

# Unravelling a notorious species complex by using integrative taxonomy: The case of *Gyratrix hermaphroditus*

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## INTRODUCTION & AIM

**Challenge:** The flatworm *Gyratrix hermaphroditus* (Platyhelminthes: Polycystididae) exhibits high morphological and genetic variation, indicating notable **cryptic diversity**.

**Aim:** Resolve the taxonomic status of this species complex using an integrative approach.

### Goals:

- Integrate molecular, morphometric, and high-resolution imaging data.
- Provide a reliable, morphology-based framework for species identification.
- Establish a solid foundation for future studies of *Gyratrix*.

## METHOD

### Data collection (Globally):

- **Morphology:**
  - Light microscopic study of 328 specimens
  - Scanning Electron Microscopy (SEM) images of 73 specimens (\*Vanstraelen *et al.*, 2025)
- **Morphometrics:** Measurements from 328 specimens
- **Molecular:** Sequenced specimens for four ribosomal gene regions (18S, 5.8S, ITS2, partial 28S)

### Analysis:

- **Phylogeny:** Maximum likelihood and Bayesian inference (building further on the phylogeny of \*Tessens *et al.*, 2021)
- **Morphology:** Interpretation of whole mounts and SEM images
- **Morphometric Variation:** Principal Component Analysis (PCA)
- **Distribution:** Compiled maps from all sampling localities

## RESULTS & DISCUSSION

Integrating morphological and molecular data revealed strong congruence between distinct morphotypes and monophyletic lineages, supporting the recognition of 14 species within the complex. Light microscopy allows reliable identification of most species, but SEM reveals finer details and offers even higher accuracy.



## CONCLUSION

This study presents an extensive attempt to resolve the long-standing taxonomic ambiguity surrounding *G. hermaphroditus*, demonstrating that it represents a complex of at least 14 species. Our integrative approach, combining the resolution of **SEM-based morphology** with **molecular evidence**, provides a robust framework for future turbellarian taxonomy.

## FUTURE PERSPECTIVES

Future research should explore reproductive biology and copulatory organ function, while expanded molecular sampling will further clarify the group's evolutionary diversification. The integrative approach applied here will also aid in discovering and describing additional species within the genus *Gyratrix* that undoubtedly remain undescribed.

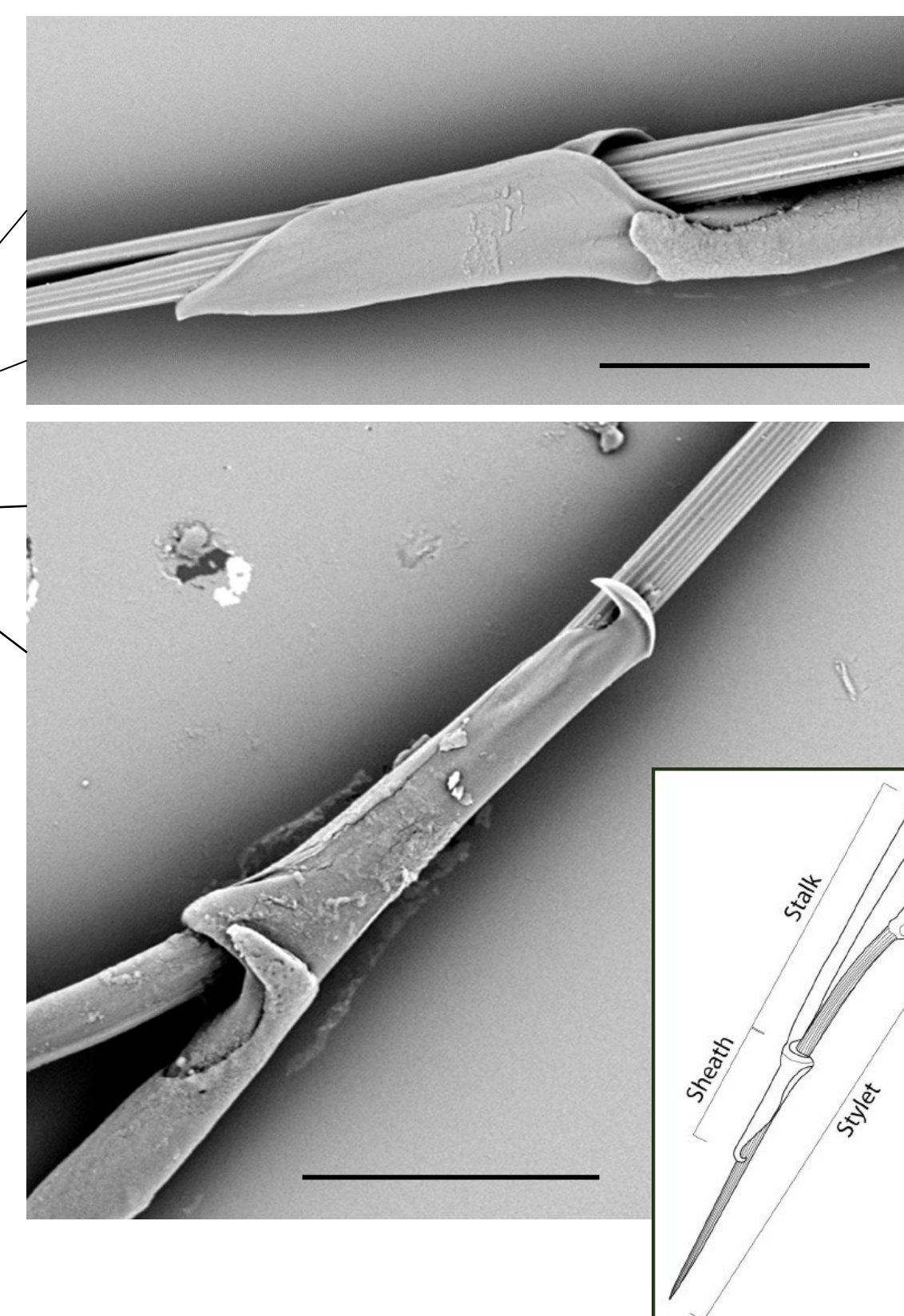
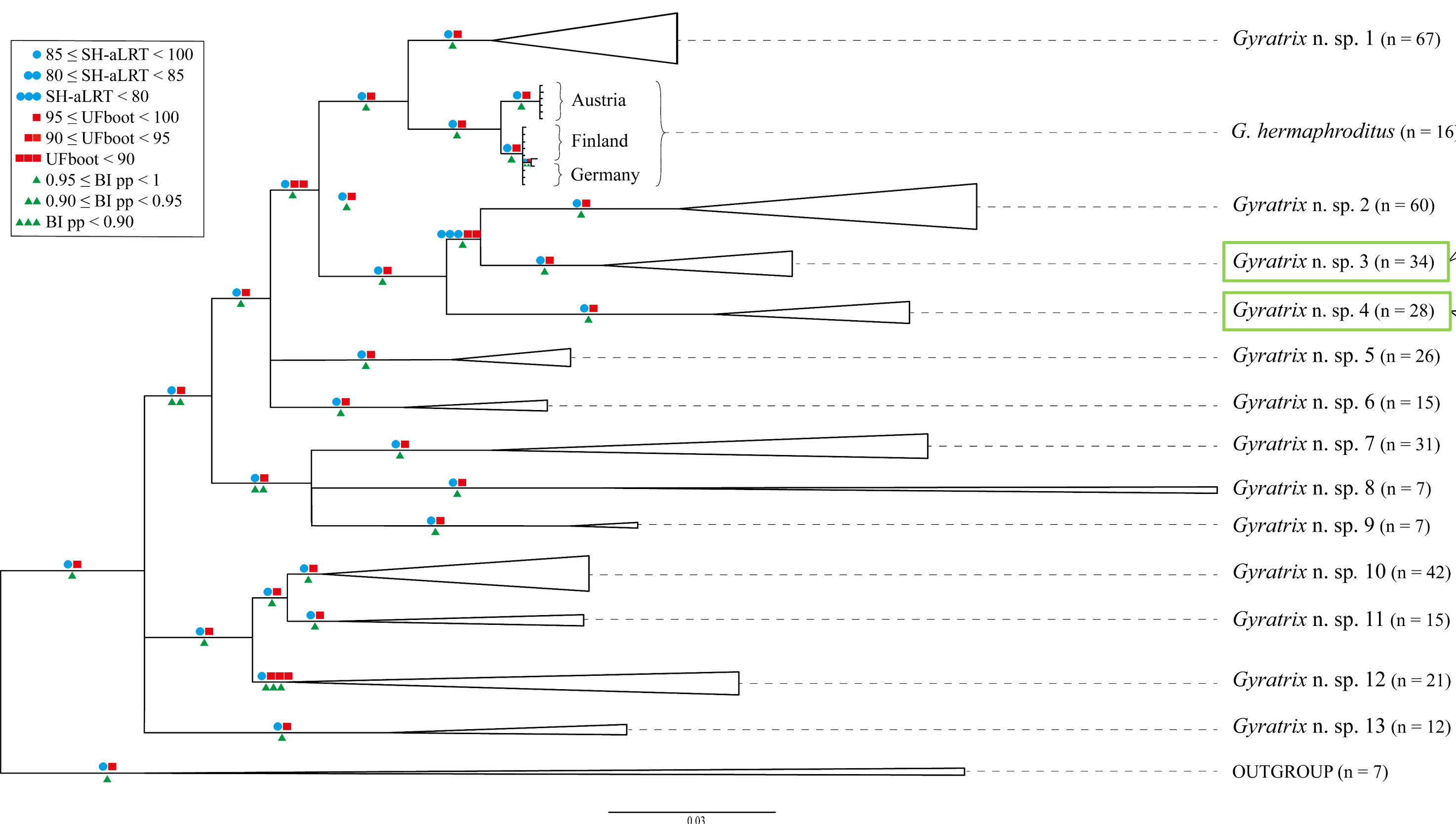


Figure exemplifying the congruence between molecular data and high-resolution SEM images: *Gyratrix* n. sp. 3 and *Gyratrix* n. sp. 4 are clearly distinguished as separate species in the phylogenetic tree, but they also exhibit a distinct morphology of the sheath region of the sclerotised male copulatory organ. A schematic drawing of the sclerotised copulatory organ is added for clarity. Scale bars = 20  $\mu$ m)

\*Tessens, B., Monnens, M., Backeljau, T., et al. (2021). Is 'everything everywhere'? Unprecedented cryptic diversity in the cosmopolitan flatworm *Gyratrix hermaphroditus*. *Zoologica Scripta*, 50(6), 837-851.

\*Vanstraelen, L., Artois, T., Backeljau, T., et al. (2025). A scanning electron microscopy method to visualise the copulatory organ morphology of microturbellarian flatworms: *Trigonostomum* Schmidt, 1852 as a case study. *Journal of Morphology*, 286(3).