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Editorial

Palynology for Sustainability: A Classical and Versatile Tool for New Challenges—Recent Progress

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1. Introduction

Palynology deals with several topics closely linked to sustainability [1] as it has always acted as a bridge between different research fields within environmental sciences [2–4]. This centenary discipline, which studies both fossils and modern pollen and spores, represents a landmark in multidisciplinary research on both past and current environmental issues [5,6]. In addition, palaeoenvironmental studies based on pollen analysis from sediments and archaeological layers offer a long-term perspective for understanding ecosystem responses to different human and climate triggers [7–10]. In this sense, recent palynological research has repeatedly demonstrated that, since prehistory, past cultures have strongly relied on natural resources, with nature and culture being interrelated and interdependent [11,12]. There is (archaeo)botanical evidence showing that cultural choices have been combined/plotted according to social and environmental characteristics to enable human populations to cope with environmental and climatic changes in different regions (e.g., [13,14]). In prehistory, this ensured social resilience by using multi-functional land uses to exploit nature without compromising the environment [15–19], while in historical phases, the pressure of human activities impacted in a clearer manner with the help of rapid advances in techniques in different regions [20–24].

In the field of palaeoecology, pollen, non-pollen palynomorphs, and sedimentary charcoal are excellent bioindicators for detecting human impact and landscape development [25–31]. This Special Issue brings together several interdisciplinary bio-geo-archaeological investigations on on-site/off-site palynology carried out in Holocene contexts to disseminate the role of pollen as a marker of biodiversity, environmental transformations, and human–plant ecological interactions. Three main themes emerge from the papers: A—long floristic lists that are comprehensive enough to significantly contribute to our understanding of plant biodiversity in archaeological sites; B—improved knowledge of plant biodiversity through studies on detailed pollen morphology; C—examples of research from modern analogues to long core reconstructions. Regarding points A and B, the sites are part of BRAIN, the Botanical Records of Archaeobotany Italian Network, and are therefore also referenced by their ID numbers in the database [32].

2. The Three Main Themes of the Special Issue

2.1. A. Long Floristic Lists from Archaeological Sites

Although palynology has a known key role in the understanding of archaeological environments [33], archaeopalynology has only considerably developed in recent decades

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thanks to rigorous collaboration with archaeologists, correct sampling strategies, interdisciplinary interpretations, and the refinement of extraction methods from sediments in contexts that do not perfectly preserve pollen and macroremains [34–36].

Zappa and colleagues [37] study the Neolithic pile-dwelling archaeological site of Palù di Livenza (NE Italy), which developed over several phases between the 6th and 5th millennia BP. The on-site palynological analysis of the trench PaluON1 clearly shows that the settlement caused local interference with the hygrophilous ecosystem, with people adopting a multiple land-use economy. During the occupation phases, different vegetation cover, the use of woody resources, cereal and flax fields, and animal husbandry or pastoral practices were evident, as well as plant processing within the village. Vegetation responses to environmental changes were forced by both climatic fluctuations and human pressure. The settlement favoured the spread of synanthropic plants and the presence of regional and local fires. Interestingly, after the abandonment due to changing conditions, swamps and hygrophilous woods returned to the site, showing a rapid rewilding to the pristine environment.

Tecchiati and colleagues [38] investigate the Late Neolithic–Bronze Age site of Colombare di Negrar di Valpolicella in the Lessini Mountains (N Italy). Integrated data from pollen and plant macroremains indicate a close relationship between natural resources and the socio-economic development of the territory. The on-site palynological analysis reveals that natural clearings in the wood favoured the establishment of the houses. The proximity to the forest ensured supply for leaf forage, timber, and wild fruits such as hazelnut and walnut. The forest cover was characterised by a mixed oakwood with *Ulmus* and *Tilia* species, suggesting cool conditions. In the riparian forests, which thrived on moist soils, hygrophilous trees were present alongside *Vitis vinifera*. The multiple land-use economy consisted of a sylvo-pastoral and crop farming mixed system, where most of the natural resources were offered by a hilly landscape characterised by great ecological and phytogeographical diversity.

Gattiglia and colleagues [39] report the results of an interdisciplinary study conducted at the Charterhouse of Calci, in central Italy. Pollen was extracted from a unique set of contexts that are particularly challenging for palaeoenvironmental interpretation: the three monks' gardens—those of the Prior, the Apothecary, and the Master. The palynological records mostly document horticultural and gardening practices across different phases, from the Middle Ages to the recent period. Beautiful flowers and ornamental plants and aromatic and medicinal herbs grew in the gardens (see also [40]). To complete the environmental reconstruction, green spaces outside the cloister walls, consisting of courtyards and orchards, were also sampled. Evidence of arboriculture was recognised based on records of chestnut, olive tree, almond tree, and grapevine. Overall, pollen analysis provided valuable insights into both individual and collective activities carried out by the monks, including the cultivation of gardens and the surrounding green spaces as well as the management of local hilly woods.

2.2. B. Knowledge of Biodiversity from Pollen Morphology

Biodiversity trends are among the primary targets of palynological research [41,42]. In palaeopalynology, investigations on flora and taxonomy may reach a level of knowledge that often parallels modern taxonomical studies, also involving molecular sciences. However, based on the intrinsic morphology of pollen [43], there are similar questions regarding floristic presence and distribution that can be further explored with the help of records from past contexts.

In the paper by Tecchiati et al. [38], mentioned above, the presence of lime hybrids has been recorded based on the intermediate morphology of pollen grains. The two distin-

guishing features are intermediate size and exine between *Tilia cordata* and *T. platyphyllos* pollen. Although the possibility of discriminating natural hybrids in *Tilia* is known [44], this can be regarded as the first evidence of such hybrids in Italian palaeorecords and from archaeological contexts.

Mercuri and colleagues [45] describe a rare case of multiporate pollen of Poaceae observed in Takarkori rockshelter, an archaeological site in southwestern Libya, in the central Sahara. The records dated between the early and middle Holocene. This monocotyledon family is typically anaporate, but the production of additional pores is attributed to polyploidy and hybridisation in some species. Overall, palaeoenvironmental research at this site testified to a long period of occupation with phases of plant gathering. The presence of multiporate pollen reveals that grasses faced several kinds of stress in the central Sahara, such as climate change in earlier phases, while human pressure became stronger during the following periods. These environmental changes triggered adaptive responses in polyploids, which were able to produce multiporate pollen.

Clò and colleagues [46] report a study on wild grapevine populations growing in the River Crati Natural Reserve, in southern Italy. Wild grapevines have declined in the IUCN Red List of Threatened Species as a consequence of anthropogenic disturbance and habitat destruction. A population of *Vitis vinifera* subsp. *sylvestris* lives in a rewilding wet forest close to the Ionian Sea, including dioicous plants. The results of the dendroecological and palynological study support molecular evidence of a viable population. Pollen dimorphism in this species was especially studied, as it may be very important, given that its domestication history involves the transition from monoecious to hermaphroditic flowers. Interestingly, abortive, inaperturate pollen is produced by female flowers. The implications of this variability in past pollen spectra are still not fully understood, although a case of female pollen has recently been published for a Bronze Age archaeological site [47].

2.3. C. From Modern Analogues to Long Core Reconstructions

Quaternary palaeoecologists have pressed conservationists to consider palaeoecological studies in their management plans to include a historical perspective on changes in biodiversity [48,49], biotic responses to environmental change, and ecosystem dynamics [50,51].

Studies on pollen dispersion have shown that pollen assemblages recorded in natural traps can generally provide an accurate representation of the local vegetation [52–55]. Attolini and colleagues [56] investigate recent pollen samples from 201 plant populations in NW Italy. Pollen was collected from moss polsters, and vegetation was recorded using phytosociological methods. The growing interest in recent pollen deposits is reflected in the expansion of databases like the EMPD [57], with a continually increasing number of contributors. This research fills gaps in pollen rain studies in the Mediterranean mountains and coastal areas, providing new data for interpreting fossil pollen spectra. While certain vegetation types, like tree-dominated plant communities, are easily identified through recent pollen deposition, others, like shrublands and *Larix* forests, present more complexity. Some tree taxa (e.g., *Pinus*, *Quercus*, *Alnus*) are overrepresented in areas where their cover is low, suggesting an extra-local contribution. Herbaceous and shrubby communities, with low pollen dispersal, are often poorly represented, and regional influences are more evident. Pollen threshold values were calculated, indicating pollen percentages that help distinguish locally produced pollen from that transported over long distances.

Masci and colleagues [58] outline the importance of comparing palaeoecological data with subsequent land uses in changing cultures. They presented the high-resolution pollen analysis of a sediment core drilled from Paliouras Lagoon in the Halkidiki Peninsula, in Greece. The palynological research allowed the reconstruction of environmental dynamics during the last 4000 years, revealing different main vegetation and landscapes correspond-

ing to different historical phases. In other words, distinct phases of human–environment interactions corresponded to different cultural phases. From the Late Bronze Age until the Late Roman period, the Mediterranean vegetation was largely alternated with mixed deciduous forest and pine stands. In Roman times, intensive land management was visible, with evidence of arboriculture (*Olea*, *Castanea*, and *Vitis*) and cereal cultivation (*Secale* and *Hordeum* group). Then, an expansion of forests and the abandonment of fields marked a period of reduced human pressure determined by warfare-related crises. During the Ottoman period, the massive increase in pastoral activities was possibly linked to the significant demographic growth of the nearby city of Thessaloniki.

Kafetzidou and colleagues [59] analyse a long pollen record from the Gulf of Corinth, a biodiversity hotspot in central Greece, as part of the International Ocean Discovery Program (IODP). This study reveals no significant shifts in arboreal pollen between glacial and interglacial periods. Mediterranean and mesophilous taxa remain abundant, with cool mixed evergreen needleleaf and deciduous broadleaf forests in interglacials and graminoid–forb and xerophytic shrubs in glacials. These data support the hypothesis that the Gulf of Corinth acted as a refugium for tree species during Quaternary climate cycles.

3. Conclusions

In conclusion, this Special Issue effectively highlights the significant contributions of interdisciplinary palynological studies, both on- and off-site, with a focus on Holocene contexts. The papers collectively present an integrated approach that combines extensive floristic lists, advances in detailed pollen morphology, and the use of modern analogues [57] to reconstruct long core sequences. This comprehensive framework enhances our understanding of plant biodiversity, environmental changes, and human–plant interactions over time [60].

Such an approach opens new pathways for future research, reinforcing the crucial role of palynology not only in reconstructing past environments and human activity but also in addressing current and future challenges related to sustainability [61]. As suggested by the title "Palynology for Sustainability: A Classical and Versatile Tool for New Challenges", pollen-based analyses offer valuable insights into past ecosystems, helping to inform environmental and conservation strategies, and enhancing our capacity to tackle modern ecological and climatic issues.

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References

1. Jiménez-Zamora, T.; Galicia, L.; Espinosa, D.; Rivera-González, I.; Luna-Vega, I. Understanding perspectives of current palynology: Using science with practical discourse. *Bot. Sci.* **2023**, *101*, 341–357. [CrossRef]
2. Erdtman, G. *An Introduction to Pollen Analysis*; Chronica Botany Company: Waltham, MA, USA, 1943.
3. Fægri, K.; Iversen, J.; Kaland, P.E.; Krzywinski, K. *Textbook of Pollen Analysis*, 4th ed.; The Blackburn Press: Caldwell, ID, USA, 1989.
4. Mercuri, A.M.; Marignani, M.; Sadori, L. Palynology: The bridge between palaeoecology and ecology for the understanding of human-induced global changes in the Mediterranean area. *Ann. Bot.* **2013**, *3*, 107–113. [CrossRef]
5. Edwards, K.; Fyfe, R.; Jackson, S. The first 100 years of pollen analysis. *Nat. Plants* **2017**, *3*, 17001. [CrossRef]
6. Birks, H.J.B.; Berglund, B.E. One hundred years of Quaternary pollen analysis 1916–2016. *Veg. Hist. Archaeobot.* **2018**, *27*, 271–309. [CrossRef]
7. Fægri, K. Quaternary pollen analysis—Past, present and future. *Adv. Pollen Spore Res.* **1974**, *1*, 62–69.
8. Sadori, L. Postglacial Pollen Records of Southern Europe. In *Encyclopedia of Quaternary Science*; Elias, S.A., Ed.; Elsevier: Amsterdam, The Netherlands, 2013; pp. 179–188.
9. Nordlund, C. Four points on Lennart von Post and the invention of "Pollen Statistics". *Veget. Hist. Archaeobotany* **2018**, *27*, 311–317. [CrossRef]
10. Mercuri, A.M.; Florenzano, A. The Long-Term Perspective of Human Impact on Landscape for Environmental Change (LoTEC) and Sustainability: From Botany to the Interdisciplinary Approach. *Sustainability* **2019**, *11*, 413. [CrossRef]
11. Mercuri, A.M.; Sadori, L. Mediterranean Culture and Climatic Change: Past Patterns and Future Trends. In *The Mediterranean Sea*; Goffredo, S., Dubinsky, Z., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 507–527. [CrossRef]
12. Stephens, L.; Fuller, D.; Boivin, N.; Rick, T.; Gauthier, N.; Kay, A.; Marwick, B.; Armstrong, C.G.; Barton, C.M.; Denham, T.; et al. Archaeological assessment reveals Earth's early transformation through land use. *Science* **2019**, *365*, 897–902. [CrossRef]
13. Cremaschi, M.; Mercuri, A.M.; Benatti, A.; Bosi, G.; Brandolini, F.; Clò, E.; Florenzano, A.; Furia, E.; Mariani, G.S.; Mazzanti, M. The SUCCESSO-TERRA Project: A Lesson of Sustainability from the Terramare Culture, Middle Bronze Age of the Po Plain (Northern Italy). *IANSA* **2018**, *9*, 221–229. [CrossRef]
14. Izdebski, A.; Guzowski, P.; Poniat, R.A.; Masci, L.; Palli, J.; Vignola, C.; Bauch, M.; Cocozza, C.; Fernandes, R.; Ljungqvist, F.C. Palaeoecological data indicates land-use changes across Europe linked to spatial heterogeneity in mortality during the Black Death pandemic. *Nat. Ecol. Evol.* **2022**, *6*, 297–306. [CrossRef]
15. Mercuri, A.M.; Florenzano, A.; Burjachs, F.; Giardini, M.; Kouli, K.; Masi, A.; Picornell-Gelabert, L.; Revelles, J.; Sadori, L.; Servera-Vives, G.; et al. From influence to impact: The multifunctional land use in Mediterranean prehistory emerging from palynology of archaeological sites (8.0-2.8 ka BP). *Holocene* **2019**, *29*, 830–846. [CrossRef]
16. Ruiz, I.; Sanz-Sánchez, M.J. Effects of historical land-use change in the Mediterranean environment. *Sci. Total Environ.* **2020**, *732*, 139315. [CrossRef] [PubMed]
17. Revelles, J.; Allué, E.; Alcolea, M.; Antolín, F.; Berihuete-Azorín, M.; Expósito, I.; Garay, B.; Mas, B.; Piqué, R.; Obea, L.; et al. Site formation processes, human activities and palaeoenvironmental reconstructions from archaeobotanical records in cave and rock-shelter sites in NE Iberia. *Rev. Palaeobot. Palynol.* **2022**, *299*, 104612. [CrossRef]
18. Ruiz, I.; Sanz-Sánchez, M.J. Sustainable Land Management for Rural Adaptation in the Mediterranean and Middle Eastern Watersheds. In *Climate Change in the Mediterranean and Middle Eastern Region. Climate Change Management*; Leal Filho, W., Manolas, E., Eds.; Springer: Cham, Switzerland, 2022; pp. 433–456. [CrossRef]
19. Mercuri, A.M.; Florenzano, A.; Clò, E. Sustainability in the Neolithic and the Bronze Age Through the Lens of Archaeobotany. In *The Palgrave Handbook of Global Sustainability*; Brinkmann, R., Ed.; Palgrave Macmillan: Cham, Switzerland, 2023; pp. 2249–2262. [CrossRef]
20. Mensing, S.A.; Schoolman, E.M.; Tunno, I.; Noble, P.J.; Sagnotti, L.; Florindo, F.; Piovesan, G. Historical ecology reveals landscape transformation coincident with cultural development in central Italy since the Roman Period. *Sci. Rep.* **2018**, *8*, 2138. [CrossRef]
21. Florenzano, A.; Zerboni, A.; Carter, J.C.; Clò, E.; Mariani, G.S.; Mercuri, A.M. Environmental and land use changes in a Mediterranean landscape: Palynology and geoarchaeology at ancient Metapontum (Pantanello, Southern Italy). *Quat. Int.* **2022**, *635*, 105–124. [CrossRef]
22. Clò, E.; Furia, E.; Florenzano, A.; Mercuri, A.M. Flora-vegetation history and land use in Medieval Tuscany: The palynological evidence of a local biodiversity heritage. *Quat. Int.* **2024**, *705*, 1–15. [CrossRef]
23. Palli, J.; Mensing, S.A.; Schoolman, E.M.; Solano, F.; Piovesan, G. Historical ecology identifies long-term rewilding strategy for conserving Mediterranean mountain forests in south Italy. *Ecol. Appl.* **2023**, *33*, e2758. [CrossRef]
24. Masci, l.; Liakopoulos, G.C.; Gromig, R.; Kolovos, E.; Kouli, K.; Moros, M.; Sadori, L.; Sarantis, A.; Slavin, P.; Sypiański, J. Consilience in practice: Social–ecological dynamics of the Lake Volviregion (Greece) during the last two millennia. *J. Quat. Sci.* **2024**, 1–22. [CrossRef]
25. Hooghiemstra, H. Non-pollen palynomorphs: From unknown curiosities to informative fossils. *Celebr. Sci. Career Bas Van. Geel. Rev. Palaeobot. Palynol.* **2012**, *186*, 2–4. [CrossRef]

26. Mercuri, A.M.; Bandini Mazzanti, M.; Florenzano, A.; Montecchi, M.C.; Rattighieri, E.; Torri, P. Anthropogenic Pollen Indicators (API) from archaeological sites as local evidence of human-induced environments in the Italian peninsula. *Ann. Bot.* **2013**, *3*, 143–153. [CrossRef]
27. Florenzano, A.; Marignani, M.; Rosati, L.; Fascetti, S.; Mercuri, A.M. Are Cichorieae an indicator of open habitats and pastoralism in current and past vegetation studies? *Plant Biosyst.* **2015**, *149*, 154–165. [CrossRef]
28. Clò, E.; Florenzano, A. Heterocysts of *Rivularia* Type for Interpreting a Palaeoenvironmental Context of the Late Quaternary in Northern Italy. *Sustainability* **2022**, *14*, 15332. [CrossRef]
29. Deza-Araujo, M.; Morales-Molino, C.; Conedera, M.; Henne, P.D.; Krebs, P.; Hinz, M.; Heits, C.; Hafner, A.; Tinner, W. A new indicator approach to reconstruct agricultural land use in Europe from sedimentary pollen assemblages. *Quat. Sci. Rev.* **2022**, *599*, 111051. [CrossRef]
30. Lee, C.M.; van Geel, B.; Gosling, W.D. On the Use of Spores of Coprophilous Fungi Preserved in Sediments to Indicate Past Herbivore Presence. *Quaternary* **2022**, *5*, 30. [CrossRef]
31. Servera-Vives, G.; Mus Amezquita, M.; Snitker, G.; Florenzano, A.; Torri, P.; Ruiz, M.; Mercuri, A.M. Human-Impact Gradients through Anthropogenic Pollen Indicators in a Mediterranean Mosaic Landscape (Balearic Islands). *Sustainability* **2023**, *15*, 8807. [CrossRef]
32. Mercuri, A.M.; Clò, E.; Zappa, J.; Bosi, G.; Furia, E.; Ricucci, C.; Di Lena, M.; Camerini, F.; Florenzano, A. Brain—Holocene archaeo-data for assessing plant-cultural diversity in Italy and other Mediterranean regions. *Sci. Data* **2024**, *11*, 520. [CrossRef]
33. Fægri, K. The importance of palynology for the understanding of the archaeological environment in northern Europe. *Cent. De. Rech. Archáeologiques Notes Monogr. Tech.* **1985**, *17*, 333–342.
34. Mercuri, A.M. Genesis and evolution of the cultural landscape in central Mediterranean: The 'where, when and how' through the palynological approach. *Landsc. Ecol.* **2014**, *29*, 1799–1810. [CrossRef]
35. Berihuete-Azorin, M.; Kerfant, C.; Allué, E.; Burguet-Coca, A.; Burjachs, F.; Expósito Barea, I.; Fernández Iriarte, T.; Garay Palacios, B.; Revelles, J.; Robledo, A.; et al. Archaeobotany in an era of change and challenge: Potential and fragility of macro- and micro-remains. *World Archaeol.* **2023**, *55*, 299–314. [CrossRef]
36. López-Sáez, J.A.; Bernal-Casasola, D.; Pérez-Díaz, S.; Luelmo-Lautenschlaeger, R.; Díaz-Rodríguez, J.J.; Expósito-Álvarez, J.A.; Jiménez-Camino, R.; Portillo-Sotelo, J.L.; Villada-Paredes, F.; Vargas-Girón, J.M.; et al. New challenges in archaeopalynology: Pollen analysis on Roman bivalve shells from south-western Europe and North Africa. *Rev. Palaeobot. Palynol.* **2023**, *312*, 104876. [CrossRef]
37. Zappa, J.; Degasperi, N.; Bassetti, M.; Florenzano, A.; Torri, P.; Servera-Vives, G.; Mercuri, A.M.; Micheli, R. Plants, Fire and Landscape at the Prehistoric Pile-Dwelling Village of Palù di Livenza (PaluON1), UNESCO Site in the Italian Alps. *Quaternary* **2023**, *6*, 34. [CrossRef]
38. Tecchiati, U.; Salzani, P.; Gulino, F.; Proserpio, B.; Reggio, C.; Putzolu, C.; Rattighieri, E.; Clò, E.; Mercuri, A.M.; Florenzano, A. Palaeoenvironment, Settlement, and Land Use in the Late Neolithic—Bronze Age Site of Colombare di Negrar di Valpolicella (N Italy, On-Site). *Quaternary* **2022**, *5*, 50. [CrossRef]
39. Gattiglia, G.; Rattighieri, E.; Clò, E.; Anichini, F.; Campus, A.; Rossi, M.; Buonincontri, M.; Mercuri, A.M. Palynology of Gardens and Archaeobotany for the Environmental Reconstruction of the Charterhouse of Calci-Pisa in Tuscany (Central Italy). *Quaternary* **2023**, *6*, 45. [CrossRef]
40. Clò, E.; Gattiglia, G.; Rattighieri, E.; Anichini, F.; Campus, A.; Rossi, M.; Buonincontri, M.; Mercuri, A.M. The Fathers' cell gardens of the Charterhouse of Calci-Pisa in Tuscany (Central Italy): Pollen and multidisciplinary reconstruction. In Proceedings of the 2023 IMEKO TC-4 International Conference on Metrology for Archaeology and Cultural Heritage, Rome, Italy, 19–21 October 2023; pp. 941–946. [CrossRef]
41. Berglund, B.E.; Gaillard, M.-J.; Björkman, L.; Persson, T. Long-term changes in floristic diversity in southern Sweden: Palynological richness, vegetation dynamics and land-use. *Veget. Hist. Archaeobot.* **2008**, *17*, 573–583. [CrossRef]
42. Birks, H.J.B.; Felde, V.A.; Seddon, A.W.R. Biodiversity trends within the Holocene. *Holocene* **2016**, *26*, 994–1001. [CrossRef]
43. Joosten, H.; de Klerk, P. What's in a name? Some thoughts on pollen classification, identification, and nomenclature in Quaternary palynology. *Rev. Palaeobot. Palynol.* **2002**, *122*, 29–45. [CrossRef]
44. Erdtman, G. Handbook of Palynology. In *An Introduction to the Study of Pollen Grains and Spores*; Munksgaard: Copenhagen, Denmark, 1969.
45. Mercuri, A.M.; Clò, E.; Florenzano, A. Multiporate Pollen of Poaceae as Bioindicator of Environmental Stress: First Archaeobotanical Evidence from the Early–Middle Holocene Site of Takarkori in the Central Sahara. *Quaternary* **2022**, *5*, 41. [CrossRef]
46. Clò, E.; Torri, P.; Baliva, M.; Brusco, A.; Marchianò, R.; Sgarbi, E.; Palli, J.; Mercuri, A.M.; Piovesan, G.; Florenzano, A. A Multidisciplinary Study of Wild Grapevines in the River Crati Natural Reserve, South Italy (Calabria): Implications in Conservation Biology and Palaeoecological Reconstructions. *Quaternary* **2023**, *6*, 43. [CrossRef]

47. Mercuri, A.M.; Torri, P.; Florenzano, A.; Clò, E.; Mariotti Lippi, M.; Sgarbi, E.; Bignami, C. Sharing the Agrarian Knowledge with Archaeology: First Evidence of the Dimorphism of *Vitis* Pollen from the Middle Bronze Age of N Italy (Terramara Santa Rosa di Poviglio). *Sustainability* **2021**, *13*, 2287. [CrossRef]
48. Carter, V.A.; Chiverrell, R.C.; Clear, J.L.; Kuosmanen, N.; Moravcová, A.; Svoboda, M.; Svobodová-Svitavská, H.; van Leeuwen, J.F.N.; van der Knaap, W.O.; Kuneš, P. Quantitative Palynology Informing Conservation Ecology in the Bohemian/Bavarian Forests of Central Europe. *Front. Plant Sci.* **2018**, *8*, 2268. [CrossRef]
49. Mercuri, A.M.; Cannavò, V.; Clò, E.; Di Renzoni, A.; Florenzano, A.; Rattighieri, E.; Yoon, D.; Levi, S.T. Palynology of San Vincenzo-Stromboli: Interdisciplinary perspective for the diachronic palaeoenvironmental reconstruction of an island of Sicily. *J. Archaeol. Sci. Rep.* **2020**, *30*, 102235. [CrossRef]
50. Piovesan, G.; Mercuri, A.M.; Mensing, S.A. The potential of paleoecology for functional forest restoration planning: Lessons from Late Holocene Italian pollen records. *Plant Biosyst.* **2018**, *152*, 508–514. [CrossRef]
51. Birks, H.J.B. Contributions of Quaternary botany to modern ecology and biogeography. *Plant Ecol. Divers.* **2019**, *12*, 189–385. [CrossRef]
52. Mazier, F.; Galop, D.; Brun, C.; Buttler, A. Modern pollen assemblages from grazed vegetation in the western Pyrenees, France: A numerical tool for more precise reconstruction of past cultural landscapes. *Holocene* **2006**, *16*, 91–103. [CrossRef]
53. Morales-Molino, C.; Devaux, L.; Georget, M.; Hanquiez, V.; Sánchez Goñi, M.F. Modern pollen representation of the vegetation of the Tagus Basin (central Iberian Peninsula). *Rev. Palaeobot. Palynol.* **2020**, *276*, 104193. [CrossRef]
54. Fang, Y.; Bunting, M.J.; Ma, C.; Yang, X. Are modern pollen assemblages from soils and mosses the same? A comparison of natural pollen traps from subtropical China. *Catena* **2022**, *209*, 105790. [CrossRef]
55. Servera-Vives, G.; Mus Amezquita, M.; Snitker, G.; Florenzano, A.; Torri, P.; Estrany Bertos, J.; Mercuri, A.M. Modern analogs for understanding pollen-vegetation dynamics in a Mediterranean mosaic landscape (Balearic Islands, Western Mediterranean). *Holocene* **2022**, *32*, 716–734. [CrossRef]
56. Attolini, D.; Ciani, F.; Guido, M.A.; Montanari, C. Assessment of Pollen Representation in NW Italy (Liguria and Piedmont). *Quaternary* **2023**, *6*, 36. [CrossRef]
57. Davis, B.A.S.; Chevalier, M.; Sommer, P.; Carter, V.A.; Finsinger, W.; Mauri, A.; Phelps, L.N.; Zanon, M.; Abegglen, R.; Åkesson, C.M. The Eurasian Modern Pollen Database (EMPD), version 2. *Earth Syst. Sci. Data* **2020**, *12*, 2423–2445. [CrossRef]
58. Masci, L.; Vignola, C.; Liakopoulos, G.C.; Kouli, K.; Koukousioura, O.; Aidona, E.; Moros, M.; Vouvalidis, K.; Izdebski, A.; Masi, A. Landscape Response to Dynamic Human Pressure in the Paliouras Lagoon, Halkidiki Peninsula, Macedonia, Greece. *Quaternary* **2022**, *5*, 54. [CrossRef]
59. Kafetzidou, A.; Fatourou, E.; Panagiotopoulos, K.; Marret, F.; Kouli, K. Vegetation Composition in a Typical Mediterranean Setting (Gulf of Corinth, Greece) during Successive Quaternary Climatic Cycles. *Quaternary* **2023**, *6*, 30. [CrossRef]
60. Woodbridge, J.; Fyfe, R.; Smith, D.; Pelling, R.; de Vareilles, A.; Batchelor, R.; Bevan, A. What drives biodiversity patterns? Using long-term multidisciplinary data to discern centennial-scale change. *J. Ecol.* **2021**, *109*, 1396–1410. [CrossRef]
61. Florenzano, A.; Clò, E.; Servera-Vives, G.; Mercuri, A.M. Palynology for Sustainability: A Classical and Versatile Tool for New Challenges: Editorial. *Sustainability* **2025**, *17*, 1938. [CrossRef]