

KELPS vs URCHINS

The role of sea urchins in the kelp carbon cycle

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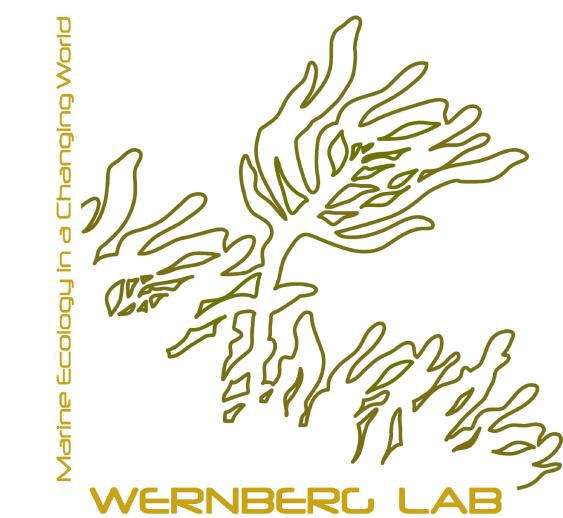
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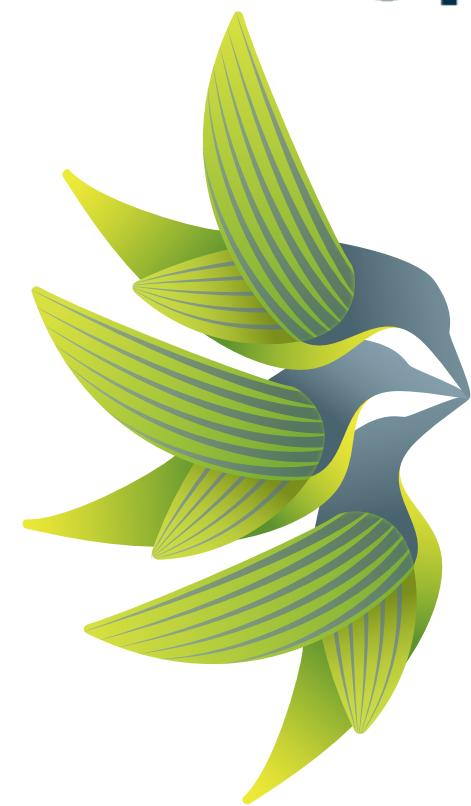
Acknowledgements



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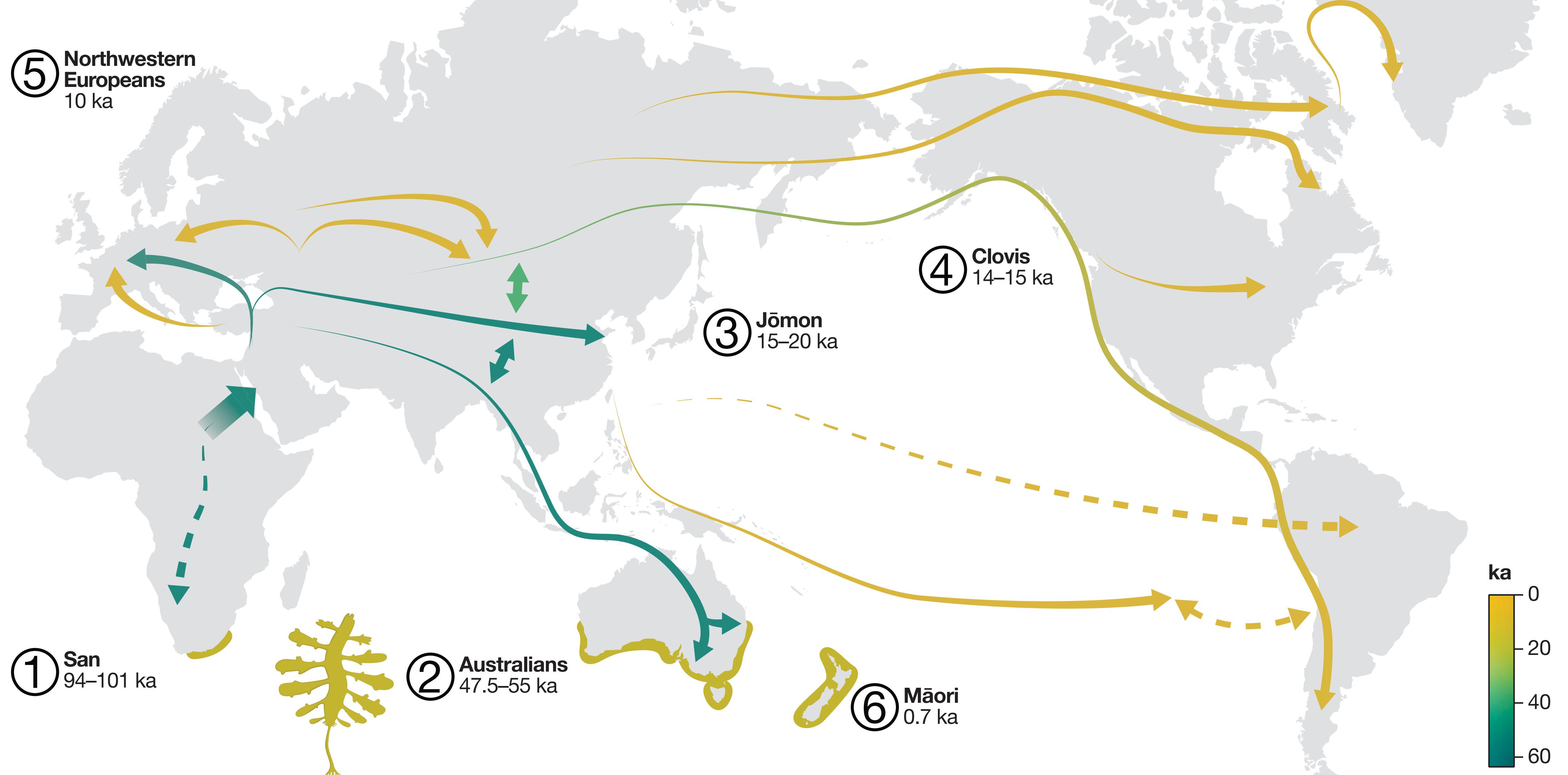


ECOLOGICAL
SOCIETY
OF AUSTRALIA



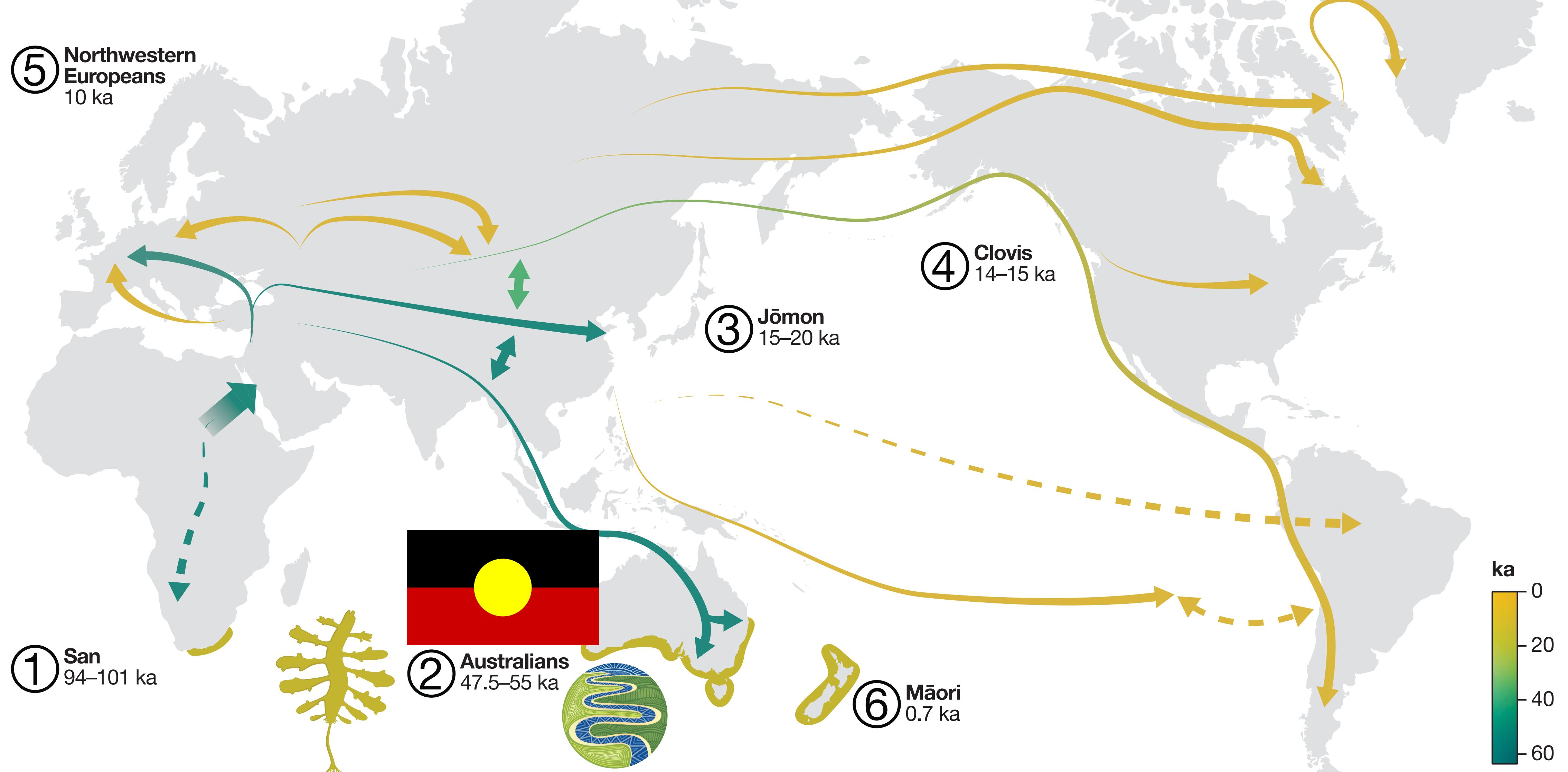
The Research
Council of Norway

Humans and temperate reefs



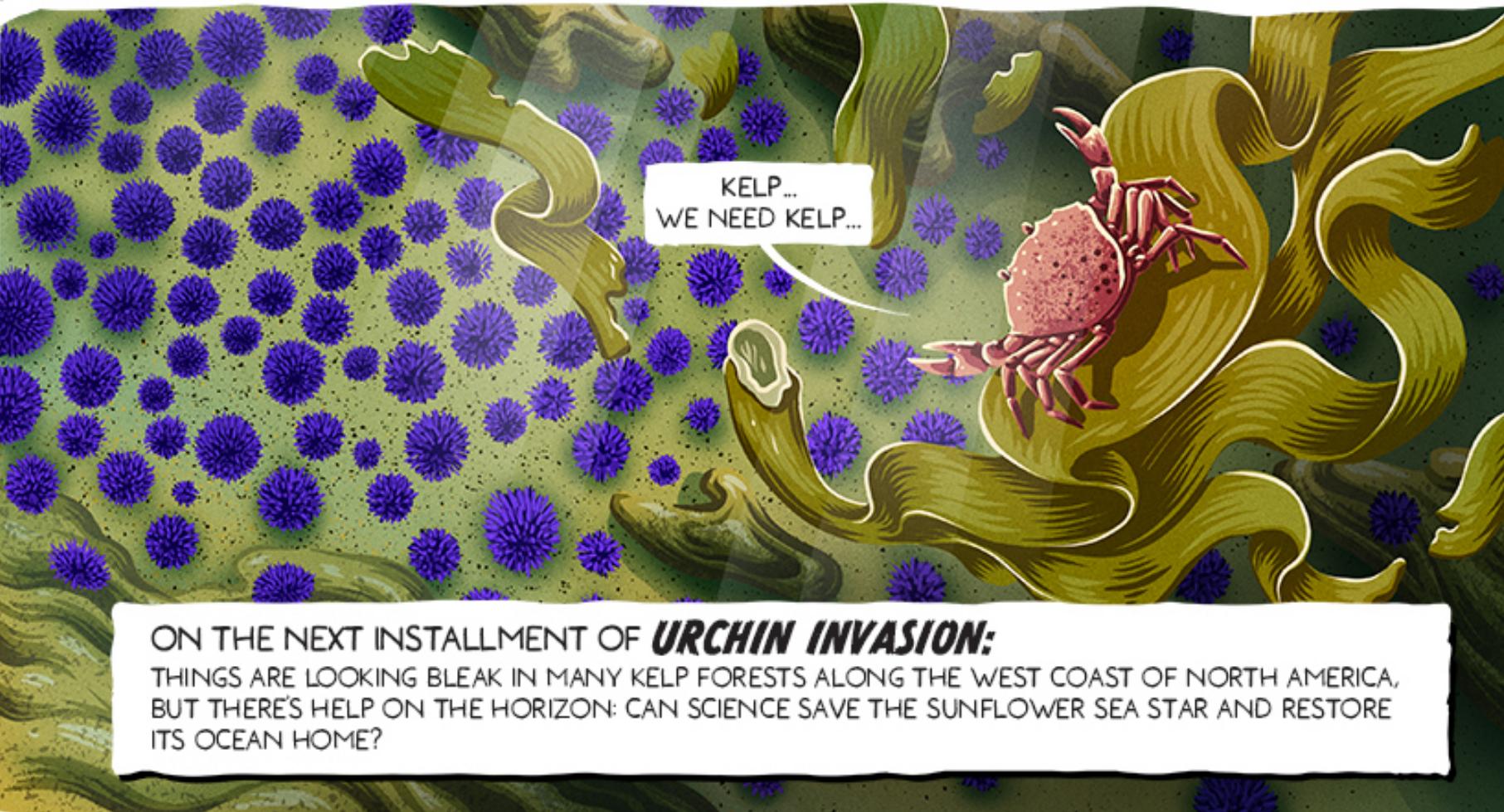
Adapted from Nielsen et al. 2017. *Nature*. doi 10.1038/nature21347.

Humans and temperate reefs

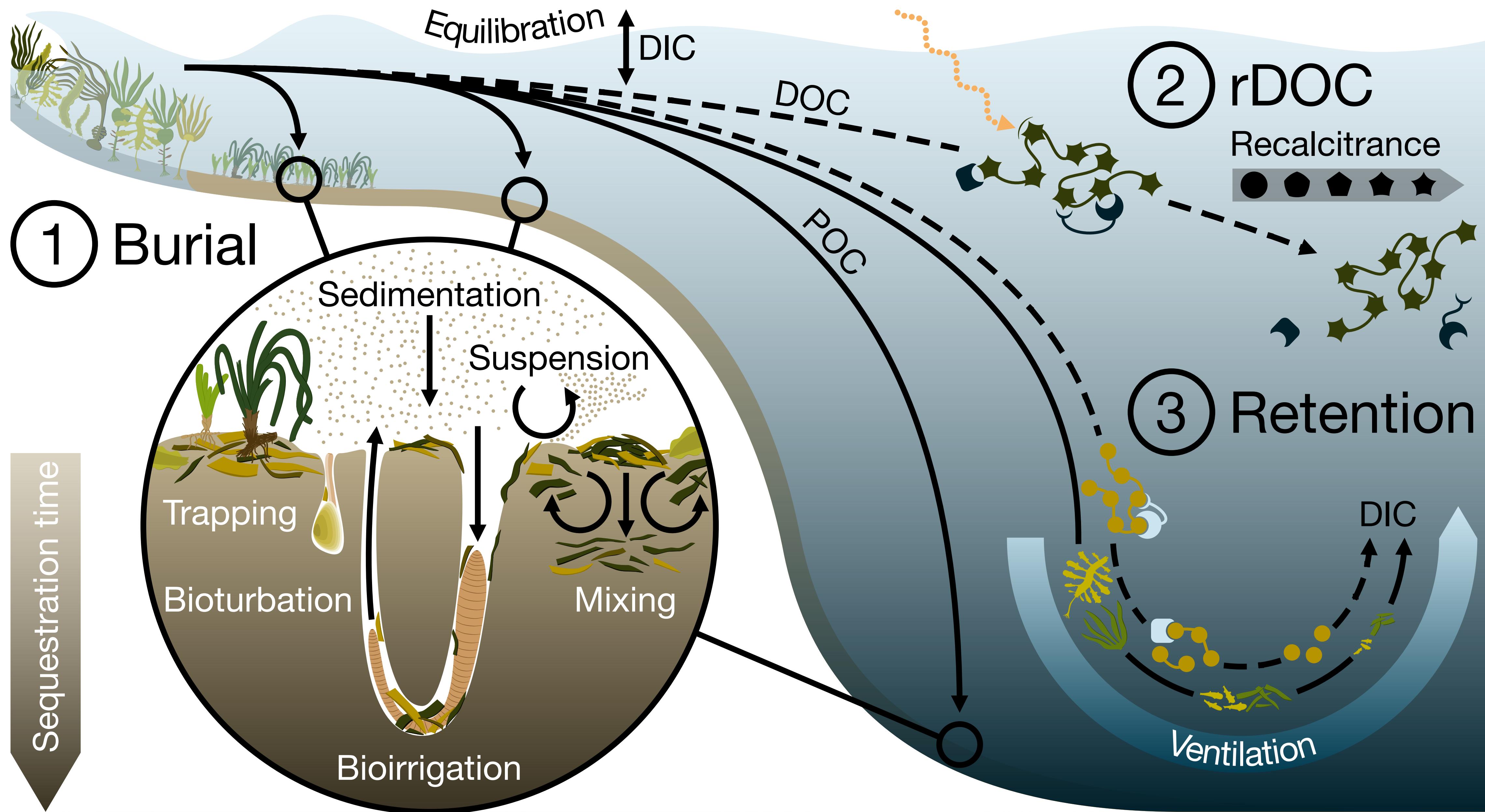


Adapted from Nielsen et al. 2017. *Nature*. doi 10.1038/nature21347.

Background



What is the role of sea urchins the kelp carbon cycle?



**What is the role of sea urchins the kelp carbon cycle?
Well, duh...**



But...

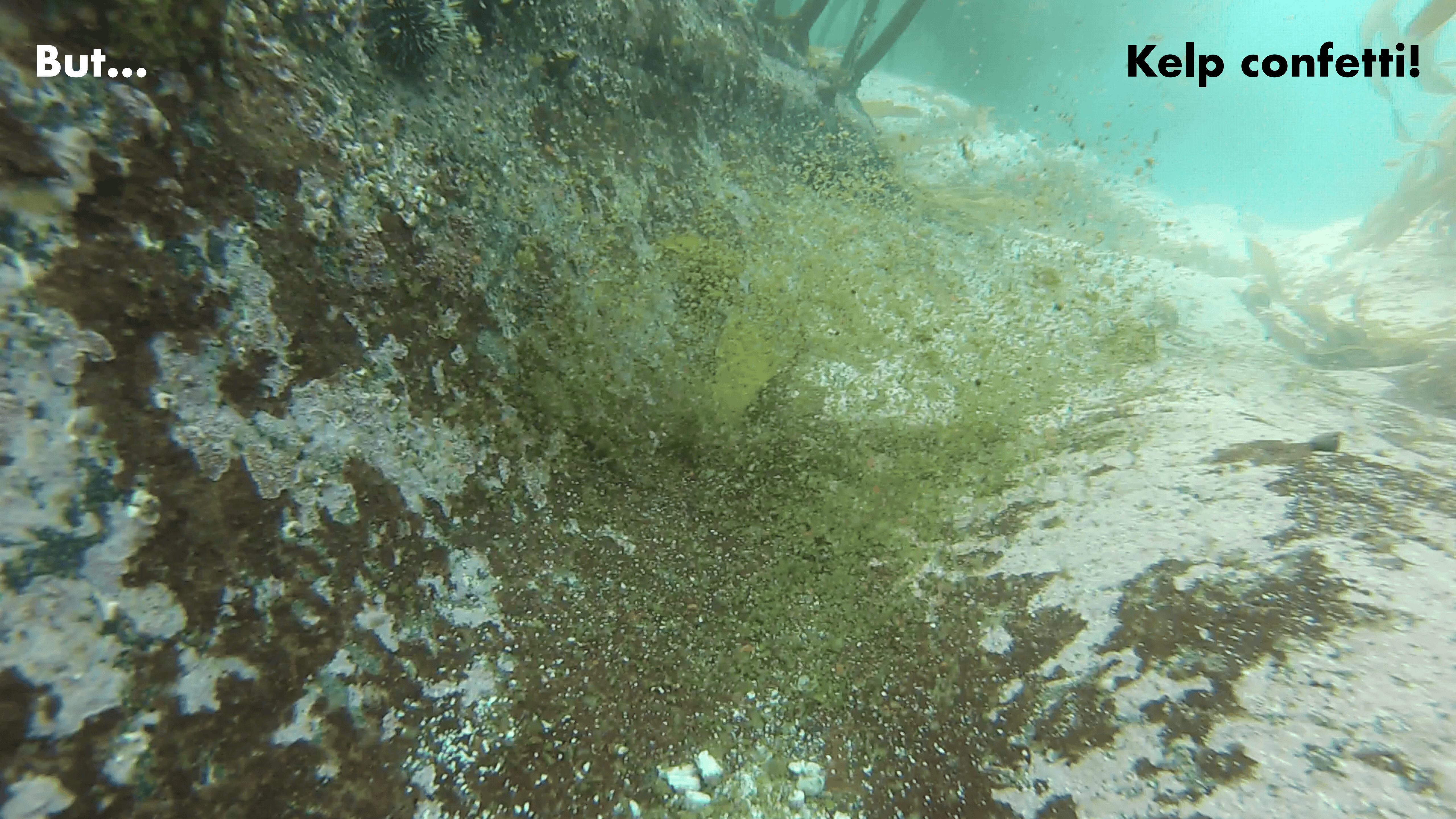


But...



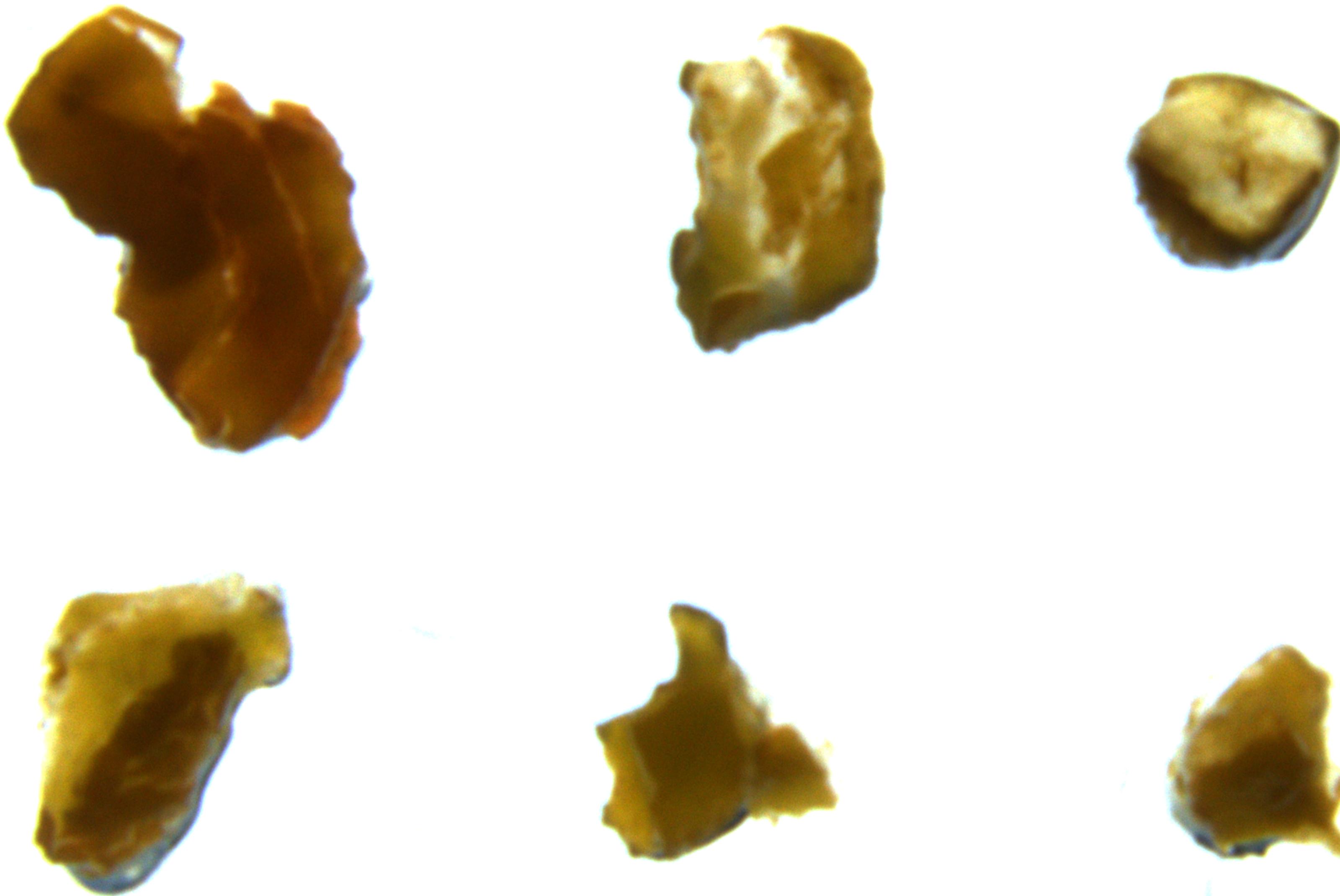
But...

Kelp confetti!



But...

Kelp confetti!



1 mm

But...

Kelp confetti!

Grazers extend blue carbon transfer by slowing sinking speeds of kelp detritus

Thomas Wernberg  ^{1,2} & Karen Filbee-Dexter ^{3,4}

ECOSYSTEM ECOLOGY – ORIGINAL RESEARCH



Carbon export is facilitated by sea urchins transforming kelp detritus

Karen Filbee-Dexter ^{1,2}  · Morten Foldager Pedersen ³ · Stein Fredriksen ^{1,4} · Kjell Magnus Norderhaug ¹ · Eli Rinde ² · Trond Kristiansen ² · Jon Albretsen ¹ · Thomas Wernberg ^{3,5}

1. Sinking

Prior Kelp Faeces



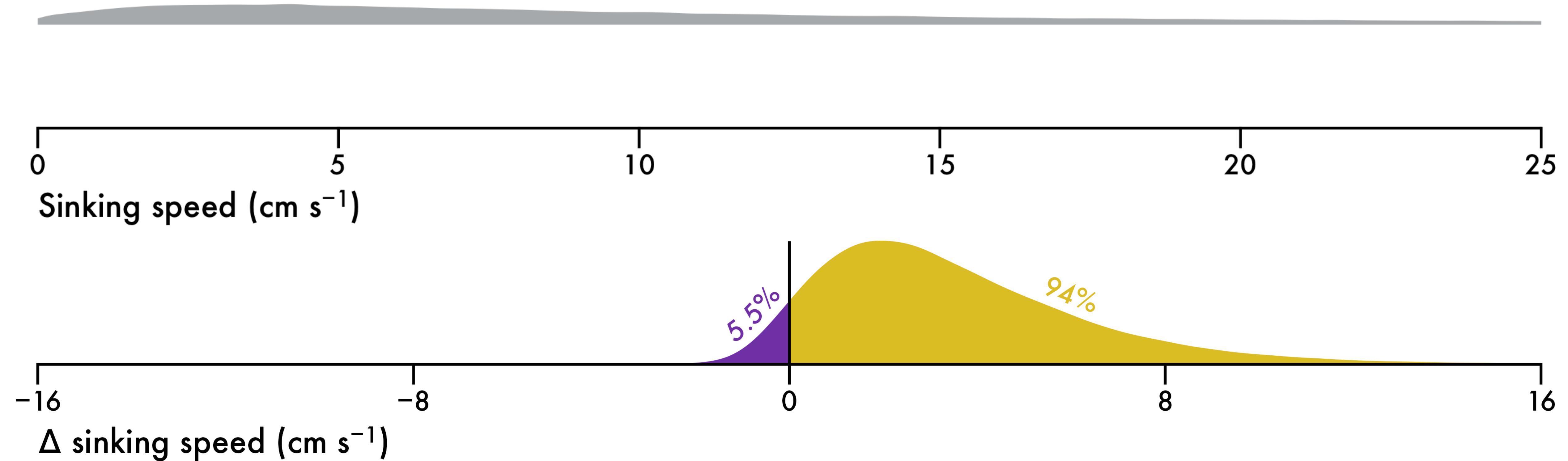
1. Sinking

Prior Kelp Faeces



1. Sinking

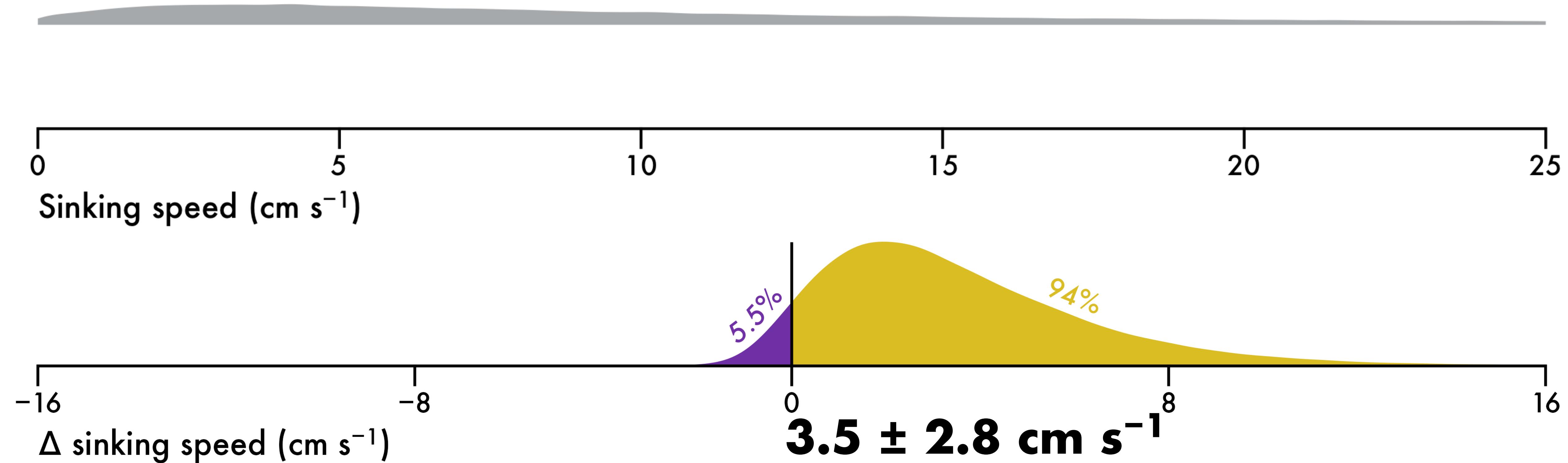
Prior Kelp Faeces



Data from Figure 2 in Wernberg & Filbee-Dexter 2018. *Scientific Reports*. doi 10.1038/s41598-018-34721-z.

1. Sinking

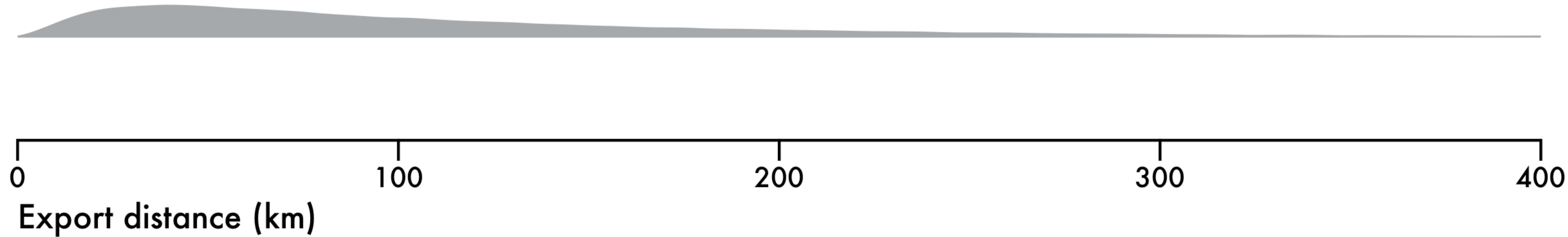
Prior Kelp Faeces



Data from Figure 2 in Wernberg & Filbee-Dexter 2018. *Scientific Reports.* doi 10.1038/s41598-018-34721-z.

2. Distance

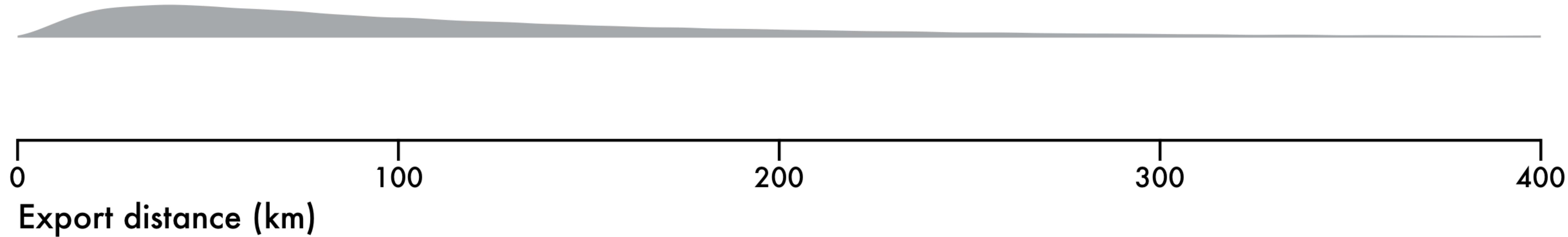
Prior Kelp Faeces



Data from Figure 7 in Filbee-Dexter et al. 2020. *Oecologia*. doi 10.1007/s00442-019-04571-1.

2. Distance

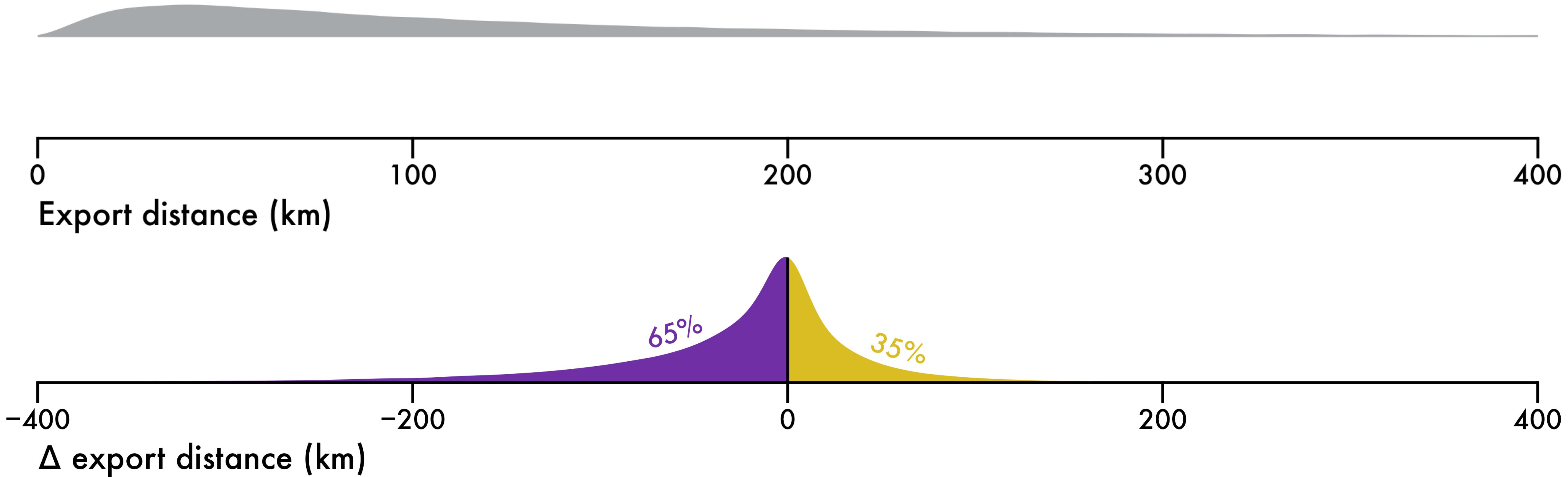
Prior Kelp Faeces



Data from Figure 7 in Filbee-Dexter et al. 2020. *Oecologia*. doi 10.1007/s00442-019-04571-1.

2. Distance

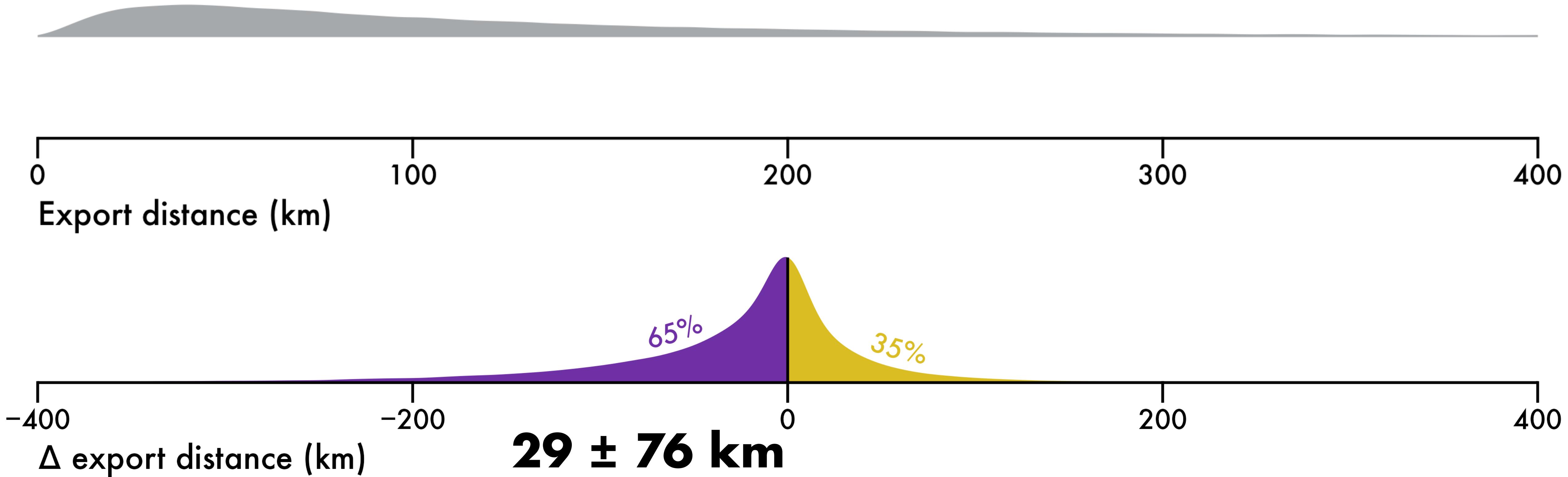
Prior Kelp Faeces



Data from Figure 7 in Filbee-Dexter et al. 2020. *Oecologia*. doi 10.1007/s00442-019-04571-1.

2. Distance

Prior Kelp Faeces

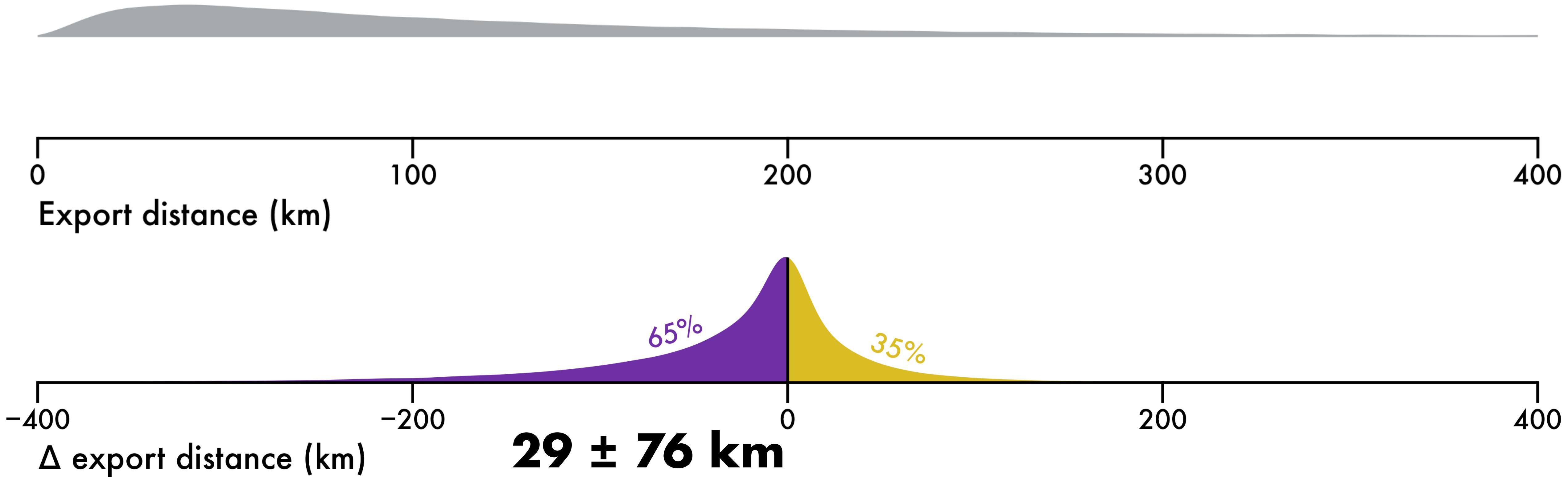


Data from Figure 7 in Filbee-Dexter et al. 2020. *Oecologia*. doi 10.1007/s00442-019-04571-1.

2. Distance

$$\text{Faeces} = 2.3 \pm 0.14 (\mu) \times \text{Kelp}$$

Prior Kelp Faeces



Data from Figure 7 in Filbee-Dexter et al. 2020. *Oecologia*. doi 10.1007/s00442-019-04571-1.

Assumptions

Assumptions

1. No carbon loss to urchin

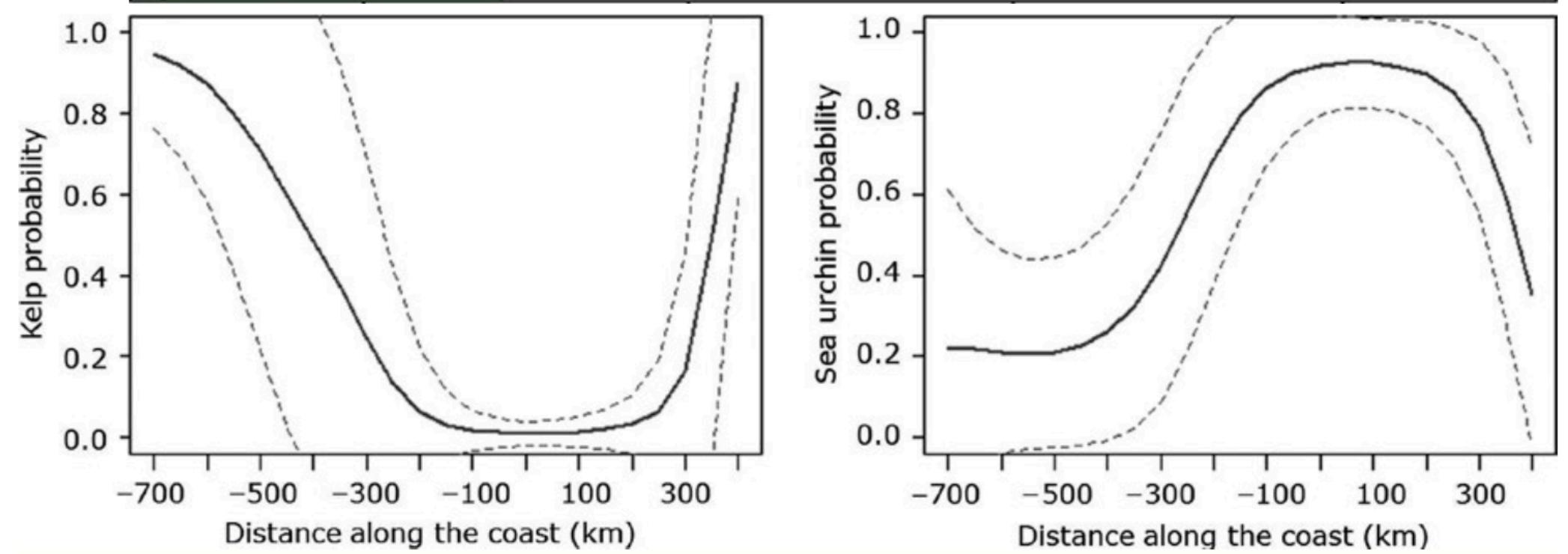
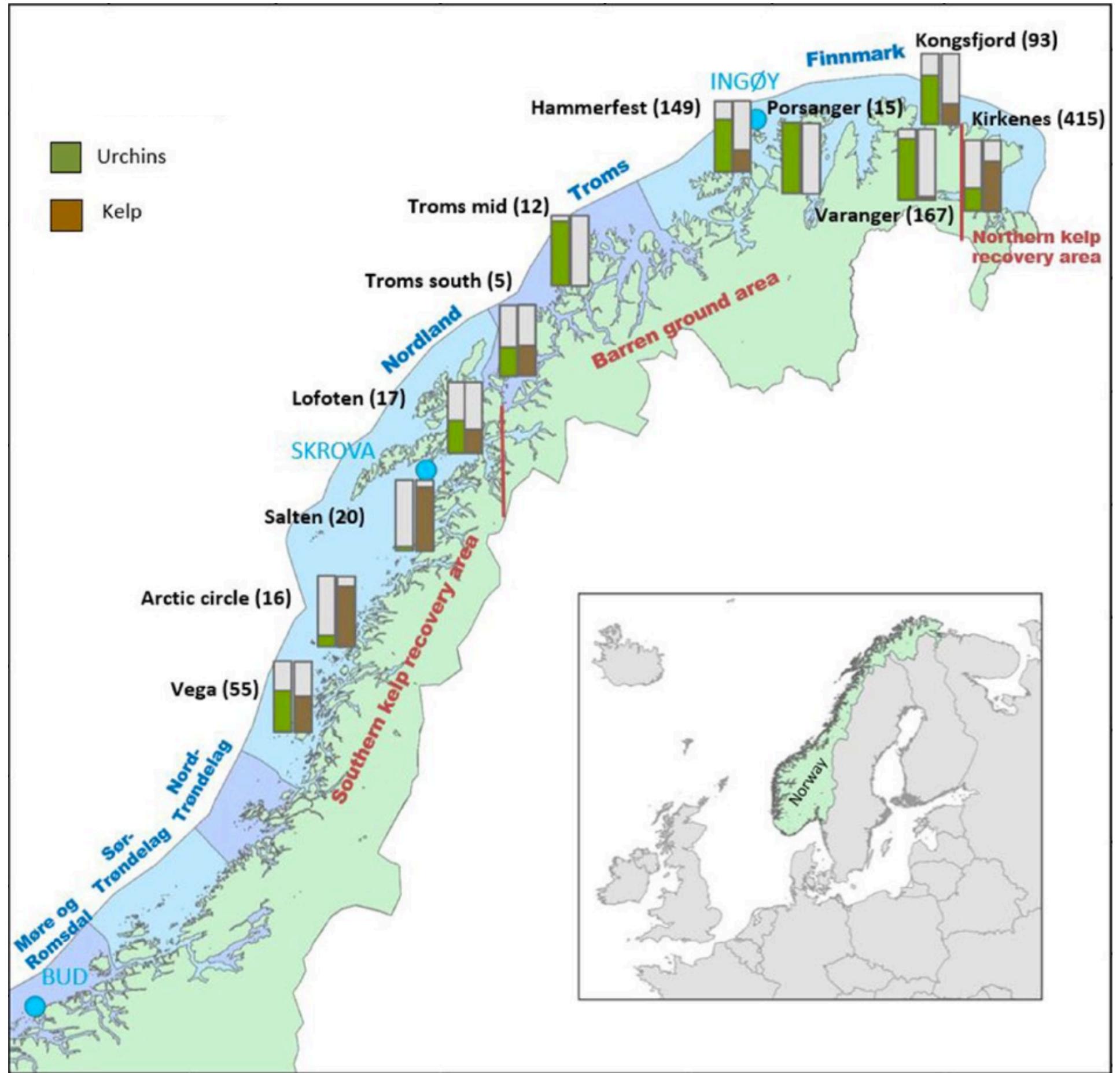
Assumptions

- 1. No carbon loss to urchin**
- 2. Identical decomposition rate**

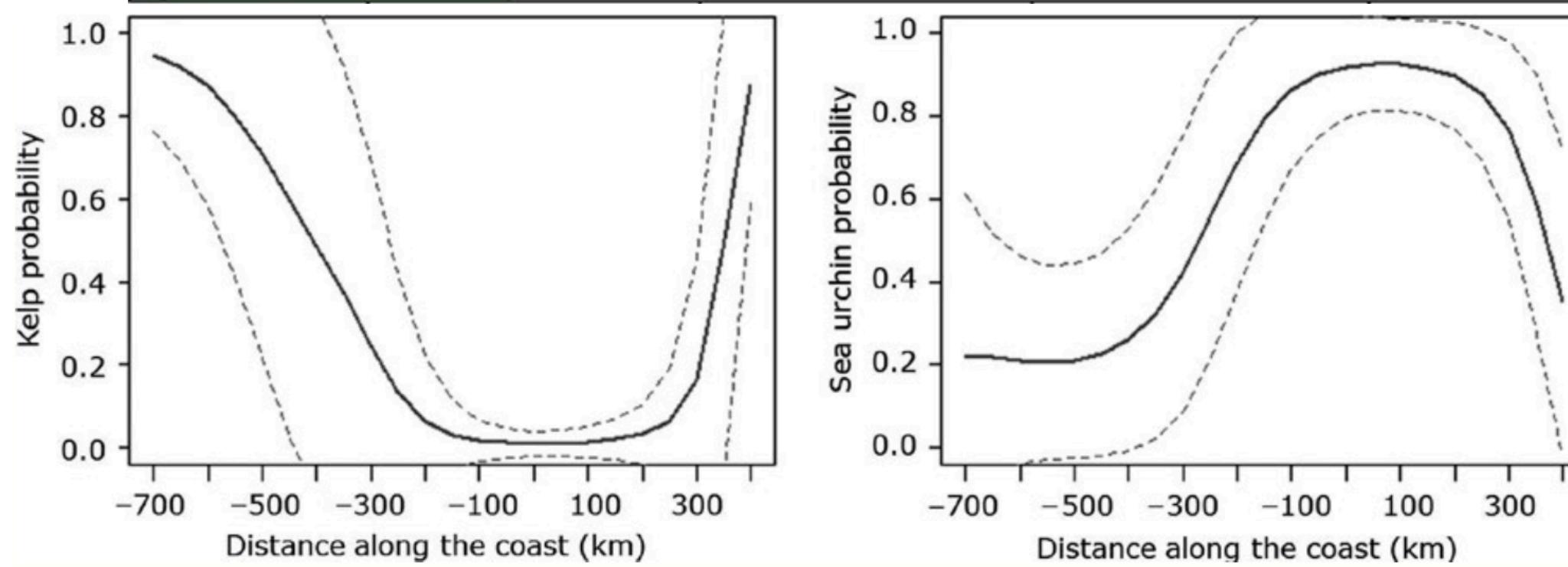
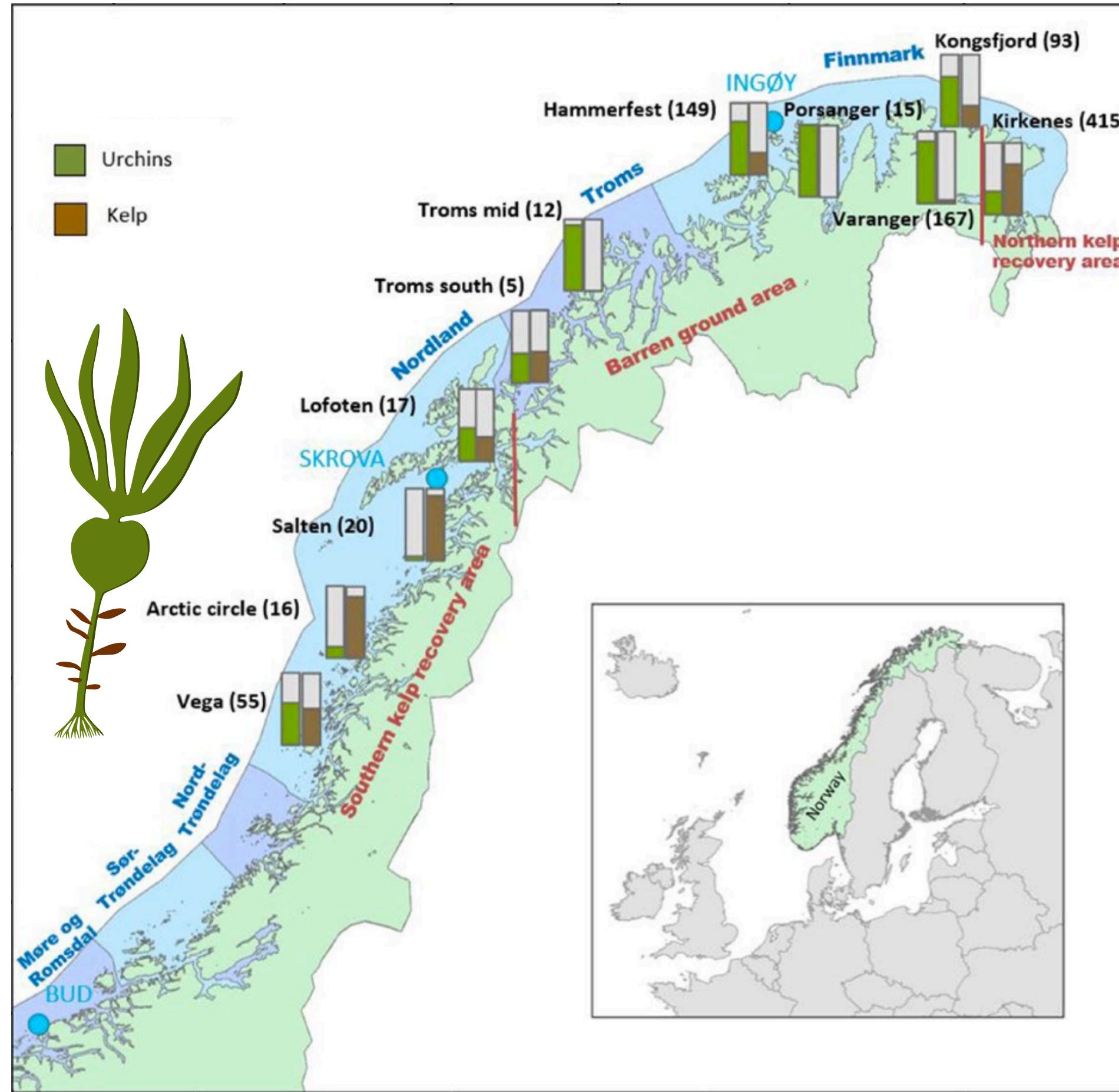
Question

Do sea urchins really extend kelp carbon transfer?

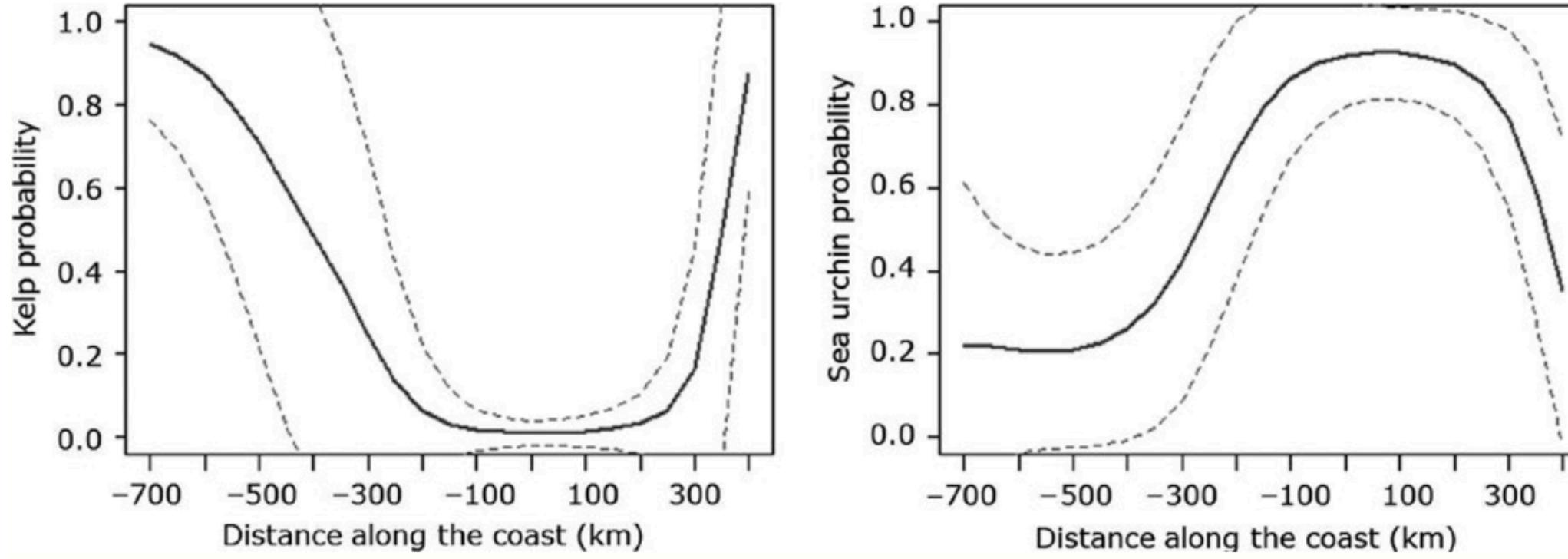
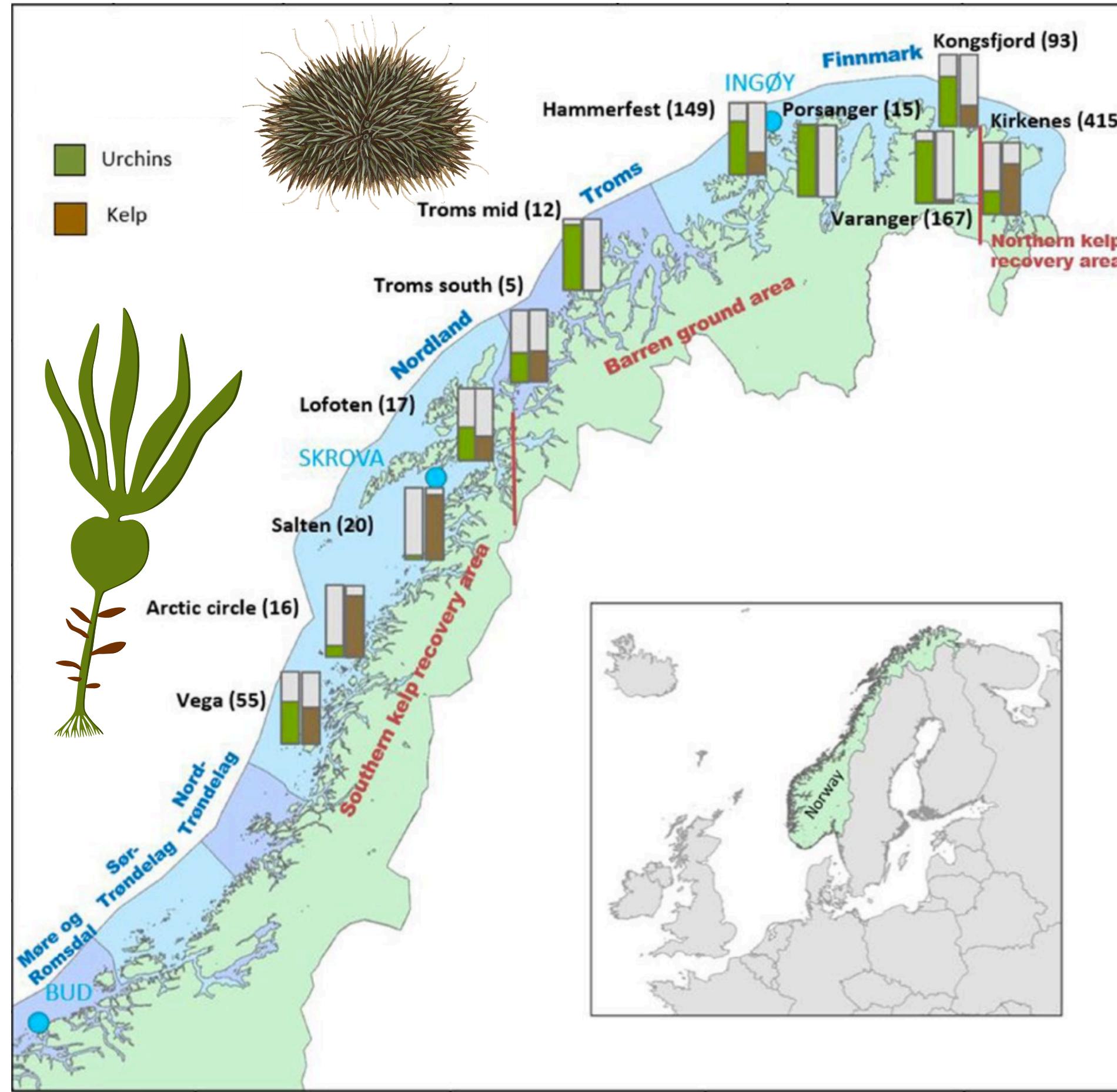
Study site



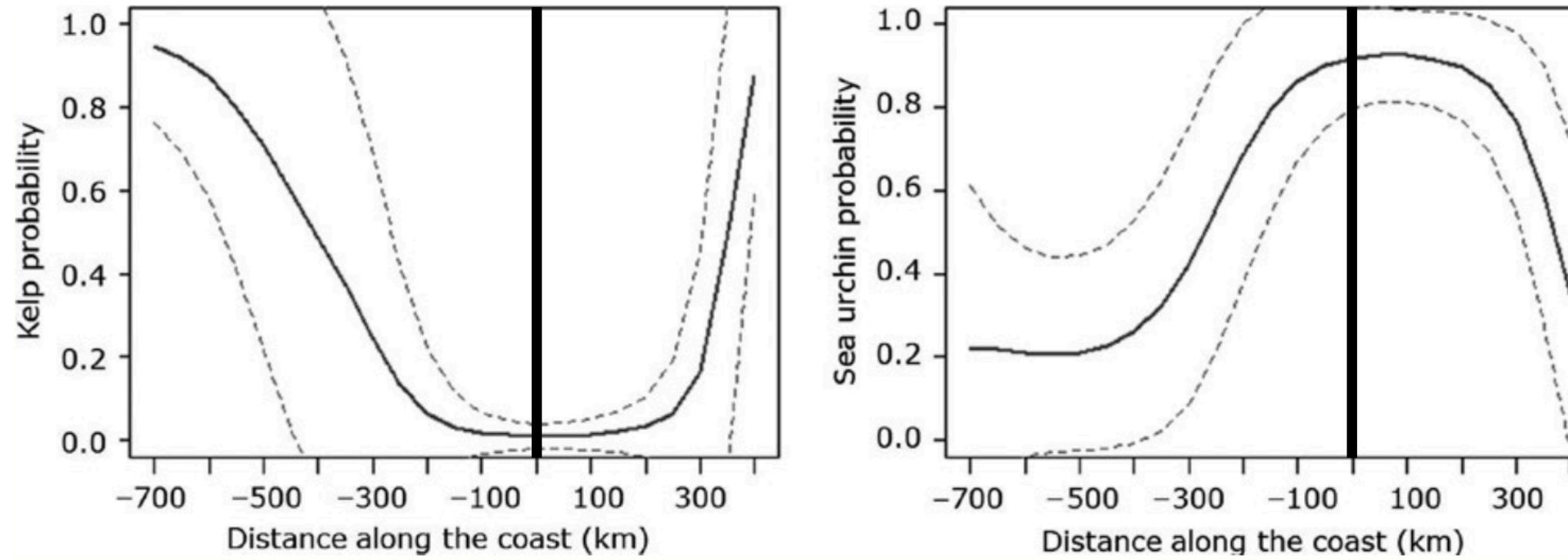
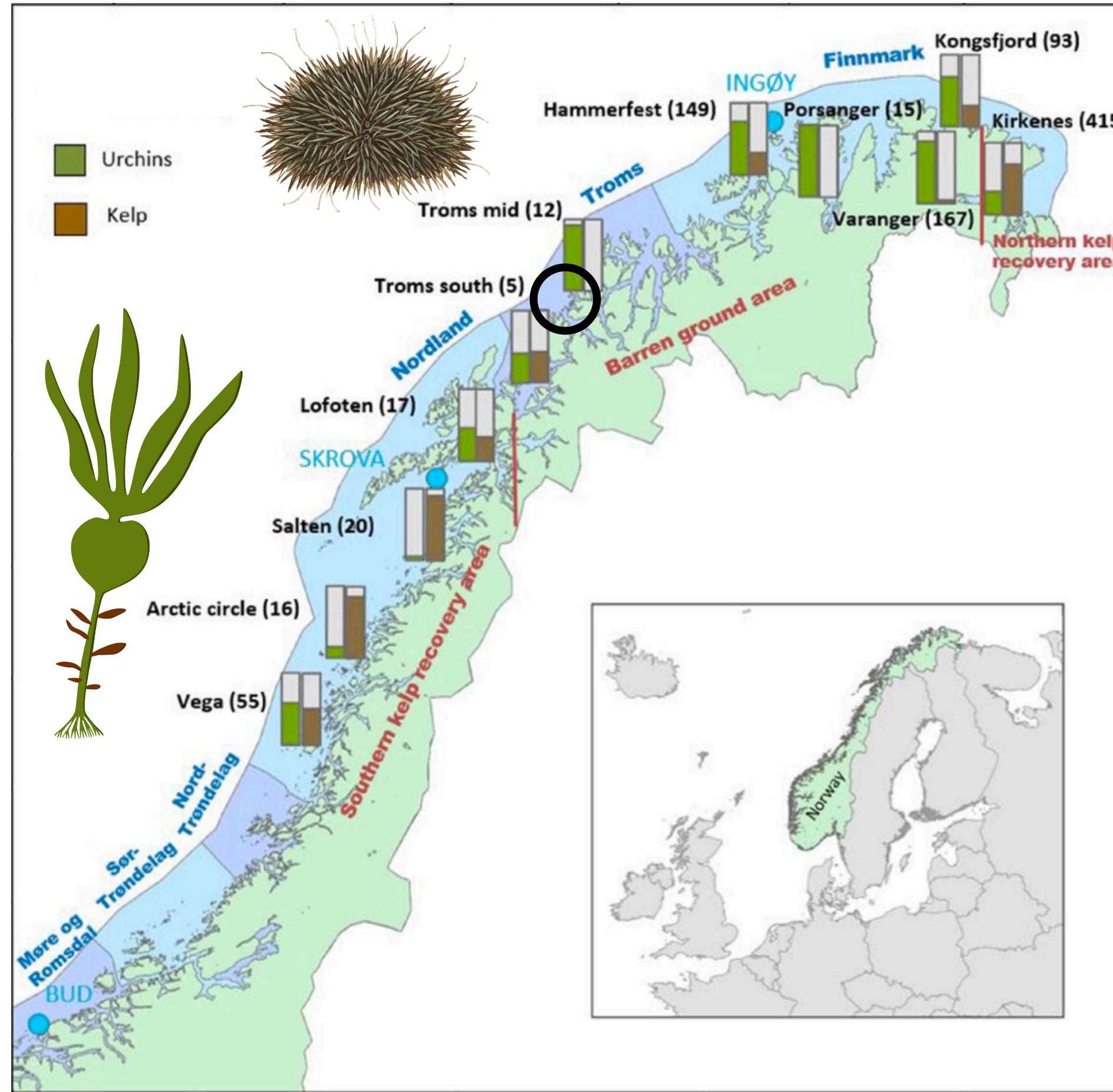
Adapted from Christie et al. 2019. *Ecology and Evolution*. doi 10.1002/ece3.4963.



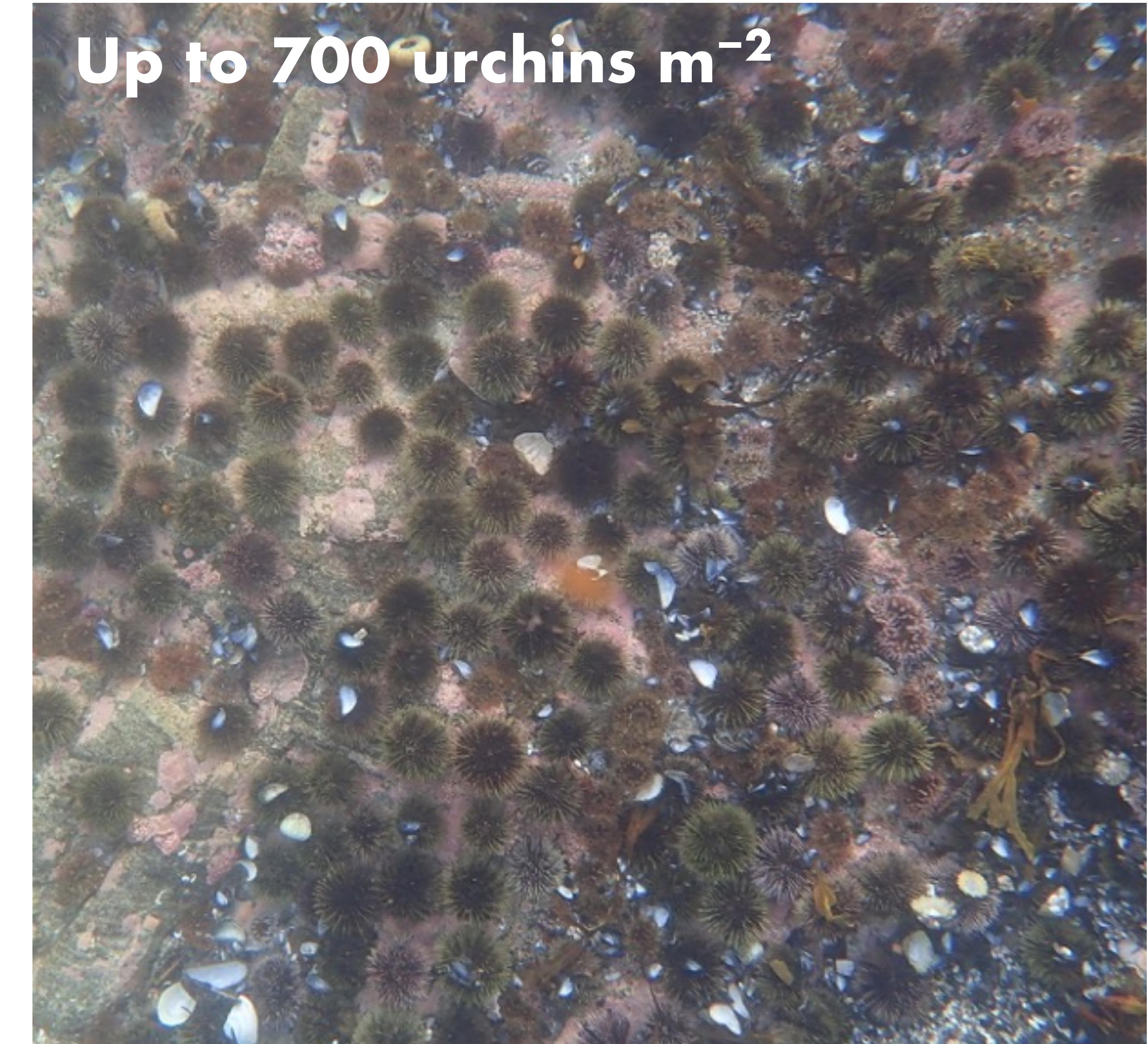
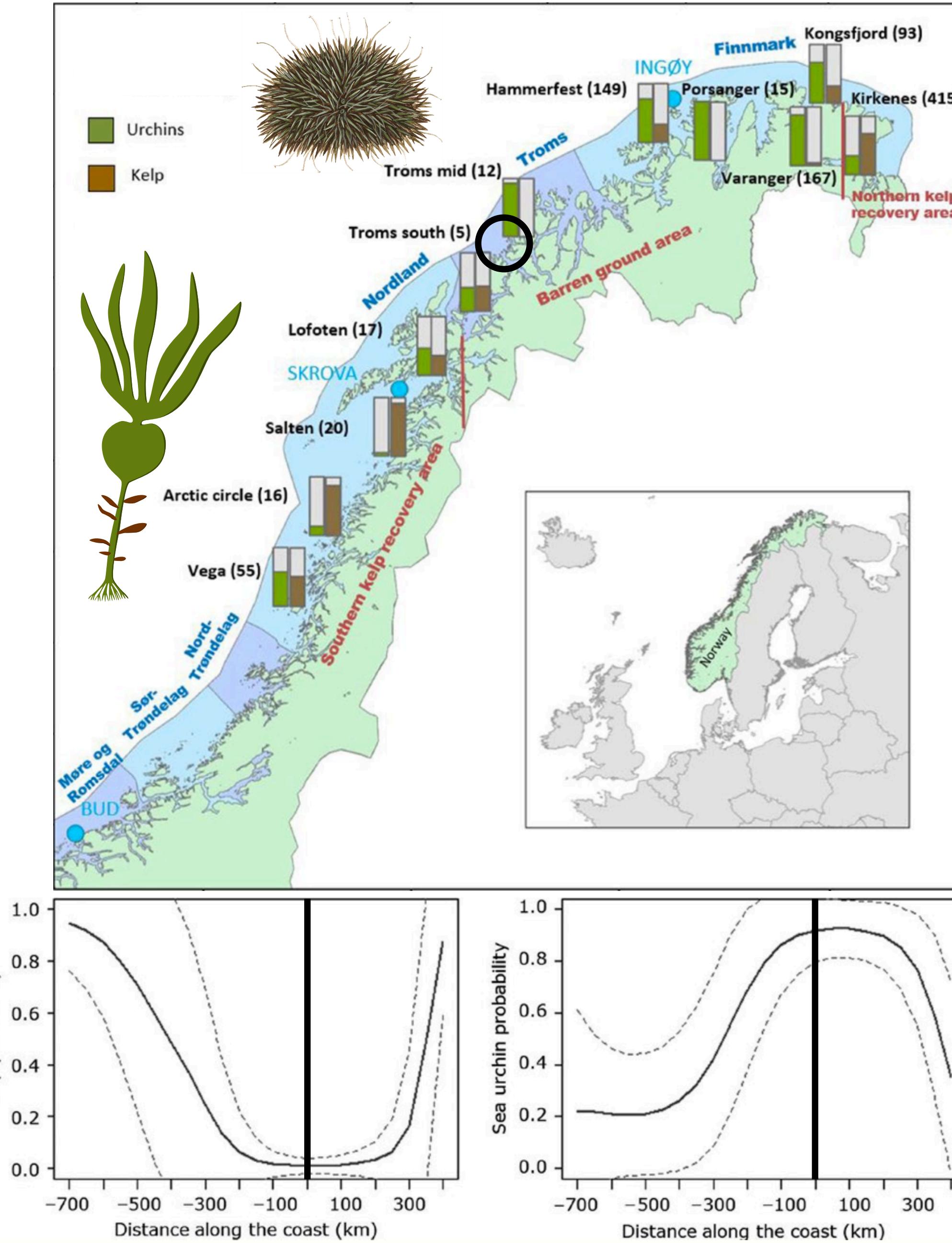
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Adapted from Christie et al. 2019. *Ecology and Evolution*. doi 10.1002/ece3.4963.

Results

Results

1. Biomass

Results

- 1. Biomass**
- 2. Carbon**

Results

- 1. Biomass }**
 - 2. Carbon }**
- Carbon transfer**

Results

- 1. Biomass**
 - 2. Carbon**
 - 3. Chemical defence**
- } **Carbon transfer**

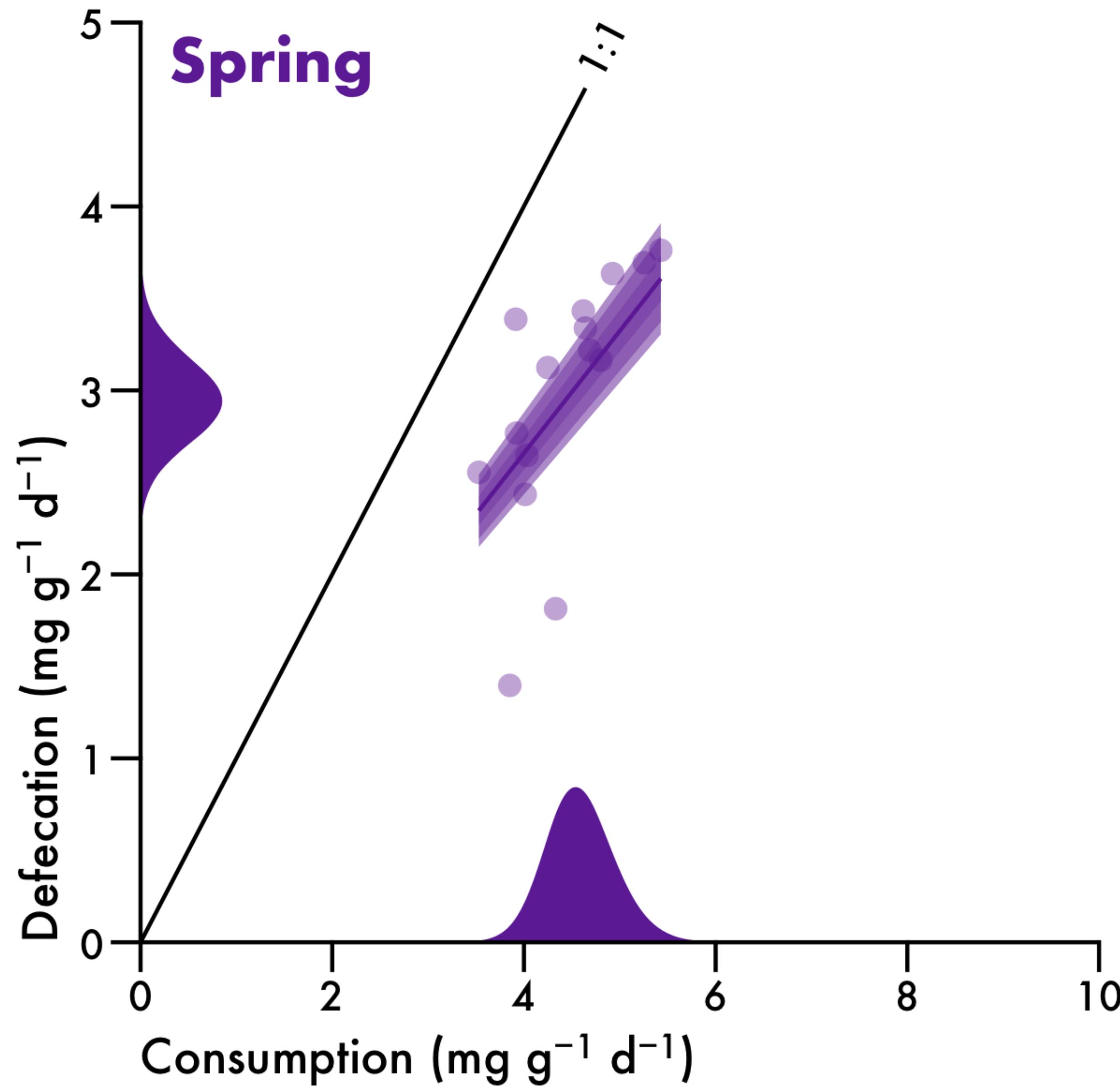
Results

- 1. Biomass**
 - 2. Carbon**
 - 3. Chemical defence**
 - 4. Photophysiology**
- } **Carbon transfer**

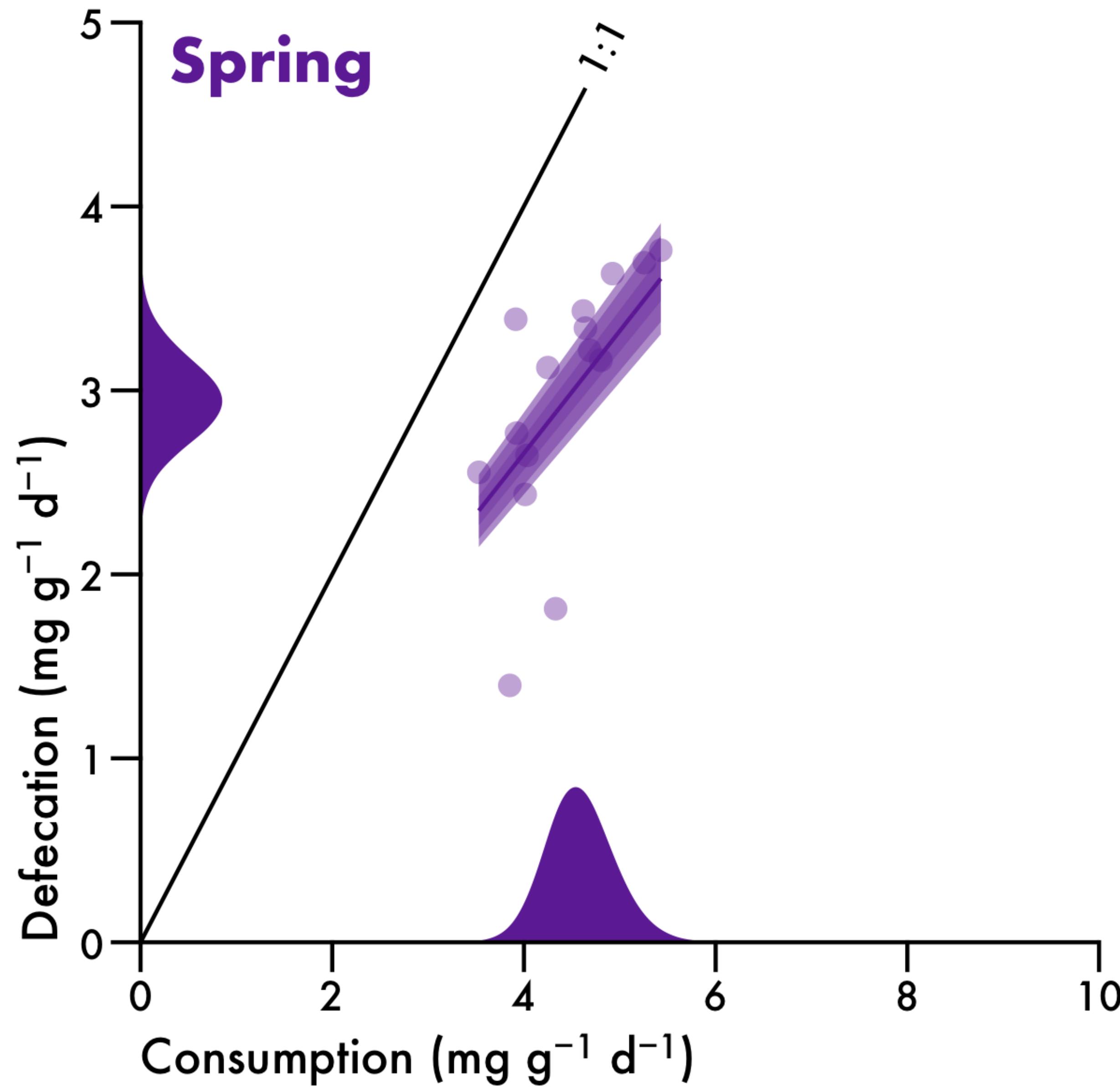
Results

- 1. Biomass } Carbon transfer
- 2. Carbon } Decomposition
- 3. Chemical defence }
- 4. Photophysiology }

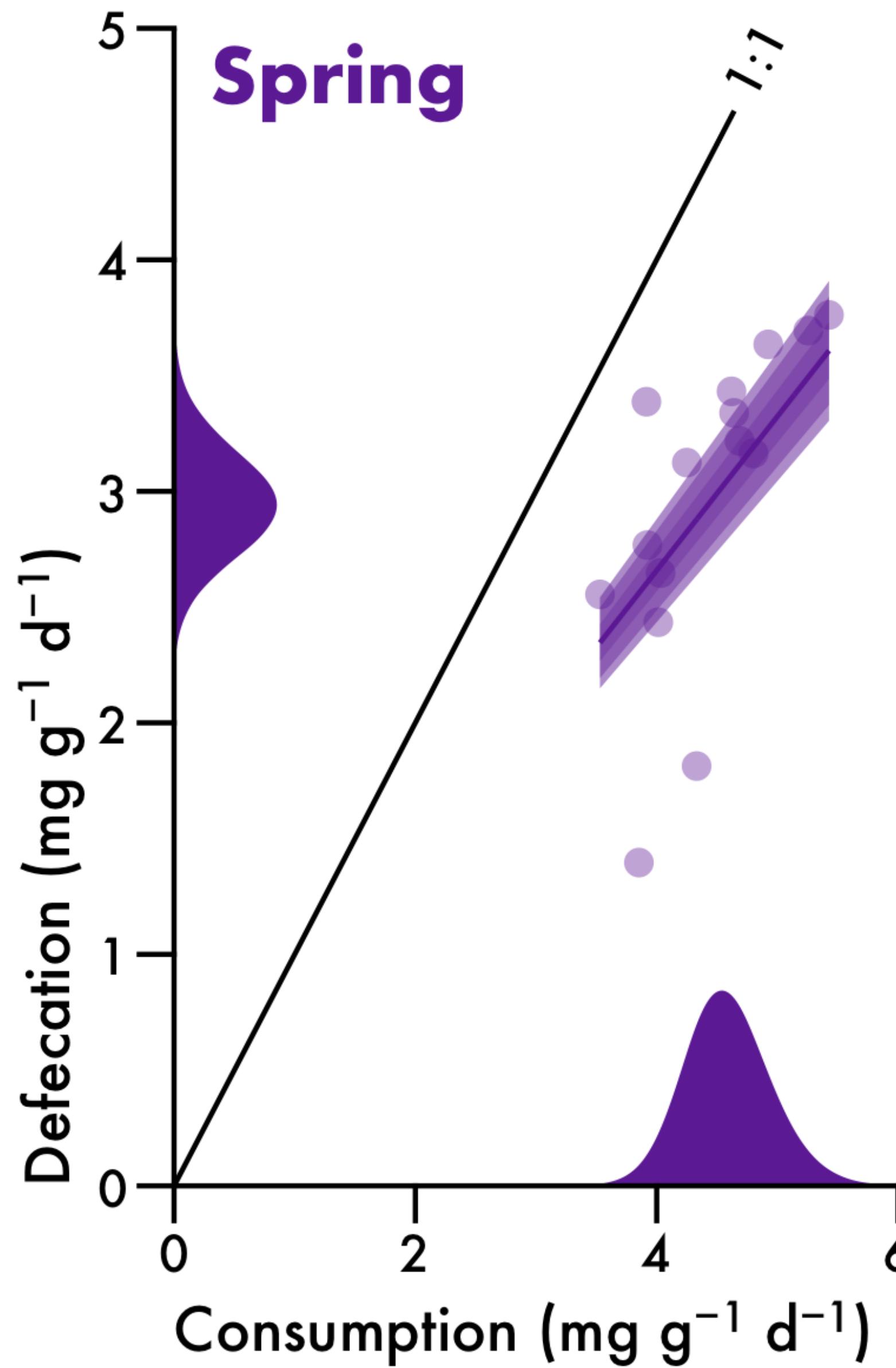
1. Biomass



1. Biomass

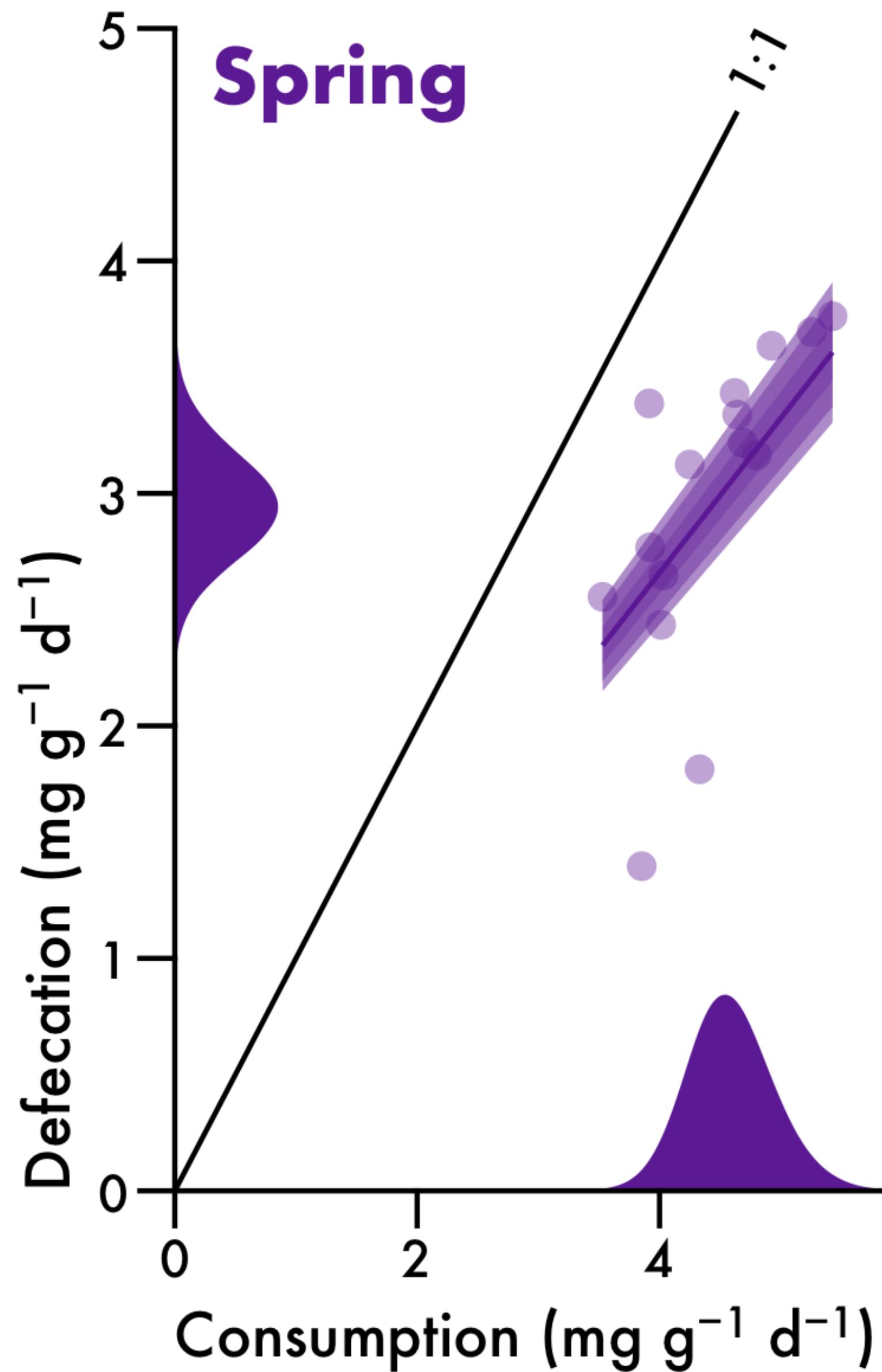


1. Biomass



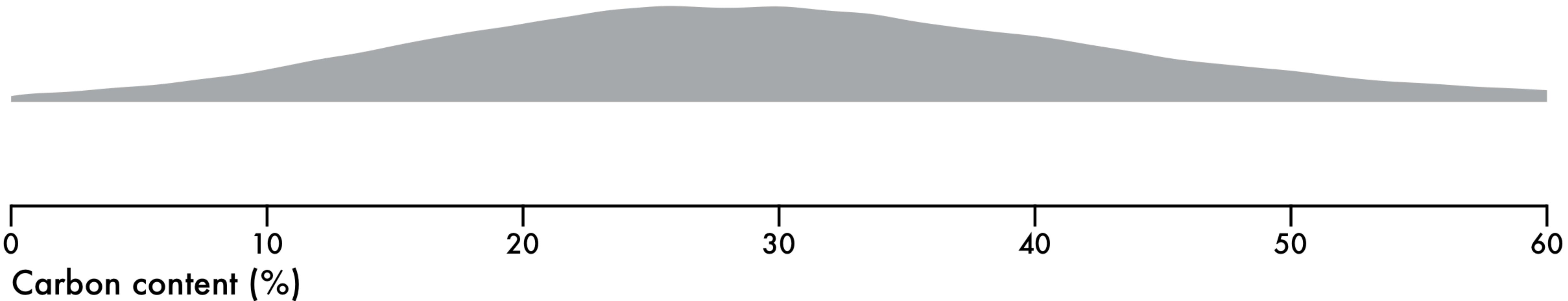
1. Biomass

Annual: $44 \pm 20\%$



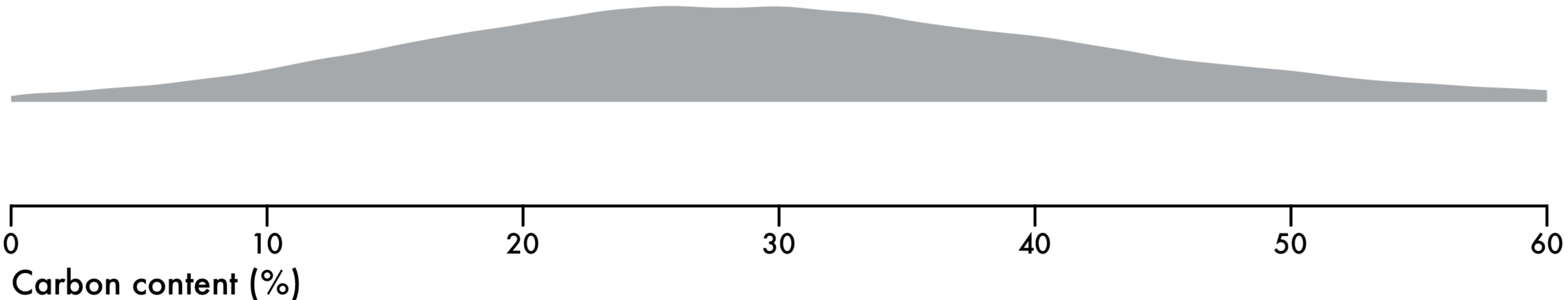
2. Carbon

Prior Kelp Faeces



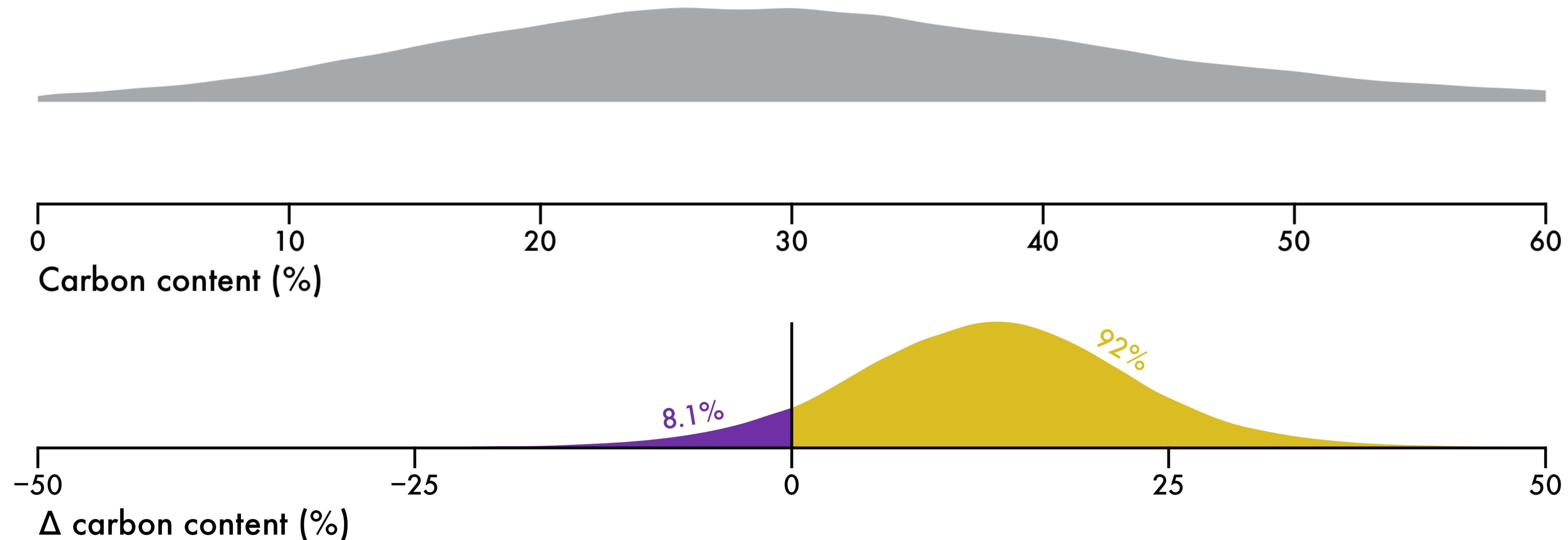
2. Carbon

Prior Kelp Faeces



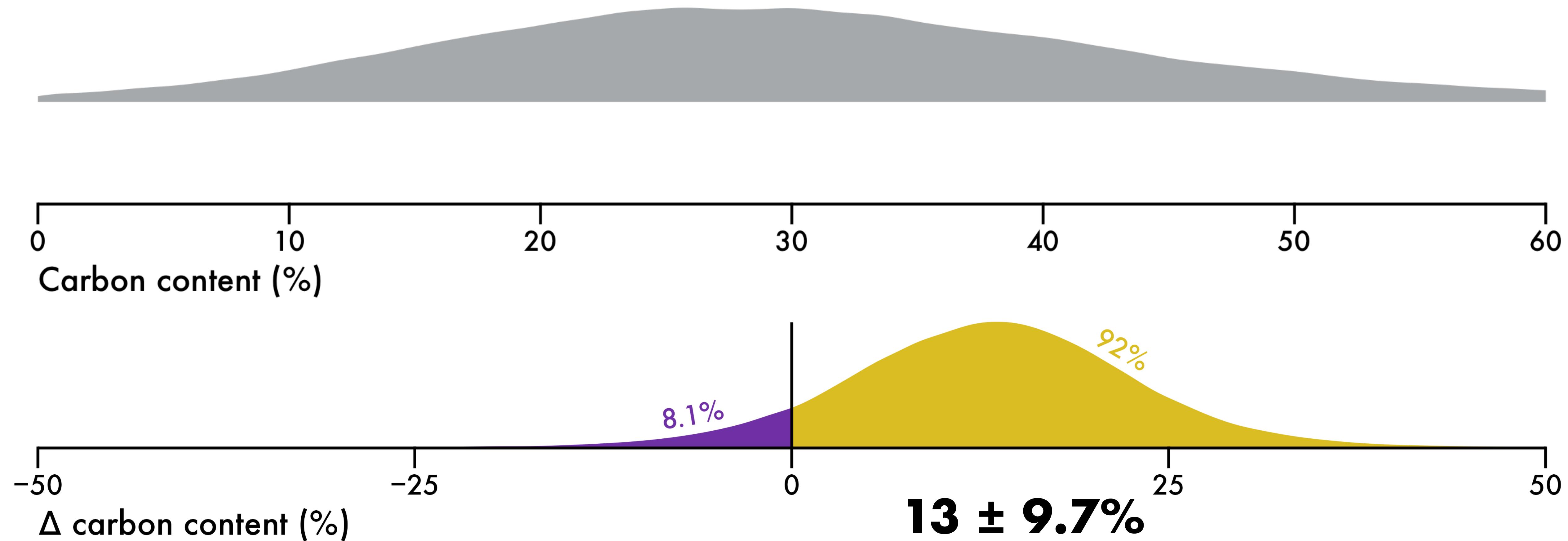
2. Carbon

Prior Kelp Faeces



2. Carbon

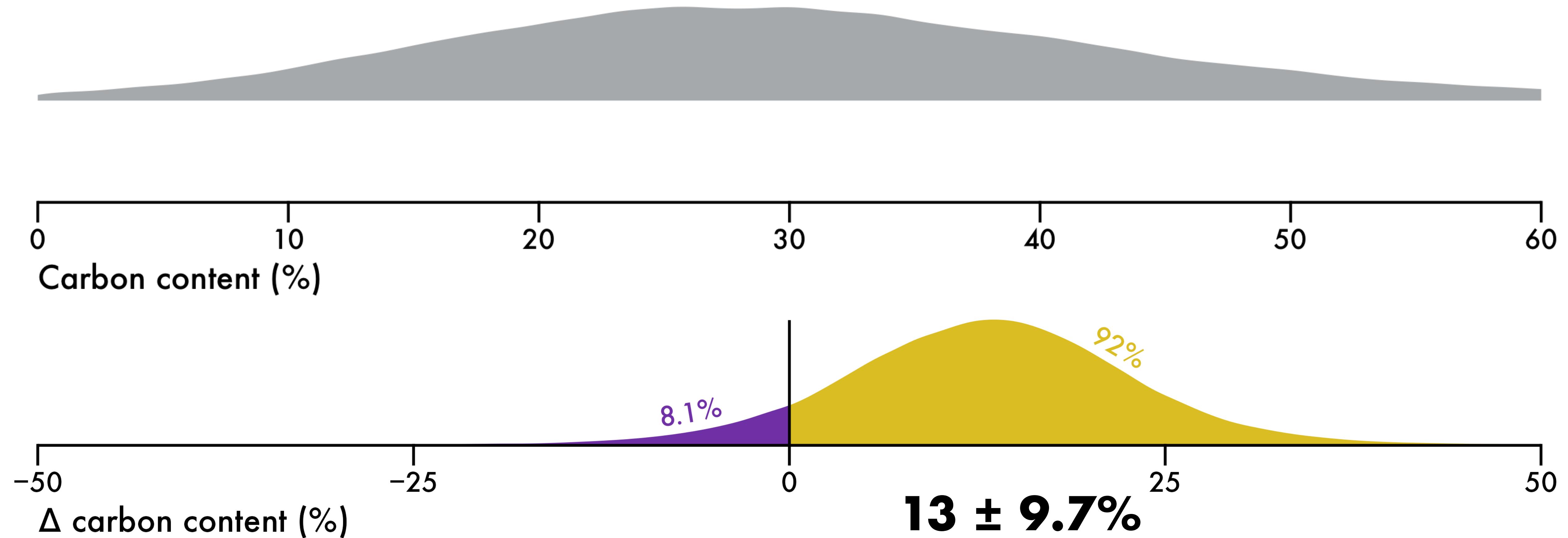
Prior Kelp Faeces



2. Carbon

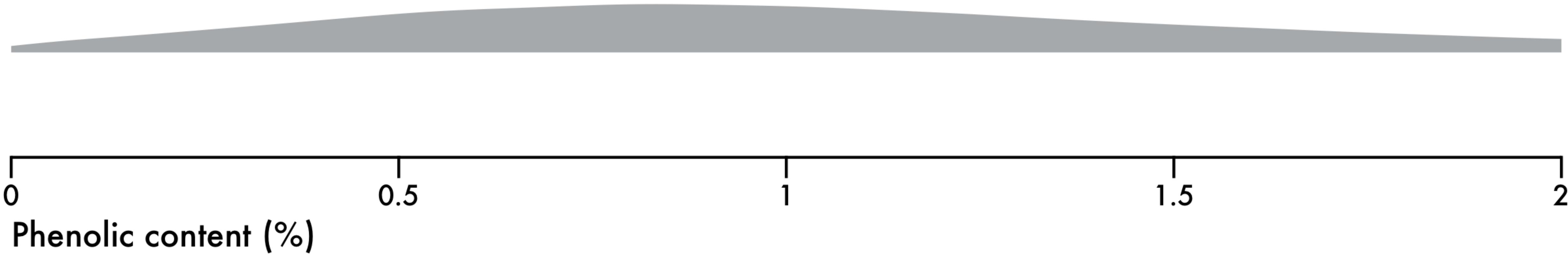
$$\text{Faeces} = 0.65 \pm 0.27 \times \text{Kelp}$$

Prior Kelp Faeces



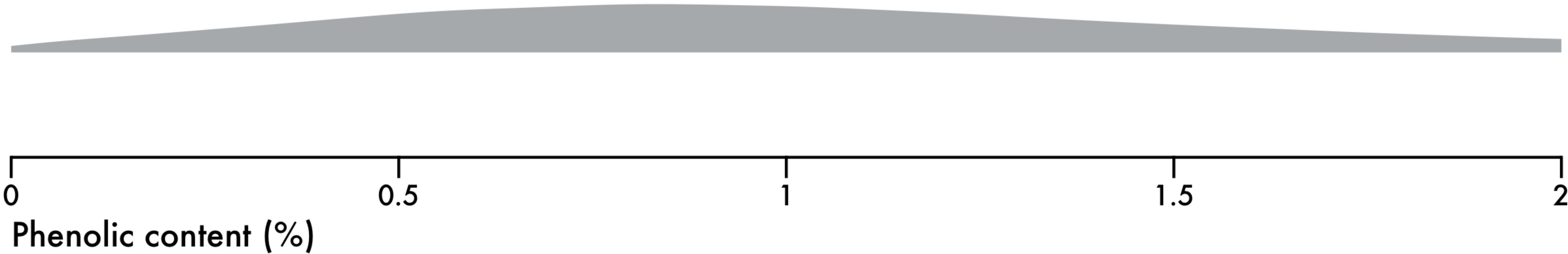
3. Chemical defence

Prior Kelp Faeces



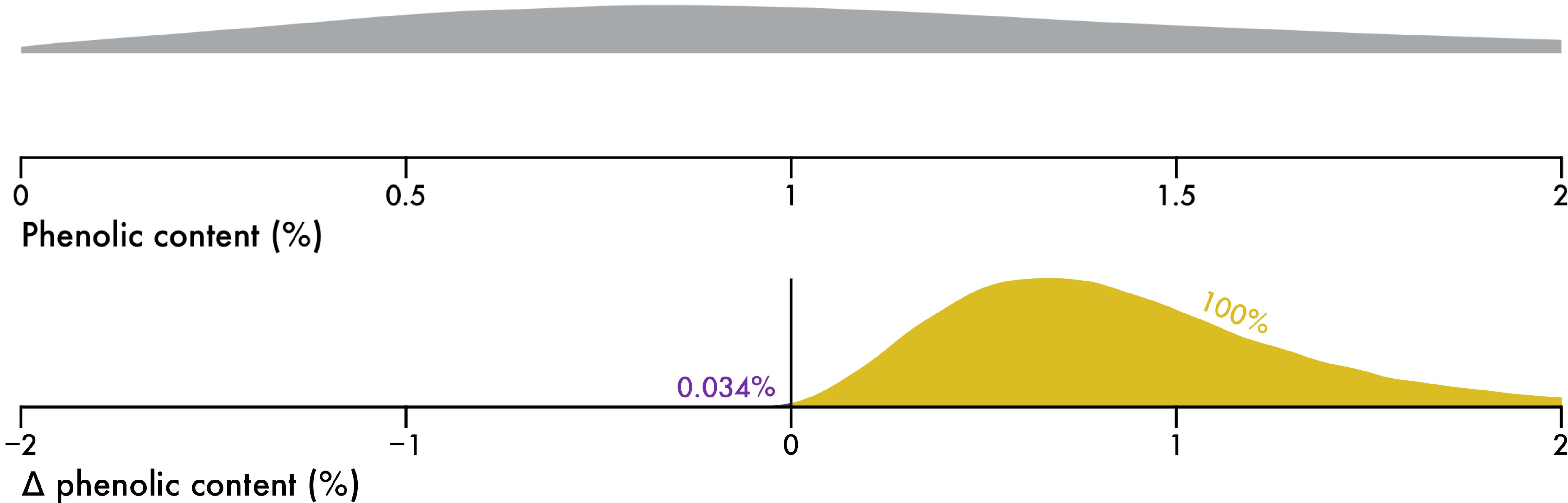
3. Chemical defence

Prior Kelp Faeces



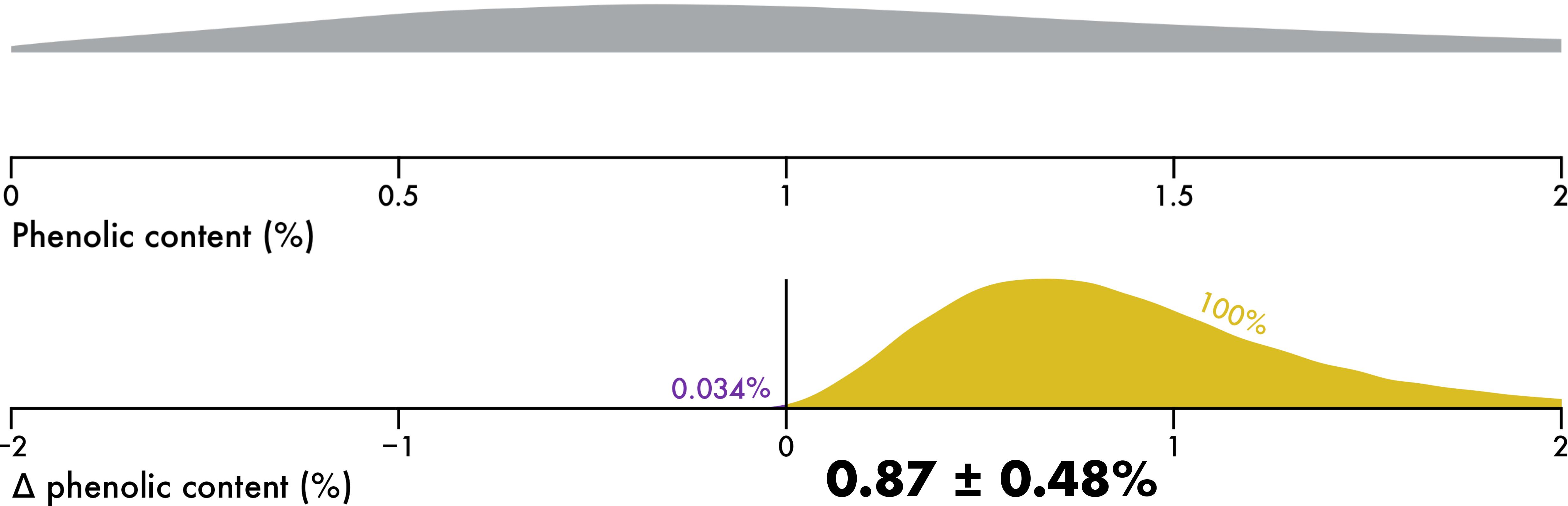
3. Chemical defence

Prior Kelp Faeces



3. Chemical defence

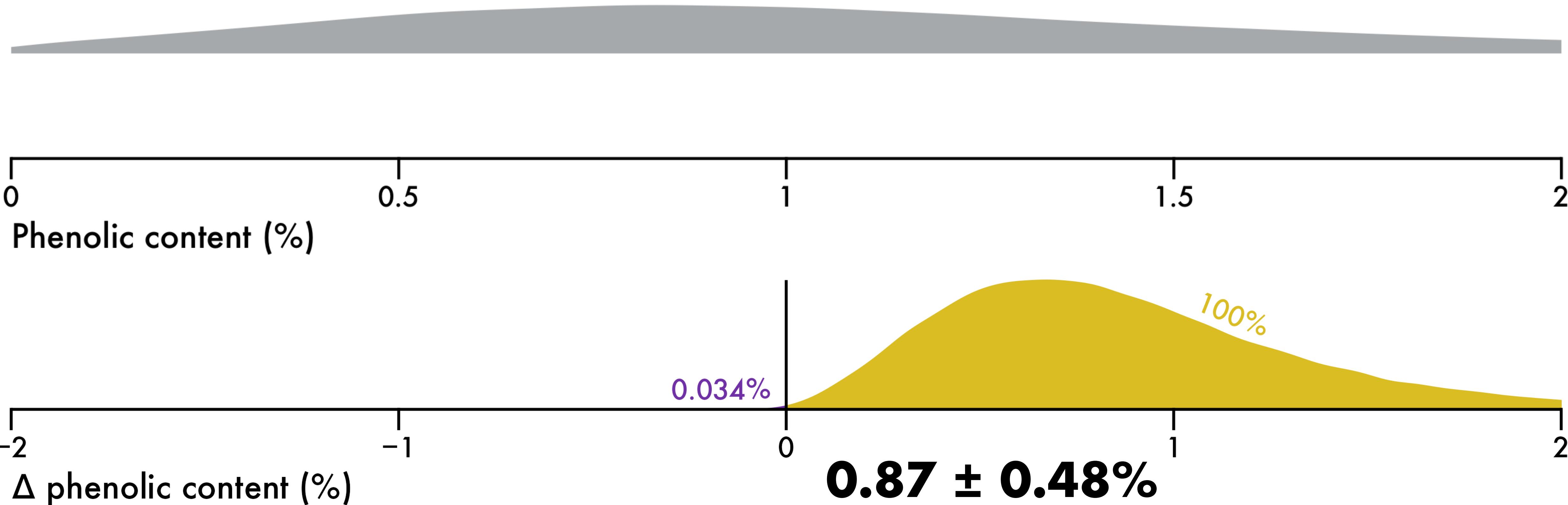
Prior Kelp Faeces



3. Chemical defence

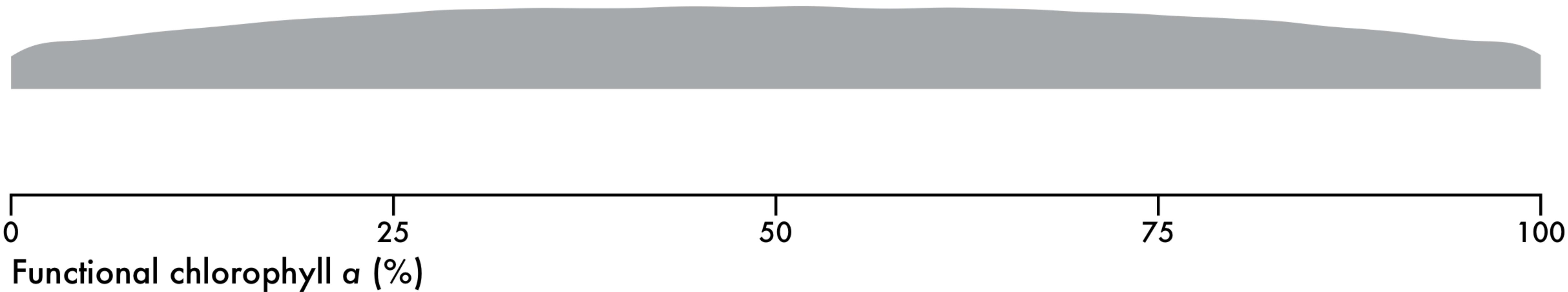
Increased palatability

Prior Kelp Faeces



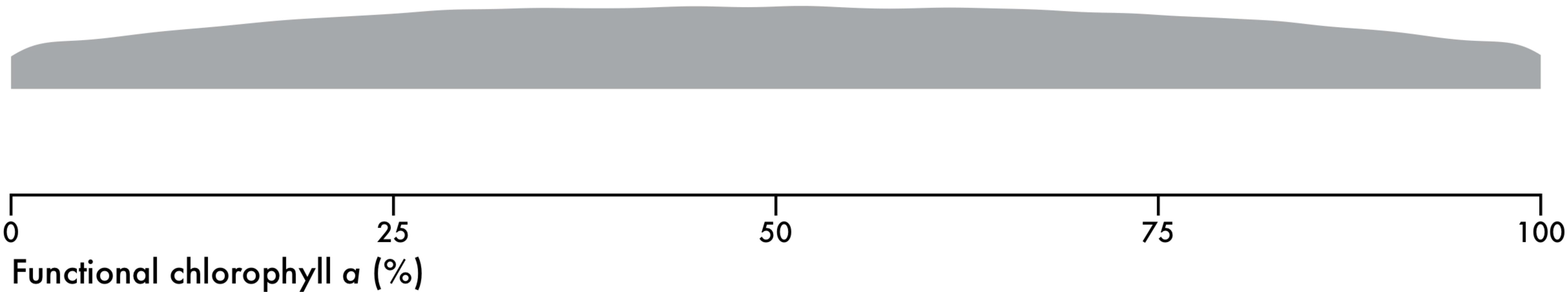
4. Photophysiology

Prior Kelp Faeces



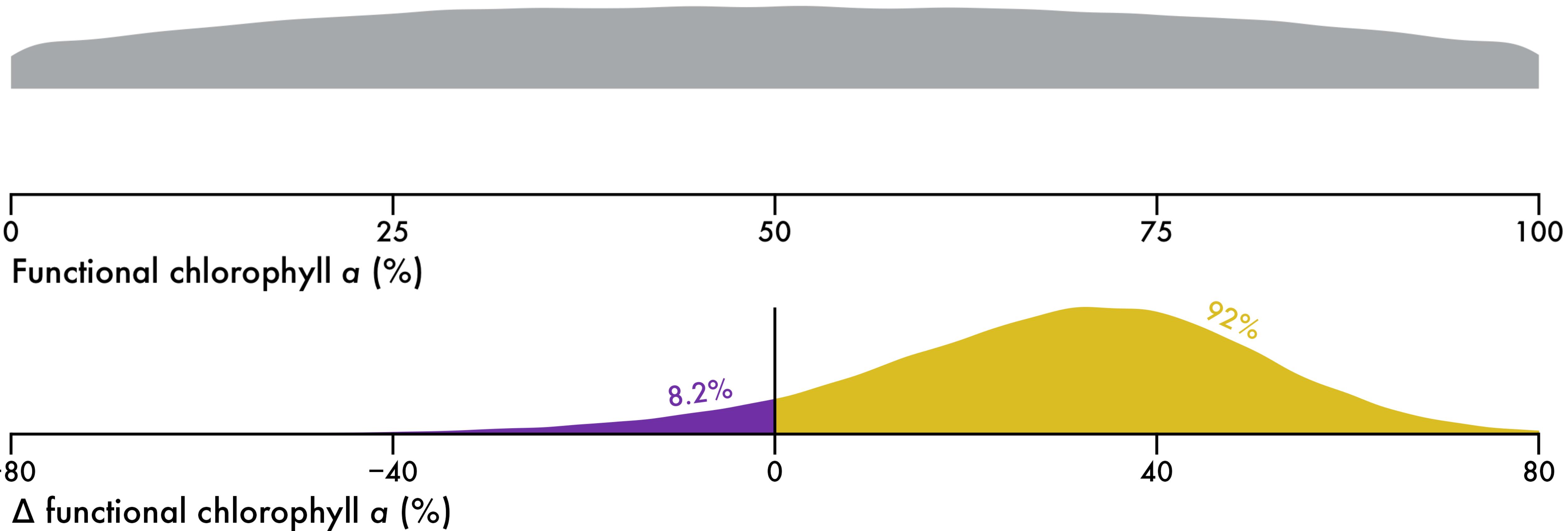
4. Photophysiology

Prior Kelp Faeces



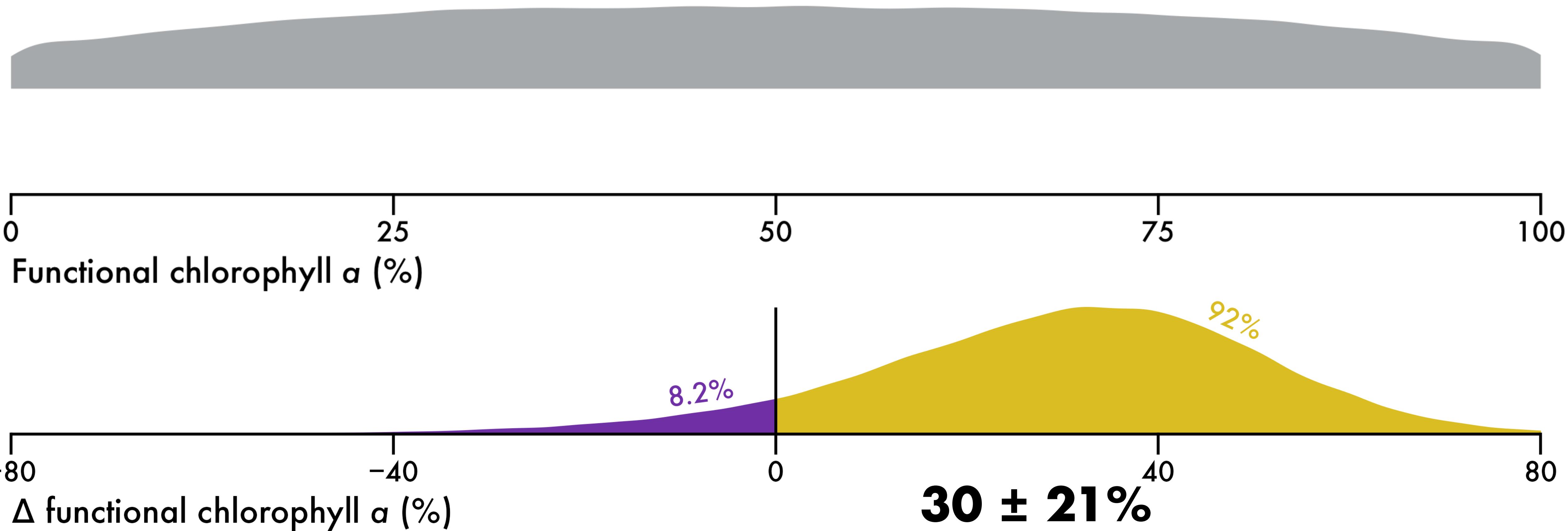
4. Photophysiology

Prior Kelp Faeces



4. Photophysiology

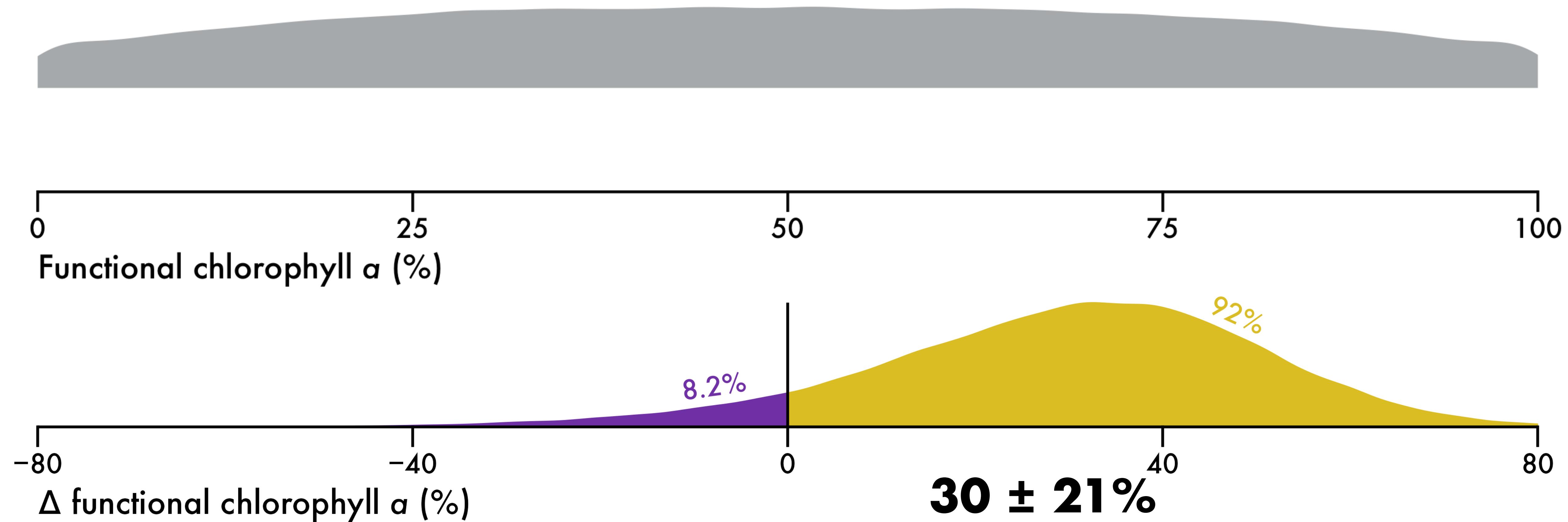
Prior Kelp Faeces



4. Photophysiology

No detrital photosynthesis

Prior Kelp Faeces



Findings

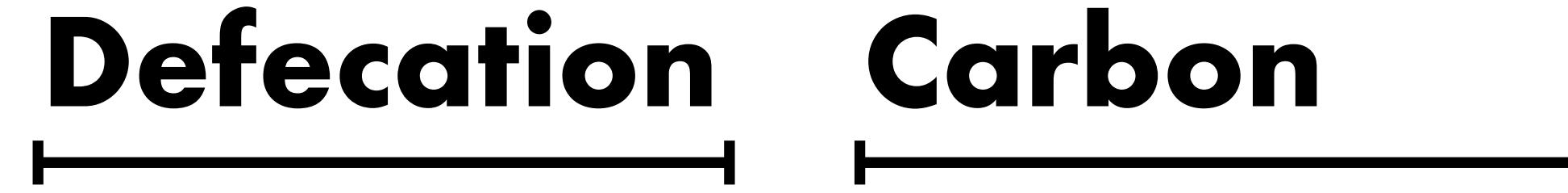
Findings

1. Carbon transfer is $0.44 \pm 0.2 \times 0.65 \pm 0.27 = 0.29 \pm 0.19$

$$\begin{array}{c} \text{Defecation} \quad \text{Carbon} \\ \hline \end{array}$$

Findings

Defecation Carbon



1. Carbon transfer is $0.44 \pm 0.2 \times 0.65 \pm 0.27 = 0.29 \pm 0.19$
2. Urchin faeces likely decompose much faster

Answer

Do sea urchins really extend kelp carbon transfer?

Answer

**Do sea urchins really extend kelp carbon transfer?
No. Probably the opposite.**

Answer

Do sea urchins really extend kelp carbon transfer?

No. Probably the opposite.

**Relative carbon sequestration potential of urchin faeces is
 $0.29 \pm 0.19 \times 2.3 \pm 0.14 = 0.67 \pm 0.44$ (no decomposition).**

 Transfer

Export

Contact

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