

Recently deglaciaded areas on Heard Island as candidate sites for investigation of colonization and relictualism

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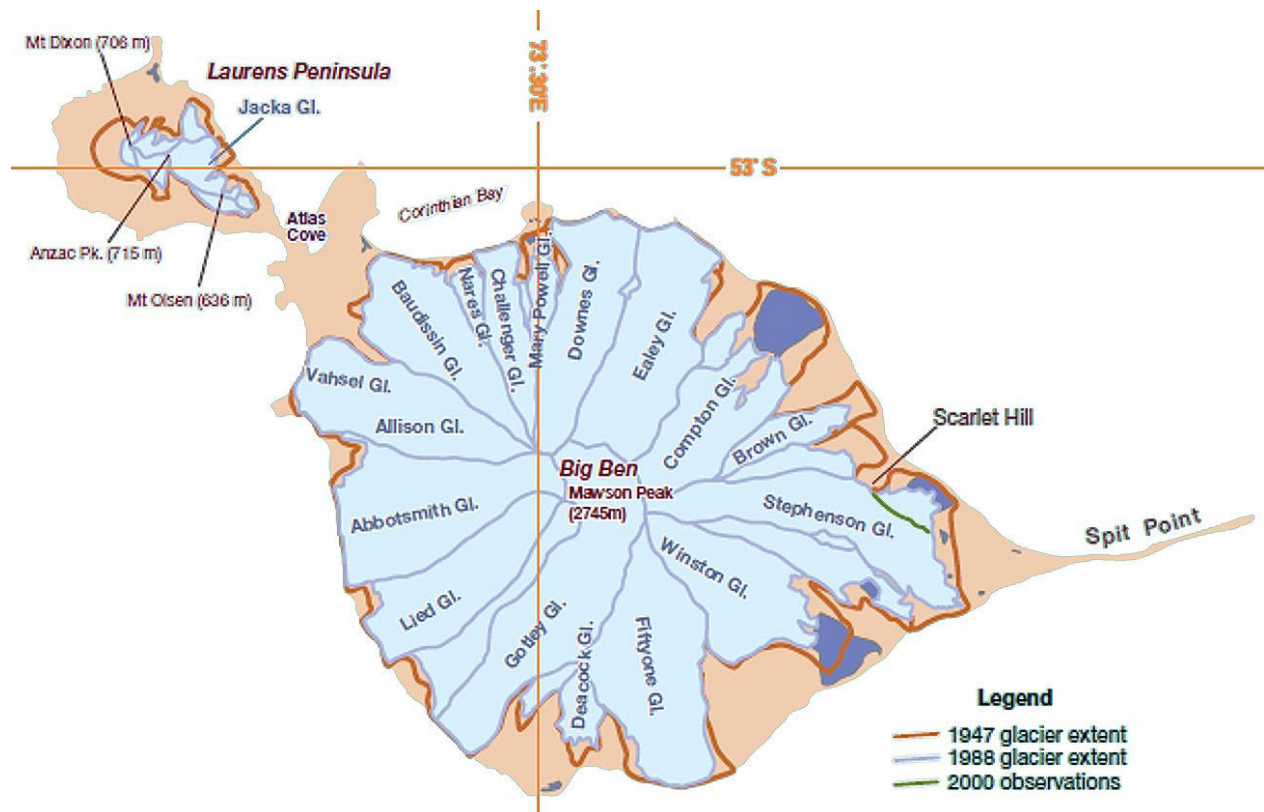
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Most of the glaciers on Heard Island are retreating at relatively high rates, presumably due to global warming. The newly exposed areas enable invasion from nearby established plants, and could enable regrowth of relicts that have been covered during long periods of glaciation.

I begin here a preliminary informal note on candidate sites for investigating colonization and relictualism within recently deglaciaded areas on Heard Island, during the 2016 expedition.

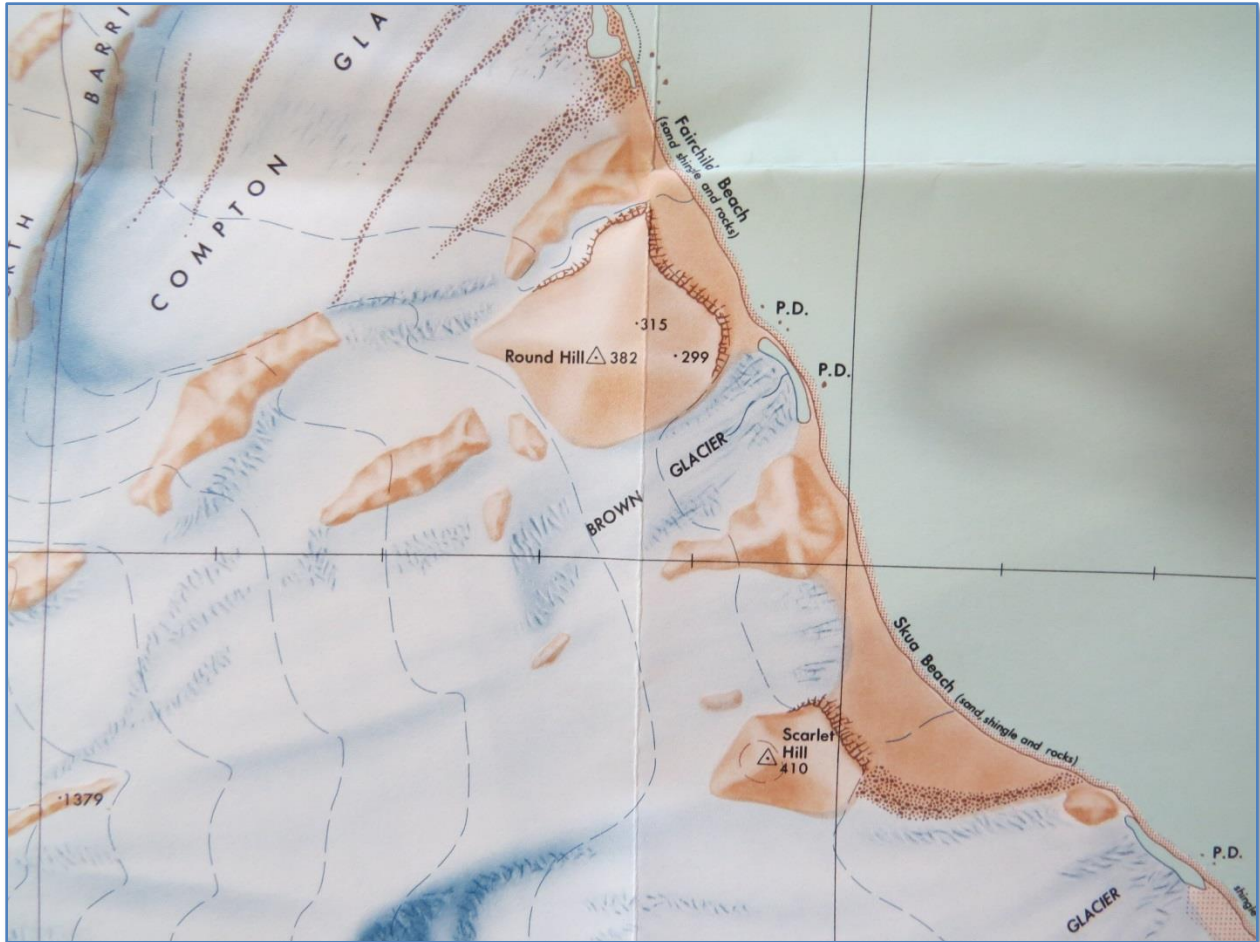
The glaciers of Heard Island



[Source: AAD]

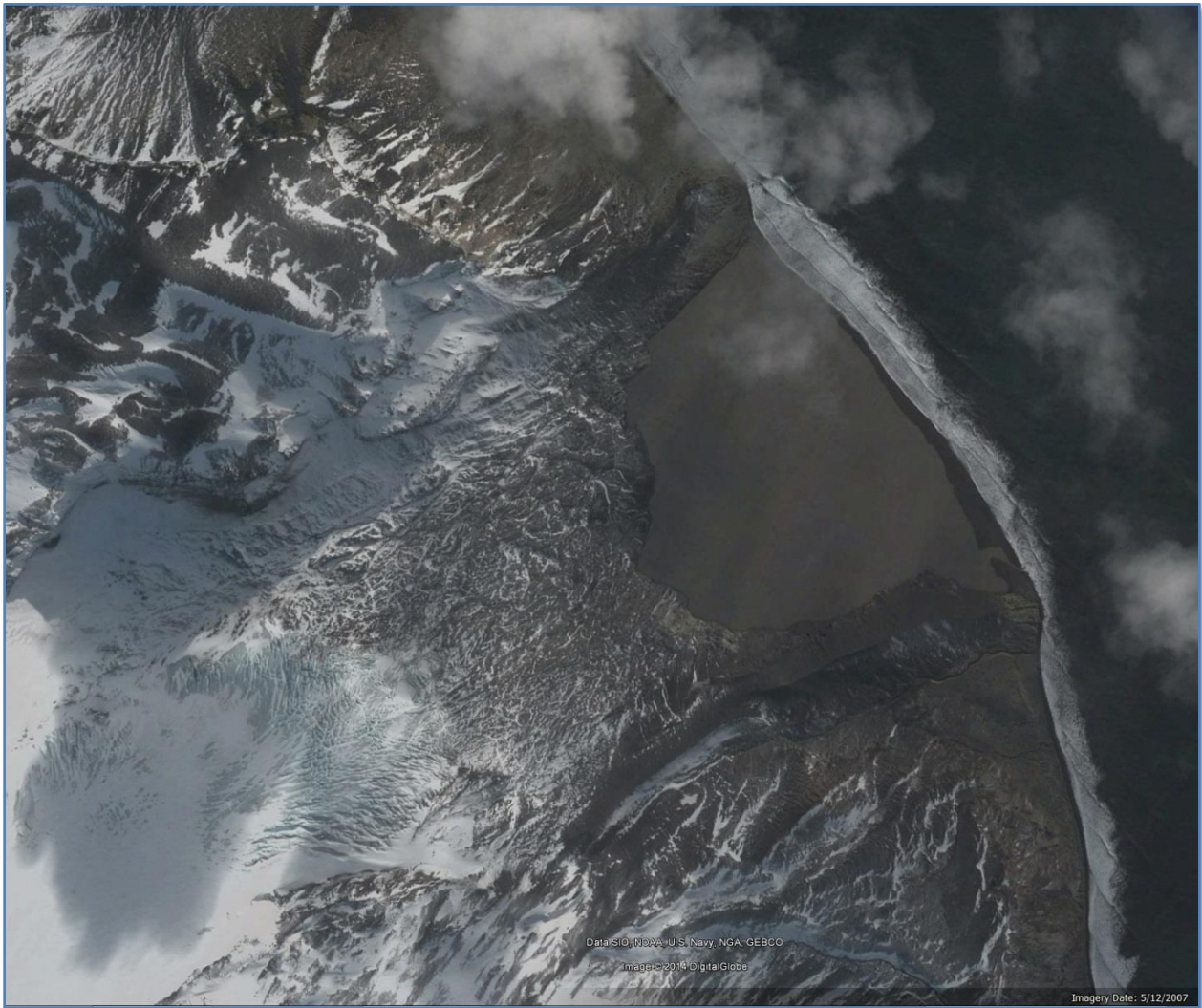
Brown Glacier

The following map shows Brown Glacier in 1953. This image is a fragment of a complete map of Heard Island.



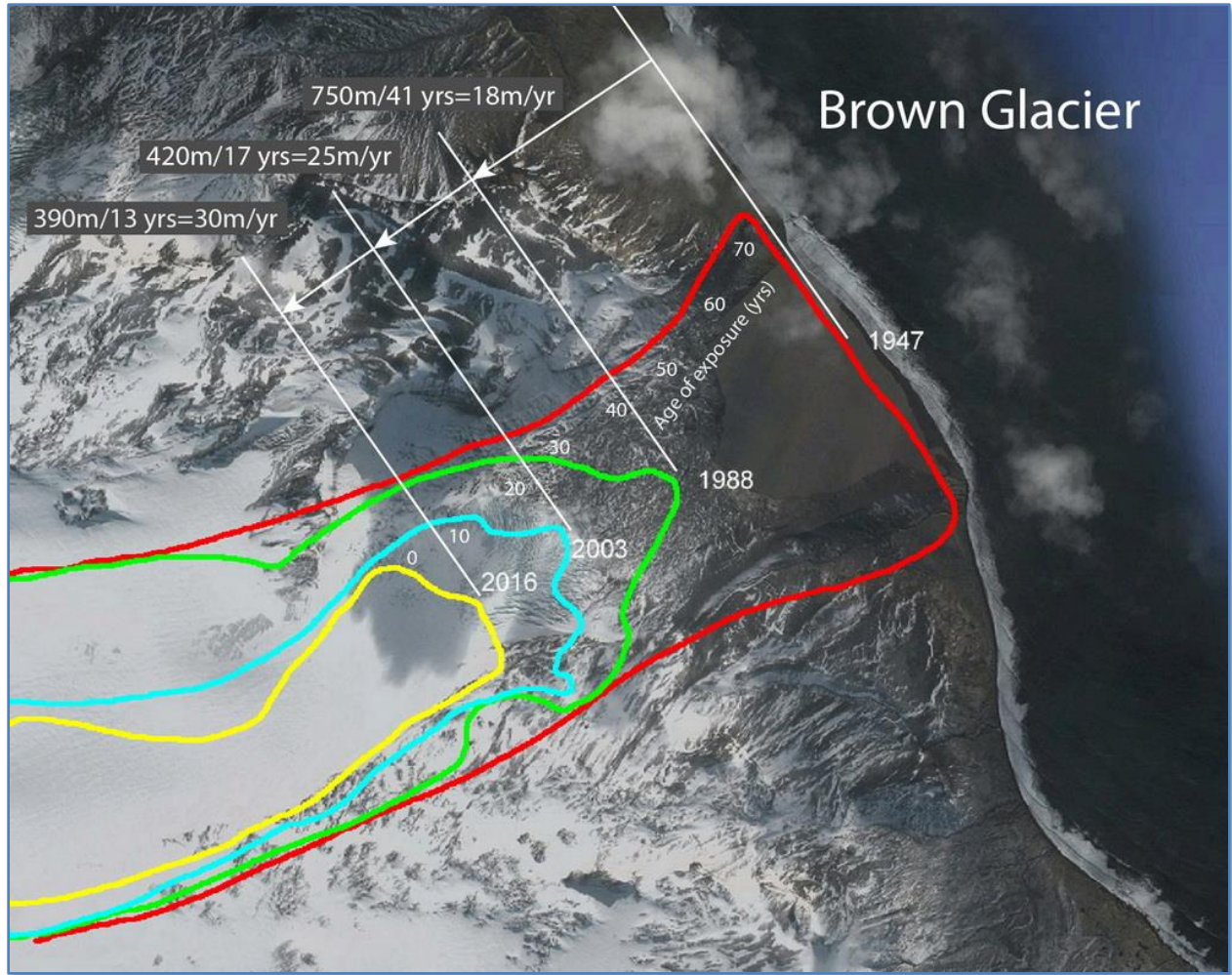
[Source: Grahame Budd]

A recent (2007) satellite view of Brown Glacier. Between 1947 and 2007, its terminus retreated from the coastline by about 1.2 km. By the time of the 2016 expedition, it will have retreated another 400m.



[Source: Google Earth]

Boundaries of the Brown Glacier since 1947. The extrapolation to 2016 was made by extrapolating the rate of retreat and then extrapolating the retreat itself.



[Source: AAD]

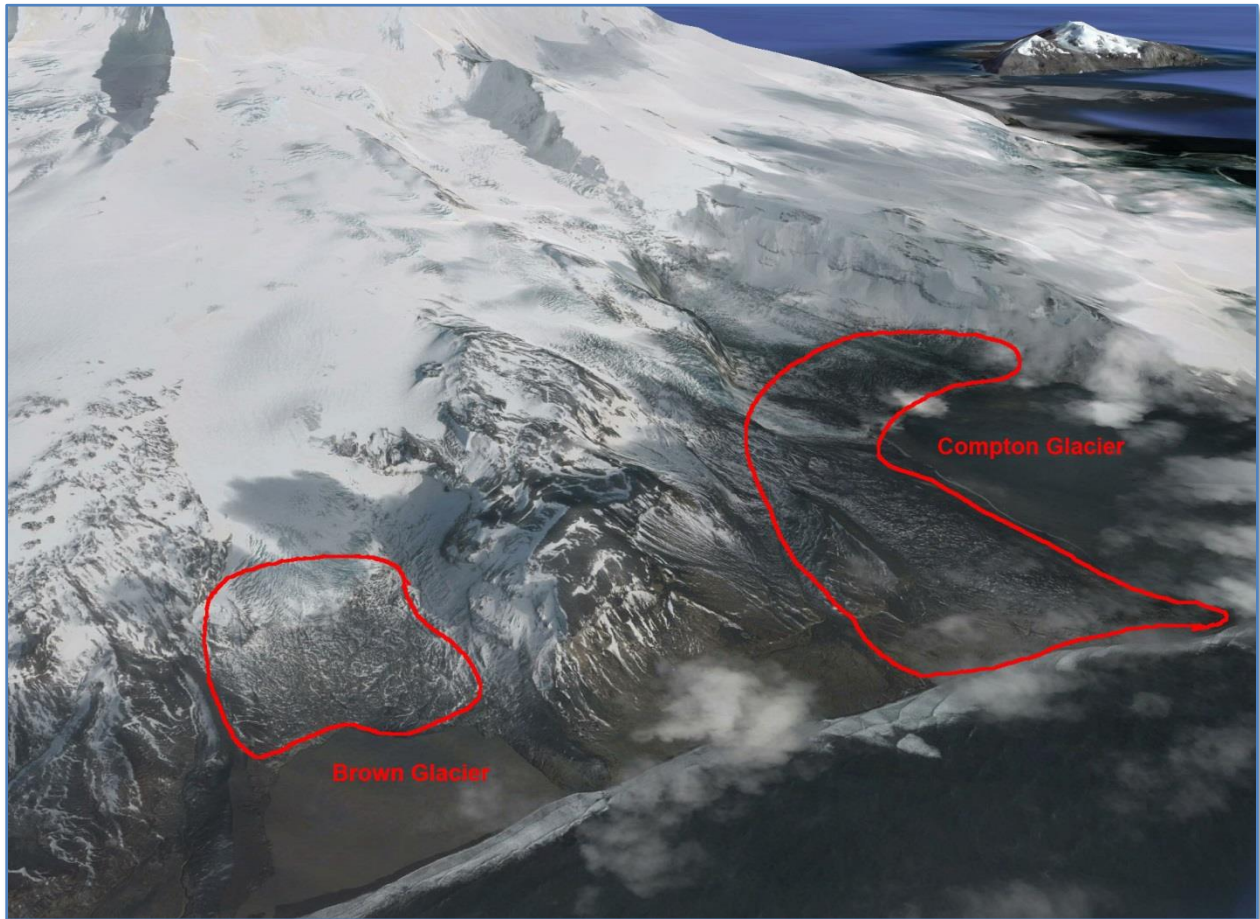
Vegetation near Brown Glacier, in 2003, shown in red. Small areas of vegetation are showing on the edges of the recently deglaciaded areas of Brown Glacier, making it virtually certain that colonization and/or relictualism are generating post-glacial populations.



[Source: AAD]

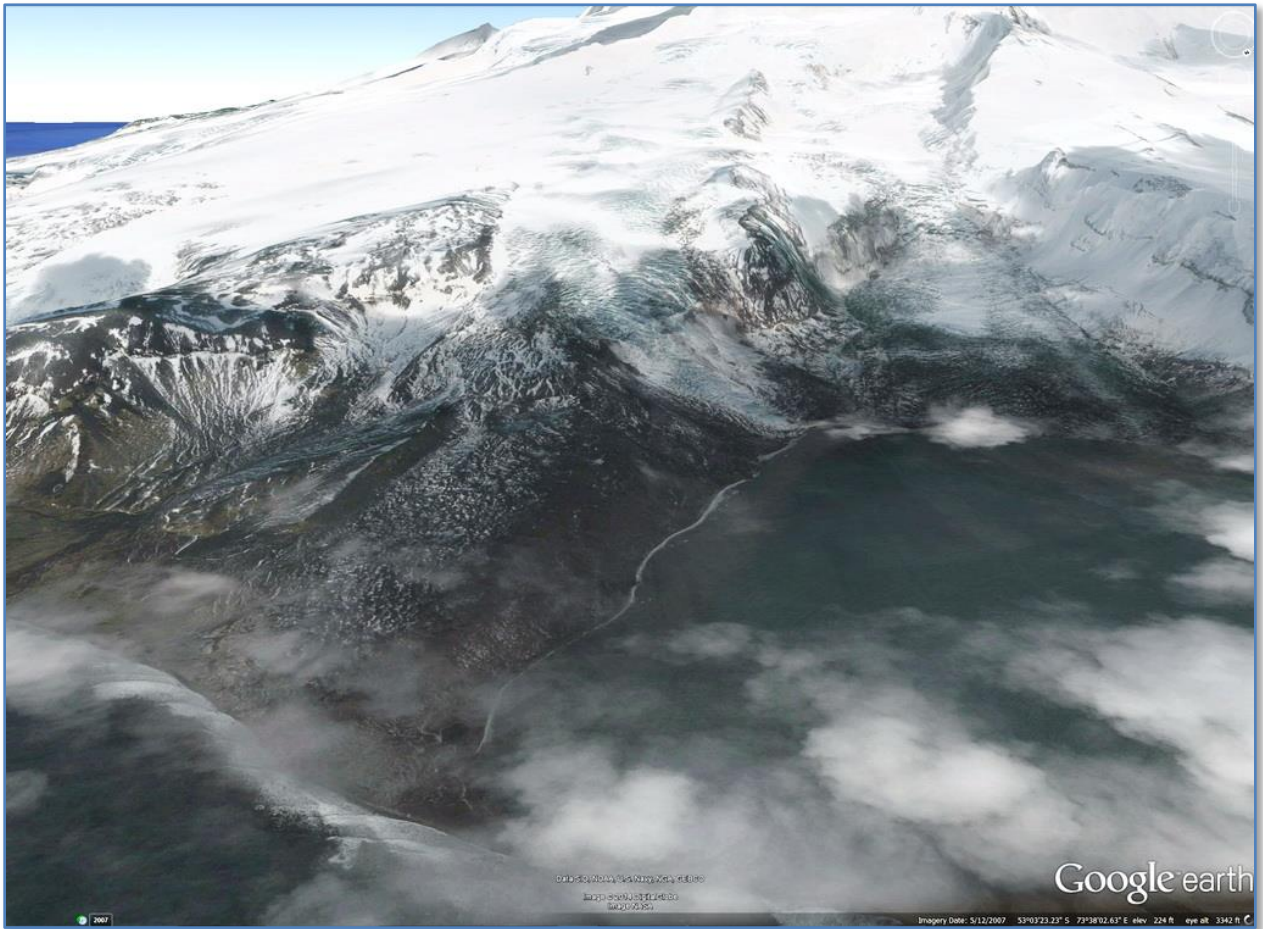
Compton Glacier

Compton Glacier lies just to the west of Brown Glacier. The following figure shows recently (<100 yrs) deglaciated areas of these glaciers. It is estimated that the areas comprise 160,000 m² on Brown Glacier and 650,000 m² on Compton Glacier.



[Source: Google Earth]

The eastern region of Compton Glacier, showing a large deglaciaded ridge. The area is estimated to be about 0.4 km².



[Source: Google Earth]

List of plant species on Heard Island

[Source: K. Green and E. Woehler, Eds., *Heard Island: Southern Ocean Sentinel*, Surrey Beatty & Sons, 2006. Pp. 257-258.]

Appendix 1

Marine macro-algae recorded from Heard Island. (From Ricker 1987).

CHLOROPHYTA — Green algae	Bonnemaisoniales
Chaetophorales	Bonnemaisoniaceae
Chaetophoraceae	<i>Delisea pulchra</i> (Greville) Montagne
<i>Endophyton atroviridis</i> O'Kelly sp. ined.	Nemaliales
Acrosiphoniales	Chaetangiaceae
Acrosiphoniaceae	<i>Chaetangium fastigiatum</i> (Bory de Saint-Vincent) J. Agardh
<i>Acrosiphonia pacifica</i> (Montagne) J. Agardh	Gigartinales
Codiolaceae	Gigartinaceae
<i>Urospora penicilliformis</i> (Roth) Areschoug	<i>Iridaea cordata</i> (Turner) Bory de Saint-Vincent
Cladophorales	Plocamiaceae
Cladophoraceae	<i>Plocamium hookeri</i> Harvey in Hooker f. and Harvey
<i>Rhizoclonium ambiguum</i> (Hooker f. and Harvey) Kützing	Palmariales
PHAEOPHYTA — Brown algae including giant kelps	Palmariaaceae
Desmarestiales	<i>Palmaria decipiens</i> (Reinsch) R. W. Ricker comb. nov.
Desmarestiaceae	<i>Palmaria georgica</i> (Reinsch) R. W. Ricker comb. nov.
<i>Desmarestia chordalis</i> Hooker f. and Harvey	Ceramiales
Durvillaeales	Ceramiaaceae
Durvillaeaceae	<i>Ballia callitricha</i> (C. Agardh) Kützing
<i>Durvillaea antarctica</i> (Chamisso) Hariot	<i>Plumariopsis eatoni</i> (Dickie) De Toni
RHODOPHYTA — Red algae	Delesseriaceae
Bangiales	<i>Schizoseris condensata</i> (Reinsch) R. W. Ricker comb. nov.
Bangiaceae	Rhodomelaceae
<i>Porphyra columbina</i> Montagne	<i>Bostrychia vaga</i> Hooker f. and Harvey
	<i>Lophurella hookeriana</i> (J. Agardh) Falkenberg

Appendix 2

Bryophytes recorded from Heard Island. (From Bergstrom and Seppelt 1988, Bergstrom and Selkirk 1997, Váña and Gremmen (in press), Bergstrom (unpubl. data). *indicates taxa that are currently undergoing taxonomic investigation that are likely to lead to nomenclature change in the near future (Ochyra, pers. comm. 2004).

MUSCI — MOSSES	Crimmiales
Andracales	Grimmiaceae
Andreaeaceae	* <i>Grimmia immersoleucophaea</i> (Müll. Hal.) Paris
* <i>Andreaea acuminata</i> Mitt.	* <i>Racomitrium crispulum</i> (Hook. f. and Wilson) Hook. f. and Wilson var. <i>crispulum</i>
<i>Andreaea mutabilis</i> Hook. f. and Wilson	<i>Grimmia</i> sp.
Fissidentales	<i>Racomitrium lanuginosum</i> (Hedw.) Brid.
Fissidentaceae	* <i>Schistidium apocarpum</i> (Hedw.) Bruch and Schimp.
<i>Fissidens</i> sp.	<i>Schistidium falcatum</i> (Hook. f. and Wilson) B. Bremer
Dicranales	Bryales
Ditrichaceae	Bryaceae
<i>Ceratodon purpureus</i> (Hedw.) Brid.	<i>Bryum dichotomum</i> Hedw.
<i>Ditrichum conicum</i> (Mont.) Mitt.	<i>Bryum pseudotriquetrum</i> (Hedw.) P. Gaertn., B. Mey. and Scherb.
<i>Ditrichum immersum</i> Zanten	<i>Bryum</i> sp.
<i>Ditrichum subaustrale</i> Broth.	<i>Pohlia wahlenbergii</i> (F. Weber and D. Mohr) A. L. Andrews
Dicranaceae	<i>Pohlia</i> sp.
<i>Dicranella campylophylla</i> (Taylor) A. Jacger	Bartramiaceae
<i>Dicranella</i> sp.	<i>Bartramia patens</i> Brid.
<i>Dicranoloma billardieri</i> (Brid. ex Hoppe) Paris	<i>Philonotis</i> cf. <i>angustifolia</i> Kaal.
* <i>Dicranoweisia antarctica</i> (Müll. Hal.) Kindb.	Orthotrichales
* <i>Dicranoweisia brevipes</i> (Müll. Hal.) Cardot	Orthotrichaceae
* <i>Dicranoweisia breviseta</i> Cardot	<i>Muelleriella crassifolia</i> (Hook. f. and Wilson) Dusén var. <i>acuta</i> (Müll. Hal.) Vitt
Seligeriales	Hypnales
Seligeriaceae	Amblystegiaceae
* <i>Blindia coniecta</i> (Hook. f. and Wilson) Müll. Hal.	<i>Amblystegium serpens</i> (Hedw.) Schimp.
<i>Blindia robusta</i> Hampe	<i>Saniotia uncinata</i> (Hedw.) Loeske
* <i>Verrucidens microcarpus</i> (Mitt.) Zanten	Brachytheciaceae
* <i>Verrucidens tortifolius</i> (Hook. f. and Wilson) Reimers	<i>Brachythecium austroralebraeum</i> (Müll. Hal.) Kindb.
Pottiales	<i>Brachytheciistrum paradoxum</i> (Hook. f. and Wilson) Ignatov and Huttunen
Pottiaceae	
<i>Henediella heimii</i> (Hedw.) R. H. Zander	
<i>Syntrichia anderssonii</i> (Angstr.) R. H. Zander	
<i>Syntrichia geheebopsis</i> (Müll. Hal.)	
<i>Trichostomum</i> sp.	

Appendix 2 — continued

MUSCI — MOSSES — continued

- Polytrichales
 Polytrichaceae
Polytrichastrum alpinum (Hedw.) G. L. Sm.
Polytrichum piliferum Hedw.
 Polytrichaceae sp.
Notoligotrichum australe (Hook. f. and Wilson) G. L. Sm.

HEPATICAE — LIVERWARTS

- Jungermanniales
 Cephaloziaceae
Cephalozia badia (Gottsche) Steph.
 Cephaloziellaceae
Cephaloziella varians (Gottsche) Steph.
 Jungermanniaceae
Anastrophyllum auritum (Lehm.) Steph.
Cryptochila grandiflora (Lindenb. and Gottsche) Grolle
Jungermannia coniflora Schiffn.
Lophozia leucorhiza (Mitt.) R. M. Schust.
 Gymnomitriaceae
Herzogobryum atrocapillum (Hook. f. and Taylor) Grolle
Herzogobryum vermiculare (Schiffn.) Grolle

HEPATICAE — LIVERWORTS — Jungermanniales — continued

- Blepharidophyllaceae
Blepharidophyllum densifolium (Hook.) C. Massal.
 Geocalycaceae
Chiloscyphus coadunatus (Sw.) J. J. Engel and R. M. Schust.
Chiloscyphus gremmenii Váňa spec. nova
Clasmatocolea rigens (Hook. f. and Taylor) J. J. Engel
Pachyglossa fissa (Mitt.) Herzog and Grolle
Pachyglossa grolleana Váňa, spec. Nova
Pedinophyllopsis abdita (Sull.) R. M. Schust. and Inoue
 Metzgeriales
 Fossombroniaceae
Austrofossombronia australis (Mitt.) R. M. Schust.
 Marchantiales
 Aneuraceae
Riccardia georgiensis (Steph.) Gabriela G. Hässel subsp.
sympodea R. M. Schust.
Riccardia sp.
 Marchantiaceae
Marchantia berteroana Lehm. and Lindenb.

Appendix 3

Vascular plants recorded from Heard Island. From George *et al.* (1993) and Turner *et al.* (in press). *denotes recorded from McDonald Island.

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| <p>Asteraceae
 <i>Leptinella plumosa</i> Hook. f.
 Apiaceae
 *<i>Azorella selago</i> Hook. f.
 Brassicaceae
 *<i>Pringlea antiscorbutica</i> R. Br. ex Hook. f.
 Caryophyllaceae
 *<i>Colobanthus kerguelensis</i> Hook. f.
 Callitricaceae
 *<i>Callitriche antarctica</i> Engelm. ex Hegelm.
 Poaceae
 <i>Deschampsia antarctica</i> E. Desv. In J. E. Gay</p> | <p>Poaceae — continued
 <i>Poa annua</i> L.
 *<i>Poa cookii</i> Hook. f.
 <i>Poa kerguelensis</i> (Hook. f.) Steud.
 <i>Poa cookii</i> × <i>kerguelensis</i> hybrid
 Portulacaceae
 <i>Montia fontana</i> L.
 Ranunculaceae
 <i>Ranunculus crassipes</i> Hook. f.
 Rosaceae
 <i>Acaena magellanica</i> (Lam.) Vahl</p> |
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Appendix 4

Invertebrates recorded from Heard Island. The main source of these data is a list compiled by P. Greenslade. The mite list was compiled by D. J. Marshall, and the insects updated by S. L. Chown — adapted from Chown *et al.* (in press). ^ = introduced species.

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|--|--|
| <p>PROTISTA
 Rhizopoda
 <i>Arcella</i> sp.
 <i>Arcella vulgaris</i> Ehrenberg
 <i>Diffugia constricta</i> Ehrenberg
 <i>Diffugia globulosa</i> Dujardin
 <i>Diffugia piriformis</i> Perty
 <i>Euglypha seminulum</i> Ehrenberg
 <i>Nebella collaris</i> Ehrenberg
 Ciliata
 nr. <i>Paramecium</i> sp.
 ACOELOMATA
 Platyhelminthes
 GASTROTRICHA
 <i>Chaetomus</i> sp.</p> | <p>TARDIGRADA
 <i>Acutuncus antarcticus</i> Richters
 <i>Dactylobiotus</i> sp.
 <i>Echiniscus</i> sp.
 <i>Hypsibius dujardini</i> Doy
 <i>Hypsibius</i> sp. nov.
 <i>Macrobiotus oberhauseri</i> Doy (doubtful record, W. Miller, pers. comm.)
 "Minibiotus asteris"
 <i>Macrobiotus</i> sp.
 NEMATODA
 Mononchidae
 <i>Coomansia gerlachei</i> de Man
 Dorylaimidae
 <i>Mesodorylaimus</i> sp. nov.
 <i>Endorylaimus</i> sp. nov.</p> |
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The occurrence of plants on Heard Island:

[Source: Wikipedia, Heard Island and McDonald Islands]

One of the most rapidly changing physical settings in the subantarctic has been produced on Heard Island by a combination of rapid glacial recession and climate warming. The consequent increase in habitat available for plant colonisation, plus the coalescing of previously discrete ice-free areas, has led to marked changes in the vegetation of Heard Island in the last 20 years or so. Other species and vegetation communities found on subantarctic islands north of the Antarctic Convergence now absent from the Heard Island flora may colonise the island if climate change produces more favourable conditions.

Some plant species are spreading and modifying the structure and composition of communities, some of which are also increasing in distribution. It is likely that further changes will occur, and possibly at an accelerated rate. Changes in population numbers of seal and seabird species are also expected to affect the vegetation by changing nutrient availability and disturbance through trampling.

One plant species on Heard Island, *Poa annua*, a cosmopolitan grass native to Europe, was possibly introduced by humans, though is more likely to have arrived naturally, probably by [skuas](#) from the Kerguelen Islands where it is widespread. It was initially recorded in 1987 in two recently deglaciated areas of Heard Island not previously exposed to human visitation, while being absent from known sites of past human habitation. Since 1987 *Poa annua* populations have increased in density and abundance within the original areas and have expanded beyond them. Expeditioner boot traffic during the Australian Antarctic program expedition in 1987 may be at least partly responsible for the spread, but it is probably mainly due to dispersal by wind and the movement of seabirds and seals around the island.

The potential for introducing additional plant species (including invasive species not previously found on subantarctic islands) by both natural and human-induced means is high. This is due to the combination of low species diversity and climatic amelioration. During the 2003/04 summer a new plant species, *Cotula plumosa*, was recorded. Only one small specimen was found growing on a coastal river terrace that had experienced substantial development and expansion of vegetation over the past decade. The species has a circumantarctic distribution and occurs on many subantarctic islands.

Description of the Heard Island vegetation

J. J. Scott and D. M. Bergstrom, Vegetation of Heard Island and the McDonald Islands, in K. Green and E. Woehler, Eds., *Heard Island: Southern Ocean Sentinel*, Surrey Beatty & Sons, 2006. Pp. 69-90.