

REPLY TO ELIAS ET AL.:

Multiproxy evidence of widespread landscape disturbance in multiple Azorean lakes before the Portuguese arrival

Pedro M. Raposeiro^{a,b,1}, Armand Hernández^c, Sergi Pla-Rabes^d, Vítor Gonçalves^{a,b}, Roberto Bao^e, Alberto Sáez^f, Timothy Shanahan^g, Mario Benavente^c, Erik de Boer^f, Nora Richter^{h,i}, Verónica Gordonⁱ, Helena Marques^{a,b}, Pedro M. Sousa^{j,k}, Martín Souto^{a,b}, Miguel G. Matias^{l,m}, Nicole Aguiar^b, Cátia Pereira^{l,m}, Catarina Ritter^{a,b}, María Jesús Rubio^c, Marina Salcedo^b, David Vázquez-Loureiro^e, Olga Margalef^{d,f,n}, Linda A. Amaral-Zettler^{h,i,o}, Ana Cristina Costa^{a,b}, Yongsong Huangⁱ, Jacqueline F. N. van Leeuwen^p, Pere Masqué^{q,r,s,t}, Ricardo Prego^u, Ana Carolina Ruiz-Fernández^v, Joan-Albert Sanchez-Cabeza^v, Ricardo Trigo^{k,w}, and Santiago Giralt^c

Q:6 Despite the multidisciplinary and comprehensive approach taken in ref. 1, we acknowledge that there are still open questions that require further research. We emphasize that our study relies on multiple records that show the synchronous arrival of humans on multiple islands before ca. 1400 CE. Elias et al. (2) raise specific concerns about the record from Peixinho Lake, one of the five lakes included in the study, while ignoring the other multiproxy lake sediment records. The arguments presented by Elias et al. (2) do not undermine in any way the main conclusions of our paper, but still we would like to explicitly address the main criticisms with regard to the only record in question.

Q:7 Elias et al. (2) question the age model developed for Peixinho due to possible “old” volcanic carbon contamination. Previous work in the Azores has

shown that dating aquatic macrophytes can result in “old” carbon contamination (3); however, our pollen concentrates are almost entirely composed of terrestrial pollen grains, not aquatic macrophytes. Terrestrial pollen grains are not affected by volcanic carbon emissions (4). The age model from Peixinho (figure S6C of ref. 1) included two tephra layers at 650 and 700 CE, which correspond to the dates of the tephra layers found in the record of Pico Bog (see figure 2 of ref. 5). For this reason, we are puzzled by the figure presented by Elias et al. (figure 1 of ref. 2), where the authors seem to artificially wiggle-match the two pollen curves without taking into account two key stratigraphic layers and ignoring the two tephra layers (Pico-4 and Pico-5) published in ref. 5.

Common key indicators of human impacts on islands reflect multiple and synchronous changes in

^aCentro de Investigação em Biodiversidade e Recursos Genéticos, Rede de Investigação em Biodiversidade e Biologia Evolutiva – Laboratório Associado, 9500-321 Ponta Delgada, Portugal; ^bFaculdade de Ciências e Tecnologia, Universidade dos Açores, 9500-321 Ponta Delgada, Portugal; ^cGeosciences Barcelona (Geo3BCN-CSIC), Consejo Superior de Investigaciones Científicas, 08028 Barcelona, Spain; ^dCenter for Ecological Research and Forestry Applications, 08193 Cerdayola del Valles, Spain; ^eCentro de Investigaciones Científicas Avanzadas, Facultad de Ciencias, Universidade da Coruña, 15071 A Coruña, Spain; ^fDepartment de Dinàmica de la Terra i de l'Oceà, Facultat de Ciències de la Terra, Universitat de Barcelona, 08028 Barcelona, Spain; ^gDepartment of Geosciences, University of Texas at Austin, Austin, TX 78712; ^hDepartment of Marine Microbiology & Biogeochemistry, Royal Netherlands Institute for Sea Research, 1790 AB Den Burg, The Netherlands; ⁱDepartment of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912; ^jInstituto Português do Mar e da Atmosfera, 1749-077 Lisboa, Portugal; ^kInstituto Dom Luiz, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal; ^lDepartamento de Biogeografia y Cambio Global, Museo Nacional de Ciencias Naturales, Consejo Superior de Investigaciones Científicas, 28006 Madrid, Spain; ^mBiodiversity Research Chair, Mediterranean Institute for Agriculture, Environment and Development, Universidade de Évora, 7000-890 Évora, Portugal; ⁿGlobal Ecology Unit Centre de Recerca Ecològica i Aplicacions Forestals–Consejo Superior de Investigaciones Científicas–Universitat Autònoma de Barcelona, 08193 Catalonia, Spain; ^oDepartment of Freshwater and Marine Ecology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, 1012 WX Amsterdam, The Netherlands; ^pInstitute of Plant Sciences and Oeschger Center for Climate Change Research, University of Bern, 3013 Bern, Switzerland; ^qInternational Atomic Energy Agency, 98000 Principality of Monaco, Monaco; ^rInstitute of Environmental Science and Technology, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; ^sPhysics Department, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain; ^tSchool of Natural Sciences, Centre for Marine Ecosystems Research, Edith Cowan University, Joondalup, WA 6027, Australia; ^uDepartment of Oceanography, Marine Research Institute, Consejo Superior de Investigaciones Científicas, 36208 Vigo, Spain; ^vInstituto de Ciencias del Mar y Limnología, Unidad Académica Mazatlán, Universidad Nacional Autónoma de México, 82040 Mazatlán, Mexico; and ^wDepartamento de Meteorología, Universidade Federal do Rio de Janeiro, Rio de Janeiro 21941-919, Brazil

Author contributions: P.M.R., A.H., S.P.-R., V.G., R.B., A.S., and S.G. designed research; P.M.R., A.H., S.P.-R., V.G., R.B., A.S., T.S., M.B., E.d.B., N.R., V.G., H.M., P.M.S., M.S., M.G.M., N.A., C.P., C.R., M.J.R., M.S., D.V.-L., O.M., L.A.A.-Z., A.C.C., Y.H., J.F.N.v.L., P.M., R.P., A.C.R.-F., J.-A.S.-C., R.T., and S.G. performed research; P.M.R., A.H., S.P.-R., V.G., R.B., A.S., E.D., R.T., and S.G. analyzed data; and P.M.R., A.H., S.P.-R., V.G., R.B., A.S., T.S., N.R., M.G.M., C.P., A.C.C., R.T., and S.G. wrote the paper.

The authors declare no competing interest.

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¹To whom correspondence may be addressed. Email: pedro.mv.raposeiro@uac.pt.

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the landscape, e.g., fire, deforestation, the presence of cereal grains, and fecal biomarkers (6, 7). In the record from Peixinho and the lake records from the other islands, we observed an increase in macrocharcoal and polycyclic aromatic hydrocarbons, the presence of *Secale cereale*, 5 β -stigmastanol, coprostanol, and coprophilous spores, as well as a decrease in arboreal pollen. These signals are followed by increases in lake trophic states. The grains of *Secale* were counted in subsequent pollen slides indicating a local source and not erratic long-distance dispersal. *Plantago* spp. were identified to *Plantago lanceolata* and *Plantago coronopus*, of which *P. lanceolata* is an introduced species

(5) and is an indicator of pastures (8). This evidence clearly demonstrates changes in the Azorean landscape resulting from human arrival before the 15th century. The early decrease in arboreal pollen is also observed in figure 5 of ref. 5, although this was not highlighted in the original paper.

As stated in ref. 1, we acknowledge the point raised by Elias et al. (2) that the Portuguese arrival led to more extensive changes in the landscape. Our multiproxy, multisite datasets strongly suggest that people had already occupied the Azores Archipelago and altered the pristine landscape before the official arrival of the Portuguese.

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