MORPHYLL -

A data base for the acquisition of ecophysiologically relevant morphometric data of fossil leaves

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Background

Foliage of modern plants provides a wealth of morphometric properties that are relevant for ecological and climatological research. Numerous important and famous fossil floras are housed in various museum collections in Europe whose potential has not yet been fully evaluated. In this project, which is part of „Scientific Library Services and Information Systems (LIS)"-Project of the DFG, it is intended to initiate access to morphometric data of fossil leaf collections by digitising fossil leaves from selected collections and to classify them according to their morphometry. The aim is the creation of a data base that allows for

1) a morphotype-based data base search, and
2) palaeoecological analysis of fossil leaves using morphometric traits.

Morphometric data and data base

Intention of this project is not only to provide images of fossil leaf collections but also morphometric information. Fossil leaf collections are scanned and digitised in order to analyse their morphometric properties qualitatively and quantitatively.
Qualitative data such as leaf shape, leaf margin and venation type are recorded according to standards given in Manual of Leaf Architecture (Beth et al. 2009) and Compendium Index Categories CICs (Green & Hickey 2005). Some of the recorded morphometric parameters are listed in figure 1.

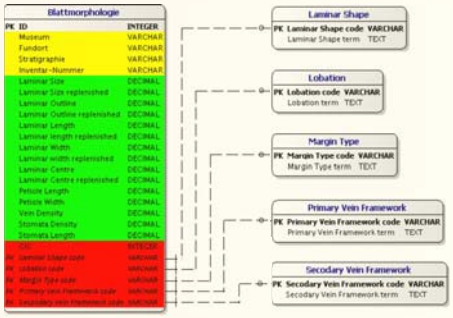

Figure 1:
Concept of MORPHYLL-database showing metadata (yellow), quantitative data (green) and qualitative data (red) of fossil leaf collections.

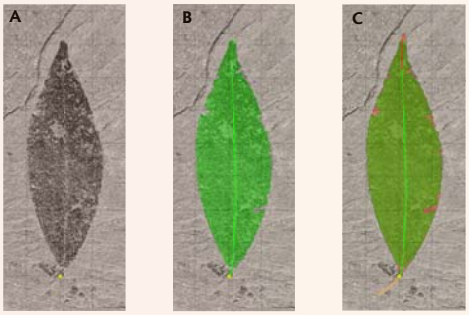

Figure 2:
(A) scanned, geo-referenced fossil leaf of *Platanus neptuni* (Ettingsh.) Buzek, Holy & Kvacek;
(B) digitised leaf outline and primary vein (green);
(C) same as (B) and additional replenished parts of the lamina, primary vein (red) and petiole (orange);
scale: 1cm grid.

Quantitative physiognomic traits are derived from digitised leaf outlines and venation system in order to calculate for example leaf length and width, leaf area and venation density. Calculations are carried out within a PostgreSQL database using the spatial extension PostGIS which enables a variety of spatial (morphometric) queries. Some steps of digitisation process are demonstrated in figure 2.

Data publishing and scientific integration

Long-term objective of this project is to provide qualitative and quantitative morphometric data as well as digital geometries of fossil leaves from various collections within a prospective data portal of the Humboldt-Ring. For this purpose the local database is retrieved by wrapper programs provided by Diversity Workbench software tools.
In the current starting phase, this project will be focused on floras from Eocene to Oligocene time intervals that encountered substantial changes in climate and atmospheric CO_2. Comprehensive statistical analyses of leaf morphometrics from different locations and time slices will offer a better understanding of ecophysiological adaptations in changing environments (cf. figure 3).

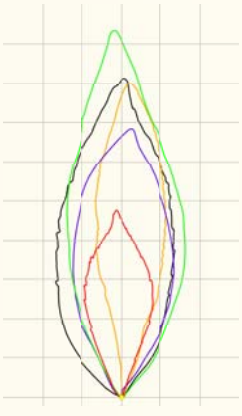

Figure 3:
five leaf outlines of *Platanus neptuni* (Ettingsh.) Buzek, Holy & Kvacek from the Early Oligocene flora of Frauenweiler (south-west Germany), intra- specific variabilty can be quantified on the basis of morphometric descriptors; scale: 1 cm grid.