorax) that are not found in any other sabethine and its closest relatives are the tree-hole breeding *Tripteroides* known from Australia and the Pacific Islands (Pillai 1965, Belkin 1968, Judd, 1996). The ecology of *M. argyropus* is largely unknown, but it is recognized to have strictly sylvan habits (Pillai 1965, Belkin 1968, Hayes 1974). The larvae seem to occur mostly in phytotelmata, such as tree holes (*Nothofagus* spp.), rot holes (Pillai 1965, Hayes 1974), water filled ponga stumps and logs (silver tree fern, *Cyathea dealbata* Swartz) (Laird, 1995) and fallen nikau palm fronds (*Rhopalostylis sapida*), which seem to be the main breeding habitat of *M. argyropus* in the Auckland region (Derraik, unpublished data). This species is also capable of utilizing artificial breeding containers such as rainwater tanks, tins, jars and tyres (Pillai 1965, Belkin 1968, Hayes 1974), a recent adaptation since European settlement (Pillai 1965).

According to Hayes (1974) and Pillai (1965), *M. argyropus* cannot survive outside large remnants of native forest. It appears to be rare and the few historical and museum records indicate that it has a limited and disjunct presence in the North and South Islands. It has also been recorded from Little Barrier Island (Belkin, 1968). The current national distribution is not known and the isolated records may be a consequence of extensive anthropogenic environmental change in the 20th century, and in particular the fragmentation of lowland forests and isolation of fragments. Graham (1929) gave a comprehensive account on its distribution in native forest in the Auckland region, but extensive sampling by Hayes (1974) in the same area only recorded *M. argyropus* at two locations (Houghton's Bush and Karekare).

Recent surveys

Extensive surveys carried out between November 2001 and April 2004 as part of two large research projects undertaken to establish the present status of the Culicid fauna of New Zealand (Derraik unpublished data, Snell unpublished data) add support to the claims of Hayes (1974) and Pillai (1965) that the species has become restricted to relatively large and near-pristine patches of native forest. These studies included a dedicated search

(using CO₂-baited light traps) and larval surveys of seven native forest sites in the Auckland Region (Cascade-Kauri Park, Goldies Bush, Logues Bush, McElroy Reserve, Pohuehue Reserve, Wenderholm Regional Park, and a private property in Wainui), five native forest sites in the Wellington Region (Belmont Regional Park, Nga Manu Nature Reserve (Waikanae), Karori Wildlife Sanctuary, Otari-Wilton's Bush and Kaitoke Regional Park) and one edge patch of native forest near Whataroa in February 2002. Despite the extensive search, no adults were found, and larvae were only recorded within the Waitakere Ranges Regional Park (Cascade-Kauri Park and Goldies Bush) (Derraik *et al.* 2005, Derraik, unpublished data, Snell, unpublished data).

A review of recent collection records, museum records, published literature and data provided by NZ Biosecure indicates that *M. argyropus* seems to have disappeared from many North Island sites, such as Otari-Wilton's Bush where it was once collected in 1922 by G.V. Hudson (Belkin 1968). The only other native forest sites where this species was collected in the Wellington Region were from the Colonial Knob track at Porirua and in Tararua Forest Park in the Otaki Forks area (Laird 1995, Jenny Easton, Tasman District Council, pers comm. 2005). The only other recent collection records for this species on the North Island are from Opuia (Bay of Islands) (August 2002) and Tutukaka (December 2002) (NZ Biosecure, unpublished data). There is little information on its distribution in the South Island and, as far as we know, there have been no published South Island records for this species in the past 30 years. However, *M. argyropus* is still present in the South Island as indicated by a collection of larvae from a rainwater tank in Purakanui (near Dunedin) (NZBiosecure, unpublished data).

Possible loss of blood feeding habit

We consider that the apparent inability of *Mg. argyropus* to survive outside large patches of native forest cannot be due to an absence of adequate breeding habitats, as this species is clearly capable of breeding in artificial containers. We have also recorded *M. argyropus* in the Wairere Nursery near the boundaries of the Waitakere Ranges, where the species was collected in high densities with the exotic *Ochlerotatus (Finlaya) notoscriptus*

(Skuse) from a cut bamboo, a drinking trough and a broken bottle. Interestingly, *M. argyropus* did not seem attracted to leaf axils, as these artificial larval habitats were close to two large specimens of the exotic bromeliad *Alcantarea imperialis*, in which *O. notoscriptus* and the endemic *Culex (Culex) asteliae* Belkin were abundant in numerous leaf axils, but *M. argyropus* was absent.

It is therefore plausible that the species' confinement to relatively large areas of native forest may be related to behavioural characteristics of the adults, rather than ecological requirements of larvae. In addition, we concur with the view of Hayes (1974) who suggested that *M. argyropus* does not blood-feed. This would explain for instance, the lack of records for this species in CO₂-baited adult traps, or actively biting a host. Most members of the Sabethini appear to be poorly attracted to these traps (Phil Lounibos, personal communication 2004), and few mosquito species in this tribe seem to bite humans (Belkin 1962). The only description of *M. argyropus* biting a host was given by Graham (1929), and both Hayes (1974) and Belkin (1968) suggested that those records are errors, since Graham described this species as persistent biters, which clearly contradicts the findings of all other authors. Belkin (1968) pointed out that *M. argyropus* is not readily attracted to humans, and we have also failed to observe any adults of the species biting in the field.

Hayes (1974) carried out extensive attempts to induce human blood-feeding in *M. argyropus* females under laboratory conditions, but was unsuccessful, he showed that females were capable of laying up to three batches of eggs on a diet of sugar solution, leading to the conclusion that *M. argyropus* is an autogenous species which has largely or completely lost the blood-feeding habit, even though it is morphologically capable of taking blood (Hayes 1974). This is not a particularly unusual feature, as numerous mosquito species do not blood-feed (Collins & Blackwell 2000), even though many such species have retained the piercing-type mouthparts (O'Meara 1985). The reasons for the loss of the blood-feeding habit in many mosquito species are not yet understood (O'Meara 1985), but Corbet (1964) suggested that autogeny could be an evolutionary response to low availability of suitable hosts, and in such species the "burden of accruing materials for egg

production is shifted from adult to larva" (O'Meara 1985, p.122). Hayes (1974) demonstrated that *M. argyropus* can develop and lay the first batch of eggs "without any adult food at all but water", and that this was dependent "on food reserves carried over from the larval stage" (p.91). Su & Mulla (1997) obtained a strong association between emergence weight and autogeny expression in *Culex (Culex) tarsalis* Coquillett, and in the case of *M. argyropus*, the species' larvae are very large. They are of similar size to that of *Opifex fuscus* Hutton, another primitive endemic mosquito that is autogenous for its first gonotrophic cycle (Haeger and Provost, 1965). Therefore, in *M. argyropus*, the burden of acquiring the main supply of reproductive resources has probably shifted to the larval stage, as suggested by Hayes (1974).

Mosquitoes are known to feed on plant resources, and sugar feeding is vital for adults of both sexes (Clements 2000, Foster 1995, Foster & Hancock 1994, Mattingly 1969). Mosquitoes may feed on floral and extrafloral nectaries, damaged fruits, damaged and healthy vegetative tissues, and honeydew (Clements 2000, Joseph 1970). *Maorigoeldia argyropus* might have developed an obligatory reliance on particular native plants that may not persist in small forest fragments and anthropic environments. As a result, the absence of *M. argyropus* from such sites might be an indirect effect of forest fragmentation via the local extinction of certain food resources, which would negatively affect the adults. This could explain why larvae are found in areas adjacent to native forests, but why the species invariably appears to fail to establish further away from forest boundaries. It is important to point out however, that there might be other explanations for the species' failure to survive in highly modified habitats. For example, relatively pristine native forests may offer microclimatic conditions that are fundamental for adult hibernation during winter months or adequate larval development. Still, the species' ability to successfully breed in exposed habitats such as drinking troughs adjacent to native forests suggests that microclimatic explanations *per se* are unlikely to limit its distribution.

Shared characteristics with other endemic taxa?

There is a high degree of endemism in both the

New Zealand vertebrate and invertebrate fauna (Daugherty *et al.* 1993). Our observations, viewed with existing information on *M. argyropus* and, in particular its taxonomic status (Belkin 1968), seem to be consistent with some characteristics recognised as typical of the New Zealand endemic fauna, and more generally of geologically isolated island biotas. Such characteristics include a tendency to develop strong ties to particular habitats, often with co-evolved ecological associations, and niche shifts in the absence of some native fauna taxa, in particular, the near absence of native mammals (Daugherty *et al.* 1993). The association of *M. argyropus* with large areas of native forest, despite the ability to colonize exposed artificial containers, and its possible reversion from blood to sugar feeding seem to be in keeping with this. Further research is needed to address feeding habits, flight activity and dispersal, which could be crucial to understanding what limits this species.

The observed persistence of *M. argyropus* in larger areas of native forest could reflect its ability to maintain viable populations, or perhaps the persistence of particular host plants in these habitats, at a time when New Zealand lowland forests are becoming increasingly fragmented (Simpson 1997). In this regard we suggest that this species may be slowly disappearing from many sites throughout New Zealand, and that its long-term survival could be at risk.

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