

DAVIS EXPEDITION FUND

REPORT ON EXPEDITION / PROJECT

Expedition/Project Title: DNA barcoding of the leafy liverwort genus *Herbertus* in North America

Travel Dates: July/August 2011

Location: North America

Group Members: David Bell

Aims: Collection of herbarium and silica-dried material for a combined morphological and molecular study to resolve the taxonomy of the leafy liverwort genus *Herbertus* in North America

Outcome (not less than 300 words):-

See attached report.

Report to the Davis Expedition Fund

DNA barcoding of the leafy liverwort genus *Herbertus* in North America

David Bell - January 2012

Introduction

Herbertus, a cosmopolitan genus of leafy liverwort, has a particularly complicated taxonomic history, largely due to a lack of stable morphological characters for species delimitation and there has been no universally applied species concept within the genus. DNA barcoding has proved useful for resolving relationships between species of *Herbertus* in Europe and has also contributed to the discovery of a species new to science (Bell *et al.* 2012). The aim of the current study is to build on this foundation by expanding the study area to include North America. Resolving relationships of *Herbertus* in North America is a logical progression of this work due to the reported affinities with European taxa, while the results of this study will also make a future revision of the more complex Asian *Herbertus* flora more achievable.

The number of *Herbertus* species recognised in North America has been in a state of flux for over 200 years, as has the nomenclature used for different taxa. It is hoped that the integrated molecular and morphological approach used to successfully resolve *Herbertus* relationships in Europe will have similar results for the North American taxa.

While there are many specimens of *Herbertus* from North America in various herbaria including E, DUKE, NY and UBC, there are relatively few recent collections suitable for DNA extraction, necessitating the fieldwork reported here.

Results

Herbertus has been recorded in eastern North America along the Appalachian range and along the coast in the Pacific Northwest. The main study areas were North Carolina (with trips into Tennessee and Virginia) and British Columbia, with sites selected based on herbarium label data and published accounts.

In eastern North America only one species of *Herbertus* has previously been recognised, at scattered sites along the Appalachian mountain range from Georgia to Newfoundland. However, preliminary molecular work suggested there might in fact be three phylogenetically disparate taxa in this area. To investigate this, a variety of sites at different elevations were visited across 3 states (NC, TN and VA) and field observations of morphology and habitat were recorded along with digital images and collections of herbarium specimens and silica-preserved material. The excellent road networks here allowed easy access to sites and it was possible to cover a large geographical area with ease.

In British Columbia, the herbarium at the University of British Columbia in Vancouver was first visited to study specimens and label data before fieldwork began. Here, the target sites for fieldwork were all on Haida Gwaii (the Queen Charlotte Islands) with the exception of Mt. Hays on the mainland adjacent to the Islands. Progress was slower on Haida Gwaii than it had been in North Carolina due to the limited road networks (primarily logging roads) and unmaintained mountain trails. The active logging industry on the islands also meant that some sites were recently disturbed and consequently bryologically poor. However, good *Herbertus* habitat was found when more remote mountains were reached, particularly on Moresby Island to the south, and the full range of variation seen in *Herbertus* was sampled.

Conclusions

The findings in the Appalachians are particularly interesting and suggest diversity in *Herbertus* has been overlooked as morphological plasticity in the past. The opportunity to study these species in the field has been invaluable, as habitat, substrate and habit offer clues to identification which aren't always readily available from herbarium specimens. The field observations support the theory that there are 3 species of *Herbertus* present here rather than the single species recognised in the past.

In British Columbia the full range of variation seen in *Herbertus* was collected, representing at least 3 species. Haida Gwaii is very close to the type locality for *Herbertus aduncus* (Banks Island) and this was by far the most common species seen, particularly at lower elevations.

The material studied in the herbarium at UBC shows additional diversity not seen on Haida Gwaii, particularly to the north in Alaska and the Aleutian Islands and some of these specimens have been sent on loan for the project. Additional recently-collected material for the study has also been sourced through contacts made at UBC.

Collections were kindly posted to Edinburgh by UBC staff and have now been prepared for DNA extraction. A more critical morphological examination will follow in light of the molecular results.

32 specimens of *Herbertus* were collected during the trip, and additional material for the study has been sourced through the contacts made at UBC.

A total of 183 bryophyte collections were made during the trip, with associated silica-preserved samples prepared for almost half of these. These collections include species from several additional genera currently being studied at RBGE, including *Atrichum*, *Bryum*, *Marsupella*, *Orthotrichum* and *Sphagnum*. Specimens will be deposited in the herbarium at E, with duplicates (where available) distributed to UBC and DUKE.

Results of the combined molecular and morphological study will be published as a revision of *Herbertus* in North America. Molecular analyses will soon be underway and it is anticipated that the morphological revision will be completed and a manuscript prepared for publication during the summer of 2012.

Acknowledgements

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Reference

Bell, D., Long, D.G., Forrest, A.D., Hollingsworth, M.L., Blom, H.H., Hollingsworth, P.M. (2012). DNA barcoding of European *Herbertus* (Marchantiopsida, Herbertaceae) and the discovery and description of a new species. *Molecular Ecology Resources*, 12: 36-47. doi: 10.1111/j.1755-0998.2011.03053.x