

Text from the Abstract of Morard et al 2024:

that show genetic diversity increases poleward. Finally, we observe that MOTUs have a narrower geographic distribution than morphospecies and that in some cases the MOTUs belonging to the same morphospecies (cryptic species) have different environmental preferences. Overall, our analysis reveals that even in the light of global genetic sampling, planktonic foraminifera diversity is modest and finite. However, the extent and structure of the cryptic diversity reveals that genetic diversification is decoupled from morphological diversification, hinting at different mechanisms acting at different levels of divergence.

Text from the results of Morard et al 2024:

(1) Cryptic diversity patterns of low-latitude morphospecies

Here we focus on morphospecies with multiple MOTUs primarily occurring in tropical and subtropical environments. A significant overlap occurs in the ecological niches of the MOTUs of *G. siphonifera*, *G. glutinata*, *G. conglobatus*, *G. ruber albus*, *O. universa*, *H. pelagica*, and *P. obliquiloculata* (Fig. 12). Only *C. nitida* and *T. clarkei* exhibit differentiated environmental preferences between their MOTUs Ivl-2. The prevailing lack of pronounced differentiation in environmental preferences among these MOTUs is mirrored in their geographical distribution. The MOTUs belonging to the tropical and subtropical morphospecies mentioned above occur in warm waters of both the Atlantic and the Indo-Pacific regions. There are some rare exceptions to this pattern, such as *G. siphonifera* Ild, *G. ruber albus* Ila, and *P. obliquiloculata* Ila, which are either scarce or absent in the Atlantic region. Despite these exceptions, our analysis seems to indicate a lack of environmental or geographical divergence among MOTUs belonging to the same morphospecies. This could be caused by our approach that lacks the resolution required locally to unveil subtle ecological differences between MOTUs. For instance, the MOTUs Ila and Ilb of *H. pelagica*, occurring at the same location, exhibit a distinct depth distribution (Weiner *et al.*, 2012). However, demonstrating this potential distinction for all morphospecies would require a systematic depth-stratified sampling at all locations, which is rarely available. Our analysis is restricted to the horizontal (biogeographic) distribution of MOTUs and hence we cannot rule out the possibility of environmental differentiation with depth. Nevertheless, it indicates that cryptic diversity in low-latitude morphospecies is rarely accompanied by strong biogeographical or environmental differentiation of the MOTUs in the surface ocean.

(2) Biogeography of mid- to high-latitude morphospecies

Here we focus on morphospecies with multiple MOTUs primarily occurring in temperate, subpolar and polar environments. We observe a pronounced differentiation in environmental preferences between MOTUs of *N. pachyderma*, *G. bulloides*, *G. truncatulinoides*, *T. quinqueloba* and *G. inflata* (Fig. 12). Among mid to high-latitude morphospecies, only *N. incompta* MOTUs do not show signs of environmental differentiation. The differentiation observed for the other morphospecies is caused by MOTUs collected in water below 15 °C such as *G. bulloides* II, *N. pachyderma* I and IV or *T. quinqueloba* II, and MOTUs occurring in water above 15 °C such as *G. bulloides* I, *N. pachyderma* V and VI or *T. quinqueloba* I (Figs 9 and 10). Also, some cold-water MOTUs appear restricted to a single basin such as *G. bulloides* IIe, which occurs in the North Pacific, or *N. pachyderma* Ila and *G. inflata* Ib, which occur in the southern hemisphere only. We also observe bipolar MOTUs for the morphospecies *T. quinqueloba* Ila–IIc, *G. bulloides* Ila and IIb, *N. incompta* Ia and *G. inflata* Ia in temperate waters of both hemispheres (but not necessarily in both the North Pacific and North Atlantic). In contrast to the warm-water morphospecies, cold-water morphospecies show clearly contrasted biogeography and/or environmental preferences of the MOTUs belonging to the same morphospecies.