Evolutionary diversification and historical biogeography of orchidaceae in Central America with emphasis on Costa Rica and Panama

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References

References

Abbott, R., Albach, D., Ansell, S., Arntzen, J.W., Baird, S.J.E., Bierne, N., Boughman, J., Brelsford, A., Buerkle, C.A., Buggs, R., Butlin, R.K., 2013. Hybridization and speciation. J. Evol. Biol. 26, 229–246. https://doi.org/10.1111/j.1420-9101.2012.02599.x

Abele, D.A., 2007. Phylogeny of the Genus *Masdevallia* Ruiz & Pav . (Orchidaceae) Based on Morphological and Molecular Data. (PhD dissertation). Hamburg University, Hamburg, Germany.

Ackerman, J.D., Rodríguez-Robles, J.A., Melendez, E.J., 1994. A meager nectar offering by an epiphytic orchid is better than nothing. Biotropica 26, 44–49.

Álvarez, L.E., 2011. Polinización *Lepanthes*. El Orquideólogo Boletín la Asoc. Bogotana Orquideología 46, 15–16.

Anderson, B., Johnson, S.D., 2006. The effects of floral mimics and models on each others' fitness. Proc. R. Soc. B Biol. Sci. 273, 969–974. https://doi.org/10.1098/rspb.2005.3401

Anderson, B.M., Thiele, K.R., Krauss, S.L., Barrett, M.D., 2017. Genotyping-by-sequencing in a species complex of Australian hummock grasses (Triodia): Methodological insights and phylogenetic resolution, PLoS ONE. https://doi.org/10.1371/journal.pone.0171053

Antonelli, A., Dahlberg, C.J., Carlgren, K.H.I., Appelqvist, T., 2009a. Pollination of the Lady's slipper orchid (*Cypripedium calceolus*) in Scandinavia - taxonomic and conservational aspects. Nord. J. Bot. 27, 266–273. https://doi.org/10.1111/j.1756-1051.2009.00263.x

Antonelli, A., Nylander, J.A.A., Persson, C., Sanmartín, I., 2009b. Tracing the impact of the Andean uplift on Neotropical plant evolution. Proc. Natl. Acad. Sci. U. S. A. 106, 9749–9754. https://doi.org/10.1073/pnas.0811421106

Antonelli, A., Sanmartín, I., 2011. Why are there so many plant species in the Neotropics? Taxon 60, 403–414.

Antoniou Kourounioti, R.L., Band, L.R., Fozard, J.A., Hampstead, A., Lovrics, A., Moyroud, E., Vignolini, S., King, J.R., Jensen, O.E., Glover, B.J., 2012. Buckling as an origin of ordered cuticular patterns in flower petals. J. R. Soc. Interface 10, 1–9.

Arditti, J., Ghani, A.K.A., 2000. Numerical and physical properties of orchid seeds and their biological implications. New Phytol. 145, 367–421. https://doi.org/10.1046/j.1469-8137.2000.00587.x

Armbruster, W.S., 2014. Floral specialization and angiosperm diversity: Phenotypic divergence, fitness trade-offs and realized pollination accuracy. AoB Plants 6, 1–24.

Arroyo, M.T.K., Armesto, J.J., Primack, R.B., 1985. Community studies in pollination ecology in the high temperate Andes of Central Chile II. Effect of temperature on visitation rates and pollination possibilities. Plant Syst. Evol. 149, 187–203.

Arroyo, M.T.K., Primack, R.B., Armesto, J.J., 1982. Community studies in pollination ecology in the high temperate Andes of Central Chile I. Pollination mechanisms and altitudinal variation. Am. J. Bot. 69, 82–97. https://doi.org/10.2307/2442833.

Arsene, C., Schulz, S., Van Loon, J.J.A., 2002. Chemical polymorphism of the cuticular lipids of the cabbage white Pieris rapae. J. Chem. Ecol. 28, 2627–2631.

Bacon, C.D., Silvestro, D., Jaramillo, C., Tilston, B., Chakrabarty, P., 2015. Biological evidence supports an early and complex emergence of the Isthmus of Panama 112.

Balbuena, J.A., Míguez-Lozano, R., Blasco-Costa, I., 2013. PACo: A Novel Procrustes Application to Cophylogenetic Analysis. PLoS One 8, 1–15. https://doi.org/10.1371/journal.pone.0061048

Barbosa, A.R., de Melo, M.C., Borba, E.L., 2009. Self-incompatibility and myophily in *Octomeria*

(Orchidaceae, Pleurothallidinae) species. Plant Syst. Evol. 283, 1–8. https://doi.org/10.1007/s00606-009-0212-6

Barkman, T.J., Simpson, B.B., 2001. Origin of high-elevation *Dendrochilum* species (Orchidaceae) endemic to Mount Kinabalu, Sabah, Malaysia. Syst. Bot. 26, 658–669. https://doi.org/10.1043/0363-6445-26.3.658

Bartareau, T., 1994. Pollination *Bulbophyllum macphersonii* Rupp by a midge fly (Forcipomyia sauteri). The Orchadian 11, 255–258.

Barthlott, W., Große-Veldmann, B., Korotkova, N., 2014. Orchid seed diversity: a scanning electron microscopy survey, 1st ed. Botanic Garden and Botanical Museum Berlin, Berlin.

Bell, C.D., Donoghue, M.J., 2005. Phylogeny and biogeography of Valerianaceae (Dipsacales) with special reference to the South American valerians. Org. Diverisity Evol. 5, 147–159.

Benzing, D., Pridgeon, A., 1983. Foliar trichomes of Pleurothallidinae (Orchidaceae): functional significance. Am. J. Bot. 70, 173–180. https://doi.org/10.2307/2443261

Bermúdez, M., Hoorn, C., Bernet, M., Carrillo, E., Beek, P.A. Van Der, Mora, J.L., Mehrkian, K., 2015. The detrital record of late-Miocene to Pliocene surface uplift and exhumation of theVenezuelan Andes in the Maracaibo and Barinas foreland basins. Basin Res. 10.1111/bre.12154. https://doi.org/10.1111/bre.12154

Blanco, M., Vieira, S., 2011. Pollination in *Lepanthes*. Orchids 80, 356–357.

Blanco, M.A., Barboza, G., 2005. Pseudocopulatory pollination in *Lepanthes* (Orchidaceae: Pleurothallidinae) by fungus gnats. Ann. Bot. 95, 763–772. https://doi.org/10.1093/aob/mci090

Blanco, M.A., Carnevali, G., Whitten, W.M., Singer, R.B., Koehler, S., Williams, N.H., Ojeda, I., Neubig, K.M., Endara, L., 2007. Generic realignment in Maxillariinae (Orchidaceae). Lankesteriana 7, 515–537.

Bogarín, D., 2007. A new *Lycaste* (Orchidaceae: Maxillariinae) from Costa Rica. Lankesteriana 7, 543–549.

Bogarín, D., Fernández, M., Borkent, A., Heemskerk, A., Pupulin, F., RamÍrez, S., Smets, E., Gravendeel, B., 2018a. Pollination of *Trichosalpinx* (Orchidaceae: Pleurothallidinae) by biting midges (Diptera: Ceratopogonidae). Bot. J. Linn. Soc. 186, 510–543.

Bogarín, D., Fernández, M., Karremans, A.P., Pupulin, F., Smets, E., Gravendeel, B., 2018b. Floral anatomy and evolution of pollination syndromes in *Lepanthes* and close relatives, in: Pridgeon, A.M. (Ed.), 22nd Proceedings of the World Orchid Conference. Guayaquil, Ecuador, pp. 396–410.

Bogarín, D., Fernández, M., Serracín, Z., 2017. *Lepanthes aures-ursinae* and *L. vertebrata* spp. nov. (Orchidaceae: Pleurothallidinae) from Panama. Nord. J. Bot. https://doi.org/10.1111/njb.01292

Bogarín, D., Karremans, A.P., Fernández, M., 2018c. Genus-level taxonomical changes in the *Lepanthes* affinity (Orchidaceae, Pleurothallidinae). Phytotaxa 340, 128–136.

Bogarín, D., Pérez-Escobar, O.A., Groenenberg, D., Holland, S.D., Karremans, A.P., Moriarty Lemmon, E., Lemmon, A.R., Pupulin, F., Smets, E., Gravendeel, B., 2018d. Anchored Hybrid Enrichment generated nuclear, plastid and mitochondrial markers resolve the *Lepanthes horrida* (Orchidaceae: Pleurothallidinae) species complex. Mol. Phylogenet. Evol. 129, 27–47.

Bogarín, D., Pupulin, F., Arrocha, C., Warner, J., 2013. Orchids without borders: Studying the hotspot of Costa Rica and Panama. Lankesteriana 13, 13–26.

Bogarín, D., Pupulin, F., Smets, E.F., Gravendeel, B., 2016. Evolutionary diversification and historical biogeography of the Orchidaceae in Central America with emphasis on Costa Rica and Panama, in: Pridgeon, A.M. (Ed.), Lankesteriana. Universidad de Costa Rica, San José, Costa Rica, pp. 189–200.

Bogarín, D., Serracín, Z., Samudio, Z., 2014a. Illustrations and studies in Neotropical Orchidaceae. The *Specklinia condylata* group (Pleurothallidinae) in Costa Rica and Panama. Lankesteriana 13, 185–206. https://doi.org/10.3989/ajbm.2388

Bogarín, D., Serracín, Z., Samudio, Z., Rincón, R., Pupulin, F., 2014b. An updated checklist of the Orchidaceae of Panama. Lankesteriana 14, 1–364. https://doi.org/10.1017/CBO9781107415324.004

Bollback, J.P., 2006. SIMMAP: Stochastic character mapping of discrete traits on phylogenies. BMC Bioinformatics 7, 1–7. https://doi.org/10.1186/1471-2105-7-88

Borba, E., Semir, J., 2001. Pollinator Specificity and Convergence in Fly-pollinated *Pleurothallis* (Orchidaceae) Species: A Multiple Population Approach. Ann. Bot. 88, 75–88. https://doi.org/10.1006/anbo.2001.1434

Borba, E.L., Barbosa, A.R., Melo, M.C., Gontijo, S.L., Oliveira, H.O., 2011. Mating systems in the Pleurothallidinae (Orchidaceae): evolutionary and systematic implications. Lankesteriana 11, 207–221.

Borba, E.L., Semir, J., 1998. Wind-assisted fly pollination in three *Bulbophyllum* (Orchidaceae) species occurring in the Brazilian Campos Rupestres. Lindleyana 13, 203–218.

Borba, E.L., Shepherd, G.J., Van Den Berg, C., Semir, J., 2002. Floral and vegetative morphometrics of five *Pleurothallis* (Orchidaceae) species: Correlation with taxonomy, phylogeny, genetic variability and pollination systems. Ann. Bot. 90, 219–230.

Borkent, A., 2016. World species of biting midges (Diptera: Ceratopogonidae) [WWW Document]. URL http://www.inhs.illinois.edu/ research/ (accessed 5.16.16).

Borkent, A., 2004. The biting midges, the Ceratopogonidae (Diptera), in: Marquardt, W.. (Ed.), Biology of Disease Vectors. Elsevier Academic Press, Burlington, pp. 1–785.

Borkent, A., Bissett, B., 1990. A revision of the Holarctic species of *Serromyia* Meigen (Diptera: Ceratopogonidae). Syst. Entomol. 15, 153–217.

Borkent, A., Rocha-Filho, L.C., 2006. First record of female adult Atrichopogon Kieffer (Diptera: Ceratopogonidae) biting in the Neotropical Region. Proc. Entomol. Soc. Washingt. 108, 998–1001.

Borkent, A., Spinelli, G.R., 2007. Neotropical Ceratopogonidae (Diptera, Insecta): Ceratopogonidae Neotropicales (Diptera, Insecta), Aquatic biodiversity in Latin America. Pensoft.

Borkent, A., Spinelli, G.R., 2007. Neotropical Ceratopogonidae (Diptera: Insecta), in: Adis, J., Arias, J.R., Rueda-Delgado, G., Wantzen, K.M. (Eds.), Aquatic Biodiversity in Latin America, Aquatic Biodiversity in Latin America. Pensoft Publishers, Sofia, pp. 1–198.

Borkent, A., Spinelli, G.R., Grogan, W.L., 2009. Ceratopogonidae (Biting midges, purrujas), in: Brown, V., Borkent, A., Cumming, J.M., Wood, D.M., Woodley, N.E., Zumbado, M. (Eds.), Manual of Central American Diptera. NRC Research Press, Ottawa, pp. 407–435.

Bower, C., Towle, B., Bickel, D., 2015. Reproductive success and pollination of the Tuncurry Midge Orchid (*Genoplesium littorale*) (Orchidaceae) by Chloropid Flies. Telopea 18, 43–55. https://doi.org/10.7751/telopea8127

Brandley, M.C., Bragg, J.G., Singhal, S., Chapple, D.G., Jennings, C.K., Lemmon, A.R., Lemmon, E.M., Thompson, M.B., Moritz, C., 2015. Evaluating the performance of anchored hybrid enrichment at the tips of the tree of life: a phylogenetic analysis of Australian Eugongylus group scincid lizards. BMC Evol. Biol. 15, 62. https://doi.org/10.1186/s12862-015-0318-0

Britton, T., Lisa, C., Jacquet, D., Lundqvist, S., Bremer, K., 2007. Estimating Divergence Times in Large Phylogenetic Trees Estimating Divergence Times in Large Phylogenetic Trees. Syst. Biol. 56, 741–752. https://doi.org/10.1080/10635150701613783

Bronner, R., 1975. Simultaneous demonstration of lipids and starch in plant tissues. Stain Technol. 50,

1–4. https://doi.org/10.3109/10520297509117023

Brumfield, R.T., Edwards, S.V., 2007. Evolution into and out of the Andes: a Bayesian analysis of historical diversification in *Thamnophilus antshrikes*. Evolution (N. Y). 61, 346–369. https://doi.org/10.1111/j.1558-5646.2007.00039.x

Bruyn, M., Stelbrink, B., Morley, R., Hall, R., Carvalho, G., Cannon, C., van den Bergh, G., Meijaard, E., Metcalfe, I., Boitani, L., Maiorano, L., Shoup, R., von Rintelen, T., 2014. Borneo and Indochina are major evolutionary hotspots for Southeast Asian biodiversity. Syst. Biol. 63, 879–901. https://doi.org/10.1093/sysbio/syu047

Buddenhagen, C., Lemmon, A.R., Lemmon, E.M., Bruhl, J., Cappa, J., Clement, W.L., Donoghue, M., Edwards, E.J., Hipp, A.L., Kortyna, M., Mitchell, N., Moore, A., Prychid, C.J., Segovia-Salcedo, M.C., Simmons, M.P., Soltis, P.S., Wanke, S., Mast, A., 2016. Anchored Phylogenomics of Angiosperms I: Assessing the Robustness of Phylogenetic Estimates. bioRxiv.

Bystrak, P.G., Wirth, W.W., 1978. The North American Species of Forcipomyia, Subgenus Euprojoannisia (Diptera: Ceratopogonidae). USDA Tech. Bull. 1–51.

Cai, J., Liu, X., Vanneste, K., Proost, S., Tsai, W.-C., Liu, K.-W., Chen, L.-J., He, Y., Xu, Q., Bian, C., Zheng, Z., Sun, F., Liu, W., Hsiao, Y.-Y., Pan, Z.-J., Hsu, C.-C., Yang, Y.-P., Hsu, Y.-C., Chuang, Y.-C., Dievart, A., Dufayard, J.-F., Xu, X., Wang, J.-Y., Wang, J., Xiao, X.-J., Zhao, X.-M., Du, R., Zhang, G.-Q., Wang, M., Su, Y.-Y., Xie, G.-C., Liu, G.-H., Li, L.-Q., Huang, L.-Q., Luo, Y.-B., Chen, H.-H., Van de Peer, Y., Liu, Z.-J., 2014. The genome sequence of the orchid *Phalaenopsis equestris*. Nat. Genet. 47, 65–72. https://doi.org/10.1038/ng.3149

Cai, J., Liu, X., Vanneste, K., Proost, S., Tsai, W.C., Liu, K.W., Chen, L.J., He, Y., Xu, Q., Bian, C., Zheng, Z., Sun, F., Liu, W., Hsiao, Y.Y., Pan, Z.J., Hsu, C.C., Yang, Y.P., Hsu, Y.C., Chuang, Y.C., Dievart, A., Dufayard, J.F., Xu, X., Wang, J.Y., Xiao, X.J., Zhao, X.M., Du, R., Zhang, G.Q., Wang, M., Su, Y.Y., Xie, G.C., Liu, G.H., Li, L.Q., Huang, L.Q., Luo, Y.B., Chen, H.H., Van De Peer, Y., Liu, Z.J., 2015. Erratum: The genome sequence of the orchid *Phalaenopsis equestris*. Nat. Genet. 47, 186. https://doi.org/10.1038/ng0215-186

Calderón-Sáenz, E., 2012. Remoción de polinarios de *Lepanthes yubarta* por una mosca fungosa del género *Bradysia*, bajo condiciones seminaturales. Orquideología XXIX, 31–34.

Caradonna, P.J., Ackerman, J.D., 2010. Reproductive assurance for a rewardless epiphytic orchid in Puerto Rico: *Pleurothallis ruscifolia* (Orchidaceae, Pleurothallidinae). Caribb. J. Sci. 46, 249–257.

Cardoso-Gustavson, P., Campbell, L.M., Mazzoni-Viveiros, S.C., De Barros, F., 2014. Floral colleters in Pleurothallidinae (Epidendroideae: Orchidaceae). Am. J. Bot. 101, 587–597. https://doi.org/10.3732/ajb.1400012

Chamberlain, S., Ram, K., Hart, T., 2016. spocc: Interface to Species Occurrence Data Sources. R Packag. version 0.4.5. https//CRAN.R-project.org/package=spocc.

Chan, Y.-B., Ranwez, V., Scornavacca, C., 2017. Inferring incomplete lineage sorting, duplications, transfers and losses with reconciliations. J. Theor. Biol. 432, 1–13. https://doi.org/10.1016/j.jtbi.2017.08.008

Chase, M.W., Cameron, K.M., Freudenstein, J. V., Pridgeon, A.M., Salazar, G., van den Berg, C., Schuiteman, A., 2015. An updated classification of Orchidaceae. Bot. J. Linn. Soc. 177, 151–174. https://doi.org/10.1111/boj.12234

Chase, M.W., Peacor, D., 1987. Crystals of calcium oxalate hydrate on the perianth of *Stelis* Sw. Lindleyana 2, 91–94.

Chiron, G., Guiard, J., van den Berg, C., 2012. Phylogenetic relationships in Brazilian *Pleurothallis sensu lato* (Pleurothallidinae, Orchidaceae): evidence from nuclear ITS rDNA sequences. Phytotaxa

46, 34–58.

Chomicki, G., Bidel, L.P.R., Ming, F., Coiro, M., Zhang, X., Wang, Y., Baissac, Y., Jay-Allemand, C., Renner, S.S., 2015. The velamen protects photosynthetic orchid roots against UV-B damage, and a large dated phylogeny implies multiple gains and losses of this function during the Cenozoic. New Phytol. 205, 1330–1341. https://doi.org/10.1111/nph.13106

Chomicki, G., Renner, S.S., 2017. Partner abundance controls mutualism stability and the pace of morphological change over geologic time. Proc. Natl. Acad. Sci. 114, 3951–3956. https://doi.org/10.1073/pnas.1616837114

Christensen, D.E., 1994. Fly pollination in the Orchidaceae, in: Arditti, J. (Ed.), Orchid Biology: Reviews and Perspectives VI. John Wiley & Sons, New York, pp. 415–454.

Condamine, F.L., Sperling, F.A.H., Kergoat, G.J., 2013. Global biogeographical pattern of swallowtail diversification demonstrates alternative colonization routes in the Northern and Southern hemispheres. J. Biogeogr. 40, 9–23. https://doi.org/10.1111/j.1365-2699.2012.02787.x

Conran, J.G., Bannister, J.M., Lee, D.E., 2009. Earliest orchid macrofossils: Early Miocene Dendrobium and Earina (Orchidaceae: Epidendroideae) from New Zealand. Am. J. Bot. 96, 466–474. https://doi.org/10.3732/ajb.0800269

Crain, B., Tremblay, R., 2012. Update on the distribution of *Lepanthes caritensis*, a rare Puerto Rican endemic orchid. Endanger. Species Res. 18, 89–94. https://doi.org/10.3354/esr00442

Crookham, J., Dapson, R., 1991. Hazardous Chemicals in the Histopathology Laboratory. Anatech, Michigan.

Crosswhite, F.S., Crosswhite, C.D., 1984. The southwestern pipevine (*Aristolochia watsonii*) in relation to snakeroot oil, swallowtail butterflies, and ceratopogonid flies. Desert Plants 6, 203–207.

Cuatrecasas, J., 1958. Aspectos de la vegetación natural de Colombia. Rev. académica Colomb. Ciencias Exactas 10, 221–264.

da Silva, U.F., L. Borba, E., Semir, J., Marsaioli, A.J., 1999. A simple solid injection device for the analyses of *Bulbophyllum* (Orchidaceae) volatiles. Phytochemistry 50, 31–34. https://doi.org/10.1016/S0031-9422(98)00459-2

Darriba, D., Taboada, G.L., Doallo, R., Posada, D., 2012. jModelTest 2: more models, new heuristics and parallel computing. Nat. Methods 9, 772–772. https://doi.org/10.1038/nmeth.2109

Darwin, C., 1877. On the various contrivances by which british and foreign orchids are fertilised by insects. Appleton and CO., New York.

Davies, K.L., Stpiczyńska, M., 2014. Labellar anatomy and secretion in *Bulbophyllum* Thouars (Orchidaceae: Bulbophyllinae) sect. Racemosae Benth. & Hook. f. Ann. Bot. 114, 889–911. https://doi.org/10.1093/aob/mcu153

de Melo, M.C., Borba, E.L., Paiva, E.A.S., 2010. Morphological and histological characterization of the osmophores and nectaries of four species of *Acianthera* (Orchidaceae: Pleurothallidinae). Plant Syst. Evol. 286, 141–151. https://doi.org/10.1007/s00606-010-0294-1

de Oliveira, I.G., Moraes, A.P., de Almeida, E.M., de Assis, F.N.M., Cabral, J.S., de Barros, F., Felix, L.P., 2015. Chromosomal evolution in Pleurothallidinae (Orchidaceae: Epidendroideae) with an emphasis on the genus *Acianthera*: Chromosome numbers and heterochromatin. Bot. J. Linn. Soc. 178, 102–120. https://doi.org/10.1111/boj.12273

De Pádua Teixeira, S., Borba, E.L., Semir, J., 2004. Lip anatomy and its implications for the pollination mechanisms of *Bulbophyllum* species (Orchidaceae). Ann. Bot. 93, 499–505. https://doi.org/10.1093/aob/mch072

De Queiroz, K. De, 2007. Species concepts and species delimitation. Syst. Bot. 56, 879–886. https://doi.org/10.1080/10635150701701083

De Queiroz, K., 2005. Different species problems and their resolution. BioEssays 27, 1263–1269. https://doi.org/10.1002/bies.20325

Degnan, J.H., Rosenberg, N.A., 2009. Gene tree discordance, phylogenetic inference and the multispecies coalescent. Trends Ecol. Evol. 24, 332–340. https://doi.org/10.1016/j.tree.2009.01.009

Denyer, P., Alvarado, G.E., 2007. Mapa geológico de Costa Rica.

Dirks-Mulder, A., Butôt, R., van Schaik, P., Wijnands, J.W.P.M., van den Berg, R., Krol, L., Doebar, S., van Kooperen, K., de Boer, H., Kramer, E.M., Smets, E.F., Vos, R.A., Vrijdaghs, A., Gravendeel, B., 2017. Exploring the evolutionary origin of floral organs of *Erycina pusilla*, an emerging orchid model system. BMC Evol. Biol. 17, 89. https://doi.org/10.1186/s12862-017-0938-7

Donoghue, M.J., Sanderson, M.J., 2015. Confluence, synnovation, and depauperons in plant diversification. New Phytol. 207, 260–74. https://doi.org/10.1111/nph.13367

Donoghue, M.J., Winkworth, R., 2005. Viburnum phylogeny based on combined molecular data: implications for taxonomy and biogeography. Am. J. Bot. 92, 653–666.

Doyle, J.J., Doyle, J.L., 1987. A rapid DNA isolation procedure for small quantities of fresh leaf tissue. Phytochem. Bull. 19, 11–15.

Dressler, R.L., Pupulin, F., 2015. *Sobralia lentiginosa*: an attractive new species from Costa Rica. Orchids 84, 375–376.

Drummond, A.J., Bouckaert, R.R., 2014. Bayesian evolutionary analysis with BEAST 2. Cambridge University Press.

Drummond, C., Eastwood, R., Miotto, S., Hughes, C.E., 2012. Multiple continental cadiations and correlates of diversification in *Lupinus* (Leguminosae): testing for key innovation with incomplete taxon sampling. Syst. Biol. 61, 443–460. https://doi.org/10.1093/sysbio/syr126

Duque-Buitrago, C.A., Alzate-Quintero, N.F., Otero, J.T., 2014. Nocturnal pollination by fungus gnats of the colombian endemic species, *Pleurothallis marthae* (Orchidaceae: Pleurothallidinae). Lankesteriana 13, 407–417.

Duque, O., 1993. Polinización en Pleurothallis. Orquideología 19, 55–76.

Edwards, S. V., 2009. Is a new and general theory of molecular systematics emerging? Evolution (N. Y). 63, 1–19. https://doi.org/10.1111/j.1558-5646.2008.00549.x

Endara, L., Grimaldi, D., Roy, B.A., 2010. Lord of the flies: pollination of *Dracula* orchids. Lankesteriana 10, 1–12.

Fernández, M., 2014. Tratamiento sistemático del género *Trichosalpinx* (Orchidaceae: Pleurothallidinae) en Costa Rica.

Fernández, M., Bogarín, D., 2013. A new species of *Trichosalpinx* (Orchidaceae: Pleurothallidinae) from Costa Rica. Brittonia 65, 96–101. https://doi.org/10.1007/s12228-012-9265-x

Fernández, M., Bogarín, D., 2011. A new *Trichosalpinx* (Orchidaceae: Pleurothallidinae) from the northern Pacific lowlands of Costa Rica. Phytotaxa 38, 41–48.

Fisher, D.B., 1968. Protein staining of ribboned epon sections for light microscopy. Histochemie 16, 92–96. https://doi.org/10.1007/BF00306214

Fitzjohn, R.G., 2012. Diversitree: comparative phylogenetic analyses of diversification in R. Methods Ecol. Evol. 3, 1084–1092. https://doi.org/10.1111/j.2041-210X.2012.00234.x

Folmer, O., Black, M., Hoeh, W., Lutz, R., Vrijenhoek, R., 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. Mol. Mar. Biol.

Biotechnol. 3, 294–299. https://doi.org/10.1371/journal.pone.0013102

Forest, F., Goldblatt, P., Manning, J.C., Baker, D., Colville, J.F., Devey, D.S., Jose, S., Kaye, M., Buerki, S., 2014. Pollinator shifts as triggers of speciation in painted petal irises (*Lapeirousia*: Iridaceae). Ann. Bot. 113, 357–371. https://doi.org/10.1093/aob/mct248

Fragoso-Martínez, I., Salazar, G.A., Martínez-Gordillo, M., Magallón, S., Sánchez-Reyes, L., Moriarty Lemmon, E., Lemmon, A.R., Sazatornil, F., Granados Mendoza, C., 2016. A pilot study applying the plant Anchored Hybrid Enrichment method to New World sages (*Salvia* subgenus *Calosphace*; Lamiaceae). Mol. Phylogenet. Evol. 117, 124–134. https://doi.org/10.1016/j.ympev.2017.02.006

Franceschi, V.R., Horner, H.T., 1980. Calcium oxalate crystals in plants. Bot. Rev. 46, 361–427.

Fujita, M.K., Leaché, A.D., Burbrink, F.T., McGuire, J.A., Moritz, C., 2012. Coalescent-based species delimitation in an integrative taxonomy. Trends Ecol. Evol. 27, 480–488. https://doi.org/10.1016/j.tree.2012.04.012

Gamisch, A., Fischer, G.A., Comes, H.P., 2014. Recurrent polymorphic mating type variation in Madagascan *Bulbophyllum* species (Orchidaceae) exemplifies a high incidence of auto-pollination in tropical orchids. Bot. J. Linn. Soc. 175, 242–258. https://doi.org/10.1111/boj.12168

Gandrud, C., 2013. Reproducible Research with R and R Studio 294.

Gentry, A.H., 1986. Species richness and floristic composition of Choco region plant communities. Caldasia 15, 71–91. https://doi.org/10.1039/c5ta01093d

Gentry, A.H., 1982. Neotropical Floristic Diversity: Phytogeographical Connections Between Central and South America, Pleistocene Climatic Fluctuations, or an Accident of the Andean Orogeny? Ann. Missouri Bot. Gard. 69, 557–593. https://doi.org/10.2307/2399084

Gentry, A.H., Dodson, C.H., 1987. Diversity and Biogeography of Neotropical Vascular Epiphytes. Ann. Missouri Bot. Gard. https://doi.org/10.2307/2399395

Gerlach, G., 2011. The genus *Coryanthes*: a paradigm in ecology. Lankesteriana 11, 253–264.

Gerlach, G., Pérez-Escobar, O.A., 2014. Looking for missins swans: phylogenetics of Cycnoches. Orchids 83, 434–437. https://doi.org/10.1126/science.337.6100.1274-a

Gerlach, G., Schill, R., 1991. Composition of Orchid Scents Attracting Euglossine Bees. Bot. Acta 104, 379–384. https://doi.org/10.1111/j.1438-8677.1991.tb00245.x

Gibernau, M., Macquart, D., Przetak, G., 2004. Pollination in the Genus *Arum* – a review. Aroideana 27, 148–166.

Givnish, T.J., Spalink, D., Ames, M., Lyon, S.P., Hunter, S.J., Zuluaga, A., Doucette, A., Caro, G.G., McDaniel, J., Clements, M.A., Arroyo, M.T.K., Endara, L., Kriebel, R., Williams, N.H., Cameron, K.M., 2016. Orchid historical biogeography, diversification, Antarctica and the paradox of orchid dispersal. J. Biogeogr. 43, 1905–1916. https://doi.org/10.1111/jbi.12854

Givnish, T.J., Spalink, D., Ames, M., Lyon, S.P., Hunter, S.J., Zuluaga, A., Iles, W.J.D., Clements, M.A., Arroyo, M.T.K., Leebens-Mack, J., Endara, L., Kriebel, R., Neubig, K.M., Whitten, W.M., Williams, N.H., Cameron, K.M., 2015. Orchid phylogenomics and multiple drivers of their extraordinary diversification. Proc. R. Soc. B 282, DOI: 10.1098/rspb.2015.1553. https://doi.org/10.1098/rspb.2015.1553

Godden, G.T., 2002. Pollination and speciation of *Lepanthes*: an approach to understanding orchid evolution. Pleurothallid News Views 14, 52–54.

Goldberg, E., Lancaster, L., Ree, R.H., 2011. Phylogenetic inference of reciprocal effects between geographic range evolution and diversification. Syst. Biol. 60, 451–465. https://doi.org/10.1093/sysbio/syr046

Gontijo, S.L., Barbosa, A.R., De Melo, M.C., Borba, E.L., 2010. Occurrence of different sites of self-incompatibility reaction in four *Anathallis* (Orchidaceae, Pleurothallidinae) species. Plant Species Biol. 25, 129–135. https://doi.org/10.1111/j.1442-1984.2010.00277.x

Granados Mendoza, C., Wanke, S., Salomo, K., Goetghebeur, P., Samain, M.S., 2013. Application of the phylogenetic informativeness method to chloroplast markers: A test case of closely related species in tribe Hydrangeeae (Hydrangeaceae). Mol. Phylogenet. Evol. 66, 233–242. https://doi.org/10.1016/j.ympev.2012.09.029

Gravendeel, B., Bogarín, D., Dirks-mulder, A., Wati, R.K., Pramanik, D., 2018. The orchid genomic toolkit, in: Proceedings of the 18th EOCCE - What Future for Orchids? The. Cahiers De La Société Française D'orchidophilie, pp. 72–76.

Gregory-Wodzicki, K.M., 2000. Uplift history of the Central and Northern Andes: a review. Geol. Soc. Am. Bull. 112, 1091–1105. https://doi.org/10.1130/0016-7606(2000)112<1091

Gruenstaeudl, M., 2016. WARACS: Wrappers to Automate the Reconstruction of Ancestral Character States. Appl. Plant Sci. 4, 1500120. https://doi.org/10.3732/apps.1500120

Hamann, T., Smets, E., Lens, F., 2011. A comparison of paraffin and resin-based techniques used in bark anatomy. Taxon 60, 841–851.

Hamilton, C.A., Lemmon, A.R., Lemmon, E.M., Bond, J.E., 2016. Expanding anchored hybrid enrichment to resolve both deep and shallow relationships within the spider tree of life. BMC Evol. Biol. 16, 212. https://doi.org/10.1186/s12862-016-0769-y

Hebert, P.D.N., Penton, E.H., Burns, J.M., Janzen, D.H., Hallwachs, W., 2004. Ten species in one: DNA barcoding reveals cryptic species in the neotropical skipper butterfly *Astraptes fulgerator*. Proc. Natl. Acad. Sci. U. S. A. 101, 14812–14817. https://doi.org/10.1073/pnas.0406166101

Heiduk, A., Brake, I., Tolasch, T., Frank, J., Jürgens, A., Meve, U., Dötterl, S., 2010. Scent chemistry and pollinator attraction in the deceptive trap flowers of *Ceropegia dolichophylla*. South African J. Bot. 76, 762–769. https://doi.org/10.1016/j.sajb.2010.07.022

Heiduk, A., Brake, I., von Tschirnhaus, M., Göhl, M., Jürgens, A., Johnson, S.D., Meve, U., Dötterl, S., 2016. *Ceropegia sandersonii* mimics attacked honeybees to attract kleptoparasitic flies for pollination. Curr. Biol. 26, 1–7. https://doi.org/10.1016/J.CUB.2016.07.085

Heiduk, A., Kong, H., Brake, I., Von Tschirnhaus, M., Tolasch, T., Tröger, A.G., Wittenberg, E., Francke, W., Meve, U., Dötterl, S., 2015. Deceptive *Ceropegia dolichophylla* fools its kleptoparasitic fly pollinators with exceptional floral scent. Front. Ecol. Evol. 3, 1–13. https://doi.org/10.3389/fevo.2015.00066

Heyduk, K., Trapnell, D.W., Barrett, C.F., Leebens-Mack, J., 2016. Phylogenomic analyses of species relationships in the genus *Sabal* (Arecaceae) using targeted sequence capture. Biol. J. Linn. Soc. 117, 106–120. https://doi.org/10.1111/bij.12551

Hijmans, R.J., Elith, J., 2016. Species distribution modeling with R.

Hoorn, C., Flantua, S., 2015. An early start for the Panama land bridge. Science (80-.). 348, 186–187.

Hoorn, C., Guerrero, J., Sarmiento, G.A., Lorente, M.A., 1995. Andean tectonics as a cause for changing drainage patterns in Miocene northern South America. Geology 23, 237–240.

Hoorn, C., Mosbrugger, V., Mulch, A., Antonelli, A., 2013. Biodiversity from mountain building. Nat. Geosci. 6, 154–154. https://doi.org/10.1038/ngeo1742

Hoorn, C., Wesselingh, F.P., Steege, H., Bermudez, M.A., Mora, A., Sevink, J., Sanmartín, I., Anderson, C.L., Figueiredo, J.P., Jaramillo, C., Riff, D., 2010. Amazonia through time: Andean uplift, climate change, landscape evolution, and biodiversity. Science (80-.). 330, 927–931. https://doi.org/10.1126/science.1194585

Huang, H., Lacey Knowles, L., 2016. Unforeseen consequences of excluding missing data from next-generation sequences: Simulation study of rad sequences. Syst. Biol. 65, 357–365. https://doi.org/10.1093/sysbio/syu046

Huelsenbeck, J.P., Ronquist, F., 2001. MRBAYES : Bayesian inference of phylogenetic trees. Bioinformatics 17, 754–755.

Huerta-Cepas, J., Serra, F., Bork, P., 2016. ETE 3: Reconstruction, Analysis, and Visualization of Phylogenomic Data. Mol. Biol. Evol. 33, 1635–1638.

Hughes, C., Eastwood, R., 2006. Island radiation on a continental scale: exceptional rates of plant diversification after uplift of the Andes. Proc. Natl. Acad. Sci. U. S. A. 103, 10334–10339. https://doi.org/10.1073/pnas.0601928103

Hughes, C.E., Atchison, G.W., 2015. The ubiquity of alpine plant radiations: from the Andes to the Hengduan mountains. New Phytol. 207, 275–282.

Hughes, C.E., Pennington, R.T., Antonelli, A., 2013. Neotropical plant evolution: assembling the big picture. Bot. J. Linn. Soc. 171, 1–18.

Humeau, L., Micheneau, C., Jacquemyn, H., Gauvin-Bialecki, A., Fournel, J., Pailler, T., 2011. Sapromyiophily in the native orchid, *Bulbophyllum variegatum*, on Réunion (Mascarene Archipelago, Indian Ocean). J. Trop. Ecol. 27, 591–599. https://doi.org/10.1017/S0266467411000411

Humphreys, A.M., Linder, H.P., 2009. Concept versus data in delimitation of plant genera. Taxon 58, 1054–1074. https://doi.org/10.2307/27757002

Huson, D.H., Bryant, D., 2006. Application of phylogenetic networks in evolutionary studies. Mol. Biol. Evol. 23, 254–267. https://doi.org/10.1093/molbev/msj030

Huson, D.H., Scornavacca, C., 2012. Dendroscope 3: An interactive tool for rooted phylogenetic trees and networks. Syst. Biol. 61, 1061–1067. https://doi.org/10.1093/sysbio/sys062

Jeffroy, O., Brinkmann, H., Delsuc, F., Philippe, H., 2006. Phylogenomics: the beginning of incongruence? Trends Genet. 22, 225–231. https://doi.org/10.1016/j.tig.2006.02.003

Jensen, W.A., 1962. Botanical histochemistry, WH Freeman. ed. WH Freeman and Company, San Francisco.

Jersáková, J., Johnson, S.D., Kindlmann, P., 2006. Mechanisms and evolution of deceptive pollination in orchids. Biol. Rev. 81, 219–235. https://doi.org/10.1017/S1464793105006986

Johnson, S.D., 2010. The pollination niche and its role in the diversification and maintenance of the southern African flora. Philos. Trans. R. Soc. Lond. B. Biol. Sci. 365, 499–516. https://doi.org/10.1098/rstb.2009.0243

Johnson, S.D., Peter, C.I., Agren, J., 2004. The effects of nectar addition on pollen removal and geitonogamy in the non-rewarding orchid *Anacamptis morio*. Proc. R. Soc. London B Biol. Sci. 271, 803–809.

Jombart, T., Kendall, M., Almagro-Garcia, J., Colijn, C., 2017. TREESPACE : Statistical exploration of landscapes of phylogenetic trees. Mol. Ecol. Resour. https://doi.org/10.1111/1755-0998.12676

Jørgensen, P.M., León-Yánez, S., 1999. Catalogue of the Vascular Plants of Ecuador. Monogr. Syst. Bot. Missouri Bot. Gard.

Jost, L., 2004. Explosive local radiation of the genus *Teagueia* (Orchidaceae) in the upper Pastaza watershed of Ecuador. Lyonia 7, 41–47.

Jürgens, A., Dötterl, S., Meve, U., 2006. The chemical nature of fetid floral odours in stapeliads (Apocynaceae-Asclepiadoideae-Ceropegieae). New Phytol. 172, 452–468.

Karremans, A.P., 2016. Genera Pleurothallidinarum: an updated phylogenetic overview of the Pleuroth-

allidinae. Lankesteriana 16, 219–241.

Karremans, A.P., 2014. *Lankesteriana*, a new genus in the Pleurothallidinae (Orchidaceae). Lankesteriana 13, 319–332.

Karremans, A.P., Albertazzi, F.J., Bakker, F.T., Bogarín, D., Eurlings, C.M., Pridgeon, A., Pupulin, F., Gravendeel, B., 2016. Phylogenetic reassessment of *Specklinia* and its allied genera in the Pleurothallidinae (Orchidaceae). Phytotaxa 272, 1–36. https://doi.org/10.11646/phytotaxa.272.1.1

Karremans, A.P., Bakker, F.T., Smulders, M.J.M., 2013. Phylogenetics of *Stelis* and closely related genera (Orchidaceae: Pleurothallidinae) 151–176. https://doi.org/10.1007/s00606-012-0712-7

Karremans, A.P., Díaz-Morales, M., 2018. The Pleurothallidinae: extremely high speciation driven by pollinator adaptation, in: Pridgeon, A.M. (Ed.), 22nd Proceedings of the World Orchid Conference. Guayaquil, pp. 376–395.

Karremans, A.P., Pupulin, F., Gravendeel, B., 2015a. *Specklinia dunstervillei*, a new species long confused with *Specklinia endotrachys* (Orchidaceae: Pleurothallidinae). PLoS One 10. https://doi.org/10.1371/journal.pone.0131971

Karremans, A.P., Pupulin, F., Gravendeel, B., 2013. Taxonomy, molecular phylogenetics, reproductive isolation, and niche differentiation of the *Specklinia endotrachys* species complex (Orchidaceae: Pleurothallidinae). Lankesteriana 13, 132–133.

Karremans, A.P., Pupulin, F., Grimaldi, D., Beentjes, K.K., Butôt, R., Fazzi, G.E., Kaspers, K., Kruizinga, J., Roessingh, P., Smets, E.F., Gravendeel, B., 2015b. Pollination of *Specklinia* by nectar-feeding *Drosophila*: The first reported case of a deceptive syndrome employing aggregation pheromones in Orchidaceae. Ann. Bot. 116, 437–455. https://doi.org/10.1093/aob/mcv086

Karremans, A.P.A.P., Bogarín, D., Díaz-Morales, M., Fernández, M., Oses, L., Pupulin, F., 2016. Phylogenetic reassessment of *Acianthera* (Orchidaceae: Pleurothallidinae). Harvard Pap. Bot. 21, 171–187. https://doi.org/10.3100/hpib.v21iss2.2016.n4

Katoh, K., Standley, D.M., 2013. MAFFT multiple sequence alignment software version 7: Improvements in performance and usability. Mol. Biol. Evol. 30, 772–780. https://doi.org/10.1093/molbev/mst010

Kay, K.M., Schemske, D.W., 2008. Natural selection reinforces speciation in a radiation of neotropical rainforest plants. Evolution (N. Y). 62, 2628–2642.

Kearse, M., Moir, R., Wilson, A., Stones-Havas, S., Cheung, M., Sturrock, S., Buxton, S., Cooper, A., Markowitz, S., Duran, C., Thierer, T., Ashton, B., Meintjes, P., Drummond, A., 2012. Geneious Basic: An integrated and extendable desktop software platform for the organization and analysis of sequence data. Bioinformatics 28, 1647–1649.

Kendall, M., Colijn, C., 2016. Mapping Phylogenetic Trees to Reveal Distinct Patterns of Evolution. Mol. Biol. Evol. 33, 2735–2743. https://doi.org/10.1093/molbev/msw124

Kirby, S., 2011. Active mountain building and the distribution of “core” Maxillariinae species in tropical Mexico and Central America. Lankesteriana 11, 275–291.

Kirby, S.H., 2016. Active tectonic and volcanic mountain building as agents of rapid environmental changes and increased orchid diversity and long-distance orchid dispersal in the tropical americas: opportunities and challenges. Lankesteriana 16, 243–254.

Kirby, S.H., 2007. Geological processes and orchid biogeography with applications to southeast central America. Lankesteriana 7, 53–55.

Kolanowska, M., 2014. The orchid flora of the Colombian Department of Valle del Cauca. Rev. Mex. Biodivers. 85, 445–462. https://doi.org/10.7550/rmb.32511

Kosakovsky Pond, S.L., Frost, S.D.W., Muse, S. V., 2005. HyPhy: Hypothesis testing using phylogenies. Bioinformatics 21, 676–679. https://doi.org/10.1093/bioinformatics/bti079

Kowalkowska, A.K., Kozieradzka-Kiszkurno, M., Turzyński, S., 2014. Morphological, histological and ultrastructural features of osmophores and nectary of *Bulbophyllum wendlandianum* (Kraenzl.) Dammer (*B.* section *Cirrhopetalum* Lindl., Bulbophyllinae Schltr., Orchidaceae). Plant Syst. Evol. 301, 609–622. https://doi.org/10.1007/s00606-014-1100-2

Kreft, H., Koster, N., Kuper, W., Nieder, J., Barthlott, W., 2004. Diversity and biogeography of vascular epiphytes in Western Amazonia, Yasuni, Ecuador. J. Biogeogr. 31, 1463–1476. https://doi.org/10.1111/j.1365-2699.2004.01083.x

Krömer, T., Gradstein, S.R., 2003. Species richness of vascular epiphytes in two primary forests and fallows in the Bolivian Andes. Selbyana 24, 190–195.

Küper, W., Kreft, H., Nieder, J., Köster, N., Barthlott, W., 2004. Large-scale diversity patterns of vascular epiphytes in Neotropical montane rain forests. J. Biogeogr. 31, 1477–1487. https://doi.org/10.1111/j.1365-2699.2004.01093.x

Lagomarsino, L.P., Condamine, F.L., Antonelli, A., Mulch, A., Davis, C.C., 2016. The abiotic and biotic drivers of rapid diversification in Andean bellflowers (Campanulaceae). New Phytol. 210, 1430–1442. https://doi.org/10.1111/nph.13920

Lahaye, R., van der Bank, M., Bogarin, D., Warner, J., Pupulin, F., Gigot, G., Maurin, O., Duthoit, S., Barraclough, T.G., Savolainen, V., 2008. DNA barcoding the floras of biodiversity hotspots. Proc. Natl. Acad. Sci. U. S. A. 105, 2923–2928. https://doi.org/10.1073/pnas.0709936105

Landis, Mi.J., Matzke, N.J.M., Moore, B.R.R., Huelsenbeck, J.P., 2013. Bayesian Analysis of Biogeography when the Number of Areas is Large. Syst. Biol. 62, 789–804. https://doi.org/10.1093/sysbio/syt040

Lemmon, A.R., Emme, S.A., Lemmon, E.M., 2012. Anchored hybrid enrichment for massively high-throughput phylogenomics. Syst. Biol. 61, 727–744. https://doi.org/10.1093/sysbio/sys049

Lemmon, A.R., Lemmon, E.M., 2012. High-throughput identification of informative nuclear loci for shallow-scale phylogenetics and phylogeography. Syst. Biol. 61, 745–761. https://doi.org/10.1093/sysbio/sys051

Léveillé-Bourret, É., Starr, J.R., Ford, B.A., Moriarty Lemmon, E., Lemmon, A.R., 2018. Resolving Rapid Radiations within Angiosperm Families Using Anchored Phylogenomics. Syst. Biol. 67, 94–112. https://doi.org/10.1093/sysbio/syx050

Lindley, J., 1843. Catasetidae. Edwards's Bot. Regist. 29, sub t. 22.

Liu, L., Wu, S., Yu, L., 2015. Coalescent methods for estimating species trees from phylogenomic data. J. Syst. Evol. 53, 380–390. https://doi.org/10.1111/jse.12160

Liu, L., Yu, L., 2011. Estimating species trees from unrooted gene trees. Syst. Biol. 60, 661–667. https://doi.org/10.1093/sysbio/syr027

Liu, L., Yu, L., 2010. Phybase: An R package for species tree analysis. Bioinformatics 26, 962–963. https://doi.org/10.1093/bioinformatics/btq062

Liu, L., Yu, L., Edwards, S. V, 2010. A maximum pseudo-likelihood approach for estimating species trees under the coalescent model. BMC Evol. Biol. 10, 302. https://doi.org/10.1186/1471-2148-10-302

Liu, L., Yu, L., Pearl, D.K., Edwards, S. V., 2009. Estimating species phylogenies using coalescence times among sequences. Syst. Biol. 58, 468–477.

Liu, W.-Y., Lee, S.-J., Yang, E.-C., 2009. Evaluation for attractiveness of four chemicals to the bit-

ing midge, *Forcipomyia taiwana* (Diptera: Ceratopogonidae). J. Am. Mosq. Control Assoc. 25, 448–455. https://doi.org/10.2987/09-0005.1

López-Giráldez, F., Townsend, J.P., 2011. PhyDesign: An online application for profiling phylogenetic informativeness. BMC Evol. Biol. 11, 2–5. https://doi.org/10.1186/1471-2148-11-152

Luebert, F., Hilger, H.H., Weigend, M., 2011. Diversification in the Andes: age and origins of South American *Heliotropium* lineages (Heliotropiaceae, Boraginales). Mol. Phylogenet. Evol. 61, 90–102. https://doi.org/10.1016/j.ympev.2011.06.001

Luer, C.A., 2007. Icones Pleurothallidinarum XXIX. A third century of *Stelis* of Ecuador. Systematics of *Apoda-prorepentia*. Systematics of miscellaneous small genera addenda: new genera, species, and combinations (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 112, 1–130.

Luer, C.A., 2006. Icones Pleurothallidinarum XXVIII. A reconsideration of *Masdevallia*. Systematics of *Specklinia* and vegetatively similar taxa (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 105, 1–274.

Luer, C.A., 2004. Icones Pleurothallidinarum XXVI. Pleurothallis subgenus *Acianthera* and three allied subgenera; A Second Century of New Species of *Stelis* of Ecuador; *Epibator, Ophidion, Zootrophion*. Monogr. Syst. Bot. from Missouri Bot. Gard. 95, 1–265.

Luer, C.A., 2003a. *Lepanthes*, in: Hammel, B.E., Grayum, M.H., Herrera, C., Zamora, N.A. (Eds.), Manual de Plantas de Costa Rica. Vol. III. Monographs in Systematic Botany from the Missouri Botanical Garden, St. Louis, Missouri, pp. 216–255.

Luer, C.A., 2003b. *Stelis*, in: Hammel, B.E., Grayum, M.H., Herrera, C., Zamora, N.A. (Eds.), Manual de Plantas de Costa Rica. Vol. III. Monographs in Systematic Botany from the Missouri Botanical Garden, St. Louis, Missouri, pp. 521–545.

Luer, C.A., 2002. Miscellaneous new species in the Pleurothallidinae (Orchidaceae). Selbyana 23, 1–45.

Luer, C.A., 1999. Icones Pleurothallidinarum XVIII. Systematics of *Pleurothallis* Subgen. *Pleurothallis* Sect. *Pleurothallis* Subsect. Antenniferae, Subsect. Longiracemosae, Subsect. *Macrophyllae-Racemosae*, Subsect. *Perplexae*, Subgen. *Pseudostelis*, Subgen. *Acuminatia*. Monogr. Syst. Bot. from Missouri Bot. Gard. 76, 1–182.

Luer, C.A., 1997. Icones Pleurothallidinarum XV. Systematics of *Trichosalpinx*. Monogr. Syst. Bot. from Missouri Bot. Gard. 64, 1–121.

Luer, C.A., 1997. New species of *Lepanthes* and *Pleurothallis* (Orchidaceae) from Guatemala, Panama, Peru, Suriname, and Venezuela. Lindleyana 12, 34–55.

Luer, C.A., 1996a. Icones Pleurothallidinarum XIV. Systematics of *Draconanthes, Lepanthes* Subgenus *Marsipanthes* and Subgenus *Lepanthes* of Ecuador; Addenda to *Brachionidium*, *Lepanthes* Subgen. *Brachycladium, Platystele, Pleurothallis* Subgen. *Aenigma*, and Subgen. *Ancipitia*. Monogr. Syst. Bot. from Missouri Bot. Gard. 14, 1–255.

Luer, C.A., 1996b. Icones Pleurothallidinarum XIV. : Systematics of *Draconanthes, Lepanthes* Subgenus *Marsipanthes* and Subgenus *Lepanthes* of Ecuador; Addenda to *Brachionidium*, *Lepanthes* Subgen. *Brachycladium, Platystele, Pleurothallis* Subgen. *Aenigma*, and Subgen. *Ancipitia*. Monogr. Syst. Bot. from Missouri Bot. Gard. 14, 1–255.

Luer, C.A., 1996. Icones Pleurothallidinarum XIV. Systematics of *Draconanthes*, *Lepanthes* subgenus marsipanthes and subgenus *Lepanthes* of Ecuador. Monogr. Syst. Bot. from Missouri Bot. Gard. 61, 1–225.

Luer, C.A., 1991. Icones Pleurothallidinarum VIII. Systematics of *Lepanthopsis*, *Octomeria* subgenus *Pleurothallopsis, Restrepiella, Restrepiopsis, Salpistele*, and *Teagueia*. Addenda to Platystele, *Porroglossum*, and *Scaphosepalum*. Monogr. Syst. Bot. from Missouri Bot. Gard. 39, 1–161.

Luer, C.A., 1990. Icones Pleurothallidinarum VII. Systematics of *Platystele* (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 38, 1–115.

Luer, C.A., 1986a. Icones Pleurothallidinarum I. Pleurothallidinae (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 15, 1–81.

Luer, C.A., 1986b. Icones Pleurothallidinarum III. Systematics of *Pleurothallis* (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 20, 1–107.

Luer, C.A., 1984. Miscellaneous new species in the Pleurothallidinae. Phytologia 55, 175–193.

Luer, C.A., 1983. *Trichosalpinx*, a new genus in the Pleurothallidinae. Phytologia 54, 393–398.

Luer, C.A., 1982. *Ophidion* and *Zootrophion*, two new genera in the Pleurothallidinae (Orchidaceae) 7, 79–87.

Luer, C.A., Dressler, R.L., 1986. Nuevas especies de *Lepanthes* de Panamá. Orquideología 16, 3–26.

Luer, C.A., Thoerle, L., 2012. Icones Pleurothallidinarum XXXII. *Lepanthes* of Colombia (Orchidaceae). Illustrations. Monogr. Syst. Bot. from Missouri Bot. Gard. 1, 1–300.

Luer, C.A., Thoerle, L., 2012. Icones Pleurothallidinarum XXXII. *Lepanthes* of Colombia (Orchidaceae). Monogr. Syst. Bot. from Missouri Bot. Gard. 123, 1–300.

Lugo, M.A., Ferrero, M., Menoyo, E., Estévez, M.C., Siñeriz, F., Anton, A., 2008. Arbuscular mycorrhizal fungi and rhizospheric bacteria diversity along an altitudinal gradient in South American Puna grassland. Microb. Ecol. 55, 705–713. https://doi.org/10.1007/s00248-007-9313-3

Maddison, W.P., 1997. Gene Trees in Species Trees. Syst. Biol. 46, 523–536. https://doi.org/10.1093/sysbio/46.3.523

Madriñán, S., Cortés, A.J., Richardson, J.E., 2013. Páramo is the world's fastest evolving and coolest biodiversity hotspot. Front. Genet. 4, 1–7. https://doi.org/10.3389/fgene.2013.00192

Mallo, D., Posada, D., 2016. Multilocus inference of species trees and DNA barcoding. Philos. Trans. R. Soc. London B 371, 20150335. https://doi.org/10.1098/rstb.2015.0335

Mant, J., Brändli, C., Vereecken, N.J., Schulz, C.M., Francke, W., Schiestl, F.P., 2005. Cuticular hydrocarbons as sex pheromone of the bee *Colletes cunicularius* and the key to its mimicry by the sexually deceptive orchid, *Ophrys exaltata*. J. Chem. Ecol. 31, 1765–1787. https://doi.org/10.1007/s10886-005-5926-5

Marcus, M.F., 2016. Golden orb web spider with ectoparasitic biting midges. Singapore Biodivers. Rec. 2016, 13.

Marshall, S.A., Borkent, A., Agnarsson, I., Otis, G.W., Fraser, L., d'Entremont, D., 2015. New observations on a neotropical termite-hunting theridiid spider: opportunistic nest raiding, prey storage, and ceratopogonid kleptoparasites. J. Arachnol. 43, 419–421. https://doi.org/10.1636/0161-8202-43.3.419

Mason-Gamer, R.J., Kellog, E.A., 1996. Testing for phylogenetic conflict among molecular data sets in the tribe Triticeae (Gramineae). Syst. Biol. 45, 524–545. https://doi.org/10.2307/2413529

Matzke, N.J., 2014. Model selection in historical biogeography reveals that founder-event speciation is a crucial process in island clades. Syst. Biol. 63, 951–970. https://doi.org/10.1093/sysbio/syu056

Matzke, N.J., 2013. Probabilistic historical biogeography: new models for founder-event speciation, imperfect detection, and fossil allow improved accuracy and model-testing. Front. Biogeogr. 5, 243–248. https://doi.org/10.5811/westjem.2011.5.6700

Matzke, N.J., 20018. BioGeoBEARS: BioGeography with Bayesian (and likelihood) Evolutionary Analysis with R Scripts. https://doi.org/http://dx.doi.org/10.5281/zenodo.1478250

Mayer, J.L.S., Cardoso-Gustavson, P., Appezzato-da-Glória, B., 2011. Colleters in monocots: New

record for Orchidaceae. Flora Morphol. Distrib. Funct. Ecol. Plants 206, 185–190. https://doi.org/10.1016/j.flora.2010.09.003

McCartney-Melstad, E., Mount, G.G., Shaffer, H.B., 2016. Exon capture optimization in amphibians with large genomes. Mol. Ecol. Resour. 16, 1084–1094. https://doi.org/10.1111/1755-0998.12538

McGuire, J.A., Witt, C.C., Remsen, J. V, Corl, A., Rabosky, D.L., Altshuler, D., Dudley, R., 2014. Molecular phylogenetics and the diversification of Hummingbirds. Curr. Biol. 24, 1–7. https://doi.org/10.1016/j.cub.2014.03.016

Meade, A., Pagel, M., 2016. BayesTraits V3 81.

Merckx, V.S.F.T., Hendriks, K., Beentjes, K., Mennes, C., Becking, L.E., Peijnenburg, K.T.C.A., Afendy, A., Arumugam, N., Boer, H. De, Biun, A., Buang, M.M., Hovenkamp, P., Imbun, P., Ipor, I., Janssens, S.B., Jocque, M., Nieser, N., Pereira, J.T., Rahman, H., Sabran, S., Sawang, A., Schwallier, R.M., Shim, P., Smit, H., Sol, N., Spait, M., Stech, M., Stokvis, F., Sugau, J., Sulieman, M., Sumail, S., Thomas, D., van Tol, J., Tuh, F., Yahya, B., Nais, J., Repin, R., Lakim, M., Schuilthuizen, M., 2015. Evolution of endemism on a young tropical mountain. Nature 524, 347–350. https://doi.org/10.1038/nature14949

Meve, U., Liede, S., 1994. Floral biology and pollination in stapeliads - new results and a literature review. Plant Syst. Evol. 192, 99–116. https://doi.org/10.1007/BF00985911

Meyer, M., Kircher, M., 2010. Illumina sequencing library preparation for highly multiplexed target capture and sequencing. Cold Spring Harb. Protoc. 5. https://doi.org/10.1101/pdb.prot5448

Miller, M.A., Pfeiffer, W., Schwartz, T., 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees, in: Proceedings of the Gateway Computing Environments Workshop (GCE). New Orleans, Baton Rouge, pp. 1–8.

Miller, M.A., Schwartz, T., Pickett, B.E., He, S., Klem, E.B., Scheuermann, R.H., Passarotti, M., Kaufman, S., Oleary, M.A., 2015. A RESTful API for access to phylogenetic tools via the CIPRES science gateway. Evol. Bioinforma. 11, 43–48. https://doi.org/10.4137/EBO.S21501

Mirarab, S., Warnow, T., 2015. ASTRAL-II: Coalescent-based species tree estimation with many hundreds of taxa and thousands of genes. Bioinformatics 31, i44–i52. https://doi.org/10.1093/bioinformatics/btv234

Mitchell, N., Lewis, P.O., Lemmon, E.M., Lemmon, A.R., Holsinger, K.E., 2017. Anchored phylogenomics improves the resolution of evolutionary relationships in the rapid radiation of Protea L. Am. J. Bot. 104, 102–115. https://doi.org/10.3732/ajb.1600227

Molnar, P., 2008. Closing of the Central American Seaway and the Ice Age : A critical review 23, 1–15. https://doi.org/10.1029/2007PA001574

Montes, C., Cardona, A., Jaramillo, C., Pardo, A., Silva, J.C., Valencia, V., Ayala, C., Pérez-Angel, L.C., Rodriguez-Parra, L. a, Ramirez, V., Niño, H., 2015. Middle Miocene closure of the Central American Seaway. Science (80-.). 348, 226–229. https://doi.org/10.1126/science.aaa2815

Moore, B.R., Höhna, S., May, M.R., Rannala, B., Huelsenbeck, J.P., 2016. Critically evaluating the theory and performance of Bayesian analysis of macroevolutionary mixtures 1–6. https://doi.org/10.1073/pnas.1518659113

Morlon, H., Lewitus, E., Condamine, F.L., Manceau, M., Clavel, J., Drury, J., 2016. RPANDA: An R package for macroevolutionary analyses on phylogenetic trees. Methods Ecol. Evol. 7, 589–597. https://doi.org/10.1111/2041-210X.12526

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853–858.

Nevado, B., Atchison, G.W., Hughes, C.E., Filatov, D.A., 2016. Widespread adaptive evolution

during repeated evolutionary radiations in New World lupins. Nat. Commun. 7, 1–9. https://doi.org/10.1038/ncomms12384

Neyland, R., Urbatsch, L.E., Pridgeon, A.M., 1995. A Phylogenetic Analysis of Subtribe Pleurothallidinae (Orchidaceae). Bot. J. Linn. Soc. 117, 13–28. https://doi.org/http://dx.doi.org/10.1006/bojl.1995.0002

Nixon, K.C., 1999. The parsimony ratchet, a new method for rapid parsimony analysis. Cladistics 15, 407–414. https://doi.org/10.1006/clad.1999.0121

Nunes, E.L.P., Smidt, E.C., Stützel, T., Coan, A.I., 2014. What do floral anatomy and micromorphology tell us about Neotropical *Bulbophyllum* section *Didactyle* (Orchidaceae: Bulbophyllinae)? Bot. J. Linn. Soc. 175, 438–452. https://doi.org/10.1111/boj.12176

Nunes, E.L.P., Smidt, E.C., Stützel, T., Ike Coan, A., 2015. Comparative floral micromorphology and anatomy of species of Bulbophyllum section Napelli (Orchidaceae), a Neotropical section widely distributed in forest habitats. Bot. J. Linn. Soc. 177, 378–394.

O'Doherty, D., Zoll, J., 2012. *Forcipomyia hardyi* (Diptera: Ceratopogonidae), a Potential Pollinator of Cacao (Theobroma cacao) Flowers in Hawaii, in: Proceedings of the Hawaiian Entomological Society. pp. 79–81.

Oelschlägel, B., Nuss, M., von Tschirnhaus, M., Pätzold, C., Neinhuis, C., Dötterl, S., Wanke, S., 2015. The betrayed thief - the extraordinary strategy of Aristolochia rotunda to deceive its pollinators. New Phytol. 206, 342–351. https://doi.org/10.1111/nph.13210

Ollerton, J., Masinde, S., Meve, U., Picker, M., Whittington, A., 2009. Fly pollination in Ceropegia (Apocynaceae: Asclepiadoideae): biogeographic and phylogenetic perspectives. Ann. Bot. 103, 1501–1514. https://doi.org/10.1093/aob/mcp072

Ossenbach, C., Pupulin, F., Dressler, R.L., 2007. Orquídeas del Istmo Centroamericano: Catálogo y Estado de Conservación/Orchids of the Central American isthmus: Checklist and Conservation Status. Editorial 25 de Mayo, San José.

Pagel, M., 1999. The MaximumLikelihood Approach to Reconstructing Ancestral Character States of Discrete Characters on Phylogenies. Syst. Biol. 48, 612–622.

Pagel, M., 1994. Detecting correlated evolution on phylogenies: a general method for the comparative analysis of discrete characters. Proc. R. Soc. B Biol. Sci. 255, 37–45.

Pagel, M., Meade, A., 2006. Bayesian analysis of correlated evolution of discrete characters by reversible-jump Markov chain Monte Carlo. Am. Nat. 167, 808–825.

Pandey, M., Sharma, J., Taylor, D.L., Yadon, V.L., 2013. A narrowly endemic photosynthetic orchid is non-specific in its mycorrhizal associations. Mol. Ecol. 22, 2341–2354. https://doi.org/10.1111/mec.12249

Pansarin, E.R.A., Pansarin, L.M.B., Martucci, M.E.P.C., 2016. Self-compatibility and specialisation in a fly-pollinated *Acianthera* (Orchidaceae: Pleurothallidiinae). Aust. J. Bot. 64, 359–367.

Pansarin, L.M., De Moraes Castro, M., Sazima, M., 2009. Osmophore and elaiophores of *Grobya amherstiae* (Catasetinae, Orchidaceae) and their relation to pollination. Bot. J. Linn. Soc. 159, 408–415. https://doi.org/10.1111/j.1095-8339.2009.00953.x

Papadopulos, A.S.T., Powell, M.P., Pupulin, F., Warner, J., Hawkins, J. a, Salamin, N., Chittka, L., Williams, N.H., Whitten, W.M., Loader, D., Valente, L.M., Chase, M.W., Savolainen, V., 2013a. Convergent evolution of floral signals underlies the success of Neotropical orchids. Proc. Biol. Sci. 280, 20130960. https://doi.org/10.1098/rspb.2013.0960

Papadopulos, A.S.T., Powell, M.P., Pupulin, F., Warner, J., Hawkins, J.A., Salamin, N., Chittka, L., Williams, N.H., Whitten, W.M., Loader, D., Valente, L.M., Chase, M.W., Savolainen, V., 2013b.

Convergent evolution of floral signals underlies the success of Neotropical orchids. Proc. R. Soc. B Biol. Sci. 280.

Paradis, E., Claude, J., Strimmer, K., 2004. APE: Analyses of phylogenetics and evolution in R language. Bioinformatics 20, 289–290.

Parks, M., Wickett, N., Alverson, A., 2017. Signal, uncertainty, and conflict in phylogenomics data for a diverse lineage of microbial eukaryotes (diatoms, bacillariophyta). Mol. Biol. Evol. https://doi.org/10.1093/molbev/msx268/4460110/Signal-Uncertainty-and-Conflict-in-Phylogenomic

Parra-Sánchez, E., Retana, J., Armenteras, D., 2016. Edge Influence on diversity of orchids in Andean cloud forests. Forests 7, 1–13. https://doi.org/10.3390/f7030063

Pedersen, H., 1995. Anthecological observations on *Dendrochilum longibracteatum*, a species pollinated by facultatively anthophilous insects. Lindleyana 10, 19–28.

Peloso, P.L. V, Frost, D.R., Richards, S.J., Rodrigues, M.T., Donnellan, S., Matsui, M., Raxworthy, C.J., Biju, S.D., Lemmon, E.M., Lemmon, A.R., Wheeler, W.C., 2016. The impact of anchored phylogenomics and taxon sampling on phylogenetic inference in narrow-mouthed frogs (Anura, Microhylidae). Cladistics 32, 113–140. https://doi.org/10.1111/cla.12118

Pennington, R.T., Lavin, M., Särkinen, T., Lewis, G.P., Klitgaard, B.B., Hughes, C.E., 2010. Contrasting plant diversification histories within the Andean biodiversity hotspot. Proc. Natl. Acad. Sci. 107, 13783–13787. https://doi.org/10.1073/pnas.1001317107

Pérez-Escobar, O.A., Balbuena, J.A., Gottschling, M., 2016a. Rumbling Orchids: How to Assess Divergent Evolution between Chloroplast Endosymbionts and the Nuclear Host. Syst. Biol. 65, 51–65. https://doi.org/10.1093/sysbio/syv070

Pérez-Escobar, O.A., Balbuena, J.A., Gottschling, M., 2016. Rumbling Orchids: How to Assess Divergent Evolution between Chloroplast Endosymbionts and the Nuclear Host. Syst. Biol. 65. https://doi.org/10.1093/sysbio/syv070

Pérez-Escobar, O.A., Chomicki, G., Condamine, F.L., Karremans, A.P., Bogarín, D., Matzke, N.J., Silvestro, D., Antonelli, A., 2017a. Recent origin and rapid speciation of Neotropical orchids in the world's richest plant biodiversity hotspot. New Phytol. 215, 891–905.

Pérez-Escobar, O.A., Gottschling, M., Chomicki, G., Condamine, F.L., Klitgaard, B.B., Pansarin, E.R., Gerlach, G., 2017. The improbable journeys of epiphytic plants across the Andes: historical biogeography of *Cycnoches* (Catasetinae, Orchidaceae). BioRxiv 106393. https://doi.org/dx.doi.org/10.1101/106393

Pérez-Escobar, O.A., Gottschling, M., Chomicki, G., Condamine, F.L., Klitgård, B.B., Pansarin, E., Gerlach, G., 2017b. Andean Mountain Building Did not Preclude Dispersal of Lowland Epiphytic Orchids in the Neotropics. Sci. Rep. 7.

Pérez-Escobar, O.A., Gottschling, M., Whitten, W.M., Salazar, G., Gerlach, G., 2016b. Sex and the Catasetinae (Darwin's favourite orchids). Mol. Phylogenet. Evol. 97, 1–10. https://doi.org/10.1016/j.ympev.2015.11.019

Phillips, R.D., Scaccabarozzi, D., Retter, B.A., Hayes, C., Brown, G.R., Dixon, K.W., Peakall, R., 2014. Caught in the act: Pollination of sexually deceptive trap-flowers by fungus gnats in *Pterostylis* (Orchidaceae). Ann. Bot. 113, 629–641. https://doi.org/10.1093/aob/mct295

Pirie, M.D., Chatrou, L.W., Mols, J.B., Erkens, R.H.J., Oosterhof, J., 2006. "Andean-centred" genera in the short-branch clade of Annonaceae: Testing biogeographical hypotheses using phylogeny reconstruction and molecular dating. J. Biogeogr. 33, 31–46.

Plummer, M., Best, N., Cowles, K., Vines, K., 2006. CODA: convergence diagnosis and output analysis for MCMC. R News 6, 7–11. https://doi.org/10.1159/000323281

Policha, T., Davis, A., Barnadas, M., Dentinger, B.T.M., Raguso, R.A., Roy, B.A., 2016. Disentangling visual and olfactory signals in mushroom-mimicking *Dracula* orchids using realistic three-dimensional printed flowers. New Phytol. 210, 1058–1071.

Portik, D.M., Blackburn, D.C., 2016. The evolution of reproductive diversity in Afrobatrachia: A phylogenetic comparative analysis of an extensive radiation of African frogs. Evolution 70, 2017–2032. https://doi.org/10.1111/evo.12997

Pridgeon, A., 2005. Subtribe Pleurothallidinae, in: Genera Orchidacearum Volume 4: Epidendroideae (Part 1). pp. 319–422.

Pridgeon, A.M., 1982. Diagnostic Anatomical Characters in the Pleurothallidinae (Orchidaceae). Am. J. Bot. 69, 921. https://doi.org/10.2307/2442889

Pridgeon, A.M., Chase, M.W., 2001. A phtylogenetic reclassification of the Pleurothallidinae (Orchidaceae). Lindleyana 16, 235–271.

Pridgeon, A.M., Cribb, P., Chase, M.W., Rasmussen, F.N., 2005. Genera Orchidacearum Volume 4: Epidendroideae (Part 1), Genera Orchidacearum. OUP Oxford.

Pridgeon, A.M., Cribb, P.J., Chase, M.W., Rasmussen, F.N., 2009. Genera Orchidacearum: Vol. 5. Epidendroideae (part two). Oxford University Press, Oxford.

Pridgeon, A.M., Solano, R., Chase, M.W., 2001. Phylogenetic relationships in Pleurothallidinae (Orchidaceae): Combined evidence from nuclear and plastid DNA sequences. Am. J. Bot. 88, 2286–2308. https://doi.org/10.2307/3558390

Pridgeon, A.M., Stern, W.L., 1985. Osmophores of *Scaphosepalum* (Orchidaceae). Bot. Gaz. 146, 115–123.

Pridgeon, A.M., Stern, W.L., 1983. Ultrastructure of osmophores in *Restrepia* (Orchidaceae). Am. J. Bot. 70, 1233–1243.

Prouvost, O., Trabalon, M., Papke, M., Schulz, S., 1999. Contact sex signals on web and cuticle of *Tegenaria atrica* (Araneae, Agelenidae). Arch. Insect Biochem. Physiol. 40, 194–202.

Prum, R.O., Berv, J.S., Dornburg, A., Field, D.J., Townsend, J.P., Moriarty Lemmon, E., Lemmon, A.R., 2015. A comprehensive phylogeny of birds (Aves) using targeted next-generation DNA sequencing. Nature 526, 569–573. https://doi.org/10.1038/nature15697

Prychid, C.J., Rudall, P.J., 1999. Calcium Oxalate Crystals in Monocotyledons: A Review of their Structure and Systematics. Ann. Bot. 84, 725–739. https://doi.org/10.1006/anbo.1999.0975

Pupulin, F., 2001. Contributions to a reassessment of Costa Rican Zygopetalinae (Orchidaceae). The genus Kefersteinia Rchb.f. Ann. des Naturhistorischen Museums Wien 103 B, 525–555.

Pupulin, F., Bogarín, D., 2019. *Lepanthes* Sw., in: Pupulin, F. (Ed.), Vanishing Beauty. Native Costa Rica Orchids 2: *Lacaena–Pteroglossa*. Koeltz Botanical Books, Oberreifenberg, Germany, pp. 444–511.

Pupulin, F., Bogarín, D., 2014. Aliae *Lepanthes machogaffenses* (Orchidaceae: Pleurothallidinae). Harvard Pap. Bot. 19, 193–200.

Pupulin, F., Bogarín, D., 2012. *Lepanthes novae tapantienses*. Orchid Dig. 20–29.

Pupulin, F., Bogarín, D., 2009. A New *Oncidium* from Costa Rica. Lindleyana Orchid.

Pupulin, F., Bogarin, D., Karremans, A.P., 2018. How many species of Pleurothallids are there?, in: Pridgeon, A.M. (Ed.), 22nd Proceedings of the World Orchid Conference. Guayaquil, Ecuador, pp. 308–375.

Pupulin, F., Jiménez, D., Bogarín, D., 2009. New species and records in Mesoamerican *Lepanthes*. Orchid Digest. 73: 136–145.

Pupulin, F., Karremans, A.P., Gravendeel, B., 2012. A reconsideration of the empusellous species of *Specklinia* (Orchidaceae: Pleurothallidinae) in Costa Rica. Phytotaxa 63, 1–20.

Pupulin, F., Medina, H., Bogarín, D., 2010. Two *Lepanthes* (Orchidaceae: Pleurothallidinae) with strongly reduced corolla. Orchid. J. 3, 117–121.

Pyron, R.A., Hendry, C.R., Chou, V.M., Lemmon, E.M., Lemmon, A.R., Burbrink, F.T., 2014. Effectiveness of phylogenomic data and coalescent species-tree methods for resolving difficult nodes in the phylogeny of advanced snakes (Serpentes: Caenophidia). Mol. Phylogenet. Evol. 81, 221–231. https://doi.org/10.1016/j.ympev.2014.08.023

Pyron, R.A., Hsieh, F.W., Lemmon, A.R., Lemmon, E.M., Hendry, C.R., 2016. Integrating phylogenomic and morphological data to assess candidate species-delimitation models in brown and red-bellied snakes (Storeria). Zool. J. Linn. Soc. 177, 937–949. https://doi.org/10.1111/zoj.12392

R Core Team, 2017. A language and environment for statistical computing. R Foundation for Statistical Computing.

Rabosky, D.A.L.R., Itchell, J.O.S.M., Hang, J.O.C., 2017. Is BAMM Flawed ? Theoretical and Practical Concerns in the Analysis of Multi-Rate Diversification Models 66, 477–498. https://doi.org/10.1093/sysbio/syx037

Rabosky, D.L., 2014. Automatic detection of key innovations, rate shifts, and diversity-dependence on phylogenetic trees. PLoS One 9. https://doi.org/10.1371/journal.pone.0089543

Rabosky, D.L., Donnellan, S.C., Grundler, M., Lovette, I.J., 2014a. Analysis and visualization of complex macroevolutionary dynamics: an example from Australian scincid lizards. Syst. Biol. 63, 610–627. https://doi.org/10.1093/sysbio/syu025

Rabosky, D.L., Grundler, M., Anderson, C., Title, P., Shi, J.J., Brown, J.W., Huang, H., Larson, J.G., 2014b. BAMMtools: An R package for the analysis of evolutionary dynamics on phylogenetic trees. Methods Ecol. Evol. 5, 701–707. https://doi.org/10.1111/2041-210X.12199

Rambaut, A., 2006. FigTree v.1.4: tree figure drawing tool.

Ramirez, S.R., Eltz, T., Fujiwara, M.K., Gerlach, G., Goldman-Huertas, B., Tsutsui, N.D., Pierce, N.E., 2011. Asynchronous diversification in a specialized plant-pollinator mutualism. Science (80-.). 333, 1742–1746. https://doi.org/10.1126/science.1209175

Ramírez, S.R., Gravendeel, B., Singer, R.B., Marshall, C.R., Pierce, N.E., 2007. Dating the origin of the Orchidaceae from a fossil orchid with its pollinator. Nature 448, 1042–1045.

Ramos-Castro, S.E., Castañeda-Zárate, M., Solano-Gómez, R., Salazar, G.A., 2012. Stelis zootrophionoides (Orchidaceae: Pleurothallidinae), a New Species from Mexico. PLoS One 7. https://doi.org/10.1371/journal.pone.0048822

Ramsey, J., Ripley, B., 2010. pspline: penalized smoothing splines. R Packag. version 1.0. http//CRAN.R-project.org/package=pspline.

Rangel-Ch, J.O., Lowy-C, P.D., Aguilar-P, M., 1997. Distribucion de los tipos de Vegetación en las regiones naturales de Colombia: aproximación inical, in: Rangel-Ch, J.O., Lowy-C, P.D., Aguilar-P, M. (Eds.), Colombia Diversidad Biotica, Volumen II. Instituto de Ciencias Naturales - Universidad Nacional de Colombia, pp. 383–402.

Razzak, M.A., Ali, T., Ali, S.I., 1992. The Pollination Biology of *Aristolochia bracteolata* Lamk (Aristolochiaceae). Pakistan J. Bot. 24, 79–87.

Ree, R.H., Smith, S.A., 2008. Maximum Likelihood Inference of Geographic Range Evolution by Dispersal , Local Extinction , and Cladogenesis. Syst. Biol. 57, 4–14.

Revell, L.J., 2012. phytools: An R package for phylogenetic comparative biology (and other things).

Methods Ecol. Evol. 3, 217–223. https://doi.org/10.1111/j.2041-210X.2011.00169.x

Richter, M., Diertl, K., Emck, P., Peters, T., Beck, E., 2009. Reasons for an outstanding plant diversity in the tropical Andes of Southern Ecuador. Landsc. Online 12, 1–35.

Robinson, D.F., Foulds, L.R., 1981. Comparison of phylogenetic trees. Math. Biosci. 53, 131–147. https://doi.org/10.1016/0025-5564(81)90043-2

Rokyta, D.R., Lemmon, A.R., Margres, M.J., Aronow, K., 2012. The venom-gland transcriptome of the eastern diamondback rattlesnake (*Crotalus adamanteus*). BMC Genomics 13, 1–23. https://doi.org/10.1186/1471-2164-13-312

Ronquist, F., 1997. Dispersal-vicariance analysis: a new approach to the quantification of historical biogeography. Syst. Biol. 46, 195–203.

Ruane, S., Raxworthy, C.J., Lemmon, A.R., Lemmon, E.M., Burbrink, F.T., 2015. Comparing species tree estimation with large anchored phylogenomic and small Sanger-sequenced molecular datasets: an empirical study on Malagasy pseudoxyrhophiine snakes. BMC Evol. Biol. 15, 221. https://doi.org/10.1186/s12862-015-0503-1

Ruzin, S.E., 1999. Plant Microtechnique and Microscopy. Oxford University Press, New York.

Rykaczewski, M., Przemysław, B., Kolanowska, M., 2017. A new species of *Lepanthopsis* (Orchidaceae, Pleurothallidiane) from Peru. Phytotaxa 311, 225–234.

Salguero-Faría, J.A., Ackerman, J.D., 1999. A nectar reward: is more better? Biotropica 31, 303–311. https://doi.org/10.1111/j.1744-7429.1999.tb00142.x

Sanmartín, I., Ree, R.H., 2018. Conceptual and statistical problems with the DEC+J model of founder-event speciation and its comparison with DEC via model selection. J. Biogeogr. 45, 741–749. https://doi.org/10.1111/jbi.13173

Santos, J.C., Coloma, L.A., Summers, K., Caldwell, J.P., Ree, R., Cannatella, D.C., 2009. Amazonian amphibian diversity is primarily derived from late Miocene Andean lineages. PLoS Biol. 7, 0448–0461. https://doi.org/10.1371/journal.pbio.1000056

Sayyari, E., Mirarab, S., 2016. Fast Coalescent-Based Computation of Local Branch Support from Quartet Frequencies. Mol. Biol. Evol. 33, 1654–1668.

Schlechter, R., 1922. *Orchidaceae Powellianae Panamenses*. Repert. Specierum Nov. Regni Veg. Beihefte 17, 1–95.

Schlechter, R., 1913. *Orchidaceae novae et criticae*. Repert. Specierum Nov. Regni Veg. Beihefte 12(317-321, 202–206.

Schliep, K.P., 2011. Phangorn: Phylogenetic analysis in R. Bioinformatics 27, 592–593. https://doi.org/10.1093/bioinformatics/btq706

Schoch, C.L., Sung, G.H., López-Giráldez, F., Townsend, J.P., Miadlikowska, J., Hofstetter, V., Robbertse, B., Matheny, P.B., Kauff, F., Wang, Z., Gueidan, C., Andrie, R.M., Trippe, K., Ciufetti, L.M., Wynns, A., Fraker, E., Hodkinson, B.P., Bonito, G., Groenewald, J.Z., Arzanlou, M., Sybren De Hoog, G., Crous, P.W., Hewitt, D., Pfister, D.H., Peterson, K., Gryzenhout, M., Wingfield, M.J., Aptroot, A., Suh, S.O., Blackwell, M., Hillis, D.M., Griffith, G.W., Castlebury, L.A., Rossman, A.Y., Lumbsch, H.T., Lücking, R., Büdel, B., Rauhut, A., Diederich, P., Ertz, D., Geiser, D.M., Hosaka, K., Inderbitzin, P., Kohlmeyer, J., Volkmann-Kohlmeyer, B., Mostert, L., O'Donnell, K., Sipman, H., Rogers, J.D., Shoemaker, R.A., Sugiyama, J., Summerbell, R.C., Untereiner, W., Johnston, P.R., Stenroos, S., Zuccaro, A., Dyer, P.S., Crittenden, P.D., Cole, M.S., Hansen, K., Trappe, J.M., Yahr, R., Lutzoni, F., Spatafora, J.W., 2009. The ascomycota tree of life: A phylum-wide phylogeny clarifies the origin and evolution of fundamental reproductive and ecological traits. Syst. Biol. 58, 224–239. https://doi.org/10.1093/sysbio/syp020

Schwery, O., Onstein, R.E., Bouchenak-Khelladi, Y., Xing, Y., Carter, R.J., Linder, H.P., 2015. As old as the mountains: the radiations of the Ericaceae. New Phytol. 207, 355–367.

Shaw, T.I., Ruan, Z., Glenn, T.C., Liu, L., 2013. STRAW: Species TRee Analysis Web server. Nucleic Acids Res. 41, 238–241. https://doi.org/10.1093/nar/gkt377

Sheehan, D.C., Hrapchak, B., 1980. Theory and Practice of Histotechnology, Second Edi. ed. Battelle Press, Ohio.

Sikes, D.S., Lewis, P.O., 2001. Beta software, version 1. PAUPRat: PAUP* implementation of the parsimony ratchet.

Simmons, M.P., Gatesy, J., 2015. Coalescence vs. concatenation: Sophisticated analyses vs. first principles applied to rooting the angiosperms. Mol. Phylogenet. Evol. 91, 98–122. https://doi.org/10.1016/j.ympev.2015.05.011

Simpson, G.G., 1953. The major features of evolution. Columbia University Press, New York.

Singer, R.B., 2002. The pollination mechanism in *Trigonidium obtusum* Lindl (Orchidaceae: Maxillariinae): sexual mimicry and trap-flowers. Ann. Bot. 89, 157–163. https://doi.org/10.1093/aob/mcf021

Sivinski, J., Stowe, M., 1980. A Kleptoparasitic Cecidomyiid and Other Flies Associated with Spiders. Psyche (New York) 87, 337–348. https://doi.org/10.1155/1980/27685

Smith, B.T., McCormack, J.E., Cuervo, M., Hickerson, M.J., Aleixo, A., Burney, C.W., Xie, X., Harvey, M.G., Faircloth, B.C., Cadena, C.D., Pe, J., Glenn, T.C., Derryberry, E.P., Prejean, J., Fields, S., Brumfield, R.T., 2014. The drivers of tropical speciation. Nature 515, 406–409. https://doi.org/10.1038/nature13687

Smith, S.A., Moore, M.J., Brown, J.W., Yang, Y., 2015. Analysis of phylogenomic datasets reveals conflict, concordance, and gene duplications with examples from animals and plants. BMC Evol. Biol. 15, 150. https://doi.org/10.1186/s12862-015-0423-0

Smith, S.D., 2010. Using phylogenetics to detect pollinator-mediated floral evolution. New Phytol. 188, 354–363. https://doi.org/10.1111/j.1469-8137.2010.03292.x

Smith, S.D., Ané, C., Baum, D.A., 2008. The role of pollinator shifts in the floral diversification of Iochroma (Solanaceae). Evolution (N. Y). 62, 793–806. https://doi.org/10.1111/j.1558-5646.2008.00327.x

Soltis, P.S., Soltis, D.E., 2016. Ancient WGD events as drivers of key innovations in angiosperms. Curr. Opin. Plant Biol. 30, 159–165. https://doi.org/10.1016/j.pbi.2016.03.015

Southworth, D., 1973. Cytochemical reactivity of pollen walls. J. Histochem. Cytochem. 21, 73–80. https://doi.org/10.1177/21.1.73

Stamatakis, A., 2014. RAxML version 8: A tool for phylogenetic analysis and post-analysis of large phylogenies. Bioinformatics 30, 1312–1313. https://doi.org/10.1093/bioinformatics/btu033

Stamatakis, A., Hoover, P., Rougemont, J., 2008. A rapid bootstrap algorithm for the RAxML web servers. Syst. Biol. 57, 758–771. https://doi.org/10.1080/10635150802429642

Stenzel, H., 2000. Pollen morphology of the subtribe Pleurothallidinae Lindl. (Orchidaceae). Grana 39, 108–125. https://doi.org/10.1080/001731300300045247

Stern, W.W.L., Pridgeon, A., Luer, C., 1985. Stem structure and its bearing on the systematics of Pleurothallidinae (Orchidaceae). Bot. J. Linn. Soc. 91, 457–471. https://doi.org/10.1111/j.1095-8339.1985.tb01015.x

Stpiczyńska, M., Davies, K.L., Kamińska, M., 2015. Diverse labellar secretions in African *Bulbophyllum* (Orchidaceae: Bulbophyllinae) sections *Ptiloglossum*, *Oreonastes* and *Megaclinium*. Bot. J. Linn. Soc. 179, 266–287. https://doi.org/10.1111/boj.12315

Stull, G.W., Schori, M., Soltis, D.E., Soltis, P.S., 2018. Character evolution and missing (morphological) data across *Asteridae*. Am. J. Bot. 105, 1–10. https://doi.org/10.1002/ajb2.1050

Sugawara, R., Muto, T., 1974. Attraction of Several Dipterous Insects to Aliphatic Esters (Diptera : Milichiidae, Chloropidae and Ceratopogonidae). Appl. Entomol. Zool. 9, 11–18.

Sukumaran, J., Knowles, L.L., 2017. Multispecies coalescent delimits structure, not species. Proc. Natl. Acad. Sci. 114, 1607–1612. https://doi.org/10.1073/pnas.1607921114

Sun, M., Soltis, D.E., Soltis, P.S., Zhu, X., Burleigh, J.G., Chen, Z., 2015. Deep phylogenetic incongruence in the angiosperm clade Rosidae. Mol. Phylogenet. Evol. 83, 156–166. https://doi.org/10.1016/j.ympev.2014.11.003

Swofford, D.L., 2002. PAUP. Phylogenetic Analysis Using Parsimony (and other methods).

Talavera, G., Castresana, J., 2007. Improvement of phylogenies after removing divergent and ambiguously aligned blocks from protein sequence alignments. Syst. Biol. 56, 564–577.

Tang, L., Zou, X.H., Zhang, L. Bin, Ge, S., 2015. Multilocus species tree analyses resolve the ancient radiation of the subtribe Zizaniinae (Poaceae). Mol. Phylogenet. Evol. 84, 232–239. https://doi.org/10.1016/j.ympev.2015.01.011

Team, Rs., 2016. RStudio: Integrated Development for R.

ter Steege, H., Pitman, N.C., Sabatier, D., Baraloto, C., Salomão, R.P., Guevara, J.E., Phillips, O.L., Castilho, C. V, Magnusson, W.E., Molino, J.-F., Mendoza, A.M., Nuñez Vargaz, P., Montero, J.C., Feldpausch, T.R., Coronado, E.N.H., Killeen, T.J., Mostacedo, B., Vasquez, R., Assis, R.L., Terborgh, J., Wittmann, F., Andrade, A., Laurence, W.F., Laurence, S.G.W., Marimon, B.S., Jr, B.M., Guimarães, I.C., Amaral, I.L., Brienen, R., Castellanos, H., López, D.C., Duivenvoorden, J.F., Mogollón, H.F., Almeida, F., Dávila, N., García-Villacorta, R., Diaz, P.R., Costa, F., Emilio, T., Levis, C., Schietti, J., Souza, P., Alonso, A., Dallmeier, F., Montoya, A.J., Piedade, F., Araujo-Murakami, A., Arroyo, L., Gribel, R., Fine, P., Peres, C.A., Toledo, M., Aymard, G., Baker, T.R., Cerón, C., Engel, J., Henkel, T.W., Maas, P., Petronelli, P., Stropp, J., Zartman, C.E., Daly, D., Neil, D., Silveira, M., Paredes, M.R., Chave, J., Lima Filho, D., Jørgensen, P.M., Fuentes, A., Schöngart, J., Cornejo Valverde, F., Di Fiore, A., Jimenez, E.M., Mora, M.C., Phillips, J.F., Rivas, G., Andel, T.R. Van, Hildebrand, P. Von, Hoffman, B., Zent, E., Malhi, Y., Prieto, A., Rudas, A., Ruschell, A., Silva, N., Vos, V., Zent, S., Oliveira, A.A., Schutz, A., Gonzalez, T., Nascimento, M., Ramirez-Angulo, H., Sierra, R., Tirado, M., Umaña, M., van der Heijden, G., Vela, C., Vilanova Torre, E., Vriesendorp, C., Wang, O., Young, K., Baider, C., Balslev, H., Ferreira, C., Mesones, I., Torres-Lezama, A., Urrego Giraldo, L.E., Zagt, R., Alexiades, M.N., Hernandez, L., Huamantupa-Chuquimaco, I., Milliken, W., Cuenca, W.P., Pauletto, D., Sandoval, E.H.V., Gamarra, L.V., Dexter, K., Feeley, K., Lopez-Gonzalez, G., Silman, M.R., 2013. Hyperdominance in the Amazonian tree flora. Science (80-.). 342, 325–342.

Than, C., Ruths, D., Nakhleh, L., 2008. PhyloNet: a software package for analyzing and reconstructing reticulate evolutionary relationships. BMC Bioinformatics 9, 322. https://doi.org/10.1186/1471-2105-9-322

Townsend, J.P., 2007. Profiling phylogenetic informativeness. Syst. Biol. 56, 222–231. https://doi.org/10.1080/10635150701311362

Trabalon, M., Assi-Bessekon, D., 2008. Effects of web chemical signatures on intraspecific recognition in a subsocial spider, *Coelotes terrestris* (Araneae). Anim. Behav. 76, 1571–1578. https://doi.org/10.1016/j.anbehav.2008.07.015

Tremblay, R.L., Ackerman, J.D., 2001. Gene flow and effective population size in *Lepanthes* (Orchidaceae): a case for genetic drift. Biol. J. Linn. Soc. 72, 47–62. https://doi.org/10.1006/bijl.2000.0485

Tremblay, R.L., Ackerman, J.D., Zimmerman, J.K., Calvo, R.N., 2005. Variation in sexual reproduction

in orchids and its evolutionary consequences: a spasmodic journey to diversification. Bot. J. Linn. Soc. 84, 1–54.

Tsutsumi, C., Chen, C.-W., Larsson, A., Hirayama, Y., Kato, M., 2016. Phylogeny and classification of Davalliaceae on the basis of chloroplast and nuclear markers. Taxon 65, 1236–1248.

Ulloa, C.U., Acevedo-rodríguez, P., Beck, S., Belgrano, M.J., Bernal, R., Berry, P.E., Brako, L., Celis, M., Davidse, G., León-yánez, S., Magill, R.E., Neill, D.A., Nee, M., Raven, P.H., Stimmel, H., Strong, M.T., Villaseñor, J.L., Zarucchi, J.L., Zuloaga, F.O., Jørgensen, P.M., 2017. An integrated assessment of the vascular plant species of the Americas. Science (80-.). 358, 1614–1617.

Uribe-Convers, S., Tank, D.C., 2015. Shifts in diversification rates linked to biogeographic movement into new areas: An example of a recent radiation in the Andes. Am. J. Bot. 102, 1–16. https://doi.org/10.3732/ajb.1500229

Vaidya, G., Lohman, D.J., Meier, R., 2011. SequenceMatrix: Concatenation software for the fast assembly of multi-gene datasets with character set and codon information. Cladistics 27, 171–180. https://doi.org/10.1111/j.1096-0031.2010.00329.x

Valencia, R., Balslev, H., Miño C, G., 1994. High tree alpha-diversity in Amazonian Ecuador. Biodivers. Conserv. 3, 21–28.

Valente, L.M., Manning, J.C., Goldblatt, P., Vargas, P., 2012. Did Pollination Shifts Drive Diversification in Southern African Gladiolus? Evaluating the Model of Pollinator-Driven Speciation. Am. Nat. 180, 83–98. https://doi.org/10.1086/666003

van der Cingel, N.., 2001. An atlas of orchid pollination: America, Africa, Asia and Australia. Balkema Publishers, Rotterdam.

Van der Niet, T., Johnson, S.D., 2012. Phylogenetic evidence for pollinator-driven diversification of angiosperms. Trends Ecol. Evol. 27, 353–361. https://doi.org/10.1016/j.tree.2012.02.002

Vargas, P., Zardoya, R., 2014. The tree of life. Sinauer Associates, Sunderland.

Verboom, G.A., Archibald, J.K., Bakker, F.T., Bellstedt, D.U., Conrad, F., Dreyer, L., Forest, F., Galley, C., Goldblatt, P., Henning, J., Mummenhoff, K., Linder, H.P., Muasya, A.M., Oberlander, K., Savolainen, V., Snijman, D., van der Niet, T., Nowell, T., 2009. Origin and diversification of the Greater Cape flora: ancient species repository, hot-bed of recent radiation, or both? Mol. Phylogenet. Evol. 51, 44–53. https://doi.org/10.1016/j.ympev.2008.01.037

Vogel, S., 2001. Flickering bodies: Floral attraction by movement. Beitraege zur Biol. der Pflanz. 72, 89–154.

Vogel, S., 1990. The role of scent glands in pollination: on the structure and function of osmophores. Amerind, New Delhi.

von Hagen, K.B., Kadereit, J.W., 2003. The diversification of *Halenia* (Gentianaceae): ecological opportunity versus key innovation. Evolution (N. Y). 57, 2507–2518.

Wagner, C.E., Keller, I., Wittwer, S., Selz, O.M., Mwaiko, S., Greuter, L., Sivasundar, A., Seehausen, O., 2013. Genome-wide RAD sequence data provide unprecedented resolution of species boundaries and relationships in the Lake Victoria cichlid adaptive radiation. Mol. Ecol. 22, 787–798.

Wanke, S., Granados Mendoza, C., Müller, S., Paizanni Guillén, A., Neinhuis, C., Lemmon, A.R., Lemmon, E.M., Samain, M.S. 2017. Recalcitrant deep and shallow nodes in *Aristolochia* (Aristolochiaceae) illuminated using anchored hybrid enrichment. Mol. Phylogenet. Evol. 117, 111–123. https://doi.org/10.1016/j.ympev.2017.05.014

Wati, R.K., van Vugt, R.R., Gravendeel, B., 2018. A Linnaeus NG interactive key to the species of *Glomera* (Orchidaceae, Coelogyninae) from Southeast Asia. PhytoKeys 110, 9–22.

Whitten, W.M., Neubig, K.M., Williams, N.H., 2014. Generic and subtribal relationships in neotropical Cymbidieae (Orchidaceae) based on matk/ycf1 plastid data. Lankesteriana 13, 375–392. https://doi.org/10.15517/lank.v13i3.14425

Wilkinson, J.D., Daugherty, D.M., 1970. The Biology and Immature Stages of *Bradysia impatiens* (Diptera: Sciaridae). Ann. Entomol. Soc. Am. 63, 656–660. https://doi.org/10.1093/aesa/63.3.656

Williams, G., Adam, P., 2010. The Flowering of Australia's Rainforests: A Plant and Pollination Miscellany, CSIRO Publ. ed. CSIRO Publishing.

Williams, L.O., 1946. Flora of Panama Part III. Fascicle 2. 98, 242–244. https://doi.org/10.1017/S0032247400052736

Willis, J.C., 1922. Age and area. Cambridge University Press, London.

Wilson, M., Frank, G.S., Jost, L., Pridgeon, A.M., Vieira-Uribe, S., Karremans, A.P., 2017. Phylogenetic analysis of *Andinia* (Pleurothallidinae; Orchidaceae) and a systematic re-circumscription of the genus. Phytotaxa 295, 101–131.

Winder, J.A., 1978. The role of non-dipterous insects in the pollination of cocoa in Brazil. Bull. Entomol. Res. 68, 559–574. https://doi.org/10.1017/S0007485300009536

Woodcock, T.S., Larson, B.M.H., Kevan, P.G., Inouye, D.W., Lunau, K., 2014. Flies and flowers II: floral attractants and rewards. J. Pollinat. Ecol. 12, 63–94. https://doi.org/10.2307/2992015

Xi, Z., Liu, L., Davis, C.C., 2015. Genes with minimal phylogenetic information are problematic for coalescent analyses when gene tree estimation is biased. Mol. Phylogenet. Evol. 92, 63–71. https://doi.org/10.1016/j.ympev.2015.06.009

Yang, Z., Kumar, S., Nei, M., 1995. A new method of inference of ancestral nucleotide and amino acid sequences. Genetics 141, 1641–1650. https://doi.org/8601501

Yang, Z., Rannala, B., 2010. Bayesian species delimitation using multilocus sequence data. Proc. Natl. Acad. Sci. Natl. Acad. Sci. 107, 1–6. https://doi.org/10.1073/pnas.0913022107

Young, A.M., Severson, D.W., 1994. Comparative analysis of steam distilled floral oils of cacao cultivars (*Theobroma cacao* L., Sterculiaceae) and attraction of flying insects: Implications for a Theobroma pollination syndrome. J. Chem. Ecol. 20, 2687–2703. https://doi.org/10.1007/BF02036201

Yu, G., Smith, D.K., Zhu, H., Guan, Y., Lam, T.T.Y., 2017. Ggtree: an R Package for Visualization and Annotation of Phylogenetic Trees With Their Covariates and Other Associated Data. Methods Ecol. Evol. 8, 28–36. https://doi.org/10.1111/2041-210X.12628

Yu, W.-B., Huang, P.-H., Li, D.-Z., Wang, H., Aphay, S.L., Chase, M., 2013. Incongruence between Nuclear and Chloroplast DNA Phylogenies in *Pedicularis* Section *Cyathophora* (Orobanchaceae). PLoS One 8, e74828. https://doi.org/10.1371/journal.pone.0074828

Yu, Y., Dong, J., Liu, K.J., Nakhleh, L., 2014. Maximum likelihood inference of reticulate evolutionary histories. Proc. Natl. Acad. Sci. 111, 16448–16453. https://doi.org/10.1073/pnas.1407950111

Zhang, G.-Q., Xu, Q., Bian, C., Tsai, W.-C., Yeh, C.-M., Liu, K.-W., Yoshida, K., Zhang, L.-S., Chang, S.-B., Chen, F., Shi, Y., Su, Y.-Y., Zhang, Y.-Q., Chen, L.-J., Yin, Y., Lin, M., Huang, H., Deng, H., Wang, Z.-W., Zhu, S.-L., Zhao, X., Deng, C., Niu, S.-C., Huang, J., Wang, M., Liu, G.-H., Yang, H.-J., Xiao, X.-J., Hsiao, Y.-Y., Wu, W.-L., Chen, Y.-Y., Mitsuda, N., Ohme-Takagi, M., Luo, Y.-B., Van de Peer, Y., Liu, Z.-J., 2016. The Dendrobium catenatum Lindl. genome sequence provides insights into polysaccharide synthase, floral development and adaptive evolution. Sci. Rep. 6, 19029. https://doi.org/10.1038/srep19029

Zotz, G., Winkler, U., 2013. Aerial roots of epiphytic orchids: The velamen radicum and its role in water and nutrient uptake. Oecologia 171, 733–741. https://doi.org/10.1007/s00442-012-2575-6.

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Curriculum Vitae

Diego G. Bogarín Chaves was born on October 15th, 1982, in San José, Costa Rica, and grew up in Heredia Province. During his childhood at age 10, he developed a strong interest in orchids. Each family trip was a means to explore the rich Costa Rican ecosystems in search of different orchids species. At 12, he followed a free course "Introduction to Orchidology" at the National University of Costa Rica. After completing his secondary studies at Liceo Samuel Sáenz Flores in Heredia, his growing interest in orchids led him to study biology at the University of Costa Rica, where he obtained his B.Sc. degree in 2006. In 2001 during his studies, he became involved at the Lankester Botanical Garden (JBL), first, as a volunteer and, later, as an assistant of research in the systematic orchid projects led by his mentor and great friend, Franco Pupulin. With Franco, he witnessed the beginnings of the transformation of the JBL into an active orchid research center in the Neotropics. With the main goal of documenting the vast orchid flora of Costa Rica, Diego learned from his mentor the capacity of studying orchid species scientifically. This is why he contributed to several floristic and monographic research projects, describing more than 80 species of Neotropical orchids to date in approximately 90 scientific articles. During this time, Diego also supported new students, conducted extensive fieldwork, and was in charge of the orchid collections until the establishment of the JBL herbarium.

Since August 2005, the University of Costa Rica hired Diego as a researcher based at Lankester Botanical Garden. He first worked on the project "Conservation and Monitoring of Mesoamerican Orchids" in collaboration with the Royal Botanic Gardens, Kew, UK, where he participated in the development of DNA barcodes for Costa Rican orchids at the Jodrell Laboratory and digitized part of the orchid herbarium types at Kew. Later, in 2010, he completed his M.Sc. degree at the UCR under the supervision of Dr. Robert L. Dressler on systematics of the orchid genus *Campylocentrum*. In 2012, Diego met his co-promotor, Dr. Barbara Gravendeel, who visited JBL as part of the research activities of Adam Karremans' Ph.D. project. At that time, Dr. Gravendeel encouraged him to apply for a doctorate under her supervision to study the evolution of the species-rich genus *Lepanthes*. After obtaining a scholarship from the University of Costa Rica, Diego traveled to the Netherlands in September 2015 to begin his Ph.D. project at Naturalis Biodiversity Center and Leiden University under the supervision of Dr. Gravendeel and Dr. Erik Smets. After obtaining his doctorate, Diego will continue to work as a researcher at JBL and take charge of the chair of orchidology at the School of Biology of UCR. His main future research projects will be focused on the biotic and abiotic factors that shaped the rich orchid flora of southern Central America by applying bioinformatics, genomics, next-generation sequencing, taxonomy, and systematics. Diego is also interested in orchid in-situ conservation and the development of a research center at the herbarium UCH, at the Autonomous University of Chiriquí, Panama, where he is a Research Associate.

List of publications

Bogarín, D., E. Kaes, M. Díaz-Morales. 2019. *Lepanthes elusiva* – a New Species of *Lepanthes* (Orchidaceae: Pleurothallidinae) from Tapantí Area in Cartago, Costa Rica. Die Orchidee 5(3): 19-28.

Bogarín, D., M. Fernández, A. Borkent, A. Heemskerk, F. Pupulin, S. Ramírez, E. Smets & B. Gravendeel. 2018. Pollination of *Trichosalpinx* (Orchidaceae: Pleurothallidinae) by biting midges (Diptera: Ceratopogonidae). Botanical Journal of the Linnean Society 186: 510–543.

Bogarín, D., Fernández, F., Karremans, A.P., Pupulin, F., Smets, E. & Gravendeel, B. 2018. Floral anatomy and evolution of pollination syndromes in *Lepanthes* and close relatives. In A. M. Pridgeon (Ed.), 22nd Proceedings of the World Orchid Conference (pp. 396–410).

Pupulin, F., **Bogarín, D.,** Karremans, A.P., 2018. How many species of Pleurothallids are there?, in: Pridgeon, A.M. (Ed.), 22nd Proceedings of the World Orchid Conference. Guayaquil, Ecuador, pp. 308–375.

Bogarín, D., A. Karremans & M. Fernández. 2018. Genus-level taxonomical changes in the *Lepanthes* affinity (Orchidaceae, Pleurothallidinae). Phytotaxa 340(2): 128–136.

Bogarín, D., Pérez-Escobar, O.A., Groenenberg, D., Holland. S.D., Karremans, A.P., Lemmon, E.M., Lemmon, A.R., Pupulin, F., Smets, E. & Gravendeel, B. 2018. Anchored hybrid enrichment generated nuclear, plastid and mitochondrial markers resolve the *Lepanthes horrida* (Orchidaceae: Pleurothallidinae) species complex. Molecular Phylogenetics and Evolution 129: 27–47.

Bogarín, D., Z. Serracín & Z. Samudio. 2018. A new *Maxillariella* (Orchidaceae: Maxillariinae) from Costa Rica and Panama. Brittonia DOI 10.1007/s12228-018-9542-4.

Gravendeel, B., **D. Bogarín**, A. Dirks-Mulder, R.K. Wati & D. Pramanik. 2018. The orchid genomic toolkit. In: Proceedings of the 18th EOCCE - What future for orchids?, pp. 72–76. Cahiers De La Société Française D'orchidophilie 9: 73-77.

Pessoa, E. M., Viruel, J., Alves, M., **Bogarín, D.,** Whitten, W. M., & Chase, M. W. 2018. Evolutionary history and systematics of *Campylocentrum* (Orchidaceae: Vandeae: Angraecinae): a phylogenetic and biogeographical approach. Botanical Journal of the Linnean Society 186. 158–178.

Zambrano Romero, B.J., **D. Bogarín** & R. Solano-Gómez. 2018. *Telipogon sonia-juaniorum* (Orchidaceae: Oncidiinae) a new species from Southwestern Ecuador. Phytotaxa 340(2): 167–174.

Bogarín, D., L. Oses & C.M. Smith. 2017. *Masdevallia luerorum* (Orchidaceae: Pleurothallidinae), a new species from Costa Rica. Lankesteriana 17(2): 235–244.

Karremans A.P. & **D. Bogarín**. 2017. Two novelties in genus *Platystele* (Orchidaceae: Pleurothallidinae) from Costa Rica. Lankesteriana 17(2): 215–221.

Pérez-Escobar, O.A., G. Chomicki, F.L. Condamine, A.P. Karremans, **D. Bogarín**, N.J. Matzke, D. Silvestro & A. Antonelli. 2017. Recent origin and rapid speciation of Neotropical orchids in the world's richest plant biodiversity hotspot. New Phytologist 215: 891–905.

Bogarín, D., Z. Serracín & M. Fernández. 2017. *Lepanthes aures-ursinae* and *L. vertebrata* spp. nov. (Orchidaceae: Pleurothallidinae) from Panama. Nordic Journal of Botany 36(1-2): 1–8.

Karremans, A.P., **D. Bogarín**, M. Díaz-Morales, M. Fernández, L. Oses & F. Pupulin. 2016. Phylogenetic reassessment of *Acianthera* (Orchidaceae: Pleurothallidinae). Harvard Papers in Botany 21(2): 171–187.

Pupulin, F., **D. Bogarín**, M. Fernández, M. Díaz-Morales, J. Aguilar & C. Ossenbach. 2016. Orchidaceae Tonduzianae: typification of Costa Rican Orchidaceae described from collections of Adolphe Tonduz. Harvard Papers in Botany 21(2): 263–320.

Karremans, A.P. Albertazzi, F., Bakker, F.T., **D. Bogarín**, M. Eurlings, A. Pridgeon, F. Pupulin & B. Gravendeel. 2016. Phylogenetic reassessment of *Specklinia* and its allied genera in the Pleurothallidinae (Orchidaceae). Phytotaxa 272(1): Doi: http://dx.doi.org/10.11646/phytotaxa.272.1.1

Bogarín, D., F, Pupulin, E. Smets & B. Gravendeel. 2016. Evolutionary diversification and historical biogeography of the Orchidaceae in Central America with emphasis on Costa Rica and Panama. Proceedings of the V Scientific Conference on Andean Orchids, Cali, Colombia, Pontificia Universidad Javeriana. Lankesteriana 16(2): 189-200.

Serracín, Z., J.S.Harrison, **D. Bogarín** & L.Sánchez. 2016. *Epidendrum adsettii* Serracín, J.S.Harrison, Bogarín et L.Sánchez, sp. nov. Icon. Orchid. (Mexico) 15(2): t. 1569.

Vieira-Uribe, S. & **D. Bogarín**. 2016. Una hermosa nueva especie de *Masdevallia* (Pleurothallidinae: Orchidaceae) de los Andes centrales de Colombia. Orquideología XXXIII-1: 14-19.

Bogarín, D., & A.P. Karremans. 2016. A new *Brachionidium* (Orchidaceae: Pleurothallidinae) from the first botanical expedition to the Volcán Cacho Negro, Costa Rica. Systematic Botany 41(4): 919–923.

Bogarín, D., F. Pupulin & S. Strigari. 2016. The New Refugium Botanicum. *Lycaste bruncana*. Orchids (Bull. Amer. Orch. Soc.) 85(2): 94–96.

Ortiz-Valdivieso, P., P. Viveros, C.A. Luer, M. Celis, E. Hágsater, M. Blanco, H.C. Dueñas, G. Gerlach, C. van der Berg, G. Carnevali Fernández-Concha, G. Giraldo, **D. Bogarín**, H.F. Oakeley, G. Romero-González, C.L. Leopardi-Verde, E. Noguera-Savelli, W. Cetzal, R. Bernal, E.C. Smidt, L.N. Peraza & R. Balam-Narváez 2016-05-24. ORCHIDACEAE. *In* Bernal, R., S.R. Gradstein & M. Celis (eds.). 2015. Catálogo de plantas y líquenes de Colombia. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá.

Bogarín, D., 2015. A New *Campylocentrum* from Parque Internacional La Amistad, Costa Rica. Novon 24(2):120-125.

Bogarín, D., A.P. Karremans & M. Muñoz García. 2015. *Brachionidium kirbyi*, eine neue Art zu Ehren des Gründers des Orchideenprojektes „Bosque de Paz" in Costa Rica. Die Orchidee 66(5): 404-409.

Karremans, A.P., **D. Bogarín**, F. Pupulin, C.A. Luer & B. Gravendeel. 2015. The glandulous *Specklinia*: morphological convergence versus phylogenetic divergence. Phytotaxa 218(2): 101–127.

Pupulin, F. **D. Bogarín** & S. Strigari. 2015. The New Refugium Botanicum. *Teuscheria horichiana*. Lindleyana in Orchids (Bull. Amer. Orch. Soc.) 84(7): 410–440.

Bogarín, D., & D. Jiménez. 2015. *Lepanthes Novae Durikaenses*. Orchids (Bull. Amer. Orch. Soc.) 84(7): 396–398.

Karremans, A.P., **D. Bogarín** & B. Gravendeel. 2015. *Specklinia lugduno-batavae* (Pleurothallidinae: Orchidaceae), a new species in the *S. digitalis* group. Blumea 59:180-184.

Smith, C. M., **D. Bogarín** & F. Pupulin. 2015. A New *Reichantha* (Orchidaceae: Pleurothallidinae) from Nicaragua and Costa Rica. Systematic Botany 40(1): 83–87.

Bogarín, D., & A.P. Karremans. 2015. *Prosthechea tinukiana* (Orchidaceae: Laeliinae): an update of the *Prosthechea prismatocarpa* complex. Turkish Journal of Botany 39: 499-505.

Igea, J., **D. Bogarín**, A.S.T. Papadopulos & V. Savolainen. 2015. A comparative analysis of island floras challenges taxonomy-based biogeographical models of speciation. Evolution 69: 482–491. **Bogarín, D.,** Z. Serracín, Z. Samudio, R. Rincón & F. Pupulin. 2014. An updated checklist of the Orchidaceae of Panama. Lankesteriana 14(3): 135-364.

Bogarín, D., Z. Serracín, Z. Samudio, R. Rincón & F. Pupulin. 2014. Un listado actualizado de las Orchidaceae de Panamá. Lankesteriana 14(3) Supplement: 1-31.

Pupulin, F. & **D. Bogarín**. 2014. *Aliae Lepanthes Machogaffenses* (Orchidaceae: Pleurothallidinae). Harvard Papers in Botany 19(2): 193–200.

Pupulin, F. & **D. Bogarín**. 2014. Illustrations and studies in Neotropical Orchidaceae. 6. The *Lepanthes guatemalensis* group (Pleurothallidinae) in Costa Rica. An. Jard. Bot. Madrid 71(1): 1-17.

Bogarín, D., & Y. Kisel. 2014. A new *Lepanthes* from Costa Rica. Orchid Review 122(1305): 28–31.

Bogarín, D., Z. Serracín & Z. Samudio. 2014. Illustrations and studies in Neotropical Orchidaceae. The *Specklinia condylata* group (Orchidaceae) in Costa Rica and Panama. Lankesteriana 13(3): 185-206.

Fernández, M., **D. Bogarín**, A.P. Karremans & D. Jiménez. 2014. New species and records of Orchidaceae from Costa Rica III. Lankesteriana 13(3): 259-282.

Bogarín, D., A.P. Karremans, R. Rincón & B. Gravendeel. 2013. A new *Specklinia* (Orchidaceae: Pleurothallidinae) from Costa Rica and Panama. Phytotaxa 115(2): 31–41.

Karremans, A.P. & **D. Bogarín**. 2013. Three new species of *Dracontia* (Pleurothallidinae, Orchidaceae) from Costa Rica. Systematic Botany 38(2): 307–315.

Karremans, A.P. & **D. Bogarín**. 2013. Costa Rica, land of endless orchids. Orchids (West Palm Beach) 82(7): 408–411.

Bogarín, D., F. Pupulin, C. Arrocha & Jorge Warner. 2013. Orchids without borders: studying the hotspot of Costa Rica and Panama. P. 13–26 *in* A. Pridgeon, ed., Proceedings of the Fourth Scientific Conference of Andean Orchids. Lankesteriana 13(1–2): 1–154.

Fernández, M. & **D. Bogarín**. 2013. A new species of *Trichosalpinx* (Orchidaceae: Pleurothallidinae) from Costa Rica. Brittonia 65(1): 96–101.

Bogarín, D., & A. P. Karremans. 2013. *Trichocentrum pupulinianum* (Orchidaceae), a new species from Costa Rica and Panama. Orchids (West Palm Beach) 82(2): 106–110.

Pupulin, F. & **D. Bogarín**. 2013. Species from the dry side. Looking for orchids where you least expect them. Orchids (West Palm Beach) 82(1): 18–27.

Bogarín, D., C.M. Smith & D. Jiménez. 2012. Illustrations and studies in Neotropical Orchidaceae. 5. The *Lepanthes ovalis* group (Pleurothallidinae) with three new species from Costa Rica. Journal of the Botanical Research Institute of Texas 6(2): 361–373.

Bogarín, D., 2012. A new *Telipogon* from Mexico close to *Telipogon standleyi* (Orchidaceae: Oncidiinae). Lankesteriana 12(2): 115–119.

Bogarín, D., F. Pupulin & A.P. Karremans. 2012. Three New *Lepanthes* (Orchidaceae: Pleurothallidinae) from South-East Costa Rica. Lankesteriana 12(2): 107–114.

Kisel, Y., A. C. Moreno-Letelier, **D. Bogarín**, M. P. Powell, M. W. Chase, T. G. Barraclough. 2012. Testing the link between population genetic differentiation and clade diversification in Costa Rican orchids. Evolution 66–10: 3035–3052.

Karremans, A.K., **D. Bogarín**, M. Fernández, C. Smith & M. Blanco. 2012. New species and records of Orchidaceae from Costa Rica II. Lankesteriana 12(1): 19–51.

Pupulin, F & **D. Bogarín**. 2012. A taxonomic revision of *Encyclia* (Orchidaceae: Laeliinae) in Costa Rica. Botanical Journal of the Linnean Society. Soc. 168: 395–448.

Pupulin, F. & **D. Bogarín**. 2012. A new *Oncidium* from Costa Rica. Lindleyana in Orchids, Bull. Amer. Orch. Soc. 81(3): 176–179.

Pupulin, F. & **D. Bogarín**. 2012. *Lepanthes novae Tapantienses*. Orchid Digest 76(1): 20–29.

Fernández, M. & **D. Bogarín**. 2011. A new *Trichosalpinx* (Orchidaceae: Pleurothallidinae) from the northern Pacific lowlands of Costa Rica. Phytotaxa 38: 41–48.

Bogarín, D., 2011. How many orchid species in Costa Rica? a review of the latest discoveries. Pages 1--371 in A. Pridgeon & H. Navarrete, eds., Proceedings of the Third Scientific Conference of Andean Orchids. Lankesteriana 11(3): 185–206.

Pupulin, F. & **D. Bogarín**. 2011. Of greenish *Encyclia*: natural variation, taxonomy, cleistogamy, and a comment on DNA barcoding. Pp. 1–371 *in* A. Pridgeon & H. Navarrete, eds., Proceedings of the Third Scientific Conference of Andean Orchids. Lankesteriana 11(3): 235–336.

Pupulin, F. & **D. Bogarín**. 2011. Eine neue, großblütige *Lepanthes*-Art aus Costa Rica. A new, large-flowered species of *Lepanthes* from Costa Rica. Die Orchidee (Hamburg) 62(6): 469–477.

Karremans, A.P. & **D. Bogarín**. 2011. *Pleurothallis adventurae* (Orchidaceae: Pleurothallidinae), eine neue Art aus einer unerforschten Region in Costa Rica. Orchideen J. 18(3): 111–114.

Dressler, R.L. & **D. Bogarín**. 2011. *Sobralia sanctorum* and *Sobralia purpurella*: two elusive lost species are found. Lindleyana in Orchids, Bull. Amer. Orch. Soc. 80(5): 307–310.

Bogarín, D. & F. Pupulin. 2011. *Lepanthes daniel-jimenezii* (Pleurothallidinae: Orchidaceae), a new species from Costa Rica close to *Lepanthes guardiana*. Die Orchidee (Hamburg) 62(2): 111–115.

Bogarín, D., J. Warner, M. Powell & V. Savolainen. 2011. The orchid flora of Cocos Island National Park, Puntarenas, Costa Rica. Botanical Journal of the Linnean Society 166(1): 20–39.

Pupulin, F. & **D. Bogarín**. 2011. Two new *Lepanthes* from Costa Rica. Lindleyana in Orchids, Bull. Amer. Orch. Soc. 80(3): 169–181.

Russell, A. R. Samuel, V. Klejna, **D. Bogarín**, S. Fernando, M.W. Chase. 2011. Genetic variation and phylogenetic relationships of a pantropical *Polystachya* (Orchidaceae) species group. Botanical Journal of the Linnean Society 165(3): 235–250.

Bogarín, D. & F. Pupulin. 2010. The genus *Campylocentrum* (Orchidaceae: Angraecinae) in Costa Rica: a review. Harvard Papers in Botany 15(2): 353–414.

Pupulin, F, **D. Bogarín** & M. Fernández. 2010. A note on *Pleurothallis luctuosa* (Orchidaceae: Pleurothallidinae), with a new species. Ann. Naturhist. Mus. Wien. B, 112: 239–252.

Bogarín, D. & A. Karremans. 2010. A new *Platystele* (Orchidaceae: Pleurothallidine) from Central Costa Rica. Orquideología XXVII(2): 208–220.

Pupulin, F., H. Medina & **D. Bogarín**. 2010. Two *Lepanthes* (Orchidaceae: Pleurothallidinae) with strongly reduced corolla. Orchideen Journal. 17(3): 117–121.

Pupulin, F & **D. Bogarín**. 2010. Illustrations and studies in Neotropical Orchidaceae. 1. The *Lepanthes jimenezii* group (Pleurothallidinae). Harvard Papers in Botany 15(1): 111–121

Bogarín, D. & F. Pupulin. 2010. Two new species of *Mormolyca* from Costa Rica and Panama. Orchid Digest 74(1): 43-47.

Bogarín, D. & M. Fernández. 2010. *Lepanthes arenasiana* (Pleurothallidinae: Orchidaceae), a new species from Costa Rica. Lankesteriana 9(3): 487–489.

Dressler, R.L. & **D. Bogarín**. 2010. Some new Sobraliae from Costa Rica and Panama. Lankesteriana 9(3): 475–485.

Pupulin, F, **D. Bogarín** & C. Smith. 2010. Two new species of *Lepanthes* from Costa Rica close to *L. schizocardia* (Orchidaceae: Pleurothallidinae). Lankesteriana 9(3): 423–430.

Pupulin, F, **D. Bogarín** & M. Fernández. 2010. On the identity of *Myoxanthus scandens* (Orchidaceae: Pleurothallidinae), with a new species from Costa Rica. Lankesteriana 9(3): 467–473.

Hollingsworth, P., L. Forrest , J. Spouge , M. Hajibabaei, S. Ratnasingham , M. van der Bank , M. Chase , R. Cowan, D. Erickson , A. Fazekas , S. Graham, K James KE , K-J Kim , W. J. Kress, H. Schneider, J. van Alphen Stahl , S. Barrett, C van den Berg, **D. Bogarín** , K Burgess, K Cameron,

M. Carine, J. Chacón, A. Clark, J. Clarkson, F Conrad , D. Devey , C. Ford , T. Hedderson , M. Hollingsworth , B. Husband , L. Kelly , P. Kesanakurti, J. Kim, Y. Kim, R. Lahaye , H-L Lee, D. Long , S. Madriñán, O. Maurin , I Meusnier, S Newmaster, C-W Park , D. Percy , G Petersen , J. Richardson , G. Salazar , V. Savolainen, O Seberg, M. Wilkinson, D-K Yi, D. Little. 2009. *A DNA barcode for land plants*. Proc Natl Acad Sci USA. 106(31): 12794–12797.

Dressler, R.L. & **D. Bogarín**. 2009. Der *Trichopilia tortilis* komplex (Orchidaceae: Oncidiinae) mit einer schwierig zu bestimmenden neuen art. The *Trichopilia tortilis* complex (Orchidaceae: Oncidiinae) with an elusive new species. Orchideen Journal 60(2): 56–65.

Pupulin, F., **D. Bogarín** & D. Jiménez. 2009. New species and records in Mesoamerican *Lepanthes*. Orchid Digest. 73: 136–145.

Bogarín, D., & F. Pupulin. 2009. The genus *Campylocentrum* (Orchidaceae: Angraecinae) in Costa Rica: some critical questions and a few answers. Pp 32–45, *in* Pridgeon, A & J. P. Suárez. eds. Proceedings of the Second Scientific Conference on Andean Orchids. Universidad Técnica Particular de Loja, Loja, Ecuador.

Blanco, M.A., G. Carnevali, **D. Bogarín**, & R. B. Singer. 2008. Further disentangling of a taxonomic puzzle: *Maxillaria ramosa*, *Ornithidium pendulum*, and a new species, *O. elianae* (Orchidaceae). Harvard Papers in Botany 13(1): 137–154.

Bogarín, D., A. Karremans & F. Pupulin. 2008. New species and records of Orchidaceae from Costa Rica. Lankesteriana 8(2) 53–74.

Bogarín, D., F. Pupulin & H. Medina. 2008. A new *Rodriguezia* (Orchidaceae: Oncidiinae) from Ecuador. Orchids, Mag. Amer. Orchid Soc. in Lindleyana 21(2): 15–18.

Lahaye, R., M. van der Bank, **D. Bogarín**, J. Warner, F. Pupulin, G. Gigot, O. Maurin, S. Duthoit, T. Barraclough & V. Savolainen. 2008. DNA Barcoding the Floras of Biodiversity Hotspots. Proc Natl Acad Sci USA 105:2923–2928.

Bogarín, D., 2007. A new *Lycaste* (Orchidaceae: Maxillarieae) from Costa Rica. Lankesteriana 7(3): 543–549.

Dressler, R.L. & **D. Bogarín**. 2007. *Elleanthus ligularis*, a name for a relatively common "new" species of *Elleanthus* Sect. *Chloidelyna*. Lankesteriana 7(3) : 539–542.

Pupulin, F. & **D. Bogarín**. 2007. A second new species in the genus *Restrepiella* (Orchidaceae:Pleurothallidinae). Willdenowia 37: 323–329.

Dressler, R.L. & **D. Bogarín**. 2007. Two attractive new species of *Sobralia* from Panama. Orchids 76 (9): 696–701.

Dressler, R.L. & **D. Bogarín**. 2007. A new and bizarre species in the genus *Condylago* (Orchidaceae: Pleurothallidinae) from Panama. Harvard Papers in Botany 12 (1): 1–5.

Gigot, G., J. Van Alphen-Stahl, **D. Bogarín**, J. Warner, M.W. Chase & V. Savolainen. 2007. Finding a suitable barcode for Mesoamerican orchids. Lankesteriana 7 (1-2): 200–2003.

Bogarín, D., & F. Pupulin. 2007. Las orquídeas del Parque Nacional Barra Honda, Guanacaste, Costa Rica. Lankesteriana 7 (1-2): 446–449.

Pupulin, F. & **D. Bogarín**. 2005. The genus *Scelochilus*: determining the number of species in Central America. Orchids 76 : 526–533.

Pupulin, F. & **D. Bogarín**. 2005. The genus *Brassia* in Costa Rica: A survey of four species and a new species. Orchids 74 : 202–207.

Pupulin, F. & **D. Bogarín**. 2004. Two new species of *Lepanthes* (Orchidaceae: Pleurothallidinae) from Costa Rica. Kew Bulletin 59 : 559–563.

Abstracts

Bogarín, D., Pérez-Escobar, Pupulin, F., Smets, E. & Gravendeel, B. Evolutionary diversification of *Lepanthes* (Pleurothallidinae): a hyperdiverse Neotropical orchid lineage. 7th International Orchid Conservation Congress (IOCC), Kew, London, UK, May 28th–June 1st, 2019. (Oral presentation)

Bogarín, D., Pérez-Escobar, O.A., Groenenberg, D., Holland. S.D., Karremans, A.P., Lemmon, E.M., Lemmon, A.R., Pupulin, F., Smets, E. & Gravendeel, B. Anchored hybrid enrichment resolves a species complex derived from recent rapid diversifications. 6th International Conference on Comparative Biology of Monocotyledons (Monocots VI), Natal, Brazil, October 7–12, 2018. (Oral presentation)

Bogarín, D., Pérez-Escobar, O.A., Groenenberg, D., Holland. S.D., Karremans, A.P., Lemmon, E.M., Lemmon, A.R., Pupulin, F., Smets, E. & Gravendeel, B. Anchored hybrid enrichment generated nuclear, plastid and mitochondrial markers resolve the *Lepanthes horrida* (Orchidaceae: Pleurothallidinae) species complex. 18th European Orchid Council Conference and Exhibition, Paris, France, March 23–25, 2018. (Poster presentation)

Bogarín, D., Pupulin, F., Smets, E. & Gravendeel, B. Pollination of sexually deceptive genus *Lepanthes* (Orchidaceae: Pleurothallidinae). XIX International Botanical Congress, Shenzhen, China, July 23 – 29, 2017. (Oral presentation)

Bogarín, D., Karremans, Fernández, M., Pupulin, F., Smets, E. & Gravendeel, B. Floral anatomy and evolution of pollination syndromes in *Lepanthes* and close relatives. 22nd World Orchid Conference, Guayaquil, Ecuador, 8– May 12, 2017. (Oral presentation)

Bogarín, D., M. Fernández, A. Borkent, A. Heemskerk, F. Pupulin, S. Ramírez, E. Smets & B. Gravendeel. Pollination of *Trichosalpinx* (Pleurothallidinae) by biting midges (Diptera: Ceratopogonidae). 6th International Orchid Conservation Congress In conjunction with 12th International Symposium on the Diversity and Conservation of Asian Orchids, Hong Kong SAR, People's Republic of China, May 16–20, 2016. (Oral presentation)