

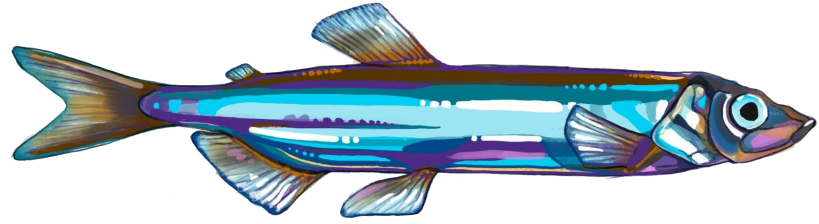
What can otolith chemistry reveal about capelin migrations?

Romaric Jac ^{1,2}

Elisabeth Van Beveren³, Olivier Le Pape², Lola Coussau³, Mathieu Boudreau³, Pascal Sirois⁴, Dominique Robert¹, Pablo Brosset²

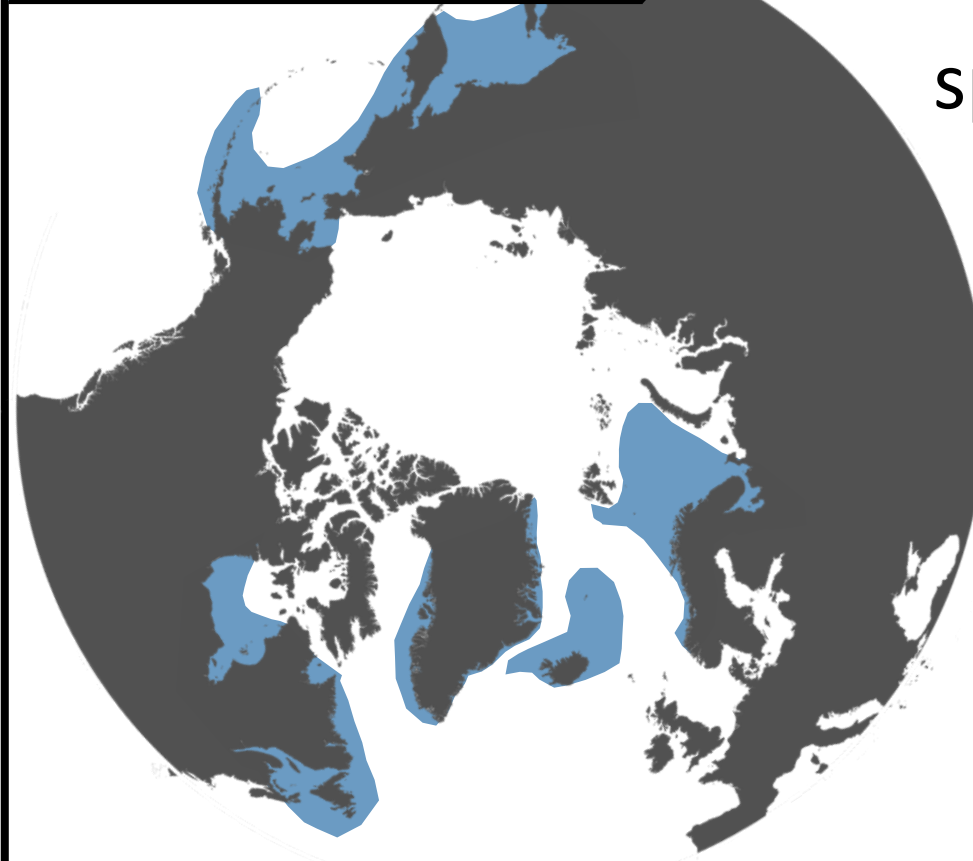
1. University of Quebec in Rimouski, Rimouski, Canada
2. UMR DECOD, L'institut Agro, INRAE, Ifremer, Rennes, France
3. Fisheries and Oceans Canada, Mont-Joli, QC, Canada
4. University of Quebec in Chicoutimi, Chicoutimi, Canada

1 – Capelin: identity card



Mallotus villosus
(Müller, 1778)

Distribution



**Main forage
species in boreal
environments**

Preferred
-1 to 4°C

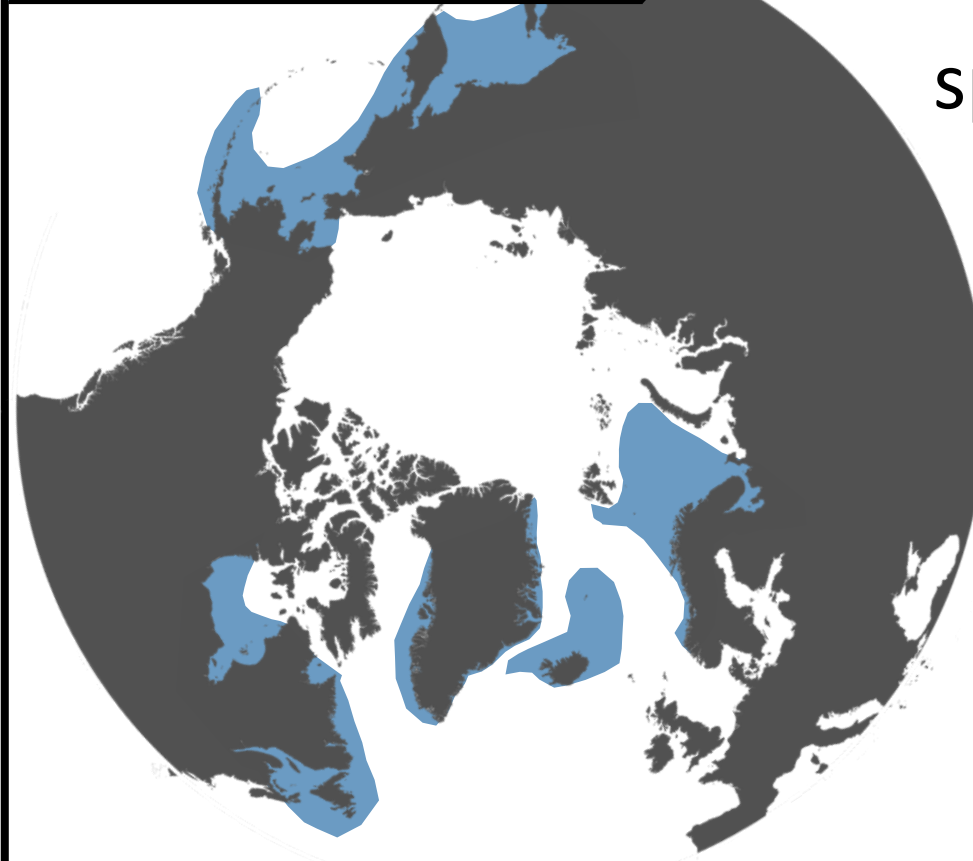
Tolerated
-2 to 14°C

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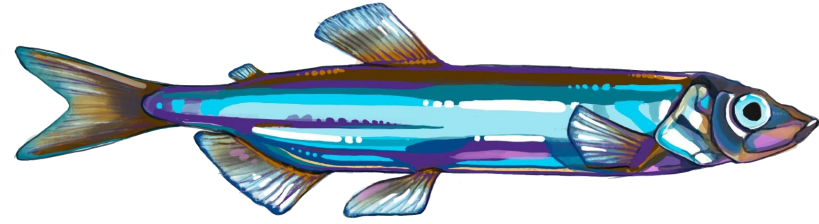
Migrations

Extensive migrations during its ontogeny

Studying **migration patterns:** population dynamic, stock assessment, climate changes

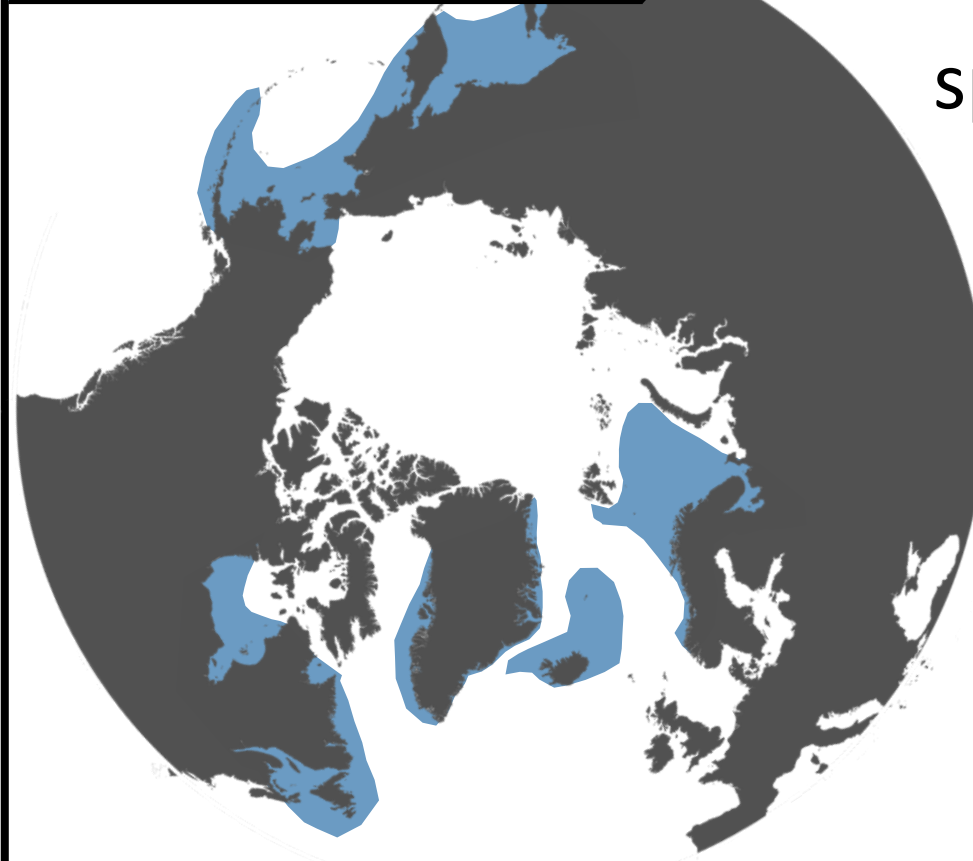
Contrasting level of knowledge

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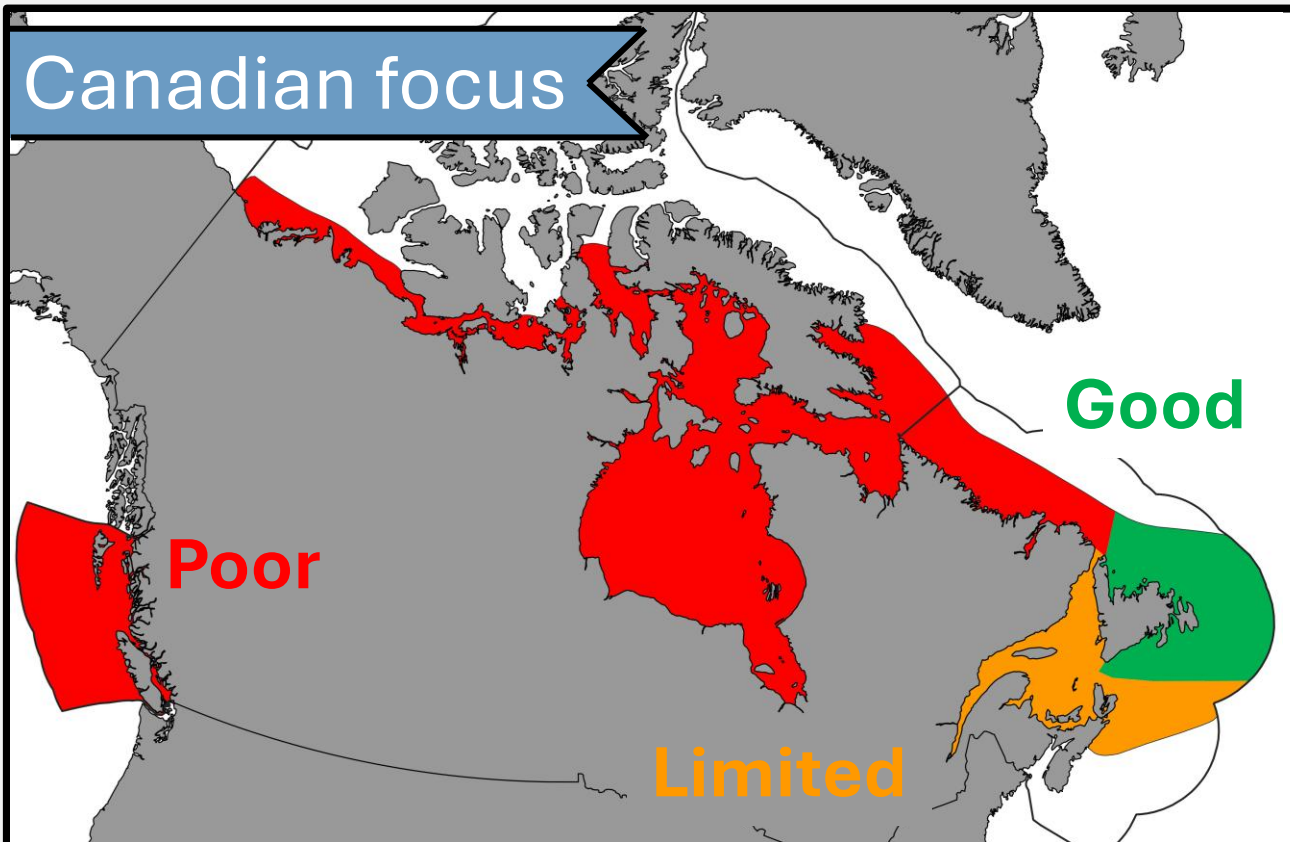
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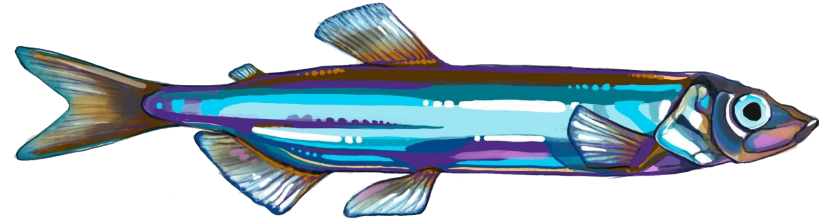
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Contrasting level of knowledge

Canadian focus

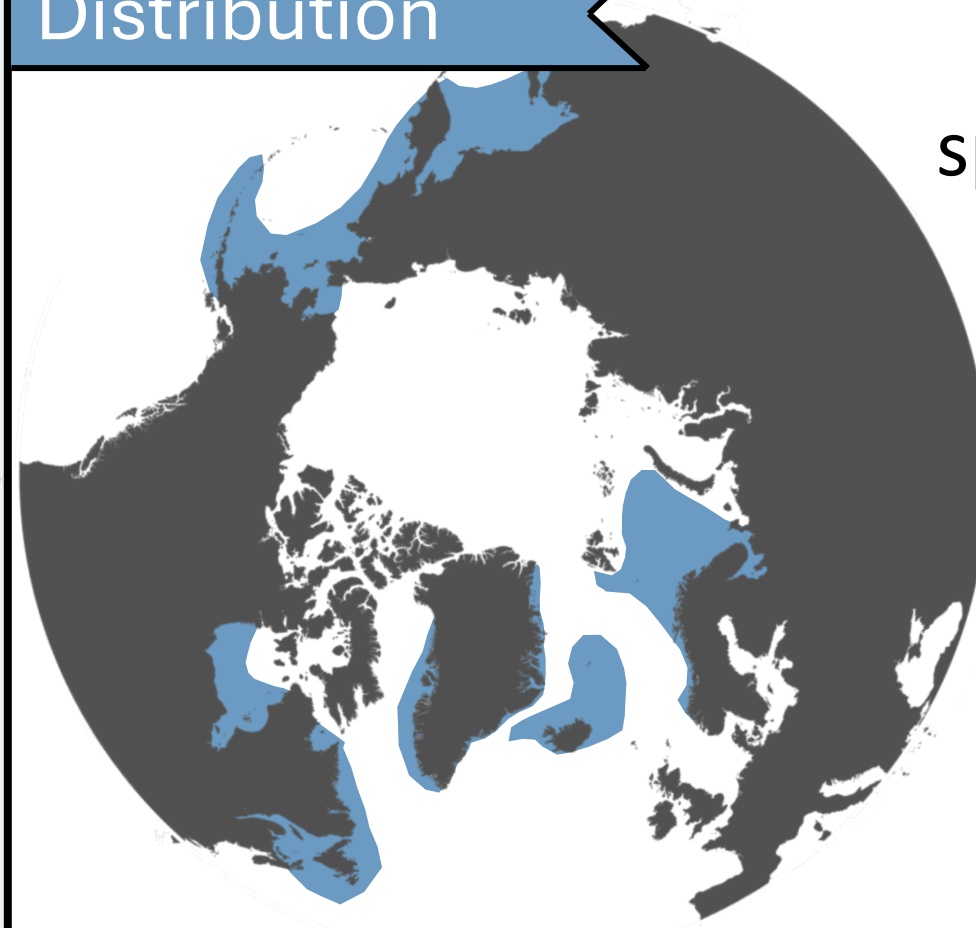


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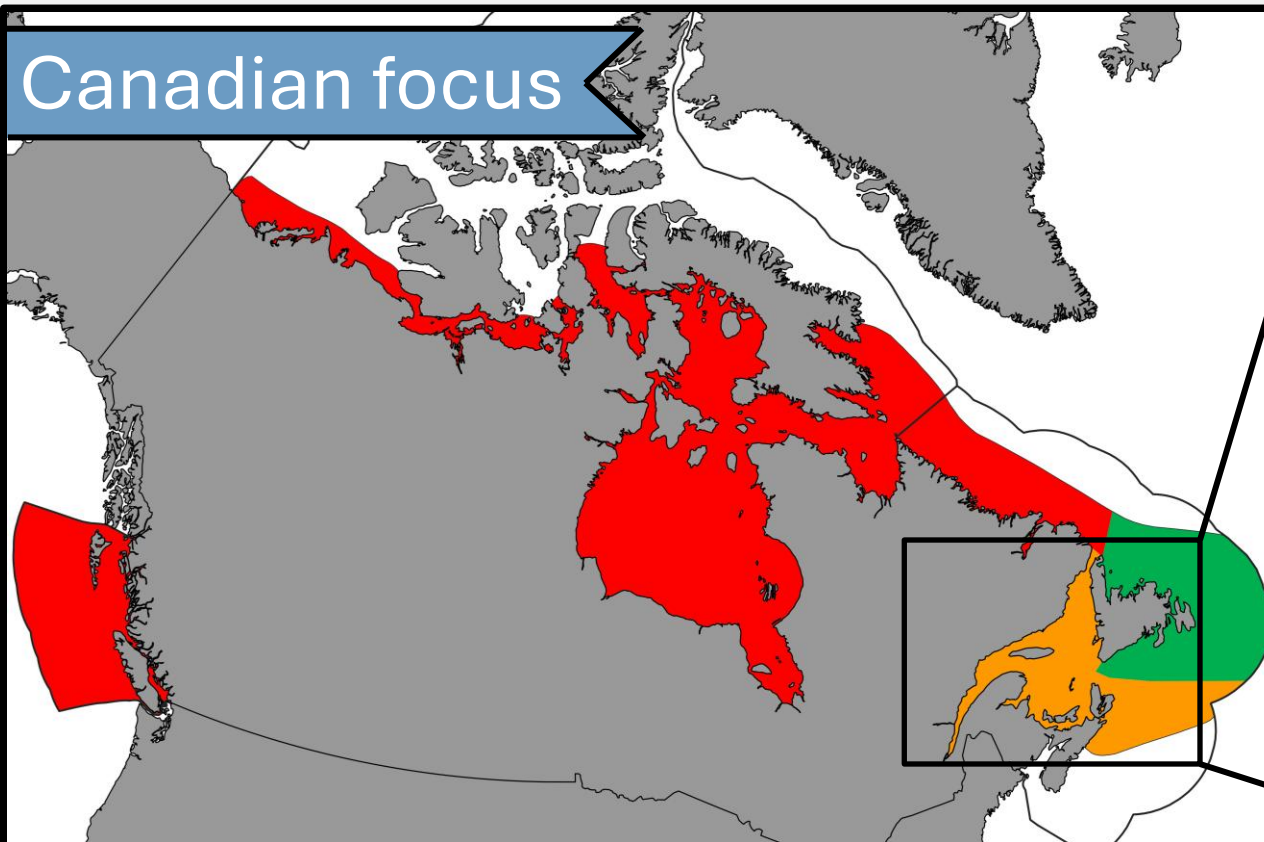
Migrations

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Contrasting level of knowledge

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Gulf of St. Lawrence (GSL)



Low commercial interest

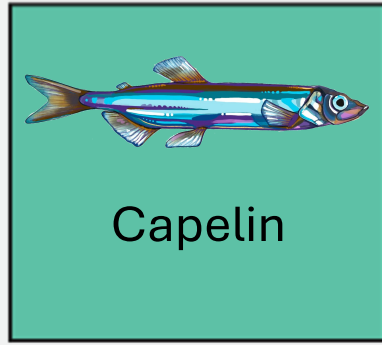
Data-limited stock

Managed as a **single unit**

Migrations between key zones remain **largely unknown**

2 – Methods used to study capelin migrations

(Jac *et al.*, 2025)



Commercial fisheries-dependent data

Otolith chemistry

Fisheries-independent survey

Capture-mark-recapture

Acoustic telemetry

Spawning

Foraging

Overwintering

Rev Fish Biol Fisheries
<https://doi.org/10.1007/s11160-025-09981-4>

REVIEW

Tracking the schools: a review of approaches to address knowledge gaps in the migratory ecology and habitat use of Canadian forage fishes

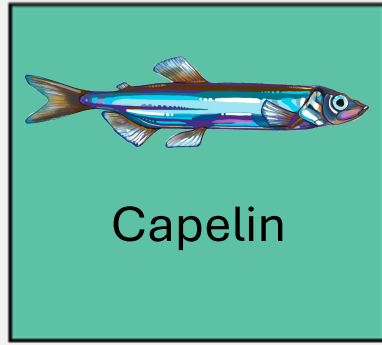
Romaric Jac · Morgan L. Piczak · Elisabeth Van Beveren · Jennifer L. Boldt · Pablo Brosset · Jacob Burbank · Jaclyn S. Cleary · Linnea A. Flostrand · Les N. Harris · Sarah Hawkshaw · Harri Pettitt-Wade · Clifford L. K. Robinson · Caliyena R. Brown · Robert J. Lennox

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3 – Otolith chemistry

Calcareous structures of the inner ear involved in balance and hearing

Proportional development with the length of the fish from the embryonic stage

Age determination based on alternating growth rings: rapid growth (wide rings) and slow growth (narrow rings)

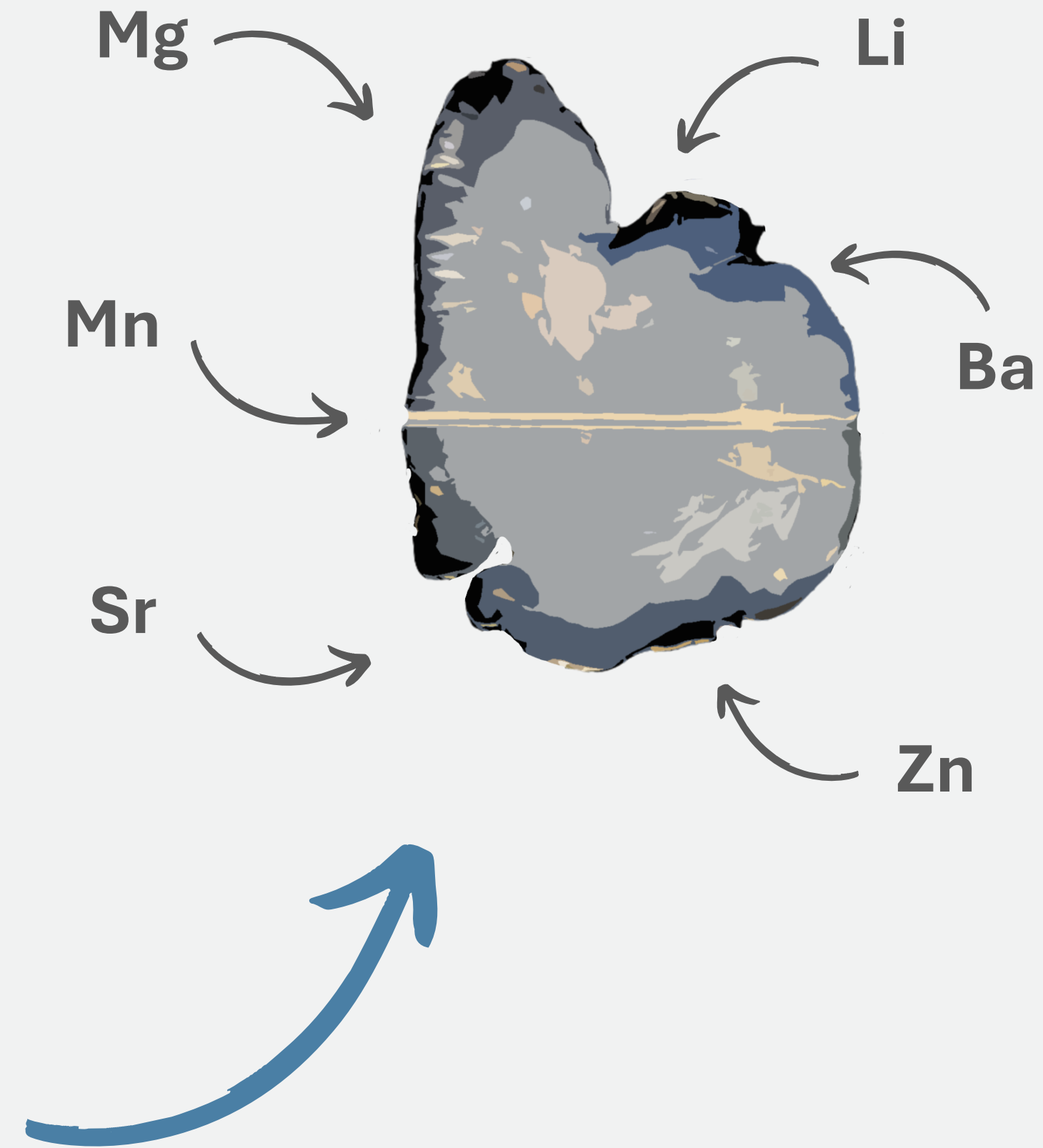


3 – Otolith chemistry

Incorporation of chemical elements through substitution of calcium

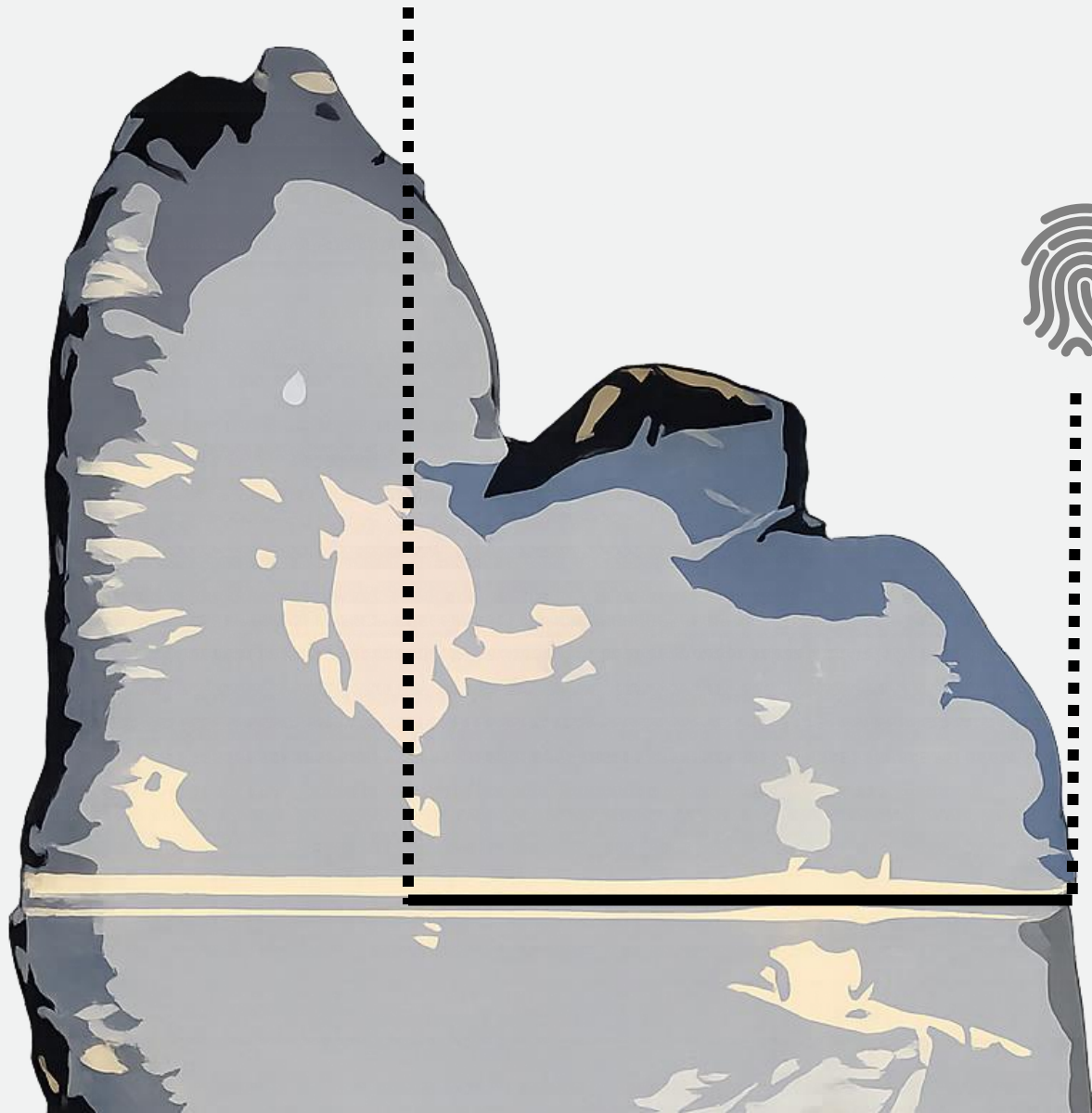
Record the chemical composition of the environment at the time of formation

Permanent archiving



4 – Reading the otolith

Natal origin



Capture site

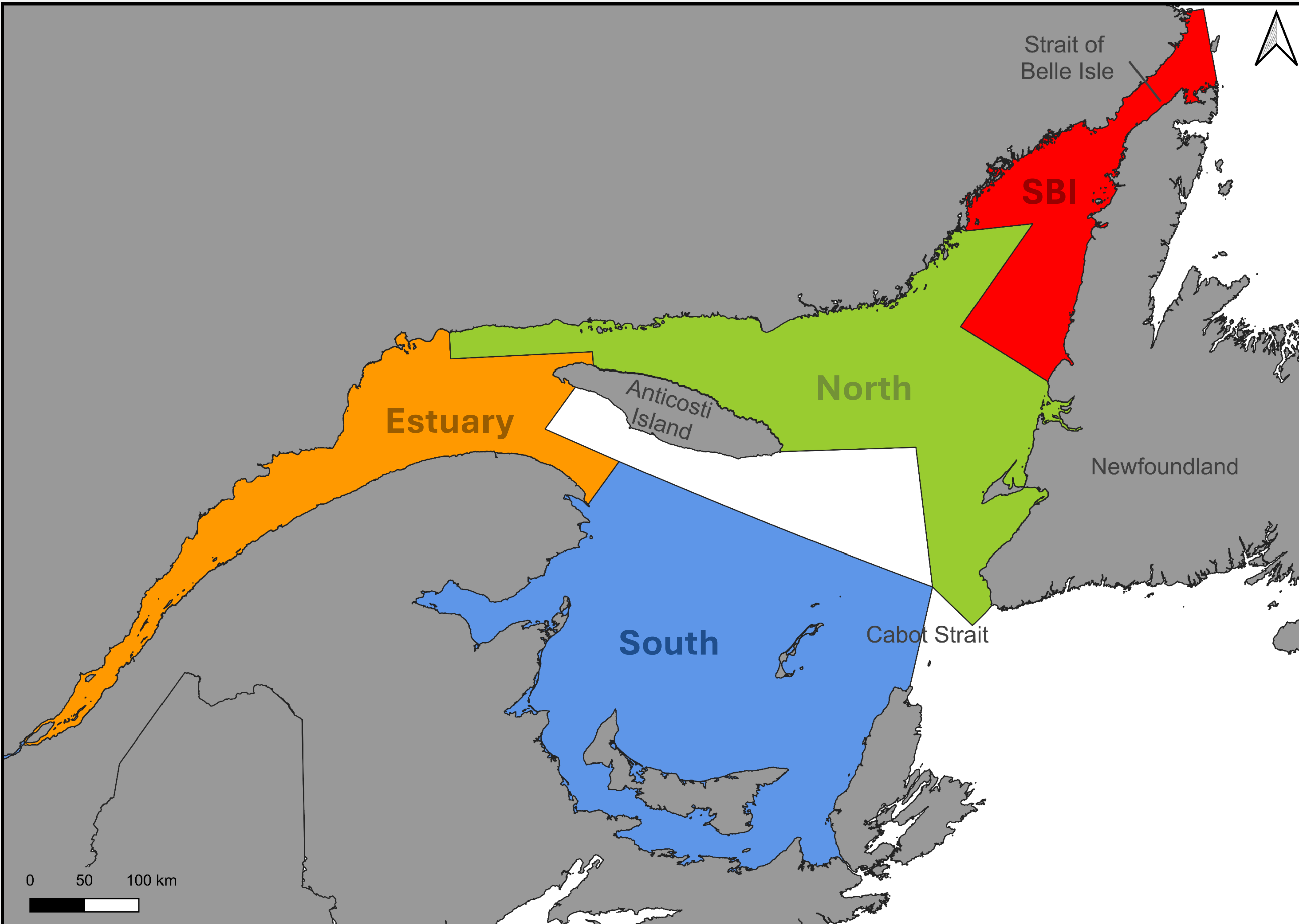


Laser Ablation Inductively Coupled Plasma Mass Spectrometry - LA-IPCMS

One measure every 5 μm

38 elements

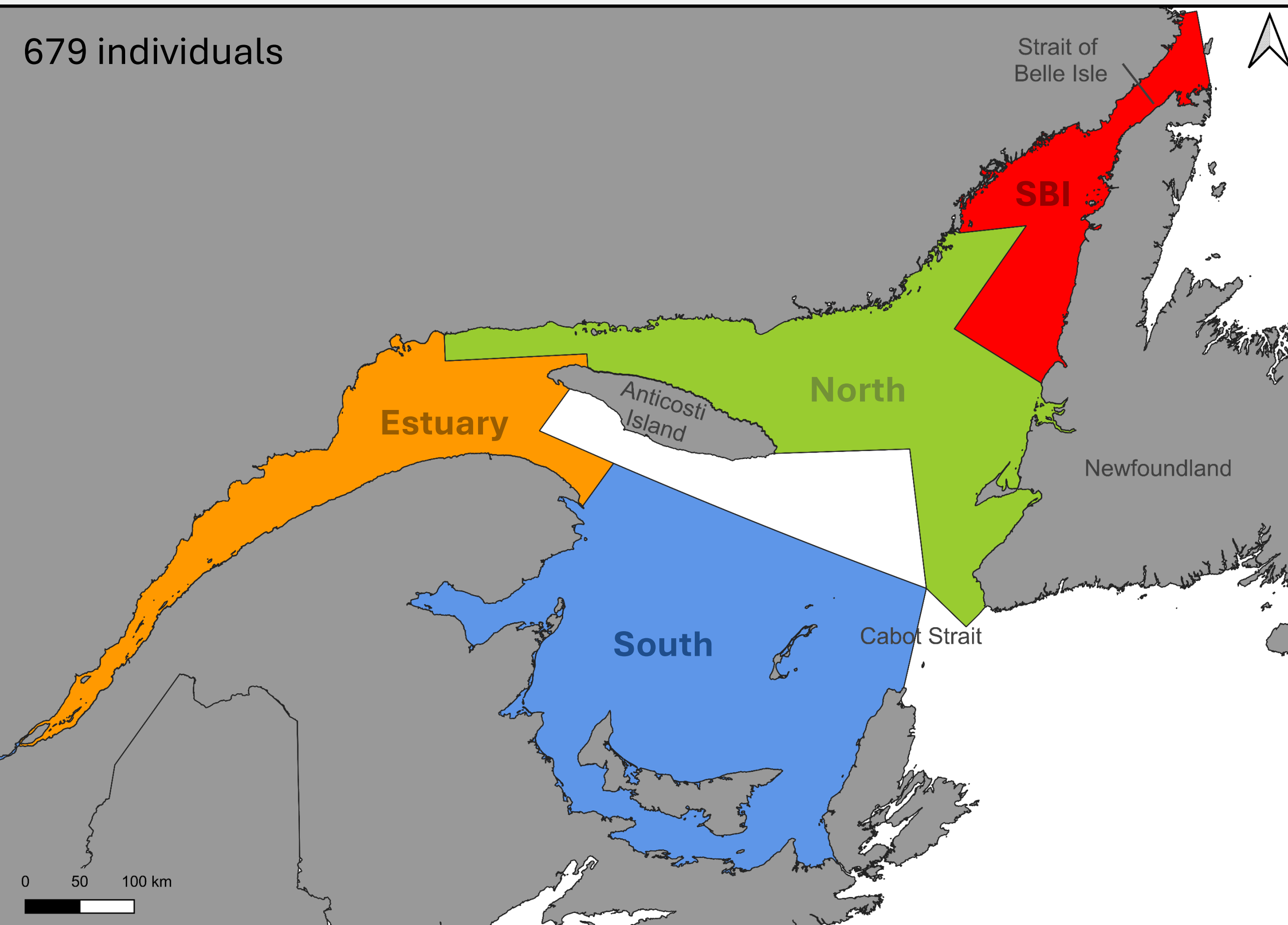
5 – Dataset



Four majors oceanographical distinct regions

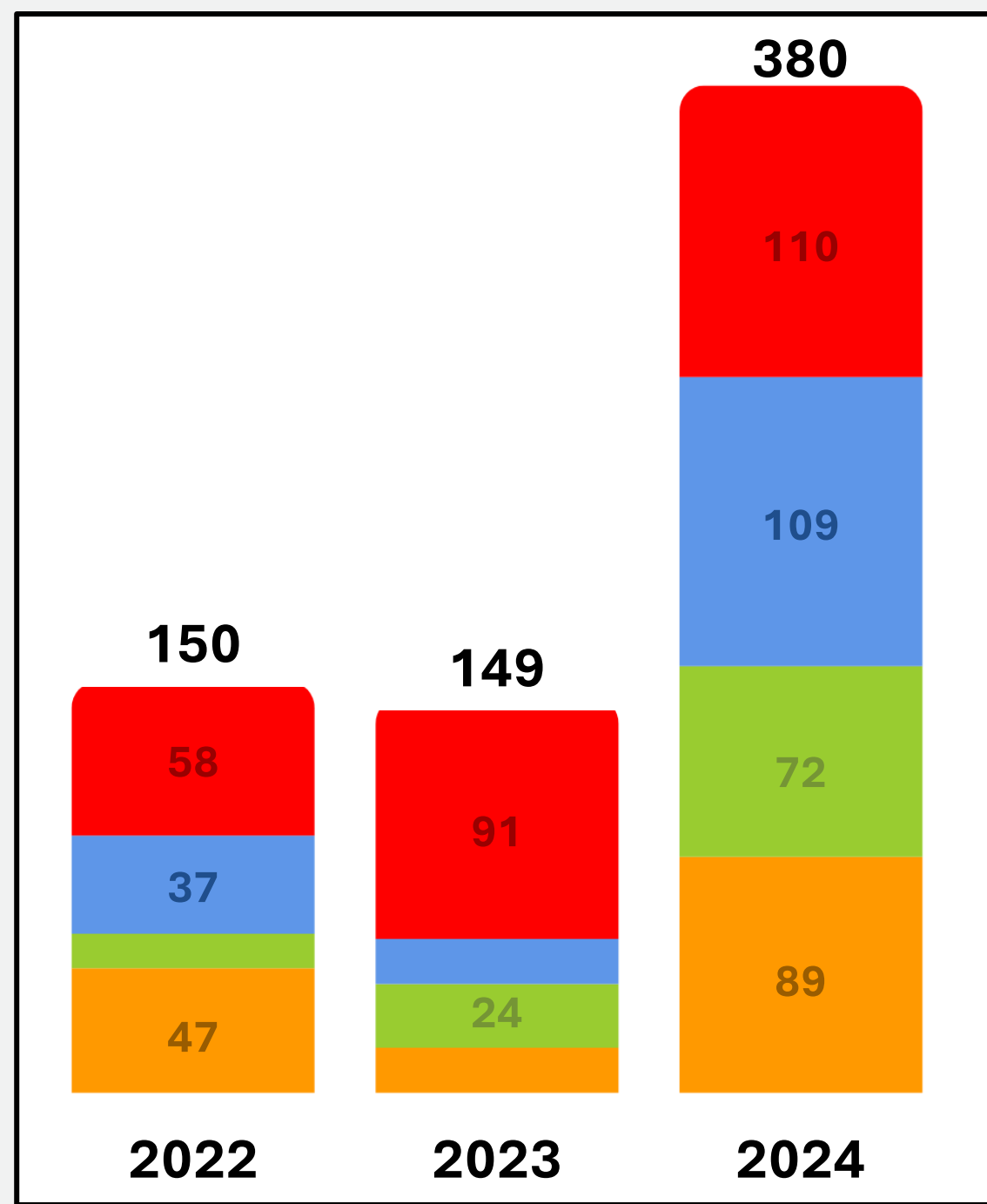
Consistent with **previous otolith chemistry studies**

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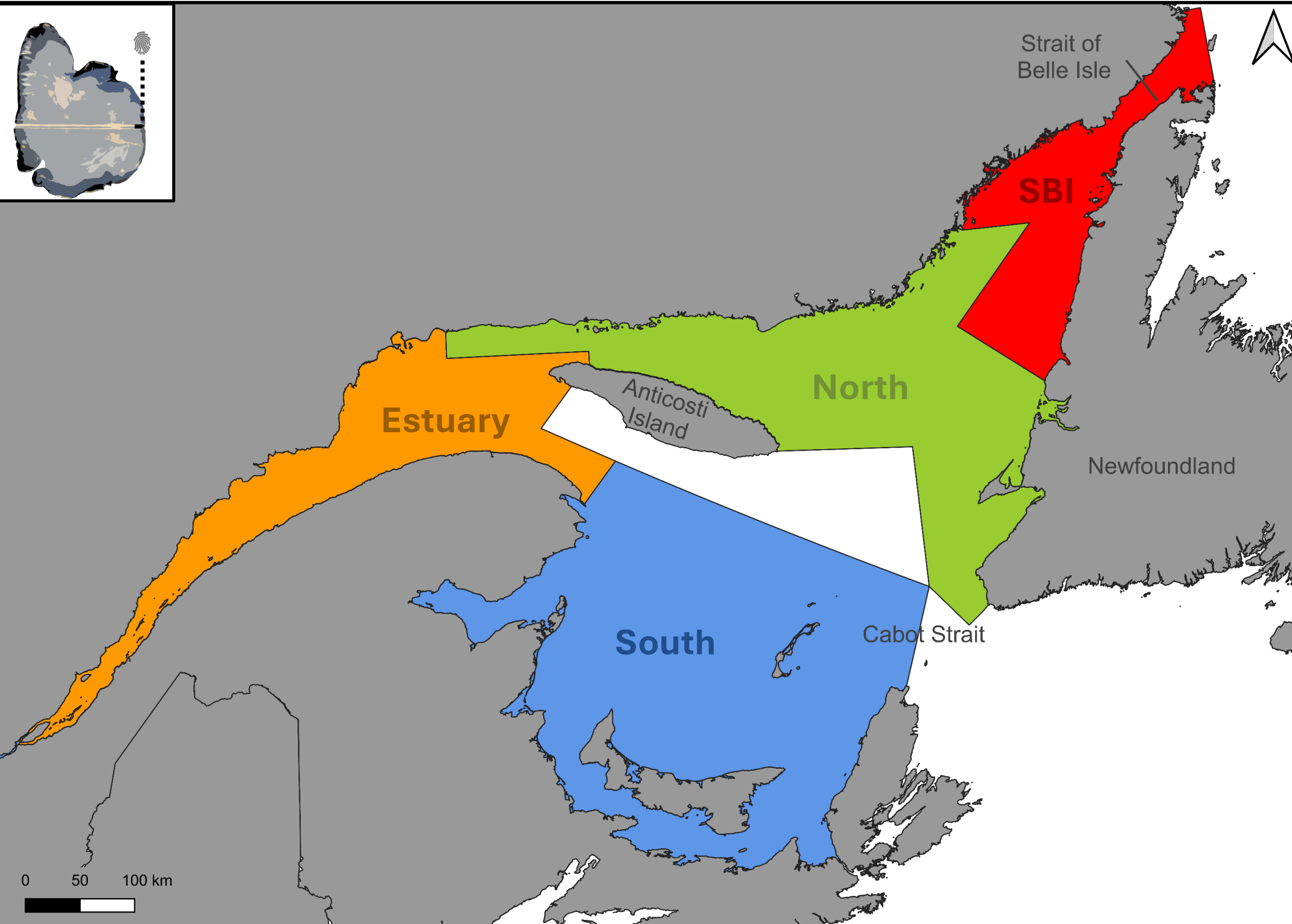
Four majors oceanographical distinct regions

Consistent with **previous otolith chemistry studies**



6 - Multi-year stability of spatial patterns

(Jac *et al.*, 2026)



Fisheries Research 295 (2026) 107671

Contents lists available at ScienceDirect

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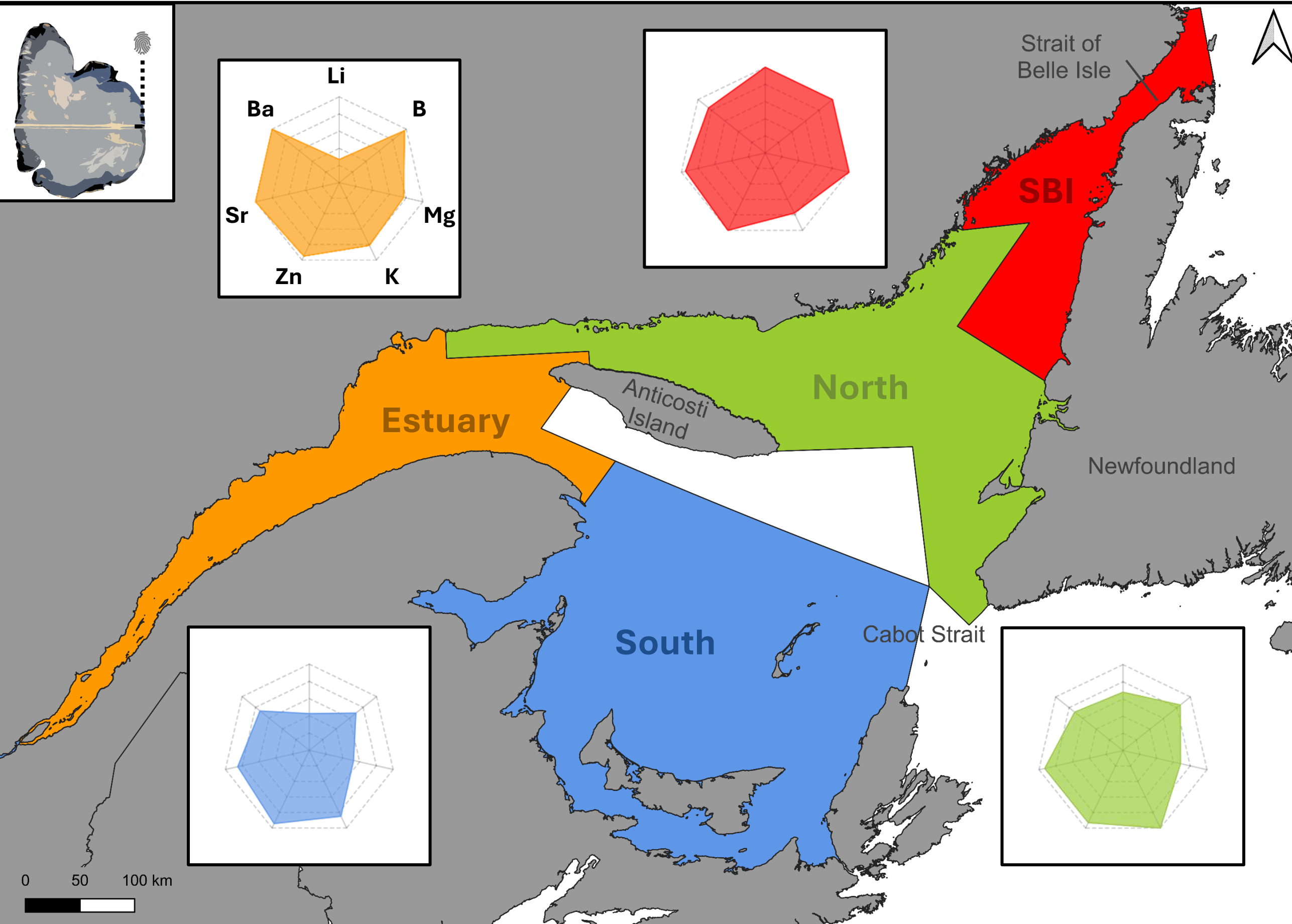
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ELSEVIER

Check for updates

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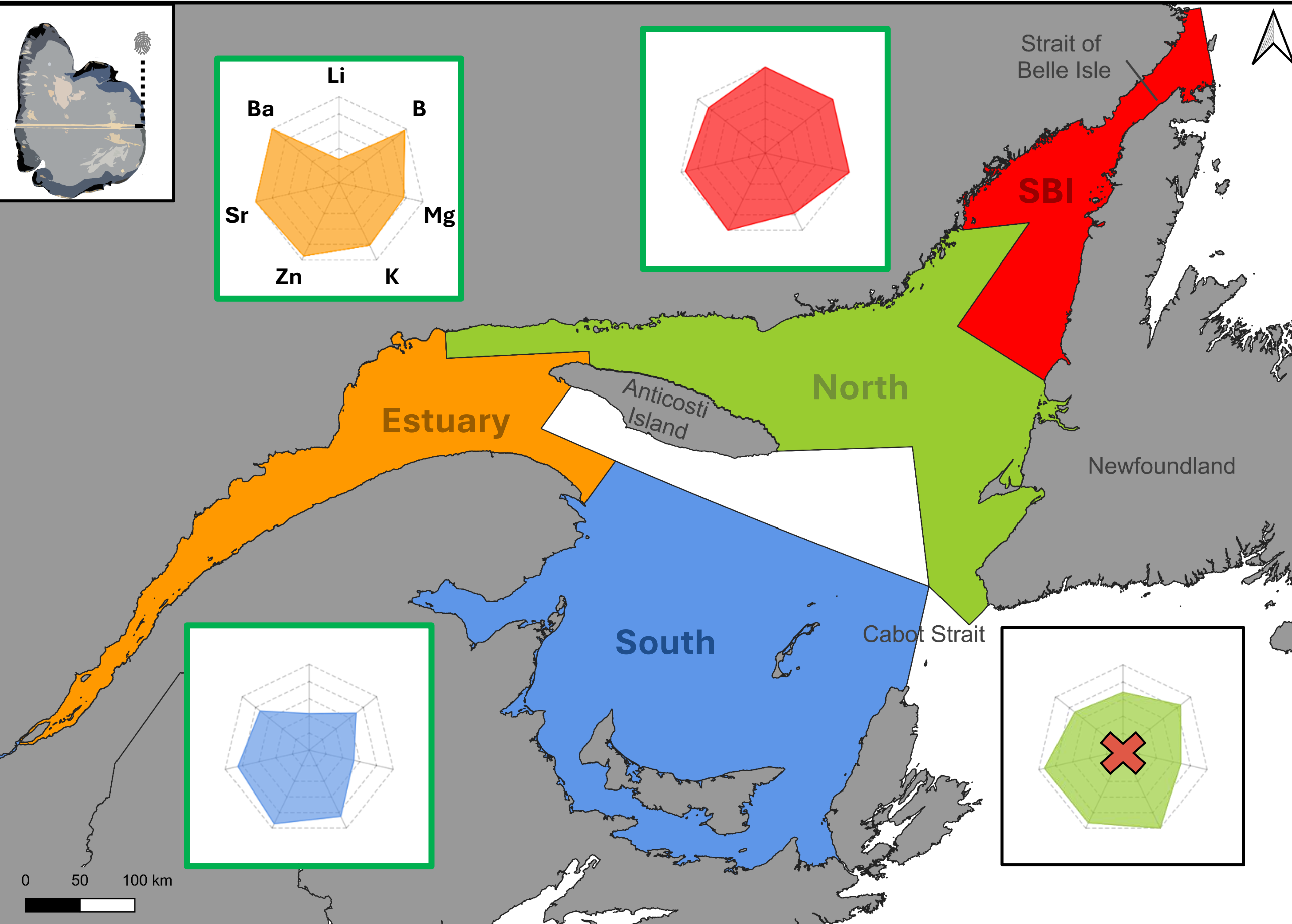
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7 éléments

7	11	25	39	64	88	138
Li	B	Mg	K	Zn	Sr	Ba

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North ✘

Three distinct regional fingerprints

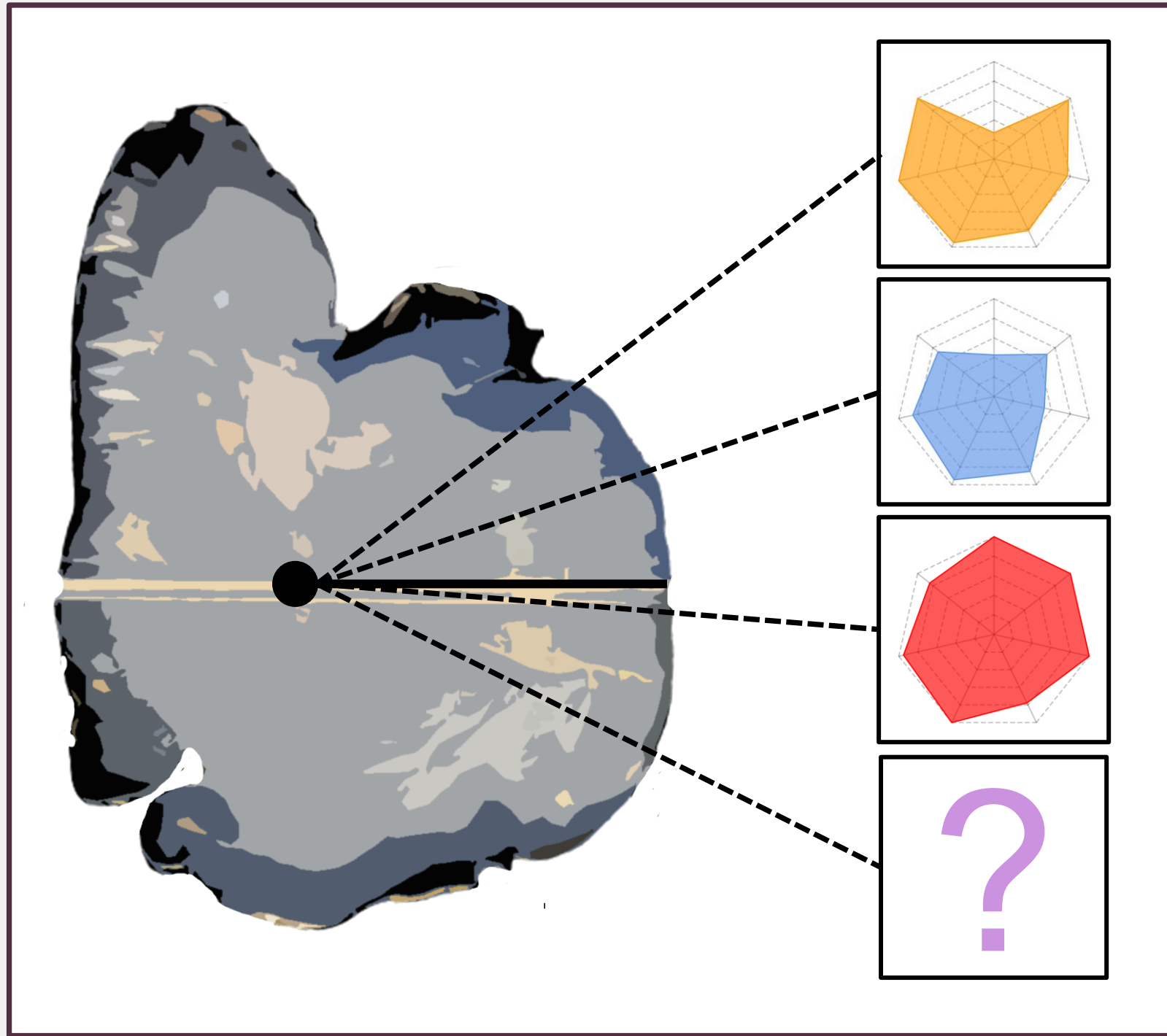
Low probability of incorrect reassignment

Spatial variability ✓

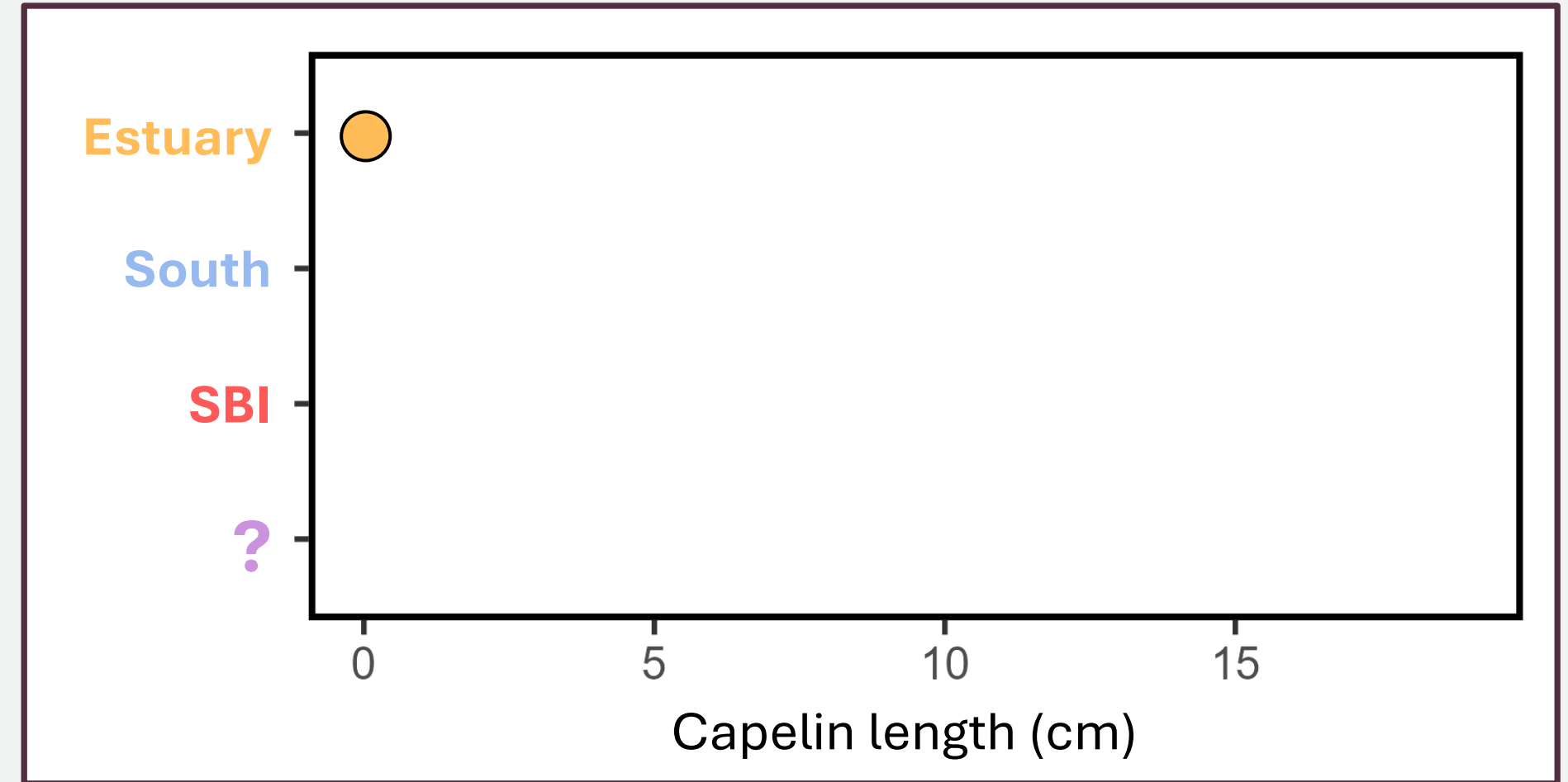
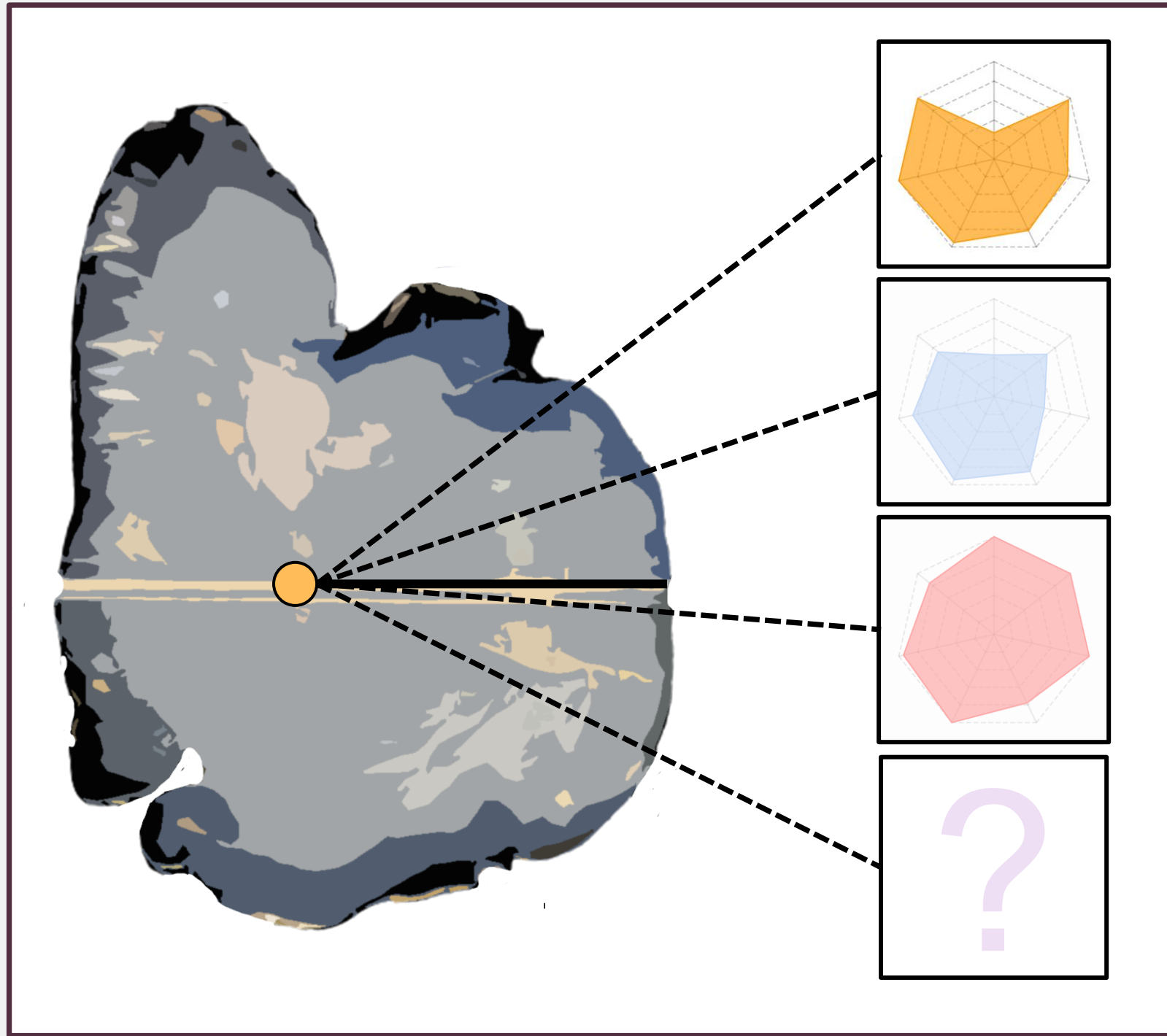
Temporal stability ✓

No cohort effect ✓

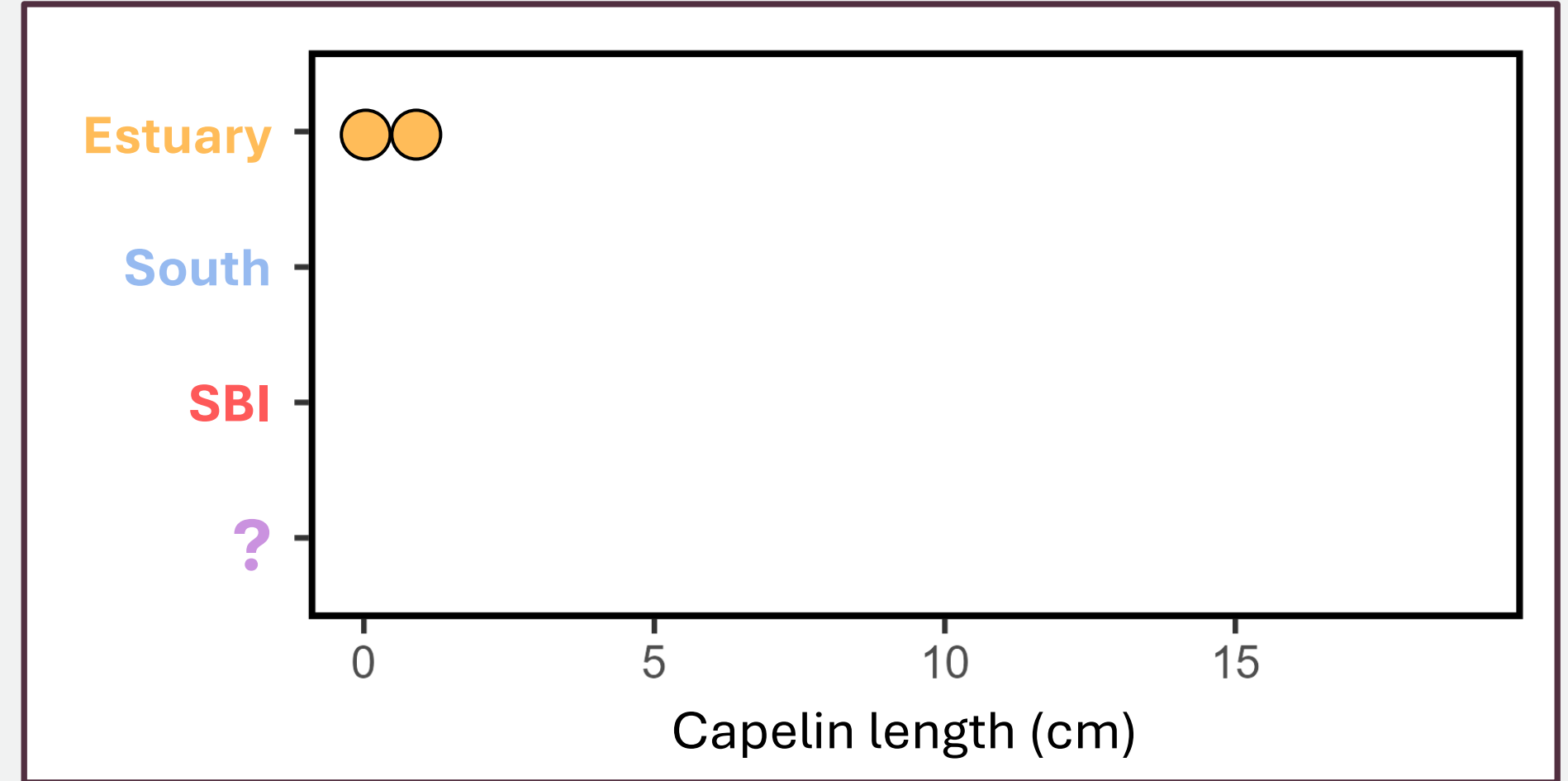
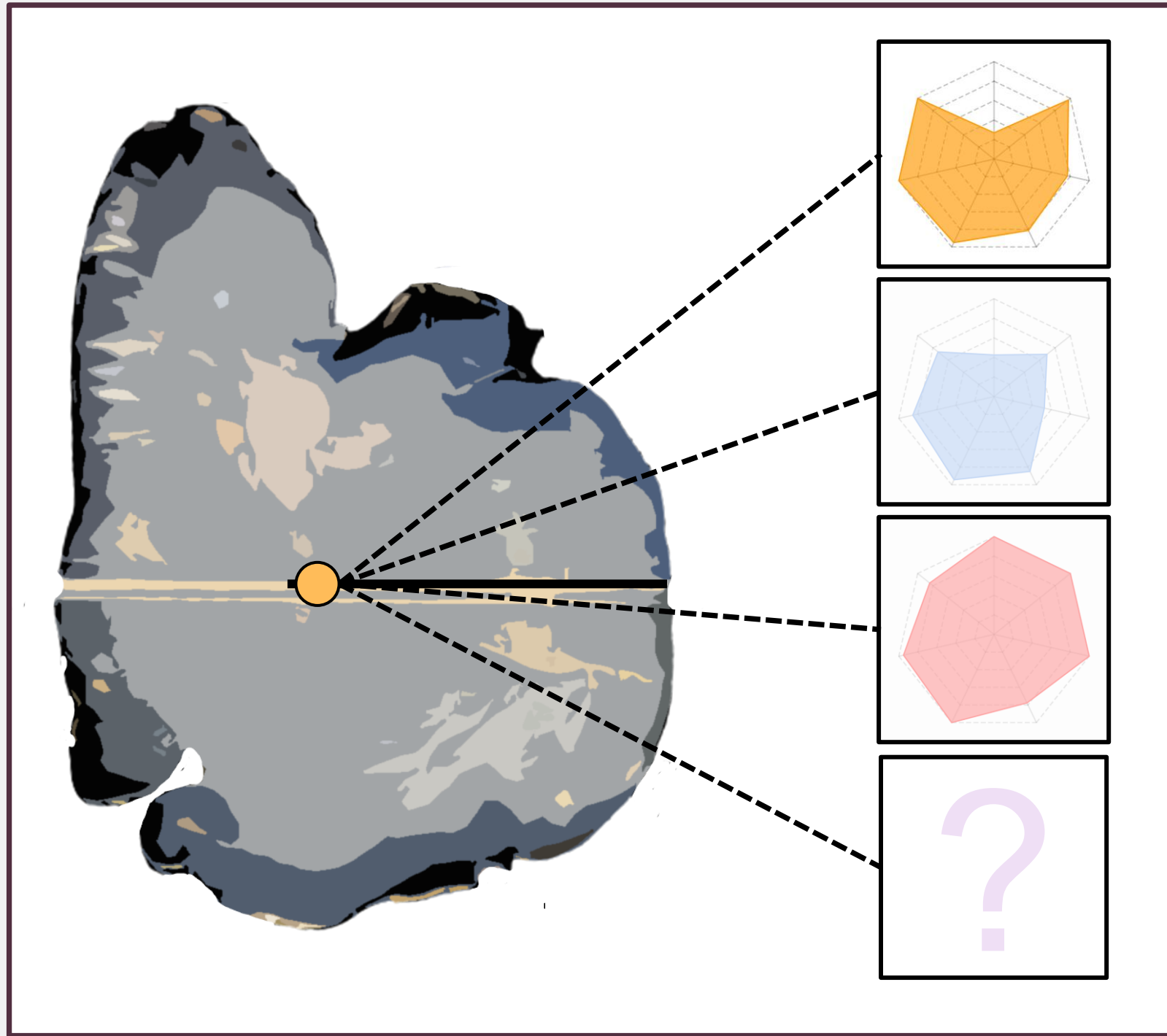
7 – Edge-to-transect reassignment approach



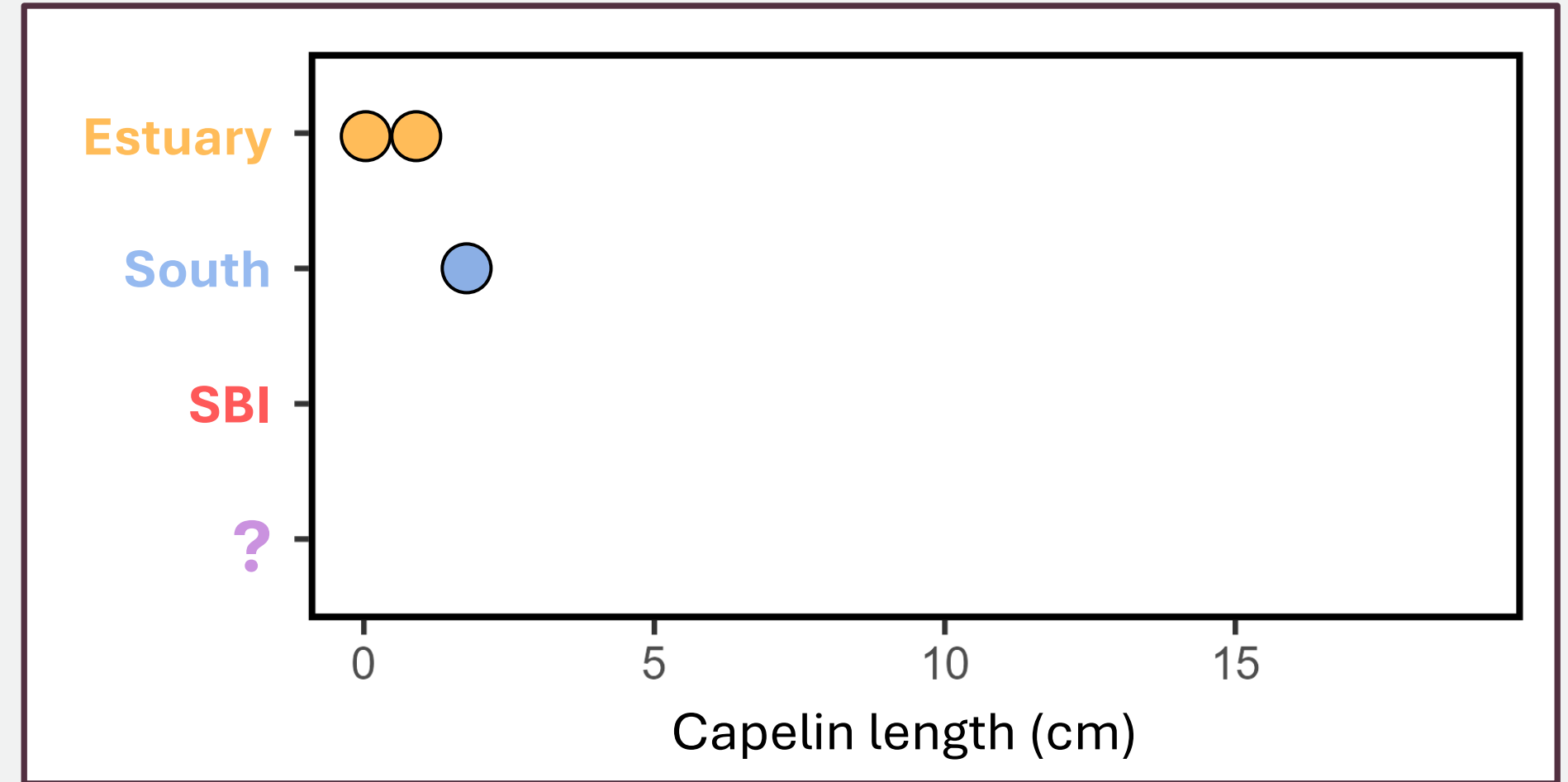
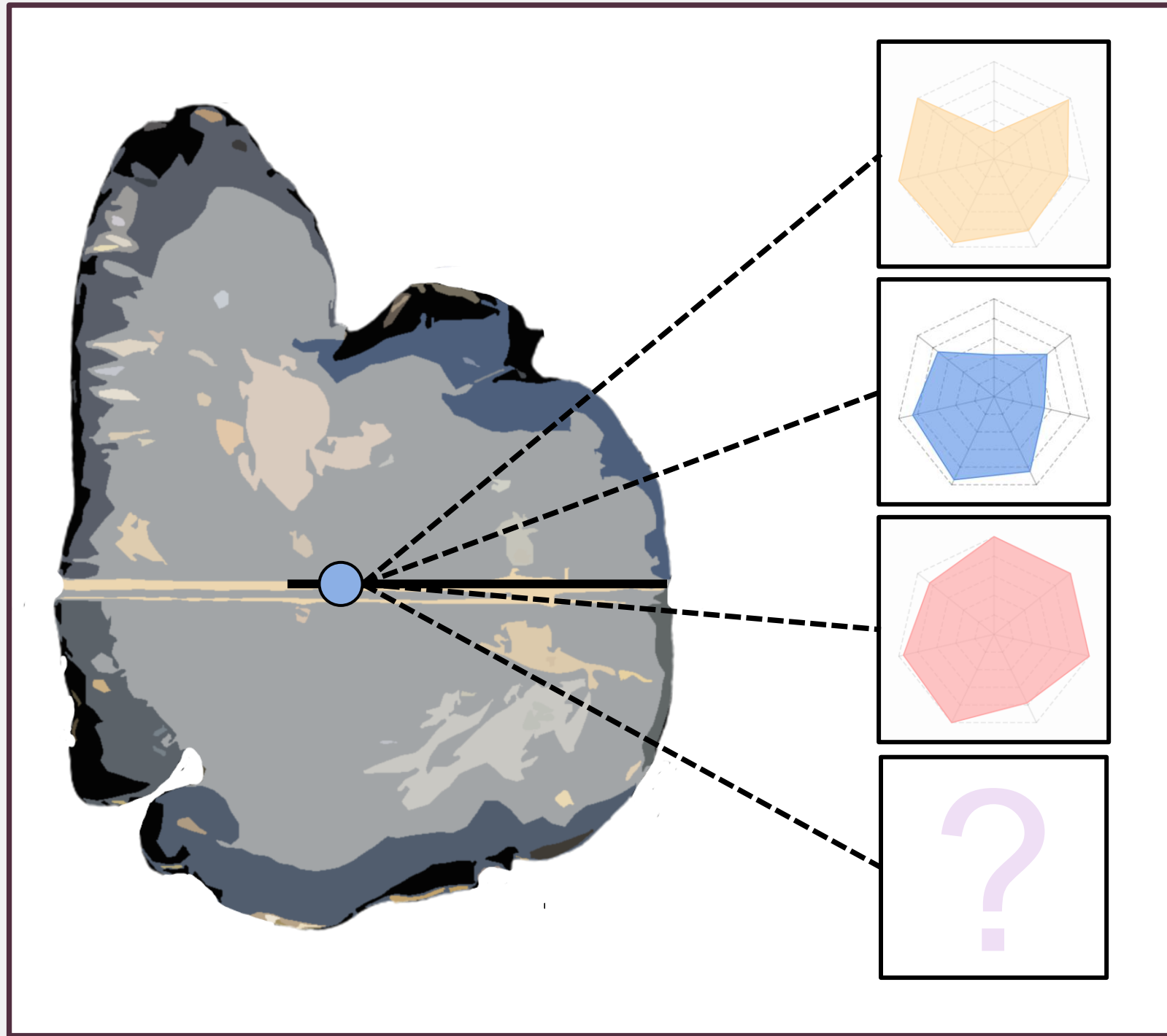
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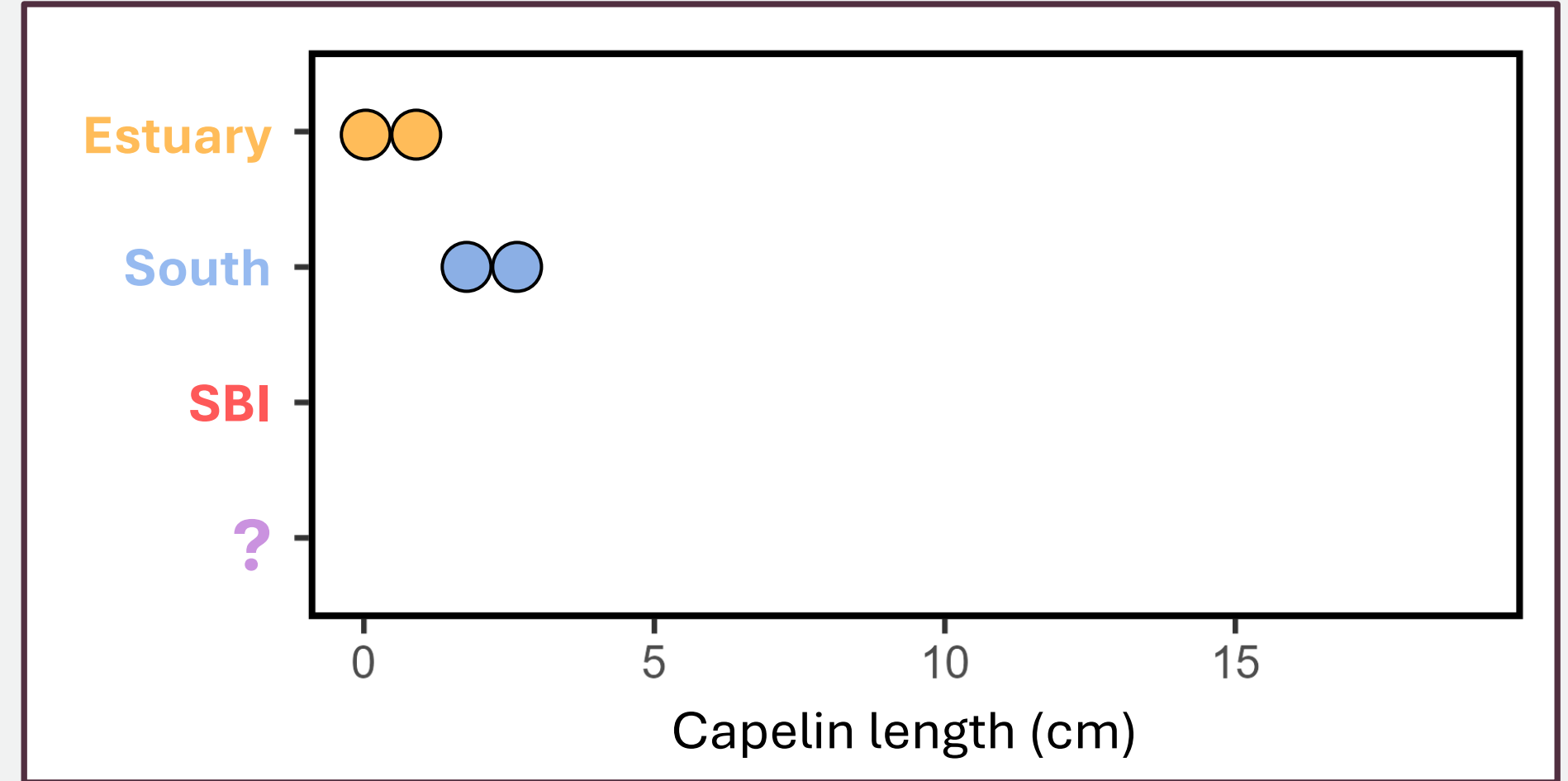
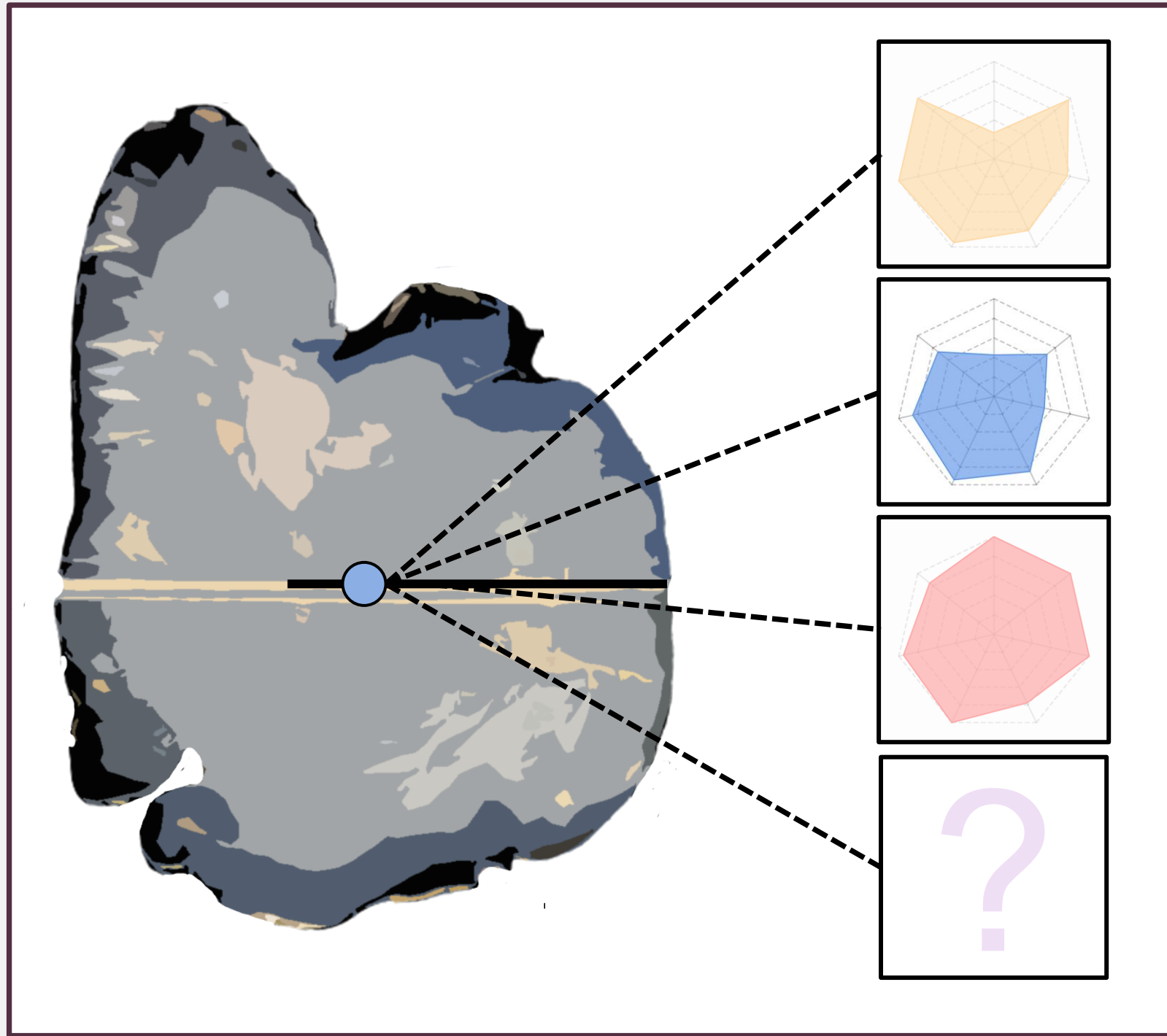
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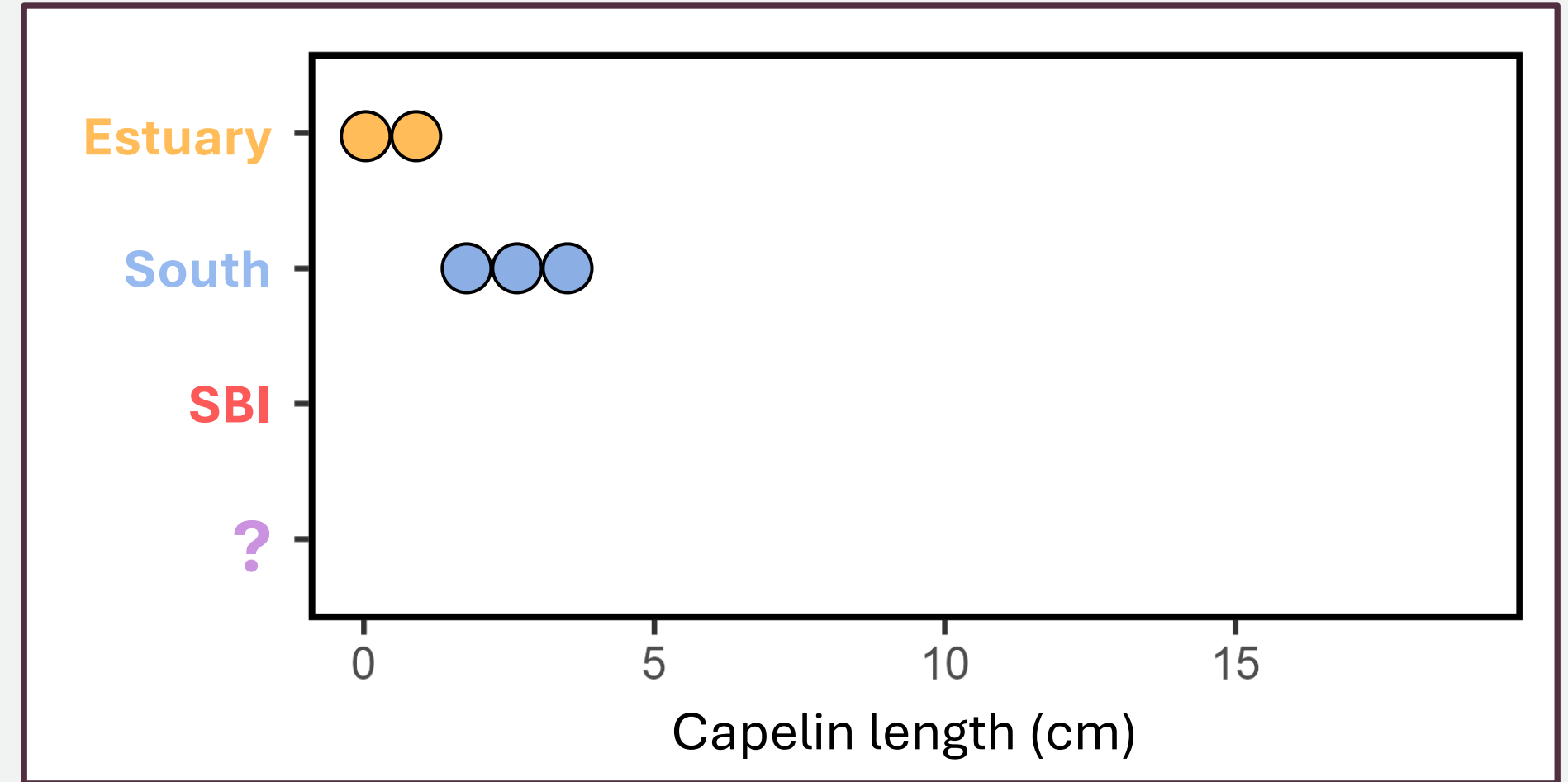
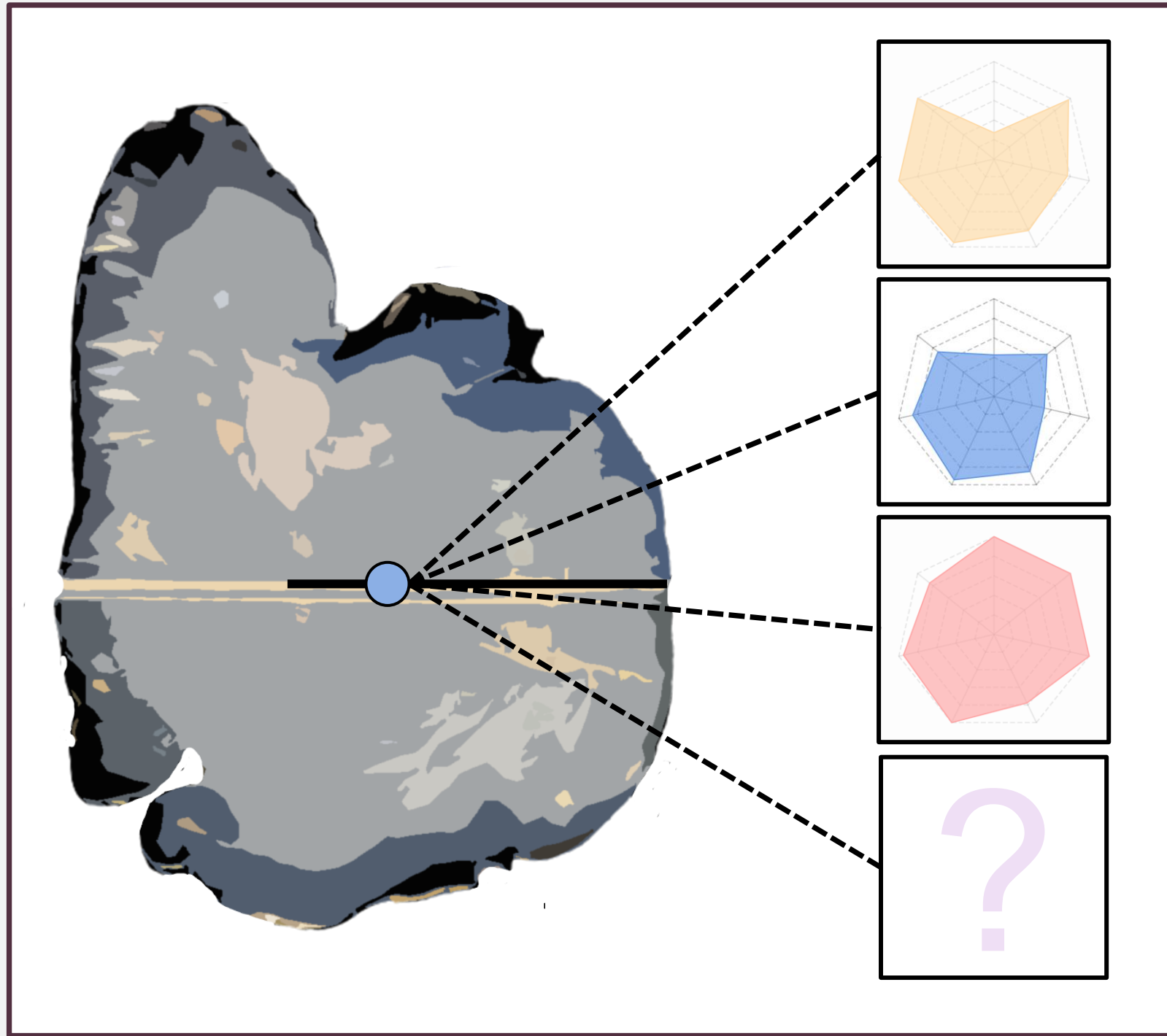
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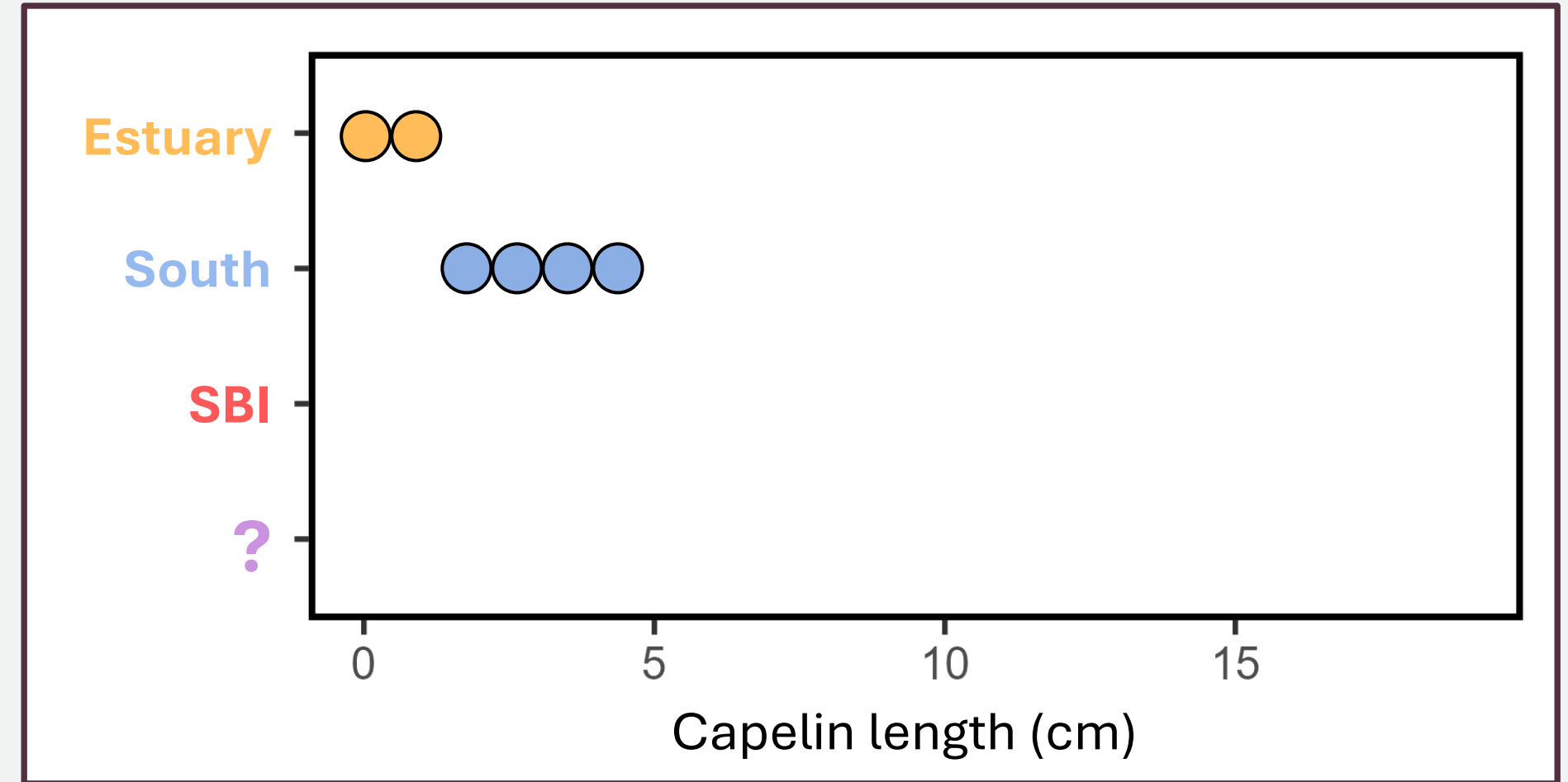
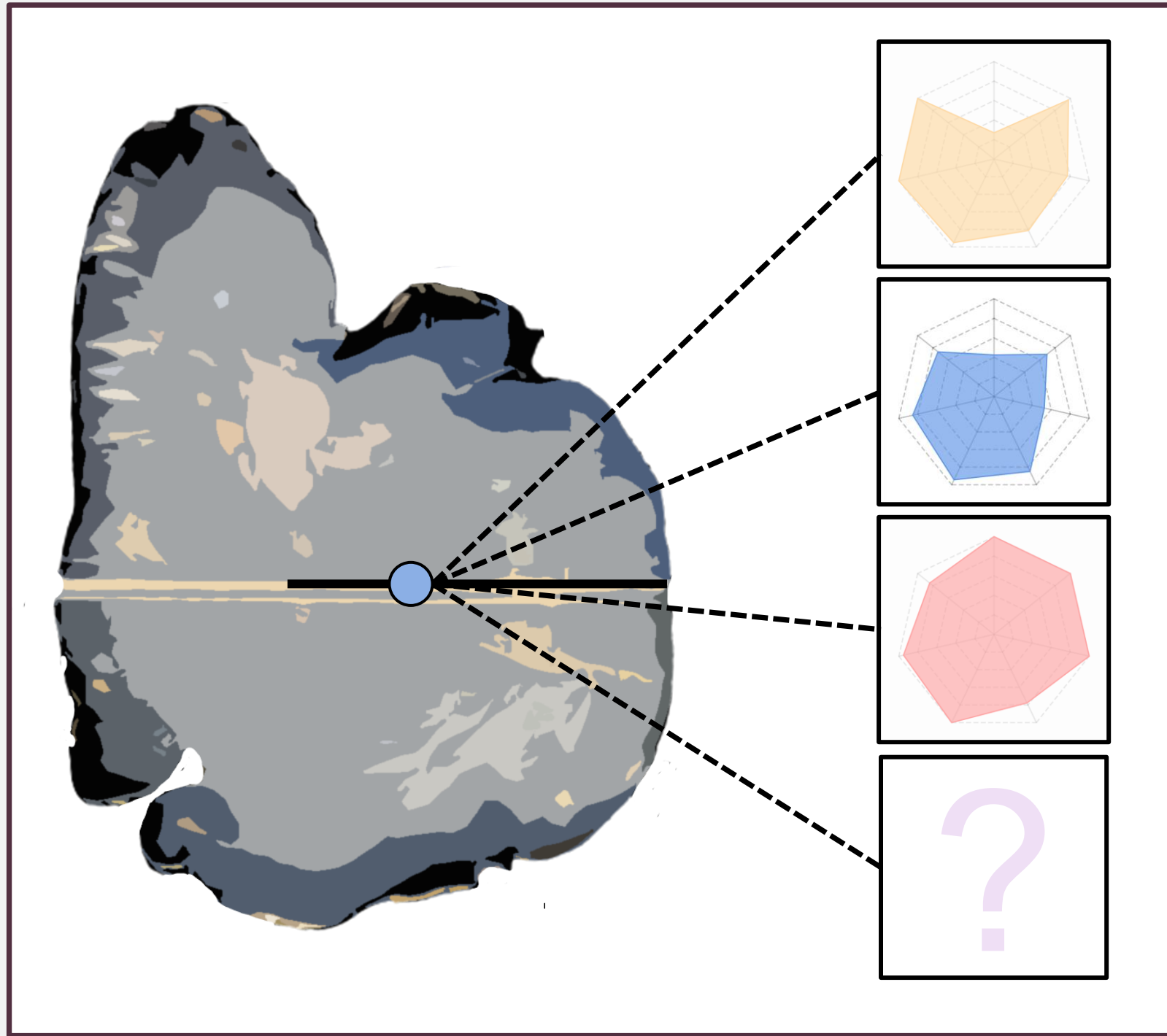
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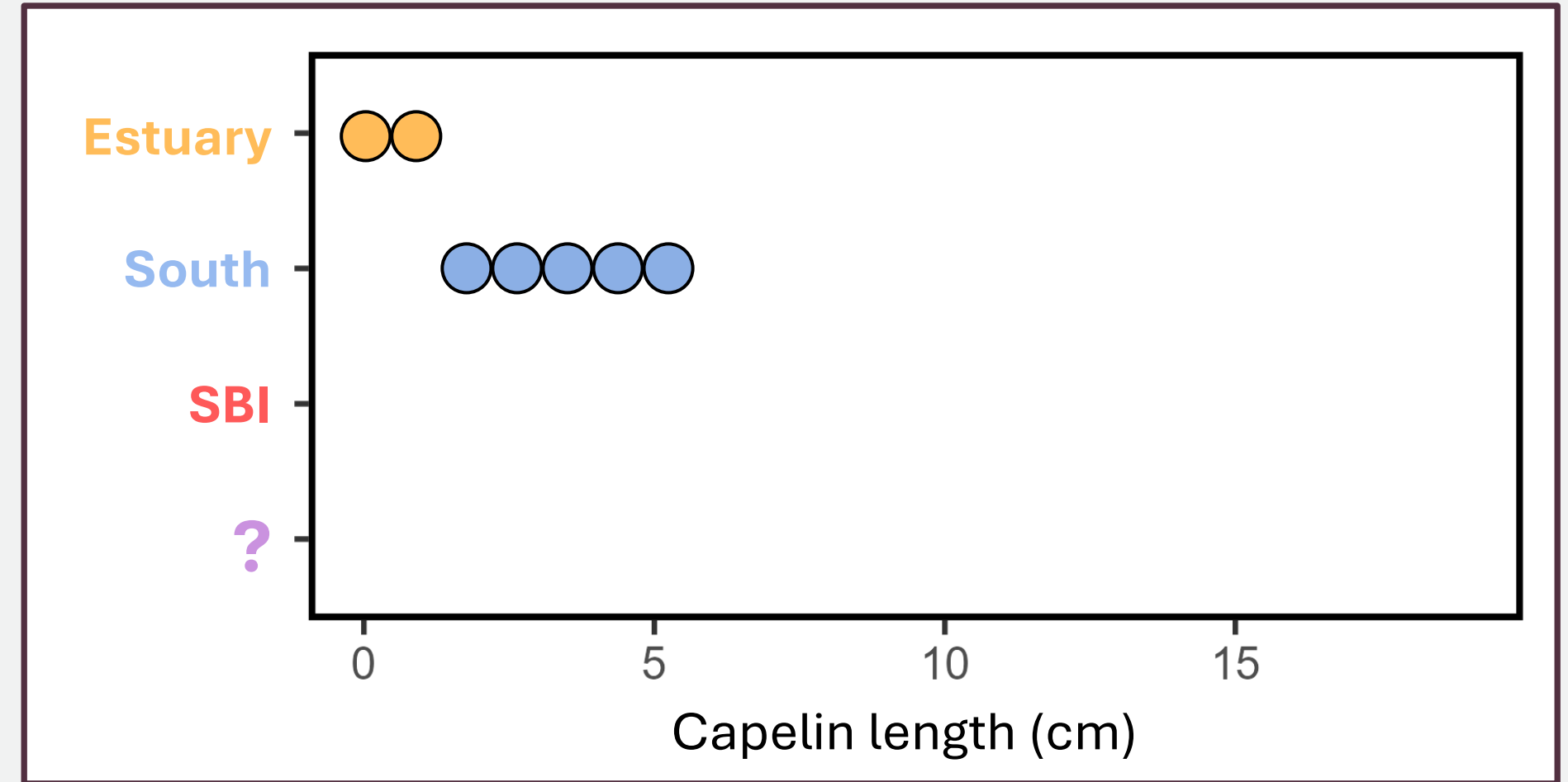
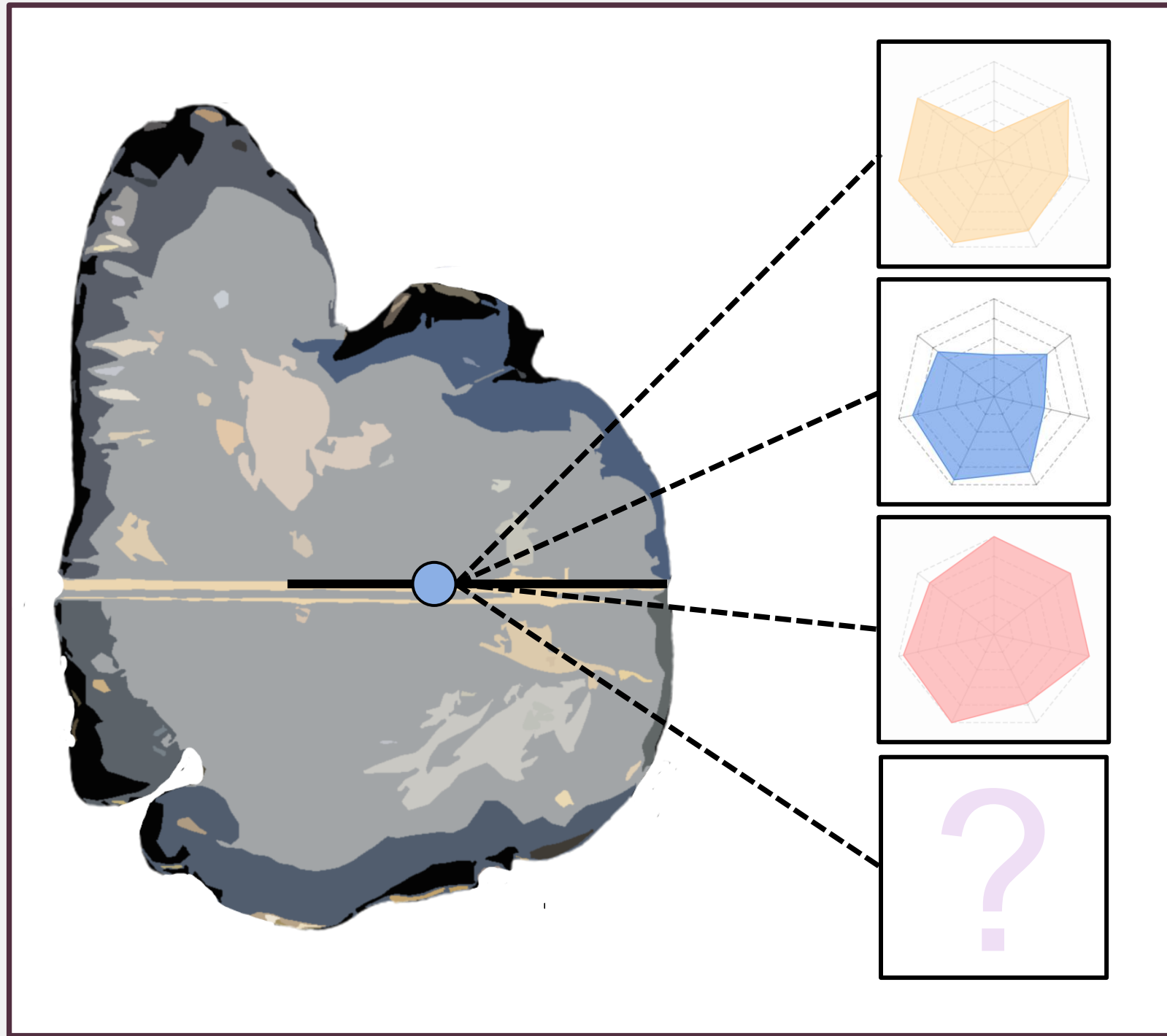
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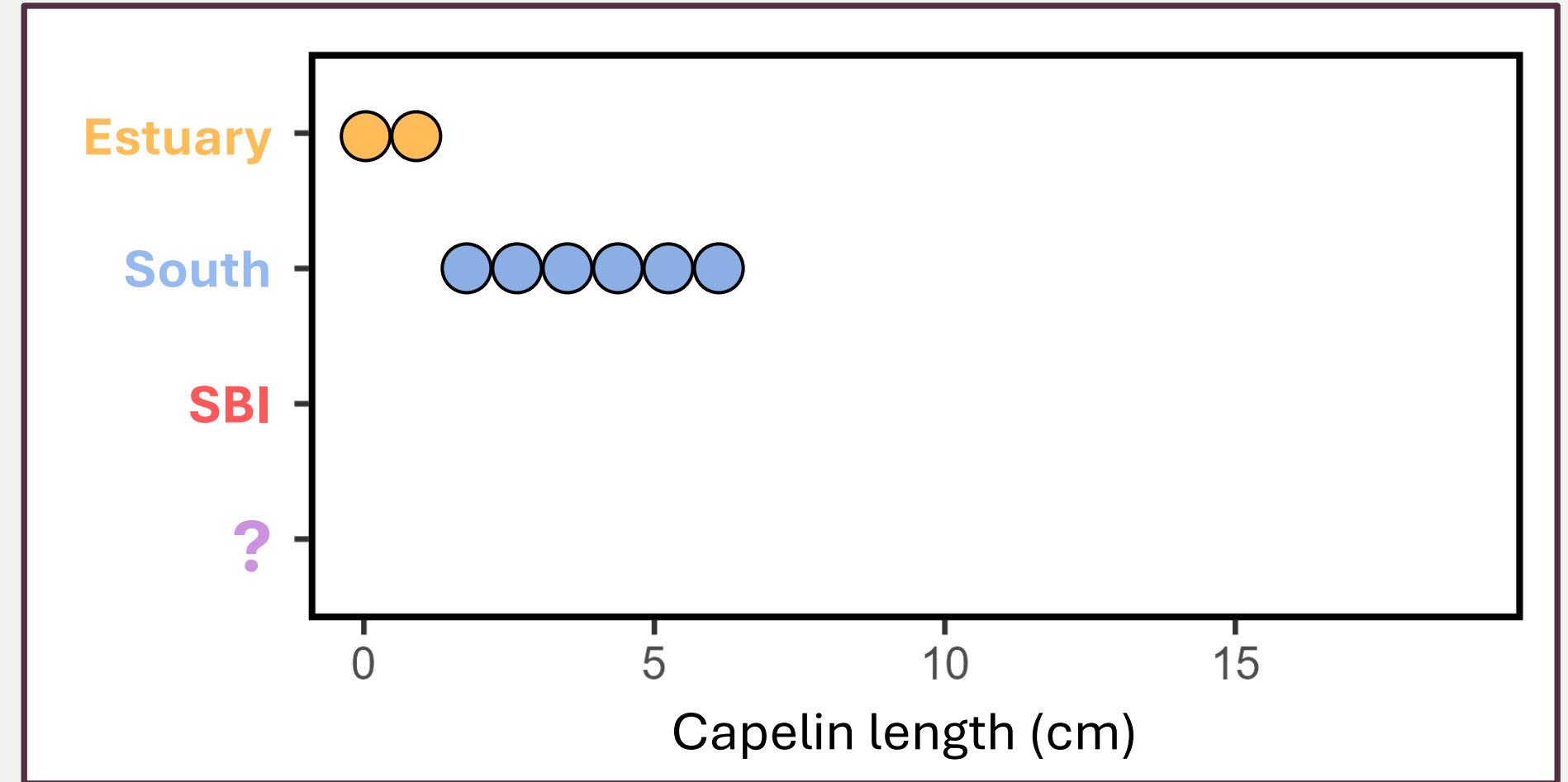
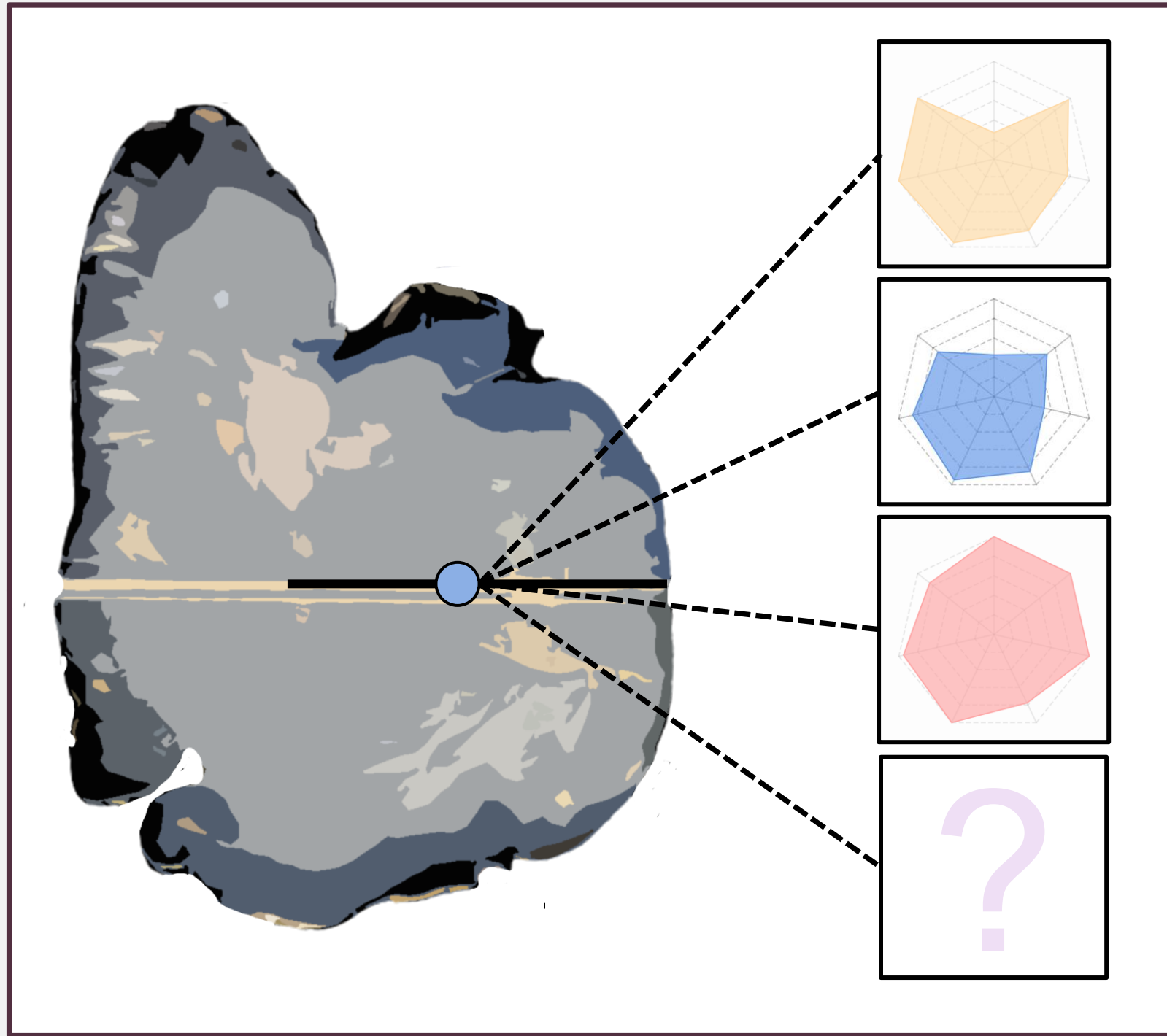
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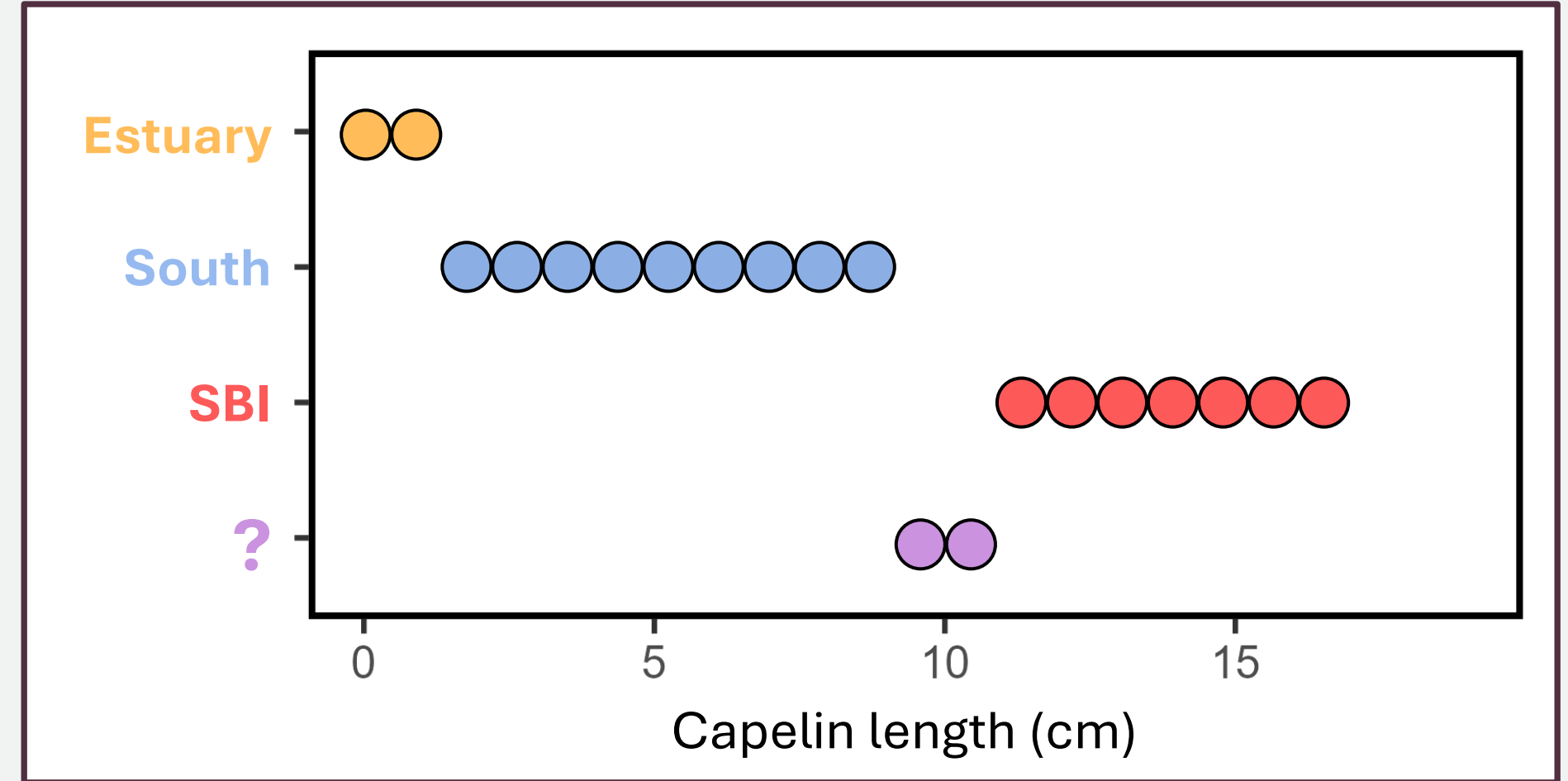
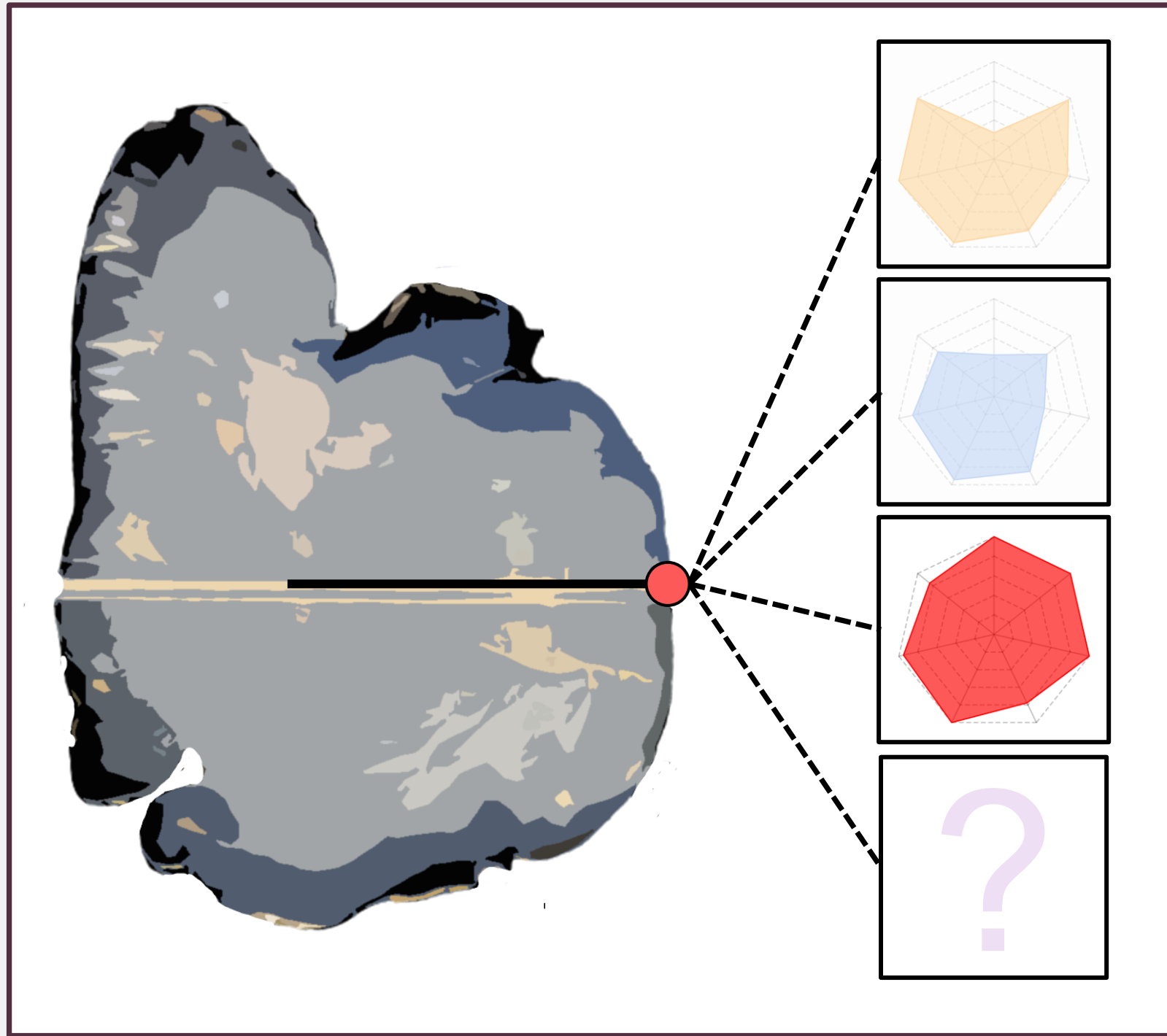
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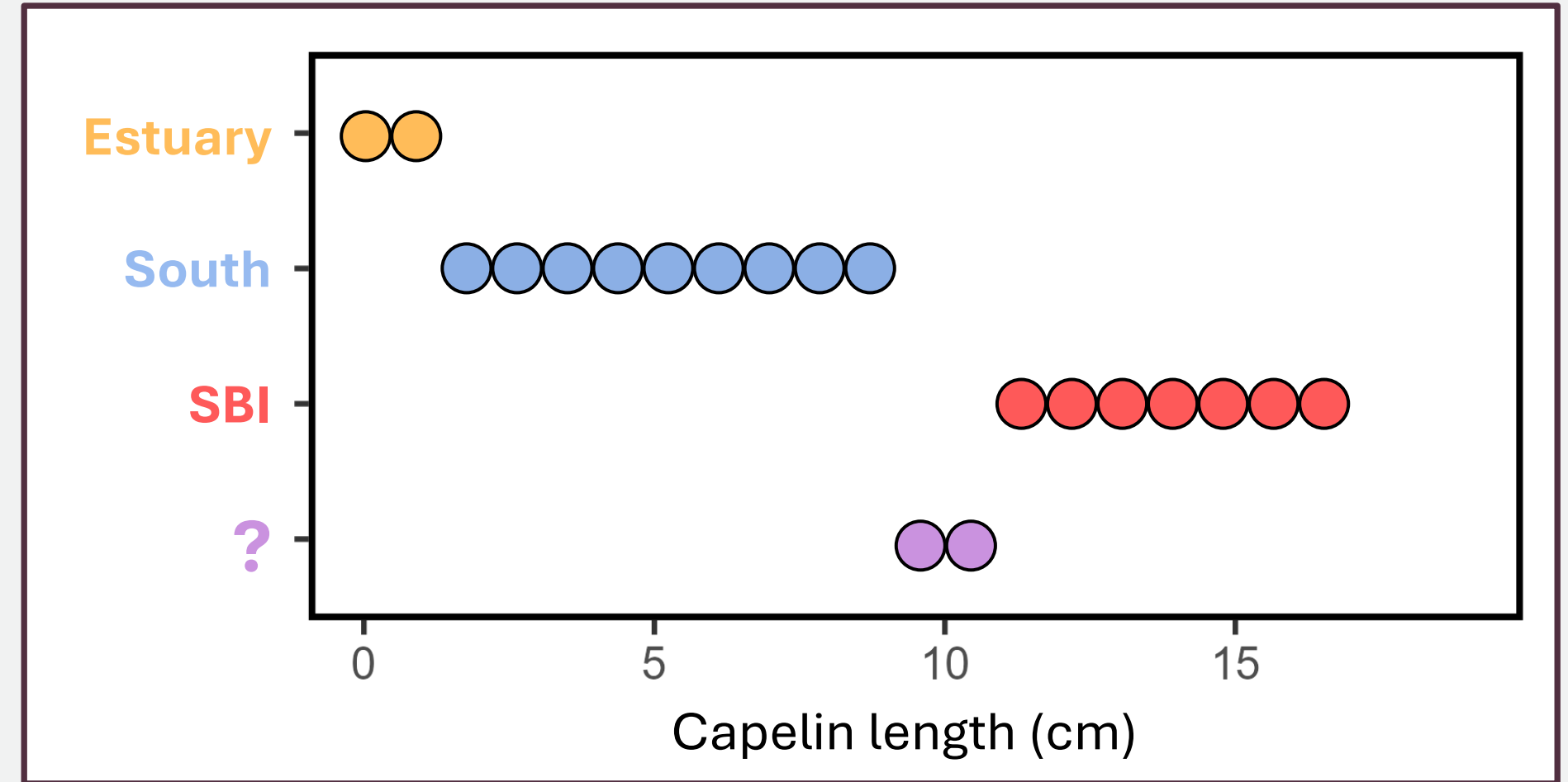
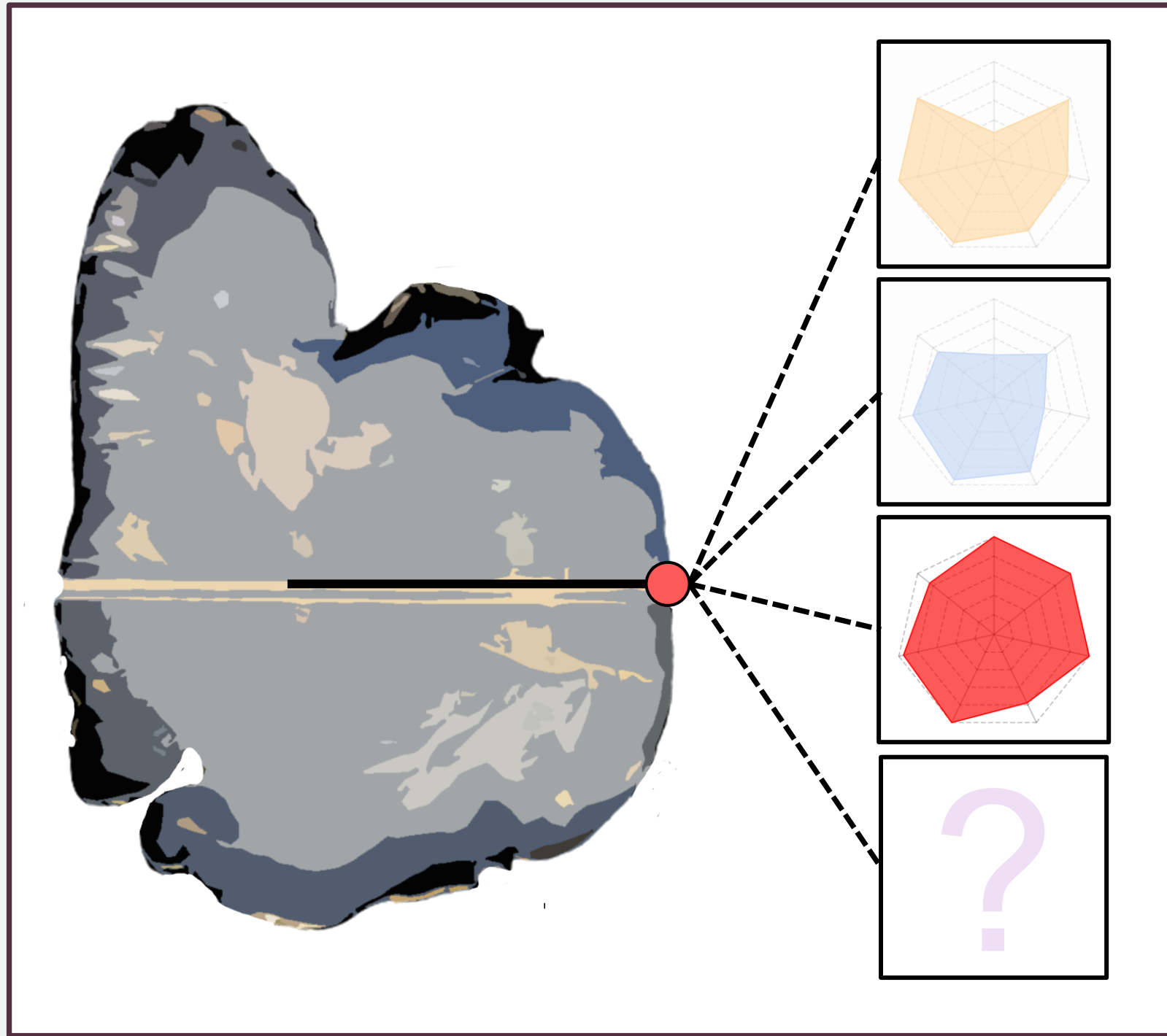
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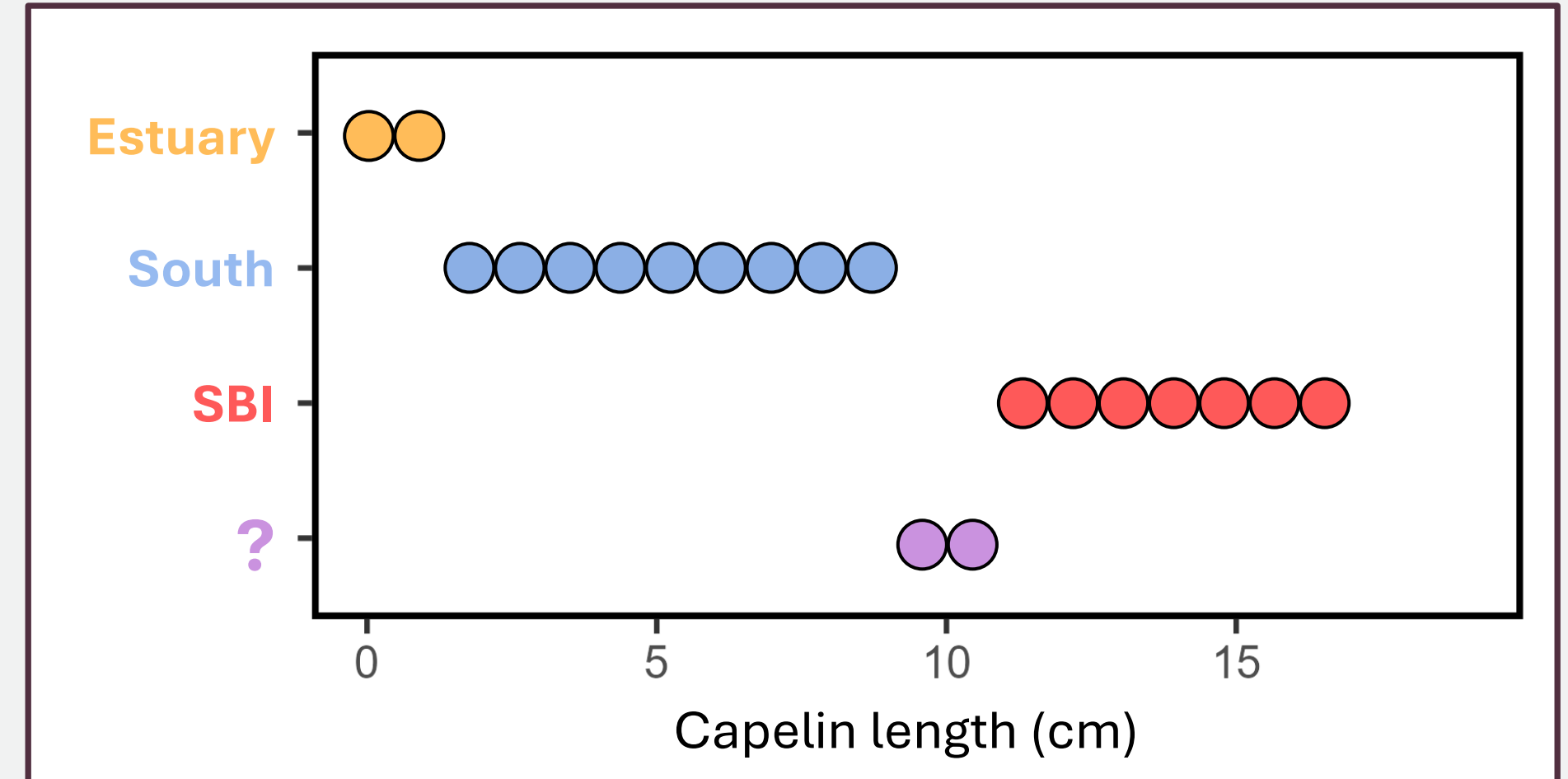
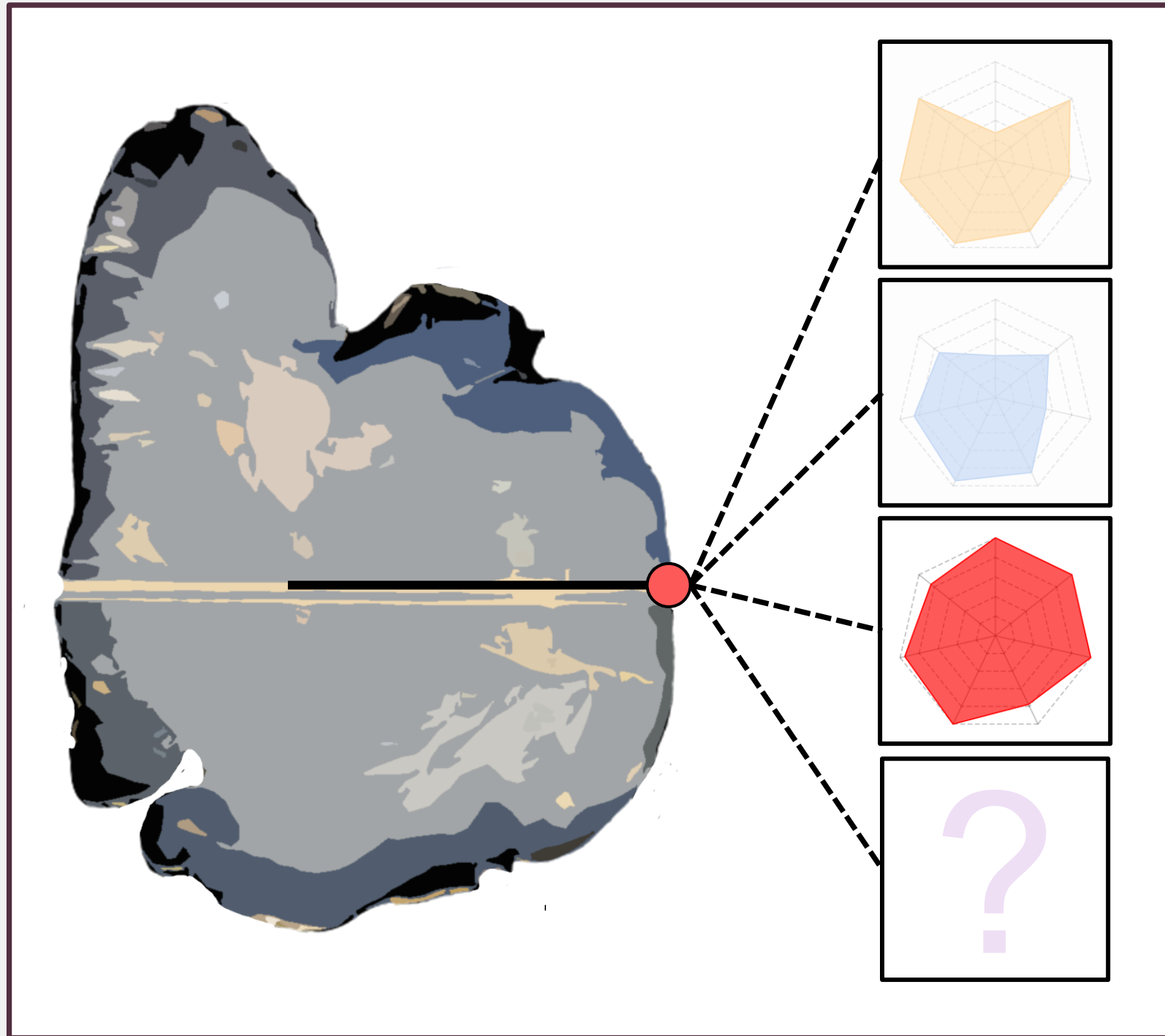


7 – Edge-to-transect reassignment approach



**Element incorporation
varies during the ontogeny**

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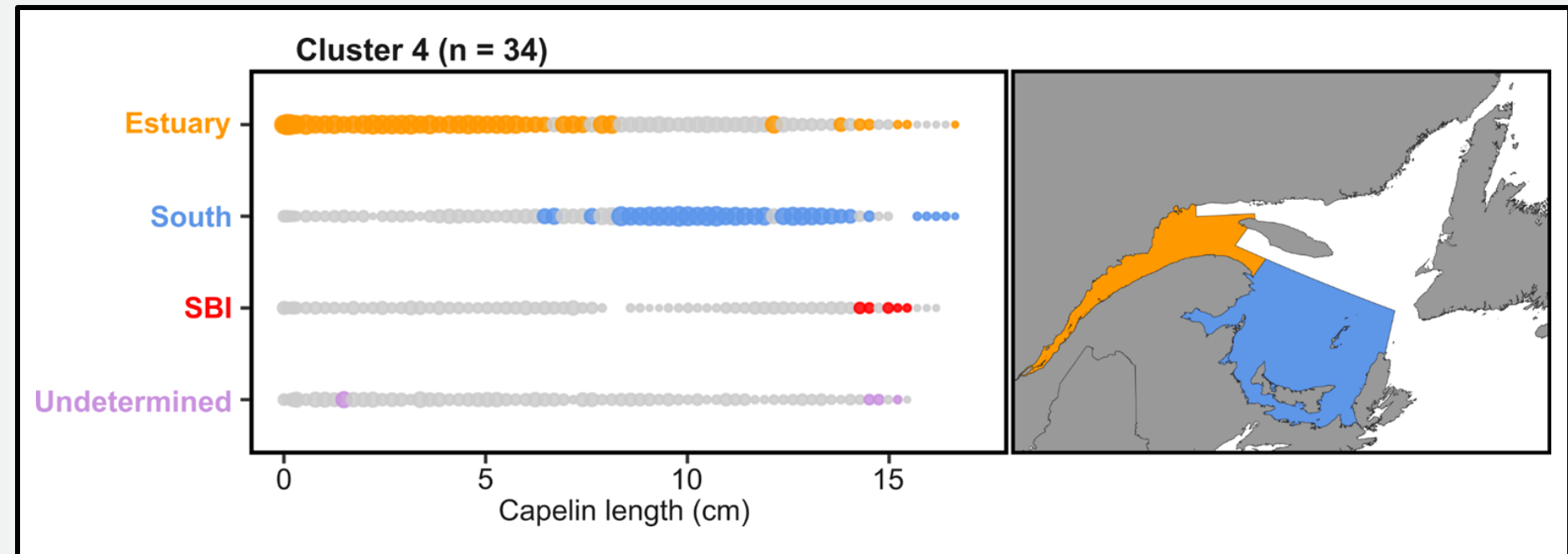
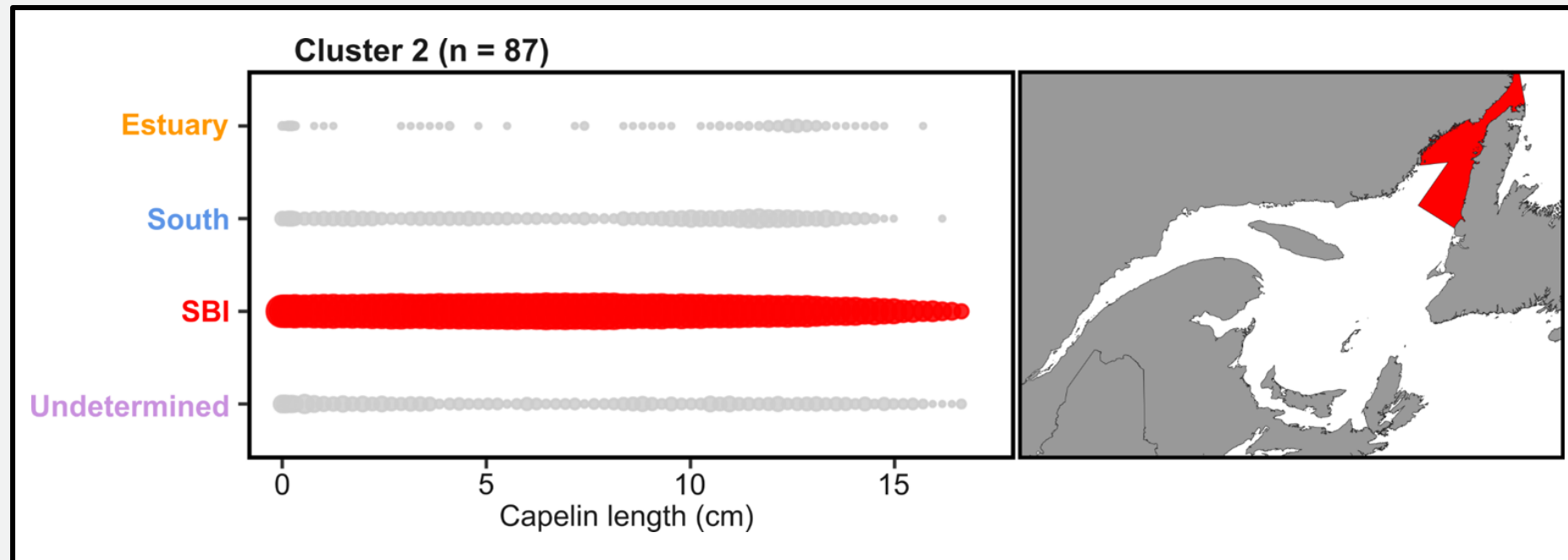
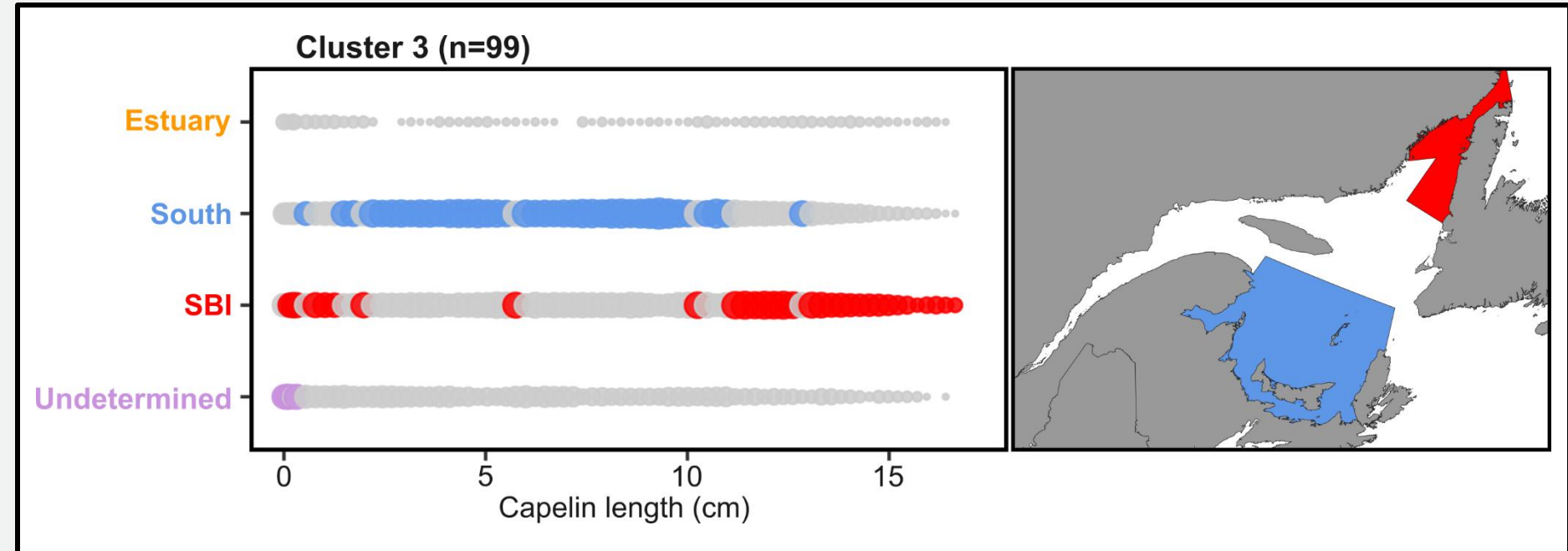
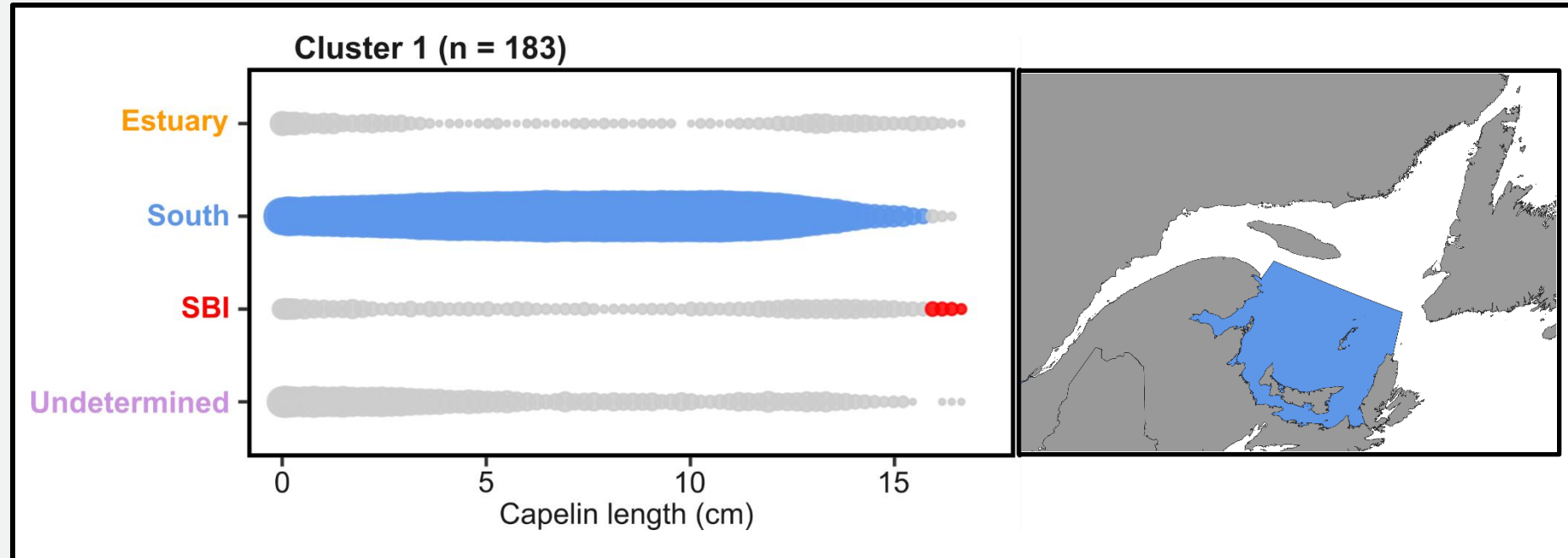
**Element incorporation
varies during the ontogeny**

**Highly differentiated regional fingerprints
enable robust assignments, with minimal risk
of misclassification**

8 – Migratory contingents

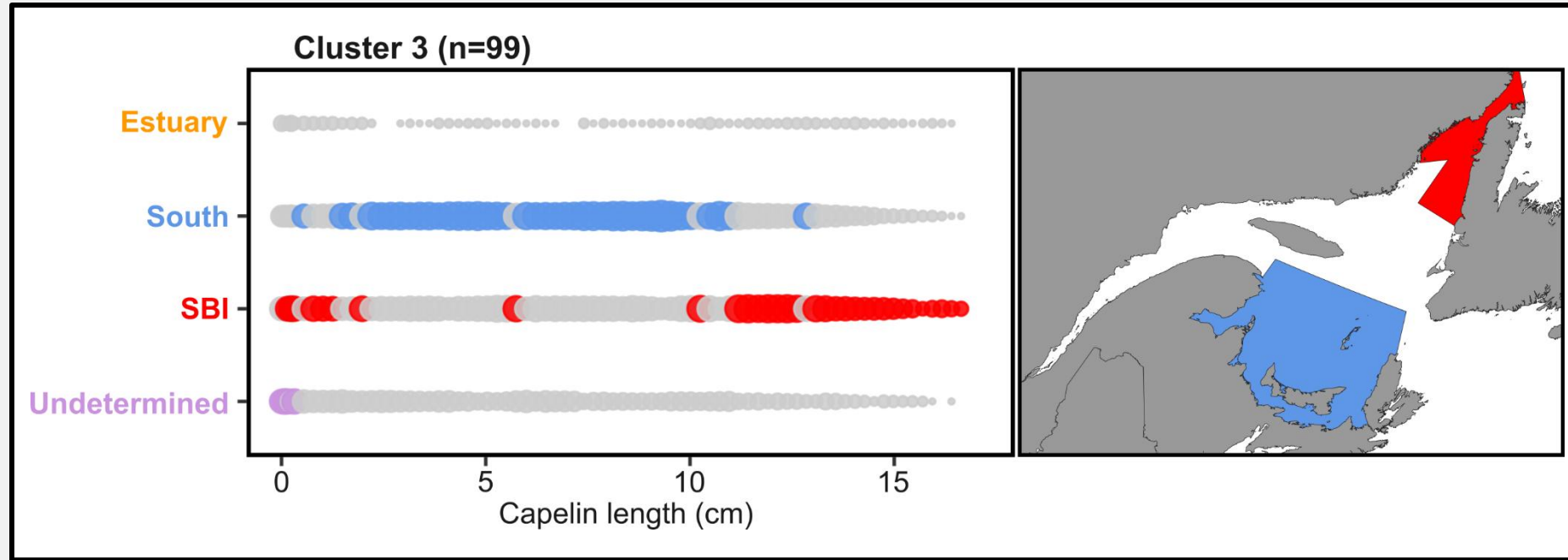
Residents

Migrants

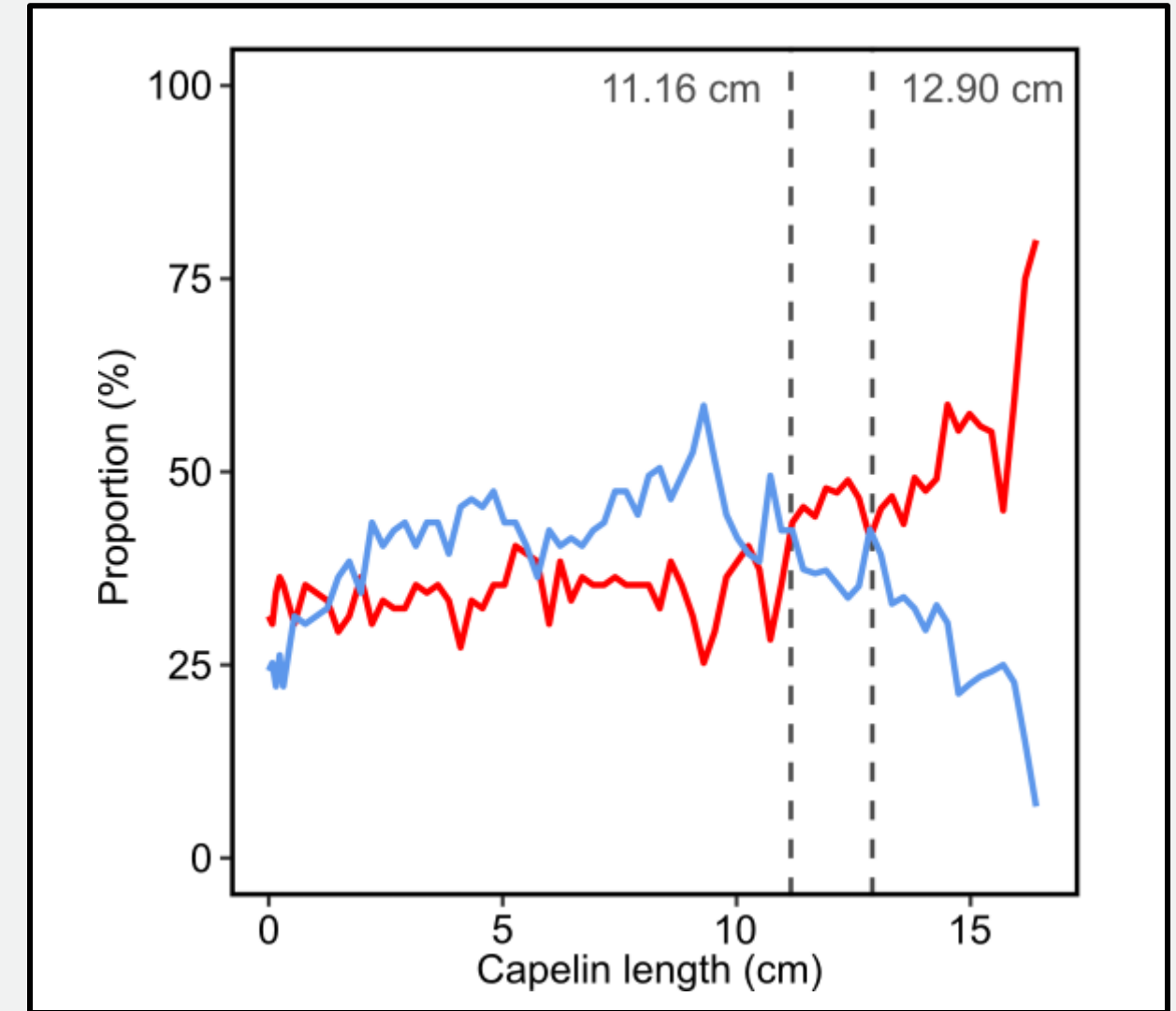
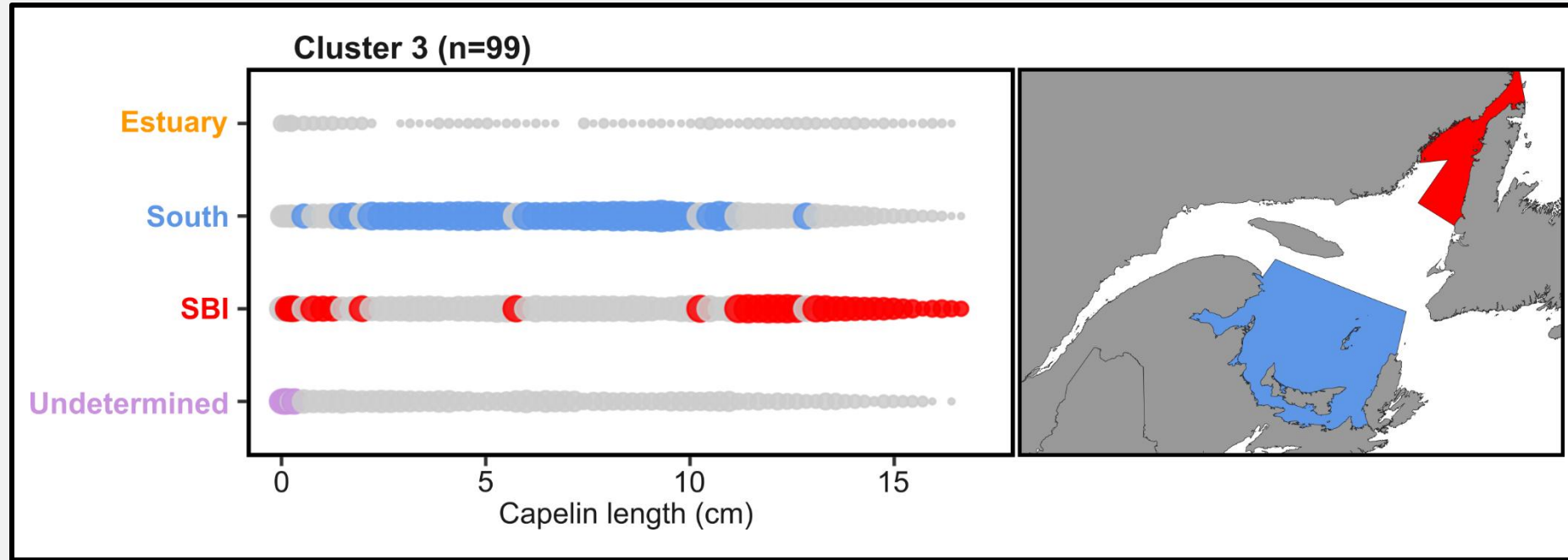


Coexistence of dispersive and regionally faithful strategies:
portfolio effect - buffers against localised disturbances
and recruitment failures

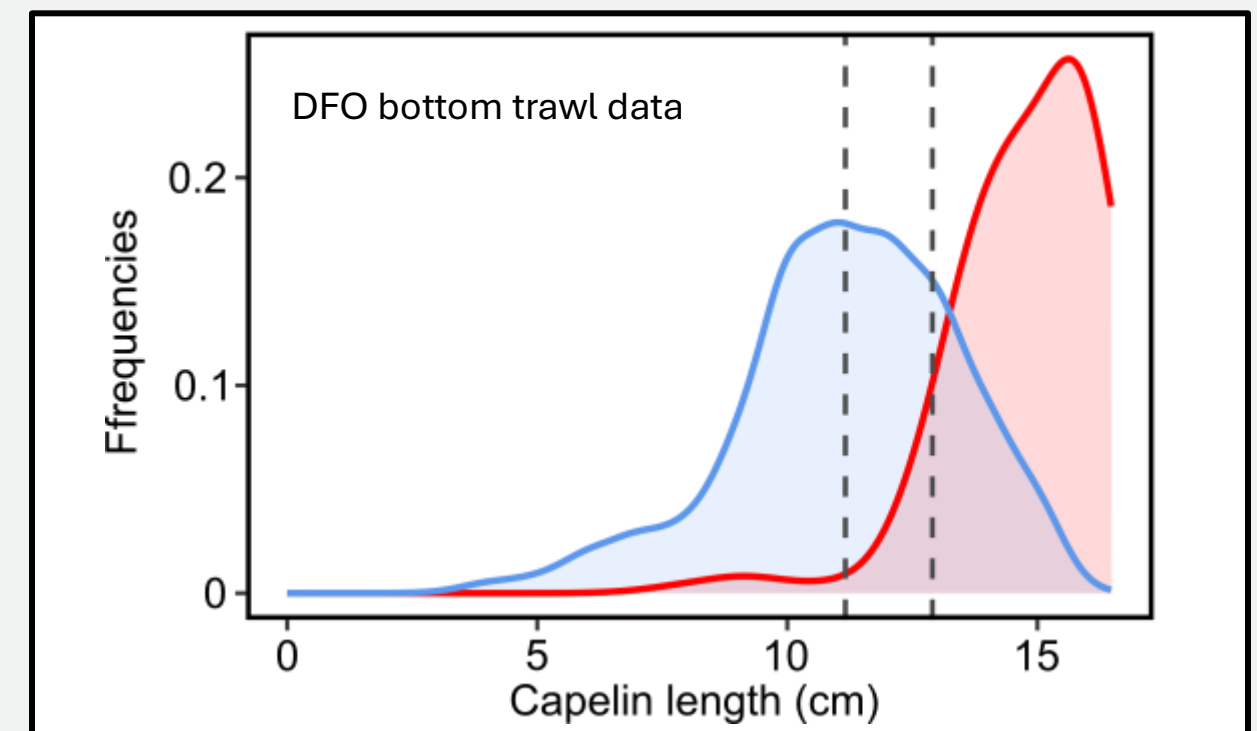
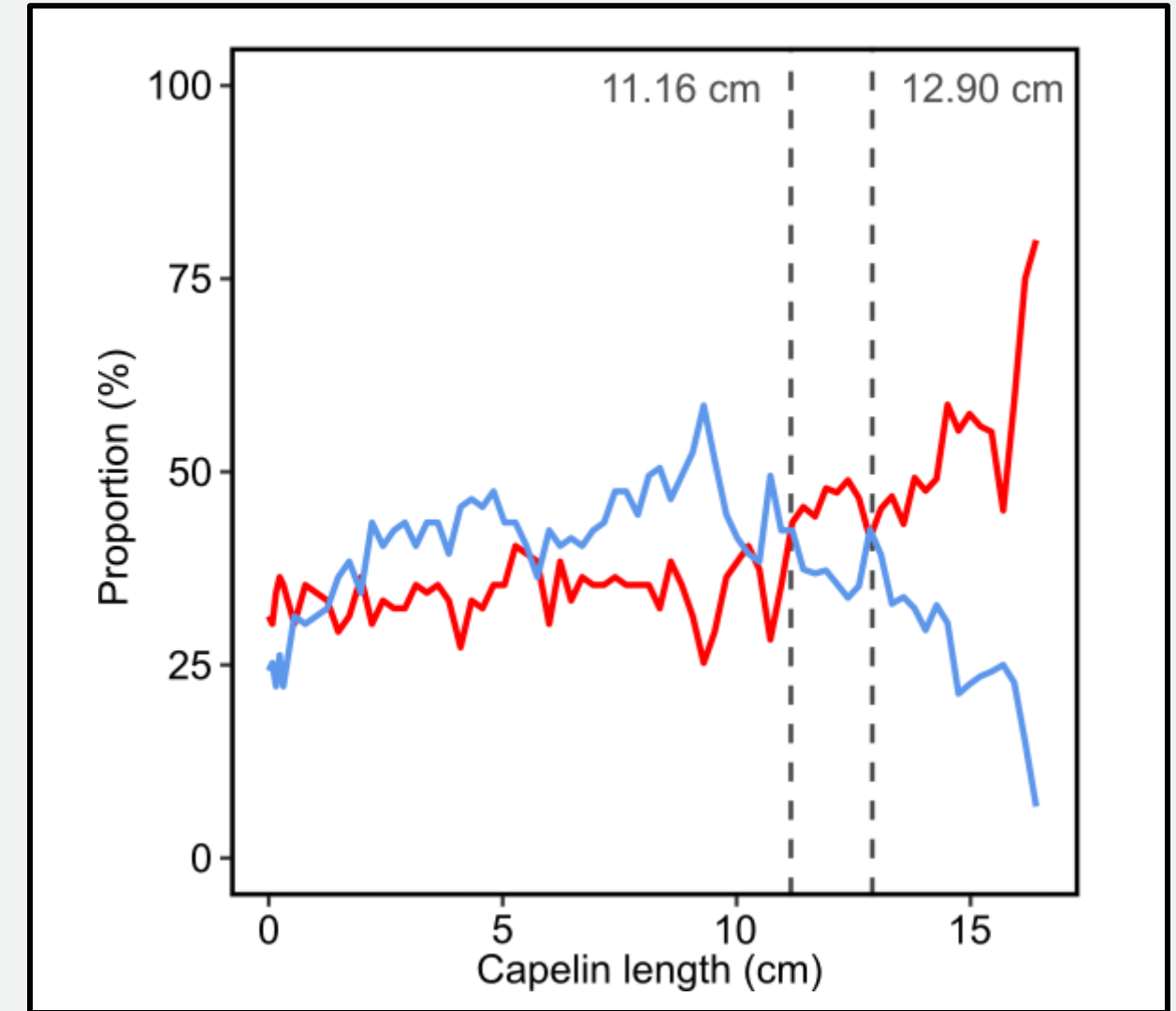
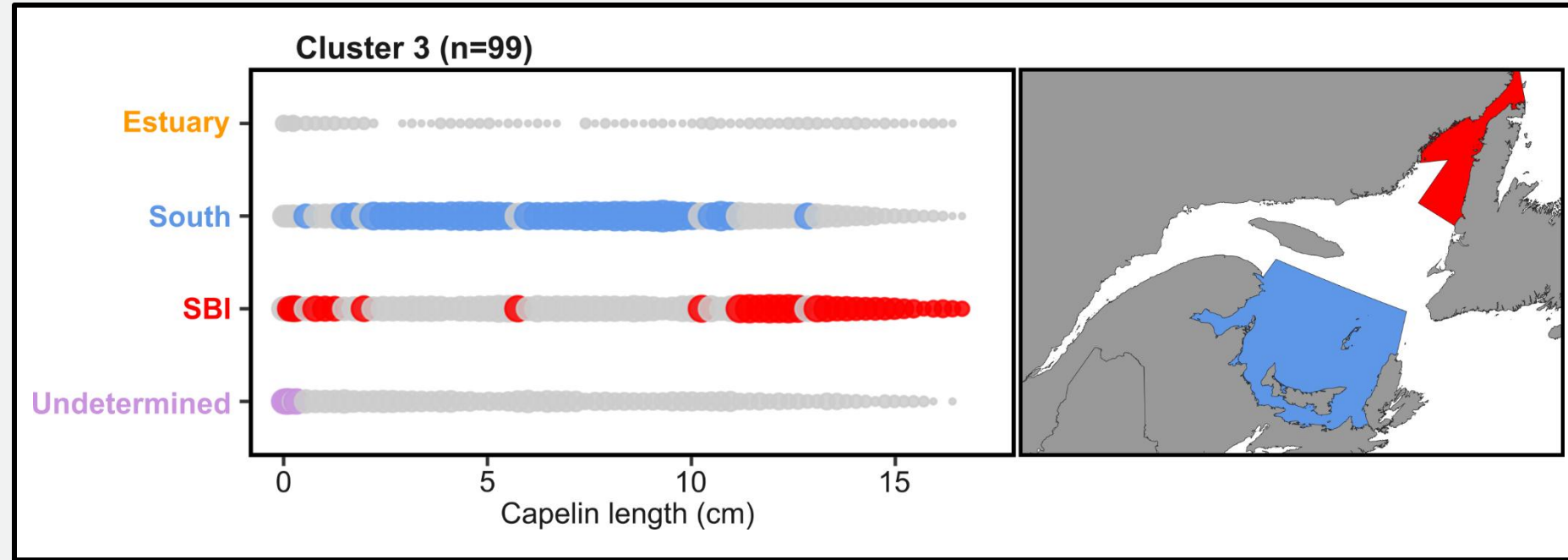
9 – South-SBI migration timing



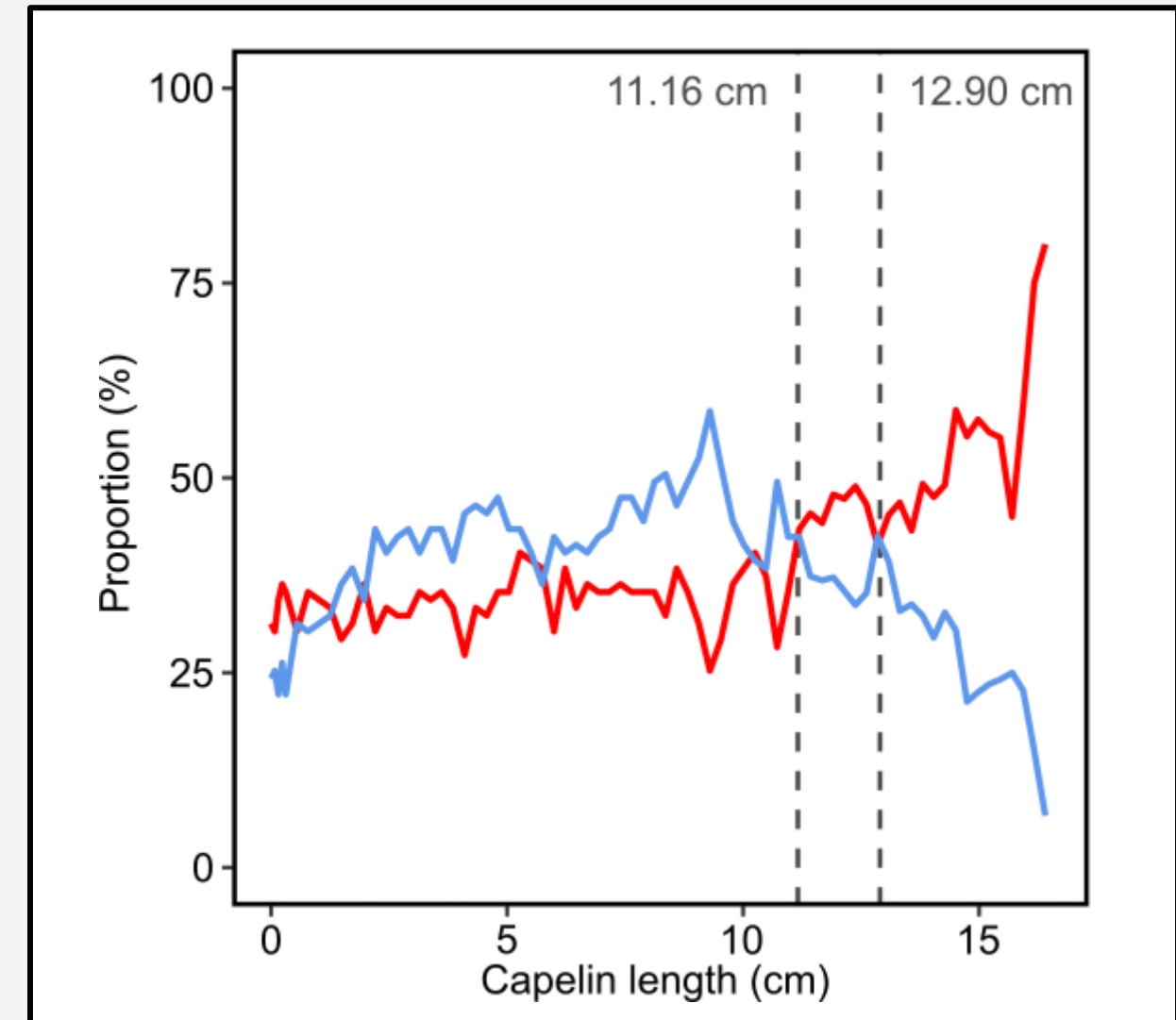
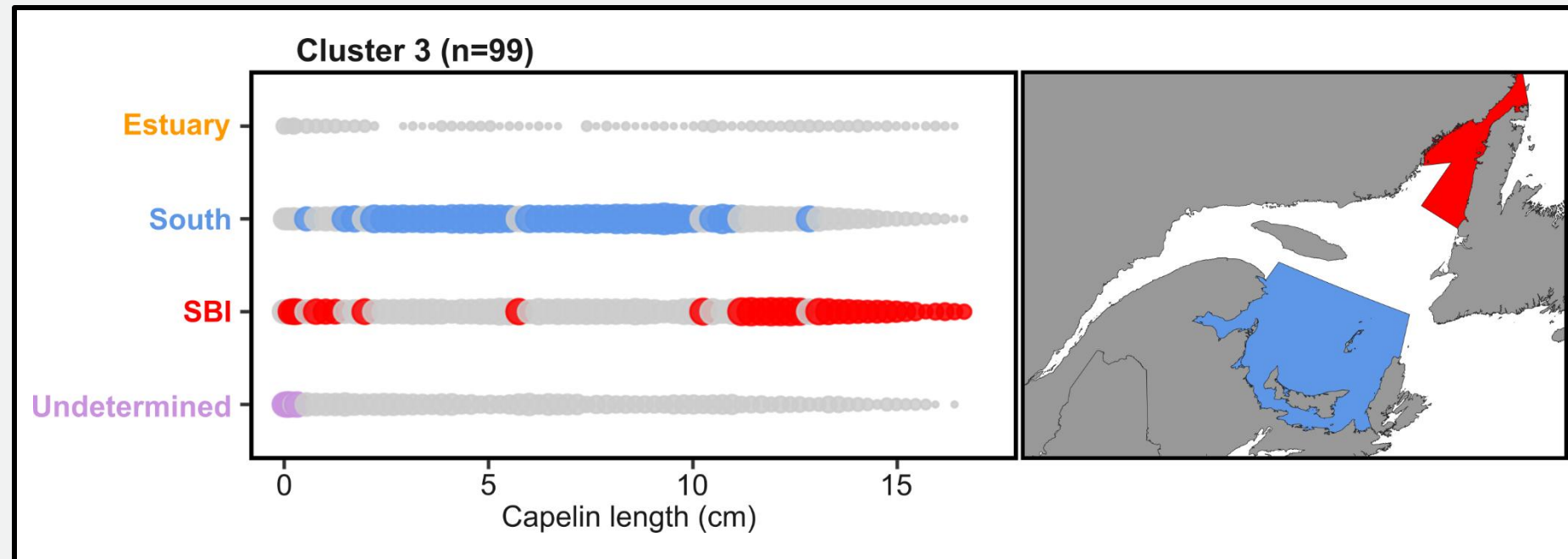
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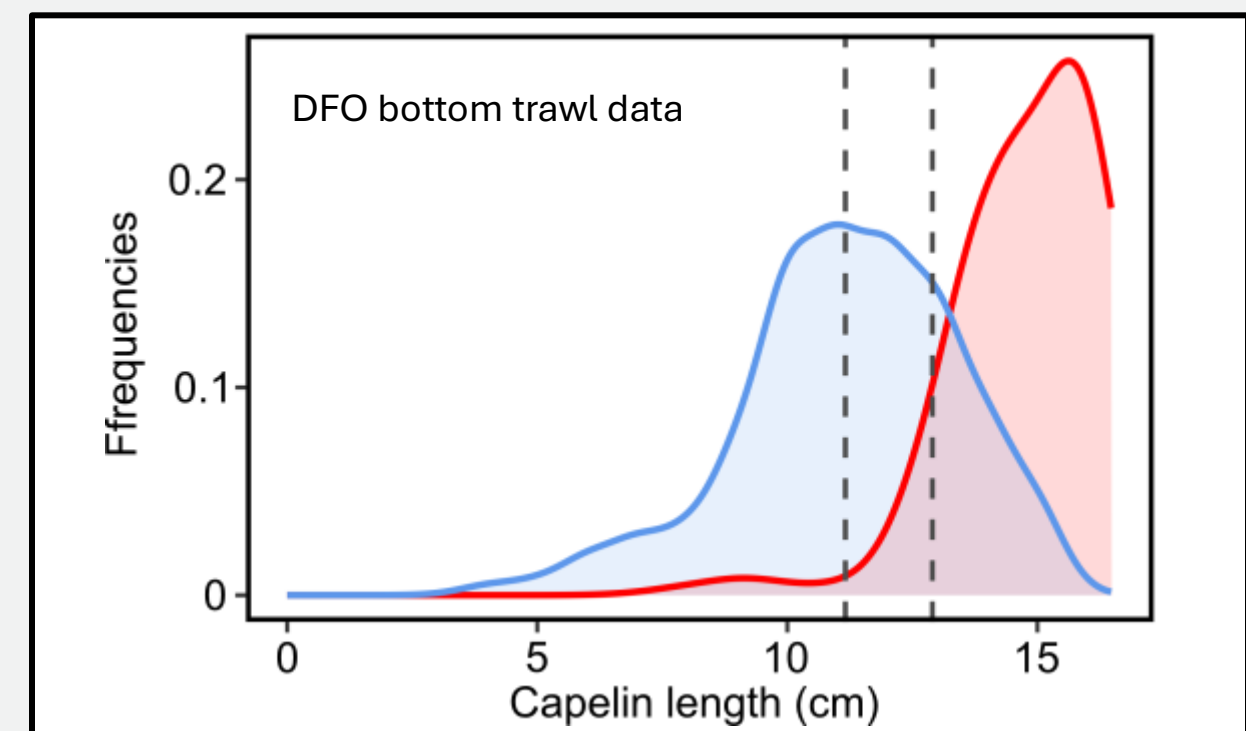


9 – South-SBI migration timing



South - **Primary feeding area:** ice-associated productivity fuels energy accumulation before spawning

SBI - **Preferred spawning area:** colder water and air temperatures create favourable conditions for reproduction



Take home messages

Otolith chemistry can be used to study **capelin migrations in the GSL**

Local residency
in the South and SBI



Seasonal migrations
from the South to SBI

Take home messages

Otolith chemistry can be used to study **capelin migrations in the GSL**

Local residency in the South and SBI



Seasonal migrations from the South to SBI

Acoustic tagging study

The block contains three logos. On the left is the Canadian flag. In the center is the text 'Fisheries and Oceans Canada' and 'Pêches et Océans Canada'. On the right is the Dalhousie University crest and logo, and the Ocean Tracking Network logo featuring a fish with a tracking signal.

Fisheries and Oceans
Canada

Pêches et Océans
Canada

DALHOUSIE
UNIVERSITY

OCEAN
TRACKING NETWORK

Thank you for your attention

Further reading

Jac, R., Piczak, M. L., Van Beveren, E., Boldt, J. L., Brosset, P., Burbank, J., ... Lennox, R. J. (2025). Tracking the schools: a review of approaches to address knowledge gaps in the migratory ecology and habitat use of Canadian forage fishes. *Reviews in Fish Biology and Fisheries*.

Jac, R., Coussau, L., van Beveren, E., Boudreau, M., Le Pape, O., Dominique, R., ... Sirois, P. (2026). Chemical fingerprint of capelin otolith edge reveals consistent spatial variation over time in the Gulf of St. Lawrence, Canada. *Fisheries Research*.

Coussau, L., Van Beveren, E., Boudreau, M., & Jac, R. (2026). Preliminary results for the investigation of natal origin in capelin (*Mallotus villosus*) from the Gulf of St. Lawrence using otolith chemistry. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 3762: vii, 40.