Quaternary Science Reviews 247 (2020) 106608

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

Book review

Quaternary ecology, evolution, and biogeography, Valenti Rull. Academic Press, Elsevier (2020). 256 pp + 99 illustrations (96 in full color), £95.95, ISBN: 978-0-12-820473-3

An abundant number of books have been published on aspects of geology, climate change, floral evolution, deep-time ecology, and biogeography of the Quaternary but few address this period from such a rich perspective as 'Quaternary ecology, evolution and biogeography' by Valentí Rull. This book represents a fascinating interplay between relevant facts for understanding the Quaternary Period (the last 2.58 million years: Head and Gibbard, 2015) and a range of experience-based opinions providing a deeper view from this versatile scientist. Rull's narrative combines key aspects for biogeographers, evolutionary ecologists, modern-day ecologists and paleoecologists beyond an introductory level without feeling simplified or overwhelming. He shares abundant tips for valuable further reading, while addressing topics to which he has contributed extensively, such as the refugia concept, neotropical climate change, and speciation during the Quaternary. The book does not shy away from discussing and opinionating on what are often hot debates on old and new hypotheses, such as the refugia hypothesis of Amazonia and the development of the 'Anthropocene' concept, while also postulating solutions that would lead towards an increased understanding. Hypothesis development in biogeography and ecology often finds its roots in observations of the Holocene, and the narrow time window of the Last Glacial Maximum (LGM) around 20,000 years ago. However, this book shows how the Quaternary has shaped the Earth' surface, vegetation cover, and biodiversity in all its essence.

Valentí Rull is also a well-known advocate for the integration of ecology and paleoecology (Rull, 2010, 2012; 2014) and dedicates a strong argumentation in the introduction of the book, setting the tone for further reading. Trained in this direction by Margaret Davis, and Hazel and Paul Delcourt, Rull finds abundant support among his colleague paleoecologists (e.g., Reitalu et al., 2014; Birks and Birks, 1980; Birks, 2019). In this new book, he shows that in so many aspects 'time' is implicit, and without 'time' these disciplines would not make sense. In this respect, Rull has much support from other visionaries such as John Birks, Steven Jackson, and Kathy Willis to mention just a few. The strongest lesson drawn here is Rull's postulation that "There is no ecology of the past and another of the present but a single general ecology embracing both". This book triggers researchers to (re-)consider 'settled understanding' in a new way, perhaps fuelling the inspiration of young scientists in particular, without the burden of past decades-long debates.

In an era of interdisciplinary research it is remarkable that the closely related research fields of '(neo-)ecology' and 'paleoecology' still lack the interactions such collaboration potentially may offer. This book shows that ecology and paleoecology are multi-facetted crystals allowing both disciplines to reach each other very closely. But what is triggering the fact that both disciplines hardly click? The setting is as two magnet-halves: keeping one half of the magnet wrongly oriented, the smaller the space between both magnet halves, the stronger the resistance to make the contact. In this book, Valentí Rull provides strong arguments that scientific reasoning and common research challenges can hardly explain the current low level of testing cross-disciplinary questions, suggesting that the apparent resistance between the two magnet-halves of ecology and paleoecology is imaginary.

Perhaps it is a legacy effect that makes the contact between 'neo-ecology' and 'paleoecology' difficult. Considering how scientists have organized themselves, we observe that paleoecology was often included in national botanical societies up to the 1950s. Palynology developed into a biostratigraphical tool and began to be widely used in applied geological and Earth-science research (see Hooghiemstra and Hoek, 2019). As a consequence, in the 1950s and 1960s, palynologists moved to national geological and geographical societies, and ecologists and paleoecologists became increasingly separated. An important research agenda in paleoecology was 'ecosystem history under environmental and climate change', whereas ecologists developed their research much into subjects such as plant sociology and theoretical ecology. Today, hypothesis testing has developed into a mature branch of ecological research, stimulated by a rich database of the Global Biodiversity Information Facility (GBIF). Paleoecology is still thought to be too much of a discipline based on descriptive studies but the continental-organized pollen databases are providing teams of (macro-)ecologists and paleoecologists with fuel for innovative hypothesis testing (e.g. Adolf et al., 2020).

More recent developments in paleoecology bleach former ecologists' critiques of methods and results, such as much improved chronological controls and a temporal resolution of continuous time series up to stunning levels, such as decadel resolution over intervals of >100,000 years (e.g. Groot et al., 2011), and up to near annual resolution over intervals up to half a century (e.g. Hagemans, 2020). Indeed, paleoecology still suffers from a low level of taxonomic identification of fossil pollen grains but the extremely long series of 'quasi-permanent plot information at low taxonomic resolution' has been hardly explored by ecological methodologies and theory. Time has arrived that disciplinary organized societies (ecologists, palynologists, biogeographers, evolutionary biologists, geologists) welcome special sessions in their annual meetings for members with an explorative, cross-disciplinary mind. Alexander von Humboldt showed the relevance of cross-disciplinary thinking (Von Humboldt and Bonpland, 1807), which is still very actual today (Hoorn, 2019), and under current 'Anthropocene' pressures (see Rull's Chapter 6) perhaps even more.

So, it seems that a number of legacy effects have to be overcome. In ecology there is the settled idea that paleoecological time series

https://doi.org/10.1016/j.quascirev.2020.106608
0277-3791

would not be of interest in comparison with datasets from 'long-term ecology' (Rull's Introduction chapter). In paleoecology there is the descriptive tradition and the underdeveloped efforts to integrate vegetation change of the past with ecological theory. In biogeography there is insufficient understanding that present-day conditions - often used to formulate hypotheses – are the exception rather than the rule in the last million years (Flantua and Hooghiemstra, 2018; Flantua et al., 2019, 2020). In molecular phylogenetic studies, trees of evolution should be optimally constrained by geological and paleoecological chronostratigraphies (Quental and Marshall, 2010). In its development, geology seems the most independent discipline, but geological understanding should further diffuse into all previously mentioned research fields rather than vice versa (e.g. Antonelli et al., 2018).

Valentí Rull's book undoubtedly contributes to make the spectrum of potential cooperation visible. The book was written for a wide audience: researchers as well as the educated layman. After the Introduction (pages xi-xxii), the book is divided into six monographic chapters with a list of references about 'Climate: continuous variability and its impact on the Earth System' (pages 1–34), 'Organisms: adaptation, extinction, and biogeographical reorganizations' (pages 35–73), 'Biodiversity: diversification or impoverishment?' (pages 75–117), 'Communities: adjustments, innovations, and revolutions' (pages 119–172), 'Humans: occupation and humanization of the planet' (pages 173–221), and 'The future: natural cycles and human interference' (pages 223–242). Thoughts are well synthesized in the Epilogue (pages 243–247). The book ends with a helpful index. Illustrations, most in color, are abundant and well designed. Importantly, individual chapters have a doi-number for easy access and citation. The book is published as a paperback, making it potentially attractive as a text book for courses at the masters level. Where teachers are intending to highlight the links between disciplines, this book offers many exiting examples. In conclusion, Valentí Rull is to be congratulated for producing this very inspiring book, which should rapidly find its way into supporting academic teaching.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Adolf, C., Tovar, C., Kühn, N., Behling, H., Berrio, J.C., Dominguez-Vázguez, G., Figueroa-Rangel, B., González-Carranza, Z., Islebe, G.A., Hooghiemstra, H., Neff, H., Ol, vera-Vargas, M., Ehitney, B., Wooller, M.J., Willis, K.J., 2020. Identifying drivers of forest resilience in long-term records from the Neotropics. Biol. Lett. https://doi.org/10.1098/rsbl.2020.0005.

Antonelli, A., Zizka, A., Carvalho, F.A., Scharn, R., Bacon, C.D., Silvestro, D., Condamine, F.L., 2018. Amazonia is the primary source of neotropical biodiversity. Proceedings of the National Academy of Sciences, USA 115, 6034–6039.

Birks, H.J.B., Birks, H.H., 1980. Quaternary Paleoecology. Arnold, London, p. 289 (reprinted in 2004 by Blackburn Press, NJ, USA).

Birks, H.J.B., 2019. Contributions of Quaternary botany to modern ecology and biogeography. Plant Ecol. Divers. 12, 189–385.

Flantua, S.G.A., Hooghiemstra, H., 2018. Historical connectivity and mountain biodiversity. In: Hoorn, C., Perrigo, A., Antonelli, A. (Eds.), Mountains, Climate and Biodiversity. Wiley Blackwell, Chichester, UK, ISBN 9781119159872, pp. 171–185 (Chapter 12).

Flantua, S.G.A., O'Dea, A., Onstein, R., Giraldo, C., Hooghiemstra, H., 2019. The flickering connectivity system of the north Andean páramos. J. Biogeogr. 1–18. https://doi.org/10.1111/jbi.13607, 2019.

Flantua, S.G.A., Payne, D., Borregaard, M.K., Beierkuhnlein, C., Steinbauer, M.J., Dullinger, S., Essl, F., Irl, S.D.H., Kienle, D., Kreft, H., Lenzner, B., Norder, S.J., Rijsdijk, K.F., Rumpf, S.B., Weigelt, P., Field, R., 2020. Snapshot isolation and isolation history challenge the analogy between mountains and islands used to understand endemism, 2020 Global Ecol. Biogeogr. 1–23, 00.

Groot, M.H.M., Bogotá, R.G., Lourens, L.J., Hooghiemstra, H., Vriend, M., Berrio, J.C., Tuenter, E., Van der Plicht, J.H., Van Geel, B., Ziegler, M., Weber, S.L., 14 Fúquene Project Members, 2011. Ultra-high resolution pollen record from the northern Andes reveals rapid shifts in montane climates within the last two glacial cycles. Clim. Past 7, 299–316. DOI: 10.5194.cp-7-299-2011.

Hagemans, K., 2020. El Niño Signatures in Tropical Andean ecosystems. PhD Thesis. Utrecht University, Netherlands.

Head, M.J., Gibbard, P.L., 2015. Formal subdivision of the Quaternary System/Period: past, present, and future. Quat. Int. 383, 4–35.

Hooghiemstra, H., Hoek, W., 2019. Waldo Heliodoor Zagwijn; the instigator and architect of European chronostratigraphy. Neth. J. Geosci. 98, e7. https://doi.org/10.1017/njg.2019.9.

Hoorn, C., 2019. Celberating Alexander von Humboldt's 250th anniversary: exploring bio- and geodiversity in the Andes, 2019, Frontiers of Biogeography 11 (2), 1–4. e44178.

Quental, T.B., Marshall, C.R., 2010. Diversity dynamics: molecular phylogenies need the fossil record. Trends Ecol. Evol. 25, 434–441.

Reitalu, T., Kunes, P., Giesecke, T., 2014. Closing the gap between plant ecology and Quaternary paleoecology. J. Veg. Sci. https://doi.org/10.1111/jvs.12187.

Rull, V., 2010. Ecology and paleoecology: two approaches, one objective. Open Ecol. J. 3, 1–5.

Rull, V., 2012. Community ecology: diversity and dynamics over time. Community Ecol. 13, 102–116.

Rull, V., 2014. Time continuum and true long-term ecology: from theory to practice. Frontiers in Ecology and Evolution 2, 75.

Von Humboldt, A., Bonpland, A., 1807. Essai sur la géographie des plantes, accompagné d'un tableau physique des régions equinoxiales. Levrault & Schoell, Paris.

Henry Hooghiemstra*
Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, the Netherlands

Suzette Flantua
Department of Biological Sciences, University of Bergen, PO Box 7803, N-5020, Bergen, Norway

* Corresponding author. Science Park 904, 1098XH, Amsterdam, the Netherlands.
E-mail address: H.Hooghiemstra@uva.nl (H. Hooghiemstra).