



Whale bones: the world's most endangered bryophyte habitat

Jeff Duckett reveals remarkable bryophyte diversity on what must be the world's most bizarre and threatened unnatural bryophyte habitat: old whale bones in far flung reaches of the northern and southern hemispheres.

Field bryologists are forever delighted at finding things in unusual places. Some of the more bizarre and striking examples that immediately come to mind range from the reflecting 'luminous' thalli of *Cyathodium* in tropical caves and ditches (Duckett & Ligrone, 2006), and the protonema of *Schistostega* in various burrows, not to mention Cornish fugous, to mosses growing on weevils in Papuan cloud forests (Gressitt *et al.*, 1968) to protonemata of *Brum pseudotriquetrum* deep within the waters of a permanently frozen Antarctic lake (Rankin *et al.*, 2017). However many times you have seen them there is always a certain enchantment at finding members of the Splachnaceae on dung, pellets and rotting cadavers (Porley & Hodgetts, 2005).

Thus, the stimulus for the present study was the chance discovery of *Tetraplodon mnioides* growing on a decades-old whale skeleton, the centrepiece in an Icelandic garden (Fig.1).

What was initially a supposed bryophyte-free holiday on Iceland then turned into a systematic search for mosses on whale bones. About these remarkably little has been written and images of moss-covered whale bones on the web invariably lack any specific details. Thanks to a magnificent set of responses to my request to Bryonet for whale bone moss information I am now analysing data from well in excess of 100 individual specimen records from high latitudes in both hemispheres and from the UK.

The only published records of which I am aware of particular bryophytes growing on whale bones are *Funaria hygrometrica* on a blue whale outside the Seymour Marine Discovery Center, Long Marine Laboratory, Santa Cruz, California (Buttke, 2010), various *Syntrichia* species including *S. papillosa* and *S. subpapillosa* on the Falkland Islands (Duckett *et al.*, 2012) (Fig. 2), *S. magellanica* in Antarctica (Ochyra *et al.*, 2008), *Metzgeria furcata*, *Bryum argenteum*,



Finback whale skull on display at the old whaling station at the head of Hvalfjörður north east of Reykjavík. J. Ducken

B. capillare, *Grimmia pulvinata*, *Hypnum cupressiforme*, *Syntrichia ruralis*, *S. subulata* and *Tortula muralis* on the island of Borkum off the German coast (Koppe, 1969) and a longer list of some 13 species; *Bryoerythrophyllum recurvirostrum*, *Bryum argenteum*, *B. moravicum*, *B. pallens*, 2 unnamed *Bryum* spp., *Cirriphyllum cirrosum*, *Dichodontium pellucidum*, *Didymodon fallax*, *Distichium* sp., *Encalypta streptocarpa*, *Orthotrichum strictum* and *Schistidium dupretii* (Thér.) W.A.Web. from Northern Norway (Hedenäs, 2010).

An ongoing examination of herbarium specimens from whalebones from both northern and southern hemispheres is revealing an even wider range of species although many collections still require identification and resolution of taxonomic issues in *Syntrichia* and *Ceratodon*.

To begin with the UK: in centuries past, as a by-product of the whaling industry, there were many whale bones lying around the British countryside with several jaw bone arches becoming well known local landmarks e.g. the Bowhead jaws at Chadwell Heath, Essex (Anonymous, 2010; Jones, 2014; Redman, 2004). Most have long

since disappeared. As far as I am aware only two arches are still standing: the 15 ft bowhead whale arch on the West Cliff at Whitby and the bigger blue whale arch in Barnet, North London (Fig. 3). The latter has been in this position for the last 78 years. Scrutiny of images of the Whitby bones suggests that these are bryophyte-free just like those inside museums (e.g. the blue whale ‘Hope’ that replaced the *Diplodocus* in the central hall of the Natural History Museum, London in July 2017). Initial research on the Barnet bones revealed that, much to my horror, they were painstakingly cleaned of bryophytes in 2014. However, the bryophytes have regrown, but unfortunately we are now looking at quantity not quality as the only two species present today are *Bryum capillare* and *Hypnum cupressiforme*. I have so far tracked down three further outdoor whalebones in the UK. Richard Fisk informed me that a whale skeleton near Beccles, Suffolk is colonized by the same species as in the surrounding woodland whilst Chris Preston recorded *Bryum capillare*, *Didymodon insulanus*, *Homalothecium sericeum* and *Hypnum cupressiforme* on the vertebrata of probably a



minke whale in a Cambridge garden. The owner, Dr William Block, brought this back from Signy Island, South Orkneys, Antarctica in 1972. Mosses growing on a further vertebra, brought back from South Georgia in 1973, and now residing in a garden in Appleby, Westmorland, have yet to be identified.

These British whalebone vignettes suggest that, though the substrate may be unusual, their moss floras are extremely mundane, in contrast to the published lists (Hedenäs, 2010; Koppe, 1969) and herbarium specimens from elsewhere in the world.

Turning to the Southern Hemisphere, collections in the British Antarctic Survey and Natural History Museum, kindly provided by Helen Peat, from South Georgia and South Shetland, include the acrocarps *Ceratodon* sp., *Bryum* sp., *Pohlia nutans*, various *Syntrichia* spp. and the pleurocarps *Brachythecium subpilosum*, *Drepanocladus* sp. and *Sanionia georgico-uncinata* whilst Wolfgang Hofbauer recalls seeing an acrocarp, probably a *Syntrichia* or a *Tortula* at Puerto Williams, Navarino Island, Southern Chile.

With much appreciated assistance from Olga Belkina, Laura Briscoe, Diego Knop Henriques, Tommy Prestø, Uwe Schwartz, John Spence, and Juan Carlos Villarreal I have to date discovered, in addition to published records (Hedenas,



△Fig. 1. After discovering that this decades-old whale skeleton (the centrepiece of a garden at Grindavik, South West Iceland), supported 10 different mosses including *Ulota phyllantha* and *Tetraplodon mnioides* the author went on to make over 60 moss collections from 6 more whale bones in Iceland. J. Duckett

△Fig. 2. Vertebra in the garden of Darwin Lodge, West Falklands colonized by *Syntrichia* spp. J. Duckett



◁Fig. 3. After cleaning in 2014 the Barnet blue whale jaw bones' arch is now well colonized by *Bryum capillare* and *Hypnum cupressiforme*. J. Duckett



△Fig. 4. Humpback bones outside the Whaling Museum Húsavík, Northern Iceland. J. Duckett △Fig. 5. Blue whale skeleton on display at the library and museum Húsavík, Northern Iceland. J. Duckett

2010; Koppe, 1969; Ochyra *et al.*, 2008), further Northern Hemisphere collections from Novaya Zemlya, Svalbard, Jan Mayen Island, Alaska, Nunavut, Canadian Arctic, Southern California and Southern Norway in addition to over 60 specimens of my own from seven whale bone locations in Iceland (Figs. 4-10).

Various *Syntrichia* / *Tortula* spp. including *S. ruralis*, *S. subulata*, *T. norvegica*, *T. muralis*, several *Orthotrichum* spp. including *O. diaphanum*, *O. pallens*, *O. pylaisii*, *O. strictum* and the only Northern European record of *O. stellatum* plus a range of *Bryum* spp. including *B. argenteum* (Fig. 6), *B. capillare*, *B. inclinatum*, *B. rubens*, *B. moravicum*, *B. pallens* with several species yet to be identified and the only North American record for *B. vermigerum* in Alaska are the most speciose genera. *Ceratodon* (Fig. 7) under various specific and varietal guises is probably the commonest species. *Grimmia pulvinata* is the only *Grimmia* species recorded to date whilst I made several Iceland *Schistidium* collections, yet to be named, to add to *S. abrupticostatum* (*S. platyphyllum*) from Novaya Zemlya and *S. dupretii* from Northern Norway. Specimens of *Pogonatum* sp., *Timmia* sp. (both Southern Norway) *Ulota phyllantha* (Kodiak Island, Alaska and Iceland) (Fig. 6) and *Tetraplodon mnioides* (Fig. 9) in Iceland complete the acrocarps recorded to date.

A much shorter pleurocarp list, in addition to the published taxa, comprises *Amblystegium serpens* (Alaska and Iceland), *Pseudoleskeella*

nervosa (Alaska) and *Rhytidiadelphus squarrosus* (Iceland) (Fig.7) with liverworts represented by just a single collection of *Metzgeria furcata* from the island of Borkum (Koppe, 1969).

So what might be gleaned from this listing, however incomplete? It clearly reveals that whalebones may be colonized by a wide range of bryophytes with species diversity far outstripping that on other carcasses. The primary colonists are acrocarps with the only liverwort (*Metzgeria furcata*) reflecting that bones are a dry substrate and mostly occur in high latitude sites with dry climates. Taxonomic studies are needed to determine whether or not all the whalebone *Ceratodon* collections fall into the range of variability within *C. purpureus* as treated by Ochyra *et al.*, (2008). Whereas *Tetraplodon mnioides* is generally regarded as a somewhat transient colonist on other mammal carcasses it can clearly flourish for decades on old whale bones. The whale bone colonists comprise diverse and unique species mixtures with common weedy taxa growing alongside extremely rare taxa. More of the latter are to be expected in as yet unnamed collections.

A detailed global survey of whalebone bryophytes is now most urgent. Following the banning of commercial whaling in 1986 by the International Whaling Commission new skeletons will be in short supply (Fig. 10). However, it should be noted that Norway lodged official objections to the moratorium and have continued commercial hunting as do Iceland



△Fig. 6 (top left). *Ulota phyllantha* and *Bryum argenteum* on a vertebra of the Grindavik whale skeleton. J. Duckett

△Fig. 7 (top right). *Rhytidiadelphus squarrosus* growing over *Ceratodon purpureus* on the humpback whale skeleton, Húsavik whaling museum. J. Duckett

◁Fig. 8 (left). Typical *Tetraplodon mnioides* covering a rabbit carcass in Upper Swaledale, Yorkshire is dwarfed by the abundantly fruiting sward covering the blue whale skull outside the library and museum Húsavik (▽Fig. 9, below). J. Duckett





△Fig. 10. Disused whaler at the old whaling station at the head of Hvalfjörður north east of Reykjavik. J. Duckett

and Japan under the guise of ‘scientific whaling.’ Consequent on the latter, whale meat remains on menus however unpalatable this might appear both figuratively and literally (Fig.11). In addition, further collecting from existing whalebones has become highly restricted either on conservation grounds under the Antarctic Treaty or because of safety concerns because of asbestos on abandoned whaling stations.

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▽Fig. 11. Despite the moratorium, highly appetizing (?) whale meat is still readily available in Icelandic restaurants.

