



Corrigendum: Imprint of Climate Change on Pan-Arctic Marine Vegetation

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A Corrigendum on

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In the original article, there were mistakes in **Tables 2–4** and associated legends and text as published. The original article contained errors in the reported modeled macroalgal distribution area in the pan-Arctic and its subregions because the polygons used to calculate the areas were not correctly defined.

A correction has been made to **Tables 2–4** and their associated legends:

The Table legends missed the word “brown” and an explanatory note. The corrected **Tables 2–4** and associated legends appear below (corrections marked in bold).

A correction has been made to the **Abstract** (corrected text marked in bold):

“[...] Species distribution modeling was challenged by limited observations and lack of information on substrate, but suggested a current (2000–2017) potential pan-Arctic **brown** macroalgal distribution area of **655,111 km²** (**140,433 km²** intertidal, **514,679 km²** subtidal), representing an increase of about **45%** for subtidal- and **8%** for intertidal macroalgae since 1940–1950, and associated polar migration rates averaging 18–23 km decade⁻¹. Adjusting the potential macroalgal distribution area by the fraction of shores represented by cliffs halves the estimate (**340,658 km²**). [...]”

TABLE 2 | Past (period 1940–1950) and present (period 2000–2017) potential pan-Arctic intertidal **brown** macroalgal distribution areas (km²), and associated area increase and polar migration rate of key habitat-forming macrovegetation, assessed based on niche modeling for the pan-Arctic region and by Arctic sector (based on the Arctic Council definition of the Arctic, Huntington, 2001).

Arctic sector	Past area (km ²)	Present area (km ²)	Area increase (%)	Polar migration (km decade ⁻¹)	Warming rate avg/max (°C decade ⁻¹)
Pan-Arctic region	129,964	140,433	8.1	23.1	0.009/0.154
Alaska	36,936	37,464	1.4	–	0.028/0.119
Canada	779	779	0.0	–	0.002/0.023
W. Greenland	24,151	29,018	20.2	41.6	0.020/0.154
E. Greenland	3,959	3,959	0.0	–	0.009/0.119
Iceland	20,714	20,714	0.0	–	0.030/0.135
Svalbard	1,008	4,416	338.0	23.1	0.006/0.052
N. Norway	26,928	26,928	0.0	–	0.088/0.138
Russia	15,490	17,156	10.8	106.4	0.007/0.017

Intertidal areas typically represent upper bounds as the cell size of the model is often larger than the belt of intertidal algae. The associated warming rate is computed overall and by sector and listed as average/maximum by region.

TABLE 3 | Past (period 1940–1950) and present (period 2000–2017) potential pan-Arctic subtidal **brown** macroalgal distribution areas (km²), and associated area increase and polar migration rate of key habitat-forming macrovegetation, assessed based on niche modeling for the pan-Arctic region and by Arctic sector (based on the Arctic Council definition of the Arctic, Huntington, 2001).

Arctic sector	Past area (km ²)	Present area (km ²)	Area increase (%)	Polar migration (km decade ⁻¹)	Warming rate avg/max (°C decade ⁻¹)
Pan-Arctic region	355,932	514,679	44.6	18.3	0.009/0.154
Alaska	76,197	89,005	16.8	15.4	0.028/0.119
Canada	90,263	164,296	82.0	89.4	0.002/0.023
W. Greenland	40,025	54,297	35.7	43.2	0.020/0.154
E. Greenland	10,576	23,164	119.0	78.6	0.009/0.119
Iceland	20,714	20,714	0.0	–	0.030/0.135
Svalbard	3,407	9,262	171.9	18.5	0.006/0.052
N. Norway	26,928	26,928	0.0	–	0.088/0.138
Russia	87,823	127,014	44.6	33.9	0.007/0.017

The associated warming rate is computed overall and by sector and listed as average (avg)/maximum (max) by region.

TABLE 4 | Information on substrate conditions for Arctic coastlines and potential **total** distribution area of **brown macroalgae**, and distribution areas adjusted by substrate conditions.

Arctic sector	Coastal cliffs (% of coastline)	Modeled present macroalgal area (km ²)	Substrate-adjusted modeled present macroalgal area (km ²)
Pan-Arctic region	52	655,111	340,658
Alaska	52	126,469	65,764
Canada	63	165,075	103,997
W. Greenland	62	83,315	51,655
E. Greenland	62	27,122	16,816
Iceland	52	41,427*	21,542*
Svalbard	21	13,678	2,872
N. Norway	56	53,853*	30,159*
Russia	41	144,170	59,110
Sum of national estimates		655,111	351,915

*Substrate conditions are reported as percentage of cliffs by nation or, where no national data was available (Alaska, Iceland), based on global average (52%) (Young and Carilli, 2019). Total macroalgal areas, calculated as the sum of intertidal and subtidal areas, represent upper bounds because of overlap between the two due to the coarse resolution of the model. This was most pronounced for Norway and Iceland (marked by *) where the model could not distinguish between intertidal and subtidal areas.*

A correction has been made to the **Results, subsection ‘Modeled Potential Past and Present Pan-Arctic Macroalgal Distribution Area’, paragraphs 3 and 4** (corrected text marked in bold):

“Within the geographic boundaries defined by the Arctic Council, models developed for present conditions (2000–2017) predicted **140,433 km²** and **514,679 km²** of suitable habitats for intertidal and subtidal species, respectively, i.e., a total potential distribution area of **655,111 km²** (Figure 6 and **Tables 2, 3**). [...] The models inferred a gain in suitable habitats between 1950 and present times of **10,468 km²** (**8.1%**) and **158,747 km²** (**44.6%**) for intertidal and subtidal species, respectively (Figure 6 and **Tables 2, 3**). Across Arctic sectors, Canada represents the largest potential macroalgal distribution area followed by **Russia, Alaska, and Greenland**, however, Svalbard shows the largest **relative** gain in potential distribution area and **N. Norway and Iceland** the smallest (**Figure 6** and **Tables 2, 3**).

[...] On this basis, the substrate-adjusted modeled potential pan-Arctic distribution area of macroalgae represents about

half of the overall modeled area (**340,658–351,915 km²**, **Table 4**).”

A correction has been made to the **Discussion, paragraph 1 and 2** (corrected text marked in bold):

“[...] Our distribution model quantified the potential current suitable habitat at **655,111 km²** within the Arctic Council definition of the Arctic, based on sea ice, temperature, nutrients, and salinity but not substrate conditions (Figure 6 and **Tables 2, 3**). Demarcation of the modeled area that solely incorporates shorelines with coastal cliffs reduces the potential distribution area to about half (**340,658 km²**). [...]”

[...] Our macroalgal habitat model assessed, based on modeled changes in key habitat conditions, that the potential suitable area for Arctic macroalgae has expanded by about **8.1%** for intertidal algae and **44.6%** for subtidal algae over the past 60–70 years, with the largest relative increase in Svalbard and the smallest in **N. Norway and Iceland** (Figure 6 and **Table 2**).”

The authors apologize for these errors and state that this does not change the scientific conclusions of the article. The original article has been updated.

REFERENCES

Young, A. P., and Carilli, J. E. (2019). Global distribution of coastal cliffs. *Earth Surf. Process Landf.* 44, 1309–1316. doi: 10.1002/esp.4574

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