



Landscape ecology 40 years since Allerton Park: looking back and to the future!

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In April 1983, 25 ecologists and geographers met at Allerton Park, Illinois to discuss directions and approaches to landscape ecology (Risser et al. 1984). At this important meeting the seeds of modern landscape ecology were sown and an identity for landscape ecology was established (Wu 2013a; Forman 2023). In this editorial I reflect on this important meeting, look at its impact on landscape ecology, and suggest what landscape ecologists need to do over the next 40 years.

1983 was obviously a significant year for landscape ecology. But if we look back at what was also happening in that year, we see from the major news events, that January 1st, 1983, has been recognized as the official birthday of the Internet (<https://www.britannica.com/>). Other landmark events that year include the fact that Microsoft Word was first released, and the first cellular telephone call was made via a DynaTAC by Motorola. Sony and Philips also released CD players in the US. These are all major technological milestones that have significantly impacted the way we have lived our lives and undertaken research since that date. 1983 therefore appears to be a remarkable year not only in terms of progressing landscape ecology but also in playing a pivotal role in assisting the progression of the digital age that we now find ourselves such a part of. When we look at the digital revolution that has occurred since 1983 it is not surprising that the developments in landscape ecology over the last 40 years have also been propelled by the increased digital capabilities that have been co-evolving at the same time.

The significance of Allerton Park—laying the foundation and defining landscape ecology

Although not on the same scale as the birth of the internet, as a landscape ecologist, I acknowledge (as I am sure many do) the significance of the Allerton Park event as one that went on to not only help

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to shape my academic career but as one that has facilitated the expansion of a meta-discipline that has inspired many scientists over the last 40 years. Wu (2013a) describes what came out of the Allerton Park meeting as ‘game changing’. It certainly appears to have been a pivotal moment in the history in the development of landscape ecological thinking. The growth from which has influenced and encouraged the research of many landscape ecologists, globally, in their quest for science-based strategies for sustainable landscape management and successful biodiversity conservation.

The report that came out of the Allerton Park workshop (Risser et al. 1984) drew some interesting conclusions about what landscape ecology was and how it would or needed to develop. Notably, these included the statement that has helped to define its trademark emphasis related to understanding pattern, process and change and brought to the forefront its particular specialist focus on heterogeneity: i.e., “Conceptually, landscape ecology considers the development and maintenance of spatial heterogeneity, the spatial and temporal interactions and exchanges across heterogeneous landscapes, the influences of heterogeneity on biotic and abiotic processes, and the management of that heterogeneity” (Risser et al. 1984 p. 5). In discussing future directions Risser et al. (1984) also stated that “A special need exists for research in numerous aspects of spatial patterning and its effects on redistribution processes” (p. 5). These key statements and observations drawn as conclusions from the meeting have undoubtedly helped to define the direction that landscape ecology research has taken over the last 40 years. They also emphasize the important foundation that was laid at the Allerton Park meeting and has been built upon by landscape ecologists ever since. Wu’s (2013a) perspective article which reflected on 30 years since Allerton Park demonstrated the frequency of research considerations related to spatial and temporal heterogeneity in articles published in *Landscape Ecology* in the journal’s history. The analysis illustrates the amount of work that has been undertaken following this line of exploration since the 1980s. Understanding the ecological implications of spatial patterning has been a core focus of research that has helped us (landscape ecologists) to acquire important knowledge that can be used to better manage ecosystems and

to determine the causal relationships that influence processes and functioning (Weins 2009).

Growing with technology

Risser et al. (1984) also stated that “..models, geographic information systems and database management methods are developing rapidly in ecology and related disciplines. Continuing advances in the development of analytical tools will further aid the conceptual base of landscape ecology” (p. 5). They also made the important observation as a workshop recommendation that “Addressing some questions in landscape ecology requires the ability to acquire and manage large quantities of data. The availability and relatively low cost of computing power and mass storage will facilitate the development of landscape ecology” (p. 6). The capacity to undertake more complex spatial and temporal analysis, mapping and modeling, and the associated reduced cost of computing and data storage that have occurred since the 1980s have had a significant impact. Advancement has been further catalyzed by the ability to capture and process large amounts of time series data at fine spatial resolution, and to be able to share data and information easily on a global scale. These technological developments have undoubtedly all played a major part in where landscape ecology is to date (Yu et al. 2019; Foody 2023).

At the Allerton Park meeting the participants knew that technological advancement was coming, and this would benefit landscape ecology but perhaps no one at the time would have predicted just how far things might have developed. The capability we now have available to discern spatial and temporal heterogeneity through multidimensional data is immense compared with 40 years ago. To be able to link sophisticated spatial and temporal analysis to the ecological consequences of both natural and human-induced changes has helped to better understand global and local scale land system change. Imminent further advancements are set to provide even more in-depth conceptualisation of reality in the future (Lepczyk et al. 2021).

Responding to global challenges

Not to underestimate the impact of the Allerton Park meeting and the technological advancements over the last 40 years on the trajectory of landscape ecological progression and discovery but we must also recognize that the advancement and uptake of landscape ecological thinking in the last 40 years can arguably also be intrinsically linked to, and influenced by, an increased need to address the challenging environmental issues that face life on Earth. Driving the need for the application of landscape ecological theory, tools and techniques has been a progressive acknowledgment that multi-, inter-, and transdisciplinary approaches to landscape management are required to address complex global environmental challenges. Approaches that are informed by holistic considerations and driven by goals of resilience and adaptation in the face of changing landscape patterns and processes are seen to be paramount to tackle the world's pressing wicked problems relating to unsustainable use of natural resources and climate change. As we have progressed from the late 20th century into the 21st century it is becoming increasingly evident that urgent action is needed to address the challenge of the Anthropocene. Pressure is mounting around the imperativeness of meeting the United Nations Sustainable Development Goals at a time when multiple planetary boundaries are exceeded. We are also close to crossing the safe operating space of many others (Steffan et al. 2015; Rockstrom et al. 2009). Landscape Ecology has therefore found itself well positioned as a meta-discipline unconstrained by disciplinary boundaries and through its ability to encourage holistic thinking, to adopt new technologies to undertake innovative transdisciplinary research that focuses on spatiotemporal patterns, and to respond to the ongoing impacts of land system change. The broad conceptual focus of landscape ecology as outlined in Risser et al. (1984) has allowed researchers from many different backgrounds to apply landscape ecology in a diversity of ways to address different problems from both ecological and social perspectives related to challenging global environment issues, which as a result has informed science, policy, and management of landscapes (Mayer et al. 2016).

Much outstanding research in the name of landscape ecology has been undertaken in the 40 years that have followed Allerton Park. Over this time, we

have come to understand so much more about the relationships between pattern and process and the importance of spatial heterogeneity. We now resolutely recognize the value of landscape functioning and services and the important role they play in landscape management for conservation and sustainable landscapes (Wu 2013b). However, we continually see, almost on a daily basis, the consequences of a changing climate and land system change through land clearance to house and feed a growing population. The relevance of landscape ecology in the face of some of the most serious global challenges we have ever encountered has never been so significant. This means that there is still much work to be done to secure a sustainable future for the next generation and much landscape ecological research still needs to be undertaken. Together with its conjoined sister science of landscape sustainability science (Wu 2013b, 2021) there is great potential for landscape ecologists to address these crucial sustainability challenges.

Looking to the future

It seems pertinent then that 40 years on from the landmark Allerton Park meeting we acknowledge its occurrence and the impact it has had on landscape ecology to date, but also recognize that it will undoubtedly be the next 40 years that will be the most important in terms of what landscape ecology can achieve to preserve life on Earth as we know it. So, it will be arguably the next phase of landscape ecological application and evolution that will be its most consequential yet.

Interestingly, reaching the 40-year mark in some religions is meant to symbolise the time it takes for a new generation to arise. One could argue that this is where we are now in the field of landscape ecology. Few of the older landscape ecologists that were active 40 years ago are still active in research, and even some of their students are now heading towards retirement. It is time for the baton to be handed on to a new generation of landscape ecologists. It will be up to the new generation of landscape ecologists to take the field into its next era. This is an era where technology is also moving to a new level. Advancements in Artificial Intelligence offers both challenges and opportunities for academics and researchers (Haghighi et al. 2023). But given that landscape

ecology “is the synthetic intersection of many related disciplines that focus on the spatial-temporal patterns of the landscape” (Risser et al. 1984), there is still scope to learn and grow from all of its contributing elements as they themselves grow. There is opportunity to adapt to and utilize every technological advancement to its best capability and capacity, and to work alongside other disciplines in a more targeted manner to tackle the world's wicked problems and to achieve the levels of sustainability that we aspire to.

If we rise to the challenges ahead then one can only hope that when another 40 years have passed, when it is 80 years since Allerton Park, there won't be the same level of urgency to get landscape management right. We can have an expectation that the landscape ecologists passing on the baton at that stage will be leaving behind a legacy of work that contributed towards achieving sustainable landscapes, livelihoods, and lifestyles, that we as landscape ecologists of the past, today and tomorrow can all be proud to have played a part in creating and which drew on the musing of the 25 meeting participants at Allerton Park back in 1983!

Ways forward

So, as we look back to reflect on 40 years since Allerton Park as landscape ecologists, we must also look forward and look to the future. We must learn from where we have been. We should seize opportunities and encourage future landscape ecologists to embrace the new technology that they are provided. We are going to need holistic thinking and innovation to effectively utilize the powerful tools and technologies that are undoubtedly to come if we are to address some of the world's greatest challenges around sustainability. These new tools and technologies offer potential to further expand our understanding of the complex interrelationships between landscape patterns, processes and change and the role that people play in shaping these. But we should also not forget the important knowledge that has already been accumulated. We should not forget the foundation on which modern landscape ecology was built.

Building on foundational landscape ecology we should work hard to close the knowledge gaps identified in future landscape sustainability research agendas (Wu 2021). Focusing on the relationship between

landscape pattern and ecosystem services, human well-being and biodiversity conservation will help us to achieve more sustainable landscapes that are capable of supporting sustainable lifestyles and livelihoods whilst reducing loss of endemic species. Whilst considering the impact of land system change and climate change on these relationships and deepening our understanding of ecosystem function will help us to recognise vulnerability in our landscapes and land systems, build resilience and strategize towards adaptability (Wu 2021).

We also need to recognise that if we are to achieve truly sustainable landscapes, lifestyles and livelihoods in the future, we need to accept that the ongoing actions of people will be critical and therefore acknowledge that real change will only be possible if we fully understand human cognition of landscapes, build upon connections to landscapes and embrace people's 'sense of place' associated with landscapes (Pearson and Gorman 2023).

In our quest for sustainability, we should also encourage and support the co-production of knowledge that incorporates local, indigenous, and traditional knowledge. To date in landscape ecology, we have undervalued local and indigenous knowledge and perceptions related to landscapes, yet there is great potential to be had in better integrating scientific knowledge with local and particularly indigenous traditional knowledge. There is scope to better incorporate different cultural perspectives and indigenous traditional knowledge into landscape ecological research of the future which could make for exciting investigations with groundbreaking impact. Integrating old ways and new ways may potentially hold the key to not only sustainable landscape management but a more sustainable time to come. So, 40 years on from Allerton Park, let us look back and to the future and let us make sure that we inspire the next generation of landscape ecologists so the next 40 years of landscape ecology can be the most significant and influential yet!

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