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Phenotypic variation of sugar kelp (*Saccharina latissima*) along the western coast of Iceland

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Reducing atmospheric CO₂ is essential to mitigating the effects of climate change. Marine macroalgae has garnered interest as a potential carbon sink to sequester atmospheric CO₂. Efforts to improve macroalgae for use as a carbon sink are just beginning, and understanding the phenotypic diversity of macroalgae is a critical part of identifying favorable characteristics for a marine carbon sink. In this study, we surveyed the natural variation of the marine macroalgae, *Saccharina latissima* (sugar kelp), from eight sites along the western coast of Iceland: three in Breiðafjörður, four in Faxaflói, and one in the Atlantic Ocean south of Reykjanes. All collected sugar kelp samples were in the non-reproductive stage, and environmental data was collected at each site. All collected sugar kelp samples were phenotyped manually and through image analysis. Chlorophyll content, carbon and nitrogen content, and relative carbohydrate contents were also quantified. Strong correlations were observed between many morphological phenotypes and with environmental variables such as air temperature. While phenotypic differences between sampling locations were observed in some individual traits like blade length and chlorophyll content, principal component analysis did not reveal significant grouping of individuals by sampling location based on phenotype. These results suggest that phenotypic variation in sugar kelp populations across the Western Icelandic range is not strongly influenced by changes in environmental variation. These results are consistent with natural variation studies conducted in sugar kelp samples from New England, United States and indicate that sugar kelp can be a favorable choice for carbon sequestration across multiple environments.