frontiers in Marine Science

CORRECTION
published: 13 July 2021
doi: 10.3389/fmars.2021.701634

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

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***Specialty section:***
*This article was submitted to Global Change and the Future Ocean, a section of the journal Frontiers in Marine Science*

***Received:*** *28 April 2021*
***Accepted:*** *04 May 2021*
***Published:*** *13 July 2021*

***Citation:***
*Krause-Jensen D, Archambault P, Assis J, Bartsch I, Bischof K, Filbee-Dexter K, Dunton KH, Maximova O, Ragnarsdóttir SB, Sejr MK, Simakova U, Spiridonov V, Wegeberg S, Winding MHS and Duarte CM (2021) Corrigendum: Imprint of Climate Change on Pan-Arctic Marine Vegetation. Front. Mar. Sci. 8:701634. doi: 10.3389/fmars.2021.701634*

**Keywords: distribution, abundance, trends, Arctic, sea-ice, warming, Eelgrass (*Zostera marina*), macroalgae**

**A Corrigendum on**

**Imprint of Climate Change on Pan-Arctic Marine Vegetation**
*by Krause-Jensen, D., Archambault, P., Assis, J., Bartsch, I., Bischof, K., Filbee-Dexter, K., et al. (2020). Front. Mar. Sci. 7:617324. doi: 10.3389/fmars.2020.617324*

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** km$^2$ (**140,433** km$^2$ intertidal, **514,679** km$^2$ 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** km$^2$). [..]"

**TABLE 2 |** Past (period 1940–1950) and present (period 2000–2017) potential pan-Arctic intertidal **brown** macroalgal distribution areas (km$^2$), 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 (km$^2$), 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** $km^2$ and **514,679** $km^2$ of suitable habitats for intertidal and subtidal species, respectively, i.e., a total potential distribution area of **655,111** $km^2$ (Figure 6 and **Tables 2**, **3**). [..] The models inferred a gain in suitable habitats between 1950 and present times of **10,468** $km^2$ (**8.1**%) and 158,747 $km^2$ (**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** $km^2$, **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** $km^2$ 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** $km^2$). [..]

[..] 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