

Worms that push the limits of integrative taxonomy

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Gyratrix hermaphroditus

Long suspected to be a species complex, *Gyratrix hermaphroditus* Ehrenberg, 1831 (Polycystididae, Rhabdocoela) was recently confirmed as one of the largest complexes globally, with populations thriving in marine, freshwater, and brackish environments (Tessens, Monnens et al., 2021, Zool. Scr.).

Up to 78 species can be delineated, depending on the method used!



So let's split it up?

We should be equipped with all the necessary elements to conduct *bona fide* integrative taxonomy, which ought, theoretically, to yield robust species boundaries:

Morphology. 14 unique morphotypes, aligning with monophyletic groupings.

Barcoding (ABGD). 62 molecular species, nested within the 14 morphotypes.

Coalescent (GMYC). 78 molecular species, nested within ABGD delineations.

Morphometrics. Partially corroborates the findings of GMYC.

Ecology. In some instances aligns with GMYC, but mixed 'species' (occurring in different habitats) also exist.

There's options...

Conservative approach. Avoid all conflict and maintain a single species despite observed variation? Counterintuitive!

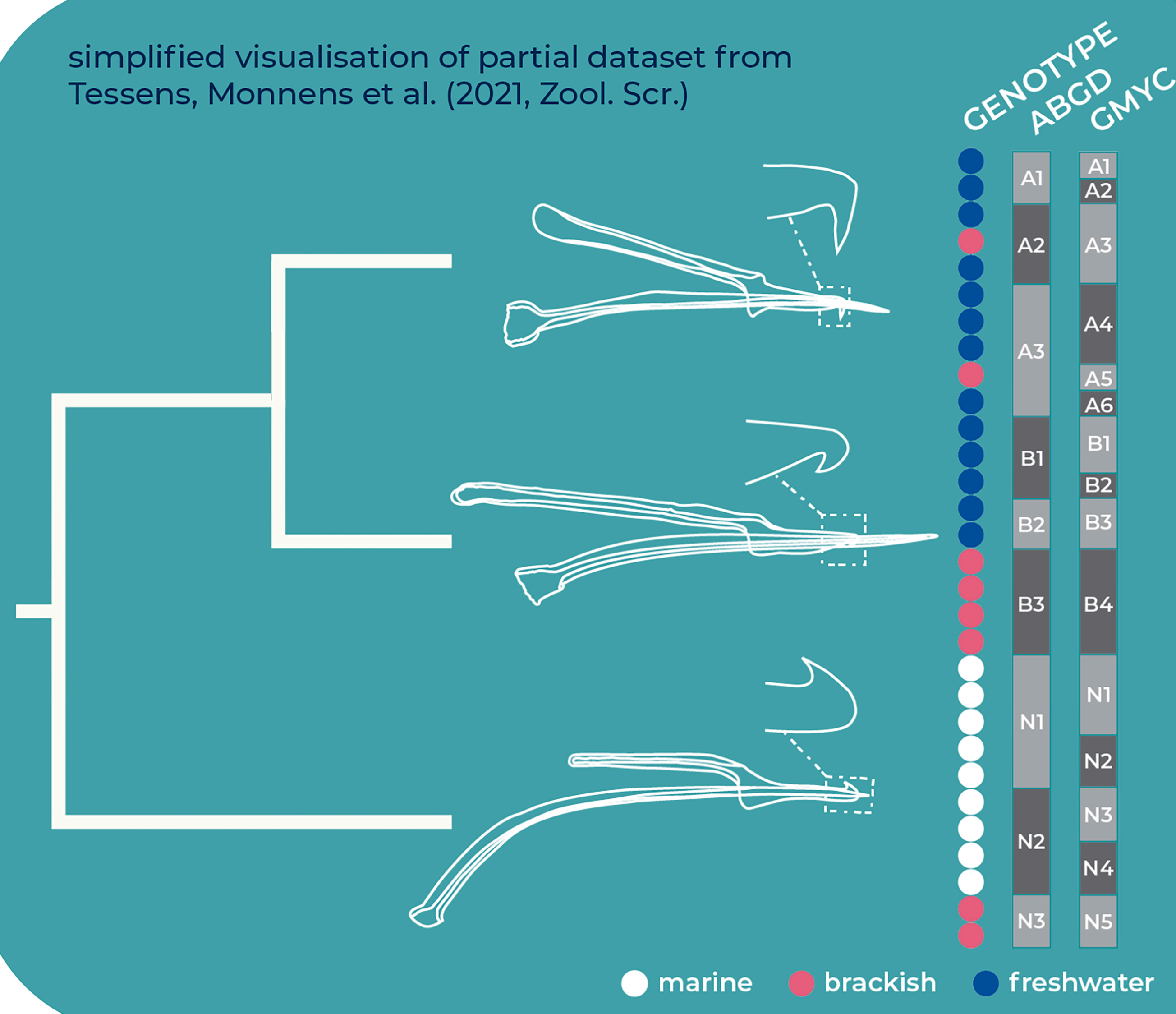
Morphology. Delineate morphological groupings? Pragmatic, corroborated by monophyly, and biologically meaningful. Implies using some genetic boundaries, while neglecting others.

Molecular. Split at finer, genetic levels (ABGD, GMYC)? Why prefer one over the other? Impractical in fieldwork, potentially resulting in numerous "*Gyratrix* sp." designations and a convoluted taxonomy.

Alternatives? Combinations?

HOW CAN WE 'INTEGRATE' THESE LINES OF EVIDENCE?

simplified visualisation of partial dataset from Tessens, Monnens et al. (2021, Zool. Scr.)



Conclusions

Relying on a single data type clearly oversimplifies the intricacies of *Gyratrix hermaphroditus*. However, the availability of multiple lines of evidence challenges taxonomists: strategies for the pivotal 'integration' step in integrative taxonomy fall short in this complex case!

To make meaningful advancements, it appears that *ad hoc* decision-making is the only viable approach. The morphology route is suggested as a way forward here, with an emphasis on transparency in both 1) the decision-making process, and 2) acknowledging potential finer resolution unaccounted for.