Supplementary material

Table S1: Summary of soil total N, organic N, and inorganic N (NO_3^- and NH_4^+), as determined by various authors on Marion Island (presented either as mean ± SE, or as a range): 1.) investigating soil from different plant communities, and 2.) the influence of animals on soil N fractions. In all sources, both total N and oN was measured according to the macro-Kjeldahl method. Inorganic N measured with MgO-Devarda alloy steam distillation (Smith 1976b, 1978), NH_4^+ by the phenol-hypochlorite reaction and NO_3^- through Griess reagents (Smith et al. 2001 and Smith and Steenkamp 1992a). See citations for more detailed information.

1. Plant community	Total N (μg g^{-1})	NH_4^+ (μg g^{-1})	NO_3^- (μg g^{-1})	Source
Polypogon magellanicus drainage line	25000 ± 1805	tr. – 29	0.0 – tr.	(Smith, 1976b)
Poa cookii tussock grassland	16600 ± 1054	9 – 84	0.0 - 10	(Smith, 1976b)
Polypogon magellanicus mire	23400 ± 1328	24 - 65	0.0 - 7	(Smith, 1976b)
Mire-grassland peat	16000 ± 27000	7 - 120	0 - 22	(Smith and Steenkamp, 1992a)
Xeric fellfield	1000 – 7000	0 – 2.9	0 – 0.3	(Smith et al. 2001)
Coastal herbfield	50000 – 250000	1.4 – 29.3	0.2 – 21.1	(Smith et al. 2001)
Biotic mud	40000 – 121000	27.5 – 1437.0	0.9 – 350.0	(Smith et al. 2001)
2. Biotic (animal) influence	**oN (μg g^{-1})**	**NH_4^+ (μg g^{-1})**	**NO_3^- (μg g^{-1})**	**Source**
Uninfluenced soil	26000 ± 2277	14 ± 3.98	2 ± 0.76	(Smith, 1978)
Slope, near King Penguin colony	29000 ± 4330	143 ± 14.66	35 ± 22.17	(Smith, 1978)
Wandering albatross nest - occupied	30000 ± 1848	545 ± 322	5 ± 0.64	(Smith, 1978)
Wandering albatross nest - unoccupied	24000 ± 1652	102 ± 39.38	19 ± 6.58	(Smith, 1978)
Giant Petrel nest - occupied	28000 ± 4503	136 ± 71.94	35 ± 20.15	(Smith, 1978)
Gentoo Penguin	36000 ± 1674	425 ± 349.3	25 ± 23.04	(Smith, 1978)

King Penguin: mud inside colony	110000 ± 6178	13442 ± 560	2603 (± 508.4)	(Smith, 1978)

tr. = traces

Table S2: Soil dissolved organic N (DON) and inorganic N (NO_3^- and NH_4^+) from five coastal sites on Marion Island (presented as mean ± SE), from Pallett et al. *in prep*. DON provides a more accurate representation of bioavailable oN. These measurements were made on 0.5 M K_2SO_4 soil extracts ($n = 20$), extracted in a 1:5 *w:v* ratio. Dissolved iN was measures using colorimetric assays, with Griess reagents (NO_3^-) and the indolphenol-blue method (NH_4^+). Total dissolved N (TDN) was measured using the persulfate oxidation method, where all TDN is oxidised to NO_3^-, which was then measured colorimetrically. DON was calculated as the difference between TDN and iN. All sites are near the coast and frequented by vertebrates by varying degrees, from no proximal colonies (row one) to a biotic beach (row five) with *Mirounga leonina* (Southern Elephant Seals), *Aptenodytes patagonicus* (King Penguins), and *Eudyptes chrysocome* (Southern Rock Hopper Penguins) amongst other visitors.

Biotic influence	GPS coordinates	oN (µg g-1)	NH_4^+ (µg g^{-1})	NO_3^- (µg g^{-1})
Coastal, no vertebrate colonies proximal.	- 46.8764°, 37.8603°	196.91 ± 35.79	41.24 ± 6.55	2.53 ± 0.41
Further inland, near inactive Procellaridae nests	- 46.8768°, 37.8531°	106.07 ± 27.68	41.98 ± 6.82	53.59 ± 8.70
Coastal, near inactive Procellaridae nests	- 46.8784°, 37.8600°	106.96 ± 16.77	58.15 ± 9.19	20.78 ± 7.83
Coastal, near inactive Procellaridae nest entrances	- 46.8775°, 37.8607°	207.74 ± 32.04	49.79 ± 13.79	117.54 ± 20.02
Coastal, adjacent to a beach with vertebrate colonies	-46.8781°, 37.8630°	131.47 ± 19.88	92.12 ± 16.90	3.62 ± 0.92

Table S3: Site coordinates for the field experiment, where ^{15}N- glycine, -NH_4^+ or -NO_3^- were supplied to grasses.

Site	Vertebrate influence	Grass species	Lon, Lat
Biotic	High	*P. magellanicus*	-46.878097°, 37.863136°
Biotic	High	*P. cookii*	-46.877789°, 37.863081°
Biotic	High	*A. stolonifera*	-46.877917°, 37.863103°
Biotic	High	*P. annua*	-46.877986°, 37.862811°
Slope	Intermediate	*P. cookii*	-46.876558°, 37.840186°
Fellfield	Low	*P. magellanicus*	-46.877092°, 37.839867°
Fellfield	Low	*P. annua*	-46.877256°, 37.839983°

Table S4: Soil N concentrations including total dissolved N (TDN) and iN for the three sites in the *in situ* ^{15}N-uptake experiment, from values provided by (Smith et al. 2001) for the three habitat types. The 'Biotic' site falls under Coastal Tussock Grassland, 'Slope' under Closed Fernbrake, and 'Fellfield' under Mesic Fellfield habitats. Values presented are means and medians in parentheses and were calculated on an oven dry soil mass basis (Smith et al. 2001).

Site	Vertebrate influence	TDN (%)	NH_4^+ (μg g^{-1})	NO_3^- (μg g^{-1})
Biotic	High	3.7 (3.7)	20.8 (17.3)	15.1 (4.7)
Slope	Intermediate	2 (2)	3.7 (0.7)	1.7 (0.1)
Fellfield	Low	0.8 (0.7)	0.5 (0.3)	0.0 (0.0)

Table S5: Elemental composition (mM) and pH of the mire solution (means ±SE).

	mM
Ca^{2+}	0.025 ± 1.5e-18
Mg^{2+}	0.082 ± 0.01
K^{+}	0.043 ± 0.005
Na^{+}	0.73 ± 0.10
Cl^{-}	1.10 ± 0.11
SO_4^{2-}	0.038 ± 0.007
Cu^{2+}	0.0004 ± 0.0001
Mn^{+2}	0.0005 ± 6.6e-5
Zn^{2+}	0.0007 ± 0.0002
B^{3+}	0.0009 ± 0
Fe^{2+}	0.007 ± 0.002
PO_4^{2-}	0.032 ± 3.1e-18
NH_4^{+}	0.02 ± 0.005
NO_3^{-}	0.05 ± 0
pH	5.1 ± 0.7

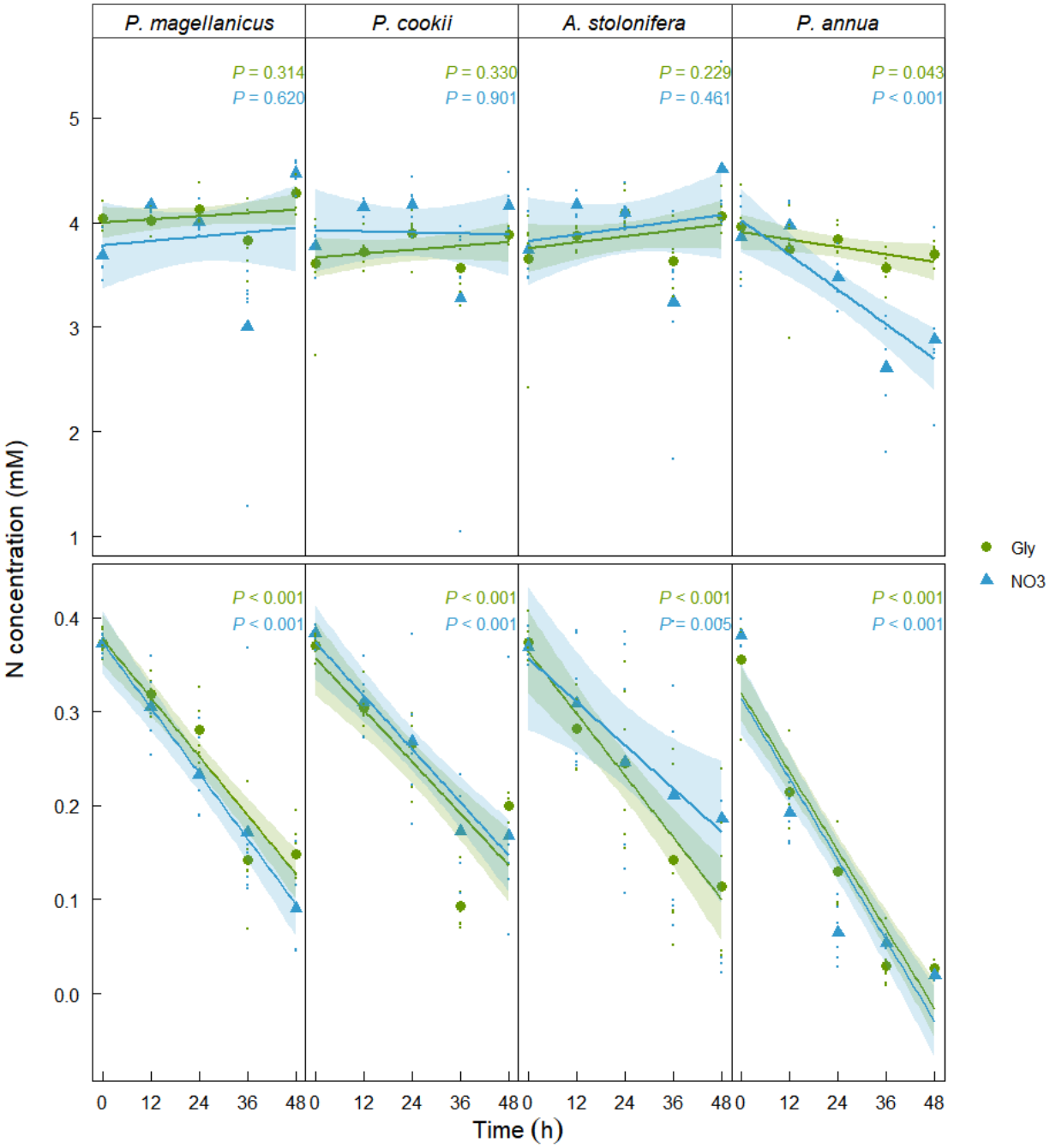

Fig. S1 Nitrogen-depletion for glycine (●, green) and NO_3^- (▲, blue) over time for each species (*Polypogon magellanicus, Agrostis stolonifera, Poa cookii, Poa annua*), in the 4 mM N (top row) and 0.4 mM N (bottom row). Points and ribbons show the individual data points and 95% CI ribbons. Diamonds and circles show mean concentrations at each time interval for NO_3^- and glycine, respectively. Plot text shows the respective *p*-value for linear models. There is a significant

difference between the glycine (green) and NO_3^- (blue) slopes in the 4 mM treatment for *P. annua*, as the 95% CI's do not overlap.