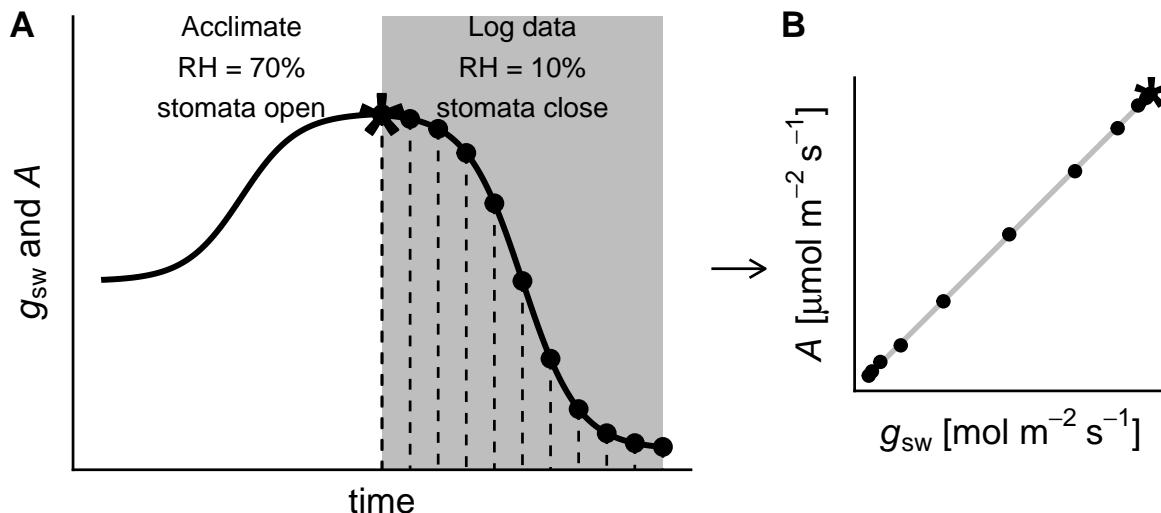


Table S1: Average traits values among ‘ilima leaves at each site.  $SD_{abaxial}$  is the stomatal density per  $\text{mm}^2$  on the abaxial (lower) surface;  $SD_{adaxial}$  is the stomatal density per  $\text{mm}^2$  on the adaxial (upper) surface;  $GCL_{abaxial}$  is the guard cell length in  $\mu\text{m}$  on the abaxial (lower) surface;  $GCL_{adaxial}$  is the guard cell length in  $\mu\text{m}$  on the adaxial (upper) surface; Leaf thickness is the length from upper cuticle to lower cuticle in  $\mu\text{m}$ ;  $A$  is the photosynthetic rate in  $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ;  $g_{sw}$  is the stomatal conductance to water vapor in  $\text{mol m}^{-2} \text{ s}^{-1}$ .

Site	Island	Habitat	$SD_{abaxial}$	$SD_{adaxial}$	$GCL_{abaxial}$	$GCL_{adaxial}$	Leaf thickness	$A$	$g_{sw}$
Kaloko-Honokōhau national historical park	Hawai‘i	coastal	412.99	92.31	14.73	20.32	189.60	17.40	0.123
Puakō petroglyph park	Hawai‘i	coastal	310.12	52.55	13.35	20.94	194.20	17.85	0.134
Kahuku Point	O‘ahu	coastal	420.43	80.80	16.23	22.77	304.24	20.88	0.155
Kaloko beach	O‘ahu	coastal	400.27	109.03	15.69	23.26	399.54	31.28	0.314
Ka‘ena Point	O‘ahu	coastal	370.14	120.34	17.61	22.89	295.82	34.77	0.336
Makapu‘u beach	O‘ahu	coastal	408.28	23.18	15.99	22.03	249.71	32.87	0.349
Hāloa ‘Āina	Hawai‘i	montane	307.94	7.61	16.49	22.59	149.41	13.07	0.116
Ka‘ohe game management area	Hawai‘i	montane	270.24	13.07	14.87	21.51	183.72	12.94	0.130
Koai‘a tree sanctuary	Hawai‘i	montane	318.58	9.55	13.89	22.86	138.89	27.88	0.358
Hawai‘i loa ridge	O‘ahu	montane	329.25	115.56	17.83	21.76	205.97	21.95	0.215
Mau‘umae Ridge	O‘ahu	montane	298.77	138.32	16.53	20.72	162.02	24.60	0.436
Wa‘ahila ridge	O‘ahu	montane	346.75	150.26	17.76	20.61	193.33	13.96	0.194

### Idealized example of $A - g_{sw}$ curve



### Interpretation of idealized amphi and pseudohypo curves

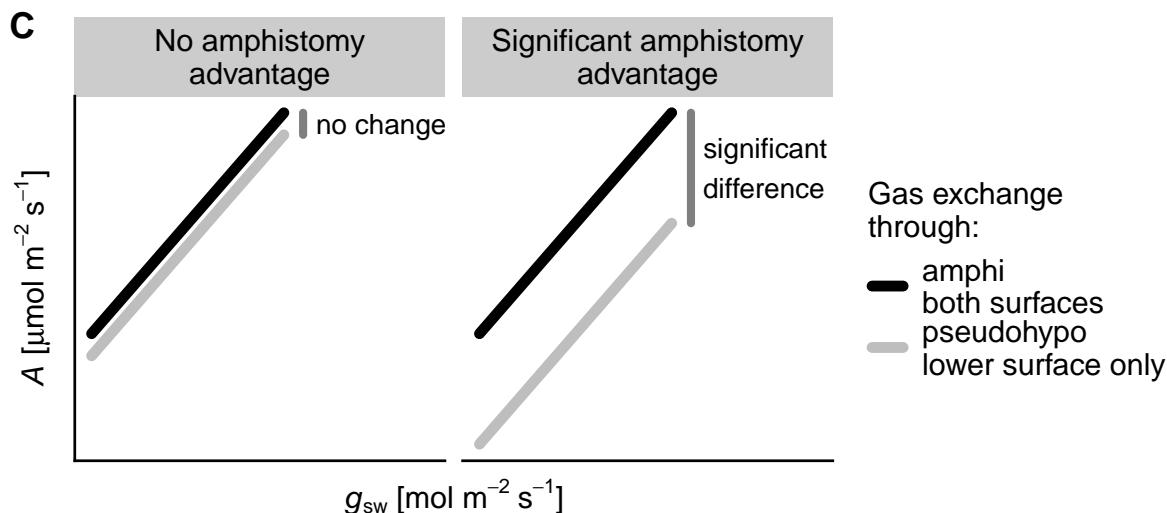


Figure S1: Idealized method for collecting  $A-g_{sw}$  curves on either amphi or pseudohypo leaves. A) After clamping the leaf into the LI-6800 chamber, it acclimates to high light (PPFD = 2000  $\mu\text{mol m}^{-2} \text{s}^{-1}$ ) and humidity (RH = 70%). This induces stomata to open, increasing  $g_{sw}$  and  $A$  until they reach a maximum. We abruptly lower the chamber humidity to  $\approx 10\%$  to close stomata and log data (black points) until  $g_{sw}$  and  $A$  reach their nadir. B) We fit  $A-g_{sw}$  curves to logged data points. The asterisk in both panels indicates the data point used for maximum  $A$  and  $g_{sw}$ . C) AA is low (left panel) when the photosynthetic rate of an amphi leaf is similar to a pseudohypo leaf at the same total  $g_{sw}$  ( $x$ -axes); large AA (right panel) is indicated when an amphi leaf has a higher photosynthetic rate than a pseudohypo leaf. Abbreviations:  $A$  is the photosynthetic rate; AA is the amphistomy advantage;  $g_{sw}$  is the stomatal conductance to water vapor; PPFD is photosynthetic photon flux density; RH is relative humidity.

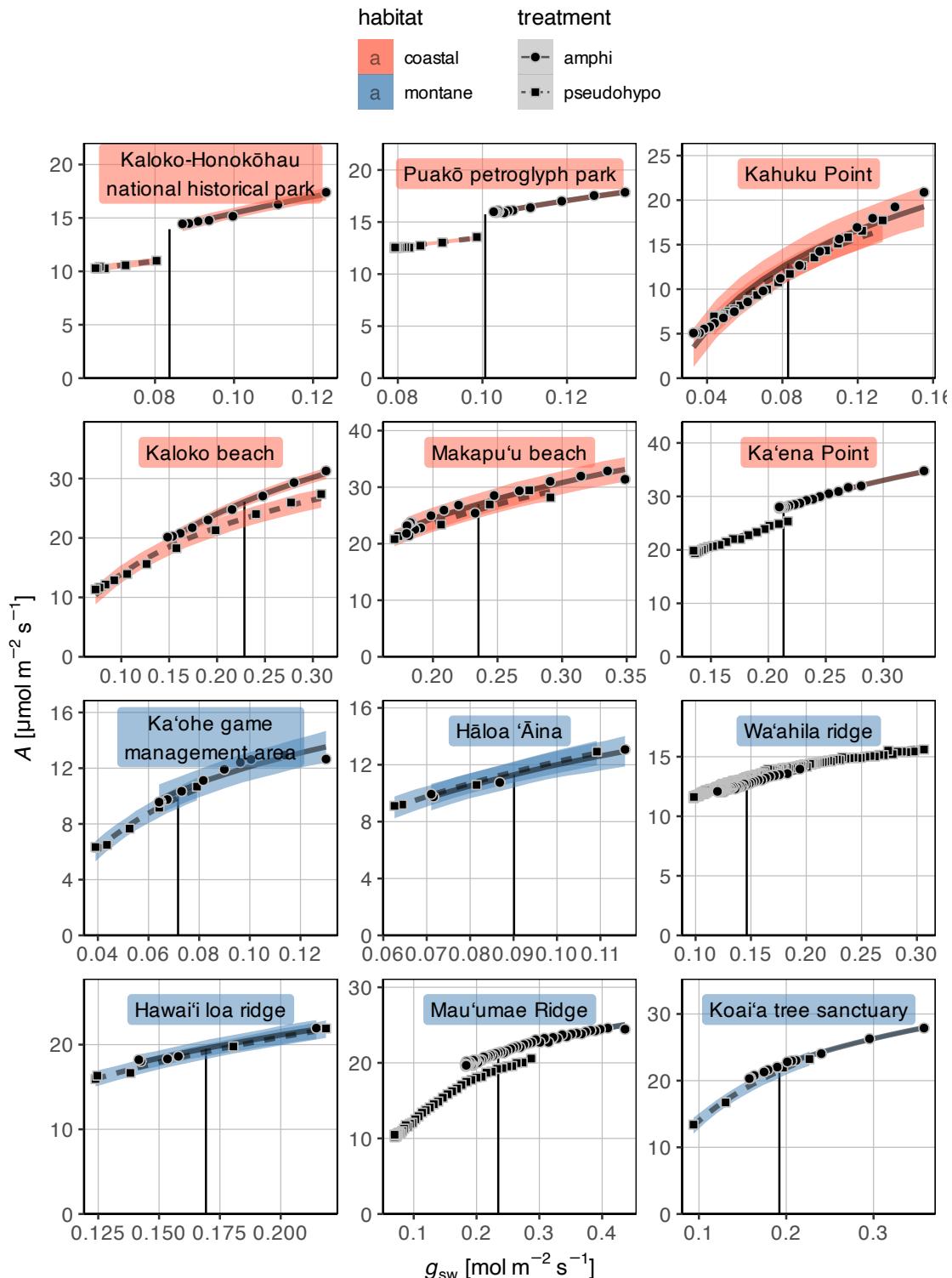


Figure S2: See next page.

Figure S2: (Continued from previous page.) Individual  $A-g_{sw}$  curves used to estimate AA. For each leaf, one per site, we measured  $A$  ( $y$ -axis) over a range of  $g_{sw}$  ( $x$ -axis) on the same leaf with two treatments: ‘amphi’ (circles, solid line) leaves were untreated; ‘pseudohypo’ (squares, dashed line) leaves had no conductance through the upper (adaxial) surface. In all coastal (orange) and montane (blue) leaves, we fit generalized additive models and 95% confidence ribbons to estimate AA at a  $g_{sw}$  where the curves overlap (vertical black line). In leaves from Kaloko-Honokōhau national historical park and Puakō petroglyph park, we extrapolated slightly beyond fitted curves because they did not quite overlap. Symbols: AA, amphistomy advantage;  $A$ , photosynthetic rate in  $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ;  $g_{sw}$ , stomatal conductance to water vapor in  $\text{mol m}^{-2} \text{ s}^{-1}$ .

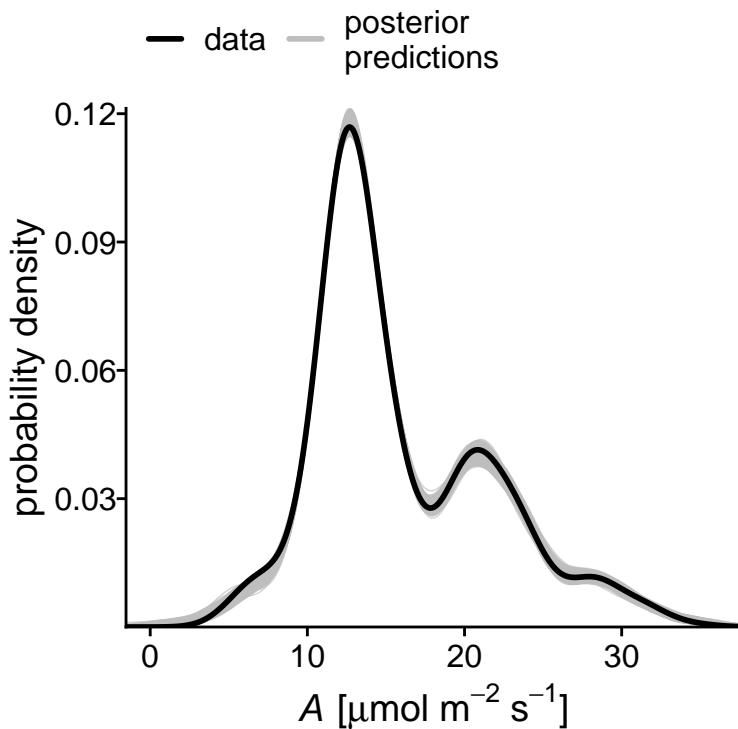


Figure S3: Posterior predictions (thin grey lines) from fitted  $A-g_{sw}$  curves closely match the observed distribution (thick black line), indicating that the statistical model adequately captures variation in the response variable over the measured range. Symbols:  $A$ , photosynthetic rate in  $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ;  $g_{sw}$ , stomatal conductance to water vapor in  $\text{mol m}^{-2} \text{ s}^{-1}$ .

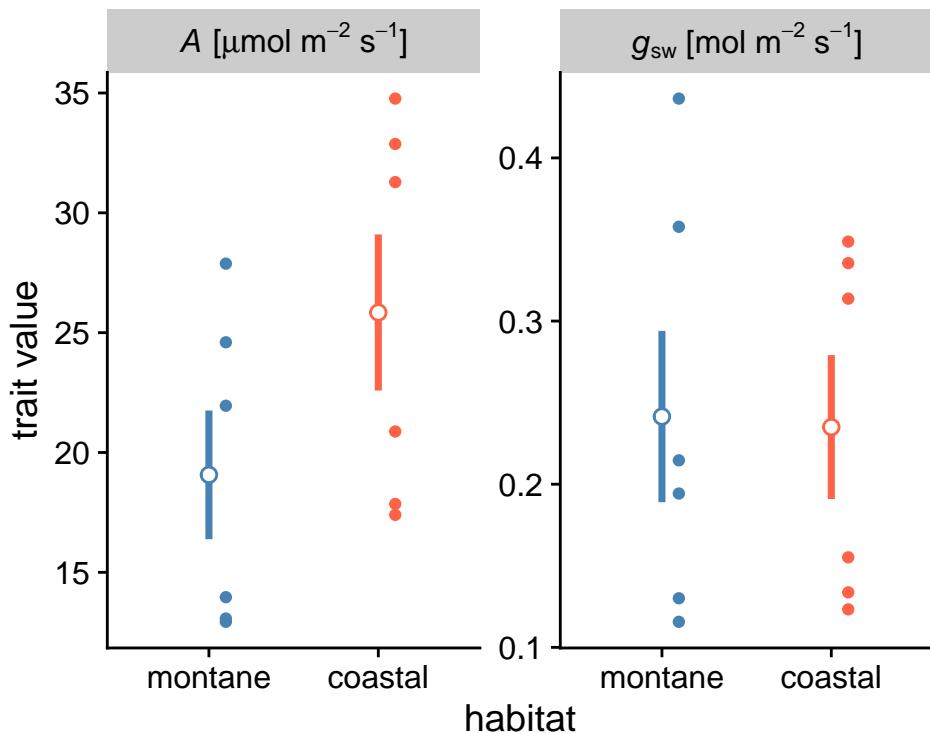


Figure S4: The photosynthetic rate (left facet) and stomatal conductance to water vapor (right facet) of montane (blue) and coastal (orange) ‘ilima leaves. Each point-interval is the median posterior estimate plus 95% confidence interval of trait value for that habitat. Smaller points next to each point-interval are the  $g_{s\max,\text{ratio}}$  of individual plants, one per site. Symbols:  $A$ , photosynthetic rate in  $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ;  $g_{sw}$ , stomatal conductance to water vapor in  $\text{mol m}^{-2} \text{ s}^{-1}$ .

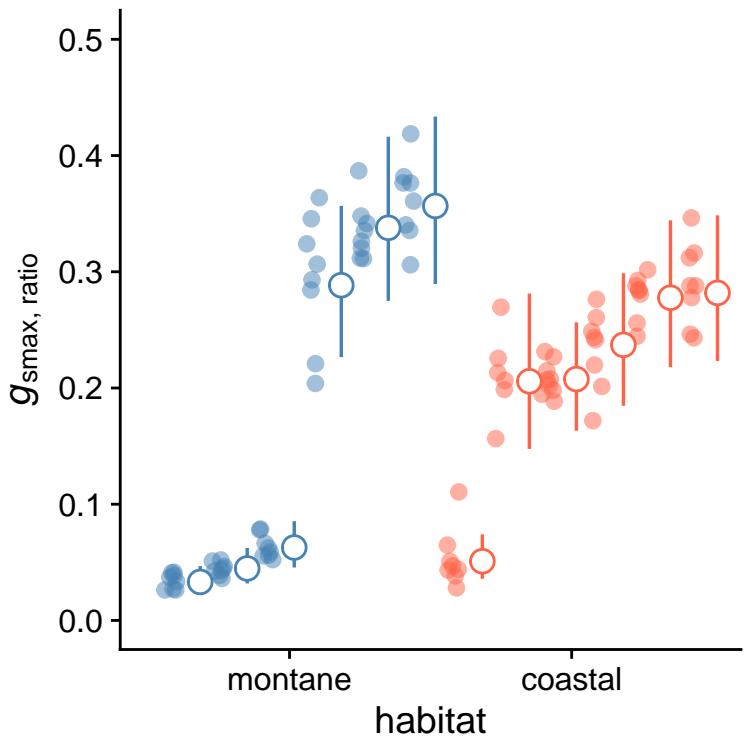


Figure S5: The  $g_{\text{smax},\text{ratio}}$  ( $y$ -axis) of montane (blue) and coastal (orange) ‘ilima leaves. Each point-interval is the median posterior estimate plus 95% confidence interval of  $g_{\text{smax},\text{ratio}}$  for that site. Sites are arranged by habitat and ascending  $g_{\text{smax},\text{ratio}}$  within habitat. Smaller, transparent points next to each point-interval are the  $g_{\text{smax},\text{ratio}}$  of individual plants. Symbols:  $g_{\text{smax},\text{ratio}}$ , the ratio of anatomical maximum stomatal conductance to water vapor on the the adaxial surface over the total.