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SUPPLEMENTARY ONLINE MATERIAL FOR

Phylogenetic relationships in *Nothofagus*: The role of Antarctic fossil leaves

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Supplementary Online Material

SOM 1. Age, and provenience of the living and fossil specimens used in the phylogenetic analysis.

SOM 2. Characters and states used in the phylogenetic analysis.

SOM 3. Branch support calculated with symmetric resampling, 500 replicates (default change probability).

SOM 1. Age and provenance of the living and fossil specimens used in the phylogenetic analysis. HRL (Ruíz Leal Herbarium), RBGE (Royal Botanical Garden Herbarium, online accessed 2022), MACN (Museo Argentino de Ciencias Naturales).

Taxa	Age	Reference for age designation	Source of coded specimens
Betula pendula	Extant	Heenan and Smissen 2013	HRL (14450, 44329)
Fagus	Extant	Heenan and Smissen 2013	HRL (56671, 6044)
Nothofagus aequilateris	Extant	Hill and Read 1991, Heenan and Smissen 2013	Jordan and Hill 1999, Swenson et al. 2000
Nothofagus alessandrii	Extant	Premoli et al. 2011, Heenan and Smissen 2013	RBGE (4333373, 638376)
Nothofagus alpina	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (37763, 9319, 66282), HRL (18242)
Nothofagus antarctica	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (62157), HRL (43537, 16069, 44167)
Nothofagus balansae	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus beardmorensis	Pliocene	Hill et al. 1996, Francis and Hill 1996	Hill et al. 1996, Ashworth et al. 2007
Nothofagus betulifolia	Paleocene–Eocene	Dutra 2000, Haomin and Zhekun 2007	Dutra 2000, Haomin and Zhekun 2007
Nothofagus betuloides	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (53060, 70500), HRL (43531, 43535)
Nothofagus brassii	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus carpinoides	early–middle Eocene	Haomin and Zhekun 2007	Haomin and Zhekun 2007

Nothofagus crenulata	middle–late Eocene, middle Miocene	Dusén 1899, Tanai 1986, Vento et al. 2017	Vento et al. 2017
Nothofagus cretacea	Campanian–Maastrichtian, middle Eocene	Zastawniak 1994, Dutra and Batten 2000, Gao et al. 2018	Zastawniak 1994
Nothofagus cunninghamii	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000, MACN (76278)
Nothofagus dombeyi	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (9317, 83743, 91634), HRL (24265, 14245
Nothofagus elongata	middle–late Eocene, middle Miocene	Dusén 1899, Vento et al. 2017	Vento et al. 2017
Nothofagus fusca	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000, HRL (62155)
Nothofagus glauca	Extant	Premoli et al. 2011, Heenan and Smissen 2013	RBGE (158604, 158495)
Nothofagus glaucifolia	early–middle Eocene	Dutra and Batten, 2000, Mozer et al. 2015	Dutra and Batten 2000
Nothofagus grandis	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus gunnii	Extant	Hill and Read 1991, Heenan and Smissen 2013	Hill 1984, 1991
Nothofagus kiandrensis	early Miocene	Paull and Hill 2003	Paull and Hill 2003
Nothofagus lobata	late Oligocene	Hill 1991	Hill 1991
Nothofagus maidenii	Oligocene–early Miocene	Hill 1983	Pole et al. 1993
Nothofagus menziesii	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus microphylla	late Oligocene, early Miocene	Hill 1991	Scriven and Hill 1996
Nothofagus moorei	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000, HRL (81042)

Nothofagus mucronata	late Oligocene	Hill 1991	Hill 1991
Nothofagus multinervis	early–middle Eocene	Haomin and Zhekun 2007	Haomin and Zhekun 2007
Nothofagus nitida	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (22549), HRL (56694, 56691
Nothofagus obliqua	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (172), HRL (20303)
Nothofagus pachyphylla	early Pleistocene	Jordan 1999	Jordan 1999
Nothofagus palustris	Oligocene–Miocene	Carpenter et al. 2014	Carpenter et al. 2014
Nothofagus perryii	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus pumilio	Extant	Premoli et al. 2011, Heenan and Smissen 2013	MACN (58994) , HRL (31243,
Nothofagus resinosa	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus serrata	late Oligocene	Hill 1991	Hill 1991
Nothofagus serrulata	middle–late Eocene, middle Miocene	Dusén 1899, Vento et al. 2017	Vento et al. 2017
Nothofagus simplicidens	middle–late Eocene, middle Miocene	Dusén 1899, Vento et al. 2017	Vento and Prámparo 2018
Nothofagus solandri	Extant	Hill and Read 1991, Heenan and Smissen 2013	Swenson et al. 2000
Nothofagus subferruginea	early–middle Eocene–middle Miocene	Dusén 1899, Berry 1937, Dutra and Batten 2000, Mozer et al. 2015	Dutra and Batten 2000, Vento et al. 2017
Nothofagus tasmanica	early Oligocene–early Miocene	Hill 1983, 1991	Hill 1991, Hill and Merrifield 1993, Carpenter and Pole 1995
Nothofagus variabilis	middle–late Eocene, middle Miocene	Dusén 1899, Vento et al. 2017	Vento et al. 2017, Hünicken 1967
Nothofagus zastawniakiae	early–middle Eocene	Dutra and Batten, 2000, Mozer et al. 2015	Dutra and Batten 2000

SOM 2. Characters and states used in the phylogenetic analysis.

0. Leaf vernation: 0-plicate; 1-planar; 2-revolute; 3-conduplicate. Heenan and Smissen (2013) from Philipson and Philipson (1979).

1. Cupule valves and fruit: 0-valves 4, fruit 2 trimerous, 1 dimerous; 1-valves 2, fruit 3 dimerous; 2- valves 2, fruit 1 dimerous; 3-valves 2, fruit 1 trimerous; 4-valves 2–4, fruit 1 trimerous, 0–1 dimerous; 5-valves 4, fruit 4–7. Heenan and Smissen (2013) from Hill and Read (1991).

2. Cupule appendage type: 0-glandular; 1-lamellate. Heenan and Smissen (2013) from Hill and Read (1991).

3. Peduncle length: 0-sessile or short; 1-long. Heenan and Smissen (2013).

4. Cupule valves: 0-woody; 1-thin; 2-thin and shorter than the fruit. Heenan and Smissen (2013).

5. Staminate flowers: 0-perianth present; 1-perianth absent, pseudanthium present. From Heenan and Smissen (2013) from Langdon (1940); Rozefelds and Drinnan (1998).

6. Pollen shape in polar view: 0-peritreme; 1-goniotreme. Heenan and Smissen (2013) from Dettmann et al. (1990).

7. Pollen polar to equatorial lengths: (l/E). 0-l/E > 0.35; 1-l/E < 0.3. Dettmann et al. (1990).

8. Pollen aperture thickening: 0-annulate; 1-heavy thickening; 2-rimmed; 3-unthickened. Dettmann et al. (1990).

9. Stipule attachment: 0-not peltate; 1-peltate. Steenis (1953).

10. Phyllotaxy: 0-distichous; 1-spiral. Heenan and Smissen (2013)

11. Glandular trichomes on cuticle: 0-present; 1-absent. Hill and Read (1991).

12. Solitary unicellular trichome type A: 0-present; 1-absent. Hill and Read (1991).

13. Solitary unicellular trichome type C: 0-present; 1-absent. Hill and Read (1991).

14. Conical trichomes: 0-present; 1-absent; 2-broad-based form; 3-SUTTB or SUTTD. Jordan and Hill (1999).

15. T pieces at stomatal poles: 0-absent; 1-present. Hill and Read (1991).

16. Stomatal orientation: 0-random; 1-mostly parallel with the midrib. Hill and Read (1991).

17. Giant stomata on veins: 0-present; 1-absent. Hill and Read (1991); Jordan and Hill (1999).

18. Stomatal size excluding giant stomata: 0-more or less even; 1-variable. Heenan and Smissen (2013)

19. Upper epidermal cells over veins: 0-more elongate than areolar cells; 1-not distinguishable from areolar cells; 2-thinner than areolar cells. Heenan and Smissen (2013)

20. Fimbrial vein: 0-absent; 1-type 1; 2-type 2. Jordan and Hill (1999).

21. Anther ornamentation: 0-type a, non-ornamented; 1-type b, isomorphic; 2-type c1, heteromorphic; 3-type c2, heteromorphic; 4-type c3, heteromorphic; 5-type c4, heteromorphic. Rozefelds (1998).

22. Filaments: 0-free; 1-connate. Rozefelds (1998) and Rozefelds and Drinnan (2002).

23. Stamen number: 0-<20; 1-usually >20. Rozefelds (1998).

24. Pollen aperture ends: 0-U-shaped; 1-V-shaped. Manos (1997) and Dettmann et al. (1990).

25. Epidermal cell walls: 0-not granular; 1-granular. Hill and Read (1991)

26. Stamen development: 0-centripetal; 1-pseudocentrifugal. Rozefelds and Drinnan (1998).

27. Staminate perianth lobe number: 0-4; 1-6–14. Rozefelds and Drinnan (1998).

28. Staminate perianth shape: 0-narrowly campanulate; 1-broadly campanulate; 2-tubular. Rozefelds and Drinnan (1998).

29. Staminate perianth lobes: 0-prominent; 1-reduced. Rozefelds and Drinnan (1998).

30. Anther distal connective protrusion: 0-absent; 1-present, weakly or strongly developed. Rozefelds (1998); Rozefelds and Drinnan (1998).

31. Cupule vestiture: 0-simple trichomes; 1-densely covered with simple trichomes; 2-glabrous. Hill and Read (1991).

32. Pollen aperture length: 0-4–11 μm; 1->15 μm. Manos (1997).

33. *Cyttaria* lineage A: 0-absent; 1-present. Peterson et al. (2010).

34. *Cyttaria* lineage B: 0-absent; 1-present. Peterson et al. (2010).

35. *Cyttaria* lineage C: 0-absent; 1-present. Peterson et al. (2010).

36. Leaf margin type: 0-Dentate 1-Crenate 2-Serrate 3-Untoothed 4-Untoothed with crenate/serration apex. Modified from Gandolfo and Romero (1992).

37. Teeth: 0-Simple 1-Composite (two or more teeth) Modified from Jordan and Hill (1999).

38. Space among teeth: 0-Regular 1-Irregular. Modified from Gandolfo and Romero (1992).

39. Teeth size: 0-Uniform 1-No uniform. Modified from Gandolfo and Romero (1992).

40. Primary vein: 0-Straight 1-Curved. Modified from Gandolfo and Romero (1992).

41. Number of secondary veins: 0-Between 4-8 pairs 1-Between 8-12 pairs 2-More than 12 pairs. Modified from Gandolfo and Romero (1992).

42. Secondary vein ending: 0-At the tooth 1-At the sinus 2-At the margin. Modified from Gandolfo and Romero (1992).

43. Apex morphology: 0-Acute 1-Rounded. Modified from Gandolfo and Romero (1992).

44. Base morphology: 0-Acute 1-Rounded. Modified from Gandolfo and Romero (1992).

45. Secondary veins: 0-Mainly opposite along midvein 1- Mainly alternate along midvein.

SOM 3. Branch support calculated with symmetric resampling, 500 replicates (default change probability) using TNT software. Values are indicated as a frequency difference. Nodes without values indicate no support.