**Fossil Digital Leaf Physiognomy Rules Document**

This document contains minor revisions and additions to that published as a supplemental in Royer et al.34.

1. Lobe vs. tooth rule (addendum to the ¼ rule)—To determine if a projection is a lobe or a tooth, carry out the following measurements (**Supplementary** **Figure 1**).
   1. Find the axis of symmetry of the projection and project a line along this axis from the apex of the projection to the nearest primary vein (d). Typically, the axis follows the trend of the principal vein for the projection.
   2. Project a perpendicular line (p) from the apical sinus of the projection to d. If the distance from the apex to p is greater than 0.25d, the feature is a lobe.
2. Differentiating subsidiary from primary teeth—Tooth type is broken into two categories: primary and subsidiary, or teeth on teeth (**Supplementary Figure 2**).
   1. Subsidiary teeth are those of higher order than the first-order teeth (*sensu* Ellis et al.44). Both primary and subsidiary teeth are included for tooth count, but for tooth area, the selection of only primary teeth yielded the most reliable results. If all teeth were selected, tooth areas would often be biased towards unreasonably small values (**Supplementary Figure 3A**).
   2. The default category for tooth selection is primary. If a tooth passes either of the following criteria, it is selected as a subsidiary.
      1. Degree of sinus incision. Subsidiary teeth have markedly unequal amounts of incision, with one sinus being less incised than the other.

2.2.2 Vein thickness. Subsidiary teeth are typically fed by principal veins of markedly thinner gauge relative to principal veins in neighboring primary teeth.

1. Pinnate lobe rule—In pinnately lobed leaves, all first-order marginal incisions that are geometrically similar to the lobes are treated as lobes (**Supplementary Figure 3B**).
2. Special case: Sometimes projections emanating from palmate lobes are large enough to qualify as pinnate lobes (palmately and pinnately lobed leaves sensu Ellis et al.44). In this case, the pinnate lobe rule does not apply to the individual palmate lobe, and each projection emanating from that palmate lobe that qualifies as a tooth according to the lobe vs. tooth rule is considered a tooth.
3. Lobe priority rule—The sinus of a lobe cannot be processed as the sinus of a tooth.

This rule prevents the selection of anomalously large teeth, for example in many *Acer* and *Quercus* species. When a tooth does not have a basal sinus, it should be selected from a straight line extending from the two previous sinuses (extension rule), or if a solidarity tooth, by using the solitary tooth rule (**Supplementary Figure 4**).

1. Solitary tooth rule—A tooth is considered solitary when there is no superjacent primary tooth, or when the superjacent tooth is spaced far enough that connecting sinuses would result in the inclusion of a large amount of leaf tissue not part of the tooth. For a solitary tooth, tooth selection is made as a line originating from the apical sinus and drawn perpendicular to the axis of symmetry of the feature (**Supplementary** **Figure 4**).
2. Primary vein rule—The intersection of a primary vein and the leaf margin cannot be processed as a sinus or a tooth. The former is most applicable to leaves with retuse and emarginate apices while the latter is most applicable to palmately veined leaves (Ellis et al.44).
3. Cordate bases—When the petiole rests upon the leaf base below where the petiole actually attaches to the leaf blade, care should be taken to cut the petiole out where it actually attaches, trace the petiole margin closely, and repair the resulting damaged margin (**Figure 5**).