

ALIEN VASCULAR PLANTS ON DECEPTION ISLAND, SOUTH SHETLAND ISLANDS

By R. E. LONGTON

ALTHOUGH a substantial alien vascular flora is present on several sub-Antarctic islands, *Poa annua* and *P. pratensis* are the only such species recorded as accidentally introduced into the Antarctic botanical zone (Greene and Greene, 1963), the record of *Stellaria media* included by Greene and Greene having subsequently been proved false by one of the authors (Holdgate, 1964a). Both grasses have been reported from Deception Island. *P. pratensis* was first collected in February 1944, while *P. annua* was not seen until 1953, when B. Frödin collected in Whalers Bay "A single, a few cm. high specimen (the only one observed), c. 5 m. above high water. In flower" (Skottsberg, 1954).

In several experimental introductions of alien plants into the Antarctic no species is known to have survived more than one winter (Holdgate, 1964a). The present paper, however, reports the persistence of *Poa annua* in the same locality on Deception Island for at least three summers and two winters, and comments on its ability to flower and set seed. The presence of other alien plants on the island is also discussed.

LOCALITY AND HABITAT OF *Poa annua*

The *Poa annua* population on Deception Island is situated on the north-east shore of Whalers Bay, approximately 0.5 km. south-east of the British Antarctic Survey station and a disused whaling station, and about 100 m. south-east of a small wooden building known locally as "engineer's hut" (Fig. 1). The grass grows on a flat area of volcanic ash by a pile of rusty iron work approximately 30 m. inshore from the high-water mark, and at an altitude of under 5 m. The ash has a very low organic content, it is both unstable and porous, and the

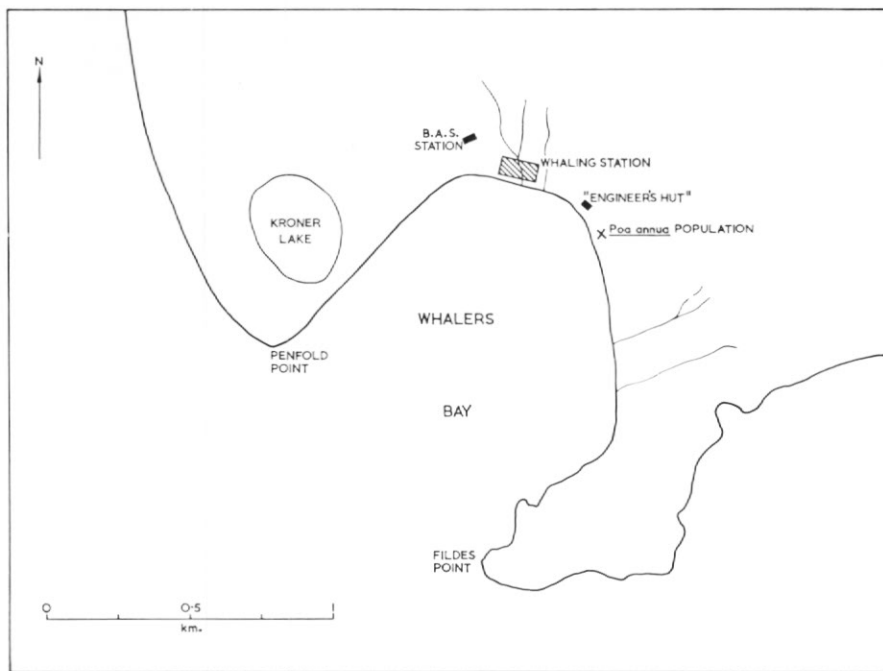


Fig. 1. Sketch map of Whalers Bay showing the position of the *Poa annua* population.

surface dries out rapidly during fine weather. The pH of an ash sample collected near the grass population on 5 April 1965 was approximately 6.8. No vegetation exists near the grass except a few widely scattered moss cushions.

Deception Island is in the maritime Antarctic as defined by Holdgate (1964*b*). Mean monthly air temperatures at sea-level range from -10°C in winter to $+1$ to $+2^{\circ}\text{C}$ during summer. There is continuous snow cover for several months during winter, and snow may lie for shorter periods throughout the summer. Persistent cloud cover results in frequent precipitation, falling as rain, sleet and snow, while the duration of sunshine normally averages only between 1 and 2 hr./day over the course of a year. The *P. annua* population on Deception Island is to some extent sheltered from the prevailing strong north-easterly winds by the ring of hills encircling Whalers Bay.

In common with other parts of the island, the shores of Whalers Bay are at times subject to slight fumarolic activity. During these periods clouds of sulphurous steam rise from fumaroles along the beach, and temperatures up to 66°C have been recorded in an artificial well on the shore (Hawkes, 1961). The effects fluctuate, however, and on other occasions the beach near the *P. annua* population is not noticeably warm. Absorbed solar radiation has been found to heat soil on Signy Island, South Orkney Islands (Holdgate, 1964*b*), and it may also have a similar effect on the black porous ash on Deception Island. A series of temperature measurements were made to the nearest Centigrade degree, using a thermistor and portable recording unit, to determine to what extent the soil around the grass roots is warmed by these agencies. The readings were made on occasions when steam was rising from adjacent stretches of beach, but not immediately below the grass population.

The temperature recorded in the ash under the grass was slightly, but consistently, above air temperature at a height of 1.5 m. (Table I), the difference being greatest on the bright sunny morning of 9 December 1964, and least following the snowfall of the previous day. Similar results were obtained in parts of the island not known to be influenced by fumarolic activity at the present time, most pertinent being readings in a layer of ash approximately 1 m. deep overlying the southern side of a glacier flowing towards Port Foster, approximately 2 km. north of Kroner Lake. At 14.00 hr. on 14 February 1965 the air temperature over the glacier was approximately 5°C , and five temperature readings at a depth of 2.5 cm. in the ash varied from 6° to 9°C , with a mean of approximately 7°C . Conditions were cloudy, and there had been no sunshine for at least 24 hr. The temperatures recorded over the glacier were clearly not influenced by fumarolic activity, suggesting that even in cloudy weather slight differences may exist between soil and air temperatures due to absorbed radiation, or possibly to the reduced wind velocity near ground level. It is not clear, therefore, whether fumarolic activity was responsible for the comparable differences between air and ash temperatures recorded in cloudy weather near the grass population.

TABLE I. ASH TEMPERATURES NEAR THE POPULATION OF *Poa annua*

Date	Time	Weather	Air Temperature above Grass ($^{\circ}\text{C}$)	Ash Temperature 2.5 cm. under Grass ($^{\circ}\text{C}$)
8 December 1964	21.00 hr.	Readings taken after a day of snowfall. Snow 5-8 cm. deep over grass	2	3
9 December 1964	10.00 hr.	Bright sunny morning	2	8
10 December 1964	10.00 hr.	Dull cloudy morning	3	7*
14 February 1965	12.30 hr.	Dull cloudy day	6	8*

Data correct to nearest $^{\circ}\text{C}$.

* Mean of five readings. Other data for single readings.

Air temperatures measured with a dry shaded thermistor at a height of approximately 1.5 m.

PERFORMANCE OF *Poa annua*

When first examined by the author on 2 December 1963, the *P. annua* population consisted of a single tuft approximately 10 cm. wide, with scattered groups of seedlings up to 0.5 m. away. The main tuft was fertile, bearing four young inflorescences just beginning to emerge from the sheaths, while two fully expanded panicles persisting from the previous summer were attached to dead material at the base of the tuft. Seeds were present in a few florets in the latter inflorescences, but most had apparently been shed.

According to C. A. Howie (personal communication), the grass flowered later in the 1963-64 summer, and further scattered seedlings appeared, but they did not form closed tufts. During the 1964 winter the population was subjected to continuous snow cover from late May until mid-October, and after the thaw all the plants persisting from the previous summer were dead. Seedlings had appeared, however, by 9 November 1964.

When the author re-visited the area on 8 December 1964 the grass was covered by 5 to 8 cm. of fresh snow, which melted during the following morning. The population then consisted of five open tufts ranging in size from 12 cm. by 10 cm. to 4 cm. by 1 cm., each composed of seedlings up to 5 cm. tall. Additional seedlings were scattered throughout an area 1 m. in diameter, as in December 1963. In contrast to the previous year, however, no inflorescences had developed, and there was no sign of the dead material noted after the thaw. In most plants only the upper parts of the leaves projected above the soil and, although buried, the leaf bases were green, suggesting that they had recently been covered by blown ash.

By 3 January 1965, however, the grass had consolidated to form five closed tufts, and the 16 inflorescences which had by then developed in four of the tufts were up to half exerted from the sheaths.

Growth continued and the population clearly became more extensive than during the previous season. On 14 February two of the tufts had merged to form a closed turf measuring 22 cm. by 13 cm. (Fig. 2), and numerous isolated shoots were scattered in an area 12 m. wide. The four main tufts, and several of the isolated shoots were fertile (Fig. 3), and the number of



Fig. 2. The largest tuft in the *Poa annua* population on Deception Island, 14 February 1965. Scale object 5 cm. in diameter.



Fig. 3. The centre of the *Poa annua* population on Deception Island, 14 February 1965. Scale object 5 cm. in diameter.

inflorescences had risen to between 70 and 75. All stages of development were represented, from young inflorescences still enclosed in the sheaths to fully expanded panicles. Some of the florets in the more advanced inflorescences were in flower, while others contained swollen green seeds.

Little further extension of the population had taken place by 18 March, but the majority of the panicles were by then fully expanded and seeds were present in most florets, some having attained a pale brown colour.

When last examined on 5 April 1965 the grass was again under approximately 5 cm. of fresh snow and the leaf apices had begun to wither, though the bases remained green. All the inflorescences seen were fully expanded and the flowers still contained a proportion of green and pale brown seeds.

GERMINATION TEST

A sample of seeds from the *P. annua* population on Deception Island was collected on 18 March 1965 and stored in an air-dried condition. During June 1965, 20 of the seeds were maintained at 5° C for 2 weeks, then plated out on moist filter paper in a Petri dish and kept at 5° C for a further 2 weeks. At this stage, when three of the seeds had germinated, the plate was transferred to a temperature of approximately 20° C and 90 per cent germination was recorded 5 days later. Most of the seedlings had developed both radicle and plumule. The plate received light in both temperature treatments.

OTHER ALIEN VASCULAR PLANTS ON DECEPTION ISLAND

There are several records of other alien vascular plants on Deception Island. An entry in Dr. I. Mackenzie Lamb's field diary for 3 February 1944, referring to "one small patch of grass a few feet in diameter outside one of the buildings, growing on volcanic ash", is supported by a flowering specimen of *Poa pratensis* collected the following day. Sterile specimens of *P. pratensis* were collected "outside the laboratory building" on 13 February 1946, and an

unpublished Falkland Islands Dependencies Survey report records that "one small tuft of grass was growing behind the old laboratory building" towards the end of the 1947-48 summer. From these observations which were made in Whalers Bay, it seems not unlikely that *P. pratensis* survived on Deception Island for at least 4 years, flowering during one or more seasons.

Seedlings of four other species, including a grass and a legume, were seen by the author near the Chilean station in Pendulum Cove on 14 February 1965. The plants were growing on a mixture of soil and straw on the western side of a sheep pen situated only a few metres inshore from the high-tide mark. The seedlings were small, widely scattered and too young for positive identification.

The specimens of *Poa pratensis* from Deception Island are housed at the British Museum (Nat. Hist.), and collections of *P. annua* and three of the seedlings from Pendulum Cove have been deposited in the British Antarctic Survey herbarium at the Department of Botany, University of Birmingham.

DISCUSSION

The present population of *Poa annua* has survived under the relatively severe climatic conditions prevailing at Deception Island for at least three summers and two winters, the presence of old inflorescences in December 1963 confirming that it flowered during the 1962-63 summer. It flowers and sets seed regularly, and appears to be thriving; it was more extensive during the 1964-65 summer than in the previous year, although development was apparently delayed early in the season. C. A. Howie's observations confirm that *P. annua* behaves as an annual on Deception Island, and it is clear that its seeds can germinate after 5 months' snow cover. The formation of viable seed in the population during the 1964-65 season has been confirmed experimentally, and at least a proportion of the seeds have been shown capable of germination at 5° C. The occurrence of the principal tufts in the same position in successive seasons, however, suggests that few seeds are dispersed far from the parent plants. *P. annua* cannot yet be regarded as fully naturalized on Deception Island.

The success of *P. annua* on Deception Island may be compared with that of *P. pratensis* at Cierva Cove, Hughes Bay, Danco Coast, and it is clear that these two populations represent the most successful introductions of alien plants yet reported in the Antarctic botanical zone. At Cierva Cove *P. pratensis* survived for at least 6 years and flowered in at least two seasons (Corte, 1961). The *P. pratensis* population occurred on soil imported from Tierra del Fuego, however, and is not known to have set seed, whereas on Deception Island *P. annua* grew on indigenous soil and seeds developed during at least three successive seasons. It seems likely that *P. pratensis* also survived on Deception Island for a period of at least 4 years. Moreover, Rudolph (1965) successfully germinated seeds of this species on local soil at Cape Hallett (lat. 72°13'S.) in Victoria Land during the austral summer of 1964; the plants were destroyed after 3 weeks, however, and Dr. S. W. Greene (personal communication) found no evidence of the grass when he visited the site in February 1965. *P. annua* and *P. pratensis* are widespread aliens on sub-Antarctic islands and they are regarded as naturalized on South Georgia, where *P. annua* is the most successful member of the alien flora (Longton, 1965).

In contrast to the comparative success of these two cosmopolitan weeds at Deception Island and Cierva Cove, none of the plants in several experiments aimed at introducing Arctic and southern cool temperate species into the Antarctic is known to have survived more than one winter (Holdgate, 1964a). Seed germination in alien plants was reported at the Argentine Islands and at Port Lockroy, however, and the seedlings observed in Pendulum Cove in February 1965 probably developed from seed germinating on Deception Island. In view of their small size, they were considered unlikely to persist through the 1965 winter.

There have been numerous opportunities for the accidental introduction of plants into Deception Island since the height of the South Shetland Islands sealing industry in 1819-22. Periodic visits by sealing and exploring vessels continued throughout the nineteenth century, and the whaling station in Whalers Bay was in operation from 1910 until 1931. The British station in Whalers Bay has been occupied continuously since 1944, while Chilean and Argentine stations are established elsewhere on the island. Sheep, pigs and hens are kept at the

Chilean station, and the seedlings growing in Pendulum Cove were probably accidentally introduced as seeds among fodder. Hens were also kept at the British station during 1959–60, being fed on grain imported from South America via the Falkland Islands (personal communication from R. D. Clements), while seaplanes used by the Falkland Islands Dependencies Air Survey Expedition (1955–57) were beached at the site of the *P. annua* population (Mott, 1956). It is not clear when *P. annua* and *P. pratensis* were first introduced into Deception Island, however, and as the present population of *P. annua* was unknown to British Antarctic Survey personnel on the island until November 1963, it cannot with certainty be regarded as a persistence of that present in Whalers Bay in 1953 (Skottsberg, 1954).

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the facilities provided by the Botany Department, University of Birmingham, through the kind permission of Professor J. Heslop-Harrison, during the preparation of this paper.

I am also grateful to W. Gilchrist, who drew my attention to the *Poa annua* population; to Dr. S. W. Greene, Dr. I. Mackenzie Lamb and C. A. Howie for allowing me to quote their unpublished observations; to Dr. M. W. Holdgate for his assistance in searching through British Antarctic Survey records; and to the Keeper of Botany at the British Museum (Nat. Hist.) for permission to examine the specimens of *P. pratensis* from Deception Island.

MS. received 16 December 1965

REFERENCES

- CORTE, A. 1961. La Primera Fanerógama Adventicia Hallada en el Continente Antártico. *Contrnes Inst. antart. argent.*, No. 62, 14 pp.
- GREENE, S. W. and D. M. GREENE. 1963. Check List of the Sub-Antarctic and Antarctic Vascular Flora. *Polar Rec.*, **11**, No. 73, 411–18.
- HAWKES, D. D. 1961. The Geology of the South Shetland Islands: II. The Geology and Petrology of Deception Island. *Falkland Islands Dependencies Survey Scientific Reports*, No. 27, 43 pp.
- HOLDGATE, M. W. 1964a. An Experimental Introduction of Plants to the Antarctic. *British Antarctic Survey Bulletin*, No. 3, 13–16.
- . 1964b. Terrestrial Ecology in the Maritime Antarctic. (In CARRICK, R., HOLDGATE, M. and J. PRÉVOST, ed. *Biologie Antarctique*. Paris, Hermann, 181–94.)
- LONGTON, R. E. 1965. Additions to the Alien Flora of South Georgia. *British Antarctic Survey Bulletin*, No. 5, 47–49.
- MOTT, P. G. 1956. Air Survey of the Falkland Islands Dependencies, 1955–56. *Polar Rec.*, **8**, No. 54, 237–45.
- RUDOLPH, E. D. 1965. Antarctic Lichens and Vascular Plants: Their Significance. *BioScience*, **15**, No. 4, 285–87.
- SKOTTSBERG, C. 1954. Antarctic Vascular Plants. *Bot. Tidsskr.*, **51**, 330–38.