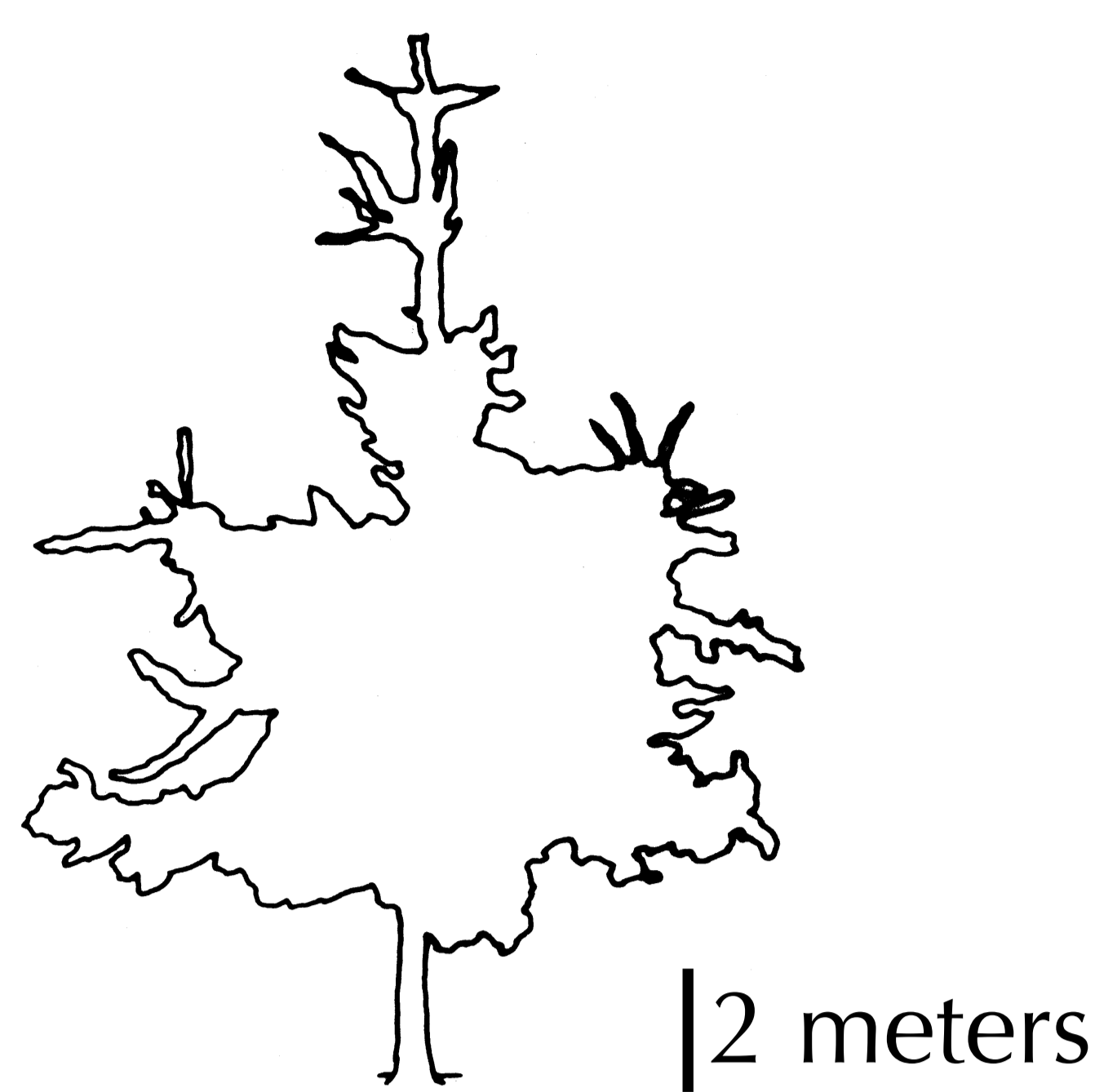


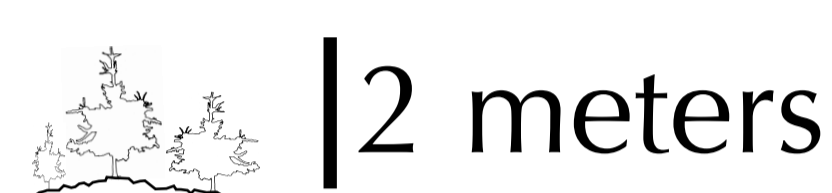
Were Mesozoic Ginkgophytes Shrubby?

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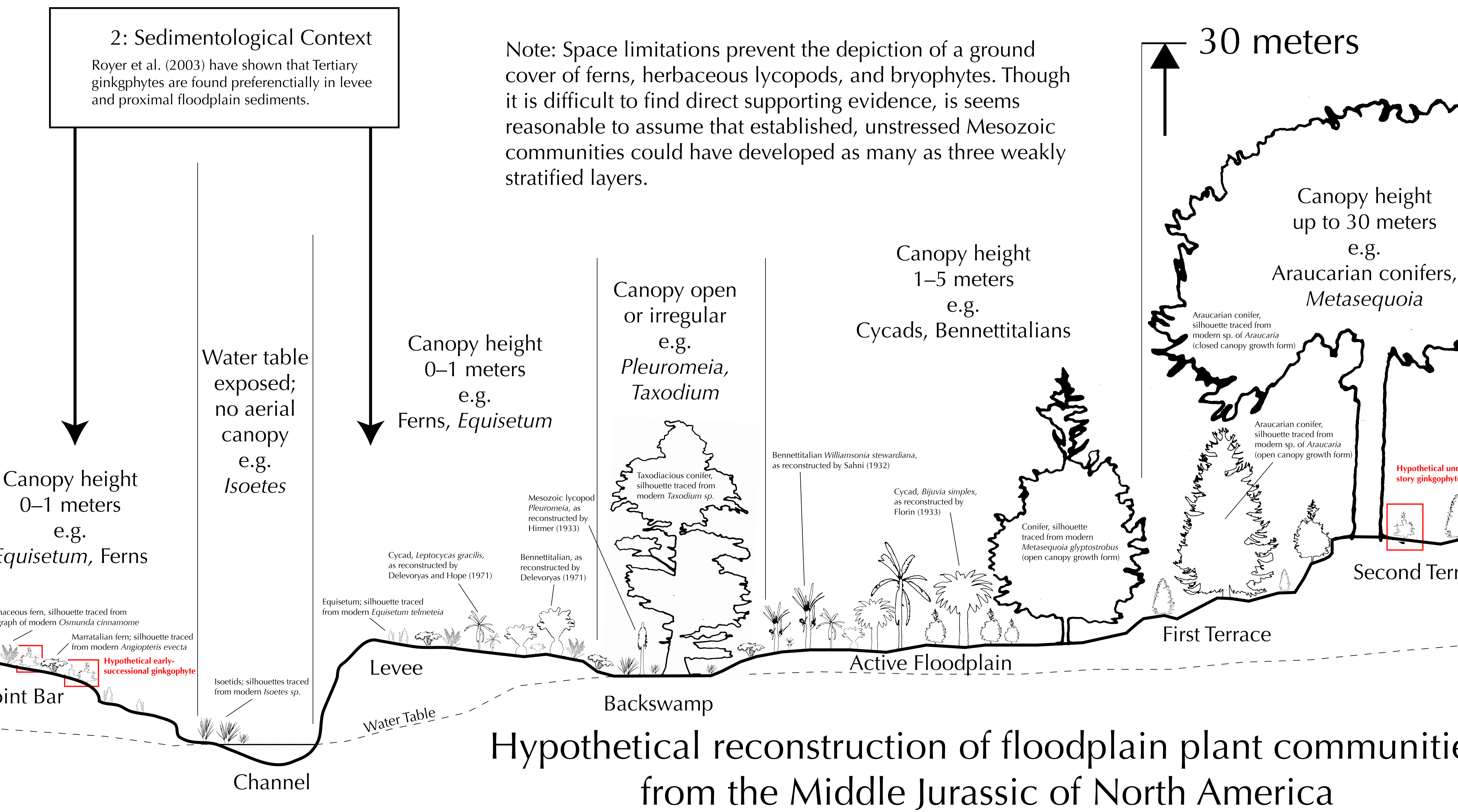
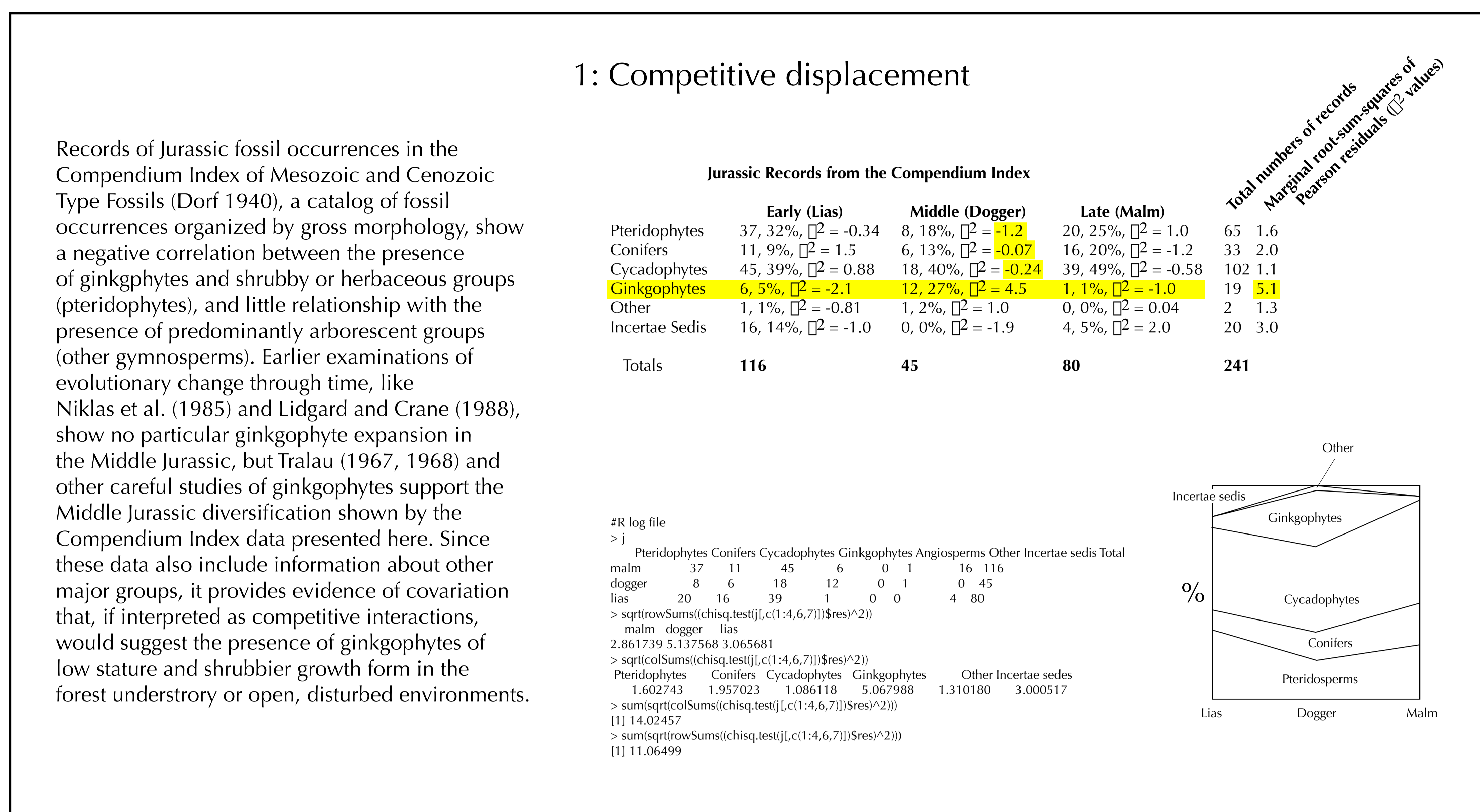
The conventional view sees all ginkgophytes as arborescent, by analogy with modern *Ginkgo biloba*:



but there is in fact little evidence for arborescent ginkgophytes before the Tertiary. On the contrary, a number of indications seem to suggest the possibility that many early ginkgophytes were small shrubs:



Data on leaf morphology in the Mesozoic of North America shows a proportional increase of bifurcated, ginkgo-like leaves during the middle of the Jurassic. This ginkgophyte acme is correlated with a decreased proportion of the leaf forms associated with herbaceous or shrubby pteridophytes, and with no substantial change in the proportion of leaf forms associated with canopy gymnosperms. The increase in ginkgo-like foliage at the same time as fern-like forms decreased in relative abundance suggests replacement of some part of the forest understory or early-successional habitats by early ginkgophytes. That is, early ginkgophytes may not have been competing for light or water in an established gymnosperm canopy. This suggests that most Mesozoic ginkgophytes were shrubs rather than being large trees like the surviving *Ginkgo biloba*. Such a result explains the absence of Mesozoic ginkgophyte wood and supports the argument that has already been made from sedimentological data, that to a much greater extent than do individuals of *Ginkgo biloba* now cultivated around the world, many ancestral ginkgophytes pursued early-successional strategies.



Proximal floodplain; disturbance frequent compared with generation time, canopy poorly developed, species likely to be short-lived, low of stature, and r-selected, investment in reproduction and vegetative growth comparatively low. Clonal reproduction and fast initial growth likely. Fossils found in coarse or well-sorted sediments showing evidence of alluvial deposition and lacking extensive soil formation. Note that the common occurrence in the fossil record of allochthonous (transported) ginkgophyte foliage in proximal facies must be discounted.

Distal floodplain; disturbance less frequent, canopy better developed, species longer lived, higher in stature and with greater investment in disseminules and non-photosynthetic vegetative growth. Fossils found in fine sediments, often with ped structures or identifiable soil stratification. Note that the gradient depicted above is frequently compressed into relatively short distances when flood disturbance is low. This representation is intended to show all the possible habitats and communities any of which may be missing in a given situation.

3: Absence of wood

Scott et al. (1962) could verify no occurrences of clear ginkgophyte wood earlier than the Eocene: "in marked contrast to the abundant leaf remains of the order, fossil woods of the Ginkgoales are rare" (Scott et al. 1962:1095). No other convincing candidates for Mesozoic ginkgophyte wood have been found, which is surprising given the amount of other well-preserved Mesozoic gymnosperm wood.

4: Atypical characters

Ginkgo biloba has polymorphic foliage, an early bolting growth phase, and poor shade tolerance, all characteristics that are rare or absent in habitually canopy-forming trees. See Royer et al. (2003) for further discussion.

- Summary of Indications
- Ginkgophytes seem to replace (negatively co-vary with) herbaceous or shrubby rather than arborescent groups.
 - Fossil ginkgophytes are found predominantly in high-energy facies that are less likely to have supported an established complex canopy.
 - Firmly identifiable ginkgophyte wood does not seem to appear in the fossil record until the late Cretaceous or Tertiary.
 - Modern *Ginkgo biloba* has a suite of characters that are not typical of canopy trees including polymorphic foliage, an early bolting growth phase, and poor shade tolerance.

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