New insight on the Early Cretaceous Pinaceae diversity from Belgium

Léa DE BRITO[1,2], Valentin FISCHER[1], Cyrille PRESTIANNI[1,2]

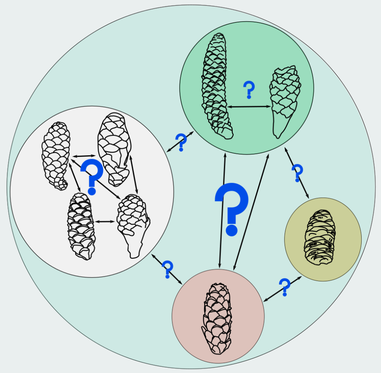
1. Evolution & Diversity Dynamics Lab, UR Geology, Université de Liège, Belgium
2. Royal Belgian Institute of Natural Sciences, Brussels, Belgium

(l.debrito@uliege.be, v.fischer@uliege.be, cyrille.prestianni@uliege.be)

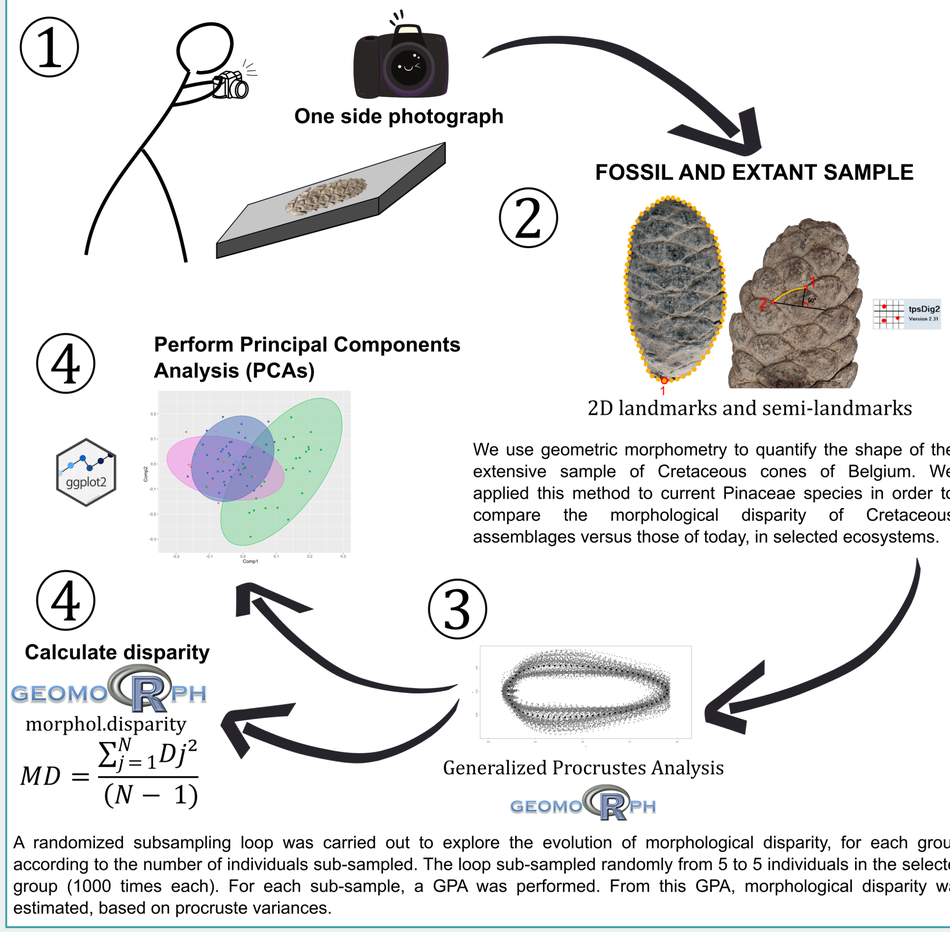
The Belgian Wealden facies deposits (Barremian-Albian, 125.0 – 100.5 My) have delivered hundreds of exceptionally well-preserved, yet isolated, pinaceous ovulate cones. These cones were placed by convention in a couple of form-genera (Alvin 1953; Alvin 1957; Alvin 1960). A total of 10 species has been described in Belgium, representing about 33% of the known fossil cone species of this period worldwide. In a previous study, we showed that species delimitation is sometimes inconsistent, with some species actually incorporating clearly distinct populations that should be separated taxonomically (De Brito and Prestianni 2021). However, the validity of these taxa is questionable as their intra- and interspecific variabilities have never poorly studied. Moreover, quantifying the expansion of Pinaceae in terms of morphospace occupation is desirable, in order to reveal the dynamics of this important radiation. By using morphological descriptions and quantitative protocols, we dust off the diversity and ecological importance of ovulate cone species described in the 20th Century and shed a new light on the shape of their Cretaceous radiation.

Can we quantify the intra/inter-specific variability of conemorpho-species using geometric morphometry?

Is the method used relevant to capture the full morphologicaldisparity of Pinaceae fossil species?

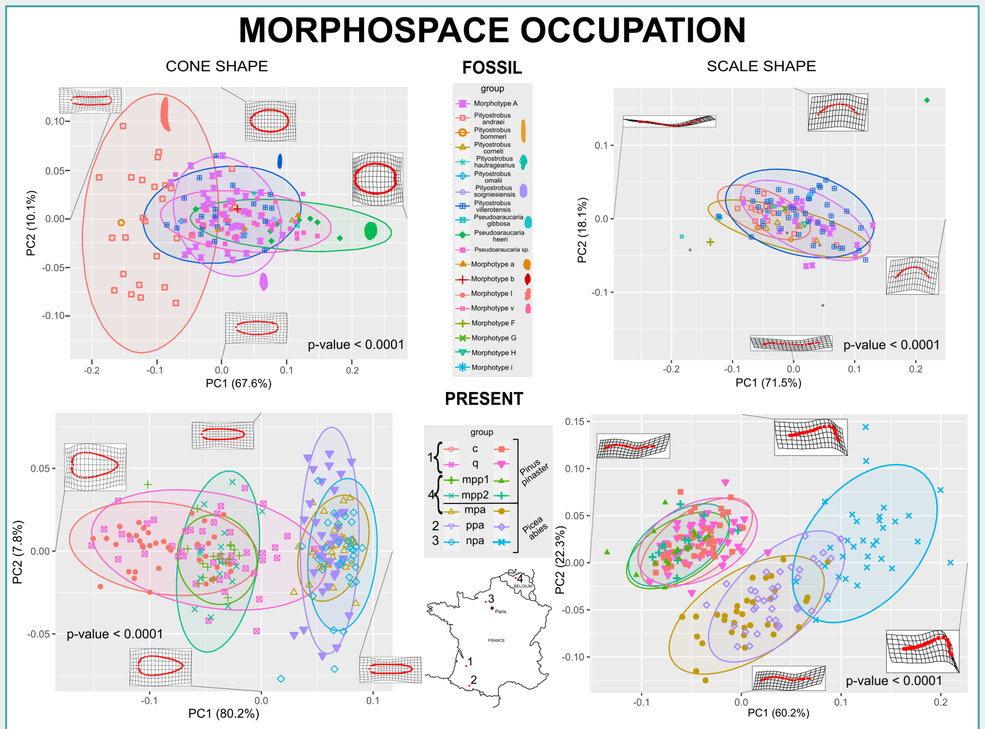


METHODS



MATERIAL

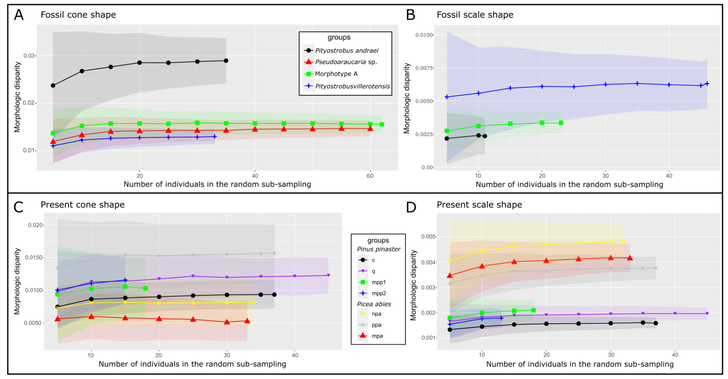
MORPHOSPACE OCCUPATION



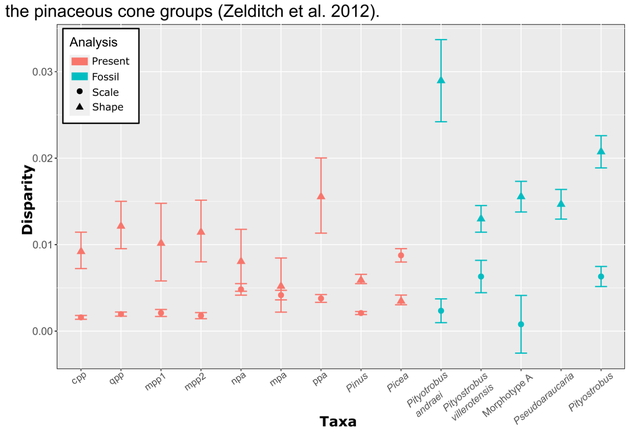
Morphospaces of the fossil groups all overlap except for the species *Pityostrobus andraei*. The present groups are well separated according to genus (*Pinus* and *Picea*). Multivariate analyses of variance (Manova) are performed for all PCAs, taking into account the total PCs of each analysis and indicate that all groups are significantly different (p-values < 0.0001).

ABOUT 15 CONES ARE NEEDED TO CORRECTLY ESTIMATE DISPARITY

We calculated disparity values to characterize the morphological diversity in the pinaceous cone groups (Zelditch et al. 2012).



We propose a method to predict at what number of specimens the maximum morphological variation by species is reached. For all groups, between 10 and 20 individuals, the disparity values stabilize and stop increasing. A sampling of 10 to 20 individuals per species allows to apprehend the totality of the variability of the cone shape and scales shape.



We observe that the morphological disparity is not higher in fossil species than in present-day species. Both morphological approaches confirm that the species *Pityostrobus andraei* presents high morphological variability.

The research presented was funded by the FRIA doctoral grant (FNRS)

References

ALVIN, K. L. 1953. Three abietaceous cones from the Wealden of Belgium. Mémoires de l'Institut Royal des Sciences Naturelles de Belgique, 125, 1–42.
———. 1957. On the two cones Pseudoaraucaria heeri (Coemans) nov. comb. and Pityostrobus villerotensis nov. sp. from the Wealden of Belgium. Mémoires de l'Institut Royal des Sciences Naturelles de Belgique, 135, 1–27.
———. 1960. Further conifers of the Pinaceae from the Wealden formation of Belgium. Mémoires de l'Institut Royal des Sciences Naturelles de Belgique, 146, 1–39.
BOOKSTEIN, F. L. 1991. Thin-plate splines and the atlas problem for biomedical images. Biennial International Conference on Information Processing in Medical Imaging, 326–342.
———. 1997. Landmark methods for forms without landmarks: morphometrics of group differences in outline shape. Medical Image Analysis, 1, 225–243.
ZELDITCH, M. L., SWIDERSKI, D. L. and SHEETS, H. D. 2012. A Practical Companion to Geometric Morphometrics for Biologists: Running analyses in freely-available software.