Table 1. List of specimens that can be found at the Auckland Botanic Garden, together with their voucher numbers at Auckland Museum (AK) and Allan (Lincoln) (CHR) herbaria.

Species	AK Herbarium	CHR Herbarium	Collected origin
Podocarpus longefoliolatus	AK 355229	n/a	Unknown
Podocarpus macrophyllus var. *maki*	AK 355231	CHR 200125	Eastwoodhill, Ngatapa
Podocarpus milanjianus	AK 355228	CHR 200217	Unknown, but a specimen is held at Kew Herbarium (1915-28101)
Podocarpus neriifolius	AK 355230	CHR 102530, CHR 102526 C	Mt Giluwe, New Guinea

collections. There are only one or two of each species at ABG and it is possible that we have the last remaining plants in New Zealand, therefore conserving these plants is very important. We hold copies of many letters between A. Dakin and J. B. Hair discussing in depth this important conifer collection, which is available for anyone to read if they are interested.

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Brian Molloy, Murray Dawson, and Sue Davison have helped us try to find more information about J. B. Hair. Ian Barton and Jack Hobbs have helped us piece together the movement of the plants once they'd arrived in Auckland. Ines Schonberger very helpfully and promptly organised the data entry of the herbarium specimens at CHR to enable us to find the wild origin of Hair's podocarps.

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The epiphytic water world of *Collospermum hastatum* (Colenso) Skottsb.

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Introduction

Epiphytic plants are often adapted to hold water, either in leaf axils, or in some sort of central cup (Richardson 1999). These bodies of water (called phytotelmata) (Fig. 1) frequently provide habitats for communities of aquatic microorganisms. Bromeliads, commonly grown as house and garden plants in New Zealand, are the most frequently studied group of phytotelmic plants (Frank & Lounibos 2009; Jocque et al. 2010; Brouard et al. 2011; Panizzo 2011).

Many gardeners will know that bromeliads provide a habitat for mosquitos, so it is not surprising to discover that a wide diversity of macro-invertebrates have been recorded from plants in a natural habitat. These include members of the Turbellaria, Rotifera, Nematoda, Annelida, Crustacea, Odonata, Hemiptera, Orthoptera, Diptera, Coleoptera, Hymenoptera, Hemiptera, Lepidoptera, Dermaptera, Blattodea, Isoptera (Frank & Lounibos 2009; Torreias & Ferreira-Keppler 2011) and Arachnida (Mogi 2004). These macro-invertebrates support amphibians in both mature and immature life stages (Wittman 2000). The high level of invertebrate diversity is, in turn, partly dependent upon algae as a source of nutrition (Brouard et al. 2011).

Fig. 1. Close up view of *Neoregelia* sp., showing the leaf rosette and phytotelmic water reservoir. Here grown under native forest at Waiatarua, Auckland, N.Z. Photo: Mark Large, 5 Aug 2014.

Fig. 2. The New Zealand native epiphyte *Collospermum hastatum.* Waiatarua, Auckland. Photo: Mark Large, 5 Aug 2014.

Fig. 3. Close up view of the epiphytic *Collospermum hastatum*, showing the water-retaining leaves of the rosette. Waiatarua, Auckland. Photo: Mark Large, 5 Aug 2014.

Various micro-algae have been reported including yellow-green Xanthophyceae, diatoms (Bacillariophyceae), green algae (Chlorophyceae), Ulvophyceae, and desmids (Zygnematophyceae). The latter appear to be particularly common, representing 58% of algae taxa reported (Sophia et al. 2004).

A range of New Zealand native plants are known to hold water (Derraik 2005b), including the predominantly epiphytic *Collospermum hastatum* (appropriately called 'tank lily') (Figs. 2, 3). Although *Collospermum* has been studied for mosquito larvae (Derraik 2009a; 2009b, Derraik & Heath 2005), we have been unable to find any assessment of other biota. Consequently in 2013 we undertook a preliminary survey of water from this species. We sampled water from plants growing across the Auckland region: from Clevedon in the south, Kaipara and Waitakere in the west, and Great Barrier Island in the Hauraki Gulf. Each sample was examined under a light microscope, tested for water pH and used for a DNA analysis.

Observations

Although no algal material was visible in the water samples from *Collospermum hastatum,* the presence of fungi, cyanobacteria, ciliates and biological detritus such as fern spores (Fig. 4), pollen grains (Fig. 5) and trichomes were noted visually. In contrast, preliminary results for the DNA assay suggest the presence of a wide range of microorganisms and bacteria, including members of the: Proteobacteria; Opisthokinta; Cyanobacteria and Euglenozoa.

All *Collospermum hastatum* water was observed to be acidic, at pH 4.26 – 6.00, despite local rainwater measuring a less acidic pH 6.2. This may, in part, be caused by decaying plant material caught within the leaf bases.

In contrast to *Collospermum*, bromeliad samples from plants grown in urban or higher light environments contained desmids and diatoms including: *Pinnularia* (Fig. 6), *Navicula, Eunotia* (Fig. 6) and *Cymbella.* The colonial alga *Dictyospaerium* (Fig. 7) was also present, as were cyanobacteria *Croococcus* sp. (Fig. 6). Interestingly, bromeliads cultivated in New Zealand forested environments lacked diatoms and desmids and this may be associated with the lower light levels in that habitat. A Brazilian study of bromeliads found that those in shaded environments had an abundance of aquatic fungi, but rarely any algae (Sophia et al. 2004).

Given that many micro-organisms are not easily identified by traditional methods, we are continuing this investigation using high-throughput DNA

Fig. 4. Fern spore of *Cyathea medullaris* in water sample from *Collospermum hastatum*. Scale 10 μm. Photo: Sarah Killick.

Fig. 5. Saccate podocarp pollen grain (possibly *Podocarpus*) in water sample from *Collospermum hastatum*. Scale 10 μm. Photo: Sarah Killick.

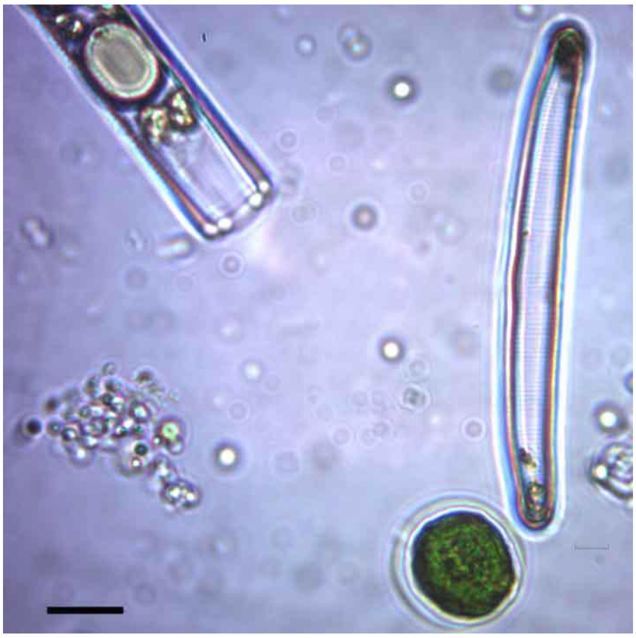

Fig. 6. *Croococcus* sp., *Pinnularia* sp. and *Eunotia* sp. in water sample from the Bromeliad genus *Aechmea* sp. Scale 10 μm. Photo: Sarah Killick.

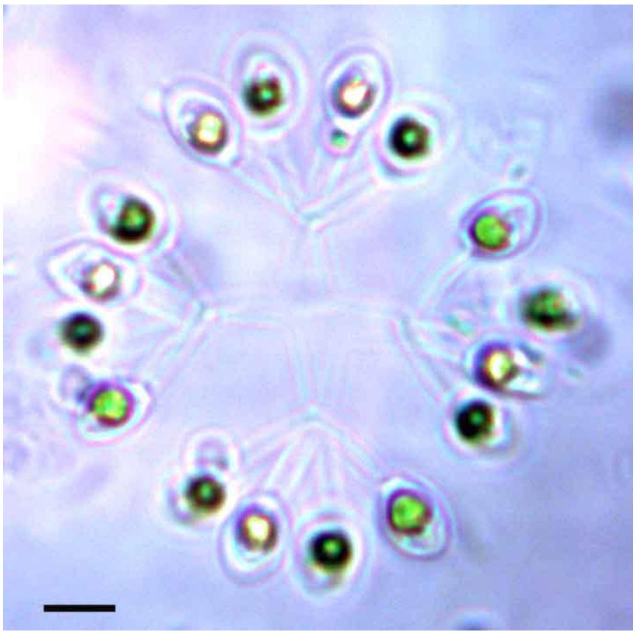

Fig. 7. *Dictyosphaerium* sp. in water sample from the Bromeliad genus *Aechmea* sp. Scale 10 μm. Photo: Sarah Killick.

sequencing. We also hope to assess why micro-algae are absent from our sampling. We are interested in sampling water from more bromeliads ideally grown under forest cover. Of particular interest is *Alcantarea*.

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The amazing beach foam of Puaotetai Bay, south Piha

Mike Wilcox

Fig. 1. Puaotetai, 'foam bay', at low tide, south Piha. Photo: Mike Wilcox, 20 Sep 2014.

Fig. 2. The Gap, south Piha. Photo: Mike Wilcox, 20 Sep 2014.

During the Bot Soc trip to Piha (Fig. 1) on 20 September 2014 we were much impressed by the abundant white foam washing through The Gap (Fig. 2) and the Taitomo Island "Keyhole" tunnel into Puaotetai Bay. The name Puaotetai actually refers to "the foam that piles up in the bay during stormy weather". According to Wikipedia, sea foam, ocean foam, beach foam, or spume is a type of foam created by the agitation of seawater, particularly when it contains higher concentrations of dissolved organic matter (including proteins, lignins, and lipids) derived from sources such as the breakdown of algal blooms. These compounds can act as surfactants or foaming agents. As the seawater is churned by breaking waves in the surf zone adjacent to the shore, the presence of these surfactants under these turbulent conditions traps air, forming persistent bubbles that stick to each other through surface tension. In this way, foam forms when dissolved organic matter in the sea is churned up. Sea foam results mainly from the enrichment of surface-active substances exuded by (i) phytoplankton blooms, (ii) seaweed or (iii) even terrestrial plants (Schilling & Zessner 2011). The enriched material is whisked into foam by the action of waves and washed ashore (Fig. 3).

When large blooms of algae decay offshore, great amounts of decaying algal matter often wash ashore and algal blooms are one common source of thick sea foams. Vivienne Cassie Cooper (1996) indicates that the main algae involved in our surf beach foam are the centric diatoms *Attheya armatus*, *Asterionellopsis glacialis* and *Aulacodiscus*