

STUDIES IN *Colobanthus quitensis* (Kunth) Bartl. AND
Deschampsia antarctica Desv.:
III. DISTRIBUTION, HABITATS AND PERFORMANCE IN THE
ANTARCTIC BOTANICAL ZONE

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ABSTRACT. A study of the distribution of *Colobanthus quitensis* and *Deschampsia antarctica* within the Antarctic botanical zone has shown that both species are found on the islands of the Scotia Ridge and on island and mainland sites along the west coast of the Antarctic Peninsula to Marguerite Bay. There are fewer localities for *C. quitensis* than *D. antarctica* and it is more restricted within a locality, being confined to drier situations at lower altitudes.

Habitat differences influence both the vegetative and reproductive performance of *D. antarctica*. Luxuriant sterile plants are found in moist situations or where there is nitrogenous enrichment of the substratum, whereas on drier or non-enriched sites plants are stunted but flower profusely. The nitrogenous status of the substratum does not appear to influence *C. quitensis* in the same way.

Viable seed can be set by both species throughout the region but probably not regularly, at least in *D. antarctica*. Failure is not correlated with latitude or altitude as both species can reproduce successfully at moderate altitudes at their most southerly station. *C. quitensis* is more frequently successful than *D. antarctica*, mature seed or seedlings having been produced at 93 per cent of localities from which information is available, against 41 per cent for the grass.

MUCH unpublished information on the distribution of *Colobanthus quitensis* (Kunth) Bartl. (= *C. crassifolius* (D'Urv.) Hook. f.) and *Deschampsia antarctica* Desv. within the Antarctic botanical zone has accumulated since Skottsberg (1954) provided the first maps showing the distribution of each species along the Scotia Ridge and the west coast of the Antarctic Peninsula. The more recent maps by Greene (1967) provided some additional localities but at that time an evaluation of unpublished records in the reports and files of the British Antarctic Survey had not been completed. Some aspects of the reproductive behaviour of both species throughout the area were given by Holtom and Greene (1967).

The present paper provides a collation of all available information on distribution, habitat and performance for each species within the Antarctic botanical zone. A separate account is presented for each geographical area but variations in the amount of data are reflected in the unevenness of treatment. Two areas, Signy Island and the Argentine Islands, are not included as they have been the subject of special study by A. D. Bailey, J. A. Edwards, R. W. M. Corner and others, and their results will be published as separate papers in the present series.

SOURCE OF RECORDS

Information on the distribution and habitats of *D. antarctica* and *C. quitensis* has been obtained from four main sources:

- i. *Published papers.*
- ii. *Herbarium specimens.* The references to herbaria follow those recommended by Lanjouw and Stafleu (1964), except that (BIRM*) has been used for specimens in the British Antarctic Survey herbarium, at present housed in the Department of Botany, University of Birmingham, and (VALP) for Department of Botany, University of Valparaiso.
- iii. *Biological registers and expedition reports.* Copies of most registers and reports which contain botanical information are filed in the British Antarctic Survey herbarium. The biological report of the British Graham Land Expedition (BGLE) is preserved in the Scott Polar Research Institute, Cambridge. Records of this type are referred to in the text as (biological register).
- iv. *Field records.* Most information from this source was specifically obtained for this study and the records bear the name of the observer followed by (personal communication) or (field record). These records were often supported by voucher specimens which were used to verify or supplement reproductive scorings made in the field.

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ASSESSMENT OF REPRODUCTIVE PERFORMANCE

Holtom and Greene (1967) have shown that Antarctic specimens exhibit considerable variation in reproductive performance both between sites and between seasons within a site. Inflorescence and flower maturity were assessed by the calculation of maturity indices, based on at least five scorings per specimen, using the maturation stages recognized by Holtom and Greene (1967). These stages are defined in Table I and illustrated in Fig. 1a and b.

TABLE I. FLOWER AND INFLORESCENCE MATURATION STAGES FOR *Colobanthus quitensis* AND *Deschampsia antarctica*

Stage	<i>Colobanthus quitensis</i>	<i>Deschampsia antarctica</i>
0	Flower buds not visible	Inflorescences not visible
1	Flower buds visible, sepals closed	Inflorescences visible, sheaths swelling but unopened
2	Sepals open, capsule closed and < 1/2 length of sepals	Sheaths open with tops of inflorescences visible
3	Sepals open, capsule closed and > 1/2 length of sepals	Inflorescences < 1/2 emerged
4	Capsules open	Inflorescences > 1/2 emerged, most branches erect to slightly spreading
5	—	Inflorescences > 1/2 emerged, most branches moderately to fully spreading

Based on Holtom and Greene (1967).

A further measure of reproductive performance was obtained by estimating the mean size of the largest seed produced in inflorescences or capsules, rather than the more usual mean seed size per specimen, as a preliminary examination had suggested that only a small proportion of seeds approached full size.

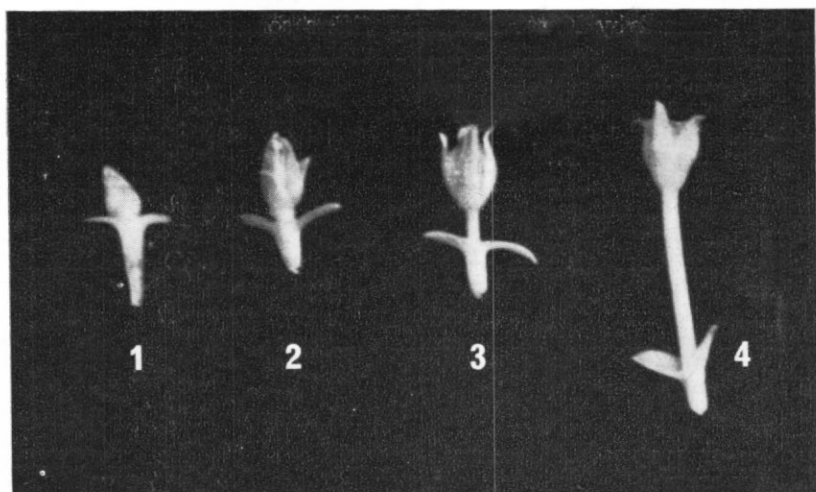
In *D. antarctica* seed size was measured as the length of the seed, excluding the style, after the palea and lemma had been removed. The two largest seeds were taken from, where possible, each of five inflorescences and seed measuring 1.5 mm. or over was considered to be full size. The length of the largest axis of the seed was measured for *C. quitensis* using where possible two seeds from each of five of the most mature capsules, 0.5 mm. or over being taken as full size. Although the most mature seed for both species had hard testae that swelled little on soaking, immature seed was often very shrivelled when dry and so was allowed to expand fully before measuring. Some seed remained shrivelled even after prolonged soaking and this was presumed to be inviable and was not measured.

Inflorescences, capsules and seeds were found to persist for more than one season but in practice those produced during the current season were easily distinguished from those formed the previous year, except in the case of material preserved in formalin. Maturity indices and seed-size measurements for different years were calculated separately. Field information on the abundance of inflorescences and capsules, the presence of seedlings and the results of any germination tests have been given.

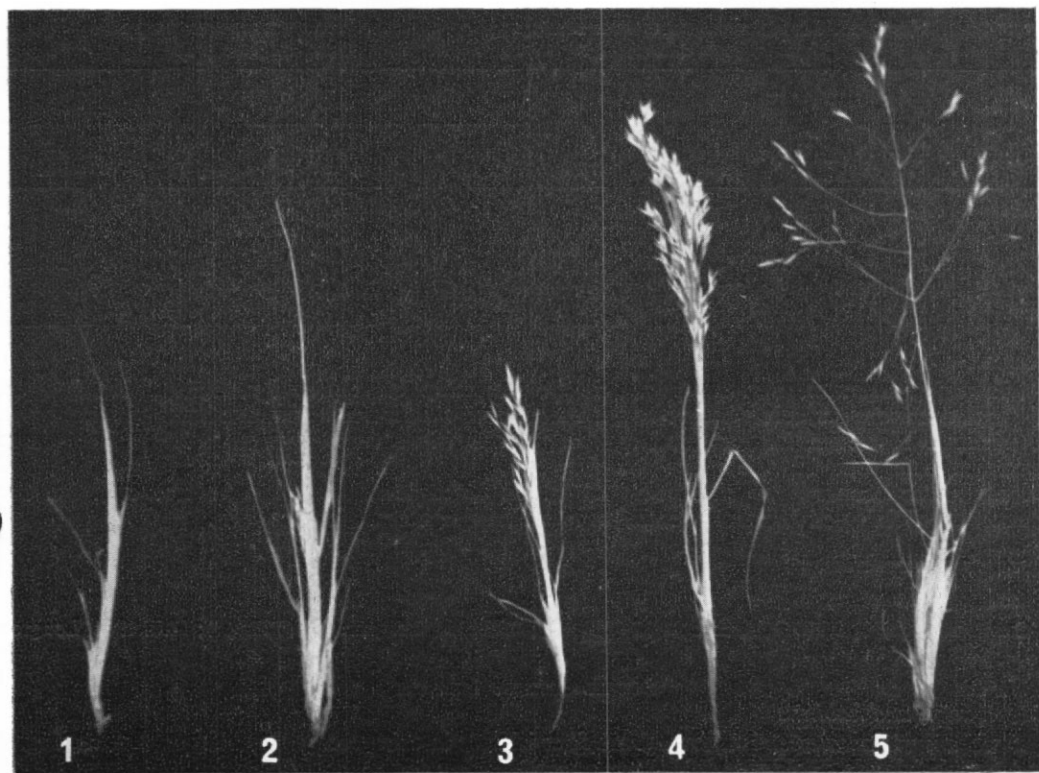
SOUTH SANDWICH ISLANDS

Distribution and habitats

D. antarctica is the only phanerogam known from this group of islands, where it appears to be confined to a single locality on Candlemas Island, north of the western lagoon. It was first seen in January 1961 by K. A. Archibald and later R. E. Longton found it to be well established. Although carefully searched for on all major islands of this group during the South Sandwich Islands survey of March 1964, no additional sites were found (personal communication from M. W. Holdgate).



a



b

Fig. 1. Reproductive stages in *Colobanthus quitensis* and *Deschampsia antarctica*.
a. 1-4. Flowers and capsules of *C. quitensis*.
b. 1-5. Inflorescences of *D. antarctica*.
(For definition of stages see Table I.)

The specimen collected by K. A. Archibald differs somewhat from those collected by R. E. Longton in having frequent stolons, a habit that elsewhere has only been noticed in a few South Georgian specimens in cultivation.

R. E. Longton (personal communication) has provided the following account of its distribution on Candlemas Island: "Single plants of *Deschampsia antarctica* were scattered throughout an area of volcanic ash approximately 0.8 km. \times 0.4 km., on flat ground and on gentle south-facing slopes at altitudes of between 30 and 60 m. Within this site two dense areas occurred near fumaroles, although the grass was not a constituent of the characteristic bryophyte vegetation surrounding many vents. Near the vent of the first fumarole, the tufts of *D. antarctica* were discrete ranging from 8 to 45 cm. in diameter, while further away individual tufts had coalesced to form a closed patch. The overall cover for the site did not exceed 50 per cent. At the second fumarole, *D. antarctica* gave only 25 per cent cover over an area 6 m. \times 4 m. where individual tufts seldom exceeded 25 cm. in diameter."

Reproductive performance

As can be seen from Table II, maturity information is only available for January and March from two different years. Both over-wintered and end-of-season seed was small, the latter being less than half size. Some over-wintered inflorescences were expanded but most new inflorescences were not. R. E. Longton (personal communication) noted that "Many tufts were fertile, bearing inflorescences half to fully exerted but not expanded" in March 1964. He observed no seedlings.

TABLE II. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM THE SOUTH SANDWICH ISLANDS

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Candlemas Island	Archibald 38	9.i.1961	5.0	0.9	1.0	—
	Longton 600	8.iii.1964	4.0	—	3.5	0.6
	Longton 601	14.iii.1964	4.5	—	3.6	0.7

Summary

Flowering plants are very restricted in their distribution on the South Sandwich Islands, *Colobanthus quitensis* being unknown with *Deschampsia antarctica* confined to one locality on one island. However, in that locality, the grass is widespread consisting of small to large scattered tufts but in one place forming a small sward. The aspect is south-facing and *D. antarctica* occurs between 30 and 60 m. on volcanic ash but it does not colonize the immediate vicinity of fumarole vents. Its reproductive success is uncertain.

Records and specimens

Deschampsia antarctica

Candlemas Island 9.i.1961, Archibald 38 (BIRM*); 8.iii.1964, Longton 600 (BIRM*); 14.iii.1964, Longton 601 (BIRM*, BM).

SOUTH ORKNEY ISLANDS

Distribution and habitats

Deschampsia antarctica is known from four islands in this group: Coronation, Lynch, Signy and Laurie Islands. Holdgate (1964) has mapped many of the localities for Signy Island, while A. D. Bailey, J. A. Edwards and others have so amplified and extended the early field work that their results will be given in a separate paper in the present series. This account is, therefore, confined to the records for the rest of the group.

Weddell's (1825) report of seeing the grass on Laurie Island when he landed at Cape Dundas on 22 January 1823 has long remained unconfirmed (Greene, 1967, 1970). Brown (1906) failed

to see it during his time on Laurie Island as a member of the Scottish National Antarctic Expedition, 1902-04, as did Falkland Islands Dependencies Survey personnel during the occupation of Cape Geddes from January 1946 to March 1947. G. de Q. Robin (biological register for Laurie Island) noted that on 23 February 1947 a particular search was made for the grass on Ferrier Peninsula without success. However, during the recent examination of a collection of bryophytes from Cape Geddes, a specimen of *Colobanthus quitensis* with inter-mixed stems of *D. antarctica* was located, so its presence on Laurie Island is confirmed.

R. M. Laws (biological register for Signy Island, 1948) reported *D. antarctica* from two localities on Coronation Island (Shingle Cove and west of Cape Hansen), but he particularly mentioned its occurrence on Lynch Island where it was so abundant that the island was provisionally named "Grass Island". The Shingle Cove locality was confirmed by W. J. L. Sladen (biological register for Signy Island), who stated that in 1950 there were several clumps of *D. antarctica* mixed with moss in a damp place. In 1965 and 1966, R. I. L. Smith (personal communication) noted it as "... locally abundant forming small swards".

The record for Cape Hansen has been confirmed by R. I. L. Smith (personal communication), who noted the species on the north-west side of the cape: "*Deschampsia* occurred on moist ledges and lower reaches of several gullies immediately opposite Lynch Island, to an altitude of, at least, 16 m.". R. I. L. Smith (personal communication) has also given information on three other localities on Coronation Island. At Meier Point, at the end of January 1966, he reported "Scattered colonies of *Deschampsia* occurred near melt pools and runnels, on dry gravelly ground and rock ledges with a northerly aspect. The tufts were generally small, rather yellowish, but fertile. The largest stand measured c. 5 m.², but the vegetation was quite open. A single plant was seen close to the cairn, at 30 m. within 25 m. of the permanent ice of Pomona Plateau. A single *Deschampsia* plant was observed on the scree slopes below Cragman Peaks, about midway between Cape Vik and Laws Glacier, at about 30 m.". In the middle of February 1965 he recorded from Mansfield Point "*Deschampsia* was locally abundant amongst bryophytes and lichens on the slope on the north side of the promontory, where the substratum was moistened by snow melt from above".

All collectors agree on the luxuriant growth on Lynch Island where M. J. Northover (personal communication) observed an area of *C. quitensis* and *D. antarctica* extending over 50 m. by 15 m. on a steep slope and terrace on the north side of the island. R. I. L. Smith (personal communication) has given the following description of this locality which he examined in January 1966: "Both flowering plants occurred in profusion on the north side of the island, with *Deschampsia* reaching close to the summit (35 m.). *Deschampsia* formed extensive closed stands, broken only by rock outcrops, particularly on the terrace behind the low coastal cliff and the north-facing slope behind this. Where the ground was relatively moist, the grass formed a luxuriant continuous sward, often devoid of associated species, although *Drepanocladus uncinatus* was frequently present. A soil approaching a brown earth type was developed below such stands to a depth of 20-30 cm. Where the substratum was drier and stonier, bryophytes and lichens became more abundant and associated *Deschampsia* plants were considerably smaller and more yellow.

"*Colobanthus* cushions were abundant amongst the grass on the drier and more gravelly ground, although the plants were generally small and seldom coalesced, but some cushions of up to 20 cm. across were seen."

C. quitensis was first collected on Lynch Island during February 1965 by N. Bacon and this occurrence, together with its recent discovery amongst a collection of mosses from Laurie Island, noted above under *D. antarctica*, provide the only two known records of the species in the South Orkney Islands apart from those from Signy Island, some of which were mentioned by Holdgate (1964).

It should be noted that the specimen in the British Museum (Nat. Hist.), cited by Skottsberg (1954) as Hooley 3029, is part of the Operation Tabarin collection and originated on South Georgia and not on the South Orkney Islands.

Reproductive performance

As can be seen from Table III, there is very little information on the reproductive performance of *Deschampsia antarctica* on Coronation Island. Some over-wintered inflorescences

were expanded in October but most seed was under full size, although the largest measured was 1.5 mm. At the end of January, new inflorescences and seed were very immature. R. I. L. Smith, who visited all five localities, reported abundant inflorescences at Shingle Cove, north-west Cape Hansen, Mansfield Point and Meier Point, but the single tuft between Cape Vik and Laws Glacier was sterile. No seedlings have been observed in the field.

TABLE III. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM THE SOUTH ORKNEY ISLANDS

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Coronation Island	Sladen H614/1	10.x.1950	5.0	1.2	—	—
	R. Smith 588	30.i.1966	4.5	—	1.4	0.2
Lynch Island	Sladen H615/1	10.x.1950	4.5	0.8	—	—
	Northover 2	i.1966	—	—	4.0	0.6
	Gimingham s.n.	24.i.1966	2.0	—	1.5	—
	Edwards s.n.	20.i.1968	—	—	2.0	—
	Longton 1192	7.ii.1965	—	—	2.7	0.7
	Lindsay 947a	16.iii.1966	—	—	3.9	1.0

The specimens of *D. antarctica* from Lynch Island show a reasonable progression of seed size from January to March but none of the seed was full size. The specimen collected by M. J. Northover has a slightly anomalous inflorescence scoring being much higher than either of the other January specimens, and the fact that this specimen and Gimingham's were collected in the same year suggests that there was a wide range of inflorescence stages at this locality. The only over-wintered seed was half size and it was smaller than Coronation Island seed collected on the same day. In view of these facts, it is interesting to note that, when C. H. Gimingham and R. I. L. Smith visited Lynch Island during January 1966, the latter (personal communication) reported that inflorescences of *D. antarctica* were abundant, their development being far in advance of those on Signy Island, and added: "Numerous seedlings were seen particularly in moist crevices near sea-level which would indicate that seed is set most years since grass plants were common from 1 year old upwards."

Table IV gives the maturity information available for *C. quitensis* and it can be seen that, although capsule maturity was low, not even over-wintered capsules being open, mature new seed was present by February and March but full-size seed was noted in an over-wintered capsule in January. R. I. L. Smith noted abundant capsules and numerous seedlings on Lynch Island. The specimen from Laurie Island collected in December had young flowers but no capsules persisting from the previous season.

Summary

Deschampsia antarctica occurs on Coronation Island as scattered colonies in north-facing sites on dry gravelly ground, becoming locally abundant in moister areas and even forming a small sward at one site. It grows from sea-level to 30 m. and is known to have produced abundant inflorescences in all sites, except one, at least during one season, but the extent of seed development is uncertain, although one mature seed has been recorded. The Lynch Island locality was more extensive than any on Coronation Island or Laurie Island and it was again north-facing, up to 35 m., with a continuous almost pure sward of the grass in the

TABLE IV. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Colobanthus quitensis* FROM THE SOUTH ORKNEY ISLANDS

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Lynch Island	Northover 1	i.1966	3.0	0.6	1.8	0.2
	Gimingham s.n.	24.i.1966	—	—	1.1	—
	Edwards s.n.	20.i.1968	—	—	1.2	0.1
	Longton 1191	7.ii.1963	—	—	2.6	0.7
	Lindsay 946a	16.iii.1966	—	—	2.0	0.5
Laurie Island	C42/1014/5a	22.xii.1946	—	—	1.0	<0.1

moister areas, but only scattered tufts in the drier areas. *C. quitensis* was confined to these drier areas where it was abundant, although the larger cushions very rarely coalesced. Both species were flowering profusely and producing abundant seedlings.

There is no information in the site descriptions which would indicate why *C. quitensis* should be absent from the drier areas on Coronation Island or why the performance of *D. antarctica* is so much better on Lynch Island. It should be noted, however, that a reasonable depth of soil has been reported from under the extensive stands of the grass on Lynch Island, a factor not mentioned for Coronation or Laurie Island.

Records and specimens

Deschampsia antarctica

Coronation Island *Shingle Cove*: 1948, Laws (biological register); 10.x.1950, Sladen H614/1 (BIRM*, BM); 8.iii.1965, R. Smith (field record); 15.x.1966, R. Smith (field record). *West of Cape Hansen*: 1948, Laws (biological register); 24.i.1966, R. Smith (field record). *Meier Point*: ii.1966, Northover (field record); 30.i.1966, R. Smith 588 (BIRM*). *Mansfield Point*: 10.ii.1965, R. Smith (field record). *Midway between Cape Vik and Laws Glacier*: 30.i.1966, R. Smith (field record).

Lynch Island 1948, Laws (biological register); 10.x.1950, Sladen H615/1 (BM); 7.ii.1965, Longton 1192 (BIRM*); i.1966, Northover 2 (field record); 24.i.1966, Gimingham s.n. (ABD); 24.i.1966, R. Smith (field record); 16.iii.1966, Lindsay 947a (BIRM*); 20.i.1968, Edwards s.n. (field record).

Laurie Island *Cape Dundas*: 22.i.1823, Weddell (1825, p. 24). *Cape Geddes*: 22.xii.1946, C42/1014/5b† (BM).

Colobanthus quitensis

Lynch Island 7.ii.1965, Longton 1191 (BIRM*); i.1966, Northover 1 (field record); 24.i.1966, Gimingham s.n. (ABD); 24.i.1966, R. Smith (field record); 16.iii.1966, Lindsay 946a (BIRM*); 20.i.1968, Edwards s.n. (field record).

Laurie Island *Cape Geddes*: 22.xii.1946, C42/1014/5a (BM).

SOUTH SHETLAND ISLANDS

Distribution and habitats of D. antarctica

The presence of a grass in these islands was first noted by Weddell (1825), although the earliest extant specimen was not collected until some years later by Eights (1833) from an unspecified locality during the 1829–30 season. *D. antarctica* was not observed again until 1909 (Gain, 1910) but it is now known from seven of the islands. Lindsay (1971) has given an account of *D. antarctica* in the South Shetland Islands and provided a map for his localities.

Very little information is available for Penguin Island, where Lindsay (1971) observed very small scattered tufts of *D. antarctica* growing on loose dry gravel of old lava flows.

The best documented area in the South Shetland Islands is Admiralty Bay, King George Island, where the grass has been seen at regular intervals since it was first noted by Gain (1910). On Keller Peninsula and at the Visca Anchorage sites, *D. antarctica* appears to be widespread

† Amongst a specimen of *Colobanthus quitensis* (C42/1014/5a).

and has been variously described as "scanty" to "quite frequent", although one record gave it as "... forming thick vegetation cover". The grass grew in cracks of rocks, among scree slopes and on ridges, and was sometimes mixed with mosses and lichens, ranging from sea-level to 30 m. with its highest station at 200 m. at Visca Anchorage. D. C. Lindsay (personal communication) recorded it as widespread with an average of 8 tufts/m.² on west-facing raised beaches and maritime outcrops at Point Hennequin but he noted only a few tufts on the south-facing slope of an outcrop above the beach at Ullmann Spur. Discrete tufts were abundant on north- and north-west-facing loose rocks on the beach at Crépin Point but they decreased in frequency towards the southern end. At Sphinx Hill, *D. antarctica* was spread along 0.8 km. of coast on north-east- and east-facing sandy slopes, giving an average density of 25 small tufts/m.². The most luxuriant growth was achieved at Point Thomas on the western fringe of an Adélie penguin rookery, where Lindsay (1971) described *D. antarctica* as being the most prominent plant over nearly all the snow-free soil, occurring along 1.5 km. of coastline to within 5 m. above high-tide level on a substrate of beach pebbles with little humus. Tussocks were found growing within the rookery up to 15 cm. tall and 30 cm. in diameter with about 20 cm. of peat accumulation, occasionally forming mats 6 m. by 4 m. with ornithocoprophilous lichens such as *Caloplaca regalis*, *Mastodia tessellata* and *Xanthoria elegans* growing on adjacent boulders. To the west of the rookery "*Deschampsia* achieved almost complete cover over c. 10,000 m.², only broken by boulders. On a sheltered north-facing slope at the edge of the penguin rookery, individual tussocks attained diameters of 50 cm., with c. 60 cm. of grass litter accumulation beneath" (personal communication from D. C. Lindsay). Elsewhere on King George Island, D. C. Lindsay (personal communication) saw scattered tufts of *D. antarctica* at Turret Point on a south-west-facing, dry sandy slope with *Polytrichum* turves at 30 m. adjacent to a penguin rookery, and at Lions Rump, where it was fairly common and formed swards 20 m.² on north-facing slopes at the edge of a penguin rookery at 50 m. Near Martins Head, the grass has been seen on slopes of volcanic tuff from sea-level to 30 m. and one specimen collected during the Discovery Investigations at 30 m. was part of "... a large divot cut from a patch of close turf, at least 50 square yards [42 m.²] in area, soil underneath at least 8-10 inches [20-25 cm.] deep." At Stranger Point, D. C. Lindsay (personal communication) observed an extensive area of *D. antarctica* "... in the drier parts of *Drepanocladus uncinatus* carpets on south-west- and south-east-facing raised beaches stretching 1.6 km. on either side of the point. The tufts were not coalescing but were denser on the western beach." A. E. Hunziker and D. C. Lindsay both noted the grass as common at Potter Cove where it grew on loose soil near the coast, as well as on a rocky promontory in dense and very extensive swards in the drier parts of moist areas. On the south shore of Barton Peninsula, D. C. Lindsay observed numerous small tufts of *D. antarctica* amongst dry *Drepanocladus* mats in sheltered hollows. B. S. John and D. E. Sugden (personal communication) noted that the grass was quite abundant on a north-facing, sloping bedrock surface from 0 to 10 m. in a bay immediately east of Flat Top Peninsula.

Above Coppermine Cove, Robert Island, D. C. Lindsay (personal communication) found *D. antarctica* uncommon but tufts up to 8 cm. in diameter grew at the edge of *Drepanocladus uncinatus* mats on the north-facing slopes of The Triplets. R. I. L. Smith (personal communication) observed "A small number of *Deschampsia* plants on the north-facing slope between Coppermine Cove and the Fort William promontory. The tufts were up to 20 cm. across and about 5-7 cm. tall. The plants were growing with scattered bryophytes and lichens on the fine moist ashy soil amongst scattered boulders of tuff, at an altitude of c. 35 m."

On Half Moon Island, the grass appears to be common on the south and south-west sides where it is said to form sparse to dense mats amongst moss turf. There is no habitat information for the locality on Desolation Island.

The first record for Livingston Island was made in 1958, when R. J. Adie collected the grass on raised beaches east of Hannah Point on the south coast of the island, where it was abundant, varying from isolated tufts to small closed swards. Since then, Lindsay (1971) has reported it from nine additional localities most of which are on Byers Peninsula. At Barnard Point, and to the north of Charity Glacier, a few small tufts of *D. antarctica* were found on tops of moraines, but the grass was more abundant on their sides where it gave a density of 38 tufts/m.² (personal communication from D. C. Lindsay). At Johnsons Dock, D. C. Lindsay

noted the grass at the base of cliffs but along South Beaches he reported it as widespread in gullies and on raised beaches at altitudes of 8–100 m., the highest site being near Devils Point. The density varied from scattered individual tufts on the dry sandy raised beach crests to closed occasionally pure swards in moist areas where the commonest associates were species of *Brachythecium* and *Drepanocladus*. At the western end of Byers Peninsula, east of Astor Island, on a north-north-west-facing 10° slope, D. C. Lindsay noted a *Deschampsia antarctica* and *Colobanthus quitensis* turf, covering hundreds of square metres where *D. antarctica* gave a high-percentage cover. But east of Lair Point, on the north shore of the peninsula, "*D. antarctica* was uncommon forming small straggling tufts less than 10 cm. in diameter on scree slopes" (personal communication from D. C. Lindsay).

D. antarctica was not noted on Deception Island until 1945, when I. M. Lamb collected a single plant on a more or less level cinder plain around the saucer-shaped "Ronald" crater, near Whalers Bay, c. 15 m. above sea-level. Despite repeated searching at this locality and elsewhere, it remained the single record for the species until February 1967 when R. I. L. Smith found the grass in a crater south-west of Ronald Hill. He described it as follows: "About a dozen very small, yellowish tufts of *Deschampsia*, no more than 8 cm. across, were seen on the dry, cindery horizontal floor of the shallow crater c. 15–20 m. to the west of a small pool, at an altitude of c. 12 m. It is interesting to note that this site was examined in the summer of 1964–65 and the grass was not observed." It is particularly unfortunate that this area was almost completely obliterated during the eruptions of 1967 (Collins, 1969).

No habitat details are available for the *D. antarctica* site on Snow Island.

Distribution and habitats of C. quitensis

The first collection of *Colobanthus quitensis*† from the South Shetland Islands was made by A. G. Bennett in 1925 at Admiralty Bay, King George Island, where the species appears to be not uncommon, occurring from 0 to 50 m. in small cushions often mixed with *D. antarctica* or amongst mosses. Elsewhere on King George Island it is known from Point Thomas, Ullmann Spur and Potter Cove. At Point Thomas, D. C. Lindsay observed it in a west-facing situation, while at Ullmann Spur he collected it from a sheltered area behind a rock outcrop. At Potter Cove, A. E. Hunziker, C. A. Howie and D. C. Lindsay all agree that the species grew on dry fine sand, while Hunziker described it as forming small cushions over a very limited area.

On Penguin Island, *C. quitensis* was collected from loose gravel in a north-east-facing situation at 10 m.

The specimens collected by D. C. Lindsay are the only known collections of *C. quitensis* from Livingston Island where it is known from four localities (Lindsay, 1971). At Johnsons Dock it occurred in crevices of a rock outcrop on a raised beach at 30 m., but north of Devils Point it was growing on an exposed north-facing slope at 20 m.; it occurred in a sheltered crevice at 30 m. south of Clark Nunatak but at the east end of South Beaches it was situated on a west-facing scree slope at 15 m. East of Astor Island it grew in turf with *Deschampsia* on a north-north-west-facing 10° slope. At Lair Point small cushions of *C. quitensis* occurred with *Polytrichum alpinum* on scree slopes from 0 to 30 m.

C. quitensis has been reported from a single site on Deception Island which was the only extensive area within the Antarctic botanical zone where it occurred without *D. antarctica* as an associate or being present in the immediate vicinity. This site consisted of black volcanic ash mixed with fragments of tuff on a moderately steep, north-facing sheltered slope of a gully below a tuff outcrop. R. E. Longton visited this site during 1964–65 and provided the following description: "*C. quitensis* was growing within a strip of ground measuring 30 m. × 3 m. below the base of the tuff outcrop. Cover over the strip as a whole was estimated at c. 30 per cent. It was most abundant on the upper side of the strip where cushions had coalesced to form continuous turves up to 1 m. in diameter. Towards the outer edge of the strip it was more sparsely distributed and isolated cushions occurred. A few scattered cushions extended beyond the main area for a distance of 30 m. but none was seen elsewhere on the island. A few of the

† Both *D. antarctica* and *C. quitensis* were seen on Elephant Island by J. S. Allison during 1970–71 (specimens in BIRM*).

larger cushions were whitish and apparently dead but much of the *Colobanthus* was strikingly green and healthy." It is unfortunate that this population was so badly damaged by ash resulting from the 1967 eruptions (Collins, 1969).

Reproductive performance

The reproductive performance of *D. antarctica* on the South Shetland Islands is summarized in Table V. On Penguin Island, inflorescences had very small seed at the end of season, although some over-wintered inflorescences were expanded with some full-size seed.

New inflorescences appear to form in December on King George Island, although they were absent in a few January specimens. The inflorescence maturity for January shows some variation but even by the end of March none of the inflorescences was expanded and the new seed was uniformly very small. In contrast, the results from the old inflorescences show that panicles were well expanded while some had full-size seed from December onwards, for example, the Discovery Investigations specimen St. 1481 which had the largest seed measuring 1.7 mm. On Half Moon Island, no new inflorescences were present in January and over-wintered inflorescences were unexpanded with very small seed. Specimens from Livingston Island were similar to those from King George Island in having new inflorescences developed by December, and very small seed at the end of January, but the average size of over-wintered seed was consistently higher from all sites than on King George Island, although the scorings for inflorescence maturity were similar. The February specimen from Deception Island was well advanced with exerted but not expanded inflorescences and larger seed than that scored from any other locality, although it will be noted that the specimen collected by J. Eights, which lacks precise locality information or date of collection, is the best developed example from the South Shetland Islands, having partially expanded new inflorescences with nearly full-size seed. R. I. L. Smith observed plants in the field with young inflorescences in sheaths on Deception Island in February 1967, and on Robert Island in January 1967.

The reproductive performance of *C. quitensis* in the South Shetland Islands, summarized in Table VI, shows that on King George Island flower production started in December but no open capsules were found by the end of season, although one January specimen with very young capsules had full-size seed. Practically all over-wintered capsules were open and most had full-size seed. Seedlings were present in a specimen from Potter Cove. It is unfortunate that there are only specimens for November and December from Livingston Island. One November specimen had young flowers and, although all the over-wintered seed was large, not every capsule was open. Seedlings were found in specimens from Byers Peninsula. Very young flowers were seen on Penguin Island in January 1966 but by February of the same year capsules with mature seed had developed and were as advanced as specimens collected in March 1960.

The specimens from Deception Island had full-size seed in February and March in rather young capsules; one March specimen also bore open over-wintered capsules with large seed. R. E. Longton (personal communication) has given the following account of the reproductive performance of *Colobanthus quitensis* on Deception Island: "On 9.xii.1964 battered open capsules persisting from the previous season were present in some tufts, but all the seeds had apparently been shed. The population flowered freely during the 1964-65 season. A large number of fertile buds and a few flowers were present in most tufts on 14 February. By 18 March capsules had formed but most were still green in colour and unopened. In a low proportion of capsules, however, the valves had recurved and elongation of the pedicels had begun. Even in the most advanced capsules, however, the seeds remained green or pale brown. A large number of seedlings was observed in and around the cushions of mature plants on 18 March." Longton's specimen contained many germinated seeds in the capsules and cushions, and R. I. L. Smith reported that in February 1967 the species was again flowering profusely with seedlings present.

Summary

On the South Shetland Islands, *D. antarctica* occurs commonly from sea-level up to 30 m. with the highest site at 200 m. at Visca Anchorage. It usually occupies north- to north-west-

TABLE V. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM THE SOUTH SHETLAND ISLANDS

Locality	Specimen number	Date	Old inflorescences		New inflorescences		
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)	
"New South Shetland Islands"	Eights s.n.	1829-30	—	—	4.4	1.2	
Penguin Island	Lindsay 801	27.i.1966	4.3	1.3	—	—	
	Leech s.n.	2.iii.1960	5.0	—	2.3	0.4	
King George Island	Bennett s.n.	13.xi.1925	4.8	0.8	—	—	
	Bennett s.n.	27.xi.1925	4.6	0.5	—	—	
	Disc. Invest. St. 1481	18.xii.1934	5.0	1.4	—	—	
	Taylor 271	24.xii.1960	4.6	1.4	1.0	—	
	Taylor 288a	24.xii.1960	—	—	1.8	0.3	
	Frödin s.n.	5.i.1953	4.0	—	—	—	
	Disc. Invest. St. 1950	7.i.1937	—	—	2.7*	0.3*	
	Howie 9	7.i.1965	—	—	1.0	0.2	
	Lindsay 694	14.i.1966	4.8	1.4	—	—	
	Hunziker 10150	20.i.1953	—	—	3.8	0.4	
	Disc. Invest. St. 1954	21.i.1937	4.3	1.0	—	—	
	Lindsay 798	26.i.1966	—	—	2.1	0.4	
	Lindsay 816	27.i.1966	4.4	—	1.0	—	
	Lindsay 825	28.i.1966	3.0	0.4	—	—	
	Lindsay 830	28.i.1966	5.0	1.5	1.0	0.3	
	Lindsay 863	31.i.1966	—	—	2.9	0.3	
	FIDS G36/12	1.iii.1947	5.0	—	3.6	0.5	
	Sladen JB232/1	23.iii.1949	—	—	4.0	0.4	
	Half Moon Island	Lindsay 590	5.i.1966	4.0	—	—	—
		Hunziker 10121	14.i.1953	3.8	0.6	—	—
Livingston Island	Lindsay 27	25.xi.1965	4.8	1.4	—	—	
	Lindsay s.n.	28.xi.1965	4.0	1.5	—	—	
	Lindsay 263	13.xii.1965	4.8	1.3	—	—	
	Lindsay 326	14.xii.1965	5.0	1.3	3.0	0.3	
	Lindsay 459	22.xii.1965	4.4	1.2	—	—	
	FIDS MISC. 1	29.xii.1958	Unscorable	1.4	1.0	—	
	Archibald 37	22.i.1961	—	—	1.6	0.3	
Snow Island	Mitchell s.n.	xi-xii.1956	4.0	0.6	—	—	
Deception Island	Lamb 2322	8.ii.1945	—	—	4.0	0.9	

* The inflorescences in this specimen were black due to preservation in formalin and so some doubt exists about their age.

TABLE VI. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Colobanthus quitensis* FROM THE SOUTH SHETLAND ISLANDS

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Penguin Island	Lindsay 800	27.i.1966	3.9	0.6	1.0	< 0.1
	Gressitt 6317	19.ii.1966	—	—	2.8	0.5
	Leech 9	2.iii.1960	—	—	3.2	0.5
	Starr s.n.	11.iii.1960	—	—	2.8	0.4
King George Island	Bennett s.n.	25.xi.1925	4.0	0.6	—	—
	Taylor 264	24.xii.1960	4.0	0.5	1.0	—
	Taylor 291a	24.xii.1960	4.0	0.6	1.0	—
	Howie 8	7.i.1965	—	—	1.0	< 0.1
	Lindsay 693	14.i.1966	4.0	0.7	1.0	< 0.1
	Disc. Invest. St. 1954	21.i.1937	—	—	2.0	0.5
	Lindsay 828	28.i.1966	4.0	0.6	1.3	0.1
	Lindsay 831	28.i.1966	3.7	0.6	1.7	0.2
	Lindsay 862	31.i.1966	4.0	0.6	2.1	0.2
	Sladen JB232/2	23.iii.1949	—	—	1.2	0.2
	Livingston Island	Lindsay 82	28.xi.1965	3.9	0.7	1.0
Lindsay 122		3.xii.1965	3.8	0.7	—	—
Lindsay 264		13.xii.1965	2.3	0.5	—	—
Lindsay 327		14.xii.1965	4.0	0.7	1.6	< 0.1
Lindsay 495		24.xii.1965	3.9	0.7	1.2	0.1
Deception Island	Longton 884	9.xii.1964	4.0	0.7	—	—
	Behn s.n. (or Concepcion 12494)	5.ii.1952	—	—	2.2	0.6
	Longton 1378	18.iii.1965	—	—	3.4	0.6
	Northover 10	28.iii.1966	3.0	0.5	2.0	—

facing situations but south- and south-west-facing sites are known on Livingston Island and west-facing ones on King George Island. The habitats vary from very dry on Penguin Island to relatively moist on King George and Livingston Islands, where the species occurs either in rock crevices or associated with mosses and *Colobanthus quitensis*. Many habitats support scattered tufts of the grass but relatively large areas with a high percentage cover are known from Keller Peninsula, Martins Head and Potter Cove with the most extensive area on King George Island occurring near Point Thomas. The most extensive area known on Livingston

Island is east of Astor Island. Even within these larger areas, the density varies from small swards to isolated tufts.

C. quitensis is normally associated with *D. antarctica*, but it has a smaller altitudinal range from sea-level to 50 m. with most records from below 30 m. The majority of the sites were north-facing but at Point Thomas it was west-facing, while a site on Keller Peninsula was south-east-facing. The species is not uncommon at many localities but the small size of the cushions is mentioned several times. However, the site on Deception Island was unique within the Antarctic botanical zone both for its extent and for the lack of *D. antarctica* as an associated species.

In *D. antarctica*, full-size seed has been found only in over-wintered inflorescences. Some *C. quitensis* seed attains full size by the end of season though the capsules remain immature; however, over-wintered seed is consistently mature and seedlings have been observed from King George, Livingston and Deception Islands.

Records and specimens

Deschampsia antarctica

South Shetland Islands Weddell (1825, p. 133).

"New South Shetland Islands" 1829-30, Eight's s.n. (K, US).

Penguin Island 2.iii.1960, Leech s.n. (BIRM*, US); 27.i.1966, Lindsay 801 (BIRM*).

King George Island Turret Point: 27.i.1966, Lindsay 816 (BIRM*). Lions Rump: 26.i.1966, Lindsay 798 (BIRM*). Near Martins Head: 7.i.1937, Disc. Invest. St. 1950 (BM, 3 specimens). Admiralty Bay: 26.xii.1909, Gain (1910, p. 420); 13.xi.1925, Bennett s.n. (BM, 2 specimens); 27.xi.1925, Bennett s.n. (BM); 5.i.1953, Frödin s.n. (S). Point Hennequin: 29.i.1966, Lindsay (field record). Ullmann Spur: 28.i.1966, Lindsay 825 (BIRM*). Visca Anchorage: 18.xii.1934, Disc. Invest. St. 1481 (BM, 2 specimens). Keller Peninsula, east side: 1.iii.1947, FIDS G36/12 (BM); ii.1948, Sladen (biological register); 23.iii.1949, Sladen JB232/1 (BM); 24.xii.1960, Taylor 271 (BIRM*); 24.xii.1960, Taylor 288a (BIRM*). Keller Peninsula, west side: 21.i.1937, Disc. Invest. St. 1954 (BM); 28.i.1966, Lindsay 830 (BIRM*). Crépin Point: 29.i.1966, Lindsay (field record). Point Thomas: 14.i.1966, Lindsay 694 (BIRM*); Sphinx Hill: 29.i.1966, Lindsay (field record). Cove west of Admiralty Bay: 30.xii.1909, Gain (1910, p. 420). Stranger Point: 29.i.1966, Lindsay (field record). Potter Cove: 20.i.1953, Hunziker 10147 (CORD); 20.i.1953, Hunziker 10150 (BIRM*, CORD); 20.i.1953, Hunziker 10152 (CORD); 20.i.1953, Hunziker 10153 (CORD); 7.i.1965, Howie 9 (BIRM*); i.1966, Aguayo-Torres s.n. (VALP); 31.i.1966, Lindsay 863 (BIRM*). Barton Peninsula: 28.xi.1965, Lindsay (field record). Flat Top Peninsula: 1.ii.1966, John and Sugden 17 (BIRM*). Bay to east of Flat Top Peninsula: 1.ii.1966, John and Sugden 20 (BIRM*).

Robert Island Coppermine Cove: 16.i.1966, Lindsay (field record). Between Coppermine Cove and Fort William promontory: 7.i.1967, R. Smith (field record).

Half Moon Island 14.i.1953, Hunziker 10121 (BIRM*, CORD); 10.ii.1953, Hunziker 10205 (CORD); 11.ii.1953, Hunziker 10112 (CORD); 5.i.1966, Lindsay 590 (BIRM*).

Desolation Island† iii.1952, Reyes s.n. [or Herb. Gunckel 21978] (Herb. H. Gunckel).

Livingston Island East of Hannah Point: 29.xii.1958, FIDS MISC.1 (BIRM*). South shore: 22.i.1961, Archibald 37 (BIRM*). Barnard Point: 25.xi.1965, Lindsay 27 (BIRM*). North of Charity Glacier: xii.1965, Lindsay (field record). Johnsons Dock: 28.xi.1965, Lindsay s.n. (BIRM*). Byers Peninsula: south side of Vietor Rock, 22.xii.1965, Lindsay 459 (BIRM*), 0.5 mile [0.8 km.] north of Devils Point, 13.xii.1965, Lindsay 263 (BIRM*), east of Astor Island, 14.xii.1965, Lindsay 326 (BIRM*), Lair Point 30.xii.1965, Lindsay (field record).

Snow Island xi-xii.1956, Mitchell s.n. (BM).

Deception Island Near Ronald Hill: 8.ii.1945, Lamb 2322 (BM); 10.ii.1967, R. Smith (field record).

Colobanthus quitensis

Penguin Island 11.iii.1960, Starr s.n. (NY); 2.iii.1960, Leech 9 (US); 27.i.1966, Lindsay 800 (BIRM*); 19.ii.1966, Gressitt 6317 (US).

King George Island Admiralty Bay: 25.xi.1925, Bennett s.n. (BM, 2 specimens). Ullmann Spur: 28.i.1966, Lindsay 828 (BIRM*). Keller Peninsula, east side: ii.1948, Sladen (biological register); 23.iii.1949, Sladen JB232/2 (BM); 24.xii.1960, Taylor 264 (BIRM*). Keller Peninsula, west side: 21.i.1937, Disc. Invest. St. 1954 (BM); 24.xii.1960, Taylor 291a (BIRM*); 28.i.1966, Lindsay 831 (BIRM*). Point Thomas: 14.i.1966, Lindsay 693 (BIRM*). Cove west of Admiralty Bay: 30.xii.1909, Gain (1910, p. 420). Potter Cove: 20.i.1953, Hunziker 10146 (CORD); 20.i.1958, Buchinger s.n. [or Darwinion 20068] (SI); 7.i.1965, Howie 8 (BIRM*); i.1966, Aguayo-Torres s.n. (VALP); 31.i.1966, Lindsay 862 (BIRM*).

Livingston Island South-east end of Johnsons Dock: 28.xi.1965, Lindsay 82 (BIRM*). Byers Peninsula: south of Clark Nunatak, 3.xii.1965, Lindsay 122 (BIRM*), extreme east end of South Beaches, 24.xii.1965, Lindsay 495 (BIRM*), 0.5 mile [0.8 km.] north of Devils Point, 13.xii.1965, Lindsay 264 (BIRM*), east of Astor Island, 14.xii.1965, Lindsay 327 (BIRM*), Lair Point, 30.xii.1965, Lindsay (field record).

† As "Isla Desolación, Antártida".

Deception Island 5.ii.1952, Behn s.n. [or Concepcion 12491] (S); 5.ii.1952, Behn s.n. [or Concepcion 12494] (CONC. S). *Between South East Point and Baily Head*: iii.1964, Howie (field record), 9.xii.1964, Longton 884 (BIRM*); 10.xii.1964, R. Smith (field record); 14.ii.1965, Longton (field record); 18.iii.1965, Longton 1378 (BIRM*); 28.iii.1966, Northover 10 (BIRM*); 10.ii.1967, R. Smith (field record).

ANTARCTIC PENINSULA (OFFSHORE ISLANDS)

Distribution and habitats of D. antarctica

Deschampsia antarctica was first seen in this area in 1902 on the Moss Islands by Skottsberg (1954), who found "Scattered tufts in a closed moss carpet with a northerly exposure". The grass was observed in the Melchior Islands by P. A. Siple who collected it in 1941 on Omega Island, but it has since been reported from Beta, Kappa and Gamma Islands where it occurred in cracks in rocks on both Beta and Kappa Islands, being abundant on the latter island (personal communication from A. R. Leal). From A. E. Hunziker's records, *D. antarctica* was rare on the south-west coast of Omega Island with isolated tufts in rock crevices and small depressions on high steep slopes where the organic remains of gulls and some soil had accumulated. It was not very frequent in rock crevices on the north-east coast but present on the north coast of the island.

Turquet (1906) discovered *D. antarctica* on Anvers Island in February 1905 and described it as forming little meadows, between boulders, with *Colobanthus quitensis* and mosses. There is one report of the species from Bonaparte Point and from a promontory north of the point but the majority of recent records are from the Norsel Point area, where it was abundant, forming isolated tufts on flat stony ground, often rooted in mosses. At one site the tufts coalesced to form a sward c. 0.5 m.².

Of the small islands in Arthur Harbour, *D. antarctica* was recorded on Litchfield and Humble Islands by R. W. M. Corner in 1964, on Laggard Island by R. E. Longton in 1965 and on Hermit Island by R. I. L. Smith in 1967 who also reported it as absent from the Outcast Islands. R. W. M. Corner (personal communication) observed only a few tufts of *D. antarctica* at the north-western end of Humble Island but found it common along the north and north-western coasts of Litchfield Island, although local farther inland on ledges with deposits of mineral material. On Laggard Island, R. E. Longton (personal communication) reported: "On the plateau the grass normally grew in cracks in flat or gently sloping rock in exposed sunny situations, often rooted among mosses, particularly *Polytrichum alpinum*, *Pohlia nutans* and *Drepanocladus uncinatus*. The scattered tufts were normally up to 7 cm. in diameter, seldom giving more than 10 per cent cover. On the cliffs on the north coast, *D. antarctica* gave up to 70 per cent cover in areas several metres in diameter, forming a mixed turf with species of *Brachythecium* and *Tortula*. The substratum was normally a thin layer of mineral soil, often including limpet shells." R. I. L. Smith (personal communication) recorded *D. antarctica* as occurring "... on moist ledges and pockets of soil on the north and north-east coasts of Hermit Island, from 3-35 m., with small tufts of the grass extending to the summit of the island c. 60 m. *Deschampsia* was locally abundant, forming closed stands of up to 1 m.²."

In the absence of precise localities, full use cannot be made of some unpublished records, for example, the reports of *D. antarctica* from unspecified localities from varying heights up to 250 m., some 50 m. higher than at Visca Anchorage, King George Island (biological register, 1947, for Anvers Island).

On Wiencke Island, *D. antarctica* was observed at Lécuyer Point in 1944 by I. M. Lamb, who noted two tufts growing on scanty black detritus in a narrow crack in a rock in an exposed situation. He pointed out that the associated lichens were species usually occupying dry situations where snow cover is moderate during winter and melts early (biological register for Operation Tabarin). J. Smith collected the grass from a north-facing sea cliff on Bryde Island in 1958.

Turquet (1906) found five or six tufts of the grass in 1904 on Booth Island ("île Booth-Wandel" or "île Wandel") amongst a group of rocks forming the northern slope of a small hill. Gain (1910) reported the species from Petermann Island where it had been discovered on the north-west coast in January 1909. It was again observed on the north coast in 1964 and 1965 by R. W. M. Corner, who described it as being "locally common on the moist flushed

ledges of the high northern cliff and on coastal rocks at the northern end, ascending to 90 m. No plants were seen on the eastern side of the island by the refuge hut."

W. J. L. Sladen (biological register for R.R.S. *John Biscoe*) described the site on the Yalour Islands as a sheltered place with a good layer of moss tundra where *D. antarctica* was growing well. Gain (1910) reported finding *D. antarctica* in January 1909 on one of the Berthelot Islands, and in March 1935 it was seen on Green Island by members of the British Graham Land Expedition (biological register). R. W. M. Corner (personal communication) has provided the following description from observations made in 1964-65 on the largest island of the group: "*Deschampsia* was locally common over north-facing slopes from 90-120 m. It was possible to divide the habitats into two main groups in relation to the high cliff which runs around the northern coast. Between the base of the cliff and the sea there was a rocky slope on which conditions were sheltered and moist from melt water which ran off the cliff above. The top tiers and ledges of the cliff supported *Polytrichum alpestre* turves and communities of the *Andreaea-Usnea* association on exposed rock. *Deschampsia* colonized the cracks and niches in the rocks, and mineral soil between *Polytrichum* turves. At the base of the cliff the grass grew on down-washed mineral material. Plants on top of the cliff were typical of the form found on dry exposed areas, being small and withered in appearance. The plants growing at the base of the cliff were larger, greener and much more vigorous in appearance." When B. J. Taylor visited Somerville Island in March 1960 most of the island was covered by snow and ice and only a few rock outcrops were bare. He noted the grass up to 25 m. mixed in a thick moss carpet which grew in well-watered gullies on the rocky slopes down to the sea. R. W. M. Corner found one tuft of *D. antarctica* on a small islet off the north coast of Darboux Island growing on top of a rocky knoll with a deposit of limpet shells at an altitude of 5 m.

As noted earlier, a detailed account of the distribution of *D. antarctica* and *C. quitensis* in the Argentine Islands will be provided in a separate paper by R. W. M. Corner.

Distribution and habitats of C. quitensis

Colobanthus quitensis is known from Lambda, Kappa, Gamma and Omega Islands but very little information is available about its frequency or habitats. A. E. Hunziker has noted that it was rare on Omega Island, where it occurred in rock fissures and depressions on high steep slopes where a certain amount of soil had accumulated. In passing, it may be noted that a specimen of *C. quitensis* labelled "Anchorage Island, Melchior Archipelago" (Siple 340 in IML) has been excluded from the discussion as it is uncertain whether it originated in the Melchior Islands, or on Anchorage Island in Marguerite Bay.

At Biscoe Bay, Anvers Island, the species was first seen in February 1905 by Turquet (1906) and in 1964 R. W. M. Corner observed a "... large number of cushions at Norsel Point and c. 50 cushions on the extreme end of Bonaparte Point, with c. ten cushions from a small unnamed promontory north-west of the former Falkland Islands Dependencies Survey station. In these localities *Deschampsia* was associated with *Colobanthus*".

From Litchfield Island, R. W. M. Corner (personal communication) described two localities: "The larger colony occupied a relatively flat area of coastal rock well colonized by bryophytes and *Deschampsia*. It measured 9 m. x 2 m. and the largest cushion was 12-15 cm. across. The other colony consisted of about six cushions scattered over a steep rocky area where flushing occurred."

"*C. quitensis* was seen in scattered localities along the north coast of Laggard Island, though not on the peninsula to the north-east and it also occurred on the southern shore of a creek on the west coast. The species was largely confined to north-facing cliff ledges and crevices in vertical rock. One typical colony comprised between 10 and 20 cushions each up to 12 cm. in diameter, growing in an area 1 m. in diameter. The plants often occurred on a thin layer of peaty soil formed by their own decaying remains, but were also seen growing among *D. antarctica* and mosses" (personal communication from R. E. Longton).

R. I. L. Smith (personal communication) reported *C. quitensis* as absent from the Outcast Islands but present on Hermit Island in the same localities as *D. antarctica* where "... although less frequent, it was generally associated with the grass and various bryophytes and lichens, particularly where the soil was of a more mineral or shelly nature."

C. quitensis was first noted on Petermann Island by Gain (1910). In 1965, R. W. M. Corner (personal communication) observed that "... a strip 3 m. \times 1 m. contained a large number of cushions together with *Deschampsia*, on a broad ledge c. 20 m. above sea-level on the north coast of the island. There was little exposed substratum on the ledge which was composed of mineral detritus." On the largest of the Berthelot Islands, R. W. M. Corner (personal communication) saw "... cushions covering an area 3 m. \times 2 m. at the base of the high northern cliff at an altitude of 40 m. A number of cushions were seen close to the sea but snow cover prevented an assessment of their distribution."

Reproductive performance

From Table VII it can be seen that seed in new inflorescences from Beta Island was very small in January and both old and new seed was small on Kappa Island, but on Omega

TABLE VII. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM THE ANTARCTIC PENINSULA (OFFSHORE ISLANDS)

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Beta Island	Leal 13207	10.i.1950	—	—	1.2	0.3 ^p
Kappa Island	Leal 13219	11.i.1950	3.6	1.0	1.0	< 0.1
Gamma Island	Leal 22892	1950	—	—	3.0	0.8
Omega Island	Hunziker 10196	6.ii.1953	—	—	4.2	—
	Hunziker 10200	6.ii.1953	—	—	4.0	0.4
	Siple 336	1.iii.1941	—	—	4.4	1.4
	Siple 341	1.iii.1941	—	—	4.5	1.4
	Siple 339	9.iii.1941	—	—	4.5	1.6
Anvers Island	FIDS MISC. 20	7.xii.1957	5.0	1.6	—	—
	Turquet s.n.	10.ii.1905	—	—	4.7	0.9
	Longton 1222	16.ii.1965	4.0	—	4.2	1.5
	ASE 7 (or FIDASE 37)	9.iii.1957	—	—	3.8	1.1
Litchfield Island	Corner 398	5.i.1964	4.4	1.5	—	—
Laggard Island	Longton 1290	3.iii.1965	—	—	4.2	1.6
	Longton 1291	3.iii.1965	—	—	4.9	1.6
Wiencke Island	Lamb 2147	30.xii.1944	5.0	1.2	—	—
Bryde Island	J. Smith M177	16.ii.1958	—	—	3.0	0.6
Petermann Island	Corner 733	6.xii.1964	3.5	—	—	—
	Corner 827	9.iii.1965	—	—	4.4	1.6
	Corner 839	9.iii.1965	3.0	—	—	—
Berthelot Islands	Corner 645	3.xi.1964	3.5	1.0	—	—
Somerville Island	Taylor 116	17.iii.1960	—	—	5.0	1.1

Island, although February seed was very small, in March 1941 full-size seed was present. There is a considerable difference in the maturity between the two February specimens from Anvers Island, one having mature seed and the other just over half size. Average size of the largest seeds from an end of season sample was under full size, although the largest measured 1.5 mm.; over-wintered seed was full size. R. E. Longton (personal communication) noted that at Norsel Point in February 1965: "Most of the abundant inflorescences were half to fully exerted from the sheaths, but only a few had expanded. Florets in the more advanced panicles contained swollen green seeds." Four out of the six seeds he tested germinated. In February 1967, R. I. L. Smith again recorded abundant inflorescences.

Over-wintered seed from Litchfield Island was full size, although the January specimen bore no new inflorescences. Mature seed was present by the beginning of March on Laggard Island where R. E. Longton (personal communication) noted: "The grass was abundantly fertile. On the plateau most inflorescences were between half and fully exerted from the sheaths but few of the panicles had expanded. Flowering was slightly more advanced on the north-facing cliff ledges where most inflorescences were fully exerted from the sheaths and many were fully expanded. The florets in the more advanced inflorescences contained apparently fully swollen seeds." Three out of the 20 seeds tested by Longton germinated. Abundant inflorescences were again produced in March 1967 (R. I. L. Smith, field record). There is no reproductive information for Humble Island but R. I. L. Smith recorded abundant inflorescences on Hermit Island in March 1967.

I. M. Lamb's specimen from Wiencke Island, collected at the end of December 1944, bore only old inflorescences which were expanded and contained some full-size seed. However, I. M. Lamb (biological register for Operation Tabarin) reported that "... young still green and closed flower spikes had emerged in fair numbers from the tufts." On 1 January he attempted to germinate four apparently ripe seeds from an over-wintered inflorescence, one of which was successful. The Bryde Island specimen had old inflorescences in February which were immature with small seed. Old inflorescences from Petermann Island were immature with no seed and one March specimen lacked new inflorescences while the other one had well-developed new inflorescences with full-size seed. The Somerville Island specimen was also collected in March and had its largest seed almost full size (1.4 mm.), although mean seed size was low.

Gain (1910) mentioned seeing *D. antarctica* in flower on the Berthelot Islands in January 1909, while R. W. M. Corner noted some fully expanded old inflorescences in early November 1964, although his specimen has only immature inflorescences and small seed. No scoring has been given for the Sladen specimen as he noted (biological register for R.R.S. *John Biscoe*): "Not quite in full flower so forced out before drying on the *John Biscoe*." Turquet (1906) reported *D. antarctica* flowering in November 1904 on Booth Island but the specimen collected by R. W. M. Corner from a small islet off the north coast of Darboux Island was sterile.

Full-size new seed was present in capsules of *C. quitensis* (Table VIII) by early March in specimens from Lambda, Omega, Laggard and Petermann Islands, but it was slightly under full size in material from Litchfield Island and very small in that from Anvers Island. But R. W. M. Corner (personal communication) noted seedlings on Petermann Island in March 1965. Over-wintered seed from Kappa, Anvers and Litchfield Islands was full size. R. I. L. Smith (personal communication) noted this species flowering profusely on Anvers Island in February 1967 and the presence of seedlings on Laggard and Hermit Islands in March 1967.

Summary

There is so little habitat information for either species on the Melchior Islands that it is difficult to assess their vegetative performance. *D. antarctica* appears to occur as isolated tufts in rock cracks and crevices, at times associated with individual cushions of *C. quitensis*. On Anvers Island and the small islands in Arthur Harbour, *D. antarctica* occurs from sea-level to 60 m. in dry to moist, sheltered or exposed, north-facing situations with its density varying from small, scattered individual tufts to small pure swards. *C. quitensis* is confined to sheltered dry sites at lower altitudes of 0-15 m. On the Berthelot Islands and Petermann Island the grass extends up to c. 140 m. and is widespread, occurring as isolated tufts in dry exposed areas but it is more abundant and more luxuriant in wetter areas. On Petermann Island a large

TABLE VIII. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Colobanthus quitensis* FROM THE ANTARCTIC PENINSULA (OFFSHORE ISLANDS)

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Lambda Island	Siple 343	2.iii.1941	—	—	4.0	0.7
Kappa Island	Leal 13218	11.i.1950	3.0	0.5	—	—
Gamma Island	Leal 22891	1950	—	—	2.4	0.4
Omega Island	Siple 337	1.iii.1941	—	—	3.5	0.6
	Siple 338	9.iii.1941	—	—	3.6	0.6
Anvers Island	Llano 3034	10.i.1966	4.0	—	1.3	< 0.1
	Corner 866	iii.1964	4.0	0.5	1.0	< 0.1
Litchfield Island	Corner 397	5.i.1964	3.6	0.5	—	—
	Corner 865	12.iii.1964	—	—	2.2	0.4
Laggard Island	Longton 1292	3.iii.1965	—	—	3.6	0.6
Petermann Island	Corner 826	9.iii.1965	—	—	3.8	0.6

number of cushions of *C. quitensis* are associated with *D. antarctica* but the species is confined to a dry situation at *c.* 20 m. *D. antarctica* does not seem to be abundant on Yalour or Somerville Islands and is rare on both Wiencke and Darboux Islands.

Abundant inflorescences have been reported from many of the *D. antarctica* localities but there are almost no records for young inflorescences at the beginning of season so it is impossible to say when inflorescence production begins. However, full-size seed is present by the end of season in many localities and germination tests have proved that some viable seed is set on Anvers, Laggard and Wiencke Islands.

The results for *Colobanthus quitensis* also indicate that in most localities full-size seed can be produced by the end of season and field observations of seedlings on Laggard, Hermit and Petermann Islands support this view. So far no germination tests have been successful with seed in the field.

Records and specimens

Deschampsia antarctica

Danco Coast *Moss Islands*: 1902, Skottsberg (1954, p. 332). *Beta Island*: 10.i.1950, Leal 13207 (Herb. R. Leal). *Kappa Island*: 11.i.1950, Leal 13219 (Herb. R. Leal). *Gamma Island*: 1950, Leal 22892 (Herb. R. Leal). *Omega Island*¹: 1.iii.1941, Siple 336 (BM, G², K, L³, S, US); 1.iii.1941, Siple 341 (US); 9.iii.1941, Siple 339 (US); 6.ii.1953, Hunziker 10190 (CORD); 6.ii.1953, Hunziker 10196 (CORD, K, S); 6.ii.1953, Hunziker 10200 (BIRM*, CORD). *Anvers Island*: *Biscoe Bay*, 10.ii.1905¹, Turquet s.n. (BM, K, L³, US, Z), *Arthur Harbour*, 9.iii.1957, ASE 7 [or FIDASE 37] (BM); 7.xii.1957, FIDS MISC. 20 (BIRM*), *Norsel Point*, 4.i.1964 and iii.1964, Corner (field record); 16.ii.1965, Longton 1222 (BIRM*); 6.i.1966, Llano 3036 (US); 12.ii.1967, R. Smith (field record), *Bonaparte Point*, iii.1964, Corner (field record), *promontory north of Bonaparte Point*, 12.ii.1967, R. Smith (field record), *Humble Island*: 4.i.1964, Corner (field record), *Litchfield Island*: 5.i.1964, Corner 398 (BIRM*). *Hermit Island*: 9.iii.1967, R. Smith (field record), *Laggard Island*: *south-west corner*, 3.iii.1965, Longton 1290 (BIRM*), *north coast*, 3.iii.1965, Longton 1291 (BIRM*), iii.1967, R. Smith (field record), *Wiencke Island*: *Lécuyer Point*, 30.xii.1944, Lamb 2147 (BM). *Un-named island between Anvers Island and Port Lockroy*: no date, Wynne-Edwards s.n. (BM). *Bryde Island*: 16.ii.1958, J. Smith M177 (BIRM*).

Graham Coast *Booth Island*²: xi.1904, Turquet (1906, p. 434). *Petermann Island*: 1, 4, 5 and 10.i.1909, Gain (1910, p. 406); ii.1909, Gain (1910, p. 407); iii.1909, Gain (1910, p. 408); 6.xii.1964, Corner 733 (BIRM*); 9.iii.1965, Corner 827 (BIRM*); 9.iii.1965, Corner 839 (BIRM*). *Yalour Islands*: 1.ii.1950, Sløden JE233/1 (BM). *Berthelot Islands*: i.1909, Gain (1910, p. 406), *Green Island*, 18.iii.1935, BGLE 1079

(biological register); 18.iii.1935, BGLE 1080 (biological register), *largest island*, 3.xi.1964, Corner 645 (BIRM*). *Somerville Island*: 17.iii.1960, Taylor 116 (BIRM*). *Darboux Island*, small islet off the north coast, 5.xi.1964, Corner 644 (BIRM*). *Biscoe Islands*: 19.iii.1952, Behn, s.n. [or Concepcion 12493] (S).

Colobanthus quitensis

Danco Coast *Lambda Island*: 2.iii.1941, Siple 343 (K). *Kappa Island*: 11.i.1950, Leal 13218 (Herb. R. Leal). *Gamma Island*: 1950, Leal 22891 (Herb. R. Leal). *Omega Island*¹: 1.iii.1941, Siple 337 (K, S, US); 9.iii.1941, Siple 338 (K, US); 6.ii.1953, Hunziker 10191 (CORD); 6.ii.1953, Hunziker 10201 (CORD). *Anvers Island*: *Biscoe Bay*, 10.ii.1905⁴, Turquet s.n. (Z⁶); 11.ii.1905⁴, Turquet (1906, p. 435, P²), *Norsel Point*, iii.1964, Corner 866 (BIRM*); 10.i.1966, Llano 3034 (US), *Bonaparte Point*, 1964, Corner (field record). *Litchfield Island*: 5.i.1964, Corner 397 (BIRM*); 12.iii.1964, Corner 865 (BIRM*). *Hermit Island*: 9.iii.1967, R. Smith (field record). *Laggard Island*: 3.iii.1965, Longton 1292 (BIRM*); iii.1967, R. Smith (field record).

Graham Coast *Petermann Island*: iii. 1909, Gain (1910, p. 408); 9.iii.1965, Corner 826 (BIRM*). *Berthelot Islands*: *largest island*, 3.xii.1964, Corner (field record).

ANTARCTIC PENINSULA (MAINLAND)

Distribution and habitats

The only known locality for *Deschampsia antarctica* on the Palmer Coast is at Almond Point, where the plant was seen by H. A. D. Cameron and P. Kennett in January 1962. They noted two small areas, one north-facing and the other west-facing, where various mosses and the grass formed quite thick swards. On the Danco Coast, *D. antarctica* was first found at Beneden Head by Racovitza in 1898 (Wildeman, 1905), at Spring Point by O. Kühnemann in 1954, and at "Almirante Brown" by M. Neushel in 1958. H. A. D. Cameron and P. Kennett (personal communication) noted for Spring Point that ". . . plants occurred tucked away in crannies and on ledges between 6 and 10 m. with swards of grass covering the ledges higher up to a height of 20 m. The area available for *Deschampsia antarctica* was restricted in altitude to between 6 and 30 m. by dense bird colonies below and steep cliffs above." Corte (1961) has also given a description of the area.

On the Graham Coast, *Deschampsia antarctica* was first reported by Gain (1910) from Rasmussen Island ["Cap Rasmussen"] and Cape Pérez ["Cap Trois-Pérez"]. Members of a Royal Navy Hydrographic Survey party found it at Cape Garcia in 1958 and R. W. M. Corner collected it at Edge Hill and Cape Tuxen in 1964. At Edge Hill, *D. antarctica* was frequent and locally common on dry or flushed rock ledges lacking *Polytrichum alpestre* turf from 5 to 175 m. At Rasmussen Island there were scattered tufts on mineral soil at 6 m. but at 70–100 m. the grass occurred occasionally between *Polytrichum alpestre* turves. At Cape Tuxen, *D. antarctica* occurred up to 200 m., although at this altitude the plants were small, withered looking and very local; at lower altitudes it was locally common on north- and west-facing slopes in dry and moist conditions. The colonies of *D. antarctica* at Cape Pérez were robust and occurred on moist flushed ledges at the base of north- and west-facing cliffs.

There is a single record of *Colobanthus quitensis* for the Palmer Coast at Almond Point, where it was collected by H. A. D. Cameron and P. Kennett in January 1962, when they observed two cushions on west-facing rock crevices and faces on a very small scree slope. On the Danco Coast, *C. quitensis* is only known from Spring Point where it was seen by Corte (1961) in rock crevices in January 1961 and by H. A. D. Cameron and P. Kennett in 1962. The specimen collected by Cameron and Kennett was growing intermingled with *D. antarctica* in crevices and on ledges of a west-facing rock face.

Gain (1910) reported *C. quitensis* from Rasmussen Island ["Cap Rasmussen"] and Cape Pérez ["Cap Trois-Pérez"] but the species has not been seen since at these localities. *C. quitensis* has never been reported from Edge Hill or Cape Tuxen and it is worth noting that R. W. M. Corner (personal communication) failed to find it at either locality during 1964 in spite of a thorough search of all likely sites.

¹ As "Lysted Island" or "Sobral Island".

² According to Skottsberg (1954).

³ Information supplied by Dr. C. G. G. J. van Stennis.

⁴ Collected near Cape Lancaster, according to Skottsberg (1954).

⁵ As "île Booth-Wandel" or "île Wandel".

⁶ Intermixed in *Deschampsia antarctica*.

Reproductive performance

From the data presented in Table IX, it appears that *Deschampsia antarctica* has the best reproductive performance at Spring Point, where mature seed was produced in 1961 and 1962, the largest seeds being 1.6 and 1.9 mm., respectively. Over-wintered seed was also mature. This contrasts sharply with the performance at other localities where new seed of similar age was very immature. Over-wintered inflorescences on specimens from Beneden Head, Edge Hill, Capes Tuxen and Pérez were well developed but full-size seed was only produced at Cape Pérez where the largest seed measured was 1.7 mm. In December 1960, Corte (1961) tested over-wintered seed formed at Spring Point and obtained 8–15 per cent germination after 12–16 days.

TABLE IX. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM THE ANTARCTIC PENINSULA (MAINLAND SITES)

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Almond Point	Cameron and Kennett 70	21.i.1962	Damaged	0.7	1.0	< 0.1
Spring Point	Kühnemann 1954/219	13.i.1954	—	—	4.0	1.1
	Cameron and Kennett 68a	20.i.1962	Damaged	1.7	4.6	1.5
	Corte 1	30.i.1961	—	—	4.6	1.2
	Corte 2	18.ii.1961	—	—	4.8	1.4
Beneden Head	Cameron and Kennett 61	20.i.1962	5.0	0.4	3.2	0.4
"Almirante Brown"	Neushel 451	13.ii.1958	—	—	3.8	0.4
Edge Hill	Corner 663	19.xi.1964	4.2	1.3	—	—
Cape Tuxen	Corner 695	26.xi.1964	4.8	1.3	—	—
Cape Pérez	Corner 643	5.xi.1964	5.0	1.4	—	—

Very little can be said about the reproductive performance of *Colobanthus quitensis* at sites along the Antarctic Peninsula. Table X shows that the specimen from Almond Point had young capsules with immature seed in January, while a specimen collected at Spring Point in the same month a year later bore immature capsules and some full-size seed. Seedlings were present in the latter specimen. Corte (1961) collected seed at Spring Point in December from over-wintered capsules and obtained 7–13 per cent germination after 19–24 days.

TABLE X. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Colobanthus quitensis* FROM THE ANTARCTIC PENINSULA (MAINLAND SITES)

Locality	Specimen number	Date	Old inflorescences		New inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Almond Point	Cameron and Kennett 71	21.i.1962	—	—	1.0	0.1
Spring Point	Corte 12	29.i.1961	—	—	2.8	0.5

Summary

Both species are known from scattered sites on the west coast of the Antarctic Peninsula from Almond Point to Cape Garcia. *D. antarctica* occurs in north- and west-facing sites usually between 5 and 30 m., although it reaches *c.* 175 m. at Edge Hill and *c.* 200 m. at Cape Tuxen. It appears to be locally common at all sites except Beneden Head in dry or moist situations on rocks or, if mixed with bryophytes, forming small stands of closed vegetation. At the higher altitudes the plants were small, local and rather withered in appearance. *C. quitensis* was more restricted and confined to west-facing sites from 5 to 20 m., being very rare at Almond Point but more frequent at Spring Point.

The best reproductive performance of both species was at Spring Point, where full-size seed has been produced and where its viability has been confirmed by germination tests. Seedlings of *C. quitensis* have been noted at Spring Point. Although inflorescences and flowers are freely produced at other sites, the absence of late season collections prevents a satisfactory assessment of reproductive performance but it may be noted that full-size seed has only been seen in an over-wintered specimen of *D. antarctica* from Cape Garcia.

*Records and specimens**Deschampsia antarctica*

Palmer Coast *Almond Point*: 21.i.1962, Cameron and Kennett 70 (BIRM*).

Danco Coast *Spring Point*¹: 13.i.1954, Kühnemann 1954/219 (BIRM*); 30.i.1961, Corte 1 (BIRM*); 18.ii.1961, Corte 2 (BIRM*); 20.i.1962, Cameron and Kennett 68a (BIRM*). *Beneden Head*²: 1.ii.1898, Racovitza (Wildeman, 1905, p. 8; Gerlache de Gomery, 1938, p. 37-38); 20.i.1962, Cameron and Kennett 61 (BIRM*). "*Almirante Brown*": 13.ii.1958, Neushel 451 (US); i.1961, Leech s.n. (BIRM*); 2.ii.1963, Schmitt 21-63 (US).

Graham Coast *Edge Hill*: 19.xi.1964, Corner 663 (BIRM*). *Rasmussen Island*³: iii.1909, Gain (1910, p. 408); 12.ii.1958, RNHS 1 (biological register); 1.iii.1964, Corner (field record). *Cape Tuxen*: 26.xi.1964, Corner 695 (BIRM*). *Cape Pérez*⁴: iii.1909, Gain (1910, p. 408); 5.xi.1964, Corner 643 (BIRM*). *Cape Garcia*: 9.iii.1958, RNHS 11 (biological register).

Colobanthus quitensis

Palmer Coast *Almond Point*: 21.i.1962, Cameron and Kennett 71 (BIRM*).

Danco Coast *Spring Point*¹: 29.i.1961, Corte 12 (BIRM*); 20.i.1962, Cameron and Kennett 68b (BIRM*).

Graham Coast *Rasmussen Island*³: iii.1909, Gain (1910, p. 408). *Cape Pérez*⁴: iii.1909, Gain (1910, p. 408).

MARGUERITE BAY

Distribution and habitats of D. antarctica

The earliest record of flowering plants in Marguerite Bay was made by Gain (1910), who reported *D. antarctica* from the Léonie Islands. The grass was seen on Lagoon Island in 1936 by the British Graham Land Expedition (biological register) but no specimens have been traced and no habitat information is available. In passing, it may be noted that *D. antarctica* was not seen by J. B. Killingbeck when he visited these islands in 1962.

D. antarctica has been reported from two localities on Adelaide Island: Sighing Peak and an unspecified site at the south-east corner of the island. At Sighing Peak it was found rooted in moss at an altitude of 15 m. in 1948. The site at the south-east corner of Adelaide Island is described as crevices on a rocky outcrop at the foot of north-east-facing slopes (biological register for BGLE).

Apart from a single record from the south-east corner of Bourgeois Fjord (biological register for BGLE) for which no specimen can be traced, the only other localities known in Marguerite Bay are Lagotellerie, Blaiklock, Jenny and Neny Islands.

Bryant (1945) described the Lagotellerie Island site, which he named "Shangri-la Valley", as follows: "A moss covered valley . . . surrounded on all sides by ice and snow fields . . . The situation of this little canyon tends to concentrate the sun's rays and furnish shelter from the wind; the snow melts quickly and trickles of running water keep the moss beds moist.

¹ As "Cabo Primavera" or "Cabo Spring".

² As "Cap van Beneden".

³ As "Cap Rasmussen".

⁴ As "Cap Trois-Pérez".

Two kinds of moss, a small flowering plant and a grass (*Deschampsia antarctica*) were found. The area covered with vegetation is nearly an acre in extent." During 1948 and 1949, Falkland Islands Dependencies Survey personnel confirmed the presence of *D. antarctica* on Lagotellerie Island (biological register for Stonington Island) but no specimens were collected.

R. I. L. Smith (personal communication) observed *D. antarctica* on Blaiklock Island in 1967 noting "*Deschampsia* and *Colobanthus* grow together in profusion as very small plants on the dry sandy soil in and around the numerous frost-heave polygons which occur on the raised beach to the north of the hut. Both are associated with an assortment of lichens and small cushion-forming mosses. The grass is generally less than 5 cm. across".

Rather more information is available for Jenny Island where *D. antarctica* was first seen in 1909 (Gain, 1910), although the precise locality is unknown. The grass is now known from five sites (Fig. 2). In 1961, B. J. Taylor found it growing amongst mosses towards the northern

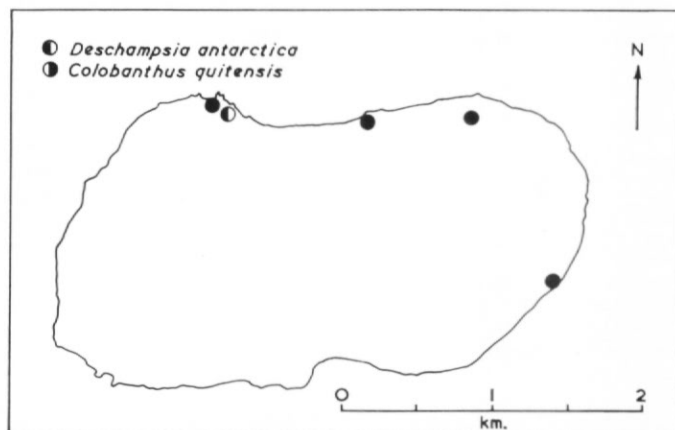


Fig. 2 Localities for *Deschampsia antarctica* and *Colobanthus quitensis* on Jenny Island, Marguerite Bay.

end of the east coast on a site consisting of two or three raised beaches, and on the scree slopes behind. Four sites are known on the north coast of the island but no habitat information is available for the two eastern sites. M. J. Northover (personal communication) described the western site as "... a U-shaped gully at an altitude of 20 m. about 50 m. from the sea with a slope of 30°, with skuas nesting both above and to one side of the area occupied by the flowering plants. The area extended 10–20 m. down the slope and 5–10 m. across it with several almost pure but not closed patches of *Deschampsia* covering 2 m. × 2 m., the remainder being in isolated tufts." At the remaining site, M. Cousins (personal communication) observed quite large tufts of *D. antarctica* in cracks in rocks from 15 to 30 m. where there were some limpet shells in the area.

Neny Island, at lat. 68°12'S., is the most southerly known station for vascular plants. The grass was first reported from here by Bryant (1945) who noted *D. antarctica* growing in cracks of rocks. It was seen again by Falkland Islands Dependencies Survey personnel between 1946 and 1949 (biological register for Stonington Island) but no precise locality or habitat information was available until R. E. Longton (personal communication) provided the following account after his visit in February 1965: "Much of the ground was very barren and vascular plants were seen only in one small area c. 80 m. above the shore, c. 100 m. south-west of Store Point. A steep north- to north-west-facing block scree slope runs down to the sea at this point, and a large rock buttress stands out from the slope. *C. crassifolius* [= *C. quitensis*] and *D. antarctica* were seen on north-north-east-facing rocks near the foot of the buttress.

"The grass occurred on sandy soil just above *C. crassifolius* (?) on similar inclined rock. It was largely confined to a triangular area with sides c. 1 m. long, where tufts of *D. antarctica* up to 12.5 cm. in diameter gave c. 10 per cent cover. Much of the grass was rather yellowish in

colour, with the leaves apparently dead but undecayed. This may have been due to the lateness of the season, however, as flowering was well advanced in most tufts."

R. I. L. Smith visited Neny Island 2 years later and noted that "*Deschampsia* and *Colobanthus* are both locally abundant between cliffs and buttresses and the shoreline to the north of Store Point. Plants of both species are invariably small, but occasionally tufts of grass coalesce to form closed patches up to 0.5 m². *Deschampsia* was recorded to an altitude of c. 83 m. while the highest *Colobanthus* plant was c. 67 m."

Distribution and habitats of C. quitensis

C. quitensis was not reported from Léonie Island by Gain (1910) but Bertram (1938) noted its presence in a closed moss association. No specimen has been traced. It was not seen by J. B. Killingbeck during his visit in 1962.

Like *D. antarctica*, *C. quitensis* was noted at the south-east corner of Adelaide Island (biological register for BGLE) where R. I. L. Smith saw it again in 1967. According to R. I. L. Smith (personal communication), "*Colobanthus* was observed in a single locality a little to the north-east of the meteorological hut. The site was a pebble and soil-filled hollow amongst rock, with a sheltered northerly aspect. The main colony comprised 15–20 cushions of 2–10 cm. in diameter, several of which had coalesced. A smaller group of plants occurred about a metre away."

C. quitensis occurred in the same habitats as *D. antarctica* on Lagotellerie Island (Bryant, 1945) and Blaiklock Island where the cushions seldom exceeded 2 cm. in diameter (personal communication from R. I. L. Smith). On Jenny Island, *C. quitensis* is known from four of the five *D. antarctica* sites (Fig. 2). According to B. J. Taylor (personal communication), the species was abundant on the east side of the island on the scree slopes behind the raised beaches, while M. J. Northover (personal communication) noted that in the U-shaped gully site at the west end of the north coast, it formed cushions up to 7.5 cm. in diameter. *C. quitensis* was first noted on Neny Island by Bryant (1945) and again in 1949 by Falkland Islands Dependencies Survey personnel (biological register for Stonington Island) but knowledge of its habitats on the island is based on the observations of R. E. Longton and R. I. L. Smith quoted under *D. antarctica*. R. E. Longton (personal communication) also noted that "*C. crassifolius* [= *C. quitensis*] was growing in c. 5 cm. of sandy soil with decaying lichen and *Colobanthus* remains on inclined rocks just above the scree. The plants were almost entirely restricted to small cushions giving very sparse cover in an area only 30 cm. by 50 cm. The plants appeared very healthy, however, and had flowered profusely."

Reproductive performance

Although R. I. L. Smith noted that *D. antarctica* was flowering freely and that numerous seedlings were present on Blaiklock Island in February 1967, his specimen (Table XI) contained very small seed. On Jenny Island a specimen collected in March again had very small seed although a little over-wintered seed was full size. By contrast, Longton's specimen from Neny Island, collected in February, had many expanded inflorescences with full-size seed but when 20 of the most mature seeds were tested they all failed to germinate (personal communication from R. E. Longton). The largest seed from the over-wintered inflorescences in the 1946 specimen measured 1.6 mm. R. I. L. Smith (personal communication) reported the species again flowering profusely in February 1967. The specimen from Adelaide Island had full-size seed when collected in September, although the inflorescences were far from mature.

On Blaiklock Island (Table XII), *C. quitensis* had nearly all the capsules open with full-size seed in February, when R. I. L. Smith (personal communication) observed it flowering profusely and noted abundant seedlings. The specimens of *C. quitensis* collected on Jenny Island between January and March all had full-size seed, although many capsules remained closed. Seedlings were seen in and around the cushions. Flowering was profuse on Neny Island in February 1965 when most capsules were open and mature seed was present, although a germination test on 20 seeds was negative (personal communication from R. E. Longton), while in February 1967, R. I. L. Smith again noted it flowering profusely with abundant seedlings.

TABLE XI. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Deschampsia antarctica* FROM MARGUERITE BAY

Locality	Specimen number	Date	Old florescences		New florescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Adelaide Island	FIDS E451/1	28.ix.1948	3.0	1.7	—	—
Blaiklock Island	R. Smith 868	28.ii.1967	—	—	3.3	0.8
Jenny Island	Killingbeck 220	24.i.1963	4.0	—	1.2	0.7
	Taylor 441a	30.i.1961	—	—	4.0	0.9
	Killingbeck 113	ii.1962	—	—	4.8	0.7
	Northover 8	1.iii.1966	4.5	1.4	4.2	0.5
Neny Island	FIDS E1007/5	7.xi.1946	4.6	1.3	—	—
	Longton 1284	25.ii.1965	—	—	4.6	1.5

TABLE XII. MATURITY INDICES AND MEAN SIZE OF LARGEST SEEDS FOR SPECIMENS OF *Colobanthus quitensis* FROM MARGUERITE BAY

Locality	Specimen number	Date	Old inflorescences		New Inflorescences	
			Maturity index	Seed size (mm.)	Maturity index	Seed size (mm.)
Blaiklock Island	R. Smith 869	28.ii.1967	—	—	3.9	0.7
Jenny Island	Taylor 438a	30.i.1961	—	—	3.1	0.5
	Killingbeck 114	ii.1962	—	—	1.8	0.5
	Northover 7	1.iii.1966	4.0	—	3.3	0.6
	Lagotellerie Island	Bryant 48b	22.xii.1940	3.5	—	—
Neny Island	Longton 1283	25.ii.1965	—	—	3.8	0.7

Summary

Plants of both species are generally very small in this area occurring on dry sandy sites, although on Jenny Island nearly pure but not closed swards of *D. antarctica* have been noted in moist areas. *D. antarctica* reaches its highest altitude in Marguerite Bay at c. 83 m. and *C. quitensis* at c. 67 m., both on Neny Island.

Despite the poor vegetative performance, the reproductive success of both species compares very favourably with other areas. Seedlings of *C. quitensis* have been reported from Adelaide, Blaiklock, Jenny and Neny Islands. Specimens of *D. antarctica* from Adelaide, Jenny and Neny Islands had full-size seed with seedlings being present on Blaiklock Island.

Records and specimens

Deschampsia antarctica

Blaiklock Island 28.ii.1967, R. Smith 868 (BIRM*).

Bourgeois Fjord South-east corner: 15.xii.1936, BGLE 1517 (biological register).

Léonie Islands *Léonie Island*: 17.i.1909, Gain (1910, p. 406). *Lagoon Island*: 25.ii.1936, BGLE 1478 (biological register).

- Jenny Island** 15 and 30.i.1909, Gain (1910, p. 406); 20.i.1949, FIDS E493 (biological register); I.iii.1966, Northover 8 (field record); 1966, Cousins (field record); 19.i.1962, Killingbeck 109 (BIRM*); ii.1962, Killingbeck 113 (BIRM*); 24.i.1963, Killingbeck 220 (BIRM*); 30.i.1961, Taylor 441a (BIRM*).
- Adelaide Island** *South-east corner*: 16.ii.1937, BGLE 1566 (biological register). *Sighing Peak*: 28.ix.1948, FIDS E451/1 (BM); 29.ix.1948, FIDS E453 (biological register).
- Lagotellerie Island** xii.1940, Bryant (1945, p. 259, 269); 9.xi.1948, FIDS E475 (biological register); 27.x.1949, FIDS E559/1a (biological register).
- Neny Island** xi.1940, Bryant (1945, p. 258); 7.xi.1946, Bingham FIDS E1007/5 (BM); 7.xi.1946, FIDS E13/5 (biological register); 22.xii.1947, FIDS E1087/1 (biological register); 20.i.1949, FIDS E492 (biological register); 25.ii.1965, Longton 1284 (BIRM*); 22.ii.1967, R. Smith (field record).

Colobanthus quitensis

- Blaiklock Island** 28.ii.1967, R. Smith 869 (BIRM*).
- Léonie Islands** *Léonie Island*: Bertram (1938, p. 524).
- Jenny Island** 15 and 30.i.1909, Gain (1910, p. 406); 30.i.1961, Taylor 438a (BIRM*); ii.1962, Killingbeck 114 (BIRM*); 24.i.1963, Killingbeck 221 (field record); I.iii.1966, Northover 7 (field record).
- Adelaide Island** *South-east corner*: 16.ii.1937, BGLE 1567 (biological register). *Near meteorological hut*: 16.ii.1967, R. Smith (field record).
- Lagotellerie Island** 22.xii.1940, Bryant 48b (IML).
- Neny Island** 4.iii.1941, Bryant 51 (K); 20.i.1949, FIDS E491 (biological register); 25.ii.1965, Longton 1283 (BIRM*); 22.ii.1967, R. Smith (field record).

DISCUSSION AND SUMMARY

The results presented above, while not appreciably altering the overall distribution pattern of *C. quitensis* and *D. antarctica* within the Antarctic botanical zone, as given by Skottsberg (1954) and Greene (1967), provide many new localities, details of habitats and an analysis of reproductive performance. Although *C. quitensis* is present over the same geographical range as *D. antarctica*, except in the South Sandwich Islands, it is more restricted in its distribution. Both species are capable of successfully completing their life cycles throughout the area but the frequency does not seem to be correlated with latitude or altitude.

Holdgate (1964) stated that, on Signy Island, the two species were confined to situations which he termed "radiation traps". In the absence of detailed information from many localities, it is difficult to assess how many sites would qualify for this description, but the term "sheltered" is frequently applied and many sites are north- to north-west-facing. However, south-, east- and west-facing sites occur and Lindsay (1971) has indicated that, on the South Shetland Islands, the distribution of the two flowering plants appears to be influenced more by wind direction than by aspect.

Plants of both species from sites within the Antarctic botanical zone are normally smaller than from farther north (Moore, 1970) but within the zone marked differences in vegetative performance between habitats have been noted, the variation being greater in *D. antarctica* than *C. quitensis*. R. W. M. Corner and R. I. L. Smith have reported that *D. antarctica* shows different growth forms in dry and moist habitats, having small discrete tufts in dry areas and more luxuriant tufts, sometimes forming small closed swards, in wetter areas. The size of cushion and perhaps the degree of compactness were the main variations seen in *C. quitensis*, which has the smaller ecological amplitude being restricted to the more favourable *D. antarctica* sites and within these to lower altitudes and drier areas. Only very exceptionally does *C. quitensis* occur without *D. antarctica* as in the remarkable site on Deception Island.

Undoubtedly *C. quitensis* is the more exacting in its habitat requirements but where conditions are suitable for vegetative growth reproduction was normally successful. There appears to be no such correlation between vegetative growth and reproductive success in *D. antarctica*; indeed well-developed plants of *D. antarctica* from moist situations were usually sterile, whereas depauperate plants from dry situations flowered profusely. On the South Shetland Islands, Lindsay (1971) noted that the most luxuriant growth of *D. antarctica* occurred at the edge of penguin rookeries but the plants were sterile, whereas stunted tufts in areas without nitrogenous enrichment were flowering. *C. quitensis* is apparently not influenced in the same way by nitrogenous enrichment.

Fig. 3 shows the distribution of the two species within the Antarctic botanical zone, together with a summary of the occurrence of mature and viable seed. As noted earlier, seed has been accepted as mature in *C. quitensis* when 0.5 mm. or over, and in *D. antarctica* when 1.5 mm.

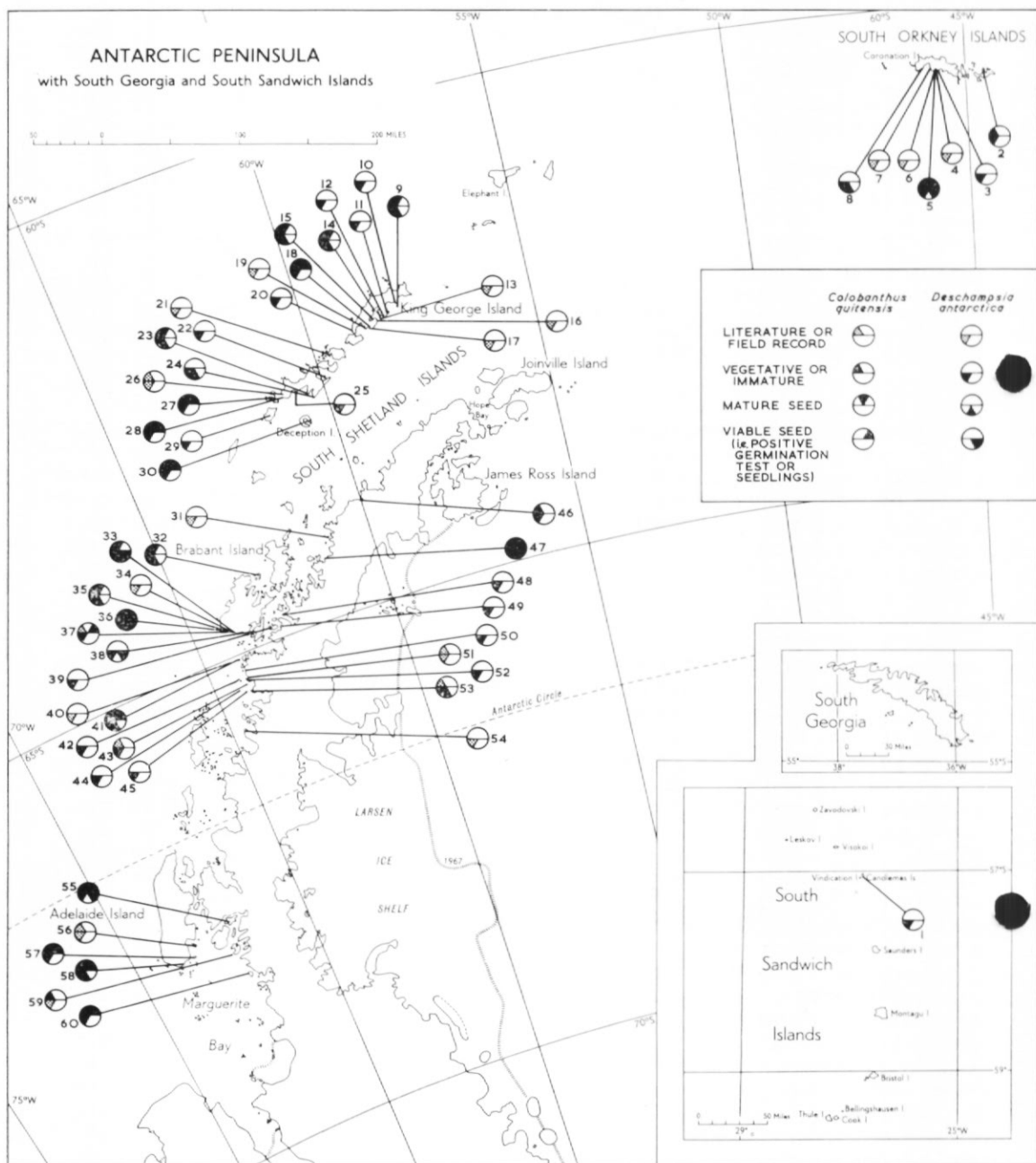


Fig. 3. Distribution of *Deschampsia antarctica* and *Colobanthus quitensis* on the South Sandwich, South Orkney and South Shetland Islands, and along the Antarctic Peninsula. Localities where the production of mature and/or viable seed has been confirmed are shown.

or over, while for both species evidence of viability has been based on reports of seedlings or positive results from germination tests. In these terms, of the 28 island and mainland localities for *C. quitensis* from which reproductive information is available, 82 per cent had mature seed, while evidence for the production of viable seed was obtained from 50 per cent, only 7 per cent of all localities lacking both. For *D. antarctica* the corresponding figures are 48 island and mainland localities, of which 33 per cent had mature seed, 13 per cent produced viable seed while 59 per cent of all localities lacked both. These figures include specimens collected throughout the year and incorporate all records of mature seed, whether from new or over-wintered inflorescences or capsules. Unfortunately no measurements are available for the size of seeds which gave positive germination results in the field and, since the criterion of maturity is based on the performance of the South Georgian seed used by Holtom and Greene (1967), it may be that these figures do not fairly assess the true field performance of either species. There is no doubt that they reflect substantial differences in behaviour between the two taxa.

The data just considered were obtained by pooling results representing many different seasons. Holtom and Greene (1967) have shown that, on Signy Island, reproductive success varies between years and that there is some evidence to suggest that immature seed at the end of a season may continue to develop over winter. Without information from a number of different localities collected in consecutive years, it is impossible to say whether this is true of

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| <p>SOUTH SANDWICH ISLANDS</p> <p>1. Candlemas Island.</p> <p>SOUTH ORKNEY ISLANDS</p> <p><i>Laurie Island</i></p> <p>2. Cape Geddes.</p> <p><i>Coronation Island</i></p> <p>3. Shingle Cove.</p> <p>4. West of Cape Hansen.</p> <p>5. Lynch Island.</p> <p>6. Midway between Cape Vik and Laws Glacier.</p> <p>7. Mansfield Point.</p> <p>8. Meier Point.</p> <p>SOUTH SHETLAND ISLANDS</p> <p><i>King George Island</i></p> <p>9. Penguin Island.</p> <p>10. Turret Point.</p> <p>11. Lions Rump.</p> <p>12. Near Martins Head.</p> <p>13. Point Hennequin.</p> <p>14. Keller Peninsula (east and west sides), Crépin Point, Visca Anchorage, Ullmann Spur.</p> <p>15. Point Thomas.</p> <p>16. Sphinx Hill.</p> <p>17. Stranger Point.</p> <p>18. Potter Cove.</p> <p>19. Barton Peninsula.</p> <p>20. Flat Top Peninsula.</p> <p><i>Robert Island</i></p> <p>21. Coppermine Cove, between Coppermine Cove and Fort William promontory.</p> | <p><i>Livingston Island</i></p> <p>22. Half Moon Island.</p> <p>23. Johnsons Dock.</p> <p>24. Barnard Point, north of Charity Glacier.</p> <p>25. East of Hannah Point.</p> <p>26. Lair Point.</p> <p>27. East of Astor Island, north of Devils Point.</p> <p>28. South-west side of Viotor Rock, extreme east end of South Beaches, south of Clark Nunatak.</p> <p>29. Snow Island.</p> <p><i>Deception Island</i></p> <p>30. Between South East Point and Baily Head, Ronald Hill.</p> <p>ANTARCTIC PENINSULA (OFFSHORE ISLANDS)</p> <p><i>Danco Coast</i></p> <p>31. Moss Islands.</p> <p>32. Beta, Kappa, Gamma and Omega Islands.</p> <p>33. Anvers Island, Arthur Harbour, Norsel Point, Bonaparte Point, promontory north of Bonaparte Point.</p> <p>34. Humble Island.</p> <p>35. Litchfield Island.</p> <p>36. Laggard Island.</p> <p>37. Hermite Island.</p> <p>38. Wiencke Island, Lécuyer Point.</p> <p>39. Bryde Island.</p> | <p><i>Graham Coast</i></p> <p>40. Booth Island.</p> <p>41. Petermann Island.</p> <p>42. Yalour Islands.</p> <p>43. Berthelot Islands.</p> <p>44. Somerville Island.</p> <p>45. Darboux Island.</p> <p>ANTARCTIC PENINSULA (MAINLAND)</p> <p><i>Palmer Coast</i></p> <p>46. Almond Point.</p> <p><i>Danco Coast</i></p> <p>47. Spring Point.</p> <p>48. Beneden Head.</p> <p>49. Paradise Harbour, "Almirante Brown".</p> <p><i>Graham Coast</i></p> <p>50. Edge Hill.</p> <p>51. Rasmussen Island.</p> <p>52. Cape Tuxen.</p> <p>53. Cape Pérez.</p> <p>54. Cape Garcia.</p> <p>MARGUERITE BAY</p> <p><i>Loubet Coast</i></p> <p>55. Blaiklock Island.</p> <p>56. Léonie Island, Lagoon Island.</p> <p>57. Jenny Island.</p> <p>58. Adelaide Island, south-east corner, Sighing Peak.</p> <p><i>Fallières Coast</i></p> <p>59. Lagotellerie Island.</p> <p>60. Neny Island.</p> |
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Specimens which were imprecisely localized have not been shown. The specimen from Desolation Island, South Shetland Islands, and all records from Signy Island, South Orkney Islands, and Argentine Islands, Graham Coast, have also been excluded.

other localities. The data in Tables II–XII clearly indicate that over-wintered seed is often larger than end-of-season seed but the information is so scanty that these differences could possibly be explained by variation in performance between seasons.

Under experimental conditions, Holtom and Greene (1967) found that temperature was one of the most important environmental factors affecting seed production but in the absence of adequate data, comparisons of micro-climate between sites is not yet possible. But it is thought likely that differences in the length of the growing season, together with temperature variations at plant level, will influence the rate of maturation processes and may provide an explanation of many of the variations between sites and years.

The new localities presented in this paper are the result of increased survey and the collation of old records, and are not necessarily evidence that the species are extending their ranges. Little is known of the way in which individual populations are maintaining themselves but at such sites as Point Thomas, King George Island, *D. antarctica* must have been present for a long time to have built up the underlying depth of peat. However, the position is obviously not static, since the population of *D. antarctica* seen on Deception Island in 1945 apparently died out and the species was not found on the island, despite repeated searching, until 20 years later. In December 1968, this population was buried under 9 cm. of ash (Collins, 1969) and its subsequent history will be of particular interest, especially as the origin of the seed from which it arose is a matter for speculation. The *C. quitensis* population on Deception Island was also severely damaged by ash during the recent eruptions, Collins (1969) noting: "It appears that the slightest burial will destroy this plant." However, he noted that a few colonies had survived in areas sheltered from the ash. Other natural phenomena such as landslips, erosion or the spread of seal or penguin colonies may also endanger populations of either species, particularly at the local level, but both are sufficiently widespread and with adequate reproductive success to maintain themselves over the region as a whole.

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