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非人类物种的城市化：动物也是地球上的一员

Nonhuman Urbanism: Animals Are Public Too

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摘要：提出在日益城市化进程中人类与非人类物种之间关系的 4 种推测。由于非人类物种也在快速城市化，它们的空间条件大部分都是由人类为自己所构建，这可以集中并强化拉图尔的生物共生理念。风景园林师应该理清自己工作的政治影响，而其中的一种方法是处理物种之间微妙而脆弱的相互关系。当然，采用未经验证的新自由主义设计在大多数情况下对非人类物种都会带来特殊的破坏性后果。本文使用“基础设施”模型探讨不同的生物群体之间如何相互影响彼此的命运。

关键词：非人类物种；景观基础设施；相遇；城市化；公共空间

Abstract: This paper offers four speculations on the relationships between humans and nonhumans in an increasing urbanizing world. Since nonhuman species are also rapidly urbanizing, the kinds of spatial conditions in which they find themselves largely constructed by humans for humans which can focus and intensify Latour's concept of a republic of beings. Landscape architects should be clear about the political ramifications of their work, and one way to achieve clarification is in the handling of the delicate, fragile interactions they arrange between species. Certainly the adoption of an untheorized neoliberal design agenda has in most cases specific and damaging consequences for nonhuman species. The paper uses the model of “infrastructure” to explore how different biopolitical user groups involve each other in their destinies.

Keywords: nonhuman; landscape infrastructure; encounter; urbanism; public space

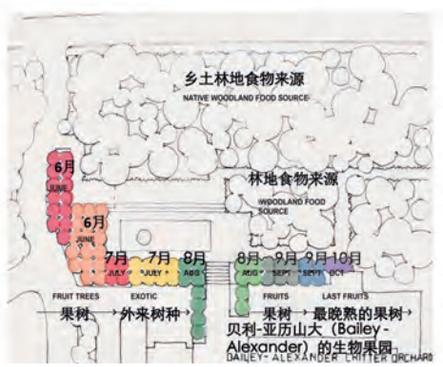
1 基础设施的共振

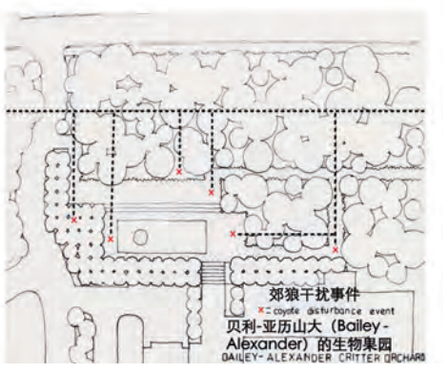
彼埃尔·贝朗格（Pierre Belanger）在他的重要著作《景观就是基础设施》[1] 中提出：20 世纪的基础设施由城市规划者规划，工程师设计，是一种针对连通性、流动性和服务性问题而提出的解决城市化退化和环境破坏的措施。它不仅破坏了人类完美的生活环境，还使得生物物理系统被压制和边缘化。

贝朗格提出将景观基础设施作为当代实践领域的构想，重点强调了城市经济流动性和地球生态动力两方面的内容。

他似乎是对的。然而，鉴于现今所谓的“非人类物种的转变”（nonhuman turn）[2]，我认为我们可以进一步挖掘基础设施的潜力。“非人类物种的转变”坚持认为，人类总是与地球上的其他生物（从微生物到哺乳动物）共同进化和相互作用。唐娜·哈拉维（Donna Haraway）[3]、布鲁诺·拉图尔（Bruno Latour）[4]、蒂莫西·莫顿（Timothy Morton）[5] 等都对将人类置于生物层级中的最高级提出质疑。在我自己的工作中，我主张人类和非人类物种共同生活在一个构建的世界中，他们相遇的主要场所很可能是公共空间——如果“公共空间”中包容了非人类物种 [6]。这些学者坚持认为，在为拯救地球而开展的人类占有活动中，有必要考虑地球是否真的只为我们人类而存在。我们在非人类物种的世界中是怎样的？如何从非人类物种的视角去考虑建造和管理地球系统？特别是城市系统，即这篇文章的主题。

通过风景园林将这些问题纳入城市思维的一种方法是扩展贝朗格的基础设施概念。可以肯定的是，有形的基础设施建设是一项重要工





1 郊狼果园：阿拉巴马州的奥本小镇地图显示了郊狼廊道与公共空间相交的位置
Coyote orchard: map of Auburn, AL showing intervention locations where coyote corridors intersect with public space

2 郊狼果园平面图
Coyote orchard plan

2-1 显示郊狼在不同季节可获得的食物
Shows seasonal availability of coyote fodder

2-2 显示随机性的郊狼相遇
Shows unscripted coyote encounters

作，但其他网络和系统也同样重要。事实上，它们有助于我们设想出新型的基础设施。例如，社会组织网络、共享网络、非物质劳动和批判性的社会和政治影响。这些系统与有形的基础设施不同，但却与其发生连接。它们联系在一起使得我们能够囊括许多理论家所说的预知情感和激情的生活维度，从而推动政治和经济发展。例如，社会理论家珊妲·慕孚（Chantal Mouffe）在对社会生活的解读中分析了政治激动机制，认为“激情”是政治决策的驱动因素[7]。

通过与非人类物种建立有意义的连接，人类如何面对、运作、应用并建立自己的主体性会成为更为短暂的基础设施建设的一部分，这是作家兼策展人纳托·汤普森（Nato Thompson）称之为共振基础设施的一个条件[8]，亦是本文的主题。

在过去的 10 年里，我负责了一个名为“雷达之下”（Under the Radar）的小型项目。它包含了一系列的设计调研，从不同视角探讨了人类与非人类物种之间的情感相遇。本文简要论述了其中的 4 个问题，试图梳理出将风景园林称之为相遇艺术的真正含义。[6]。在这些项目中，公共空间成为一个设计领域，在这个领域中，人类和非人类物种的集合变得明显和刻意，各个部分都是混合的，而且它们的自由性更强。

2 郊狼

该项目探索了美国阿拉巴马州的奥本小镇中人类与非人类物种之间的界限。奥本的郊狼数量约有 600 只[9]。当郊狼数量过多时，奥本野生动物服务办公室和保护部会定期捕捉郊狼。这些被捕捉的郊狼会被戊巴比妥药物杀死，而不是被重新安置或释放。正如一名野生动物官员在一次公开会议上所说，“只要一批郊狼被弄走了，新的郊狼就会进来，它们永远在这里。奥本是一个开放的绿色空间城市——郊狼爱它”[10]。

虽然阿拉巴马奥本的郊狼，被归为城市、远郊和农村的物种，但这种人类分类学与他们的生活和运动却没什么关系。郊狼（*Canis latrans*）是迅速发展的确定向量，它们的进化轨迹已经跨越物种边界，发展成为与人类持续相遇的状态。这次相遇的主要领域是公共开放空间，即城市河流廊道、公园边缘的林地或城市公墓。萨克拉门托动物保护研究所的卡米拉·福克斯（Camilla Fox）指出：尽管大多数人并不知道郊狼就生活在他们中间，但增进人与郊狼之间的互动是城市管理者和野生动物管理者必须面对的紧要问题。在芝加哥大都市区，多数大型绿地都被多达 12 只郊狼组成的一个个狼群所占据[11]。在美国的许多州，如阿拉巴马州，郊狼被归为“捕食者”或“毛皮兽物种”，有可能全年都会被不限量的捕杀。在阿拉巴马州，四季都可以捕猎，而且不会限制捕猎数量。因此，风景园林师面临的问题是如何建立一个人类与郊狼共存的世界。

我们在奥本大学的研究小组绘制了郊狼种群的运动轨迹，并确定了 3 个公共区域。在这 3 个区域中，我们可以设计干预措施促使人类和郊狼以一种原始而非常规的方式生活在一起（图 1）。在这个案例中，场地是一个位于林地郊狼廊道与奥本城市水体和污水处理服务中心之间的滞留池。在设计时，与城市水体和污水服务滞留池相邻的地带以及池塘本身都按照现代主义的园林类型进行了重组，参观者会认为这是一个经过设计的领域，这种做法具有目的性和友好性。矩形构图创建了直线、空间轴线以及高高的挡墙。池塘被设计成一个大型的矩形水面。在这个欧几里得式空间里，引入了一个专门为动物和昆虫提供食物的种植策略，郊狼也会吃这些动物、昆虫和植物（图 2）。

通过对郊狼的肠道和粪便分析，可以看出这个种植方案全年为郊狼提供水果和坚果，植物的季相变化从场地北边的春景开始，以场地南边的秋景结束（图 3）。乡土树种和外来树种林下都种植了冬天开花的草本植物，这些草本植物会被郊狼以及它们的猎物吃掉，特别是在食物稀少的月份。这个公共花园为周边建筑里的员工提供了座椅、阳光和荫凉，还吸引来了兔子、松鼠、昆虫、鸟类和其他野生动物，而这些物种又反过来吸引郊狼，使其通过临近的林地廊道来到这里。随着花园或者被我们称之为“生物果园”的自由生长，植物和动物将会在这种互动式的栖息环境中

超出它们原本的空间层级。

这个小项目试图建立一个相遇的地带，一个人类和非人类物种集合的场所。为了明确地表达这种集合，设计师必须考虑这里的人类与这些混合“群体”都需要保持甚至加强他们的自由性。一种去除自然与社会界限的景观包含了正在进行自我组织的集合的所有充分必要条件。为此，有必要探索拉图尔所说的“集合—自然文化”的共同世界——其没有按照时间线统一进入未来的意识，但是可以通过情感接触和相互肯定促使物种和要素之间形成错综复杂的联系和相互支持。为人类和非人类物种共生而工作的风景园林师将生命视为生长和变化的过程。她将树、孩子、岩石、天空、蜜蜂、郊狼、蛾和蝴蝶等设计成平等和关联的形式，参与这场永恒分化的运动。

3 云雀

这个“共振基础设施”项目结合了本土鸟类、人类娱乐活动和大型农业综合企业。随着工业化农业的出现和大规模市场驱动的种植业体制变化，欧亚云雀（*Alauda avensis*）严重衰落。云雀一直受人喜爱，经常出现在人们的音乐和诗歌中。其中有一部分原因是因为它们很容易在野外被观察到，尽管它们看起来如此的遥远、脆弱和不可知。

雄性云雀的求偶行为令人惊讶和欣喜：它们在空中迅速上升到一个很高的高度之后，再缓慢地以螺旋状下降，伴随着一连串动听的充满欢乐和希望的鸣叫，结束于一个自由落体运动至地面，最后优雅地站在那里。整个舞蹈就是一种不稳定和不确定的表演。

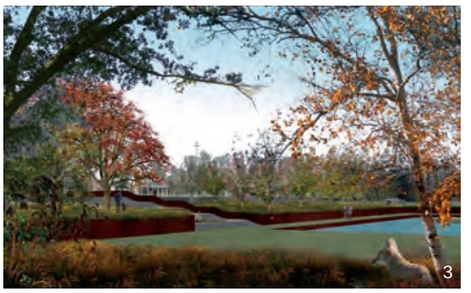
1881 年，英国诗人乔治·梅瑞狄斯（George Meredith）在《云雀高飞》中写道：

他飞起然后转身，
发出了银链般的鸣声
没有停歇，
似吱喳声、口哨声、低吟声、颤抖声，
他们相互盘旋、蔓延，
似水在潮汐中荡漾
激起涟漪
形成旋涡；
似一连串匆忙的音符在奔流
他们的舰队稀少但从来不只一支……

雄性云雀可以飞到距离地面 50~100m 的高空，在交配季节鸣叫可达 20min，它盘旋的翅膀会为了满足雌性云雀的喜好而变得更宽大，而且它还可以在长时间的休眠状态下鸣叫。身长 16cm 的云雀完全掌控了这种不平衡的状态。它通过身体的内部和外部系统实现了这种稳定的“盘旋”而下的飘移运动，这些系统可以促使它们的身体在某些不稳定和变换的时刻保持平衡。乔治·梅瑞狄斯的诗歌充分强调了云雀的这种能力，与此同时，它们还能自发地鸣唱出非常复杂的、持续不断的美妙旋律[12]。

可是，现在云雀的数量只有 30 年前的 10%。它们的栖息地已被大豆、玉米等单一作物所取代，从而降低了地形结构的多样性，干扰了鸟类的地域性需求。野外生态研究表明，在商业种植的田野中，划分出足够多的大型区域可以增加云雀筑巢和觅食的机会，进而促进它们的繁衍。因此，英国的农民创造和保护生物多样性可以获得收益，以此来增加云雀的栖息地。英国农业研究机构 SAFFIE[①]表明：在农作物播种期间适合建造云雀巢穴，当拖拉机越过地面时，关闭播种机（或提升播种机）5~10m 的伸展量以暂时阻止播种。在同一片田野的几块区域重复建造这样的云雀地块，每英亩约 2 个，这些“种子平台”能够促使云雀获得多种觅食机会。这是一个由财团牵头、农业产业联合会和塞恩斯伯里超市有限公司资助的项目。

我们的研究团队总部位于圣路易斯的华盛顿大学，在美国中西部的密苏里州探索这项技术。密苏里云雀，也被称为斯普拉格云雀（*Anthus spragueii*），是一种草原鸟类，濒临灭绝。我们发现这些云雀地块可以开发成一个物理空间网络，通过这一网络，人们可以追踪鸟类的鸣叫和飞行轨迹。因此，我们设计了一条农业开放系统的路径和多个野餐区，鼓励其他地面筑巢的鸟类如野鸡、鹧鸪等进行城乡交叉，并使它们自行扩张（图 4）。这个项目场地距离果园农场（Orchard Farm）约 2 英里（约 3.2km），是位于密苏里河和密西西比河之间的大片农田里的一个小镇。农田被排水沟渠、设备通道和地产边界所分割。我们利用现有的



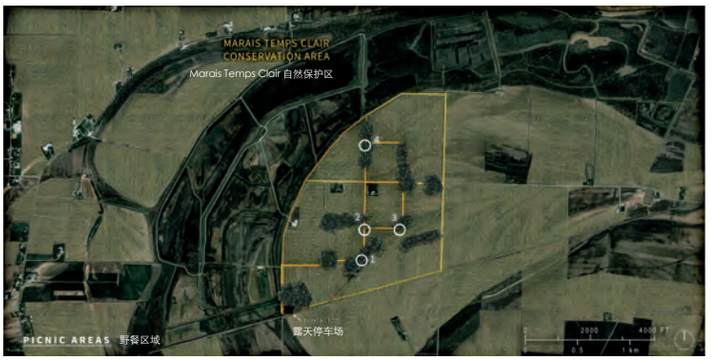
3 郊狼视角：人类与郊狼共存
Coyote perspective: humans and coyotes inhabit the same space

轨迹开发出一个通道系统。4 个野餐区——我们称之为“云雀发现者区域”——沿着通道建立，参观者可以通过密苏里云雀和其他地面筑巢的鸟类观察云雀地块的使用情况（图 5）。云雀地块（12m × 3m）分布于 2 英亩（约 0.81hm^2）范围内，横跨了不同种植者所拥有的 8 块玉米田。每个野餐区都是根据密苏里云雀的惊飞距离（也称“逃逸距离”）精准定位的。尽管每个“云雀发现者区域”的设计不同，但都是基于对人类和非人类物种的最大化保护。第一个野餐区提供鸟食平台，第二个野餐区涉及考古挖掘的几何和层次（图 6），第三个野餐区将火坑和一个由钢网组成的顶棚合并在一起，用以收集树叶并提供栖息地，而第四个野餐区则呼应了奥萨格人礼仪（Osage ritual）的保护圈，奥萨格人是密苏里平原的土著居民。

正如 20 世纪早期的英国乡村主义者所认为的，一整个区域都是一件艺术品[13]，人类和非人类物种的相互渗透有可能在广阔的农田中实现，可将商业地域与斑块和廊道的开放系统联结起来。如果按照区域和地区的规模实施，该项目可以形成一个移动的、漂流的饲养和繁殖网络，观察和感受可能失去的机会。云雀项目坚决主张将城市和乡村公共空间作为建设领域。

4 蜥蜴

“蜥蜴花园”专门为连接位于新西兰的奥克兰本地的爬行动物和人类而设计，这个花园突出了奥克兰地区独特的火山景观，并重点关注当地蜥蜴种群的生态环境，其栖息地就是这座城市所在的火山地带。该项目试图提醒人们



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4 云雀通道平面图：通道被设置于经过农田和位于重要节点的野餐区
Skylark pathway plan: pathways are inscribed through croplands, and picnic zones located at strategic points

关注奥克兰人雷达下的生物和地质关系网络，并提供他们每天与之互动的景观特质。与此同时，让生活在其中的人们注意到蜥蜴和壁虎的神秘生活，该项目有助于对蜥蜴的科学认知。这是一个为爬行动物学学生提供的户外实验室，一个为市民提供新兴科学实践的场所，一个关于定居者和原住民之间冲突历史的评论。蜥蜴花园将蜥蜴物种的科学数据与特定的社会文化数据结合起来以生成景观形式。

一旦确定了特定蜥蜴物种的栖息地和微生境，就有可能通过增加特殊功能如食物来源和栖息机会来加强对现有栖息地结构的利用。微生境的数量越多，可容纳的蜥蜴种类就越多。奥克兰蜥蜴有相同的需求：原木、岩石露头、落叶层。

温度是爬行动物生态学中最重要的单因子之一，许多物种的大部分日常活动致力于与热环境相适应[14]。然而，在任何自然环境中，都存在极大的热量多样性。一只蜥蜴会从某些来源获取热量并输出，这些获取和输出会随着一天中时间的变化而改变。与外部环境的热交换至关重要，产生热交换有以下几种方式：吸收辐射能、辐射损失、传导、对流、蒸发冷却。

早晨，蜥蜴的体温很低，它们从窝里出来，在树枝、树干和其他类似的结构上晒太阳。这时，它们通过吸收太阳辐射能来提高体温。它们只用脚与树枝接触以减少热量损失从而达到能量的最大化。有时它们会用 3 条腿趴着。当基底变暖的时候，蜥蜴就会栖息在坚实的物体上，比如本身能吸收太阳能的岩石。在这样的岩石上，蜥蜴会与它完全接触，获取太阳的热量和岩石传导的热量。因此，蜥蜴花园的设计依赖于最大限度的栖息地设计：1）表面倾斜（在新西兰朝北的地表会增加环境热量）；2）岩石裂缝（用于保护和冬眠）；3）基底质地（提供食物来源和保护）；4）栖息高度（用于热吸收和保护）；5）顶部冠层的直径和密度（将太阳能对栖息地的渗透率最大化）。

位置很重要。新西兰奥图陶瓦（Otuataua）石场历史保护区是唯一一个国家所有的毛利石场地（图 7）。它由 2 个火山锥喷发形成，其中一个火山锥已被广泛开采，而另一个相对完整。毛利人和欧洲人会使用大量的喷发火山石来营造和保护花园。墙上的遗迹清晰地显示了毛利人早期的园艺活动直至后来的果树栽培和农业耕种。毛利人的花园墙体排列整齐，主要呈 V 字形构造，这样可以最大限度地使红薯晒到阳光，墙体被欧洲农业实践特有的四边形围墙所覆盖。这一系列独特的阵列结构清晰地记录了这部分城市的定居历史。

我们已经观察到许多不同种类的蜥蜴，它们被认为可能栖息于石场。这些种类是现在濒临灭绝的莫可蜥蜴（*Oligosome moco*），铜蜥蜴（*Cyclodenia aena*），华丽蜥蜴（*Cycodenia arnate*）和彩虹蜥蜴（*Lampropholis delicata*）。奥图陶瓦蜥蜴花园的设计实现了这些物种的生态需求——它们对食物、活动空间和热量的需求。

蜥蜴花园坐落于石场保护区附近，但不在里面。在这里，海岸步道转变成 90° 而朝向石场保护区和前滩恢复区之间的边界。这条步道是蒂阿拉鲁阿（长步道）的一部分，贯穿整个新西兰。在这一点，步道经过 2 个大型的土石堆，从石场和奥克兰的马努库港 2 个方向欣赏，景观都很优美。该设计应用了一系列的干岩石形式和一个向阳的土丘，形成了热量面板，为热量吸收、传导和对流提供了一个理想的局部环境。干岩石结构（源自毛利墙的 V 形排列）为蜥蜴们晒太阳和自我保护提供了垂直的栖息地和横向的缝隙。早晨，它们在树枝和树干上栖息，树叶和地上的枯落物为昆虫提供保护和食物，因此种植进一步增加了这里的生境结构。列植的亚麻（*Phormium tenax*）成为花园的边界，为蜥蜴提供所需要的微气候条件。除了提供生境以外，花园的设计还扩展了这个保护区中具有历史意义的岩石花园结构，创造了一个新的地带，使早期园艺技术模式得到加强和集中。设计延续了石场的土坑和土丘地形，岩石结构呈现出几何形，柽柳为这个果园增加了异域风情（图 8）。

该花园为蜥蜴研究提供了一个及时的实验室。这些爬行动物是城市的指示物种，可以体现我们所在城市的生物多样性。但是，由于新西兰北部的蜥蜴种群分布范围减少，导致当地爬行动物学知识体系发展缓慢。目前，奥克兰地区为 12 种蜥蜴提供了栖息地，但在城市化之前，这儿有 18 种。长期的城市化发展和捕食者数量的增加也造成了蜥蜴种类的减少。因此，奥克兰的蜥蜴种群处在一个关键阶段。该雷达项目展示了如何在城市环境中设计新的动物栖息地，以提高濒危物种的生存机会。与此同时，它也提供一种新型的开放空间，一种融合人类公共生活和蜥蜴神秘生活的共振基础设施。

5 海潮虫

陆地和海洋之间的潮间带似乎是一个缺乏划定的梯度阈值：几乎是没有差异化的过渡。然而，潮滩有 2 个非常重要的轴线。虽然我们在视觉上没有意识到，但它们的交互作用对潮滩来说至关重要。许多世纪以来，位于新西兰的奥克兰西部海岸的马努卡港一直是毛利人居住的地方。他们的生态认识论是基于潮汐和月亮之间的交互作用，在 X 轴和 Y 轴之间，但它们本身是看不见的。

马努卡港的一个装置调查了这种交互作用。它运用了风景园林常用的横断面、识别、命名和绘图等分析方法。从陆地到港口水道的泥滩上有一条线。沿着这条线在等距的间隔处将一个个桩插入到泥滩中。

绘制的图就是在每个桩的位置观察到的生物种类，而这幅图就被钉在桩上。我们可以看到的生物有：双神经纲、双壳纲、甲壳纲、腹足纲、蜻蛉目、海潮虫（图 9、10）。

海潮虫（*Scyphax ornatus*）是一种陆生的等足类动物，在实验室恒定的条件下，它表现出昼夜节律和半月形的活动节律，这种节律使得海潮虫能够预测夜间的觅食机会[15]。在科学领域的知识内，这些生物几乎完全看不见。科学越是试图描述和解释它们，它们就变得越隐晦。对毛利人来说，收获和饮食是一种解释方法。吃活的物体就意味着把它带进光明。

波利尼西亚的捕鱼日历反映了与潮间动物相关的月亮周期，它们的节律和特征与人类不同。月亮周期是在黑暗与光明之间的一个纵向区域，这个区域既是陆地也是海洋，在那里，海水掠过地表，有生命的物体找到了阳光地带。这片柔软的海岸、潮间带、浅滩将阳光转化为海草、蛤蜊、螃蟹、小鱼苗、双壳类、腹足类、甲壳类和棘皮类动物。这是一个食物的引力场。月亮周期赋予这个阈值范围内的潮间带动物、陆生动物和空中动物生命。在这儿，波利尼西亚人也充分利用这些觅食机会。

月亮节律和穿过海岸的潮汐都是在毛利历法中预测的，在历法中，知识论和生态学融合在一起形成了日历，一个用于调节聚集食物的月球系统。毛利人将日历中所有的天体系统——太阳和恒星周期以及月球周期都包括进去，但这是 28~30d 的日历周期，月球与曼努考港泥滩上的食物密切相关，因为月球控制潮汐。在捕鱼时，了解捕鱼和月亮周期之间关系的重点是月亮的盈亏、一天中的时间变化、水的状况、鱼的种类以及邻居的捕鱼量。月亮支配一切，但太阳和星星却推动了所有生物沿着自己的进化轨迹发展。在曼努考港的泥滩上，我们在海床上会发现底栖生物和浮游生物，它们在泥和空气之间 2 英寸（约 0.05m）的薄层中游泳。当昴星宿群低至东北部天空的地平线上时，正值半月凸月，鳗鱼和鱼类都很丰富但很小，而这是丰收贝类的一天。对毛利人来说，和海潮虫一样，月亮和食物相关。

天空和陆地、海洋一样，都是一种文化资源。

5 野餐区平面图：为观察云雀行为而设计的 4 个野餐区
Picnic zone plans: four picnic zones are designed for viewing of skylark behavior

6 第二个野餐区平面图：第二个野餐区为人类使用提供各种级别
Picnic zone 2 plan: picnic zone 2 has a variety of levels for human occupation

6 结论

本文简要阐述的针对非人类物种城市化的调查主要集中在那些缺乏魅力或不明显的生物上，但它们却与人类生活在一起，并共享着景观的很多层面。这个项目的目的，正如我所说的，是为了吸引人们注意那些神秘而又常常看不到的生物群体，推此及彼，我们可以在全球公共领域中不断创造包融而非排斥。利用纳托·汤普森对共振基础设施的概念，我探索了如何将彼埃尔·贝朗格对景观基础设施的解释延伸到人类和非人类物种之间的各种相遇上。我之前已经分别讨论了这 4 个项目。这次会议的召开给了我一个机会把他们联系在一起，庆祝人类与非人类物种相互作用的这种不平衡。正如我在其他场合所说的那样，不平衡就是野生状态。野生状态就是在极度开放的条件下生存，伴随着不稳定、不确定的持续干扰。然而，野生状态并不是人类所能达到的：它是不可知的。换句话说，如果某件事是可知的，那它就不是野生的[16]。当我们没有了解野生环境的时候，我们又如何促使我们的世界达到野生状态?

注释：

① 全称为 Sustainable Arable Farmers for an Improved Environment Project (https://www.gwct.org.uk/farming/research/saffie/.)。

② 本文为作者在 2017 世界风景园林师高峰讲坛上的发言稿。

③ 图 1、3 由罗德·巴内特与钱邓（音译）（Rod Barnett and Qian Deng）提供，图 2-1、2-2、9、10 由罗德·巴内特（Rod Barnett）提供，图 4~6 由罗德巴内特与诺娜·达维塔亚（Rod Barnett and Nona Davitaia）提供，图 7、8 由布拉德伯里·麦克格（Bradbury McKegg）景观设计师提供。

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（编辑 / 张雯娟 刘昱霏）

1 An Infrastructure of Resonance

In his important book *Landscape as Infrastructure*[1] Pierre Belanger argues that 20th century infrastructure, organized by urban planners and designed by engineers, is an urbanistically degrading and environmentally destructive solution to the problems of connectivity, mobility, and service provision. Not only has it torn up perfectly good places where people live but it has suppressed and marginalized biophysical systems.

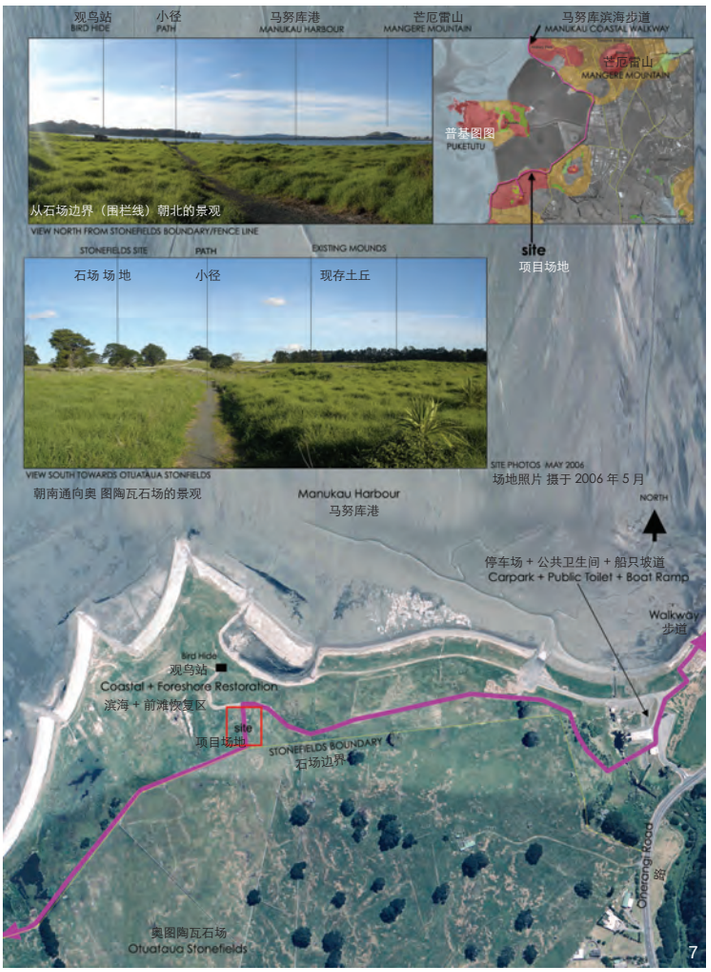
Belanger propounds the formulation of landscape infrastructure as a contemporary field of practice that addresses the flows of urban economies and the dynamics of planetary ecologies.

And he would seem to be right about this. Yet, in the light of what is now called the nonhuman turn[2] I think we can push further the potential of infrastructure. The nonhuman turn insists that humans have always coevolved and collaborated with the other creatures of the earth (from microbes to mammals). Writers from Donna Haraway[3] through Bruno Latour[4] to Timothy Morton[5] have questioned the ontological separation of beings within a vertical hierarchy that puts humans at the top. In my own work I have argued that the collective of humans and nonhumans lives together in a constructed world, and that the primary site of their encounter with each other may well be public space - if "public" is taken to include nonhuman species[6]. Amongst all the work that is going in to saving the planet for human occupation it is necessary, these writers insist, to consider whether the planet actually exists for us. How are we human in a nonhuman world? How does a consideration of a nonhuman perspective affect the way we build and manage planetary systems? Particularly, for the subject of this essay, urban systems.

One way to incorporate these questions into urban thinking through landscape architecture is to extend Belanger's concept of infrastructure. To be sure, physical infrastructure has an important job to do. But there are other networks and systems that are just as important - in fact, that help us envisage new types of infrastructure. Networks of social organizations, for instance, of shared meanings, non-material labor and - critically - social and political affect. These systems are distinct from physical infrastructure and yet connected to it. Together they enable us to include the pre-cognitive emotional and passionate dimension of life that many theorists say really drives politics and economics. Social theorist Chantal Mouffe, for instance, grounds her analysis of political agonism in a reading of social life in which "the passions" are the drivers of political decision-making[7].

How humans are exposed to, work and play with, and build their own subjectivities through meaningful connection to nonhumans can be part of this more ephemeral infrastructure, a condition that writer and curator Nato Thompson calls an infrastructure of resonance[8]. This is the subject of my essay.

Over the past ten years I have developed a small side-project called Under the Radar. It consists of a series of design investigations that explore affective encounters between humans and nonhumans from various perspectives. This essay briefly discusses four of these in an attempt to tease out what I mean when I refer to landscape



7 蜥蜴花园的位置图：奥图陶瓦石场位于新西兰奥克兰的曼努考港的边界处
Lizard garden location plan: Otuataua Stonefields are on the edge of the Manukau Harbor in Auckland, Nz

architecture as an art of encounter[6]. In these projects public space becomes a designed realm in which the collective of humans and nonhumans is made visible and intentional, where the various parties are mixed and all their freedoms enhanced.

2 Coyotes

This project explores the boundaries between the human and the nonhuman in Auburn, a small town in Alabama, USA. The Auburn urban coyote population numbers approximately 600[9]. The Auburn Wildlife Services Office and the Department of Conservation regularly trap coyotes when complaints get too numerous to ignore. The trapped coyotes are killed with pentobarbital, rather than relocated and released. As a Wildlife Officer said at a public meeting, "As soon as a bunch of coyotes are moved out, new ones will come in. They will always be here. Auburn is an open green space city - coyotes love it"[10].

While the coyotes of Auburn, AL are classified as urban, ex-urban and rural populations, this human taxonomy has little to do with their lives and movements. Coyotes (Canislatrans) are swift, determined vectors whose evolutionary trajectory

has taken them across a species boundary into a condition of continuous encounter with humans. The primary realm of this encounter is public open space, be it urban stream corridor, woods on the fringe of a park, or an urban cemetery. Camilla Fox of the Animal Protection Institute in Sacramento notes that, while most people are unaware that there are coyotes living in their midst, increasing human-coyote interaction is an urgent issue facing urban administrators and wildlife managers alike. In the Chicago metropolitan area most large green spaces are occupied by coyote packs of up to twelve individuals[11].

In many states, such as Alabama, the coyote is classified as a non-game "predator" or "furbearer species" and may be killed year round in unlimited numbers. In Alabama there is no closed trapping season and no bag limit. The question facing landscape architects is, how do we make a world in which coyotes and humans may co-exist?

Our research team at Auburn University mapped the coyote population's movements and identified three public areas where we could design interventions that put humans and coyotes together in an awkward and unconventional way (Fig. 1). In the example discussed here, the site is a detention pond located between a woodland coyote corridor and the building that houses Auburn City's Water and Sewer Services. In the design for this site, the terrain adjacent to the Water and Sewer Services detention pond, and the pond itself, are reorganized according to a modernist garden typology that can be read by human visitors as a designed realm, with purpose and amenity. The format of the rectangle creates straight lines, regular shafts of space and severe, high retaining walls. The pond is snapped into a large rectangle of water. Into this Euclidian space is introduced a planting regime designed specifically to provide food for the animals and insects that coyotes prey upon, and that coyotes themselves are known to eat (Fig. 2).

The planting scheme, based on gut and scat analyses of coyotes, is crafted to supply fruit and nuts throughout the year, according to the seasonal development of the plants, starting in the spring at the northern end of the site and ending in the fall at the south (Fig. 3). The trees, native and exotic, are underplanted with winter-flowering grasses that also are eaten by coyotes and their prey, particularly in the leaner months. This public garden, which provides seating, sun and shade for employees in the nearby buildings, attracts rabbits, squirrels, insects, birds and other wildlife. These species in turn entice coyotes in their passage along the adjacent woodland corridor. As the garden – or as we call it, the critter orchard–grows unchecked, plant and animal species will exceed its initial formal and spatial stratifications in an evolving assemblage of interactive inhabitations.

This small project attempts to establish a terrain of encounter, a place where a collective of humans and nonhumans is articulated. To articulate the collective the designer must consider the assembly of species that inhabit it when he or she mixes these 'parties' while retaining and enhancing their freedoms. A landscape that abandons the division between nature and society includes all conditions necessary and sufficient for the ongoing self-organization of the assemblage. To do this it is necessary to explore the common worlds of the collective – nature cultures, as Latour calls them – not in the sense of a unified march into the future along a line of time, but by means of enabling the formation of intricate attachments and affordances between and among species and elements through affective contact and inter-affirmation. The landscape architect who works for and with the republic of human and nonhuman nature cultures envisages life as a contingent process of growth and change. She participates in this movement of perpetual differentiation through the invention of forms that bring tree, child, rock, sky, bee, coyote, moth and butterfly into equivalence and association.

3 Skylarks

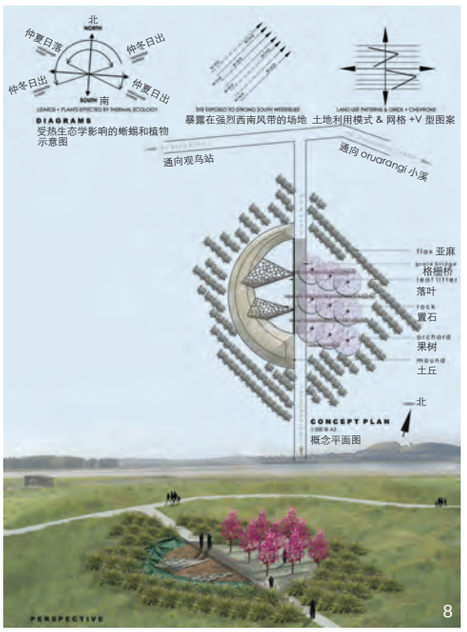
This next "resonant infrastructure" combines native birds, human recreational activities and large-scale agribusiness. The Eurasian skylark (*Alauda arvensis*) went into deep decline with the advent of industrial agriculture and the changing production regimes that accompany large-scale, market-driven cropping. But skylarks have always been beloved members of the nonhuman community, featuring often in music and poems. This is partially because they lend themselves to easy field observation yet seem so distant, so vulnerable and so unknowable. But it it is the mating behavior of the male that astonishes and delights.

But it is the mating behavior of the male that astonishes and delights: following a rapid ascent to a great height in the sky, a slow spiraling descent occurs, accompanied by a thrilling, cascading song that fills the air with hope and joy, ending in a gravity-defying plummet to the ground where, gracefully, he alights. The whole dance exhibits a kind of disequlibrious submission to instability and uncertainty.

In 1881 the British poet George Meredith wrote The Lark Ascending, in which this condition is described as follows:

He rises and begins to round,
He drops the silver chain of sound
Of many links without a break,
In chirrup, whistle, slur and shake,
All intervolv'd and spreading wide,
Like water-dimples down a tide
Where ripple rippleovercurls
And eddy into eddy whirls;
A press of hurried notes that run
So fleet they scarce are more than one …

The male lark, high in the air, 50 to 100 meters from the ground, sings for up to 20 minutes in the mating season, hovering on wings that have broadened through adaptation to female skylarks' preference for males that can sing in suspended animation for long periods of time. The 16 cm skylark occupies a far from equilibrium condition. It commits itself to a steady, "intervol'd" downward drift as energy courses through the many internal and external systems that push the small bird through moments of instability and transformation. Meredith's poem highlights the lark's capacity, as this occurs, to spontaneously



8 蜥蜴花园设计图：蜥蜴花园的设计从毛利人、定居者和蜥蜴的需求出发，展示了形式和空间条件的发展
Lizard garden concept plan: plan of Lizard Garden showing development of formal and spatial conditions from material requirements of Maori, settler society, and lizards

emit melodic song structures of extraordinary complexity and continuous novelty[12].

However, current lark numbers are only 10% of what they were 30 years ago. Their habitat has been replaced by single-species cropping, such as soybeans and corn, which reduces the structural diversity of terrains and interferes with the territorial requirements of the birds. Field ecology research has suggested that setting aside sufficiently large and numerous areas of otherwise commercially-farmed fields can help increase nesting and foraging opportunities for skylarks and thereby improve breeding success. As a result farmers in England are now paid to create and maintain biodiversity for increasing the habitat of skylarks. A British agrarian research organization, the SAFFIE ① has shown that suitable nesting sites can be made during the sowing of commercial crops by turning the seeding machine off (or lifting the seed drill) for a 5 to 10 meter stretch as the tractor goes over the ground, to briefly stop the seeds from being sown. Repeated in several areas in the same field to make about two skylark plots per acre, these "seed tables" enable breeding skylarks access to multiple foraging opportunities. This is a consortium-led project funded by, amongst others, the Agricultural Industries Confederation and Sainsbury Supermarkets Ltd.

Our research team, based in Washington University in St Louis,explored this technique in Missouri, in the Midwest of the United States. The Missouri Skylark, also known as Sprague's pipit (*Anthus spragueii*) a grassland prairie bird, is also endangered. We discovered that skylark plots can open up a network of physical spaces through which birdsong and flight can be traced by humans for their aesthetic and affective qualities. So we designed an agrarian open system of pathways and picnic areas that encourage other ground-dwelling avian species such as pheasants and partridge in the hope of emblematizing an urban-rural crossover that could spread almost on its own (Fig. 4). The site for the project is about two miles from Orchard Farm, a small town located in vast croplands between the Missouri and Mississippi Rivers. The cornfields are divided by drainage ditches, equipment access-ways, and cleared property boundaries. We developed a pathway system using these existing tracks. Four picnic areas - which we called "larkfinder zones" are located along the tracks, where visitors can observe the use of skylark plots by Sprague's pipit and other ground-nesting birds (Fig. 5). The skylark plots (12m×3m) are distributed two to the acre across 8 cornfields owned by different growers. Each picnic area is carefully located according to the flushing distance (also known as escape distance) of the Missouri skylark. The design of each larkfinder zone, although different, is based on maximizing human and nonhuman protection. The first picnic area provides bird-feeding tables; the second refers to the geometry and layers of an archeological dig (Fig. 6). The third zone incorporates fire pits and an overhead canopy of steel mesh that collects leaves and provides habitat, while the fourth echoes the protective circle of Osage ritual, the Osage being the indigenous inhabitants of the Missouri plains.

Just as the early 20th century English ruralists considered the whole of a region as a work of art [13], the interpenetration of human and nonhuman made possible by interventions that are good for both has the potential to operate across extensive territories of cropland, linking commercial fields with open systems of patches and corridors. If implemented on the scale of districts and regions the project could form a shifting, drifting network of feeding and breeding, observing and feeling opportunities which would otherwise be lost. The skylark project firmly claims urban/rural public space as a constructed realm.

4 Lizards

A "lizard garden", designed specifically to connect native reptiles and humans in Auckland, New Zealand, highlights the unique volcanic landscapes of the Auckland region by focusing on the ecology of the native lizard populations whose habitat is the volcanic field on which the city is built. It seeks to draw attention to the web of biotic and geologic relationships that lies just under the radar of Aucklanders, and provides the special character of the landscape with which they interact with on a daily basis. At the same time as bringing the cryptic lives of skinks and geckos to the attention of the people who live among them, the project contributes to the scientific understanding of lizards. An outdoor laboratory for herpetology students, a location for the burgeoning practices of citizen science, a commentary on the layered, conflictual histories of settler and indigenous peoples, the lizard garden intersects scientific data about lizard species with place-specific socio-cultural data to generate landscape form.

Once the habitat and microhabitats of particular lizard species have been defined, it is possible to enhance the use of existing habitat structures by adding special features, such as food sources and perching opportunities. The greater the number of microhabitats, the greater the number of lizard speciesthat can be accommodated. Auckland lizards share a requirement for similar structures: logs, rock outcrops, leaf litter.

Temperature is one of the most important single factors in the ecology of reptiles and a great portion of the daily activity of many species is devoted to corresponding with the thermal environment[14]. In any natural environment, however, there is tremendous thermal diversity. A lizard will gain heat from some sources and lose it to others, and these gains and losses change with the time of day. Heat exchange with the environment is critical. This occurs in the following ways: absorption of radiant energy, radiative loss, conduction, convection, evaporative cooling.

In the morning lizards have low body temperature, and come out of their lairs to bask on twigs, branches and other similar structures. At this period they increase their temperature by the absorption of radiant solar energy. Absorption is maximized by their bringing only their feet into contact with the twigs to minimize heat loss through conduction. Sometimes they will perch on three legs. Later in the day when the substrate is warmer, the lizards will tend to occupy solid perches such as rocks which have themselves absorbed solar energy. On such rocks lizards will lie in full contact with the perch, absorbing heat both from the sun and by conduction from the rock. The design of lizard gardens, then, relies on operations that maximize habitat configuration: 1) inclination of surfaces (in New Zealand north facing surfaces increase the thermal environment); 2) presence of rock crevices (for protection and hibernation); 3) substrate texture (provides food source and protection); 4) perch height (for thermal absorption and protection); 5) diameter and density of overhead canopy (maximise solar penetration to habitat)

Location is important. New Zealand's Otuataua Stonefields Historic Reserve is the only remaining Maori stonefield site in public ownership (Fig. 7). It was formed by the eruption of two volcanic cones, one of which has been extensively mined, while the other is relatively intact. Large quantities of volcanic stone from the eruptions were used both by Maori and Europeans in the making and protecting of gardens. Wall remnants clearly show the patterns of occupation and gardening from early Maori horticultural practices to latter day orcharding and farming. Maori garden wall alignments, primarily constructed in chevron patterns to maximize kumara (sweet potato) exposure to the sun, have been overlaid by quadrangular walled enclosures specific to European farming practices. The result is a singular array of structures that visibly record the history of settlement of this part of the city.

9 海潮虫观测装置照片：手绘图的横断面追踪了生活在泥滩两英寸水族馆中的生物群
Photo of Scyphax installation: transect of hand drawn images traces biota that live in the two inch aquarium of the mudflat

10 甲壳纲铅笔画：每根桩都说明了在它插入泥泞海岸的地方发现的一种处于阈限的生命形式
Pen + ink crustacean: each stick illustrates a liminal life form found at the place where the stick pierces the muddy shore

A number of different species of skink have been observed at, or may be considered as likely to inhabit, the stonefields site. These are the now endangered moko skink (*Oligosome moco*), the copper skink (*Cyclodenia aena*), the ornate skink (*Cycodenia arnate*) and the rainbow skink (*Lampropholis delicata*). The Otuataua lizard garden has been designed to fulfill the ecological destinies of these species – what they eat, the space they control, and their thermal requirements.

The lizard garden is sited close to the stonefields reserve but not actually in it, at a point where the coastal walkway turns ninety degrees and heads towards the boundary between the stonefields reserve and a foreshore restoration zone. This walkway is part of TeAraroa (The Long Pathway), a walking trail that runs the length of New Zealand. At this point the walkway passes by two large earth-covered stone mounds, and affords impressive views both of the stonefields and Auckland's Manukau Harbor. The design proposes a series of dry rock forms and an earth mound oriented to the sun, creating heat panels that provide a localized climate ideal for thermal absorption, conduction and convection. The dry rock structures (derived from the chevron-shaped alignments of the Maori walls) provide vertical perches and lateral crevices for basking and protection. Planting adds further to the habitat structure with the provision of twigs and branches for perching in the morning, and leaf and twig litter on the ground plane for protection and foraging for insects. Lines of flax (*Phormium tenax*) bound the garden and help provide the microclimate conditions lizards require.As well as providing habitat the design of the garden extends the historic stone garden structures of the reserve to create a new terrain that intensifies and focuses the patterns of early gardening techniques. The pit and mound continue the topography of the stonefields, the stone structures reflect their geometries, and tamarix trees introduce the exoticism of the orchard (Fig. 8).

The resulting garden provides a timely laboratory for the study of lizards. These reptiles are urban indicator species, and can tell us much about the biodiversity of our cities. But the body of knowledge of northern New Zealand herpetology is evolving only slowly, due to the diminished locations

and range of the endemic lizard population. The Auckland region currently provides habitat for twelve species of lizard. Prior to urbanization there were eighteen. The depredations of prolonged urban development and the corresponding growth of predator populations have taken their toll. The lizard population of Auckland is therefore in a critical phase. The Under the Radar project shows how new animal habitat can be designed in urban situations to enhance at-risk species chances of survival. At the same time it providesa new kind of open space, an infrastructure of resonance that combines the cryptic, or hidden, lives of lizards with the all-too-public lives of folks.

5 Scyphax

The intertidal zone between land and sea is a gradient threshold that seems to lack delineation: it is all barely differentiated transition. Yet the tidal flat has two very important axes. While we are not visually aware of them their interaction is critical to the zone. For many centuries the ManukauHarbour on the west coast of Auckland, New Zealand has been inhabited by Maori. Their ecological epistemology is based on the interaction between the tides and the moon, between the X and Y axes, themselves invisible, of life.

An installation at Manukau Harbor investigates this interaction. It uses the analytical landscape architectural conventions of the transect, of identifying, naming and drawing. A stringline is stretched along the mudflat from land to harbor channel. At regular intervals along the line a peg is inserted into the mud. A drawing is made of a different creature observed at the location of each peg. The drawing is punched on the peg. We see live objects: amphineura, bivalvia, crustacea, gastropeda, odonata, scyphax (Fig. 9, 10).

Scyphax ornatus is a terrestrial isopod that exhibits circadian and circa-semilunar activity rhythms when kept in constant conditions in the laboratory, suggesting that these rhythms enable Scyphax to predict nightly foraging opportunities[15]. Within scientific domains of knowledge such creatures are almost entirely invisible. The more science tries to describe them and explain them, the darker they become. To Maori, harvesting and eating is a way of explanation. To eat a live object is to bring it into the light.

The Polynesian fishing calendar reflects the lunar cycle in relation to intertidal animals, species whose rhythms and distinctions are different from humans'. The lunar cycle suspends objects dark and bright between darkness and light in a longitudinal zone that is both land and sea, where seawater skims the surface of the land and live objects find a sunlit zone. This soft shore - littoral, intertidal, epipelagic - transforms sunlight into seagrass, into cockle, crab, hatchling, bivalve, gastropod, crustacean, and echinoderm. It's a gravitational field of food. The moon's cycle gives life to intertidal animals, and to the terrestrial and aerial animals that feed in this liminal zone. Here the Polynesian takes advantage of her own foraging opportunities.

The rhythms of the moon and the tides it pulls across the shore are predicted in the Maori calendrical system, where epistemology and ecology come together to form a maramataka, a lunar system for regulating the gathering of food. Maori involve all the heavenly systems in their maramataka, the solar and stellar cycles as well as the lunar cycle, but it is the 28—30 day cycle of marama, the moon, that is most relevant to food practices on the mudflats of Manukau Harbor, since the moon controls the tides. When fishing, significant aspects for understanding the relationship between the catch and the lunar cycle are the phase of the moon, the time of day, the condition of the water, the species of fish out there, and the weight of your neighbor's catch. The moon dictates all, but the sun and the stars describe the background oscillations that pull all creatures along their evolutionary paths.

On the mudflats of the Manukau Harbor, benthic and epipelagic species are found on the seabed and swimming in the two-inch layer between the mud and the air. When the Matariki (the star constellation of the Pleiades) are low on the horizon in the north east of the sky, at the time of the half moon waxing gibbous, eel and fish are abundant, but small, and it is a productive day to collect shellfish. For the Maori, as for the Scyphax, the moon is about food.

The sky is a cultural resource, as much as the land or sea.

6 Conclusion

The investigations into nonhuman urbanism that I have discussed briefly in this essay focus specifically on creatures that are not charismatic or obvious, but with whom humans share many of the landscapes in which they live. The purpose of this side-project, as I have called it, is to draw attention to the cryptic and often invisible biota that, with a little fellow-feeling, we can include rather than exclude in the ongoing creation of the global public realm.Using Nato Thompson's notion of resonant infrastructures I have explored how Pierre Belanger's explication of landscape infrastructure can be extended to various forms of encounter between humans and nonhumans. I have previously discussed the four projects presented here separately. The conference at which this work was presented gave me an opportunity to bring them together as one piece, celebrating the disequilibrium that characterizes human interactions with nonhuman species. As I have said elsewhere, to be far from equilibrium is to be wild. To be wild is to exist in a condition of extreme openness – instability, uncertainty, and continual perturbation. And yet to be wild is not something that humans can achieve: it is unknowable. In other words, if something is knowable, it is not wild[16]. How do we enwild our world when we cannot know the wild?

Notes:

① Sustainable Arable Farmers for an Improved Environment Project (https://www.gwct.org.uk/farming/research/saffie/.)

② This is a speech delivered by the author at the International Landscape Architecture Symposium in 2017.

③ Fig. 1, 3 are provided by Rod Barnett and Qian Deng, Fig. 2-1, 2-2, 9, 10 are provided by Rod Barnett, Fig. 4~6 are provided by Rod Barnett and Nona Davitaia, Fig. 7, 8 are provided by Courtesy of Bradbury McKegg Landscape Architects.

(Editor / ZHANG Wenjuan, LIU Yufei)