

Supporting Information

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SI Materials and Methods

Study Sites.

El Montsec. *Montsechia vidalii* was first described from the Pedrera quarry, Montsec chain, western Spanish Pyrenees, Lleida Province, Spain (Fig. S1) (10). This type locality had been reported a few years earlier (30), and for a few decades limestone slabs for lithography were extracted from the quarry. Later, beds containing animal and plant fossils also were found outcropping at other localities, especially at La Cabróa. These two main fossil localities were excavated by several international teams of scientists funded by western European institutions until the end of the 1990s. The fossils that were collected are housed in various institutions in France, Germany, Spain, and the United Kingdom and provided source material for extensive literature in all fields of paleontology [see the list of references given by Martínez-Delclòs (31, 32)]. Based on the local stratigraphy and fossil charophyte and ostracod assemblages, La Pedrera and La Cabróa animal and plant fossils have been attributed to the lower Barremian (Fig. S2) (33–35).

Las Hoyas. The locality Las Hoyas was discovered in the early 1980s in the Serranía de Cuenca, southwestern Iberian chain, Cuenca Province, Spain (Fig. S1) (36). The animal and plant fossils of the La Huérguina Formation at Las Hoyas are contained in finely laminated lacustrine limestones deposited in an entirely freshwater wetland (37). Based on regional stratigraphy and charophyte and ostracod biostratigraphy, Las Hoyas animal and plant fossils are considered to be upper Barremian (Fig. S2) (38, 39).

Cladistic Analysis. The data matrix by Endress and Doyle (40) was completed by adding the characters of *Montsechia vidalii*. We have coded 47 of 110 characteristics (43%) (see list below). The morphological dataset has been phylogenetically analyzed without backbone and using the two backbones, D & E and J & M, used by Endress and Doyle (40). These analyses were performed using Mesquite (41). The position of the fossil was investigated by linking the fossil to all possible branches of the backbone tree and recalculating the number of required parsimony changes (steps) in each alternative tree.

ED1 (DE 1). Habit: tree or shrub (0); rhizomatous, scandent, or acaulescent (1); Rhizomatous or scandent: 1

ED9 (DE 20 part). Phyllotaxis: alternate (spiral or distichous) (0); opposite or whorled (1); Opposite in the short-leaved form and alternate spiral in the long-leaved form: {01}

ED10 (DE 20 part). Distichous phyllotaxis: absent (0); present on some or all branches (1); Not distichous: 0

ED11 (DE 22 modified). First appendage(s) on vegetative branch: paired lateral prophylls (0); single distinct prophyll (adaxial, oblique, or lateral) (1); First pair of leaves in the short-leaved form and single leaf in the long-leaved form: {01}

ED12 (new). Leaf base: nonsheathing (0); sheathing (half or more of stem circumference) (1); Nonsheathing base: 0

ED13 (DE 23 modified). Stipules: absent (0); adaxial/axillary (1); interpetiolar (2); paired cap (3); Stipules absent: 0

ED14 (DE 24). Axillary squamules: absent (0); present (1); Nothing at the base: 0

ED15 (DE 25). Leaf blade: bifacial (0); unifacial (1); Leaf bifacial: 0

ED16 (DE 26). Leaf shape: obovate to elliptical to oblong (0); ovate (1); linear (2); Oblong in the short-leaved form and ovate in the long-leaved form: {01}

ED19 (DE 28 modified). Base of blade: not peltate (0); peltate in some or all leaves (1); Not peltate: 0

ED20 (DE 29 modified). Leaf dissection: simple (0); some or all leaves lobed or compound (1); Simple: 0

ED22 (DE 37 part). Inflorescence: solitary flower (or occasionally with one or two lateral flowers) (0); botryoid, panicle, or thyrsoid (monotelic) (1); raceme, spike, or thyrses (polytelic) (2); Unknown in the short-leaved form and solitary flowers in the long-leaved form: 0

ED23 (new). Inflorescence: partial units, single flowers (0); cymes (1); Unknown in the short-leaved form and single flowers in the long-leaved form: 0

ED24 (new). Pedicel: present in some or all flowers (0); absent or highly reduced (flower sessile or subsessile) (1); Unknown in the short-leaved form and absent or very reduced in the long-leaved form: 1

ED25 (new). Floral subtending bracts: present (0); present in female, absent in male flowers (1); absent in all flowers (2); Unknown in the short-leaved form and absent at least in female flowers in the long-leaved form: 2

ED26 (DE 38 modified). Sex of flowers: bisexual (0); unisexual (1); ? One specimen with female flowers and one unknown in the short-leaved form and female flowers in the long-leaved form: 1

ED27 (DE 39 modified). Floral base: hypanthium absent, superior ovary (0); hypanthium present, superior ovary (1); partially or completely inferior ovary (2); Unknown in the short-leaved form and hypanthium absent in the long-leaved form: 0

ED28 (new). Floral receptacle (female portion): short (0); elongate (1); Unknown in the short-leaved form and short floral receptacle in the long-leaved form: 0

ED30 (new). Floral apex: used up after production of carpels (0); protruding in mature flower (1); unilocellate taxa scored as unknown: Unknown in the short-leaved form and no protruding floral apex in the long-leaved form: 0

ED31 (DE 41 part). Perianth: present (0); absent (1). See text for discussion: Unknown in the short-leaved form and no perianth in the long-leaved form: 1

ED36 (new). Petals: absent (0); present (1); Unknown in the short-leaved form and no petals in the long-leaved form: 0

ED37 (DE 45 modified). Nectaries on inner perianth parts: absent (0); present (1); Unknown in the short-leaved form and no nectaries in the long-leaved form: 0

ED39 (DE 44 part). Calyptra derived from the last one or two bracteate organs below the flower: absent (0); present (1); Unknown in the short-leaved form and no calyptra in the long-leaved form: 0

ED74 (DE 71). Carpel number: more than one (0); one (1); Unknown in the short-leaved form and two carpels in the long-leaved form: 0

ED75 (DE 72). Carpel form: ascidiate up to stigma (0); intermediate (both plicate and ascidiate zones present below the

stigma) with ovule(s) on the ascidiate zone (1); completely plicate or intermediate with some or all ovule(s) on the plicate zone (2); Unknown in the short-leafed form and ascidiate morphology in the long-leafed form: 0

ED76 (DE 73 part). Postgenital sealing of carpel: none (0); partial (1); complete (2); Unknown in the short-leafed form and no postgenital sealing of carpels in the long-leafed form: 0

ED79 (DE 75). Style: absent (stigma sessile or capitate) (0); present (elongated apical portion of carpel distinctly constricted relative to the ovary) (1); Unknown in the short-leafed form and no style or style scar in the long-leafed form: 0

ED81 (DE 77 part). Multicellular stigmatic protuberances or undulations: (0) absent (0); present (1); Unknown in the short-leafed form and stigma undifferentiated in the long-leafed form: 0

ED82 (DE 77 part, modified). Stigma papillae (most elaborate type): absent (0); unicellular or with a single emergent cell and one or more small basal cells (1); uniseriate pluricellular with emergent portion consisting of two or more cells (2); Unknown in the short-leafed form and stigma undifferentiated in the long-leafed form: 0

ED84 (DE 79). Carpel fusion: apocarpous (including pseudo-syncarpous) (0); parasyncarpous (1); eusyncarpous (at least basally) (2); Unknown in the short-leafed form and two apocarpous carpels in the long-leafed form: 0

ED86 (new). Long unicellular hairs on and/or between carpels: absent (0); present (1); Unknown in the short-leafed form and no hair in the long-leafed form: 0

ED87 (new). Short, curved, appressed, unlignified hairs with up to two short basal cells and one long apical cell on carpels: absent (0); present (1) (42); Unknown in the short-leafed form and no hair carpels in the long-leafed form: 0

ED88 (new). Nectary on dorsal or lateral sides of carpel or pistillode: absent (0); present (1); Unknown in the short-leafed form and no nectaries in the long-leafed form: 0

ED89 (DE 81). Septal nectaries or potentially homologous basal intercapillary nectaries: absent (0); present (1); Unknown in the short-leafed form and no nectaries in the long-leafed form: 0

ED90 (DE 82 modified). Number of ovules per carpel: one (0); two or varying between one and two (1); more than two (2); Unknown in the short-leafed form and one ovule per carpel in the long-leafed form: 0

ED92 (DE 84). Ovule direction: pendent (0); horizontal (1); ascendent (3); Unknown in the short-leafed form and ovule pendent in the long-leafed form: 0

ED93 (DE 85). Ovule curvature: anatropous (or nearly so) (0); orthotropous (including hemitropous) (1); Unknown in the short-leafed form and orthotropous in the long-leafed form: 1

ED94 (DE 86). Integuments: two (0); one (1); Unknown in the short-leafed form and one tegument in the long-leafed form: 1

ED95 (DE 91). Chalaza: unextended (0); pachychalazal (1); perichalazal (2); Unknown in the short-leafed form and unextended chalaza in the long-leafed form: 0

ED97 (DE 93 part). Fruit wall: wholly or partly fleshy (0); dry (1); Unknown in the short-leafed form and fruit wall dry in the long-leafed form: 1

ED98 (DE 93 part). Lignified endocarp: absent (0); present (1); Unknown in the short-leafed form and no endocarp in the long-leafed form: 0

ED99 (DE 94 modified). Fruit dehiscence: indehiscent or dehiscing irregularly, dorsally only, or laterally (0); dehiscent ventrally or both ventrally and dorsally (1); horizontally dehiscent with vertical extensions (2); Unknown in the short-leafed form and dehiscing irregularly in the long-leafed form: 0

ED100 (DE 95). Testa: slightly or nonmultiplicative (0); multiplicative (1); Unknown in the short-leafed form and nonmultiplicative in the long-leafed form: 0

ED101 (DE 96). Exotesta: unspecialized (0); palisade or shorter sclerotic cells (1); tabular (2); longitudinally elongated, more-or-less lignified cells (3); Unknown in the short-leafed form and exotesta unspecialized in the long-leafed form: 0

ED102 (DE 100). Ruminations: absent (0); testal (1); tegminal and/or chalazal (3); Unknown in the short-leafed form and no ruminations in the long-leafed form: 0

ED103 (DE 101). Operculum: absent (0); present (1); Unknown in the short-leafed form and no operculum in the long-leafed form: 0

ED104 (DE 102). Aril: absent (0); present (1); Unknown in the short-leafed form and no aril in the long-leafed form: 0

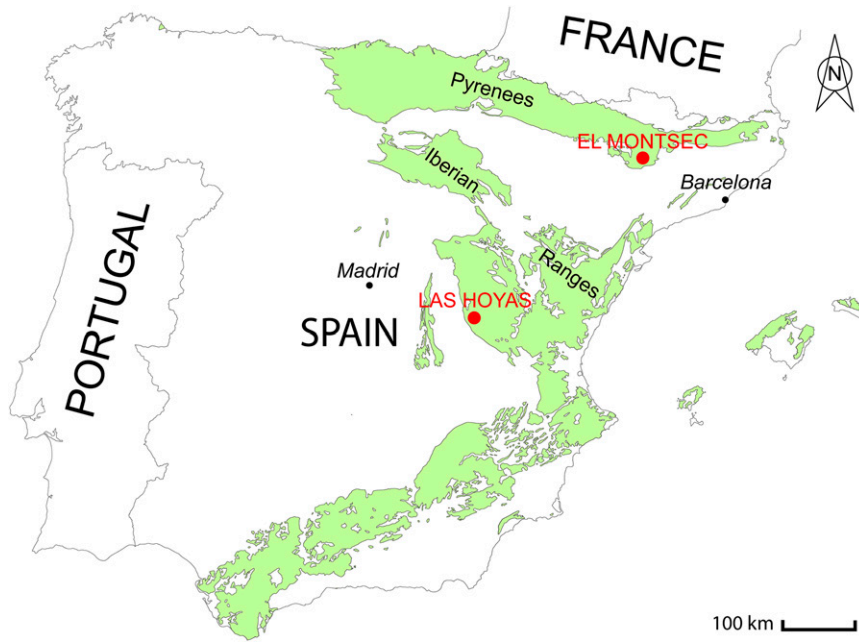


Fig. S1. Fossil location. The map shows the El Montsec and Las Hoyas localities in the Pyrenees and Iberian Range where the fossil specimens of *Montsechia vidalii* were collected.

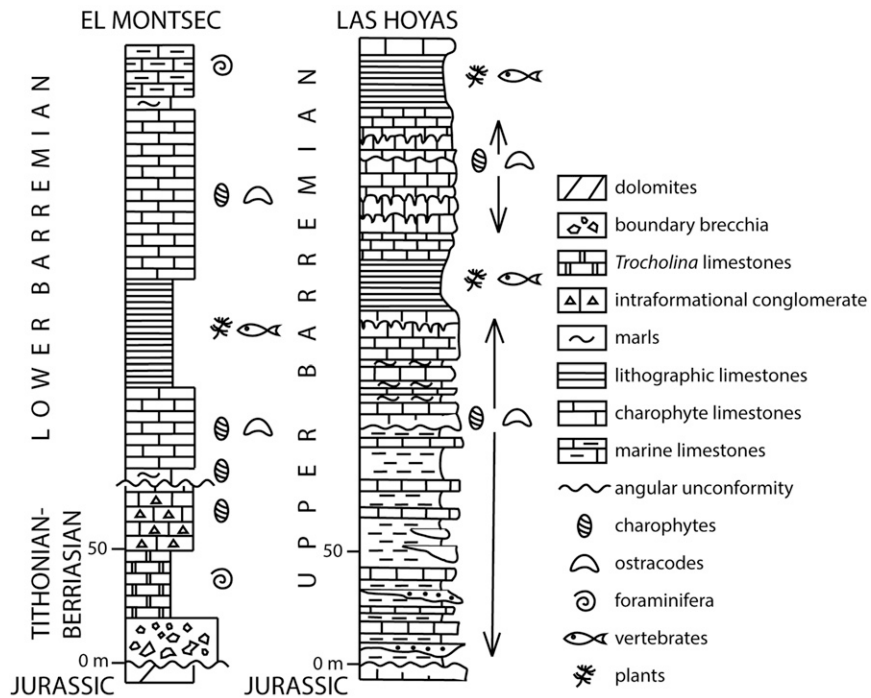


Fig. S2. Fossil age. El Montsec plant and vertebrate beds are considered lower Barremian (130–127.2 million years ago). The La Huérguina Formation at the Las Hoyas locality is considered upper Barremian (127.2–25 million years ago). Diagram by C.M.-C.

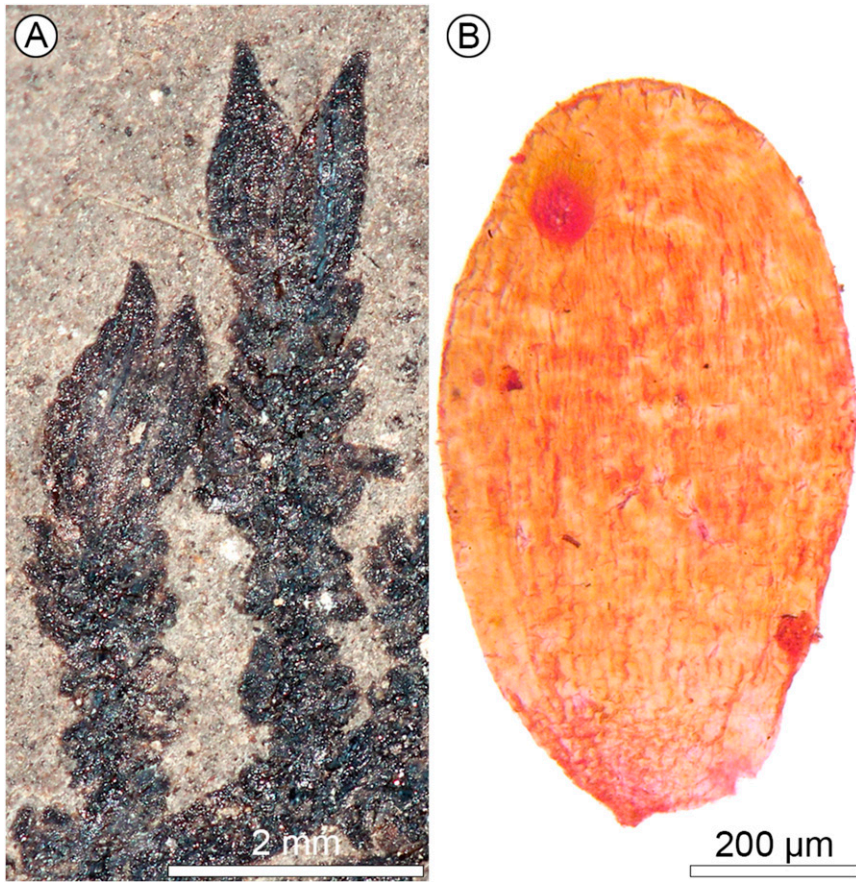


Fig. 53. Fruits and seeds of *Montsechia vidalii*. (A) The apices of short-leaved axes bear pairs of ascidiate fruits. LH 29265. (Scale bar, 2 mm.) (B) The seed is unitegmic and shows hilum and micropyle. (Scale bar, 200 μm .)

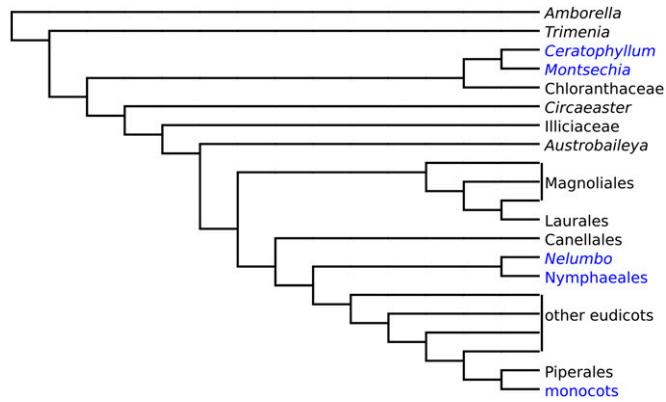


Fig. 54. Most parsimonious position of *Montsechia* in a majority-rule tree derived from the matrix by Endress and Doyle (26) and rooted with *Amborella*. Taxa in blue are considered ancestrally water-related (27). Diagram by C.C. and B.G.