

复杂景观的认知与设计： Mapping的作用、逻辑与机制研究

Cognition and Design of Complex Landscapes: The Function, Logic, and Mechanism of Mapping



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摘要

Mapping为当代复杂景观研究与实践提供了新机遇，然而其自由多样的形式与复杂晦涩的内容也在一定程度上造成了困惑与质疑。深入探究Mapping的作用、逻辑及其启发设计的机制将有助于厘清其价值，促进其理解与应用。通过文献综述与案例归纳、实践与教学研究，本文试图具体回答三个问题：Mapping如何在表达与探索之间取舍、以何种逻辑结构组织信息、以何种机制启发设计？本文主要结论包括：1) Mapping虽具有面向观者表达的功能，但主要作用是服务制图者自身的探索活动，即设计者在构建既有信息复杂关系的过程中，形成新的认识、创造新的可能。2) 虽然Mapping的形式、媒介与方法等千差万别，但它们组织信息的逻辑可大致归纳为五类，从简单到复杂依次为序列、矩阵、并行、网络与解构，它们在不同程度上反映了复杂景观自身的逻辑。3) Mapping通过一定逻辑框架下的信息与想法的汇集和连接，自下而上生成对场地的认知与设计，为根植于场地自身结构与演化过程的设计提供了可视化的操作载体。Mapping在实践与教学中的推广有助于增进设计师对复杂景观结构与过程的认知，跳出标准流程和强加文化符号的窠臼。

关键词

复杂景观；Mapping；认知逻辑；设计方法；非线性；景观设计

ABSTRACT

Being rich in form and obscure in content, mapping brings not only new opportunities, but also confusion and doubts to the research and practice of contemporary complex landscapes. Therefore, deep exploration of mapping's function, logic, and mechanism in inspiring design is needed to help recognize the value of Mapping and promote its understanding and application. Through literature review, case studies, and the authors' practice and teaching, this article attempts to answer three questions: Which function does Mapping emphasize, representation or exploration? What is the logic of mapping in arranging information? And what is the mechanism of mapping in inspiring design? The main conclusions of this article include: 1) Rather than viewer-oriented representation, mapping more often serves the cartographers themselves in their exploration activities, in which they develop new understandings and create new possibilities while constructing the complex relationship of existing information; 2) Despite the various forms, media, and methods, mapping's logical structures in organizing information would converge into five types: sequence, matrix, parallel, network, and deconstruction reflecting to various degrees the logic of complex landscapes themselves; And 3) through collecting and connecting information and ideas with certain logical frameworks, mapping helps with bottom-up generation of cognition and design of the site, which provides a visual operation carrier that reflects the site's structures and evolutionary processes. Applying mapping in teaching and practice can promote designers' cognition on structures and processes of complex landscapes and get rid of the dogma of following standardized workflows or imposed cultural symbols.

KEYWORDS

Complex Landscape; Mapping; Cognitive Logic; Design Method; Non-linearity; Landscape Design

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1 引言

弗雷德里克·斯坦纳在《人类生态学》中指出，“景观是由相互作用的部分与综合的整体所定义动态实体”^[1]。这一定义反映了景观的“复杂性”（complexity），即一种系统整体与部分在空间与时间中的非线性关系：由大量相互作用的部分组成的整体超越了部分的简单相加，可以自发地适应环境、创造秩序，并不断向更复杂的状态演化^[2]。

虽然景观都具有一定程度的复杂性，但在一些物质形态主导的小尺度建成环境中，影响景观变化的因素较少，景观的动态性不明显或受到人为限制，这类景观相对“简单”。本文关注的“复杂景观”是指在多样、动态的自然与文化因素的相互作用下形成、不断变化的景观。由于多因素间的充分相互作用往往不受边界限制且延伸至一定场域^[3]，复杂景观的尺度一般较大，从大型公园到区域景观不等，并包含多个嵌套的尺度。由于单一因素对景观整体的影响往往难以预测^[4]，因而复杂景观的认知与设计需要理解并构建大量因素之间时空关联的整体模式。

在当代社会、经济和技术背景下，景观因素的多样性、动态性与关联性日益显著，景观总体上变得越来越复杂。相应地，传统的制图方式在复杂景观的表达与设计中也越发捉襟见肘。为了应对景观的复杂性，当代景观图像的形式与操作方法日趋多样与综合，其功能也不再是被动的分析或表达，还包含了对景观中的复杂关系及可能性的认知与设计^[5]。本文在后续讨论中以“Mapping”^①指称这种新的图像形式及其操作过程。

20世纪90年代以来，景观设计及相关领域已对Mapping进行了广泛讨论，但并未对其作用和方法形成一致见解^②。在作用方面，一些实践者强调了Mapping对景观复杂性的认知与探索。例如，詹姆斯·科纳批判了现代制图方式对于复制客观现实的追求，而将Mapping视为发现和构建复杂因素及过程之间隐性联系的创造性活动，并试图用Mapping取代传统的规划（planning）^[6]。何志森指出Mapping可以自下而上挖掘场地的复杂性和丰富性，建立日常事件在更大尺度上的关联，并认为这一

1 Introduction

In *Human Ecology: Following Nature's Lead*, Frederick Steiner pointed out that “landscapes are dynamic entities defined by their interacting parts and their integrative whole”^[1]. This definition highlighted the “complexity” of landscapes, a nonlinear whole-part relationship in space and time of a system—Greater than the sum of its parts, a whole comprising large numbers of interacting components would spontaneously adapt to the environment, develop order, and evolve to higher levels of complexity^[2].

All landscapes are complex in some ways. However, in some small-scale built environments dominated by physical forms, there are fewer causes for change and landscape dynamics may be insignificant, if not constrained. The “complex landscapes” that this article refers to are constantly changing landscapes shaped by the dynamic interactions of diverse natural and cultural factors. As such interactions usually extend beyond boundaries to a field^[3], complex landscapes are normally large in scale, ranging from large parks to regional landscapes, and encompass multiple nested scales. Since any single factor's impact on the entire landscape would be difficult to predict^[4], the cognition and design of complex landscapes usually entail understanding and establishing overall patterns of the spatial-temporal relations of numerous factors.

In today's socioeconomic and technological settings, factors affecting landscapes have become increasingly diverse, dynamic, and interrelated. As a result, landscapes become more complex, beyond what traditional drawing methods can depict and design. In response to this complexity, the forms and operation techniques of current landscape architecture images have become increasingly diversified and comprehensive, supporting not only passive representation, but also the cognition and design of complex relationships and possibilities in landscapes^[5]. “Mapping”^① is used in this articles to refer to such novel forms of images and their operational processes.

Since the 1990s, mapping has been widely discussed in Landscape Architecture and related fields, while no consensus has been reached on its functions and methods^②. Some practitioners emphasized its roles in cognizing and exploring the complexity of landscapes. For example, rejecting modern cartography's pursuit of replicating objective reality, James Corner considered mapping as a creative activity to discover and construct the latent relationships between complex factors and processes, which could even be an alternative to traditional “planning”^[6]. According

① 类似的概念也有“diagram”“cartography”“notation”等，其含义各有侧重，但Mapping的范畴似乎更加广泛，基本可以包含上述概念。在中国学界的讨论中，Mapping有“图绘”“图解”“绘图学”“地图术”等多种译法，但这些翻译各有其片面性，容易造成歧义，或难以体现该词的过程性。同时，“Mapping”一词本身已为中国学者广泛接受，因此本文暂不做翻译。

② 目前与Mapping相关的理论研究往往涉及大量后现代哲学议题，较为晦涩而不便于应用。笔者试图从设计实践的视角论述，因而文献综述主要关注本领域重要亲身实践者的原创性论述。

① Similar concepts include “diagram,” “cartography” and “notation” with different emphasis, while the scope of “mapping” basically covers the above concepts. In Chinese academia, there have been many translations for “mapping”, such as “图绘”, “图解”, “绘图学”, and “地图术”. To some extent, these translations are partial, ambiguous, or failed to convey its connotation of a process. Meanwhile, given that the word “mapping” itself has been widely accepted by Chinese scholars, it is not translated in this article.

② Existing theoretical research on mapping often involves a number of post-modern philosophical topics, which would be too obscure to apply into design practice. As this article aims to discuss mapping from the design practice perspective, the literature review of this article focuses on the original discourses of important practitioners in this field.

过程就是设计^[7]。也有学者侧重Mapping的表达功能。例如，瓦莱里奥·莫拉比托认为Mapping与史前岩绘类似，是一种兼具绘画与文字特征的延伸思考和表达方式^[8]。魏方认为Mapping是对复杂的时空要素、观感与意义的视觉化重现，并论述了Mapping在设计生成中的作用^[9]。

Mapping的方法与媒介也不拘一格。科纳的Mapping多为地图、照片、数据图表等多种图像的拼贴^[6]，设计师的主观创造性在其中扮演了关键角色。荷兰建筑师韦尼·马斯和巴特·卢茨玛等认为Mapping是将所有可能影响设计的可观测因素可视化的“数据景观”（datascape）^[10]，强调客观数据与主观性的结合。莫拉比托的Mapping将手绘、印象速写或涂鸦与数字制图相结合，运用象形、表意和精神符号挖掘和强化场所特征及其深层意义^[5]。阿奴拉德哈·马图尔和迪利普·达·库尼亚的Mapping多为行走观察视角下的照片或断面的序列^[11]。近年来，中国设计教育也开始关注Mapping，并探索出多样的方法。例如，何志森强调“人的尺度”上的跟踪观察，并通过教学与实践相结合的“Mapping工作坊”介入社区营造^[7]。曾颖将“观绘”方法运用于中国美术学院的景观设计基础教学，使学生通过现场行走、感知、照片拼贴和抽象的方法探索空间与过程的联系^[12]。面对与Mapping相关的叙述与方法的多样性，吉尔·戴斯米妮曾总结道，“在研究制图的过程中，我们试图找到更多约定俗成的规则，但最终却发现自由表达才能最有效地促进地图制图学实现更广泛的应用。”^[13]

然而，这种多样性与自由性也常常会在实践与教学中造成困惑并引发质疑：Mapping似乎是一种依赖主观想象和灵感的艺术创作，没有规律可循；一些使用者仅关注其视觉表象，而不能理解其目的与内在逻辑；Mapping的图面常常表现得复杂、晦涩，以致读者往往很难理解它们所传递的信息或意图，继而质疑其实践价值。在这一情况下，深入研究Mapping在复杂景观的认知与设计中的作用、逻辑及其启发设计的机制将有助于厘清其价值，并促进理解与应用。

本文试图通过文献综述与案例归纳，以及笔者自身实践与教学中的研究与思考，探讨在复杂景观的认知与设计中的，1) Mapping的作用更侧重表达还是探索？2) Mapping以何种逻辑组织信息？3) Mapping以何种机制启发设计？

to Jason Ho, mapping investigates the complexity and richness of a site from the bottom up, establishing connections between ordinary events on a larger scale, which is also a process of “design”^[7]. Other discussions focused on mapping’s representative functions. For example, Valerio Morabito believed that mapping, like prehistoric Rupestrian art, is an approach to extend thinking and representation with characteristics of both painting and writing^[8]. Wei Fang argued that mapping is a visual representation of complex spatial-temporal elements, impressions, and meanings, and went on to examine its functions in generating design^[9].

The methods and media of mapping also differ. Corner’s mappings are typically collages of various images (maps, photos, charts, etc.) with designer’s subjective creativity playing a significant role^[6]. Dutch architects Winy Maas and Bart Lootsma reckoned mappings as “datascapes”^[10]—visual representations of all the measurable forces that may affect design, emphasizing the combination of objective data and cartographers’ subjectivity. Blending hand drawings, intuitive sketches, or doodles with digital techniques, Morabito’s mapping uses pictograms, ideograms, and psycho-ideograms to explore and reinforce the characteristics and meanings of places^[5]. Anuradha Mathur and Dilip da Cunha’s mapping is usually sequences of photographs or sections based on walking observations^[11]. In recent years, mapping has also raised attention in China’s design education, and various approaches have been explored. Devoted to tracking observation at the “human scale,” Jason Ho held “Mapping Workshops” as an integration of teaching and practice that contributes to community revitalization^[7]. In the fundamental education of landscape architecture at the China Academy of Art, Zeng Ying employed an “observation and representation” method, encouraging students to study the relationships between space and process through on-site walking, perception, photo collage, and abstraction^[12]. Given the diversity of mapping discourse and practice, Jill Desimini once concluded, “in looking to cartography, we expected to find more conventions but, in the end, what we found was a freedom of expression ready to be critically tapped for wider uses.”^[13]

However, such diversity and freedom can lead to confusion and doubts in teaching and practice: Mapping appears to be an artistic creation relying on subjective imagination and inspiration, with no intelligible rules; Focusing simply on visual representations, some users may miss the underlying purpose and logic of mapping; As mappings are often intricate and obscure, readers who find their messages or intentions difficult to understand may doubt their practical value. To make mapping more widely acknowledged, understood, and applied, in-depth study is needed on its role and logic in apprehending and designing complex landscapes, as well as its mechanism in inspiring design.

Through literature review, case studies, and studies and reflections from the authors’ practice and teaching, this article attempts to address three questions in the cognition and design of complex landscapes: 1) Which is the primary function of mapping, expression or exploration? 2) What is the logic behind mapping in the organization of information? and 3) What is the mechanism of mapping in inspiring design?

2 Mapping的作用：表达还是探索？

“map”一词最为人熟知的动词含义即“绘制地图”，目前景观行业中所说的Mapping也主要源于这一含义。除此之外，“map”还有“以某种关系或连接方式进行安排”的动词含义，例如“mind mapping”（思维导图）即头脑风暴的一种形式。这一含义更清晰地指明了mapping过程的本质。

虽然上述两个含义紧密相关（绘制地图也是一种将地理要素及其之间的关系进行投影的活动），然而，当代景观讨论中的Mapping显然不限于地图的绘制，而是广泛包含了各种表达信息和建立关系的图解活动。Mapping所呈现的信息既包括以投影图、照片和符号等表达的物质空间信息，也包括以数据、图表、流程图等呈现的社会文化信息及其动态变化。这些信息大多是客观的，尽管其搜集、观测、拍摄与表现等过程不免包含了制图者的主观性。

今天，虽然信息的获取与呈现越来越便捷，但随着影响景观的因素日益复杂，认识海量信息间的潜在联系与整体模式并非易事。Mapping作为一种建立关系的活动，其关键作用正如科纳所言，“在于发现，同时也是构建……在于揭示之前未被看到或想象到的现实，即使在看似（信息）已十分详尽的场所”，这一过程离不开制图者有意识的探索、推测与想象^[6]。从这个意义上看，Mapping的重点在于探索信息之间的复杂关系并形成新的认识，而非表达信息本身。

从另一角度看，不少学者将Mapping类比为一种语言，而语言不仅可以传达信息，还可用于思考。斯蒂芬·奈豪斯认为，人们常常更关注视觉沟通（visual communication），却很少进行视觉思考（visual thinking），但只有通过后者才能够获得新的认识^[14]。莫拉比托提出了“语言绘画”（verbal drawing）的概念，既强调其美学和表意功能，也强调了其“延伸性”——作为开放框架，不断标注和启发新的含义与想法^[5]。科纳则认为景观理论以诠释学（Hermeneutics）为基础^[15]。诠释学是一种后现代主义认识论，主张通过隐喻和象征等方式，从看似分离的文本中解读和构建出新的意义与联系，而Mapping即科纳对这一认识论的实践^[6]。与此同时，语言的类比还暗示了Mapping的另一特性：理解Mapping不仅需要“观看”，更需要像理解文字一样“阅读”^[8]。正因如此，与传统的分区平面图、统计图表或渲染图相比，Mapping往往不够直观。

虽然Mapping建立在信息清晰呈现的基础上，然而一旦开始考虑信息之间的联系，其关注点就逐渐变成了更高层次上的整体，而各种底层信息本身的清晰性便相对弱化。例如，图1所示的Mapping试图关注滨海

2 The Function of Mapping: Expression or Exploration?

“Map” has the most well-known verb meaning of “to make a map of,” which is the basic origin of “mapping” in the landscape architecture context. In addition, “map” also means “to be assigned in a relation or connection” (e.g., “mind mapping” is a form of brainstorming), which exactly specifies what process mapping is.

Although the two meanings are closely related (to make a map is also an activity to project geographic features in certain relations), mapping in today’s landscape discourses is clearly more than just making “maps.” Instead, mapping embraces the making of a wide range of graphics that present information and establish relationships. Mapping presents physical spatial information in the form of projections, photos, and symbols, as well as socio-cultural information and dynamics in statistics, diagrams, and flowcharts. The information is generally objective, though cartographers’ subjective cognitions inevitably play a part in the collecting observing, shooting, and representing process.

Collecting and representing information has been more convenient today, but identifying potential relationships between the massive information and its overall pattern remains difficult, given the increasingly complex factors affecting landscapes. The most productive effects of mapping, according to Corner, lie in “finding that is also a founding... in uncovering realities previously unseen or unimagined, even across [information] seemingly exhausted grounds,” which depends on cartographers’ conscious exploration, speculation, and imagination^[6]. In this sense, the key to mapping would be to produce new knowledge by connecting disparate pieces of information, rather than to present the information itself.

From another perspective, scholars frequently compare mapping to languages that serve as a tool not only for communication but also for thinking. According to Steffen Nijhuis, people are more focused on “visual communication” than “visual thinking,” while it is through the latter one can gain new insight^[14]. Likewise, Morabito proposed the conception of “verbal drawing.” Apart from the aesthetic and ideographic function, he accentuates mapping’s “extending” ability as an open framework for continually annotating to spark new meanings and ideas^[15]. Corner believed that landscape theories are grounded in hermeneutics—a post-modernist epistemology that interprets and constructs new meanings and connections through metaphors and symbols from seemingly separate texts, and mapping is a means of its practice^[16]. Meanwhile, the language analogy implies mapping’s another characteristic: understanding mapping requires not just “watching” but also “reading” in the same way as understanding texts^[8]. This could explain why mapping is often not as comprehensible as traditional zoning plans, statistical charts, or renderings.

While it is plausible for mapping to clearly present information, the readability of underlying information would inevitably be degraded when we begin to focus on their higher-level relationships. For example, Figure 1 shows a mapping that explores the possibility of using public buildings as temporary shelters in extreme

区域洪灾与应对基础设施不足的问题，并探讨公共建筑在极端天气下兼作避难所的可能性。图中的地理、气象和水文数据都可轻易获得，信息表达也没有脱离轴测图和柱状图表等传统方法。然而，启发设计的并不是信息本身，而是对信息关联的探索：左图建立了极端降水事件、海平面高度与区域高程的联系，在较大时空尺度（面积约50km²，时间跨度约100年）上探讨了洪水风险；右图采用了“时空路线”（space-time path）的图解方式，将社区中平日与极端天气下的一日内活动与事件的空间变化建立了联系。这一过程为避难场所的空间选择与时间协调提供了直接帮助，然而其呈现结果可能使观者很难在短时间内得到明确的信息。但如果仔细“阅读”，则可以发现景观中的复杂关系与设计的思维轨迹。

综上所述，Mapping的探索作用往往优先于表达。与设计草图类似，Mapping的服务对象更多是制图者自身，而非观者——观者看到的图像只是制图者探索活动的“副产品”。如果制图者过于关注表达效果，则难免会削弱场地与设计思维的真实复杂性。

3 Mapping的组织逻辑：如何建立信息联系？

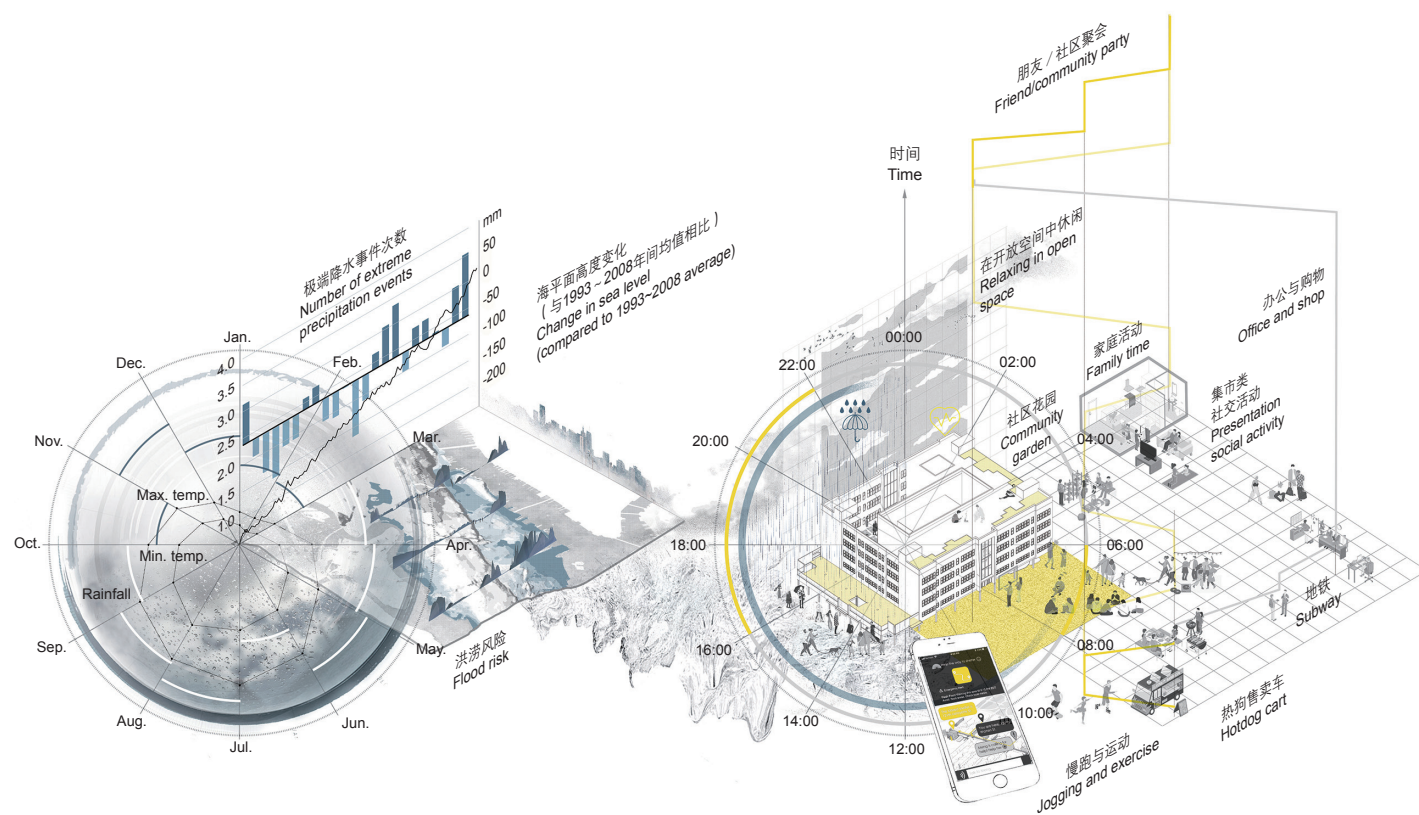
如前所述，发现并建立多种信息间的关系是Mapping的关键。那么，Mapping以何种方法或逻辑组织这些信息？如果将Mapping比作语言，这一语言具有怎样的“语法”？

weather for a coastal area with flood risks and insufficient facilities. In this mapping, the geospatial, meteorological, and hydrological data were easily accessible, and their representations were limited to traditional forms such as axonometric drawings and histograms. However, rather the data themselves, it was the exploration of their relationships that inspired the design. On the left, relationships between extreme precipitation events, sea level, and elevation data of the region showed flood risks at a large spatial-temporal scale (about 50 km² and over 100 years); On the right, a “space-time path” established connections between activities in a community and their spatial-temporal changes in a day under normal and extreme weather. The process of mapping directly assisted the authors’ spatial selection and temporal coordination of shelters, but the resultant mapping may not provide readers with instant access to explicit information. However, by carefully “reading,” one can discover the complex relationships in the landscape and the generative trajectory of the design.

As a result, we suggest that mapping’s primary function be exploration rather than representation. Like design sketches, mappings serve their authors more than viewers—what viewers see is only a “by-product” of the cartographers’ exploring process. When overly focused on the outcome, a cartographer might inevitably compromise the true complexity of site condition and design thinking.

3 The Logic of Mapping: How to Establish Information Connection?

As the key to mapping is to find and establish the relationships of information, a question may arise in what ways or logic does mapping organize the relationships? In other words, what is mapping’s “grammar” as a language?



1. Mapping的主要作用是探索信息之间的复杂关系，而非表达信息本身。

1. The primary function of Mapping is to explore the complex relationships between information rather than to represent information itself.

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科纳曾将Mapping的方法归纳为四种：“漂移”（drift）、“层叠”（layering）、“游戏板”（game-board）和“根茎”（rhizome）^[6]。其中，“层叠”和“根茎”侧重图像的组织结构，“漂移”和“游戏板”分别强调打破专制性结构，以及多种立场协商的认识论与方法论。科纳的归纳开创了一种新的景观制图的理解角度，然而其分类方式略显混乱且存在多种解读方式，较难促成普遍的理解和运用。

本文试图借助1) 复杂景观的结构与过程逻辑，以及2) 人们认识复杂事物的逻辑，归纳Mapping的常见逻辑结构。虽然景观自身十分复杂，但任何认知逻辑都或多或少包含对现实的简化。因此，Mapping的逻辑结构也包含从简单到复杂的多种类型，它们从不同方面和程度上反映或重现了复杂景观的逻辑。下文按从简单到复杂的顺序阐述这些逻辑类型，并分别讨论其使用情景。

3.1 序列

序列是一种以开放关联的时间或空间片段的顺序罗列，粗略构建复杂景观整体的逻辑结构。序列结构具有一定的线性特征，但其线性特征主要体现在观察方式上，而非通过线性因果关系理解景观因素的非线性相互作用。

运用序列逻辑图解复杂景观的一个著名案例是帕特里克·盖迪斯的“山谷断面”。在一个区域断面上，多种包含“人—工作—场所”复杂

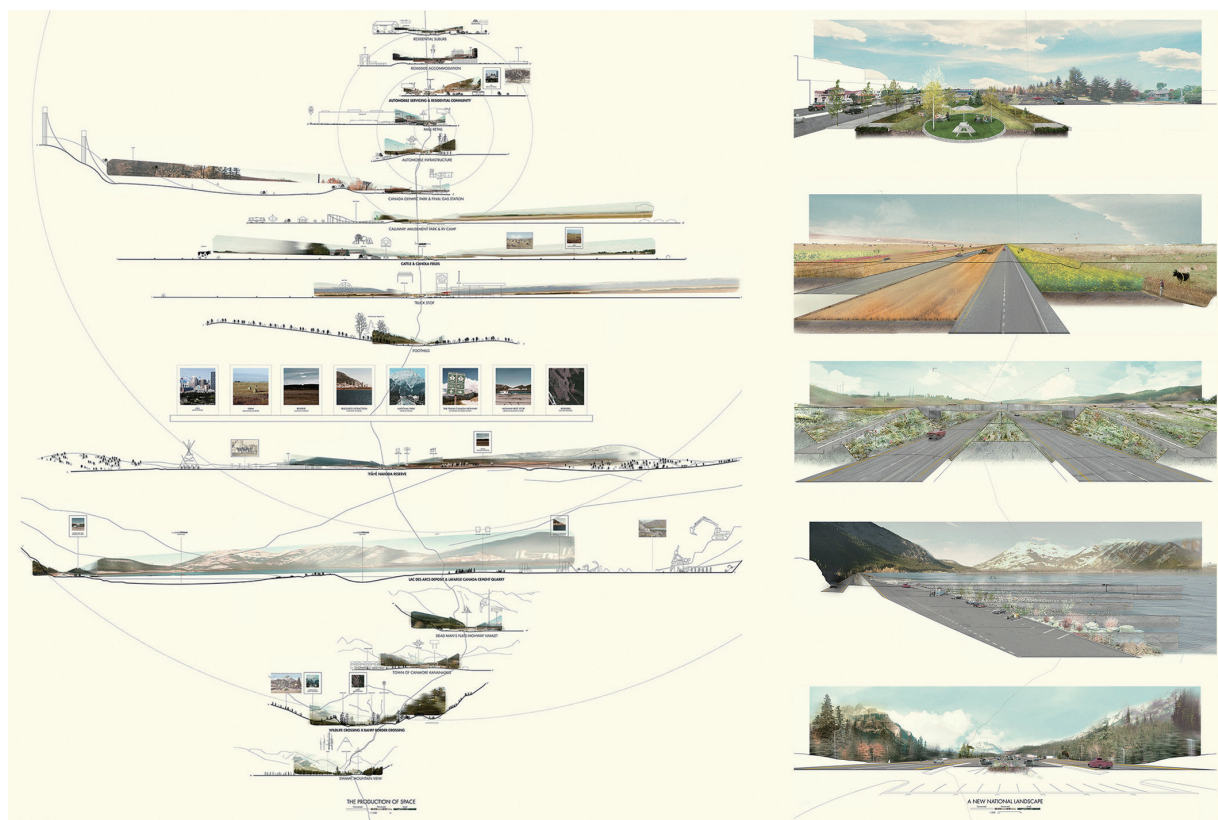
Corner identified four ways in mapping: drift, layering, game-board, and rhizome^[6]. Among them, layering and rhizome focus on the image organizational structures, whereas drift underlines an epistemology and methodology of dissolving authoritarian structures, and game-board emphasizes those of negotiation among multiple parties. This classification provides a new perspective for understanding landscape mapping, but it is also rather vague, leading to divergence in interpretations and difficulty in wide understanding and application.

The authors try to present an overview of common logic structures of mapping from the perspectives of 1) the logic of the structure and process of complex landscapes, and 2) the logic of how people perceive complex things. As any logic in understanding landscapes would simplify their true complexity to some extent, mapping's logical structures can vary from simple to complex, reflecting the logic of complex landscapes in different aspects and degrees. The following sections describe these logic types and discuss their application scenarios.

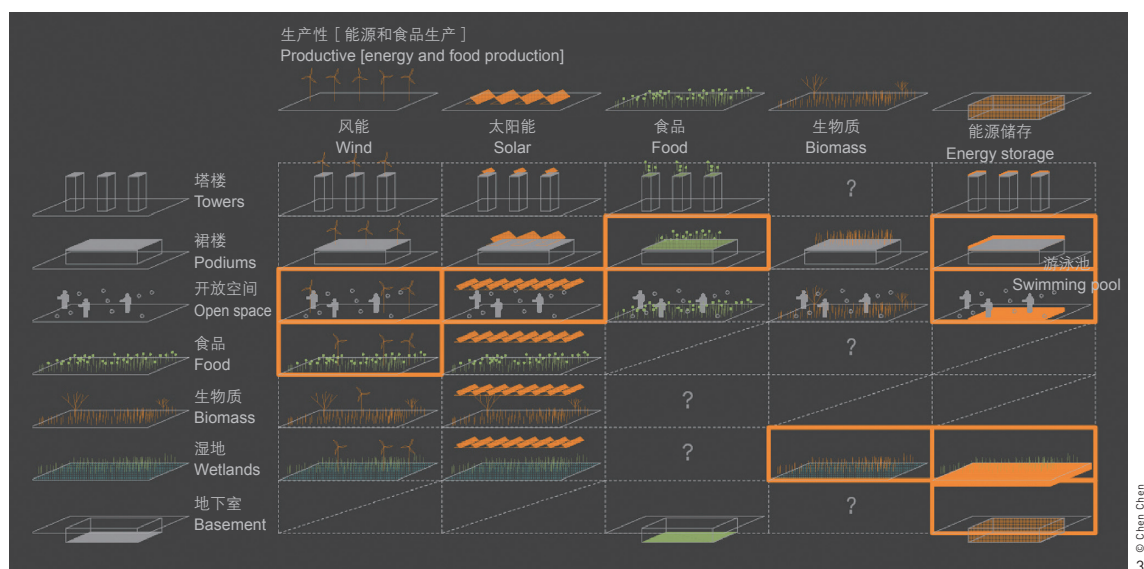
3.1 Sequence

Sequences are logical structures that list pieces in spatial or temporal order, attempting to approximate the complex landscape as a whole. While sequential mappings are inherently linear in the observational process, it does not necessarily employ linear causality to comprehend nonlinear relationships in landscapes.

Patrick Geddes's "Valley Section" is a famous example of mapping complex landscapes in sequential logic. In a regional cross-section, several units of "Folk-Work-Place" complex interactions are "manifestly successive as we descend in altitude, and



2. 序列逻辑通过开放关联的切片理解和介入复杂景观。
2. Sequential logic helps understand and manipulate complex landscapes through open related sections.



3. 矩阵逻辑通过探索多种类型的可能组合，帮助构建新的复杂整体。
3. Matrix logic helps construct a new complex whole by exploring possible combinations of multiple topologies.

关系的单元“沿着海拔变化展示出明显的连续性，也从底层开始展示了社会历史的进程”^[17]，从而构建了景观整体的演化模式，但盖迪斯并未预设这些单元之间存在因果关系。

龙加荔对加拿大横贯公路景观的研究也使用了序列的逻辑。这一景观的复杂性体现在其宏大的尺度，以及空间类型、感知体验和社会建构层面的多样性。设计者通过断面的序列构建了基于公路尺度和车辆行进速度的空间特征和时空体验（图2）^[18]。虽然这些断面只是复杂景观中的离散片段，但一定数量片段的顺序罗列暗示出它们之间的关联，从而以较为开放的方式构建了整体。与此同时，每一个断面又综合了空间要素和有关自然荒野与田园牧歌的想象等多种因素，成为一窥景观复杂性的切片。这些切片成为理解和介入这一国土尺度景观的触媒。

3.2 矩阵

传统“分析图”中简单的分类方式（例如相互独立的交通分析、植被分析、竖向分析、活动分析等）往往忽视了系统各部分间的关联，一般不适用于复杂景观的探索^[19]；而矩阵逻辑则可在分类的同时建立不同类型之间的联系，从而构建新的整体。例如，伊恩·麦克哈格在波托马克河流域研究中运用了矩阵，将大量用地类型罗列在两个维度上，并探讨了它们彼此之间的兼容性，形成未来发展规划的资源^[20]。

矩阵逻辑也具有较强的开放性和创造性。例如陈忱的“重叠城市”项目利用矩阵结构的Mapping探讨了“后化石能源时代”的城市空间组织：与化石燃料不同，新能源的产销单元可以分散在城市中，并灵活

also come down the course of social history”^[17]。The sectional mapping established an overall pattern of the landscape’s evolution, but no assumptions were made about causality among these units.

Shelley Long’s Trans-Canada Highway project also applied sequential logic in the mapping of a complex landscape. This complexity of this landscape lies in its grand scale and diversity of spaces, experiences, and social constructs. Through a sequence of transects, the designer investigated spatial identities and space-time experiences at the scale and speed of the highway (Fig. 2)^[18]. Although these transects were discrete fragments, a whole emerged from open-ended connections implied by arraying a number of them. Each transect, integrating spatial elements with perceptions of pristine wilderness or idyllic agricultural settings, offered a “slice” into of the complex landscape. The sequence of slices then acted as a medium for comprehending and manipulating the landscape at the national scale.

3.2 Matrix

Traditional analytic representations (such as traffic analysis, vegetation analysis, vertical analysis, and activity analysis independent from each other) that rely on classification often ignore the interactions between parts of a system, which are seldom applicable to the study of complex landscapes^[19]. Also based on classification, matrix logic can reconnect the classes to form a new whole. For example, in the study of Potomac River Basin, Ian McHarg developed a matrix with diverse land use classes on two coordinates and then discussed their inter-compatibility, providing a resource for future development planning^[20].

Matrix logic can also be more open and creative. For instance, Chen Chen’s project “The Overlapped City” employed a matrix mapping to study urban spaces in the “post-fossil fuel era.” Unlike traditional fossil fuels, new energy production-consumption units can be dispersed across a city and flexibly adapt to different sites, considerably increasing the complexity of future cities’ spatial organizations

地适应场地，这一特征将增加未来城市空间组织和发展方式的复杂性。设计师在能源生产（横向）与城市要素（纵向）两个维度上探索了多种可能的单元类型，然后讨论并筛选了它们的交叉组合（图3）^[21]。这些组合类型成为场地设计的“原型”，大量原型继而根据场地参数和情景假设生成了整体规划方案。这一矩阵Mapping的逻辑并不是对既定整体的要素拆解，而是对多维因素影响下的可能性的开放搜索与组合，继而形成新的整体。

3.3 并行

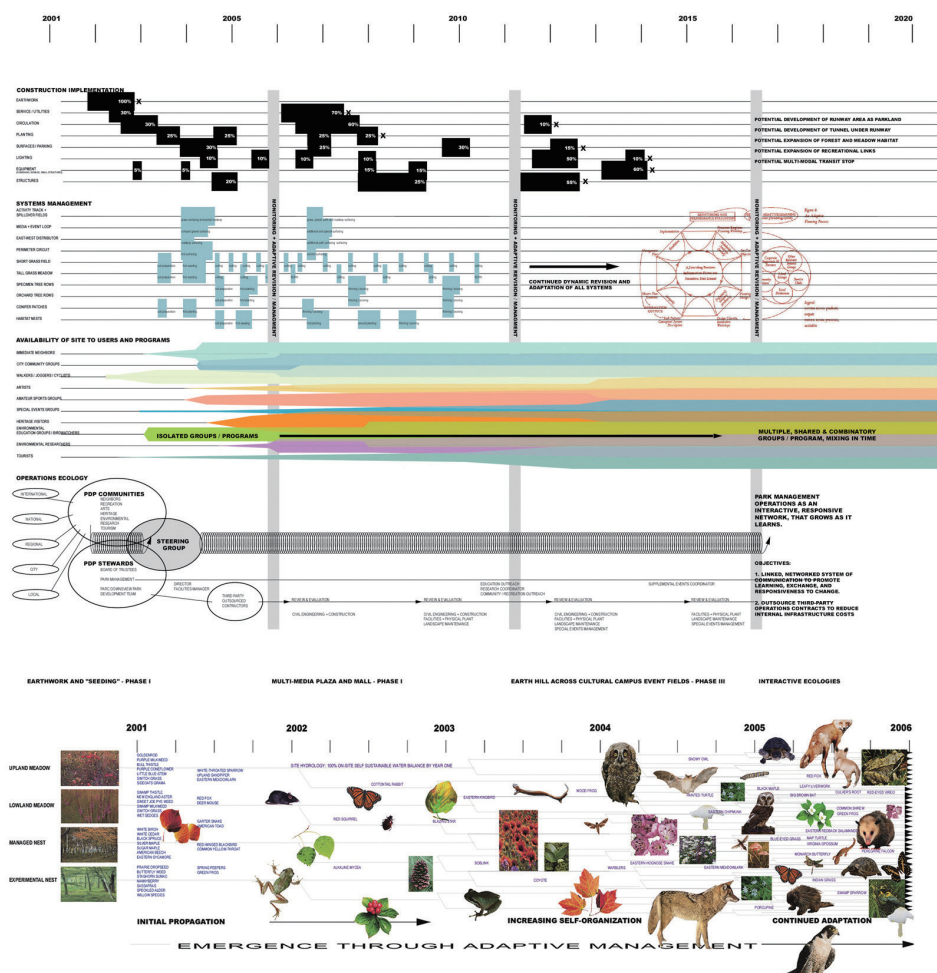
并行逻辑更深入地反映了复杂系统的演化机制——自组织：在没有中心或外部控制的情况下，相互作用的简单要素自发形成复杂结构与功能。在自组织过程中，大量主体自主适应环境，并根据彼此关系自我调整状态和行为方式；主体之间并无确定的因果或主次关系，处于没有层级的并列状态。生物群落、生态系统、自发形成的城市和景观都是自组织系统的典型案例^{[22][23]}。

并行逻辑有助于构建多种动态因素共同塑造复杂景观的过程。在2000年的加拿大多伦多市的当斯维尔公园设计竞赛中，任务书要求“将自然与人文视为不断地变化与相互作用的动态现象”^[24]。不同于常规的“线性演替”模型，科纳和斯坦·艾伦团队提出了一个持续变化的景观方案，将不同的生境设计为横向连接、并行演化的主体。在图4中，多种生境及其管理方式的变化过程被标注在平行的时间轴上，每个时间点上都同时存在多样的生境、物种与活动，从而涌现出更高的复杂性。设计的合作者、生态学家妮娜—玛丽·李斯特指出，这一逻辑反映了人们对于生态系统以及景观的认知的转变——从线性发展模型到开放、自组织和不确定的复杂适应系统模型^[25]。

3.4 网络

在复杂系统中，大量要素间的相互作用呈现多尺度复杂网络的模式。如果说并行逻辑关注复杂系统中主体的自组织，网络逻辑则将关注点从主体本身转移到主体间的关系。在多数情况下，网络是对无形的关系（如相互作用或流）所呈现的拓扑结构的抽象图解，它们支撑了有形的空间格局的形成与演化^[26]。网络逻辑的复杂性较强，常用于大尺度的区域景观规划与研究。

例如，设计公司FABRICations的“阿尔巴尼亚新陈代谢”项目关注了一个小型国家尺度（28 748km²）的发展规划。在这一尺度上，自上



and development modes. The designer listed multiple possible classes in the two dimensions of energy generation (horizontal) and urban components (vertical) before examining their cross combinations and selecting the potential ones, which then became “prototypes” for site design (Fig. 3)^[21]. An overall plan was generated by numerous such prototypes that adapted to site parameters and alternative scenarios. The logic of this matrix mapping is not a dismantling of an already-established entity, but rather an open-ended searching and combining of possibilities under multi-dimensional influences to form a new integration.

3.3 Parallel

Parallel logic reflects the evolution mechanism of complex systems—self-organization: simple interacting elements spontaneously develop complex structure and function without central or external control. In self-organizing process, a number of agents autonomously adapt to the environment and adjust their state and behavior based on their relationships; No definite causal or dependent relationships exist between the agents, which are parallel without hierarchy. Biological communities, ecosystems, spontaneously formed cities, and landscapes are all examples of self-organizing systems^{[22][23]}.

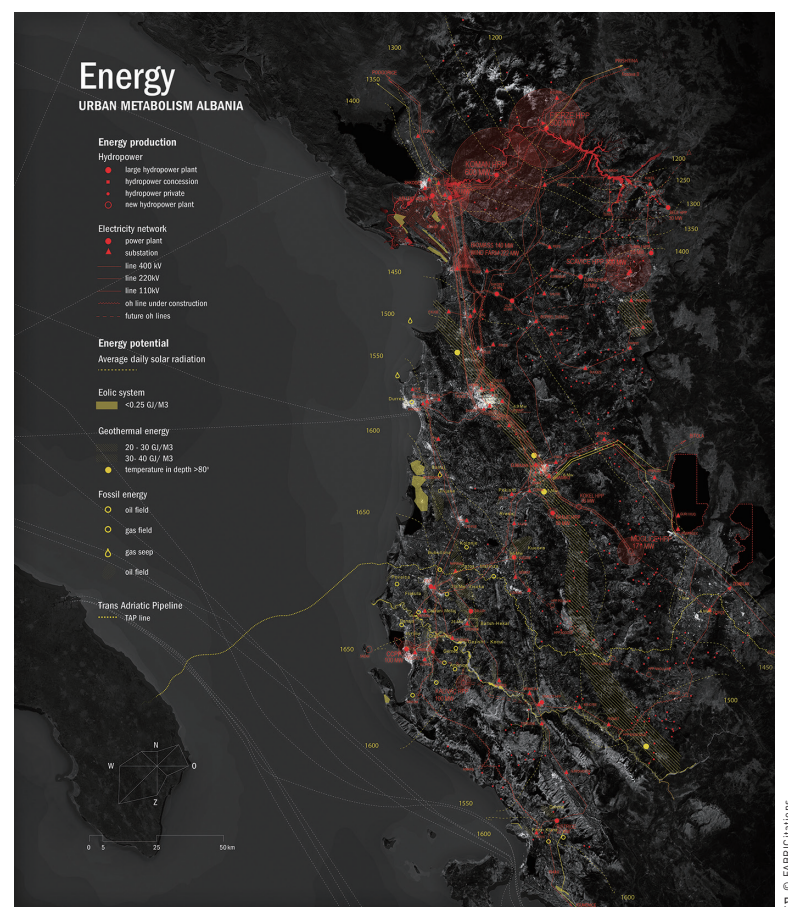
Parallel logic can help establish the process by which multiple dynamic factors interplay to shape a complex landscape. In the design competition held in 2000

- 并行逻辑通过探索多种因素的自组织过程，构建动态变化的复杂景观。
- Parallel logic helps construct dynamic complex landscapes by exploring the self-organizing processes of various factors.

而下的宏观策略难以直接实施，而只针对局部节点的策略又难以推动宏观尺度景观的转变。在这一情况下，项目团队试图从网络的视角探索这一景观的转变方式。这种网络并非景观生态规划中的“斑块-廊道”空间网络，而是包括了水、食品、能源、旅游业等有形或无形的流组成的动态关系网络。例如在能源网络的Mapping中，研究者首先标记和追踪了现有能源生产与流动（红色部分），这一过程揭示了能源网络分布的不均衡。在此基础上，研究根据场地自然地理条件增加了适宜发展太阳能、风能、地热能和化石能源的区域和节点（黄色部分），形成对原有网络的增强，并进一步构建了更大尺度上的跨区域能源流动（图5）^[27]。在这个项目中，“新陈代谢”（即有机体通过与环境进行物质、能量交换和转化而实现自我更新的过程）成为区域景观转型机制的隐喻，而网络结构成为理解和设计这一过程的载体。

3.5 解构

由于任何结构化的认知模型都难以避免对现实的简化或强加，一些Mapping试图弱化对于结构的抽象认知，转而以相对个人化的亲身观察、体验与感知建立信息联系，力求反映场地的真实复杂性与本质特征。例如，居伊·德波的“漂移”（*dérive*）方法通过对偶然观察到的事物的拼贴探讨环境对个体行为和情感的影响^[6]；何志森所使用的“跟踪”方法与之类似，但观察更具目的性^[7]。一些激进的解构主义建筑



for Downsview Park in Toronto, Canada, the brief required that “nature and humanity within it are to be treated as dynamic phenomena constantly changing and interacting”^[24]. In response, James Corner and Stan Allen’s team proposed a dynamic plan that projected different habitats, instead of following “linear succession,” as horizontally connected and parallelly evolving agents. As is shown in Figure 4, the designers annotated the changing processes of multiple habitats and their management on parallel timelines, where any time node would witness coexistence of diverse habitats, species, and activities, allowing higher levels of complexity to emerge. Ecologist Nina-Marie Lister, a collaborator of this design, pointed out that this logic reflects a shift in people’s perceptions of ecosystems and landscapes—from a linear development model to an open, self-organizing, and unpredictable complex adaptive system model^[25].

3.4 Network

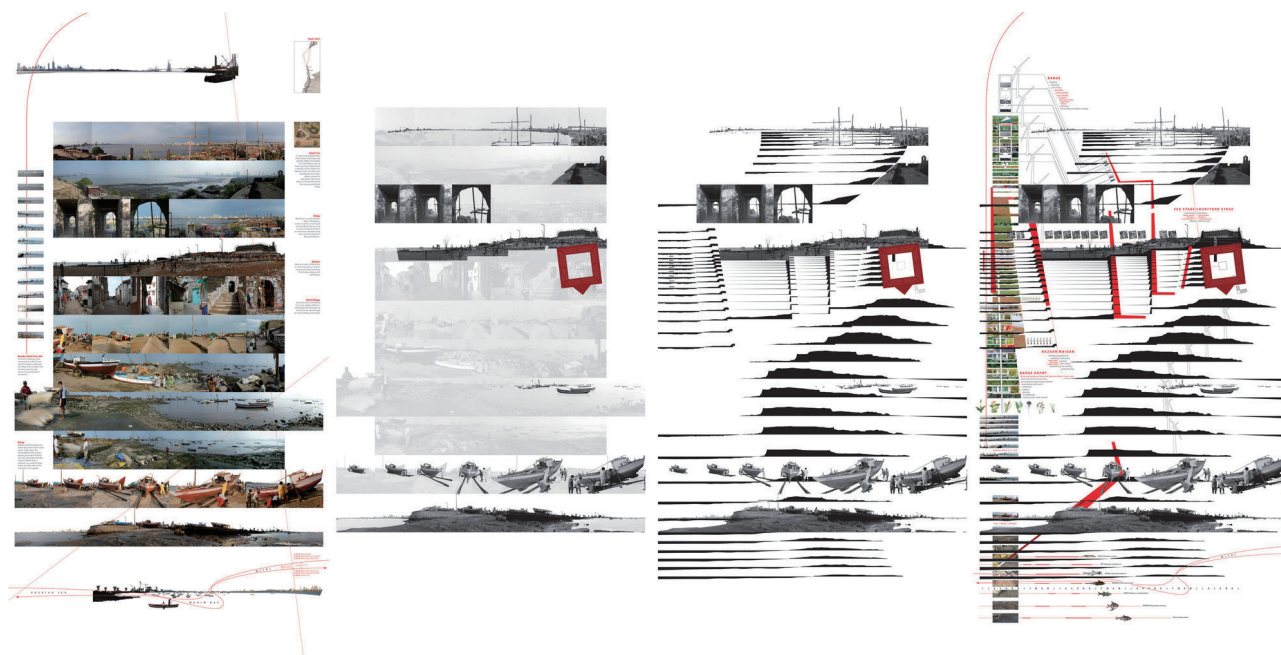
The pattern of masses of interactions in complex systems typically exhibits a multi-scale complex network. While parallel logic focuses on the self-organization of agents in complex systems, network logic shifts the focus from agents themselves to their relationships. Networks are abstract representations of topological structures of, in most cases, intangible relationships (e.g., interactions or flows) that underpin the development and evolution of tangible spatial configurations^[26]. Endowed with a high level of complexity, network logic is often applied in large-scale regional landscape planning and research.

For example, the “Metabolism of Albania” project by FABRICations focused on the development planning for a small country (28,748 km²). At such a large scale, top-down policies are difficult to implement directly, while local plans are hardly efficient in promoting macro-scale landscape change. Under such circumstances, the project team devised transformations based on a series of network mappings. Instead of the classic “patch-corridor” networks in landscape ecology, these mappings used dynamic relation networks to depict the tangible or intangible flows of water, food, energy, and tourism, etc. In the energy network, for example, the researchers marked and tracked existing energy productions and flows (in red color), revealing the energy network’s imbalanced distribution. Based on this, areas and spots suitable for the development of solar, wind, geothermal, and fossil energy were added based on physiographic conditions to augment the existing network (in yellow color), and cross-regional energy flows were then established at a greater scale (Fig. 5)^[27]. In this project, “metabolism,” or organisms’ self-renewal process through material and energy exchange with the environment and conversion, became a metaphor of the transformation process of a regional landscape, and the network structure was the carrier for its understanding and planning.

3.5 Deconstruction

Given that any structured cognition would, to some degree, simplify or restrain reality, some mapping practices seek to dissolve dominant structures instead build connections through personalized observations, experiences, and perceptions,

5. 网络逻辑通过认识大量节点之间的相互作用和流动模式，并对其进行增强，探索区域发展策略。
 6. 解构逻辑将感知性与分析性结构结合，探索场地的真实复杂性与本质特征。
5. Network logic helps explore regional development strategies through understanding and improving the patterns of interactions and flows between amounts of nodes.
 6. Deconstructive logic helps explore the true complexity and essential characteristics of places through an integrated perceptual and analytical structure.



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师，例如伯纳德·屈米、彼得·艾森曼、丹尼尔·里伯斯金等人则以更加个人化的心理感受来重构场地^[16]。

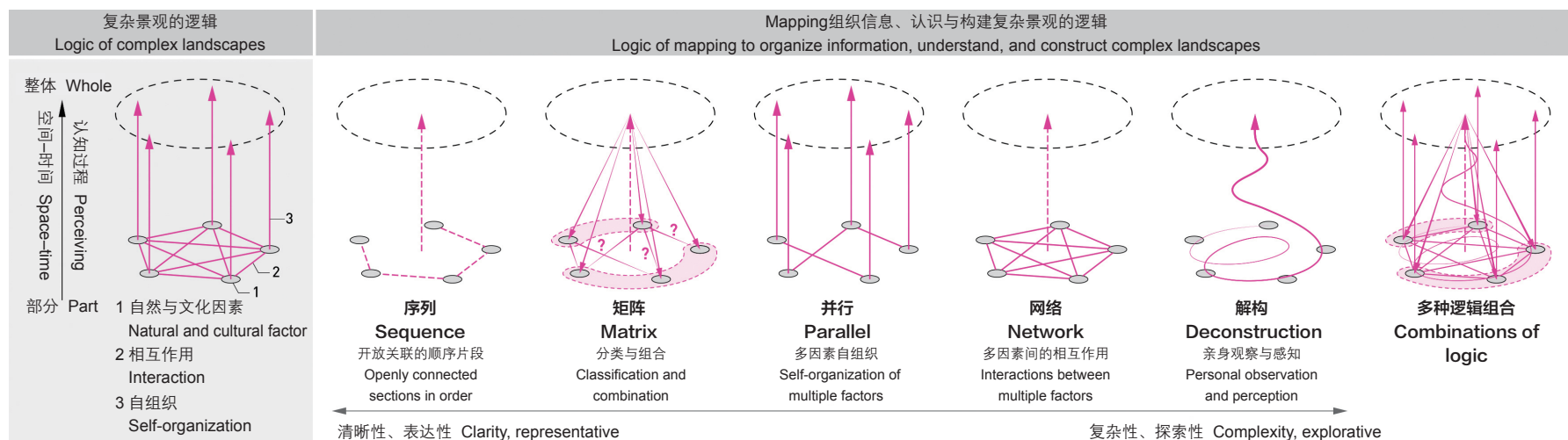
然而，在很大程度上，上述漫无目的的漂移、对少量个体的跟踪观察或心理投射方法在认知功能上更接近拼贴艺术，它们在建筑、社区或尺度较小的景观设计中运用较多，但较难独立应对较大尺度的复杂景观研究与设计。科纳认为“拼贴艺术的功能大多是含蓄的（通过暗示），而Mapping通常将素材系统性地纳入更具分析性和明示性的框架中”^[6]。理查德·韦勒则指出，“新一代设计师正在走出里伯斯金和艾森曼等诗意与理论的巨人的阴影”，并重新强调客观性、分析性与主观性的结合^[16]。

当代案例在运用个人观察和感知对景观进行解构和拼贴的同时，大多也结合了“分析性和明示性”框架。例如，马图尔和达·库尼亚的沃尔里要塞Mapping关注了印度孟买西部入海口处的一个半岛。这一景观包含了丰富的要素与过程，包括由山脊线所定义的空间轴、季节性涨落的水域、位于制高点的要塞、散布的渔业聚落和其中的日常活动等，它们之间存在复杂的关联^[11]。从图6所示的制图过程中可见，制图者首先筛选并罗列了行走过程中拍摄的照片，形成了Mapping的基本结构。照片的排列并未严格遵循实际空间位置或距离，而是反映了行走体验中所形成的印象与节奏。在这一结构的基础上，制图者提取了照片中的特征

pursuing reflections of the true complexity and essence of sites. For example, Guy Debord’s “dérive” (drift) method used collages of randomly encountered events to explore the impacts of urban environment on individual behaviors and emotions^[6]. A similar example would be Jason Ho’s “following,” which is more purposeful^[7]. Some radical deconstructionist architects, on the other hand, such as Bernard Tshumi, Peter Eisenman, and Daniel Libeskind, would reconstruct sites based on more personalized psychological projections^[16].

However, the cognitive function of aimless dérive, piecemeal tracking observations, or psychological projection would be more akin to collage art. These methods have been more widely used in building, community, or small-scale landscape design, but they may fail in larger-scale complex landscape research or design. Corner argued that “unlike collage... which functions mostly connotatively (by suggestion), mapping typically systematizes its material into more analytical and denotative schemas”^[6]. Richard Weller, noting that “a new generation of designers are moving out of the shadow of poetic and theoretical giants such as Libeskind and Eisenman,” reintroduced the objective and analytical traditions that were to be integrated with subjectivity^[16].

Most contemporary mappings that deconstruct and reconfigure landscapes with personalized observation and perception are also combined with “analytical and denotative schemas.” For example, Mathur and da Cunha’s mapping of Worli Fort focused on a peninsula at the estuary in west Mumbai, India. The landscape contains multifarious elements and processes, such as a spatial spine defined by the ridge, seasonally fluctuating water level, the fort at the vantage point, and daily activities in scattered fishery settlements, among which latent relationships exist^[11]. According to the mapping process shown in Figure 6, the cartographer first formed a basic mapping structure by picking and arraying a pile of photographs, which reflected the impression and rhythm in the walking experience rather than their



7. 反映复杂景观结构与过程的Mapping逻辑结构及其使用方式
7. Logical structures of mapping that reflect the structure and process of complex landscapes and their applications

要素，以序列性的断面建立它们之间的连接，并进一步叠加了景观中的动植物分布、人类活动和路径等分析性标注，揭示了看似凌乱的要素与活动的空间模式及其对水陆动态过程的适应。

综上所述，虽然Mapping在形式和媒介上有近乎无限的可能，但其组织信息的逻辑结构可以大致归纳为有限的类型。这些逻辑都试图通过对景观局部关系的组织实现整体的认知与构建，并在不同方面、不同程度上反映了复杂景观本身的逻辑，及其在认知过程上的逻辑（图7）。

总体而言，简单逻辑的易读性较高，但只能较为粗略地反映景观的复杂性；复杂逻辑更能深入地重复杂景观的结构与过程，但阅读起来相对困难。然而，随着系统科学、认知科学、数据分析和可视化技术的发展，人们接收和处理复杂信息的能力也在快速进步。复杂的逻辑结构有希望在未来的景观研究和设计中发挥更大的作用。

本文对Mapping逻辑结构的归纳并非试图提供通用的规则——如同语言一样，熟练的使用者一般不会有意识地关注语法，但是认识并总结“语法”有助于阅读与使用Mapping这门“语言”。虽然上述逻辑一方面在一定程度上受到当代科学模型的影响（如自组织和复杂网络），但由于种逻辑的应用都有历史上的先例，因而它们也来源于设计师对于场地自身复杂性的思考与应对。设计师往往将它们作为理解和想象复杂事

exact locations or distances in reality. Based on this structure, featured elements were extracted from the photos and their connections were established through a sequence of site sections overlaid. Finally, analytical annotations of fauna and flora distribution, human activities, and walkways were added, revealing a spatial pattern behind these seemingly messy elements and activities and their adaptations to the dynamic land water relationships.

To summarize, despite the almost unlimited forms and media, relatively limited categories could be identified in the mapping's logical structures. Pursuing cognitions and constructions of holistic landscape systems through organizations of localized relationships, these structures would mirror, in varying aspects and degrees, the logic of complex landscapes and cognition processes (Fig. 7).

In general, simpler logical structures are more understandable but reflect landscapes' complexity more loosely, whereas more complex ones, albeit less legible, dive deeper into the structures and processes of complex landscapes. Nevertheless, since contemporary progresses in system sciences, cognitive sciences, and data analysis and visualization techniques have considerably improved people's ability to acquire and handle complicated information, complex logical types will hopefully play a greater role in future landscape research and design.

This summary of mappings' logical structures here is not intended to provide any standardized rules—like grammars to a language, fluent speakers may follow them rather unconsciously, but awareness and summary of “grammars” would be helpful in learning to read and use the “language” of mapping. Receiving influence from contemporary scientific models (such as self-organization and complex networks), these logical structures would also emerge from designers' contemplations and practices in response to the complexity of landscapes themselves, due to the fact that the applications of all these types have a plenty of precedents in history. Designers may treat them, rather than principles, as heuristic frameworks that aid in understanding and imagining complex things. Also, there

物的启发性框架，而非定式。这些类型之间也没有严格的区分，复杂的Mapping往往同时包含多种逻辑的组合。

4 Mapping的作用机制：如何启发设计？

下文通过三个笔者的实践或教学案例探讨Mapping启发设计的过程和机制。每个案例的场地均较为复杂且介入方式较为综合，Mapping的使用贯穿了场地认知、设计和表达过程。

4.1 案例一：非线性的思考与操作载体

该项目关注了内蒙古自治区呼伦贝尔的游牧景观。多样的影响因素和用地方式使这一景观具有突出的复杂性和动态性，也带来了大量问题和冲突^[28]。为了认识这一场地，笔者首先搜集了影响当地景观变化的多种因素的数据，并将它们以地图或折线图的形式可视化。

在复杂的景观中，大量因素呈现并行演化、相互作用的非线性关系，因而很难将其中的某些因素视为一切现象的原因，以线性因果思维解决问题。图8所示的Mapping将这些因素的图像置入并行的时间框架中，横向上显示了各因素的变化过程，纵向上的对应则构建了这些过程之间的关联。在这一框架下，笔者一方面根据现有趋势，推测了各因素未来可能的发展，另一方面设想期望的未来（即设计目标），然后将可能实现这些目标的策略标注在框架中。这些策略针对各个目标分别提出，包括水域保护、低影响开采、尾矿修复、清洁能源转型、更高产的退耕还林、集约的城镇化等。接下来的任务便是通过特定的用地方式设计将各个目标及相应的策略整合起来。

场地现有的游牧方式为项目设计提供了启发。游牧是一种动态的用地方法，在满足当下需求的同时给草场时间以自我修复，从而实现有限资源的高效利用。设计试图将游牧的智慧应用到更多用地互动方式的重组中，使它们由相互冲突变为相互合作。笔者据此提出了两种动态的用地组织方式。第一种方式将畜牧与经济林种植结合，使高产的退耕还林目标和策略具体化：通过林草间作和定期采伐，使林地与草场周期性地更替，牧民可在其间循环游牧。第二种方式通过多种用地方式的动态序列设计，整合了低影响开采、尾矿修复和清洁能源转型策略，试图在不

are no strict separations between these logic types, and complex mappings often rely on a combination of them.

4 Mechanism of Mapping: How to Inspire Design?

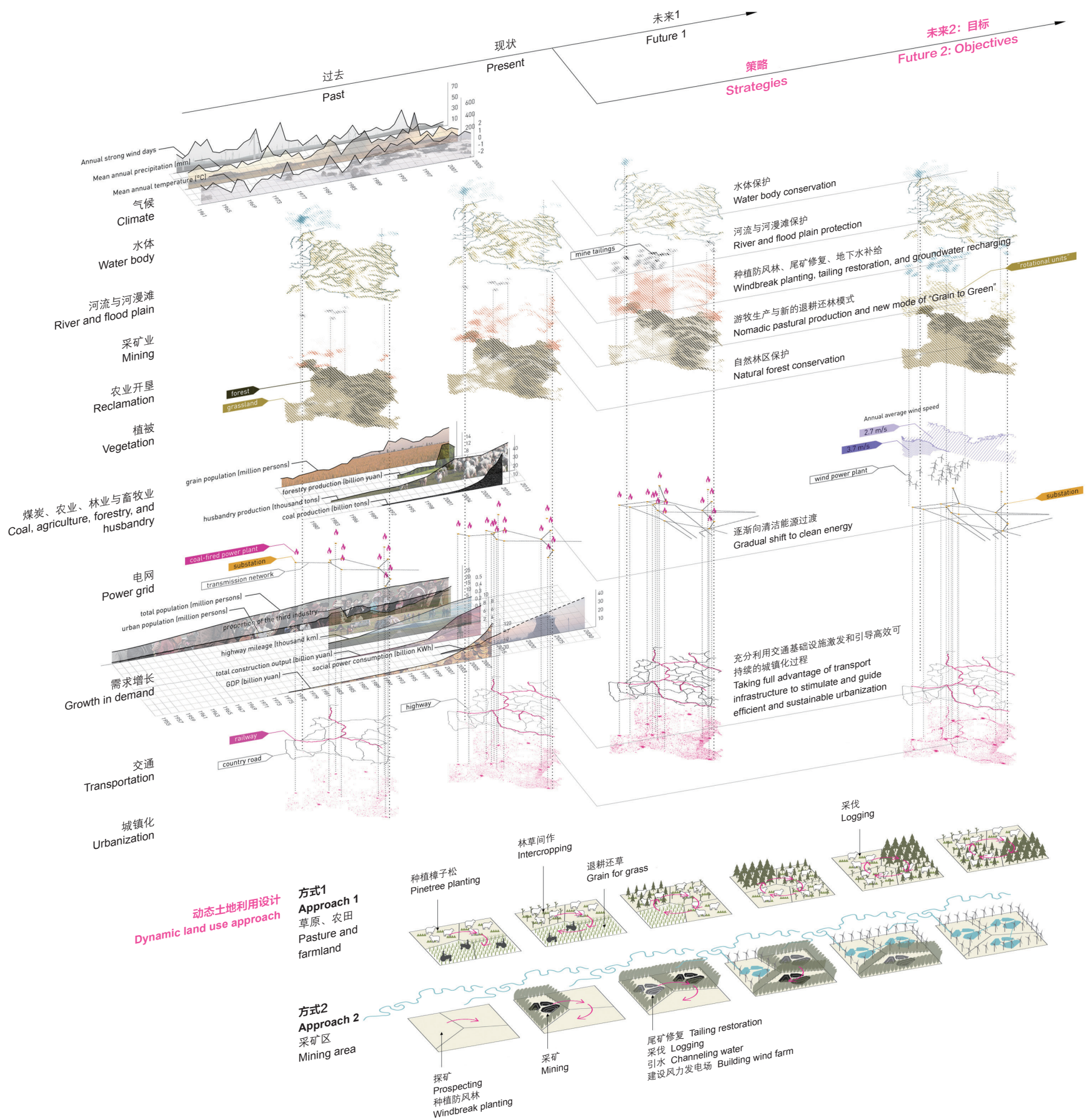
The following sections will discuss the process and mechanism of how mapping inspires design through three cases that were carried out in the authors' practice and teaching. All these cases focused on complex sites and depended on comprehensive interventions, where mapping was used throughout the cognition, design, and representation processes.

4.1 Case One: Carrier of Nonlinear Thinking and Operation

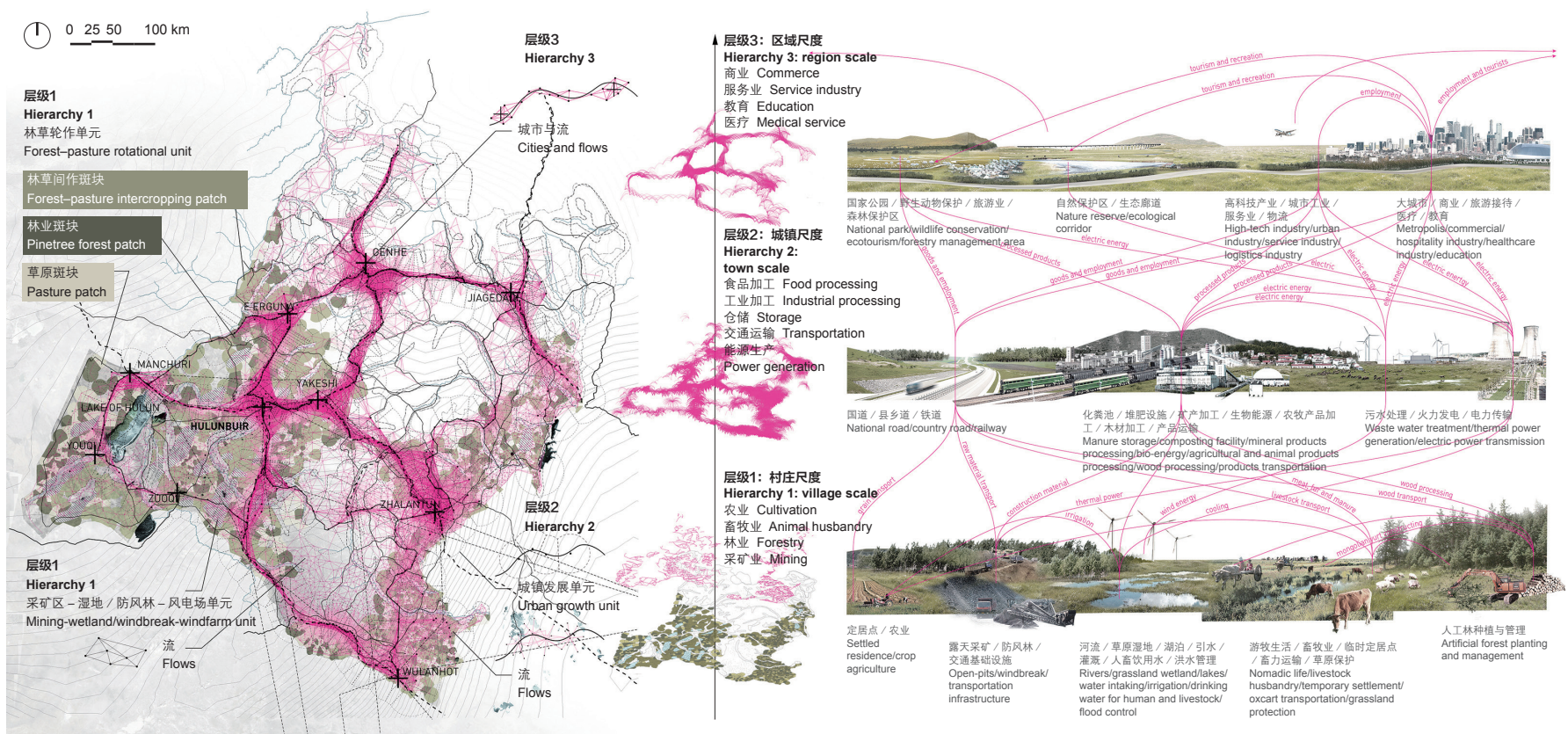
This project focused on the nomadic landscape of Hulunbuir, Inner Mongolia, China. The existence of large numbers of influencing factors and land use forms makes this landscape extremely complex and dynamic and, meanwhile, causes many problems and conflicts^[28]. Starting with site cognition, the authors collected data on various factors that may affect the landscape change and visualized them in forms of maps or line graphs.

Due to the nonlinear relationships between the many parallelly evolving and interrelated factors in this complex landscape, it is hardly possible to solve problems through linear causal thinking that treats certain factors as the origin of phenomena. The mapping shown in Figure 8 placed these factors into a parallel timeline framework, with the horizontal direction indicating their dynamics and the vertical correspondence implying their relationships. For each factor under this framework, the authors speculated about a possible future based on the current trend and conceived an expected future, namely the design objective. To address the objectives, corresponding possible strategies were then explored and annotated on this framework, including waterbody conservation, low-impact mining, tailing restoration, clean energy transition, more productive "grain for green" approaches, and intensive urbanization. Then the task would be to integrate these objectives and strategies through specific land use activity design.

The local nomadic land use provided inspirations for the design. Nomadism is a dynamic way of land use that satisfies current needs while providing time for the pasture to recover, to achieve efficient utilization of limited resources. The design tried to expand the application of nomadic wisdom into reorganizing the relationships between more land use forms, changing them from mutually conflict to cooperation. Specifically, two dynamic land use approaches were designed. The first approach, aiming for a more profitable "grain for green," combined animal husbandry with economic forestry. Through forest-grass intercropping and recurrent felling, forest and pasture shift locations periodically and herders can move in between. The second approach, through a dynamic sequence of multiple land uses, integrated the strategies of low-impact mining, tailing restoration, and clean energy transition, attempting to achieve multiple objectives without affecting current interests. Specific measures included integrating coal mining with windbreak



8. 在多因素非线性关联的框架中探讨景观变化与动态用地方式设计。
8. Exploring landscape changes and designing dynamic land uses in a framework with multiple nonlinearly interrelated factors



9. 多个尺度上的连接与流动设计及其呈现的空间模式
9. Connections and flows designed at different scales and their spatial patterns

影响当下收益的同时实现多种目标：煤矿开采与防风林种植结合以减少粉尘；开采后的地块进行林业采伐，建设风力发电场；通过引水等方式将尾矿修复为水体以补给地下水，并可与渔业养殖结合^[29]。这些用地活动的重组试图自下而上推动这一多因素并行演化的复杂系统向期望的未来状态转变（图8）。

当代生态学理论认为社会—生态系统呈现多尺度嵌套的动态网络结构。以这一结构为逻辑框架，图9在上述设计的基础上探索了“村庄—城镇—区域”三个尺度上的用地组织与物质能量流动：上述设计聚焦于村庄尺度，将促进更多的农副产品、木材和煤炭向更大尺度的城镇汇集；下一步，设计将城镇的连接和增长方式由当前的分散发展转变为沿现有交通网络聚集发展；当这一尺度运行良好之后，来自城镇的商品、能源和人口沿主要道路向位于节点处的市县流动，从而支撑区域尺度上更复杂的产业和社会发展。Mapping以网络的图示表达了这些多尺度的连接与流动所构成的空间模式，并将其叠加，形成区域规划的平面图。

在这个案例中，Mapping帮助设计者以非线性的动态框架观察和理解大量因素，并设想和重构它们的互动与连接，这得益于Mapping的

planting to reduce dust, logging windbreaks and building wind farms on the post-mining plots, and restoring tailings into water bodies to recharge groundwater and develop fishery^[29]. The reorganization of these local activities would hopefully change, from the bottom up, the complex system with multiple parallelly evolving factors to an expected future (Fig. 8).

Contemporary ecological theory believes that social-ecological systems present structures of dynamic networks at nested scales. Based on this structure, Figure 9 further explores land use organizations and material-energy flows across the scales of village, town, and region. The land use design described above has focused on the village scale, expecting that more farm and sideline products, timber, and coal would gather to towns. Moving up a level, the connections and growth of the currently scattered towns were redesigned to cluster along existing transportation networks. When things work well at the town scale, commodities, energy, and population from towns would flow via main transportation lines and meet at the nodes—counties and cities, supporting more complex industrial and social development at the regional scale. The network mapping represented the spatial pattern of these connections and flows at multiple scales, and their overlay produced a regional master plan.

In this case, mapping worked as a nonlinear dynamic framework that enabled the designer to observe and understand the mass of factors, as well as imagine and

线性信息组织逻辑与复杂景观的非线性结构与过程的契合——Mapping 为设计提供了非线性思考与操作的载体。正如马歇尔·麦克卢汉宣称的“媒介即信息”（the medium is the message）^[30]，信息载体对信息本身有重要影响。从这个意义上看，线性的语言和分析图倾向于形成确定性的设计（如用地分区规划），Mapping 则有助于实现对非线性相互作用过程与机制的认知与操作，从而激发动态与开放的设计。

4.2 案例二：保持结构的“加厚”与“加深”

这一案例是笔者在美国哥伦比亚大学“气候变化”城市设计课程中完成的，聚焦于美国纽约州与新泽西州交界处的哈德孙河谷。

笔者团队研究的方向为固碳林业。通过林业实现固碳是一个系统工程，包含多个相互关联的环节，它们对固碳的作用并非都是积极的：生长中和成熟的森林具有较好的固碳效益，而森林的衰老、腐烂、病虫害、火灾等反而会释放大量二氧化碳；适当增加采伐和木材使用有利于碳封存，但采伐和运输过程也会带来碳排放。因此，建立与现有用地活动结合的本地化的林业生产—消费循环体系是固碳林业发挥作用的关键。

设计开始于场地信息的 Mapping。通过在包含多种信息的场地平面图上叠加序列性断面，笔者构建了一个具有多个观察和操作尺度的 Mapping 框架。在各断面所构成的局部尺度上，设计根据现有地理信息建立了地形、用地活动与碳排放数值之间的空间关系。这一过程帮助识别了适合与林业复合的用地类型及其位置，包括森林斑块、农业用地、采矿区和城市空地。在此基础上，设计探讨了它们与林业结合的具体方式：加强对现有森林的管理和开发，农业用地与林业结合形成农林复合系统，采矿区的土地修复与梯田式的苗圃和温室建设结合，以及在城市中面积较大的空地上栽植新的苗木。

接下来，设计将这些复合用地与固碳林业系统中的不同角色建立了对应：森林斑块成为苗木和木材的生产者，农林复合用地为周边城市提供更多本地生产的食物，采矿区和城市空地是食品、苗木和木材的主要消费者。它们均可形成开放空间，提供多种综合服务。在多个断面组成的整体尺度上，笔者进一步将这些角色对应到具体的空间位置，并标注了它们之间的供需关系与物质循环。水网和码头等空间信息的叠加进一步揭示了以较为低碳的水运方式连接这些多功能节点的可能性。整个过

construct their interactions and connections. Owing to a match between mappings' logic in organizing information and landscapes' nonlinear structures and processes, mapping can provide a carrier for the nonlinear thinking and operations that landscape design requires. According to Marshall McLuhan's famous quote that "the medium is the message,"^[30] the carrier of information critically determines its contents. In this sense, applications of linear languages and analytical representations may eventually result in deterministic design (e.g., land use zoning planning), whereas mappings that enable cognitions and operations of nonlinear interacting processes are much more likely to inspire dynamic and open-ended design.

4.2 Case Two: Structure-Preserving "Thickening" and "Deepening"

Completed in the urban design studio "Climate Change" at Columbia University, this case focused on Hudson Valley bordering New York and New Jersey, USA.

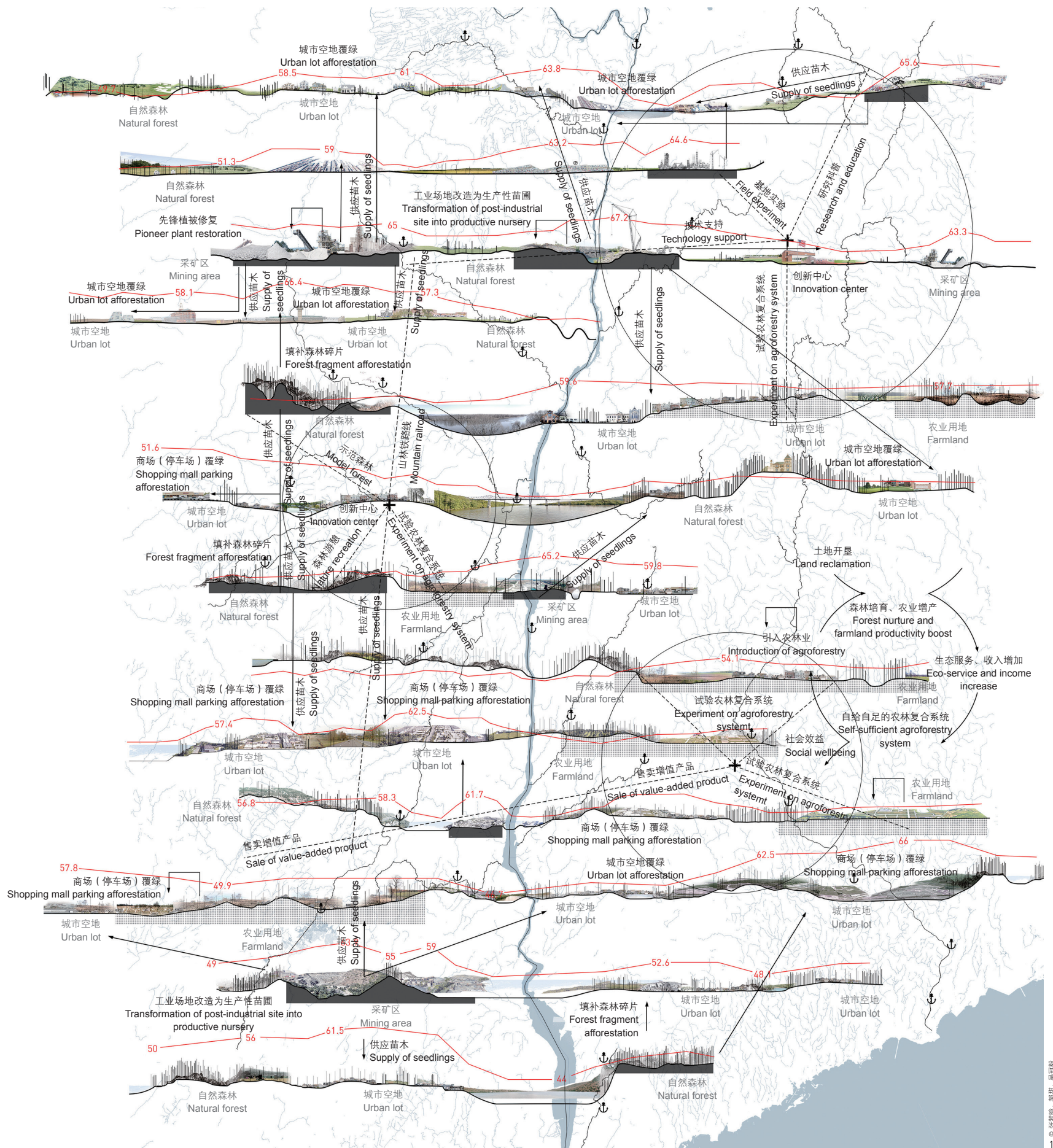
The research of the authors' team focused on carbon sequestration forestry. To capture carbon through forestry is a systematic project involving many interconnected parts, not all of which play a positive role. While growing and mature forests absorb carbon, aging, rotting, pests and diseases, and fire of forests can release substantial amounts of carbon dioxide; Properly increased timber harvesting and consumption increases carbon fixation, but the process of logging and transport in turn produces carbon emission. As a result, for forestry to efficiently sequester carbon, a localized forestry production-consumption cycle embedded in the existing land use activities would be required.

The design process started with the mapping of site information. Overlaying a sequence of sections on an information-rich site plan, the authors established a mapping framework with multiple observational and operational scales. At the local scale defined by each section, the spatial relationships between topography, land uses, and carbon emission were built based on existing geographic data. This process helped identify the types and locations of the land use that could be integrated with forestry, i.e. forest patches, farmland, mining area, and vacant urban lots, before specific integration approaches were discussed: Revitalizing existing forests through management and exploitation, developing agroforestry systems on farmland, integrating mining area land restoration with terraced nursery and greenhouse development, and afforesting large vacant urban lots.

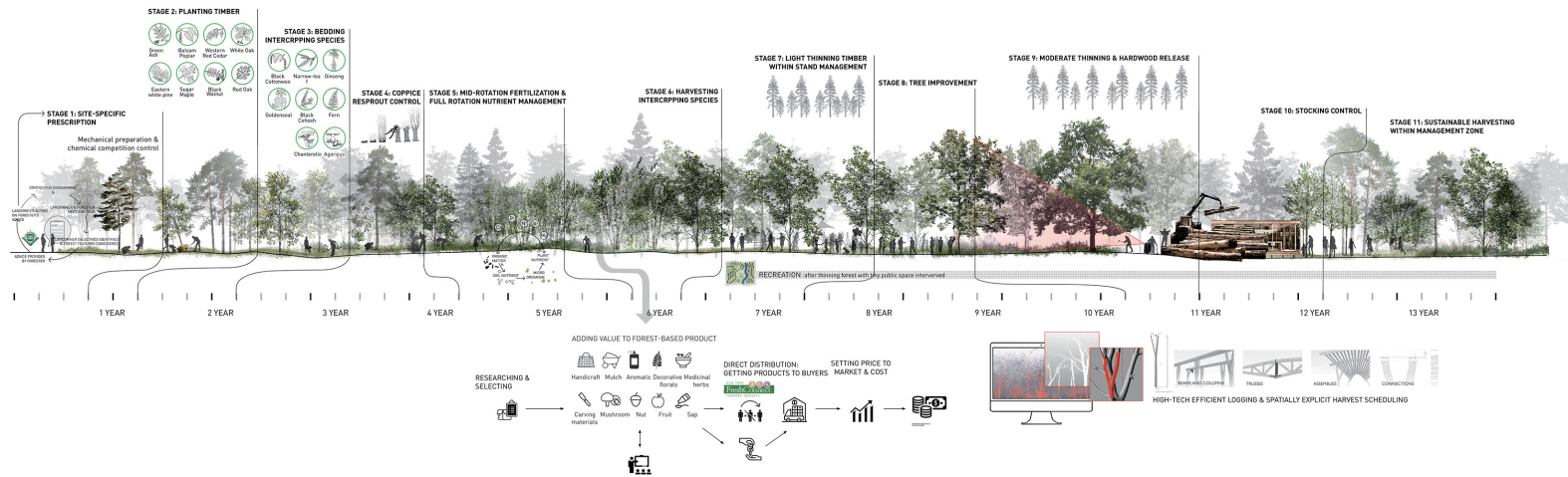
In the next step, the designer established correspondence between these composite land uses and the various roles in carbon sequestration forestry: forest patches produced seedlings and timbers, agroforestry land provided more local food for surrounding cities, and mining areas and urban lots were the primary consumers of the food, seedlings, and timbers. Meanwhile, all these roles can provide open spaces and multifunctional services. At the overall scale defined by all the sections, the authors then mapped these roles to specific locations in space and annotated their supply-demand chains and material circulations. Further overlays of river network and wharf information revealed the possibility of connecting these

10. 在同一结构的不同尺度上，通过拼贴和标注空间信息、林业活动与物质循环，景观认知与设计成为一个不断延伸的过程。

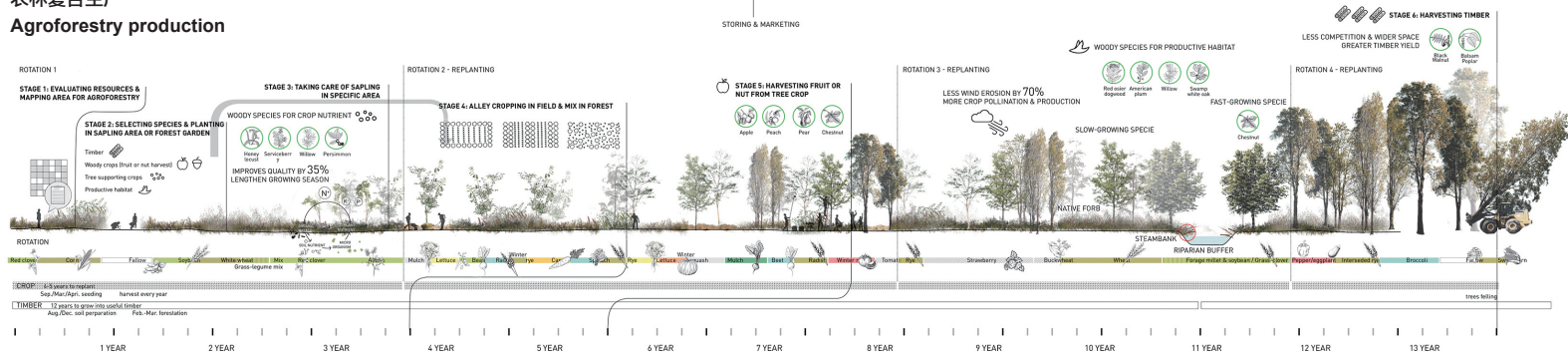
10. Through collaging and marking spatial information, forestry activities, and material cycle at different scales of a same structure, landscape perception and design become one extending process.



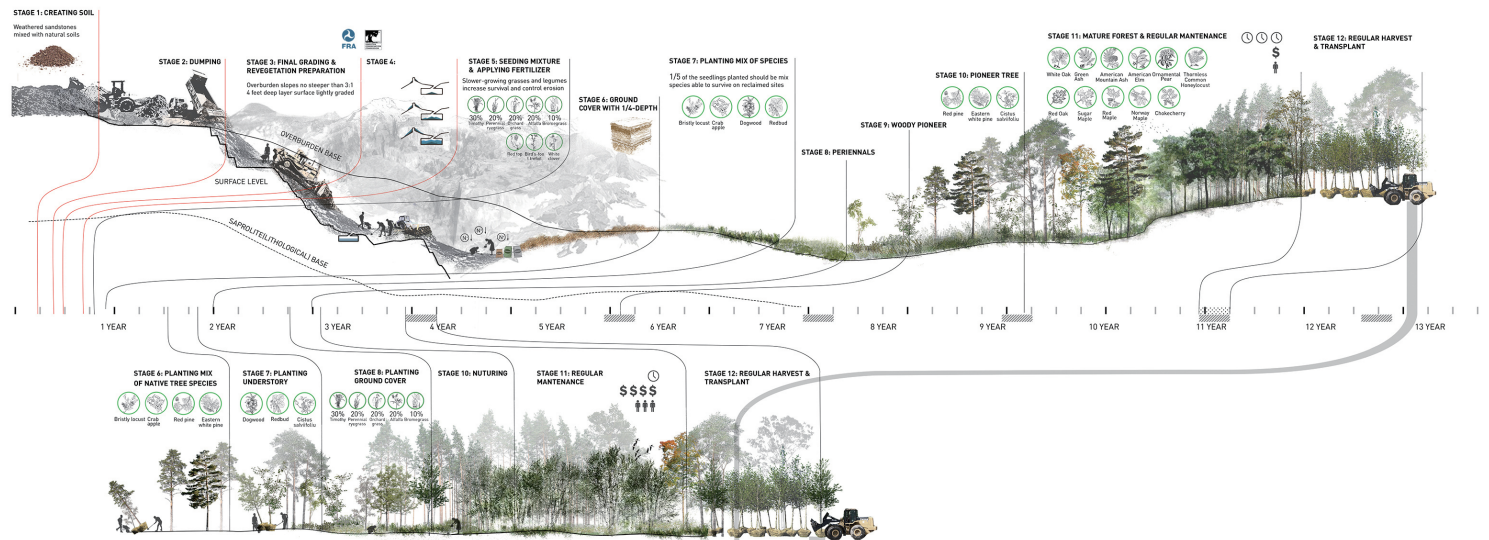
森林管理与开发 Forest management and development



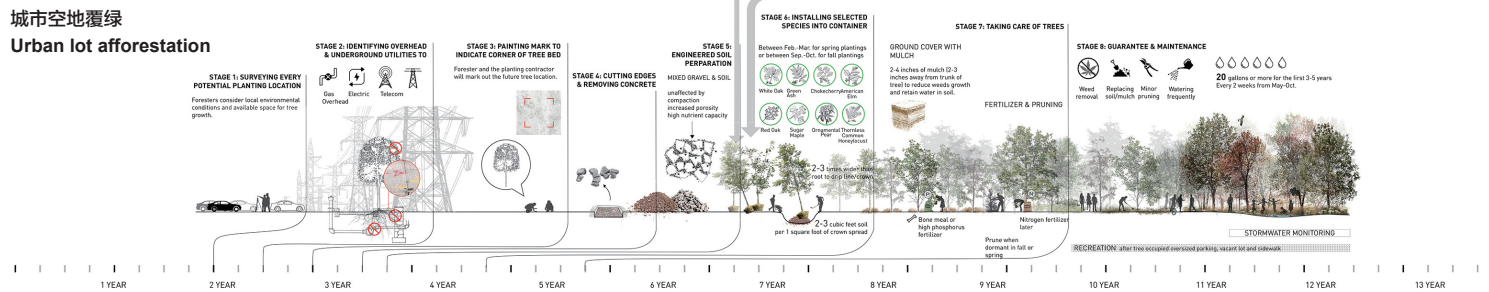
农林复合生产 Agroforestry production



尾矿生态修复 Tailings ecological restoration



城市空地覆绿 Urban lot afforestation



程在局部和整体尺度之间不断切换和反馈，最终在场地上嵌入了一个多功能林业生产—消费网络（图10）。

为了制定在上述4种用地上开展林业活动的具体实施技术与过程，笔者在查阅大量资料的同时，筛选出适合这一场地的信息并按时间顺序拼贴在不同用地的断面上。这一Mapping关注微观层面上的过程和技术，如土壤改良、苗木种植、养护、间伐、利用等步骤，以及它们所涉及的工具、方法、植物种类、物质循环、产品与效益等。与此同时，笔者在更大的Mapping尺度上探讨和标注了这些微观过程之间的关联、协作与流动。这一过程同样包含不同尺度的切换，逐渐形成一个实施策略系统（图11）。

这一案例中，Mapping与景观本身一样，也具有多尺度开放结构。随着越来越多的信息加入，这个基本结构不断“加厚”和“加深”：在同一个尺度上，新标注的信息与原有信息保持同样的组织结构，使叙述不断加厚。与此同时，Mapping的各个尺度上都可以加入更深入的信息，形成更小尺度的Mapping，使叙述逐层加深。随着信息的增多，它们之间的联系也不断加强。这些信息既包括描述性的“名词”，也包括操作性的“动词”，其标注过程可分别对应于现状认知和策略设计，二者在同一个结构中同时进行、相互作用，使设计成为场地现状的延伸。相比之下，“一次只说一件事”的线性语言或分析图往往只能通过叙述的“加长”来容纳更多信息，而加长的过程势必伴随着前后信息间联系的不不断弱化，容易使分析与设计成为两个割裂的过程。随着景观的日趋复杂，设计中需要处理的信息也将越来越庞杂，Mapping的优势也将愈加凸显。

4.3 案例三：自下而上的媒介

本案例是笔者在华南农业大学本科生课程“设计图解思考”以及毕业设计中指导学生完成的设计研究。项目场地位于广州市番禺区的海鸥岛，是一处面临转型的农业景观。学生首先访问了当地的利益相关者，根据他们关心的海水倒灌、土地征用、就业困难和缺乏景观特色等问题，确定了两个研究方向：生产性用地的改善与景观特征的构建。

生产性用地改善涉及时间与空间两个层面。在时间上，设计提出了根据海水倒灌周期调整生产方式的策略框架。学生首先将一年中的多种自然条件变化情况呈现在同一时间轴上，并邀请当地人在上面标注不同

multifunctional roles through water transportation with a lower carbon impact. Through repeated switching and feedback between the different mapping scales, a multi-functional forestry production-consumption network was implanted on the site (Fig. 10).

To formulate specific implementing strategies and procedures of the forestry activities in the four types of composite land uses, the authors searched for many references while extracting suitable information for the site and reconfiguring them on different land use sections in chronological order. This mapping focused on micro-level processes and techniques, including phases of soil improvement, seedling forestation, maintenance, inter-logging, and utilization, as well as the tools, approaches, plant species, material cycles, products and benefits involved. Meanwhile, their potential connections, coordination, and flows were studied and annotated at a broader mapping scale. This process also involved changes between scales, gradually unfolding a strategic framework for implementation (Fig. 11).

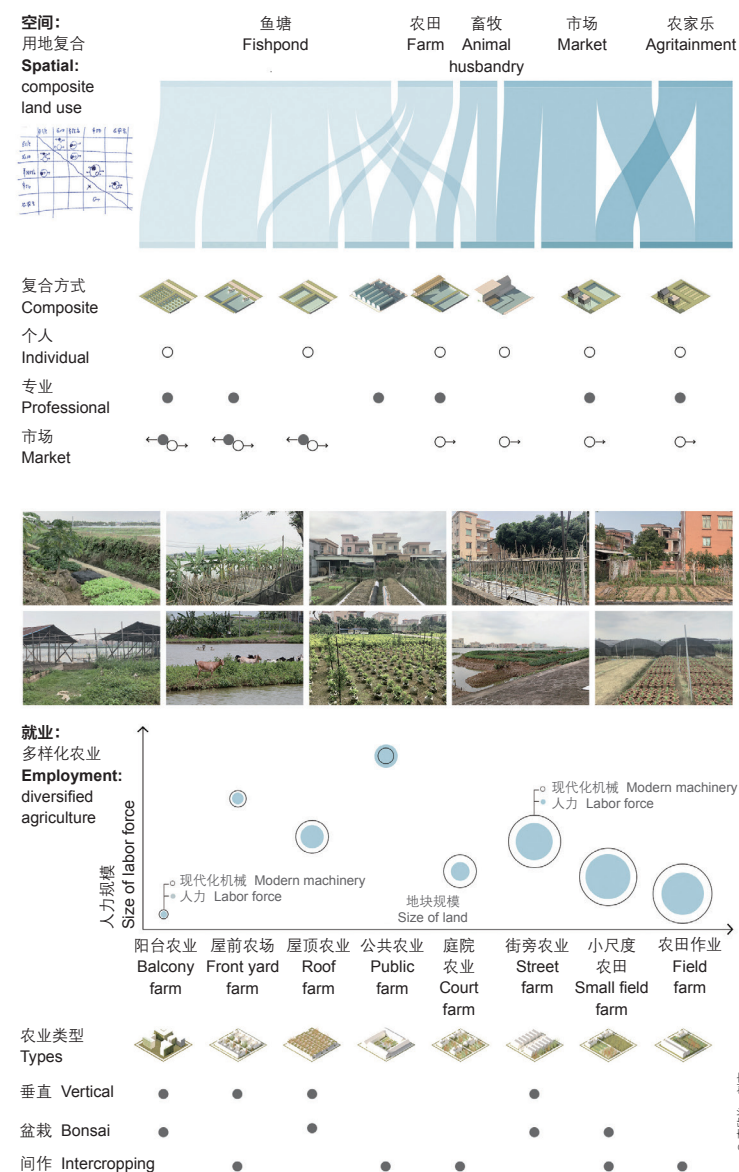
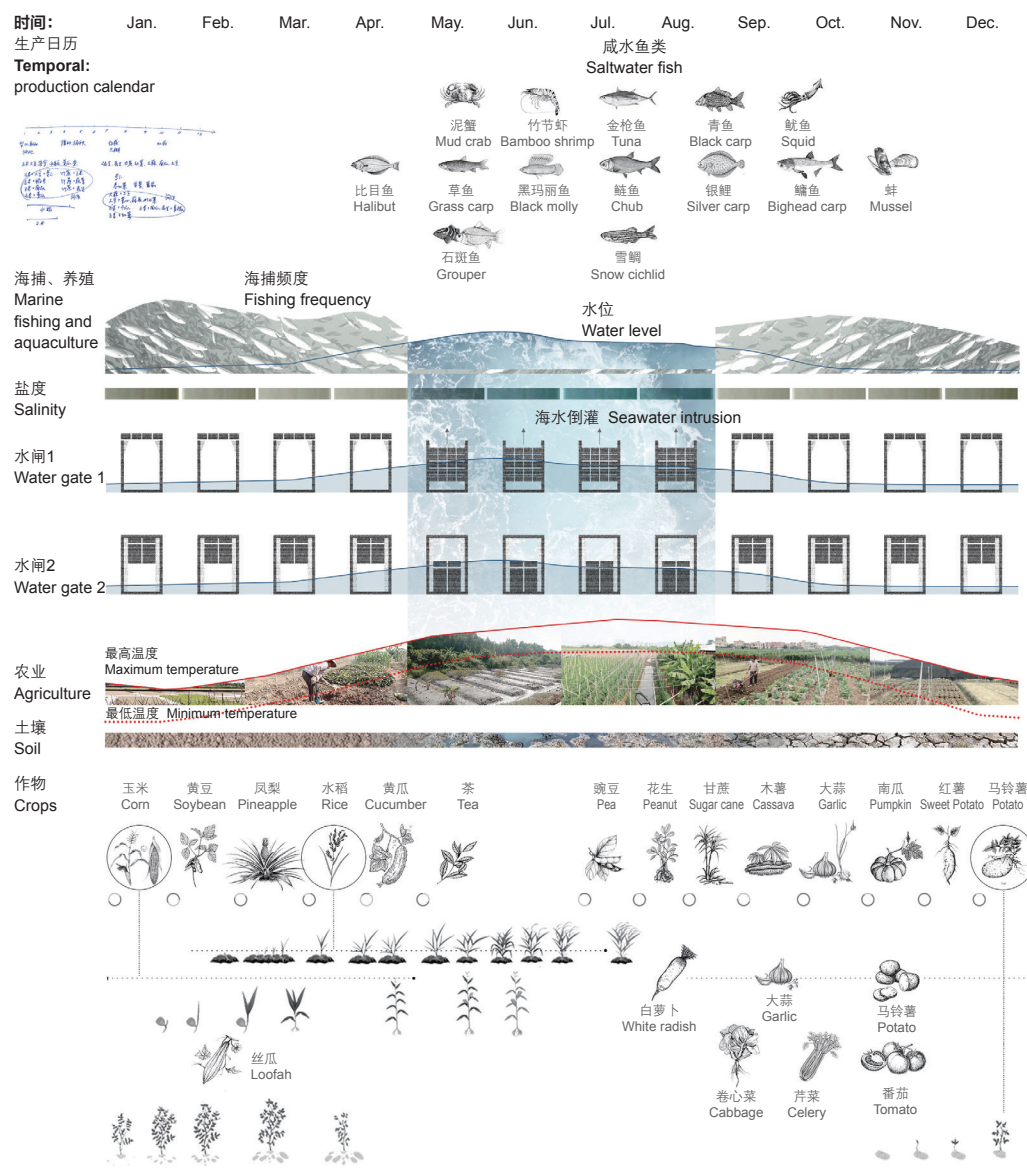
In this case, just like the landscape itself, mapping also has a multi-scale open structure—At one scale, the basic structure grows “thicker” as one annotates new information while preserving the organizational structure of the existing information; Across different scales, it becomes “deeper” as a mapping grows into several smaller-scale mappings with more detailed information joining in—the more information we add, the stronger their connections will be. Such information can be both descriptive “nouns” for apprehending the site and operational “verbs” for formulating strategies or design. Design becomes the extension of site information when cognition and design unfold simultaneously and interactively in the same structure. In contrast, for linear logic or analytical diagrams in a “one-thing-at-a-time” manner to include more information, they have to grow “longer.” However, the lengthening may inevitably coincide with a weakening of the front-rear relationship, leading to a separation of analysis and design. In a time when landscapes are becoming increasingly complex and information increasingly abundant, the advantage of mapping would be more critical than ever.

4.3 Case Three: As Bottom-Up Medium

This case is from a design research project that the authors directed students to complete in an undergraduate course “Design, Mapping and Thinking” and graduation project at South China Agricultural University. The study area is Seagull Island in Panyu District, Guangzhou, China, which is an agricultural landscape undergoing a transition. Students’ interviews with local stakeholders revealed their concerns about seawater intrusion, land acquisition, employment difficulties, and the lack of landscape characteristics, leading to the development of two research topics: productive land use improvement and landscape characteristic construction.

The improvement of productive land use activities involved both temporal and spatial considerations. In temporal terms, the students proposed a strategic framework for adjusting production modes in response to the seawater intrusion cycle. Presenting the annual change of natural condition on a timeline, the students invited local people to annotate production approaches and crop types under

11. 通过不同尺度上的信息标注，设计不同林业活动的详细过程和整体联系。
11. Designing the detailed processes and integral connections of different forestry activities by mapping information at different scales.



条件下的生产方式和作物种类，再进一步通过Mapping对信息加以整理（图12）。这一过程揭示了气温、水位、海水盐度变化与海捕、养殖和农业种植活动在时间上的交错或重合。由于海捕和农业劳作集中在春秋两季，每年5月至8月的咸水季节人们较为空闲，因而设计团队提出在这一时段开放部分水闸引入咸水的设想，并在生产日历中加入了适应咸水和高温季节的鱼类和作物生产，使渔民和农民得以持续获得收益。

在空间上，由于大量土地被征用且法律禁止变更土地性质，当地出现了一些不改变基本用地性质的复合用地方式。学生调研了现有的生产

different conditions, which were then organized through mapping (Fig. 12).

The mapping revealed the temporal coordination between the natural condition changes (temperature, water level, and water salinity) and human activity rhythms (sea fishing, aquaculture, and crop production): sea fishing and agricultural activities are concentrated in spring and autumn, while the high-salinity months from May to August become an idle season. To provide constant incomes to the locals, the design team advised opening some water gates to introduce salt water during this period and added productions of fish and crops that adapt to salt water and high temperatures on the timeline.

In terms of space, since many farmlands had been requisitioned and changing land use types was illegal, local people have invented several composite land use types. The students investigated existing land use activities and invited local people to draw connections between them and discuss their potential benefits. For example, combining agriculture and aquaculture may increase yield due to

12. 在本地知识的组织过程中形成应对海水倒灌、用地复合以及就业问题的生产方式设计。

12. Through a systematic organization of local knowledge, new production modes were developed to address seawater intrusion, composite land uses, and employment issues.

方式，邀请当地人对可行的复合方式进行连接，并共同探讨其可能的效益。例如，一些农业与养殖业复合的方式可以形成更高效的物质循环，从而提高产量；生产用地与市场、农家乐等商业和服务业结合能够进一步提高收入并促进就业。这些Mapping的结构并不复杂，但有助于挖掘和整理大量散落的地方知识，并较为系统地建立它们的关联与协作关系。

在景观特征的构建中，学生请当地人在地图中标注出具有价值和意义的场所：其中除了人们熟知的“景点”外，人还包括大量“无名景观”，例如周末的路边集市、房前屋后的微型种植园、吊脚屋养殖舍、材料或形式独特的村落建筑、滨江长堤与码头、野生红树林、风暴潮后形成的浮木河等。它们大多并不体现在正式地图中，但这些鲜活的日常景观是当地人集体记忆和情感认同中不可或缺的部分。

根据这张地图，项目团队实地感知和记录了上述场所，并通过Mapping整理和拼贴了大量照片与断面，提取和归纳了其中的重要形式、体验与活动（图13）并将这些信息对应到总平面图上。根据这些场所的特征与空间分布，设计者利用现有交通设施将其串联，并设计了一条包含“楔子”“水乡”“海港”“长堤”4个段落的景观路径。图上的距离与时间标注显示了步行与骑行的体验节奏。与传统物质空间规划相比，这一通过Mapping完成的设计更注重活动、意识和情感层面的景观特征与体验的探寻和组织。

这一案例不仅关注了景观中的个体知识、诉求与体验，还以专业性、创造性的视角思考如何将它们系统性地连接，从而形成景观的时空尺度下的设计，Mapping则成为一个自下而上的协作媒介。近年来，“自下而上”方法在景观实践和教学中得到越来越多的重视，然而人们也常常质疑：关注琐碎的日常事物与活动的意义何在？或许其重点不在于微观事物本身，而在于“以一个更大的尺度理解被观察的事物与其所在的场所、社区、城市乃至国家之间的关联”^[7]。“自下而上”是一个从微观到宏观的构建过程，并非仅停留于微观而忽视宏观。

以上三个案例从不同角度探讨了Mapping启发设计的机制：在反映复杂景观自身结构与过程的逻辑框架中，随着信息与想法的汇集与连接，对场地整体的认知与设计逐渐生成。具体来说，Mapping作为一种设计方法具有以下突出特点：

1) 动态开放的策略性：关注景观过程与介入方式的组织对空间格局的塑造，设计结果往往并非“完成的”空间形态，而是动态、开放的策略框架；

more efficient material cycles; Integrating productive usage with commercial and service functions such as markets and agritainments could additionally increase farmers' revenue and create employment. These mappings are rather simple in structure, but practical for mining and sorting the fragmented local knowledge and systematically establishing their interrelations and cooperation.

To enhance landscape characteristics, the students asked local people to label places of value and meaning on a site map. Besides some well-known scenic spots, the map was also marked with many “anonymous” landscapes, such as weekend street fairs, micro plantations attached to houses, stilted farms, village buildings with unique materials or forms, riverside dikes and piers, wild mangroves, and driftwood in rivers caused by storm surges. While most of them are not documented on official maps, these lively daily landscapes are an indispensable part of the local collective memories and identities.

The project team visited and recorded the above-mentioned places. Through mapping, they sorted and collaged photos and sections, extracted notable forms, experiences, and activities, and reorganized them on the site plan (Fig. 13). Based on the characteristics and distribution of these places, the students then connected them using existing transportation infrastructure and designed a landscape path including four sections: “Prologue,” “Waterland,” “Harbor,” and “Long Dike.” The annotations of distance and time indicated the rhythms of walking and cycling experiences. In contrast to traditional physical-spatial planning, this mapping-based design prioritized the exploration and organization of landscape characteristics and experiences in terms of activity, perception, and emotion.

This case not only focused on individuals' knowledge, demands, and experiences, but also connected them systematically in a professional and creative way to formulate a design at landscape's spatial-temporal scale, where mapping became a medium for bottom-up cooperation. In recent years, “bottom-up” approaches have received increasing attention in landscape practice and teaching, but doubts also arise: what sense does it make to focus on trivial things and daily activities? The point may not lie in the micro-scale objects themselves, but rather in “understanding the connection of the observed object to its place, community, city, and even country at larger scales”^[7]. “Bottom-up” is literally a “micro-to-macro” process rather than staying at the micro regardless of the macro.

From different perspectives, the above three cases discussed the mechanisms of mapping in inspiring design: under a logical framework that reflects the structure and process of complex landscapes, fragmented information and ideas are collected and connected while cognition and design of the site as a whole are gradually generated. Specifically, mapping as a design method has the following characteristics:

1) Dynamic and open-ended strategies: By focusing on the formation of spatial patterns through the organization of landscape processes and interventions, the resultant design is often not a “finished” spatial form but a dynamic, open-ended strategic framework.

2) 认知与设计的统一性：在同一个结构中展开对复杂场地的认知与设计，二者并无明确的先后顺序，而是紧密契合、相互反馈；

3) 自下而上的生成性：宏观设计的形成来源于微观尺度上对具体事物关系的构建，而非外加于场地的宏观抽象概念。

Mapping反映了一个朴素的原则：设计是景观自身演化结构与过程的延伸——这亦是规划设计一直追求的目标。早在一个世纪以前，盖迪斯就在《进化中的城市》中阐述了同样的方法论：“基于对事实的调查和阐释，我们可以了解演化的总体方向，甚至看到如何推进它。”^[31]麦克哈格在《设计结合自然》中指出人造物的设计应当与自然界的演化遵循同样的机制^[20]。克里斯托弗·亚历山大则在《秩序的本质》中认为好的设计是“保持结构的转变”（structure-preserving transformation）^[32]。与此同时，优秀的实践者几乎无不重视对场地真实复杂性的深入理解，并在设计中以各种方法作出回应。Mapping并非践行这一原则的唯一方法，更不是对传统的颠覆。

尽管如此，上述原则在实际操作中的应用并不容易，特别是随着当代景观的日益复杂，认识景观结构与过程变得愈加困难。作为非线性思考与操作框架、保持结构的“加厚”与“加深”过程，以及自下而上过程的媒介，Mapping为这一设计原则的应用提供了可视化的操作载体，因而具有重要且独特的实践价值。

5 结论与启示

Mapping的多样性与灵活性为复杂景观的认知与设计提供了丰富的机会，也为实践与教学带来了挑战。本文通过文献综述、案例归纳与自身实践教学研究，探讨了Mapping的作用、逻辑与作用机制。笔者认为，Mapping的主要作用是探索，即设计者在建立信息间复杂关系的过程中不断形成对场地新的认知。在表达方面，Mapping可以反映场地的复杂性以及设计者的思维轨迹，但图面的易读性不应该成为衡量其价值的首要标准。

虽然Mapping的方法千差万别，但其信息组织的底层逻辑可大致归纳为序列、矩阵、并行、网络与解构（从简单到复杂），它们在不同程度上反映了复杂景观在空间、时间和认知层面的演化结构与过程。对逻辑结构的认识有助于Mapping的阅读与使用。

2) Integrating cognition and design: The cognition and design of a complex site are carried out concurrently in the same structure, intimately integrated, and providing feedback to one another.

3) Generative from the bottom up: Macro-scale design emerges through relationships among micro-scale objects and activities, rather than abstract concepts imposed on the site.

These mapping qualities reflect a fundamental principle: design is an extension of the evolutionary structure and process of the landscape itself—a long pursuit in landscape planning and design. Over a century ago, Geddes had expounded the very same methodology in *Cities in Evolution* that “it is from facts surveyed and interpreted that we gain our general ideas of the direction of Evolution, and even see how to further this.”^[31] McHarg asserted in *Design with Nature* that design of the artificial should follow the same evolutionary mechanism as nature^[20]. Christopher Alexander, in *The Nature of Order*, stated that good design is “structure-preserving transformation”^[32]. Meanwhile, almost all excellent practitioners would pay special attention to an in-depth understanding of the intrinsic complexity of sites and respond in various ways in design. Mapping is not the only way to apply this notion, nor is it a subversion of tradition.

Nevertheless, it is also far from easy to practice this principle. Especially due to the increasing complexity of contemporary landscapes, their structures and processes would have become even more difficult to understand. Mapping, as a framework for nonlinear thinking and operation, a process of structure-preserving “thickening” and “deepening,” and a medium for bottom-up processes, embodies its critical and distinctive practical value in presenting a visualized operational carrier for the above principle.

5 Conclusions and Implications

While the diversity and flexibility of mapping provide rich opportunities for the cognition and design of complex landscapes, they also pose challenges to practice and teaching. Based on literature review, case studies, and practice and teaching, this article discusses the function, logic, and mechanism of mapping. The authors argue that the main function of mapping is exploration, namely to help designers continually develop new understandings of the site while establishing the complex relationships between information: Although mapping represents the site complexity and the designers’ thinking trajectory, the outcomes of mapping are not always highly legible.

Despite the diversity of mappings’ methods, their underlying logical structures would converge into limited types, including sequence, matrix, parallel, network, and deconstruction (from simple to complex), reflecting to various degrees the evolutionary structure and process of complex landscapes in spatial, temporal, and cognitive aspects. A gained awareness of logical structures would be helpful in reading and using mapping.

Mapping can be used as a design method, enabling design strategies in the excavation and connection of site information from bottom-up to top-down. This method reflects an important principle in landscape design: design is an extension of the landscape's evolutionary structure and process. Offering a visualized operational carrier for this principle, mapping presents unique practical value.

Landscape is a complex whole of natural, cultural factors and processes, as well as emotions and meanings. As a result, landscape cognition and design cannot rely merely on empirical scientific logic or "concepts" that are irrelevant to sites themselves. As a site-specific methodology that understands and establishes connections and possibilities from the bottom up, discussions and applications of mapping in practice and teaching would help designers improve understandings of the structure and process of complex landscapes and get rid of the dogma of following standardized workflows or imposing cultural symbols. **LAF**

Mapping also serves as a design method by enabling bottom-up generations of design strategies while exploring and connecting the site information. This method highlighted an important notion in landscape design: design is an extension of the landscape's evolutionary structure and process. Offering a visualized operational carrier for this principle, mapping presents unique practical value.

Landscapes are complex wholes that contain the interplay of numerous natural and cultural factors and processes, as well as emotions and meanings. As a result, landscape cognition and design cannot rely merely on empirical scientific logic or "concepts" that are irrelevant to sites themselves. As a site-specific methodology that understands and establishes connections and possibilities from the bottom up, discussions and applications of mapping in practice and teaching would help designers improve understandings of the structure and process of complex landscapes and get rid of the dogma of following standardized workflows or imposing cultural symbols. **LAF**

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