

THE FRIENDLY ISLANDS – A CHECKLIST OF HORNWORTS AND LIVERWORTS OF TONGA

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Abstract. The first checklist of hornworts and liverworts is provided for Tonga. Geographic coverage includes the islands Ha'apai, Niua, Tongatapu, Vava'u, and surrounding smaller islands. It is apparent that there remain many localities in Tonga, including entire islands, which have never or scarcely been collected for this group of plants. We report three hornwort and 47 liverwort taxa. Two additional liverwort taxa previously reported from Tonga are noted as doubtful records. The list is based on over 35 literature references from over 5000 papers that the ELPT project has processed so far, including monographs and regional studies. New records will undoubtedly be reported, based on regionally widespread species that have been recorded elsewhere, especially nearby Fiji and Samoa. It is clear Tonga has received negligible attention, and almost no publications exist that have focused solely on this group of islands. The current checklist is part of a broader study producing checklists for islands across the South Pacific, which we hope will foster and encourage research of liverworts and hornworts in this globally important biodiversity hotspot.

Keywords: Anthocerotophyta, Australasia, biodiversity, Marchantiophyta, Pacific region, Tonga

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INTRODUCTION

Mittermeier *et al.* (2005) identified all the islands of Micronesia and Polynesia, including the islands of Tonga, as one of 35 global biodiversity 'hotspots', often referred to as the Polynesia-Micronesia hotspot. Conservation International (www.conservation.org, accessed 16/08/2011) considers the Polynesia-Micronesia hotspot the epicentre of the current global extinction crisis. The kingdom of Tonga (sometimes referred to as the Friendly Islands because of the friendly reception of Captain Cook) comprises an archipelago of 176 islands of varying sizes (most of them uninhabited), in the tropical southwest Pacific with a land area of 714 km². The highest elevation (on the island of Kao in the Ha'apai group) is 1033 m.

No publications have focused solely on liverworts from Tonga. The most important contribution to the knowledge of Tongan liverworts is the series of papers from South Pacific by Hans Hürlimann (Hürlimann 1960–1998). *Prodromus*

florae hepaticarum polynesiae (Miller *et al.* 1983) provided a comprehensive checklist of liverworts and hornworts from the tropical islands of the Pacific, including those of Tonga. This work was based on a compilation of literature and served as a first step towards making knowledge about Pacific island bryophytes more accessible and has remained a significant work. Yet, the publication was largely an uncritical compilation of names from literature (Söderström *et al.* 2011).

We here present the first checklist of liverworts and hornworts for the islands of Tonga. The current paper is part of a larger series of papers focusing on increasing our floristic knowledge in the South Pacific including nearby Fiji (Söderström *et al.* 2011; Pócs *et al.* 2011; von Konrat *et al.* 2011) and New Caledonia (Thouvenot *et al.* 2011). Almost three decades after Miller *et al.* (1983) we hope the series of papers will work towards the same goal as spirited by them, help promote further

bryological research in the region, and provide a foundation for revisionary studies and floristic research. Undoubtedly, many new records will be reported for the Tongan islands, given that at least 190 other liverwort and hornwort species occur on the nearby islands of Samoa and at least another 230 species in Fiji. In this checklist we report 50 taxa as occurring on the Tongan islands. Two additional taxa are reported as doubtful records.

It is clear that Tongan bryophytes have been overlooked historically, compared to seed plants, birds, and other organisms forming a remarkable gap in the knowledge of the flora of Tonga. Moreover, the state of our floristic knowledge of these organisms is deficient compared to many other biodiversity hotspots and other ecologically significant areas of the globe. The island of 'Eua should be especially interesting because of its floristic affinities, as it is the oldest island of the archipelago and is thought to be partly an ancient fragment of Gondwana (Mueller-Dombois & Fosberg 1998). As an example, it has the endemic *Podocarpus foliolatus* de Laub. and podocarps are good substrates for interesting bryophytes.

METHODS AND PRESENTATION

The present checklist is based on a compilation of all the published records of species and infraspecific taxa of liverworts and hornworts from Tonga. The ELPT database (von Konrat *et al.* 2010) was an important source. The format of the present checklist follows that of the database. Accordingly, confidence levels are provided for each taxon, as follows (Söderström *et al.* 2010; von Konrat *et al.* 2010): * = serious doubts about the value of the taxon, ** = probably a good taxon, but not studied critically in the framework of a recent revision or monograph, *** = good taxon as currently understood, studied in the framework of a recent revision or monograph.

As in the recent checklists in the same series a distinction in the species lists is made between primary references (providing details on specimens and/or exact localities) and secondary ones (lacking details). Primary references are in small capitals and secondary ones in normal font.

No attempt has been made to examine the specimens of the published records and verify the identifications. Nomenclature follows the latest taxonomic opinions as much as possible and author abbreviations are according

to the International Plant Names Index (<http://www.ipni.org/index.html>). Taxa doubtfully present in Tonga and synonyms are listed separately. The list of synonyms only contains names used for Tonga.

The following abbreviations are used for the island groups: HA = the *Ha'apai* group (including *Tofua*, *Kao*, *Nomuka* and the *Lifuka* group); NI = the *Niua* group (including *Tafahi*, *Niuafo'ou* and *Niuaatoputapu*); TT = the *Tongatapu* group (including 'Eua, *Nuku'alofa* and *Ata*); VA = the *Vava'u* group (including *Fonualei*, *Tokua* and *Late*); and TON = lack of precise locality information in the cited references.

LIST OF HORNWORTS AND LIVERWORTS RECORDED FOR TONGA

ANTHOCEROTOPHYTA

Dendroceros

*** *D. javanicus* (Nees) Nees

HA: Miller *et al.* (1983); NI: HÜRLIMANN (1960); VA: Miller *et al.* (1983).

Folioceros

*** *F. fuciformis* (Mont.) D. C. Bharadwaj

HA: Miller *et al.* (1983) as *Anthoceros fuciformis*; TT: HÜRLIMANN (1960) as *Anthoceros vesiculosus*.

Megaceros

*** *M. flagellaris* (Mitt.) Steph.

TT: HÜRLIMANN (1960) as *Megaceros grandis*, HÜRLIMANN (1960) as *Megaceros vescoanus*, Miller *et al.* (1983) as *Megaceros grandis* and *Megaceros vescoanus*.

MARCHANTIOPHYTA

Acrolejeunea

*** *A. aulacophora* (Mont.) Steph.

TT: GRADSTEIN (1975), Miller *et al.* (1983), HÜRLIMANN (1989).

Archilejeunea

*** *A. planiuscula* (Mitt.) Steph.

TT: HÜRLIMANN (1991), VA: HÜRLIMANN (1991).

Bazzania

** *B. paradoxa* (Sande Lac.) Steph.

NI: HÜRLIMANN (1985).

- *** *B. tridens* (Reinw., Blume & Nees) Trevis.
NI: HÜRLIMANN (1985) as *Bazzania australis*.

Cheilolejeunea

- ** *C. ceylanica* (Gottsche) R. M. Schust.
& Kachroo
TT: HÜRLIMANN (1995); VA: HÜRLIMANN (1995).
- *** *C. intertexta* (Lindenb.) Steph.
VA: HÜRLIMANN (1995).

Cololejeunea

- ** *C. ceatocarpa* (Ångstr.) Steph.
TON: Pócs *et al.* (2011); NI: HÜRLIMANN (1987).
- *** *C. cocoscola* Tixier
TON: Eggers & Pócs (2010); VA: PÓCS *ET AL.* (2011) (TYPE).
- ** *C. hirta* Steph.
TON: Pócs *et al.* (2011); NI: HÜRLIMANN (1987).
- *** *C. kapingaensis* H. A. Mill.
VA: HÜRLIMANN (1987).
- * *C. maritima* Tixier
TT: HÜRLIMANN (1987).
- ** *C. pacifica* Pócs
TT: PÓCS (2012).
- *** *C. raduliloba* Steph.
TT: MÜLLER & SCHÄFER-VERWIMP (1999) as *Cololejeunea pakseana*.
- ** *C. vidualiana* Tixier
NI: HÜRLIMANN (1987).
- *** *C. wightii* Steph.
TON: Pócs *et al.* (2011); NI: HÜRLIMANN (1987);
TT: HÜRLIMANN (1987), ZHU & SO (1999).

Dumortiera

- *** *D. hirsuta* (Sw.) Nees
TT: Fulford (1959), HÜRLIMANN (1960), Miller *et al.* (1983).

NOTES. This is a variable species and recent studies (N. Salazar-Allen, pers. comm.) indicate

that more than one taxon may be involved. There is at least one distinct segregate in Central America (Forrest *et al.* 2011) but we do not know where Pacific reports belongs.

Harpalejeunea

- *** *H. filicuspis* (Steph.) Mizut.
TT: HÜRLIMANN (1995); VA: HÜRLIMANN (1995).

Heteroscyphus

- *** *H. argutus* (Reinw., Blume & Nees) Schiffn.
VA: HÜRLIMANN (1998).
- ** *H. jackii* (Steph.) Schiffn.
NI: HÜRLIMANN (1998); TT: HÜRLIMANN (1998).

Jackiella

- *** *J. javanica* Schiffn.
TON: Piippo (1985), Váňa (1992); TT: HÜRLIMANN (1974), Miller *et al.* (1983), HÜRLIMANN (1989).

Lejeunea

- *** *L. anisophylla* Mont.
TON: Zhu & So (2001), Lai *et al.* (2007), Pócs (2010); TT: HÜRLIMANN (1993); VA: HÜRLIMANN (1993).
- ** *L. caviloba* (Steph.) Steph. *ex Besch.*
VA: HÜRLIMANN (1993).
- ** *L. conmatistipula* (Steph.) Steph.
TT: HÜRLIMANN (1993).
- *** *L. flava* (Sw.) Nees
TT: FULFORD (1959), Miller *et al.* (1983).
- ** *L. flava* subsp. *orientalis* R. M. Schust.
TT: HÜRLIMANN (1993).
- ** *L. micholitzii* Mizut.
VA: HÜRLIMANN (1993) as *Lejeunea parvisacata*.

Leptolejeunea

- *** *L. elliptica* (Lehm. & Lindenb.) Schiffn.
NI: HÜRLIMANN (1987) as *Leptolejeunea subacuta*;
TT: HÜRLIMANN (1995) as *Leptolejeunea subacuta*; VA: HÜRLIMANN (1995) as *Leptolejeunea subacuta*.

*** *L. epiphylla* (Mitt.) Steph.

TON: HÜRLIMANN (1995).

Lopholejeunea

*** *L. subfusca* (Nees) Schiffn.

TT: Hürlimann (1991), Zhu & Gradstein (2005);
VA: Hürlimann (1991).

Mastigolejeunea

*** *M. auriculata* (Wilson) Schiffn.

VA: HÜRLIMANN (1989).

*** *M. calcarata* (Mitt. ex Steph.) Verd.

TT: HÜRLIMANN (1989).

*** *M. virens* (Ångstr.) Steph.

TT: HÜRLIMANN (1989); VA: HÜRLIMANN (1989).

Metalejeunea

*** *M. cucullata* (Reinw., Blume & Nees) Grolle

VA: HÜRLIMANN (1993) as *Lejeunea cucullata*.

Phaeolejeunea

*** *P. amicornum* (Hürl.) Pócs

TT: HÜRLIMANN (1991) as *Phaeolejeunea etesseana*
subsp. *amicorum* Hürl. (TYPE), PÓCS (2008), PÓCS *et al.*
(2011).

Plagiochila

** *P. chauviniana* Mont.

NI: HÜRLIMANN (1974) as *Plagiochila novae-
guineae*; VA: Miller *et al.* (1983) as *Plagiochila novae-
guineae*.

*** *P. javanica* (Sw.) Nees & Mont.

NI: HÜRLIMANN (1974) as *Plagiochila powellii*; VA:
Miller *et al.* (1983) as *Plagiochila powellii*.

** *P. vitiensis* Mitt.

TON: Miller *et al.* (1983), Inoue (1986); NI: HÜRLI-
MANN (1974), TT: So (2001); VA: INOUE (1970, 1981),
Scott & Bradshaw (1985).

Radula

** *R. acuta* Mitt.

TT: HÜRLIMANN (1978) as *Radula paucidens*, Miller
et al. (1983) as *Radula paucidens*.

** *R. javanica* Gottsche

TT: HÜRLIMANN (1978), Miller *et al.* (1983).

* *R. multiflora* Gottsche ex Schiffn.

NI: HÜRLIMANN (1978); VA: Miller *et al.* (1983).

*** *R. retroflexa* Taylor

NI: HÜRLIMANN (1978) as *Radula miqueliana*;
VA: Miller *et al.* (1983) as *Radula retroflexa* var. *ret-
roflexa*.

Riccardia

*** *R. alba* (Colenso) E. A. Br.

NI: HÜRLIMANN (1976) as *Riccardia samoana*;
VA: Miller *et al.* (1983) as *Riccardia samoana*, Brown
& Braggins (1989).

*** *R. graeffei* (Steph.) Hewson

TON: Miller *et al.* (1983), Furuki (2002, 2006);
NI: HÜRLIMANN (1976); TT: HÜRLIMANN (1976); VA:
Miller *et al.* (1983).

** *R. tenuicostata* Schiffn.

NI: HÜRLIMANN (1976); VA: Miller *et al.* (1983).

Schiffneriolejeunea

*** *S. tumida* (Nees) Gradst.

TT: HÜRLIMANN (1989).

Solenostoma

*** *S. haskarlianum* (Nees) R. M. Schust. ex Váňa
& D. G. Long

TON: Váňa & Inoue (1983) as *Jungermannia
haskarliana*, Váňa & Piippo (1989) as *Jungermannia
haskarliana*, Váňa (1991) as *Jungermannia haskar-
liana*, Schuster (2002) as *Solenostoma haskarlianum*;
TT: HÜRLIMANN (1974, 1989) both as *Jungermannia
haskarliana*, VÁŇA (1975) as *Jungermannia haskarliana*,
Miller *et al.* (1983) as *Jungermannia haskarliana*.

Thysananthus

** *T. spathulistipus* (Reinw., Blume & Nees)
Lindenb

VA: HÜRLIMANN (1989).

DOUBTFUL RECORD

Radula

*** *R. quadrata* Gottsche

TT: FULFORD (1959) as *Radula andicola*, Miller et al. (1983) as *Radula mollis* and *R. andicola*.

NOTE. This is an African and American taxon reported only once from the Pacific and never reported from SE Asia.

REJECTED RECORDS

Cololejeunea

*** *C. cardiocarpa* (Mont.) A. Evans

TON: Pócs et al. (2011); TT: HÜRLIMANN (1987).

NOTE. The specimen that this report is based on belongs to *C. pacifica* (Pócs 2012).

Lejeunea

*** *L. capensis* Gottsche

TT: Hürlimann (1993) as *Lejeunea* cf. *caespitosa*; VA: Hürlimann (1993) as *Lejeunea* cf. *caespitosa*.

NOTE. Only reported with some uncertainty. *Lejeunea caespitosa* is technically a synonym of *L. capensis* (Reiner-Drehwald 2009). However, specimens so named from the Pacific probably all belong to *L. anisophylla*.

SYNONYMS

Anthoceros fuciformis Mont. = *Folioceros fuciformis*

Anthoceros vesiculosus Austin = *Folioceros fuciformis*

Bazzania australis (Mont.) Trevis. = *Bazzania tridens*

Cololejeunea pakseana Tixier, nom. inval. = *Cololejeunea raduliloba*

Jungermannia haskarliana (Nees) Mitt. = *Solenostoma haskarlianum*

Lejeunea caespitosa Lindenb. = *Lejeunea capensis*

Lejeunea cucullata (Reinw., Blume & Nees) Nees, nom. illeg. = *Metalejeunea cucullata*

Lejeunea parvisaccata (Steph.) Steph. = *Lejeunea micholitzii*

Leprolejeunea subacuta Steph. ex A. Evans = *Leprolejeunea elliptica*

Megaceros grandis (Ångstr.) Steph. = *Megaceros flagellaris*

Megaceros vescoanus (Gottsche) Steph. = *Megaceros flagellaris*

Phaeolejeunea etesseana subsp. *amicorum* Hürl. = *Phaeolejeunea amicum*

Plagiochila novae-guineae Sande Lac. = *Plagiochila chauviniana*

Plagiochila powellii Mitt. ex Steph. = *Plagiochila javanica*

Radula andicola Steph. = *Radula quadrata*

Radula miqueliana Taylor = *Radula retroflexa*

Radula mollis Lindenb. & Gottsche = *Radula quadrata*

Radula paucidens Steph. ex Castle = *Radula acuta*

Riccardia samoana (Steph.) H. A. Mill. = *Riccardia alba*

Solenostoma haskarlianum (Nees) R. M. Schust. nom. inval. = *Solenostoma haskarlianum*

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