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***Azolla rubra* R.Br. (Salviniaceae) on Rēkohu / Wharekauri / Chatham Island**

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Abstract

Azolla rubra (Salviniaceae) is reported from the Chatham Islands for the first time based on chance finds made in February and April 2023 from two lakes in the north-eastern portion of Rēkohu / Wharekauri / Chatham Island (hereafter Rēkohu). The biostatus of *Azolla* on the islands is reviewed and it is believed that plants are more likely to have arrived naturally via fragments brought to the islands by waterfowl from Aotearoa / New Zealand than by other means, so should be treated as indigenous. We advise that the impact of *Azolla* on the most sheltered, shallow, freshwater bodies of the islands should be monitored, as hitherto the islands' waterbodies have been mostly devoid of free-floating aquatic plants.

Keywords

Azolla; *A. rubra* R.Br.; biostatus; Chatham Islands flora



Figure 1. *Azolla rubra* plants floating amongst the culms of *Machaerina arthropphylla*, *Isolepis prolifer* and *Eleocharis acuta*, Lake Rotorua, Kaingaroa Road, Rēkohu. Photo: P. J. de Lange.

Introduction

Azolla rubra R.Br. (Salviniaceae) is an aquatic fern whose fronds float on the surface of water bodies (Figure 1). The species is found throughout Australia, the main islands of Aotearoa / New Zealand, Te-Ika-a-Māui / North Island and Te Wai Pounamu / South Island and possibly Papua New Guinea, Indonesia and Japan (Brownsey & Perrie 2015). *Azolla rubra* has hitherto not been reported from the Chatham Islands (de Lange et al. 1999; de Lange et al. 2011; Brownsey & Perrie 2015). During February 2023, the junior author discovered *Azolla rubra* on the margins of Lake Koomutu (-43.7495°S, -176.4247°W) (Figure 2), on the side of the North Road, Rēkohu / Wharekauri / Chatham Island (hereafter Rēkohu) and later in April 2023 the senior author found another population on the western shoreline of Lake Rotorua (-43.7585°S, -176.2946°W) (Figure 1) Kaingaroa Road, Rēkohu. Here we provide a description of *Azolla rubra* based on Chatham Islands specimens and discuss the biostatus and implications of this new arrival to the islands.

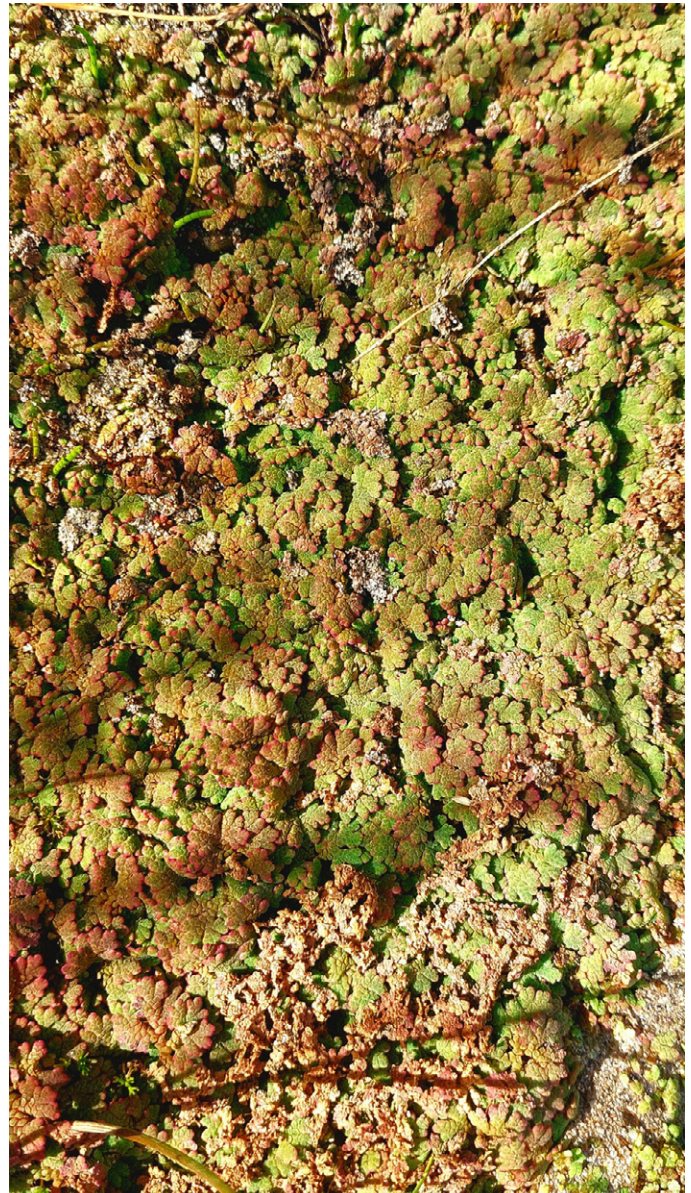


Figure 2. *Azolla rubra* forming a thick crust where the water has retreated from the lake margin, Lake Koomutu, North Road, Rēkohu. Photo: P. J. de Lange.

Taxonomy

Azolla rubra R.Br. *Prodr. Fl. Nov. Holland.* 167 (1810)

Description (Figure 1, Figure 2): Aquatic plants, free floating or forming a turf on damp margins of water bodies; plants red- or green-coloured depending on degree of light exposure and stress, forming mostly clonal masses, which usually cover the water body surface in an extensive, floating mat. Frond broadly ovate, orbicular or elliptic. Plants 6–30 × 5–30(–40) mm, broadly ovate, elliptic; stems irregularly branched, readily disarticulating; roots simple, 10–30 mm long.

Leaves densely imbricate; upper leaf lobes 0.5–2.0 × 0.5–1.5 mm ovate, broadly ovate or elliptic, red or green, papillate; apices obtuse or rounded; margins membranous, translucent. Fertile material not seen.

Specimens seen: Chatham Islands, Rēkohu / Wharekauri / Chatham Island: North Road, Lake Koomutu, P.J. de Lange CH4348, 13 Feb 2023, UNITEC 14049; Kaingaroa Road, Lake Rotorua (eastern shoreline), P.J. de Lange CH4349, 15 Apr 2023, UNITEC 14050.

Discussion

Despite a range of suitable habitats, until 2023 *Azolla* had not been reported from the Chatham Islands (de Lange 2023). The species was not noted during lake surveys of the Chatham Islands (Champion & Clayton 2004), nor was it reported by de Lange et al. (1999) and de Lange et al. (2011) or noted by staff of the Department of Conservation. The species was not recognised for the islands by Brownsey & Perrie (2015). At Lakes Koomutu and Rotorua, Rēkohu, *Azolla* is not common, plants occupy a small portion of both lakes where they were noted amongst the fringing vegetation, *Apodasmia similis* (Edgar) B.G.Briggs & L.A.S.Johnson at Koomutu and mostly *Machaerina arthophylla* (Nees) T.Koyama, *Isolepis prolifera* (Rottb.) R.Br., and *Eleocharis acuta* R.Br. at Rotorua. Both lakes have had their biota investigated by researchers from the University of Otago in 2021, 2022 and 2023 (T. Ingram, pers. comm., April 2023); they too had not noted *Azolla* until it was pointed out to them at Rotorua by the senior author during a visit there in April 2023. While it is always possible that *Azolla* has been present on the islands for some time in small numbers and so overlooked, we are confident that the 2023 finds suggest it is still a 'recent' arrival to the island, perhaps within the last year to decade. We think it unlikely that *Azolla*, had it been on the islands in the late twentieth century and early 2000s, would have been overlooked, considering the high level of research interest in the islands, lakes, ponds and streams since Champion & Clayton (2004) did their surveys.

The most likely source of these *Azolla* occurrences would be Aotearoa / New Zealand, and we suspect the fern has arrived naturally from there, most likely via bird-mediated epizoochory of *Azolla* fragments (possibly grey teal (*Anas gracilis* Buller, 1869), grey duck (*Anas superciliosa* Gmelin, 1789), mallard (*Anas platyrhynchos* Linnaeus, 1758) or black swan (*Cygnus atratus* (Latham,

1790)) between Aotearoa / New Zealand and the Chatham Islands. Notably, mallard ducks have been shown to be a key disperser of the closely related *Azolla filiculoides* Lam. in a study examining epizoochorous dispersal of aquatic macrophytes (Coughlan et al. 2016). However, wind dispersal of spores is another possibility, though a very remote one as fertile examples of Aotearoa / New Zealand-collected *Azolla* are exceedingly rare (Brownsey & Perrie 2015), and the heterosporous nature of *Azolla* would require long-distance dispersal of either fertilised megaspores or of both spore types. We think it highly unlikely that Chatham Islands occurrences of *Azolla* arose from long-distance dispersal of spores.

One last possibility is that the fern arrived by human agency. Accidental movement of *Azolla*-contaminated field equipment from Aotearoa / New Zealand-based researchers to the islands, or intentional cultivation are possible modes of anthropogenic transport. If the latter occurred, we would have expected to see *Azolla* in ponds and water gardens within islanders' gardens, which to date we have not. Furthermore, whilst Lakes Koomutu and Rotorua are easily accessed they are still remote from the main settlements of Rēkohu, and we have yet to see *Azolla* in water bodies near residential sites or in people's garden ponds. Lastly, local people are not familiar with *Azolla* (based on comments received on the posting of de Lange (2023) on the Chatham Islanders Worldwide Facebook group). Therefore, unless further information becomes available, we regard the *Azolla* occurrences reported here as evidence of a recent, natural Aotearoa / New Zealand-to-Chatham Islands dispersion, and as such regard the species as indigenous to the islands.

Irrespective of its biostatus, *Azolla* has the potential to have a major impact on those smaller, more fertile, shallow ponds and lakes of the Chatham Islands. Globally the genus is well known for forming a thick floating sūd on shallow, nutrient-rich water bodies, and, on account of its symbiosis with the nitrogen-fixing cyanobacterium *Anabaena*, elevating nitrogen levels (Jama et al. 2023). The Chatham Islands ponds, lakes and slow-flowing streams are generally sparingly colonised by aquatic macrophytes with only *Myriophyllum* L., *Ruppia* L. and, on occasion, *Callitriche* L. locally dominant. The usual associates of *Azolla* in Aotearoa / New Zealand, *Landoltia punctata* (G.Mey.) Les. & D.J.Crawford, *Lemna* spp., and *Wolffia australiana* (Benth.) Hartog & Plas, though known from the islands (de Lange et al. 2011), are still extremely uncommon – though observations since 2018 suggest that *Lemna disperma* Hegelm. is increasing in abundance,

whilst *L. aequinoctialis* Welw. was first noted on Rēkohu in May 2019 (it seems also to have recently colonised the islands). Collectively these species, along with *Azolla*, may alter the indigenous vegetation of those smaller, shallower, sheltered water bodies, through reducing surface water mixing, cutting off light penetrating the water column, reducing oxygen levels and elevating the water nutrients. In Aotearoa / New Zealand we have observed that this can result in stagnation (see also <https://www.nrc.govt.nz/environment/weed-and-pest-control/pest-control-hub/?pwsystem=true&pwid=188>, accessed: 28 May 2023). While the long-term impact of *Azolla* on the biota of the Chathams ponds, lakes and slow-flowing waterways cannot be predicted, we advise that the spread of this fern should at least be monitored and control measures planned for, 'just in case' *Azolla* proves detrimental to the islands' freshwater bodies. Realistically, though, control of this fern may prove impractical. Nevertheless, we would encourage the Chatham Islands council and biosecurity staff on the islands to increase islanders' awareness of this plant, how it spreads, the potential impacts it could have, and, further, to ensure that hygiene measures for boats and other equipment used in waterways are increased.

Data accessibility statement

No additional database

Author Contributions

Peter de Lange: Conceptualisation (lead); data curation (lead); validation (equal); visualisation (lead); writing – original draft (lead); writing – review and editing (equal)

Tom Hitchon: Writing – review and editing (equal)

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References

- Brownsey, P. J., Perrie, L. R. (2015). Salviniaceae. In: Breitwieser, I., Heenan, P. B., Wilton, A. D. (eds), *Flora of New Zealand – Ferns and lycophytes*. Fascicle 10. Lincoln: Manaaki Whenua Press. 17 pp. <https://doi.org/10.7931/B1H59T>
- Champion, P. D., Clayton, J. S. (2004). *Aquatic vegetation of Chatham Island (Rēkohu)*. DOC Science Internal Series 164. Wellington: Department of Conservation. <https://www.doc.govt.nz/globalassets/documents/science-and-technical/dsis164.pdf>
- Coughlan, N. E., Kelly, T. C., Jansen, M. A. K. (2016). “Step by step”: High frequency short-distance epizoochorous dispersal of aquatic macrophytes. *Biological Invasions*, 19: 625–634. <https://doi.org/10.1007/s10530-016-1293-0>
- de Lange, P. J. (2023). *Why is Lake Huro red this summer?* Chatham Islands, New Zealand. Available online: <https://chathams.co.nz/why-is-lake-huro-red-this-summer/> [Accessed 2023]
- de Lange, P. J., Sawyer, J. W. D. Ansell, R. (1999). *Checklist of indigenous vascular plant species recorded from Chatham Islands*. Wellington: Department of Conservation. 30 pp. https://www.nzpcn.org.nz/site/assets/files/0/12/190/chatham_is_plant_checklist.pdf
- de Lange, P. J., Heenan, P. B., Rolfe, J. R. (2011). *Checklist of vascular plants recorded from the Chatham Islands*. Wellington: Department of Conservation. 57 pp. <https://www.doc.govt.nz/globalassets/documents/conservation/native-plants/chatham-islands-vascular-plants-checklist.pdf>
- Jama, A., Widiastuti, D. P., Gafur, S., Davis, J. G. (2023). *Azolla* biofertilizer is an effective replacement for urea fertilizer in vegetable crops. *Sustainability*, 15(7): 6045. <https://doi.org/10.3390/su15076045>

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