Historical Ecology in Disciplinary Contexts

Subjects: Ecology

Contributor: Carole Crumley

Among several methodological and theoretical approaches that detail and track key elements of the human–environmental nexus and the linkages of biotic and abiotic agents and their behaviors through time (e.g., resilience, ecosystem dynamics, environmental history, and landscape biography models), the framework of historical ecology offers a comprehensive and integrated reach across knowledge sectors and clear strategies for social justice, collaboration, and application.

There is no particular need to identify one's work as historical ecology, as several other approaches employ similar principles. However, the term is widely familiar, teasing ecology to embrace the historical sciences and history to learn ecology. Historical ecology is an umbrella term describing multi-faceted research programs that assure researchers and stakeholders the advantages of diverse perspectives, the means to evaluate and share information, and a community of practice. Historical ecology unites a group of core disciplines—archaeology, anthropology, ecology, geography, and history—and draws on parallel developments in these fields.

historical ecology regions archaeology

1. Finding Tools to Meet the Future

Multiple crises, which menace not just humanity but all life on Earth, are unfolding. With its link to global warming, heedless management is accelerating the collapse of ecosystems everywhere; this means that all practitioners, whether they are scholars or anchored in a landscape, must collaborate to meet this unprecedented challenge.

How can the disintegration of ecosystems, the foundation of life on Earth, be halted and these critical systems be rehabilitated? For scholars, the action list is long: increase the pool of expertise by engaging all relevant knowledge communities, collect rapidly disappearing data, analyze with both familiar and new methods, and apply the results of actionable science to policy and practice [1][2]. This enormously complex and urgent activity requires an integrated research framework with the flexibility to accommodate the global diversity of places, peoples, and processes and to examine future options.

Based on evidence of environmental change and human activity, the framework termed historical ecology assembles tools to construct an evidence-validated, open-ended narrative of the evolution and transformation of specific ecosystems and landscapes. The term historical ecology includes humans as a component of ecosystems' evolution and defines history in a way that goes beyond the written record to encompass both the history of the Earth system and the social and physical past of humans and other species. The core idea of historical ecology is

that all sources of knowledge are combined to understand perspectives on the past in a specific place, so that its future can be more wisely managed [3][4][5].

2. Climate Change Remodels Landscapes

The availability of water will be an increasingly constraining variable in finding regions suitable for growing food as well as fibre, fuel, and fodder [6]. An ancient example comes from North and West Africa, which—due to monsoon rains in the late Pleistocene—was a region of springs and permanent lakes; the population subsisted on abundant resources that supported hunting, fishing, and gathering. With settlements anchored near water and easy access to diverse biomes and ecotones, they voyaged like ancient mariners across arid and desertic areas to find a large selection of food in water bodies, woodlands, savannahs, and oases [7]. Drawings in rock shelters and caves depict their dead as swimmers in the sand, between the islands of life and the afterlife [8]. After ca. 6000–5000 BP, the region became steadily drier; the population began to practice pastoralism and moved to the more reliable water source of the Nile River, bringing their religion with them, and founding one of the great civilizations of the world [9].

3. Landscapes: Building Frameworks and Standardizing Practice

Persistent landscape types (forests, arable land, wetlands) and functions (community-managed land, sacred places) are of particular interest because considerable evidence can deepen the baselines for key resources and activities. The research designs of landscape ecologists and archaeologists can easily accommodate other fields of study (e.g., heritage and regional planning; climate change; sustainable management).

Early work in historical ecology focused primarily on landscape types. Many established research groups study a particular mountain, forest, or grassland landscape: an early example of historical ecology as policy is the U.S. Geological Survey's work in the southwestern Rockies [10]. An early national approach is the Swiss Federal Institute for Forest, Snow and Landscape Research [11], founded in 1885 and using historical ecology since the 1990s; researcher-driven transdisciplinary work focused on the Pyrenees began about the same time [12].

While scaling, politics, and other issues impede more recent global-scale management, mountains, uplands, and forests are often studied at regional and trans-border scales [13][14][15][16][17][18][19][20]. Landscapes that were once managed as commons have been brought back into view, using a historical ecology approach termed 'environing' [21]. Scholars and practitioners under the aegis of the International Association for the Study of the Commons has planned a forest commons conference [22].

The traditional and sustainable management practices of LID communities have been explained and promoted in several contexts; good examples are several decades of regional and cross-boundary work to explain Saami practices to Scandinavian governments [23] and to rehabilitate traditional solutions [24][25]. Connections between the ongoing disappearance of African wetlands and the expansion of agriculture offer another example of how the regional study of shifting relations among landscape elements can signal major issues such as the decline of

biodiversity or looming water shortages [26][27][28]. Funded by the European Research Council [29], the MEMOLA project studied four mountainous European landscapes (in Spain, Albania, and Italy) to analyze agroecosystems that both maintain tradition and ensure the livelihood of rural communities over time.

These place- and region-based landscape projects serve the historical record, guide current decisions, and strengthen future management. Publishing outlets for local and regional work are expanding, notably the interdisciplinary journal Regional Environmental Change [30], the goal of which is to understand change, causation, and impacts at all territorial scales between the local and the global, whether they are defined by natural criteria (e.g., watersheds, ecosystems) or by human activities (urban areas/hinterlands).

Among the newest of international programs in this arena is the UNESCO BRIDGES global research coalition. BRIDGES [31] aims to integrate with UNESCO's Management of Social Transformations [32] intergovernmental science program. The aim of the coalition is to better integrate humanities, social science, and local and traditional knowledge perspectives into research, education, and action for global sustainability at local and territorial scales.

The European Research Council has funded additional future-oriented landscape projects. HERCULES [33] has a focus on the empowerment of public and private actors to protect, manage, and plan for sustainable landscapes of significant cultural, historical, and archaeological value at local, national, and pan-European scales. The European Commission has funded TERRANOVA [34], which trains next-generation researchers by charting shifting energy regimes as they have impacted land use strategies in Europe and demonstrates how landscape managers can draw on place-based solutions. The Commission also funds HERILAND [35], which addresses heritage management by exploring new ideas, tools, and training to ensure that interdisciplinary, research-based heritage, landscape management, and spatial planning are positively integrated with business activity, development, and democratic decision making.

At the national level, the U.S. National Park Service [36] published their strategy to manage cultural resources and climate change [37]. This inspired a group of researchers to form Climate Change Strategies and Archaeological Resources [38]. The group wishes to enhance archaeology's effectiveness with policy makers to increase knowledge about the multiple challenges that climate change has posed to the valuable and irreplaceable historical record.

Researcher-led coalitions have established the Historical Landscape Ecology Working Group [39], where members of the International Association for Landscape Ecology [40] and the International Association of Landscape Archaeology [41] share research and perspectives [42][43]. A group of researchers from many disciplines formed the project Integrated History and Future of People on Earth [44] in 2004. Founded on the principles of historical ecology, this global network has projects that feature collaboration with LID communities.

Global warming has already begun to transform familiar landscapes in ways that are difficult to predict in detail. French growers have begun to prepare for the future of their storied wines by working closely with climatologists, biologists, economists, sociologists, geographers, and geneticists to begin the process of adapting to anticipated

climate change [45][46]. In Sicily, olive growers have embraced historical ecology to prepare for changing conditions [47]. A geological and archaeobotanical approach to land-use change is used to identify and protect High Nature Value (HNV) Sicilian farmlands for the future [48][49].

4. The Land-Water Ecotone: Policy-Oriented Research Design

Seventy-one percent of the Earth's surface is water. Oceans and brackish water comprise about 97% of that quantity and play an important role in feeding the world's population. Fresh water—from rivers, springs, streams, lakes, and ponds—while accounting for only 2.5% of the planet's water, is vitally important for human consumption and for agriculture [6][50][51]. Throughout human history and just like the early Egyptians, people have chosen to live at ecotones, where several ecosystems converge and the biotic diversity is greatest. Lacustrine and riverine environments nourished our species; especially favored were places where a short distance separates fresh and saltwater, where rivers meet the sea.

Archaeologists can read past and present landscapes that allow them to find these places, even as shorelines and the courses of rivers have remodeled the landscape. There, they excavate the debris from long-ago expeditions to locate food, entwining human activity with the health and behavior of many species. Thus, sites containing the remains of kills and catches enter the archaeological record and allow deep knowledge of both prey and their environments. Particularly important in wildlife introductions and species history, genetic analysis can be undertaken with material from archaeological sites and collections [52]. These sites are time capsules for land and water species' histories, ecosystems, water quality, and the resource management and culinary practices of the searchers. As millennia-deep ice sheets melt, rising sea and lake levels and floods threaten these shoreline archives [53][54].

An important advantage of collaboration among archaeologists, zooarchaeologists, and paleoecologists is that baselines—a guideline or beginning point of reference—chart the history of entities (such as species) or phenomena (such as salinity) over time [55][56][57]. Thanks to a variety of techniques, it is now possible to trace species and ecosystems over centuries and millennia, enabling the assessment of shifts in climate, ecosystems, and species' abundance and health; these tools are especially useful in conservation [58][59][60].

Marine historical ecology (MHE) offers fruitful applications of historical ecology and environmental history to marine ecosystems [61], shorelines [62][63][64][65], and island ecosystems [66][67][68]. The continuing importance of coastal wetlands is underscored in the long-term analysis of their storm protection [69]. Much of this work has been accomplished by collaborating regional groups. The vibrant alliance of scholars with indigenous groups along the North Pacific façade has re-invigorated ancient practices to ensure the health of coastal resources such as herring and clams [70][71]. In south Florida, a deep-time study of marine resources in the Gulf of Mexico traces more than a thousand years of fishing and collecting [72]. The Distributed Long-term Observing Networks of the Past [53] assess human behavior and environmental change in the Arctic and subarctic regions over space and time. All these

collaborations engage multiple knowledge communities, both of heritage and of practice, while addressing climate change [73][74][75][76][77].

A seminal article [78] outlines how MHE researchers have taken the integrated methods of historical ecology directly to policy makers, and then followed up by analyzing whether the desired effects are reached and maintained. This muscular approach is a blueprint for action, precisely what is needed to ensure that historical ecology changes the thinking of policy makers and is thereby standardized.

The article identifies six policy themes: climate change, biodiversity conservation, ecosystem structure and function, habitat and seabed integrity, food security, and the importance of including social and economic considerations and facilitating 'bottom-up' governance to balance 'top-down' policies. It would not be too difficult to craft similar items for landscapes, thus clarifying collective goals while placing emphasis on policy.

MHE research reflects and explores these principles [79][80].

References

1. Palmer, M.A. Socioenvironmental Sustainability and Actionable Science. Bioscience 2012, 62, 5–6.
2. Beier, P.; Hansen, L.J.; Helbrecht, L.; Behar, D. A How-to Guide for Coproduction of Actionable Science: Coproducing Actionable Science. Conserv. Lett. 2017, 10, 288–296.
3. Balée, W. The Research Program of Historical Ecology. Annu. Rev. Anthr. 2006, 35, 75–98.
4. Crumley, C. (Ed.) Historical Ecology: Cultural Knowledge and Changing Landscapes; School of American Research: Santa Fe, NM, USA, 1994.
5. Crumley, C.L.; Kolen, J.C.A.; de Kleijn, M.; van Manen, N. Studying long-term changes in cultural landscapes: Outlines of a research framework and protocol. Landsc. Res. 2017, 42, 880–890.
6. Boretti, A.; Rosa, L. Reassessing the projections of the World Water Development Report. NPJ Clean Water 2019, 2, 1–6.
7. Garcia, E.A.A. Semi-Permanent Foragers in North and West Africa: An Archaeological Perspective. In Water and Food: From Hunter-Gatherers to Global Production in Africa; Tvedt, T., Oestigaard, T., Eds.; A History of Water, Series 3; I.B. Tauris: London, UK, 2016; Volume 3.
8. Barta, M.; Frouz, M. Swimmers in the Sand: On the Neolithic Origins of Ancient Egyptian Mythology and Symbolism; Dryada Publishing: Prague, Czech Republic, 2010.
9. Tvedt, T.; Oestigaard, T. (Eds.) Water and Food: From Hunter-Gatherers to Global Production in Africa; A History of Water; I.B. Tauris: London, UK, 2016; Volume 3.

10. Swetnam, T.W.; Allen, C.D.; Betancourt, J.L. Applied Historical Ecology: Using the Past to Manage for the Future. Ecol. Appl. 1999, 9, 1189.
11. WSL Home—WSL. Available online: https://www.wsl.ch/en/index.html (accessed on 26 June 2021).
12. Beltrán, O.; Vaccaro, I. (Eds.) Social and Ecological History of the Pyrénées: State, Market and Landscape; Left Coast Press: Walnut Creek, CA, USA, 2010.
13. Augustyn, A.M.; Brennan, J.; Feret, S.; Linhart, Z.; Soldaat, B. Territorial Approaches to Enhance Biodiversity in Rural Europe. Glob. Land Proj. News 2015, 12, 62–64.
14. Bürgi, M.; Gimmi, U. Three objectives of historical ecology: The case of litter collecting in Central European forests. Landsc. Ecol. 2007, 22, 77–87.
15. Bürgi, M.; Cevasco, R.; Demeter, L.; Fescenko, A.; Gabellieri, N.; Marull, J.; Östlund, L.; Šantrůčková, M.; Wohlgemuth, T. Where do we come from? Cultural heritage in forests and forest management. In How to Balance Forestry and Biodiversity Conservation. A View Across Europe; European Forest Institute (EFI); Swiss Federal Institute for Forest, Snow and Landscape Research (WSL): Birmensdorf, Switzerland, 2020; pp. 46–61. ISBN 978-3-905621-62-4.
16. Debarbieux, B.; Balsiger, J. Sustainable Development and the Concept of Scale. In The Elgar Companion to Geography, Transdisciplinarity & Sustainability; Sarmiento, F., Frolich, L., Eds.; Edwin Elgar: London, UK, 2020; pp. 49–66.
17. Perz, S.G.; Almeyda, A.M. A tri-partite framework of forest dynamics: Hierarchy, panarchy, and heterarchy in the study of secondary growth. In Reforesting Landscapes: Linking Pattern and Process; Nagendra, H., Southworth, J., Eds.; Landscape; Springer Science and Business Media: Berlin/Heidelberg, Germany, 2010; pp. 59–84.
18. Merçon, J.; Vetter, S.; Tengo, M.; Cocks, M.; Balvanera, P.; Rosell, J.A.; Ayala-Orozco, B. From local landscapes to international policy: Contributions of the biocultural paradigm to global sustainability. Glob. Sustain. 2019, 2, 7.
19. Adler, C.; Balsiger, J.; Grêt-Regamey, A.; Heinimann, A.; Huggel, C.; Weingartner, R.; Alcántara-Ayala, I.; Gebrekirstos, A.; Grau, R.; Jimenez, E.; et al. Making Connections for Our Changing Mountains: Future Directions for the Mountain Research Initiative (MRI). Mt. Res. Dev. 2020, 40, P1.
20. Costello, E. Hill farmers, habitats and time: The potential of historical ecology in upland management and conservation. Landsc. Res. 2020, 45, 951–965.
21. Lindholm, K.-J. Environing: The Archaeology of ‘Real Life’ Remains. In The Resilience of Heritage: Cultivating a Future of the Past, Essays in Honour of Professor Paul J.J. Sinclair; Ekblom, A., Isendahl, C., Lindholm, K.-J., Eds.; Studies in Global Archaeology; Uppsala University: Uppsala, Sweden, 2018; pp. 243–258.

22. IASC Forests Virtual Conference, September 13–17 Online Worldwide. Available online: https://2021forests.iasc-commons.org/ (accessed on 26 June 2021).
23. Svanberg, I.; Tunón, H. (Eds.) Ecological Knowledge in the North: Studies in Ethnobiology; Fyris-Tryck AB: Uppsala, Sweden, 2000.
24. Chavarría Arnau, A.; Reynolds, A. (Eds.) Detecting and Understanding Historic Landscapes; PCA Studies; SAP Società Archeologica S.R.L.: Mantova, Italy, 2015.
25. Larsson, J.; Päiviö Sjaunja, E.-L. Self-Governance and Sami Communities: Transitions in Early Modern Natural Resource Management; Palgrave Macmillan: Stuttgart, Germany, 2021.
26. Helmschrot, J.; Badjana, H.M.; Kabore/Bontogho, E.P. Land Cover Change and Its Implication for the Sustainable Management of West African Water Resources. Glob. Land Proj. News 2015, 12, 41–45.
27. Llopis, J.C.; Gardner, C.J.; Vincke, X. Land-Use and Land-Cover Change in a Global Biodiversity Conservation Priority: The Case of the Spiny Forest of Madagascar. Glob. Land Proj. News 2015, 12, 14–18.
28. Courtney Mustaphi, C.J.; Shoemaker, A.C.; Githumbi, E.N.; Kariuki, R.; Muriuki, R.M.; Rucina, S.M.; Marchant, R. Historical Ecology Perspectives of Change at Amboseli, Kenya. Glob. Land Proj. News 2015, 12, 26–29.
29. ERC: European Research Council. Available online: https://erc.europa.eu/ (accessed on 26 June 2021).
30. Regional Environmental Change. Available online: http://www.springer.com/journal/10113 (accessed on 26 June 2021).
31. UNESCO Toward the Establishment of Bridges: Action to Promote Sustainability Science. Available online: https://en.unesco.org/news/toward-establishment-bridges-action-promote-sustainability-science (accessed on 26 June 2021).
32. UNESCO Management of Social Transformations (MOST) Programme. Available online: https://en.unesco.org/themes/social-transformations/most (accessed on 26 June 2021).
33. Datahub of ERC Funded Projects. Available online: https://www.hercules-landscapes.eu/ (accessed on 26 June 2021).
34. TERRANOVA—The European Landscape Learning Initiative. Available online: https://www.terranova-itn.eu/ (accessed on 26 June 2021).
35. Cultural HERItage and the Planning of European LANDscapes|HERILAND Project|H2020|CORDIS|European Commission. Available online: https://cordis.europa.eu/project/id/813883 (accessed on 26 June 2021).

36. NPS.Gov Homepage (U.S. National Park Service). Available online: https://www.nps.gov/index.htm (accessed on 26 June 2021).
37. Rockman, M.; Morgan, M.; Ziaja, S.; Hambrecht, G.; Meadow, A. Cultural Resources Climate Change Strategy; Cultural Resources, Partnerships, and Science and Climate Change Response Program; National Park Service: Washington, DC, USA, 2016; p. 60.
38. CCSAR-Climate Change Strategies and Archaeological Resources. Available online: https://www.facebook.com/CCSAR.Info/ (accessed on 26 June 2021).
39. IALE—International Association of Landscape Ecology—Historical Landscape Ecology. Available online: https://www.landscape-ecology.org/page-18083 (accessed on 26 June 2021).
40. IALE—International Association of Landscape Ecology—Home. Available online: https://landscape-ecology.org/ (accessed on 26 June 2021).
41. International Association of Landscape Archaeology. Available online: https://iala-lac.org/ (accessed on 26 June 2021).
42. Arıkan, B.; Mohr, F.; Bürgi, M. Exploring the common ground of landscape ecology and landscape archaeology through a case study from eastern Anatolia, Turkey. Landsc. Ecol. 2020, 1–21.
43. Tappeiner, U.; Leitinger, G.; Zariņa, A.; Bürgi, M. How to consider history in landscape ecology: Patterns, processes, and pathways. Landsc. Ecol. 2020, 1–12.
44. Integrated History and Future of People on Earth. Available online: https://ihopenet.org/ (accessed on 26 June 2021).
45. Ollat, N.; Touzard, J.-M. La Vigne, Le Vin, et Le Changement Climatique En France—Projet LACCAVE—Horizon 2050. 2020. Available online: https://hal.archives-ouvertes.fr/hal-02538191/ (accessed on 26 June 2021).
46. Bellia, S.; Douguedroit, A.; Seguin, B. Impact du Réchauffement sur les Étapes Phénologiques du Développement du Grenache et de la Syrah dans les Côtes du Rhône et les Côtes de Provence (1976–2000). In Proceedings of the International and Multi-disciplinary Colloquium on Global Warming, Which Potential Impacts on the Vineyards, Dijon, France, 28 March 2007.
47. Ferrara, V.; Ekblom, A.; Wästfelt, A. Biocultural Heritage in Sicilian Olive Groves. The Importance of Heterogeneous Landscapes over the Long Term. In Encyclopedia of the World's Biomes; Elsevier: Amsterdam, The Netherlands, 2019; pp. 135–145.
48. Bazan, G.; Speciale, C.; Barba, A.C.; Cambria, S.; Micciché, R.; Marino, P. Historical Suitability and Sustainability of Sicani Mountains Landscape (Western Sicily): An Integrated Approach of Phytosociology and Archaeobotany. Sustainability 2020, 12, 3201.
49. Bazan, G.; Barba, A.C.; Rotolo, A.; Marino, P. Geobotanical approach to detect land-use change of a Mediterranean landscape: A case study in Central-Western Sicily. Geojournal 2018, 84, 795–

811.

50. Shiklomanov, I. World Freshwater Resources. In Water in Crisis: A Guide to the World's Fresh Water Resources; Gleick, P.H., Ed.; Oxford University Press: New York, NY, USA, 1993; pp. 13–23.
51. Munduruku, K.; Knudsen, D.; Safe, I.V. Rivers Are Key to Restoring the World's Biodiversity; Independent Media Institute: New York, NY, USA, 2021.
52. Wellman, H.P.; Austin, R.M.; Dagtas, N.D.; Moss, M.L.; Rick, T.C.; Hofman, C.A. Archaeological mitogenomes illuminate the historical ecology of sea otters (Enhydra lutris) and the viability of reintroduction. Proc. R. Soc. B Boil. Sci. 2020, 287, 20202343.
53. Hambrecht, G.; Anderung, C.; Brewington, S.; Dugmore, A.; Edvardsson, R.; Feeley, F.; Gibbons, K.; Harrison, R.; Hicks, M.; Jackson, R.; et al. Archaeological sites as Distributed Long-term Observing Networks of the Past (DONOP). Quat. Int. 2020, 549, 218–226.
54. Fordham, D.A.; Jackson, S.T.; Brown, S.C.; Huntley, B.; Brook, B.W.; Dahl-Jensen, D.; Gilbert, M.T.P.; Otto-Bliesner, B.L.; Svensson, A.; Theodoridis, S.; et al. Using paleo-archives to safeguard biodiversity under climate change. Science 2020, 369, eabc5654.
55. Pauly, D. Anecdotes and the shifting baseline syndrome of fisheries. Trends Ecol. Evol. 1995, 10, 430.
56. Jackson, J.B.C.; Alexander, K.E.; Sala, E. (Eds.) Shifting Baselines: The Past and the Future of Ocean Fisheries; Island Press: Washington, DC, USA, 2011.
57. Moen, J.; Hilding-Rydevik, T.; Green, C. Baselines and the Shifting Baseline Syndrome: Exploring Frames of Reference in Nature Conservation. In Issues and Concepts in Historical Ecology: The Past and Future of Landscapes and Regions; Crumley, C.L., Lennartsson, T., Westin, A., Eds.; Cambridge University Press: Cambridge, UK, 2018; pp. 112–141.
58. Klein, E.S.; Thurstan, R.H. Acknowledging Long-Term Ecological Change: The Problem of Shifting Baselines. In Perspectives on Oceans Past; Schwerdtner Máñez, K., Poulsen, B., Eds.; Springer Netherlands: Dordrecht, The Netherlands, 2016; pp. 11–29. ISBN 978-94-017-7495-6.
59. Rick, T.C.; Lockwood, R. Integrating Paleobiology, Archeology, and History to Inform Biological Conservation: Paleobiology, Archeology, and History. Conserv. Biol. 2012, 27, 45–54.
60. Rick, T.C.; Reeder-Myers, L.A.; Hofman, C.; Breitburg, D.; Lockwood, R.; Henkes, G.; Kellogg, L.; Lowery, D.; Luckenbach, M.W.; Mann, R.; et al. Millennial-scale sustainability of the Chesapeake Bay Native American oyster fishery. Proc. Natl. Acad. Sci. USA 2016, 113, 6568–6573.
61. Erlandson, J.M.; Braje, T.J.; Ainis, A.F.; Culleton, B.J.; Gill, K.M.; Hofman, C.A.; Kennett, D.J.; Reeder-Myers, L.A.; Rick, T.C. Maritime Paleoindian technology, subsistence, and ecology at an

~11,700 year old Paleocoastal site on California's Northern Channel Islands, USA. PLoS ONE 2020, 15, e0238866.

62. Toniello, G.; Lepofsky, D.; Lertzman-Lepofsky, G.; Salomon, A.K.; Rowell, K. 11,500 y of human–clam relationships provide long-term context for intertidal management in the Salish Sea, British Columbia. Proc. Natl. Acad. Sci. USA 2019, 116, 22106–22114.
63. Neudorf, C.M.; Smith, N.; Lepofsky, D.; Toniello, G.; Lian, O.B. Between a rock and a soft place: Using optical ages to date ancient clam gardens on the Pacific Northwest. PLoS ONE 2017, 12, e0171775.
64. von der Porten, S.; Lepofsky, D.; McGregor, D.; Silver, J. Recommendations for marine herring policy change in Canada: Aligning with Indigenous legal and inherent rights. Mar. Policy 2016, 74, 68–76.
65. Groesbeck, A.S.; Rowell, K.; Lepofsky, D.; Salomon, A.K. Ancient Clam Gardens Increased Shellfish Production: Adaptive Strategies from the Past Can Inform Food Security Today. PLoS ONE 2014, 9, e91235.
66. Kirch, P.V. Historical Ecology in the Pacific Islands; Yale University Press: New Haven, CT, USA, 2000.
67. Rick, T.C.; Kirch, P.; Erlandson, J.M.; Fitzpatrick, S.M. Archeology, deep history, and the human transformation of island ecosystems. Anthropocene 2013, 4, 33–45.
68. Braje, T.J.; Leppard, T.P.; Fitzpatrick, S.M.; Erlandson, J.M. Archaeology, historical ecology and anthropogenic island ecosystems. Environ. Conserv. 2017, 44, 286–297.
69. Mulder, O.J.; Mulder, K.P.; Kubiszewski, I.; Anderson, S.J.; Costanza, R.; Sutton, P. The value of coastal wetlands for storm protection in Australia. Ecosyst. Serv. 2020, 46, 101205.
70. Lepofsky, D.; Toniello, G.; Earnshaw, J.; Roberts, C.; Wilson, L.; Rowell, K.; Holmes, K. Ancient Anthropogenic Clam Gardens of the Northwest Coast Expand Clam Habitat. Ecosystems 2021, 24, 248–260.
71. Thornton, T.F.; Moss, M.L. Herring and People of the North Pacific: Sustaining a Keystone Species; University of Washington Press: Seattle, WA, USA, 2020.
72. Marquardt, W.H.; Walker, K.J. (Eds.) The Archaeology of Pineland: A Coastal Southwest Florida Site Complex; Institute of Archaeology and Paleoenvironmental Studies, University of Florida Press: Gainesville, FL, USA, 2013.
73. Ciftcioglu, G.C. Participatory and deliberative assessment of the landscape and natural resource social values of marine and coastal ecosystem services: The case of Kyrenia (Girne) Region from Northern Cyprus. Environ. Sci. Pollut. Res. 2021, 28, 27742–27756.

74. Hillerdal, C.; Knecht, R.; Jones, W. Nunalleq: Archaeology, Climate Change, and Community Engagement in a Yup'ik Village. Arct. Anthr. 2019, 56, 4–17.
75. Palsson, G. Enskilment at Sea. Man 1994, 29, 901.
76. Pullar, G.L.; Knecht, R.A.; Haakanson, S., Jr. Archaeology and Sugpiaq Renaissance on Kodiak Island: Three Stories from Alaska. Ètudes Inuit Stud. 2013, 37, 79–94.
77. Salgueiro-Otero, D.; Ojea, E. A better understanding of social-ecological systems is needed for adapting fisheries to climate change. Mar. Policy 2020, 122, 104123.
78. Engelhard, G.H.; Thurstan, R.; MacKenzie, B.; Alleway, H.; Bannister, R.C.A.; Cardinale, M.; Clarke, M.W.; Currie, J.; Fortibuoni, T.; Holm, P.; et al. ICES meets marine historical ecology: Placing the history of fish and fisheries in current policy context. ICES J. Mar. Sci. 2015, 73, 1386–1403.
79. Fitzhugh, B.; Butler, V.L.; Bovy, K.M.; Etnier, M.A. Human ecodynamics: A perspective for the study of long-term change in socioecological systems. J. Archaeol. Sci. Rep. 2019, 23, 1077–1094.
80. Smith, H.; Lozano, A.G.; Baker, D.; Blondin, H.; Hamilton, J.; Choi, J.; Basurto, X.; Silliman, B. Ecology and the science of small-scale fisheries: A synthetic review of research effort for the Anthropocene. Biol. Conserv. 2021, 254, 108895.