Seeing corridors: discovering spatial characteristics of forests through sequential sectioning

Nathan, M, Heavers [1]
[1] *Temple University*

Abstract

Landscape planning, design, and management use drawings to describe existing and proposed conditions. Drawings and maps are particularly important to analyze large land areas where interventions occur at the scale of landscape ecology. Forested corridors and greenways, for instance, are often studied and represented through aerial images, maps, and plans, but these formats obscure the three dimensionality and spatial characteristics of forests. While LIDAR point clouds allow three-dimensional canopy mapping, a visual challenge remains—how to see a whole forested landscape while concurrently understanding its spatial characteristics in detail.

How is it possible to see the parts and the whole of a forest simultaneously? Landscape architects typically use sections. Singular sections may represent the typical conditions, or they may show specific characteristics of a particular place. Sequential sections, on the other hand, may be used to show change over time and space. For example, Michael Van Valkenburgh Associates have very effectively drawn time-sequences of tree plantings maturing (Carlisle & Pevzner, 2012). While landscape architects often draw sections at key places along corridors and greenways in sequence, it less common to draw sequential sections at regular intervals or as a random stratified sample, as foresters do with transects, for instance. This approach, drawing sequences and arrays of sections to explore spatial characteristics rather than show typical conditions, as is usual in landscape architecture and planning, has value to greenway planning and design along forest corridors.

Through the author's drawings for the Urban Forest Management Plan for the George Washington Memorial Parkway, the paper demonstrates that sequential sections drawn at set intervals without pre-selecting where the sections are drawn is useful 1) to explore the varied spatial characteristics of a forest too extensive to study entirely in the field, 2) to characterize and categorize changing conditions along a forested greenway, and 3) to see and understand the spatial characteristics of the forest in terms of variety, proportion, and scale, all characteristics that are important to designers and planners who shape places for people.

Introduction

Representation in design and planning is a broad and diverse subject. Drawing, mapping, and aerial photography are invaluable means of representing landscapes. Large landscapes, such as greenways, are often viewed and analyzed from above with typical sections used to describe ground level phenomena. Typical sections represent general conditions in an area and may be adapted from specific conditions in a particular location, for instance measured through a forest transect. For example, Ian McHarg (1969) used typical sections in *Design with Nature* to describe the forests of the Potomac River Basin and Washington, DC, the forests explored in this research. McHarg's sections generally describe existing forest types across wide areas rather than characteristics at specific locations. This type of typical section contrasts with sections used for design projects or transects in forestry, which show very detailed spatial characteristics of particular places, such as stands of trees, their habits, qualities, species types, density, variation, and scale, among other features such as the shade they cast. All landscape architect's make drawings of this type with attention to the spatial characteristics of specific places to inform and develop designs.

Greenway planning and design use both typical and highly specific sections at key points but also rely heavily on aerial photography and GIS for analysis. These tools are useful to address a wide range of questions and problems, however viewing the world from above has shifted the way humans see, interpret, and experience the world and landscapes, distancing the analyst from physical places and projecting a sense of rationality and objectivity to drawings and maps (Corner 1996, p.16). Clearly, these top-down modes of representing landscapes are significant and critical to recording, representing, analyzing, planning, and designing for the health and well-being of places and the planet, however they are limited in several ways. They 1) emphasize extent and broader patterns of over granular and messy details; 2) show 2D spatial patterns more readily than ground level 3D character and sequences; and 3) may lack a healthy mixture of analytical and suppositional thinking in their creation. *How might some of these limitations be overcome through other types of representation or drawing?*

Sequential sectioning, especially drawing at regular intervals without cherry-picking the points surveyed, offers an under-appreciated complement to typical landscape analysis through GIS data and mapping and aerial photography. Sequential sectioning or drawing a series of cross sections through a landscape is a technique used by landscape architects to show changing conditions through space and time. But often the selection of sample sections in the sequence is a means to an end. What if the practice was to sample as foresters do with transects, and as modelled by landscape architects Anuradha Mathur and Dilip Da Cunha (2006) in a variety of landscape types?

This paper discusses the value of sequential sectioning to understand the spatial qualities of a forest over 25 miles. It uses examples drawn by the author in creating the Urban Forest Management Plan for the George Washington Memorial Parkway (sponsor, National Park Service). Most of the drawings shown are not part of the finished plan but rather were created in the process of seeing and understanding the forest corridor. They document provisional findings drawn from a variety of data and like all drawings are also creative expressions. They demonstrate that sequential sectioning may be useful in greenway planning and urban forest management 1) to explore the sweeping mosaic of an urban forest corridor while remaining attentive to its spatial details; 2) to characterize changing conditions along a forest greenway which are hidden in top-down drawings, and 3) to visualize the rich and detailed spatial characteristics of forests while keeping an eye on how the parts contribute to the whole.

Background

James Corner's (2014) collected essays on representation and the landscape imagination are a valuable source of theories on the importance of thinking in space and time for landscape architects and planners and offer examples of bridging the analytical and the imaginative, both of which sequential sections do. Mathur and Da Cunha foreground this sort of thinking by using sequential sectioning to read landscapes and reveal their histories and qualities. Dilip Da Cunha (personal communication, December 2024), suggested that sequential sectioning is an evolving concept not rightly attributable to any individuals or moment. Da Cunha and Mathur evolved and foregrounded the approach in their work. They did not however focus on forested landscapes, rather topography, wetness, and cultural qualities. Their students however did apply the approach to Philadelphia's forested Wissahickon Valley over a couple of decades. Of course, sequential sampling has been used the world over for analyses, such as vegetation surveys, but often such work is focused on species and their distributions rather than the spatial qualities they afford. And the notion of sequential sections is a long-used and cross-cultural concept; Chinese scroll paintings in some cases seem to reveal a journey bearing qualities of sequential sections or perhaps sequential elevations.

Sequential sectioning is firmly part of the landscape architecture drawing lexicon along with the idea of the deep or thick section (Carlisle & Pevzner 2012), but the distinction between drawing at a set interval or as a sequence of typical sections is less discussed. Ian McHarg inspired a generation of students at the University of Pennsylvania, James Corner among them, to study landscapes both in layered plans and deep sections. McHarg's work drew from Patrick Geddes' concept of the Valley Section, though he did not acknowledge the source of the drawing type (Spirn, 2000). McHarg used sections extensively often to represent typical conditions across an area, while Mathur, Corner's student and then colleague, cut sections sequentially, indexing conditions at regular intervals, a conceptual leap for landscape architecture, perhaps, building on scientific methods. Examples of sequential sectioning like Mathur's are fairly common now in landscape architecture education, though not prevalent (See Amorosa (2019)), and their use in practice is limited. Exceptions include typical before and after section drawings showing proposed changes. Among the strongest examples of sequential sections of forests are the work of Roland Gustavsson (Fig. 1) which tend to focus of time-based sequences of changing spatial characteristics rather than sections taken sequentially moving through a landscape at a given time, as explored here. And the examples discussed here make a scalar leap to planning, corridor design, and management.

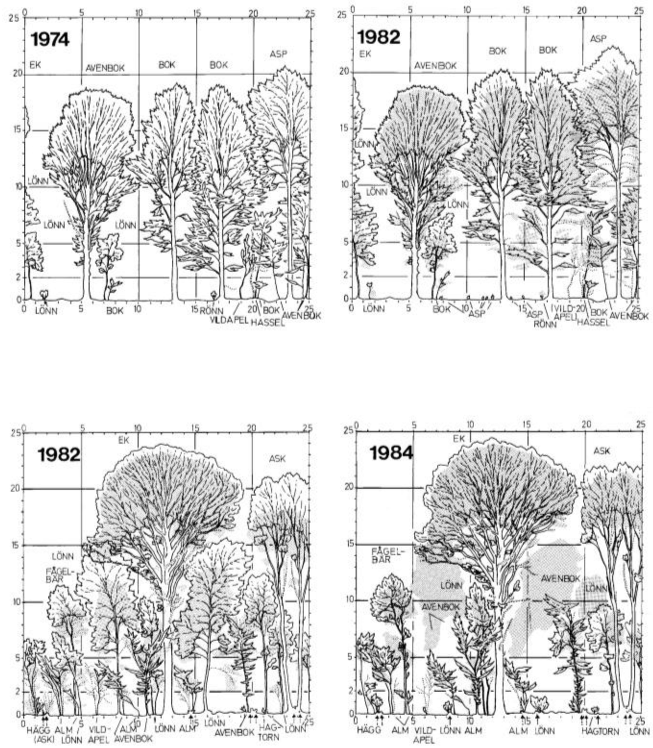


Figure 1: Example of sequential forest sections in time (Gustavsson, 2009)

Method and Data

This is a case study from urban forest planning practice within an academic setting. It looks at how the author’s sequential section drawings contributed to the analysis of the Urban Forest Plan for the George Washington Memorial Parkway. This was a small part of a large, multi-year, multi-disciplinary team effort by faculty and graduate students from Virginia Tech and Temple University. The three faculty leads were Dr. Paul Kelsch, Dr. Eric Wiseman, and the author. The research approach stems from the idea that knowledge, understanding, and even wisdom in design and planning disciplines may emerge directly from practice (Xiang, 2016; Steiner, 2022). The paper reflects on the process of studying the parkway through drawing and uses sequential sections and related drawings as evidence. The aim is to share experience and practical knowledge gained so that others might employ and further develop their own practices and the approach. The drawings shown are sketched by hand, based on a combination of data from GIS, aerial photographs, ground level photographs, field surveys, and the author’s forest expertise and imagination. Only one of the drawings was included in the final plan itself. These are planning “process drawings.” Their purpose was to make the complex and diverse forest more intelligible and its spatial characteristics more apparent, aiding in the writing of strategies and recommendations for the forest’s management.

Results

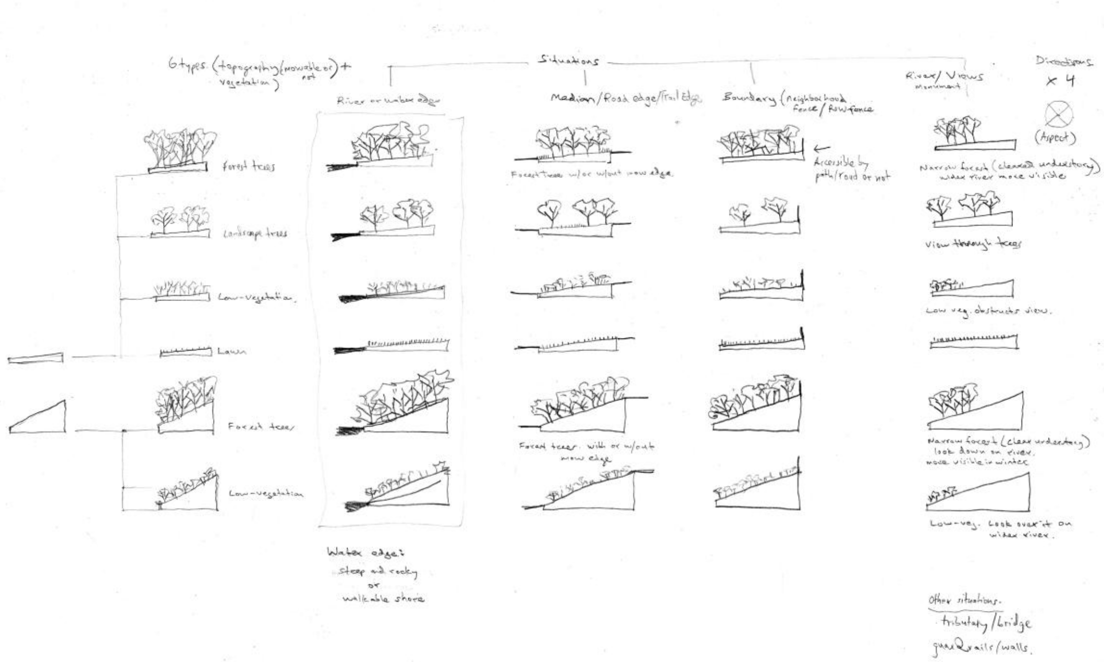
Landscape planning depends on the analysis of existing conditions, whether for an urban forest management plan, as in this case, or for large parks and greenways. It is important to assess the character, quality, and integrity of ecosystems and cultural landscapes before making suggestions about how they might be better managed. Twelve distinctive scientific studies were conducted as part of this project to understand the baseline conditions of the urban forest and develop the urban forest plan. These studies included analyses of land cover conditions, forest change detection over time, and quantification of tree decline and invasive vines along edges to name a few. The drawings shown and discussed here were a small part of this body of research focused on understanding the diverse spatial characteristics of the urban forest as it winds along the 25-mile parkway corridor parallel to the Potomac River and passing by Washington, DC, on its way to Mount Vernon.

Much of the analysis for the plan was typically top down, so these drawings were an effort to bear in mind the spatial characteristics of the forest which shape peoples' experiences of this greenway. The drawings operated at several scales and with three purposes: 1) To grasp the varied spatial characteristics of the forest in a systematic way 2) to categorize and characterize the forest edge conditions, areas most frequently viewed and experienced by visitors to the park, and 3) to see and note distinct places, such as special groves, clearings, and important local designed forest patches. The drawings are, in a sense, "virtual" walks drawn systematically. They are investigations with the intent of understanding an urban forest in three dimensions across areas too vast to survey on foot. They do not represent firm findings or conclusions about the forest but rather offer windows into its diverse spatial characteristics.

Figures 2 (left) and 3 (right): Discovering the places through tracing and seeing the whole forest, respectively, drawings by author.

Scoping drawings

Two drawings of this type were very useful to comprehend the extent and variety of the forest as well as its relationship to topography and the river. Figure 2 is a simple plan traced from GIS data showing the parkway and its relationships to the forest and the Potomac. While based on existing maps, and not factually distinct from them, it revealed the relative thinness of the corridor and how it is experienced as a series of distinct places, corresponding often to forest patches and cultural sites (Memorial Bridge between Arlington Cemetery and the National Mall is about mid-way on the plan). While not sectional, it shows the relative relationships from place to place along the greenway. The narrowness of the forest corridor may be observed and experienced in a variety of ways, but the process of drawing an overall plan revealed distinctive places, as well as the predominance of forest edge over forest interior. A second exploratory drawing examined a 5-mile portion of the parkway (Fig. 3), looking at the largest forest block at the north end of the park. This area includes a 200’ high bluff sweeping down through forest to the river. The National Land Cover Database classifies the forest cover in this area as a dozen distinct types based on species present and diverse ecological characteristics. Each section was drawn at one-mile intervals and interprets the forests it traverses in terms of their height, layers, and density. This area is accessible only by a rugged riverside trail and a few paths that navigate the slopes. Sequential sectioning was a way to survey the forest remotely and to experience it less abstractly than in a plan view. Using a monochromatic palette the twelve forest types become one forest with a variety of characteristics changing with the terrain and species present. It clothes the slopes and undulates with them. Its canopy of tulip tree, oak, hickory, and maple responds to the ground conditions—shorter on the ridges and taller in the valleys and approaching the river. This is the largest interior forest block in the corridor. Sequential sections helped make it visible vertically, especially its scale and proportions. Examining the drawing further reveals how the forest frames the parkway corridor and its own spaces between the densely layered tree trunks.



Figures 4: An array of edge types, drawing by author.

Figures 5: sequential sections along mile 3, each 1/10 of a mile, drawing by author.

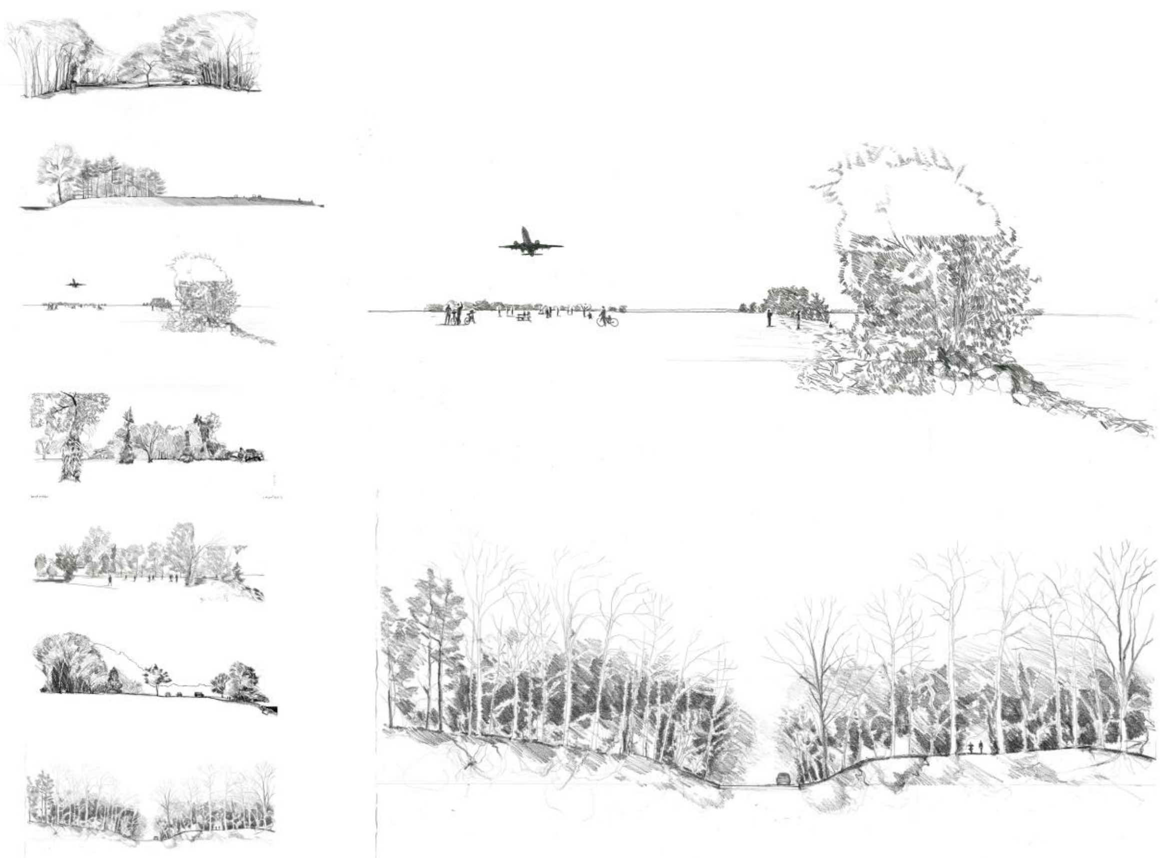
Characterizing edges

The array of sections in Figure 4 reveals that the parkway is shaped by numerous edges (roadway to forest, neighborhood to forest, and forest to river). Using small multiples, the parkway sequence is taken apart and reorganized by forest cover types, topography, and relationships of the parkway to water and neighborhoods. This was useful to understand the variety of forest edges found along the corridor especially as they relate to topography, which impacts accessibility for maintenance and use of the urban forest. Sorting the forest edges in this quick and schematic way helped bring greater clarity to the variety of spatial characteristics of the existing design. There are places to look through trees to the water whether close to the river or on a bluff. There are riverside lawns and inaccessible patches. At times the forest touches the edge of the parkway, sometimes it is set back or framed by specimen trees. The approach here is less original—identifying and representing an array of typical sections as is frequently done in landscape architecture. This contrasts with Figure 3. This array informed later analysis assessing edges for trees in decline and vine inhabitation and another set of sequential sections, drawn by Temple University graduate student Brett Barnes. Barnes' sections became illustrations (Fig. 6) in the final plan focused on invasive plant growth on the forest edges. They were drawn at random points within each mile of the parkway (random stratified sample) and are a final iteration of the type of shown in Figure 5. This set shows sequential sections at 0.1 mile intervals in the southern section of the parkway. This stretch reveals the parkway climbing a hill and rising with the forest away from the river. It begins with an open edge with views to the river and concludes under canopy on both sides and over top the roadway. Shorter intervals between sections and zooming in on a one-mile stretch improve the capacity of the sequential sections to show changing spatial relationships between topography, forest, and the river. But practically, the one-mile interval was ultimately selected for the edge vegetation analysis (Fig. 6) for a manageable sample size.

Figure 6: Section 7 of 25, George Washington Memorial Parkway, 2024, drawing by Brett Barnes

Seeing places

There is also value, as is more common in landscape architecture and planning, to use sequential sections to describe a series of places along a corridor. For instance, sections are often used to show viewpoints along parkways. The value of this approach also depends on the conditions one is anaylzing. For instance, the continuous forest of the northern end of the parkway lacks distinct designed places. There, regular sectioning was quite useful. However, in the central and southern segments of the parkway, which consist of a series of distinctive places, regular intervals for the sections missed key spots. Figure 7 reveals typical section elevations for each of eight distinctive places and presents these together collectively as a journey along the parkway (Fig. 7). It is also possible to see each place individually, for instance Figure 8 shows an area known as Gravelly Point defined by its lack of trees because of the open glide slope needed for airplanes landing at National Airport. This area is a vast lawn with wide-open views of the Potomac and Washington DC’s monuments on the horizon, and contrasts for instance with the southern end of the parkway near Mount Vernon (Fig. 9), where a native stand of mixed deciduous forest encloses the roadway and trails with native shrubs and trees arching overhead. Such sketches capture how forest edges frame open spaces in a variety of ways and how the interior of the forest also has distinctive spaces, whether in the pine grove designed by Meade Palmer at the Lyndon B. Johnson Memorial (second from top, left) or an area of “vineland” at Daingerfield Island (middle, left), where invasive plants have overwhelmed the forest canopy. This sequence of significant places, rather than typical or regular helped the team see conditions that either need to be conserved or transformed through maintenance. Less tangibly, but no less important, in the process of making these drawings, working with existing maps, photographs, and field sketches, the places drawn became ingrained in the researcher’s consciousness in-forming further analysis and planning, another value of the repetitive nature of sequential sectioning. The practice encourages the analyst to stay tuned to the frequency of certain forest characteristics, down to the number and density of tree trunks in a forest patch.



Figures 7 (left), 8 (top right), 9 (bottom right): Places distinguished along the parkway, drawings by author

Discussion and Conclusion

Sequences and arrays, as well as individual sections are important drawing types for exploring landscapes, especially linear corridors and greenways. Drawing sequential sections at regular intervals is a useful tool for sampling forest conditions across an area, not so much to identify typical circumstances, but to see and understand the variety in the forest, especially its vertically, variety and density. Landscape plans are ubiquitous and easy for many audiences to read, while section drawings vary in their explanatory value depending on the audience. Sequential sections may confuse general audiences, especially drawings in which sections are drawn over plans and sometimes even at different scales than the plans (Figure 3). It is not surprising that the illustrative sequence of sections in Urban Forest Management Plan for the George Washington Memorial Parkway appears to be a set of typical sections. They may be understood as both typical, one sample per mile, and highly specific, showing the conditions at each randomly selected spot within each mile. The sections are singular and typical (Figure 6) and together form a sequence. Figure 6 was comprehensible to the client (NPS) because it reads as typical, while Figure 5, which reveals a spatial sequence was not easily interpreted by the client but useful in our analysis for understanding the variety of conditions the plan needed to account for. Some drawings are made to understand a thing, a situation, or a process, and others are made to explain it to others. The conventions and the approaches are not necessarily the same any more than they are from one drawing type to another or one culture to the next.

Sequential sectioning at regular intervals is a significant, but underutilized drawing type for characterizing forest space. Paul Kelsch, who co-led the urban forest plan discussed here, explored its use as analytical tool on the Baltimore-Washington Parkway (Kelsch, 2019). It seems to be a useful way to bridge digital and hand-drawing methods. It is a quick and easy way in 2-D to represent systematically the 3-D characteristics of a forest. It allows the "sectioner" certain imaginative liberties that digital models do not. It affords the practitioner the ability to be true to the data and project with prior knowledge of forests from a reservoir of experience into drawings of forest space to better understand a new situation.

Sequentially sectioning by hand, unlike digital drawing, acknowledges the human dimension of analysis. Each person draws a bit differently and emphasizes various features of the forest, whether intentionally, out of habit, or unconsciously. Some works, such as Brett Barnes' (Fig. 6) are collages and hybrids (hand drawn and digital), whereas most of my work is largely with a graphite pencil and emphasizes forest structure and the space formed by tree trunks rather than canopy with the intent of focusing the viewer on the space where people and trees meet the ground together (Heavers, 2023). This is precisely the condition that seems to get lost in plans and aerial photography that collapse forested landscapes into two dimensions. Sequential sectioning is a valuable way to explore landscapes with one eye on the whole forest and the other on the characteristics of its interior and its edges, their density, variety, thickness, airiness, and atmosphere, and the sense of scale provided by trees.

In conclusion, the goal of this paper is to share knowledge that has been found to be useful in one context that might have value to other practitioners. Research through practice of this sort in the West goes back to Aristotle at least. He noticed that knowledge could emerge from practice as well as theory, and each informs the other reciprocally. This paper hopes to demonstrate that there is possibly a role for drawing sections repetitively at close regular intervals to help the practitioner view the space of a forest. This contrasts with the typical sectioning approach. Sequential sectioning at frequent intervals can inform analysis and planning by allowing the researcher to maintain a strong grasp on the three-dimensional characteristics of a forest over a wide area. Such drawings are not made to show general audiences, though they could be, but rather to inquire about existing conditions and imagine future possibilities. This work demonstrates, I think, that there is more breadth and possibility in the concept of sequential sections or "sectioning," as Mathur and Da Cunha call the process, than previously has been shown.

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Biography

Nathan M. Heavers is an associate professor of landscape architecture at Temple University, Philadelphia, Pennsylvania, where he teaches courses on forest ecology, woodland design, and research methods. His work examines the care of landscapes through tending and drawing as methods of building knowledge and nurturing places. He writes on the topics of arboreta, drawing as a method of investigation, ecological wisdom, and aesthetics. Nathan serves on the editorial board of Socio-Ecological Practice Research.