Unraveling organic matter fluxes in coastal Antarctica using compound-specific analysis of amino acid $\delta^{15}N$

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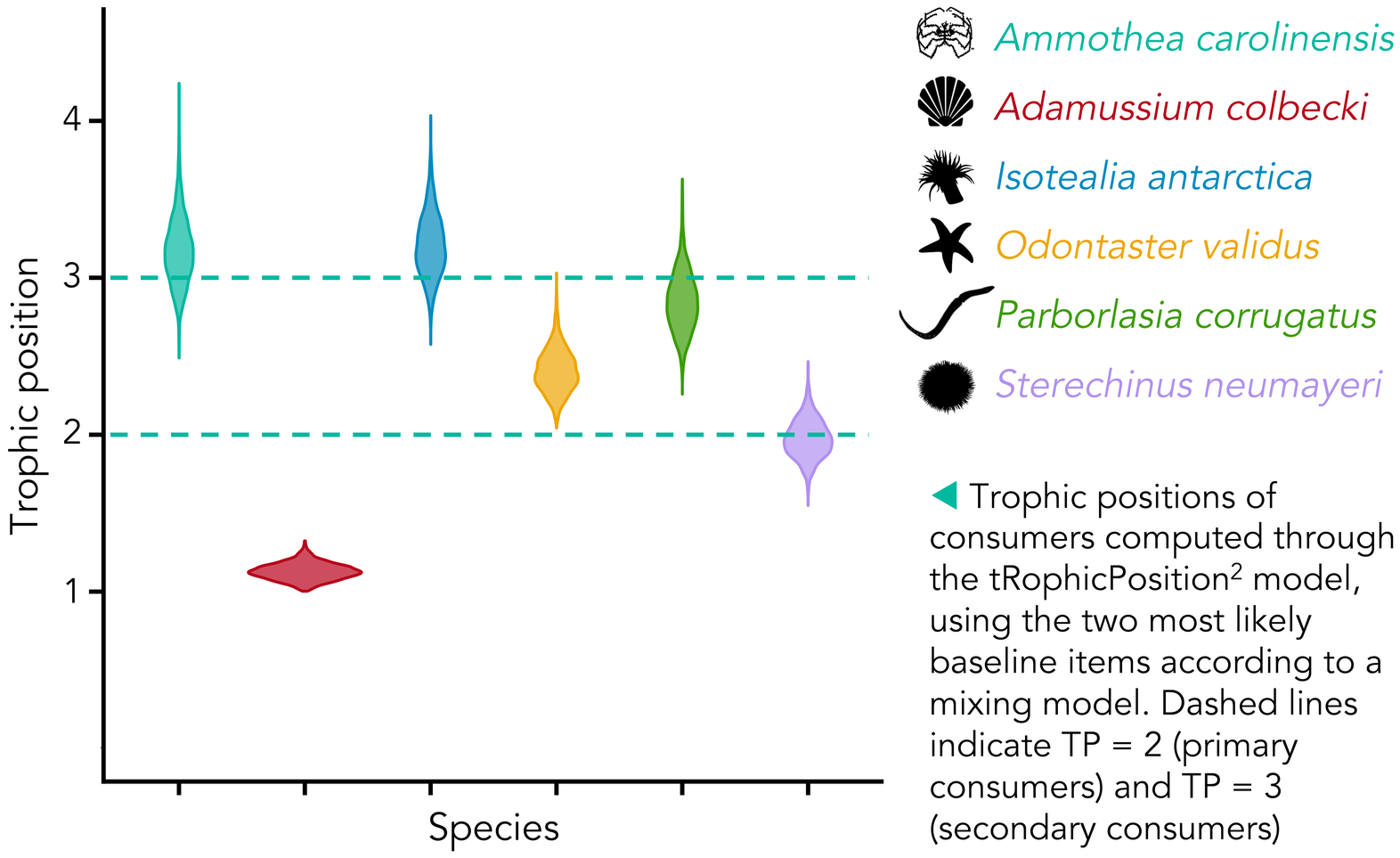
Context & objectives

Global change causes strong and contrasted environmental modifications in coastal Antarctica. Understanding how these changes impact ecosystem functioning is a major priority.

Trophic positions (TP) provide simple ways to assess organisms' functional roles and estimate energy flow through ecological communities, while taking into account complex processes such as omnivory.

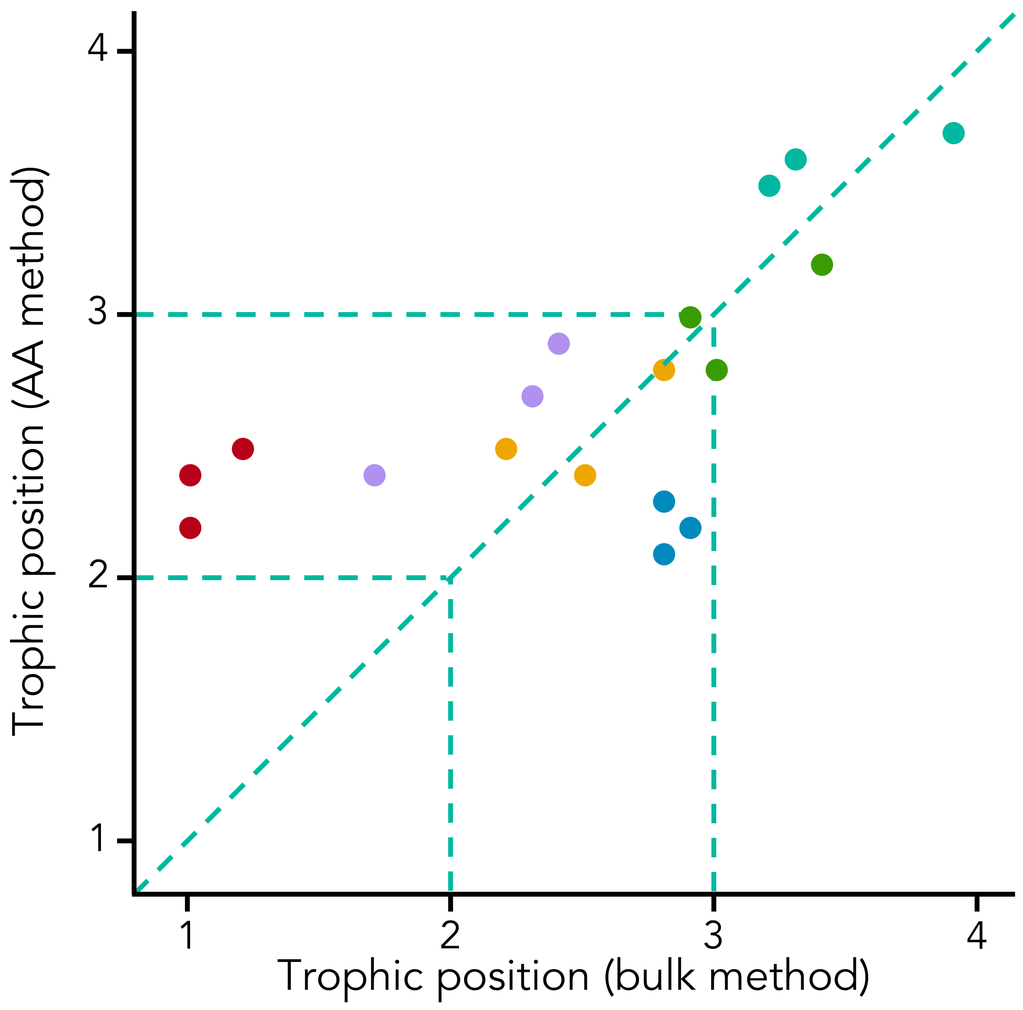
In a previous study[1], we studied trophic position in Antarctic zoobenthos sampled during an extreme high sea ice event. We used traditional bulk organic matter $\delta^{15}N$ analysis in consumer tissue and baseline items. TP estimates (▶) were strikingly low for some taxa (omnivores *O. validus* & *P. corrugatus*), sometimes conceptually unlikely so *(A. colbecki)*.

Here, we used a more novel tracer (compound-specific analysis of amino acids $\delta^{15}N$) to reassess those results.



◀ Trophic positions of consumers computed through the tRophicPosition[2] model, using the two most likely baseline items according to a mixing model. Dashed lines indicate TP = 2 (primary consumers) and TP = 3 (secondary consumers)

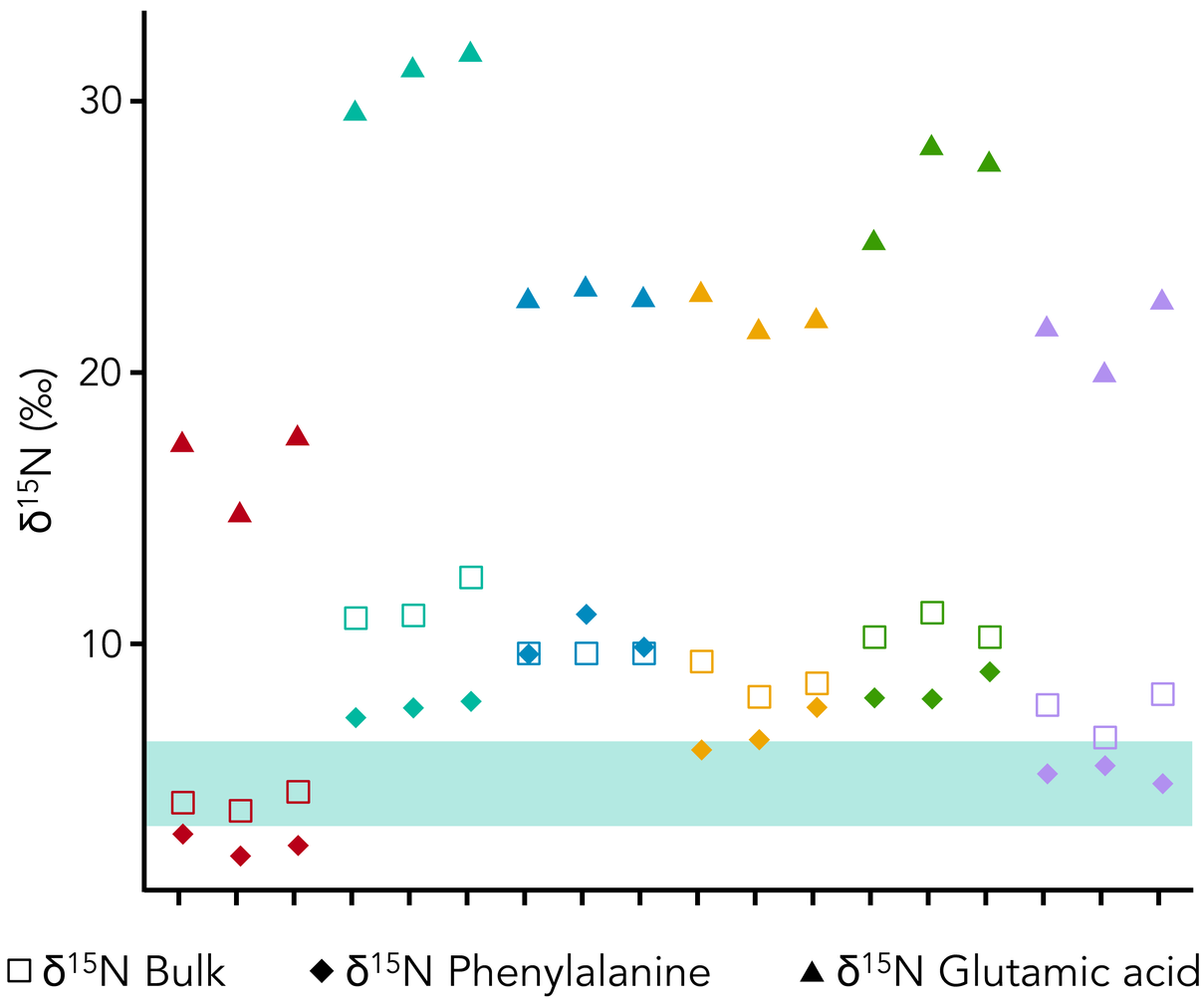
Key findings



▲ Correspondence between consumer trophic position computed using bulk[3] and amino acid[4] $\delta^{15}N$. Dashed lines indicate TP = 2, TP = 3, and the identity line. See figure above for color codes.

Good congruence for 3 species including *O. validus* and *P. corrugatus*, corroborating findings from the original paper.

TP estimates using AA $\delta^{15}N$ are notably higher (TP > 2) for *A. colbecki*, slightly higher for *S. neumayeri*, but lower for *I. antarctica*.



▲ $\delta^{15}N$ of bulk tissue, phenylalanine (source amino acid) and glutamic acid (trophic amino acid) in sampled zoobenthos. Green area: bulk $\delta^{15}N$ in sampled producers / baseline items. See figure above for color codes.

Sampled taxa likely rely on different food web baselines, as suggested by differences in $\delta^{15}N_{Phe}$.

A. colbecki (filter feeder): active selection of low $\delta^{15}N$ items? *I. antarctica* (omnivore/predator): dependence on microbially reworked OM[5]?

Take home message

The correspondence between classic and novel methods of TP estimation was species-specific.

Compound-specific AA $\delta^{15}N$ analysis confirmed the low trophic positions of omnivores *O. validus* and *P. corrugatus*, which could have implications for secondary production. This corroborates initial findings regarding how unusually high sea ice cover might influence ecosystem functioning.

Besides TP estimation, AA $\delta^{15}N$ provided invaluable info about food web structure, emphasizing the interest of this tracer in coastal Antarctica, whose remoteness, intense seasonality and extreme conditions limit insights from traditional methods.

References

[1]Michel *et al.* 2019 Sci. Rep. 9: 8062. [2]Quezada *et al.* 2019 Meth. Ecol. Evol. 9: 1592-99. [3]Post 2002 Ecology 83: 703-18. [4]Chikaraishi *et al.* 2009 Limnol. Oceanogr. Meth. 7: 740-50. [5]McCarthy *et al.* 2007 Geochim. Cosmochim. Acta 71: 4727-44.