生态系统负面服务研究与城市问题诊断

ECOSYSTEM DISSERVICE RESEARCH INTO URBAN PROBLEM DIAGNOSIS

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摘要

在中国城镇化率超过50%之后，“城市双修”成为了城市未来规划设计的核心趋势。然而，如何确定城市双修的范围和重点是一大难题。本文提议结合生态系统负面服务的相关研究，对城市问题进行诊断与评价。生态系统负面服务是与生态系统服务相对的概念，主要指生态系统对人类造成的不适或负面影响。同时，需要诊断分析其产生原因（自然状态与人工干预）、发生状态（实际现状与潜在能力），以及影响程度（相对值与绝对值）。以生态系统负面服务框架为基础，可以在城市及地域尺度上对城市双修或城市更新重点问题做出系统性的梳理和评价，并分类归纳负面清单，进而从提升生态系统自身生态功能、降低负面服务、正负服务博弈等途径系统制定城市双修策略。

关键词

生态系统服务；生态系统负面服务；负效益；负面清单；生态系统社会服务

ABSTRACT

With the acceleration of urbanization rate over 50%, the initiative of Ecological Restoration and Urban Regeneration tends to be the focus of future planning and design in China. However, how to identify where and what to be regenerated is challenging. This paper calls for the integration of ecosystem disservice (EDS) research into urban problem diagnosis. Ecosystem disservice is raised up in opposite to ecosystem services, referring to ecosystem's uncomfortable or negative influences to humans. The investigation of EDS should distinguish causes (natural factors and human intervention), influenced status (actual disservices and latent disservices), and influenced level (relative disservices and absolute disservices). Using EDS as a diagnosing framework, cities could systematically analyze key issues and hotspots, summarize the checklist of disservices, and utilize varied strategies for solutions including enhancing services, mitigating disservices and tradeoff between services and disservices.

KEY WORDS

Ecosystem Service; Ecosystem Disservice; Negative Impact; Disservice Checklist; Social Service of Ecosystem

1 引言

随着2016年中国城镇化率达到57.35%[1]，国内大多数城市的发展建设重点已经从增量转向存量，需要直面城市环境状况日益复杂、资源约束趋紧、生态环境破坏、基础设施和公共服务设施落后、居民生活质量偏低等问题，城镇化质量亟待提高。在此背景下，中共中央国务院先后颁布了《中共中央国务院关于加快推进生态文明建设的意见》（2015）和《中共中央国务院关于进一步加强城市规划建设管理工作的若干意见》（2016），提出针对当下城市发展现状，要摒弃大拆大建[2]，“有序地实施城市修补和有机更新，有计划有步骤地修复被破坏的山体、河流、湿地、植被”[3]，“城市双修”的理念应运而生。城市双修即生态修复和城市修补，较之于传统规划，其更侧重于以问题为导向的城市更新。2015年4月，住房和城乡建设部（住建部）将海南省三亚市设立为首个试点城市。2017年3月，住建部发布《关于加强生态修复城市修补工作的指导意见》，并陆续将福州等19个城市、保定等38个城市列为第二、三批城市双修试点城市，在全国范围内掀起了城市双修的建设热潮。

作为以问题为导向的城市更新手法，城市双修的重点之一在于对城市问题的诊断，即通过调查评估、综合分析，找出生态问题突出、亟需修复的区域，梳理城市基础设施、公共服务、历史文化保护、城市风貌建设等方面的问题和不足，确定城市双修的范围和重点[4]。《关

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于加强生态修复城市修补工作的指导意见》指出，修复修补内容具体包括城市生态（山体、水体、废弃地、绿地系统）和城市功能（基础设施、公共空间、出行条件、老旧小区、历史文化、城市时代风貌）等方面[5]。但在具体的实施过程中，常常无视各城市市情不同而互相模仿，或者看到什么就整治什么，问题诊断及定位有失准确。

在中国，城市双修是迫切的时代需求，但相关方法又处于初级摸索阶段，如何确定城市双修的范围和重点是一大难题。本文提议结合生态系统负面服务的相关研究，对城市问题进行诊断与评价。本文将

表1: 自然－人类复合影响下的EDS
Table 1: EDS under Nature-Human Influences

		人类活动 Human activities	
		无干预 Natural Factors	干预 Human Intervention
生态功能 Ecological functions	良好 Good	自然本身性质及功能。 ・ 自然水面可能滋生蚊虫，会对邻近住宅区造成影响； ・ 茂密的树林中可能隐藏着危险或有毒的动植物，对人身安全造成威胁。 Nature's properties and functions. • Mosquitos might breed on water surfaces, causing adverse impacts on neighborhoods. • Dangerous or poisonous animals and plants might emerge in dense forests, imposing threats to human safety.	自然本身性质及功能、人工成本与管理费用。 ・ 湿地公园建造以及后期管理运营的费用； ・ 街道两旁的银杏树，秋季落果气味引发不愉悦感； ・ 街道、公园绿地中的花朵可能引起花粉过敏。 Nature's properties and functions, and labor costs and management expenses. • Construction and follow-up expense in management and operation of wetland parks. • Fruits of ginkgo trees along the streets can bring an unpleasant smell. • Flowers on street and in parks might cause pollen allergy.
	受损 Damaged	自然本身性质及功能对ES的损害。 ・ 一片干裂的大地带给人负面的审美体验； ・ 生态系统脆弱缺乏雨洪调节能力，洪水淹没了河流周边村庄，造成经济损失。 Nature's properties and functions causing damages to ES. • Cracked lands can bring negative aesthetic experience. • When ecosystem loses its flood regulating capacity, riverside villages might be flooded, causing economic loss.	自然本身性质及功能、人工成本与管理费用对ES的损害。 ・ 渠化的河道破坏了自然河道的水生态系统，因缺乏自净功能而散发恶臭，同时单调的景观也带来了不良的审美体验； ・ 酷渔滥捕破坏了原有的海洋生态系统，降低了渔业资源的可持续性，从而损害了长期经济效益。 Nature's properties and functions, and labor costs and management expenses causing damages to ES. • Channelization has destroyed the aquatic ecosystem of natural river. Stench might spread from the channelized rivers due to the lack of self-purification function, and the monotonous landscape might also bring negative aesthetic experience. • Overfishing has destroyed the original marine ecosystem, decreasing the sustainability of fishing resources and thus damaging long-term economic benefits.

1 Introduction

As the urbanization rate in China reached 57.35% in 2016[1], most Chinese cities have shifted the focus from increment development to inventory regeneration. Many problems are to be solved to improve the quality of urbanization including resource shortage, deteriorated ecological environment, outdated infrastructure and public service facilities, and low quality of life. To cope with these problems, the CPC Central Committee and the State Council has issued Opinions on Accelerating the Eco-Civilization Construction (2015) and Several Opinions on Further Enhancing Management of Urban Planning and Development (2016), which proposed to abandon large-scale demolition and reconstruction[2], and "regenerate urban space and restore the damaged mountains, rivers, wetlands and vegetation in a planned and phased manner." [3] Compared to the conventional planning, the newly proposed idea of Ecological Restoration and Urban Regeneration emphasizes problem-oriented solutions. In April 2015, the Ministry of Housing and Urban-Rural Development of China (MOHURD) selected Sanya in Hainan Province as the first pilot city to advance the idea of Ecological Restoration and Urban Regeneration. In March 2017, MOHURD issued the Guiding Opinions on Enhancing Ecological Restoration and Urban Regeneration (Guiding Opinions for short), and then 19 cities including Fuzhou, and 38 cities including Baoding, were listed respectively as the second and third patches of pilot cities. Thereby, the Ecological Restoration and Urban Regeneration movement has been launched nationwide.

As a problem-oriented urban renewal method, one of the focuses of Ecological Restoration and Urban Regeneration is the diagnosis of urban problems, which means to identify the regions with acute ecological problems that need restoration urgently; to diagnose the drawbacks of existing urban infrastructure, public service, historical and cultural protection and urban identity; and to determine the scope and priorities of restoration and regeneration through investigation, assessment, and analysis[4]. Generally, the Guiding Opinions pointed out the importance of restoring urban ecology (mountains, water body, waste lands, and green space system) and regenerating urban functions (infrastructure, public space, transportation, old city districts, history and culture, and urban image)[5]. However, although problems of each city vary, so far efforts have been made in imitating other cities or dealing with apparently visible problems, resulting in less effective problem diagnoses.

Considering the urgent need of Ecological Restoration and Urban Regeneration in China and the less developed strategies to put the idea into practice, how to identify where and what to be regenerated is challenging. This paper calls for the integration

重点介绍生态系统负面服务的内涵以及相关框架，并就其可能的应用方法进行论述。

2 概念与内涵

2.1 生态系统负面服务的概念

生态系统负面服务（Ecosystem Disservice，以下简称EDS）作为与生态系统服务（Ecosystem Service，以下简称ES）相对的概念，在国内外仍属于研究的新兴领域。在针对ES的研究中，城市生态系统服务已经成为国内研究的前沿和热点。国外对于ES这一概念的提出和现代定义直至20世纪70年代才出现，2005年联合国发布的“千年生态系统评估”项目对推动ES研究的蓬勃发展起到了尤其关键的作用。人们已经认识到，ES可以提升健康水平、生产力、人类福祉，节约土地利用[6]~[8]，然而对于环境管理成本、生态系统外部性等负面影响，却鲜有研究。

虽然对于EDS的研究较少，但其对普通民众生活的影响已然十分广泛。例如，当提及某一生态系统内有蛇，大多数人会立即想到被咬伤的危险；而提及洪水，人们也会想到洪灾对房屋和其他基础设施的破坏。查理·沙克尔顿等人认为，针对负面服务研究的缺失造成了一系列问题：首先，负面服务客观存在，环境管理系统需要将其纳入考量，否则管理目标和预期成果将无法完全实现；其次，许多负面社会影响将严重破坏人类福祉，因此，如若实施那些无视EDS的政策和计划，即会制约ES、生物多样性和人类福祉之间的积极联系；第三，消减EDS同样可以达到保护ES和改善人类福祉的效果，从而提供了建设ES的新途径[9]。在对生态系统进行优化的过程中，仅关注ES是片面的，因为特定服务的优化也可能会衍生出相应的负面服务。也就是说，必须更广泛地认同生态系统管理的复杂性，及其在多尺度上与ES、EDS，以及生物多样性的连通性[10][11]。

EDS的概念可以追溯到19世纪的一些观点，早期的研究建立在生态系统破坏的概念之上，如农业损害、健康风险等，与负面效应相关，但并没有在负面服务这一框架下进行讨论。贾里·莱蒂马基最早明确了这一概念，将其定义为“生态系统对人类福祉产生消极影响的功能”[6]。EDS概念被提出后，国外学者大多仅对其进行了描述，尚缺少被广泛接受的定义[7][8]。

of ecosystem disservice research into urban problem diagnosis. Focusing on the concepts and research frameworks of ecosystem disservice, this paper elaborates some applicable methods by the end.

2 Concepts and Properties of Ecosystem Disservice

2.1 Concept of Ecosystem Disservice

Research on ecosystem disservice (EDS), a concept raised up in opposite to ecosystem service (ES), is still new in both China and abroad. Research about urban ecosystem service, as part of ES, has become the cutting edge and hot topic in China. The concept of ES was firstly proposed and defined in the 1970s. The UN Millennium Ecosystem Assessment Program set up in 2005 has played a key role in promoting the development of ES research. People have realized that ES helps to improve ecosystem productivity, human health and wellbeing, and optimal land utilization[6]~[8]. However, study on the negative impacts of costly environmental management and ecosystem externalities is still deficient.

Though rarely studied, EDS's influence on the lives of common people has been widely recognized. For example, snake in a specific ecosystem reminds people of the danger of being bitten, while flood reminds people of the damages to the houses and other infrastructure. Charlie Shackleton et al. believed that the lack of research on EDS had caused a series of problems: First, EDS exists objectively and needs to be taken into consideration in environmental management system; otherwise the management goals and expected results will not be completely realized. Second, EDS may impact human wellbeing; if we implement policies and plans that ignore EDS, the active connection among ES, biodiversity, and human wellbeing will be restrained. Third, the reduction of EDS can also reinforce the effects of ES and improve human wellbeing, thus providing a new way to develop ES[9]. In addition, we should focus not only on ES but also on EDS when optimizing the ecosystem, because the optimization of specific services might produce corresponding disservices. The complexity of ecosystem management, as well as its connectivity with ES, EDS, and biodiversity, should be more widely recognized[10][11].

The concept of EDS originated from some of the opinions raised in the 19th century. Early studies were conducted based on the damages to ecosystem, such as agricultural damages and health risk. However, these negative effects had not been discussed under the framework of disservice. Jari Lyytimäki was the first one to define EDS as “functions of ecosystem that have negative impacts on human wellbeing.”[6] After the concept of EDS was proposed, many foreign scholars tried to depict its contents from different perspectives, though there is not yet a widely-accepted definition[7][8].

对EDS的研究与定义大致可以分为三种不同的观点：1）基于生态学的研究，认为生态系统本身具有一定的消极功能与特征[10][12]~[14]，着重讨论由自然因素本身特有的性质所导致的人类福祉损害[15]~[19]，这类研究相对较多；2）基于环境学的研究，讨论人类作用于自然要素从而导致有害影响的产生[20][21]，如ES价值的缺失、生物多样性的衰退[22]；3）基于经济学视角，讨论维持某种ES所需的费用以及管理成本，如修剪树木的费用[23][24]。

这些描述从各自关注的问题出发，难免具有片面性，但却表述出了相似的内容：1）无论起因是生态系统本身还是人类活动，均是由于生态系统的变化对人类福祉产生了影响；2）对人类单方面或多方面的福祉造成了危害。综合各种理解，笔者提议将EDS概括为：“生态系统对人类福祉造成的实际上或感知上的消极影响的功能、过程或属性”。

从定义来看，未基于生态系统的事件或现象以及单纯人类行为并不属于EDS的范畴[13]。如果将从自然/地球物理灾害（例如地震、火山喷发）到社会危害（例如乱扔垃圾、犯罪等）视为一条连续的谱带，那么EDS则处于两极中间[9]。其分界较为模糊，例如洪水、干旱等自然灾害，可能受生物过程触发或加剧，属于EDS；也可能不受其影响，则不属于EDS。人类的行为，如街旁植树过密导致违法犯罪行为滋生，则属于EDS；而单纯的犯罪行为则不属于EDS。除此之外，EDS与自然灾害概念之间最大的差别在于，EDS涵盖了那些消极的、但不一定成为灾害的内容，二者存在程度上的差别。但这种消极影响却因为未上升至灾害层级而常常被研究学者所忽略。

任何生态系统都可能产生负面服务，EDS与ES可能产生自相同的过程或组分。例如，树木具有固碳、供氧作用，提供了ES，但它们也可以产生致敏原，带来EDS。因此，EDS的相关研究关注实际发生的问题，并以对人类福祉受损害与否为判断依据。这也意味着，由于界定损害程度具有一定难度，EDS在很大程度上取决于社会性判断[10][14]，且受当地文化、价值观、审美观、规范等影响[25]。

2.2 EDS的分类

针对不同类型的EDS需要制定不同的解决策略，因此从类型学上对其进行研究十分必要[6][14]。ES的分类基于服务类型对于人类福祉的价

The study on the definition of EDS can generally be categorized into three types: 1) Ecology-based study, which believes that ecosystem itself has some negative functions and characteristics[10][12]~[14], and focuses mainly on the damages to human wellbeing caused by natural factors[15]~[19]. This dimension is most widely studied. 2) Environment-based study, which focuses on harmful effects caused by human activities[20][21], such as the loss of ES values and the decrease of biodiversity[22]. 3) Economics-based study, which discusses the costs of sustaining and managing ES, such as the expense on tree trimming[23][24].

Though expressed from different perspectives and focuses, these different types of study share similar concerns: 1) The impacts on human wellbeing are all caused by the change of ecosystem, no matter the change is caused by ecosystem itself or human activities. 2) Damages do have impacts on human wellbeing in one or many aspects. Based on the analysis above, we propose that EDS should be defined as “the functions, processes, or properties of physical or perceptible negative impacts which ecosystem has caused upon human wellbeing.”

Events and phenomena that are not ecosystem-based, as well as single human behavior, do not belong to EDS[13]. If we consider natural or geophysical disasters (such as earthquake and volcano eruption) and social hazards (such as littering and crime) as the two ends of a continuous spectrum, then EDS will be between these two ends and its boundaries are blurred[9]. For example, if natural disasters such as floods and droughts are triggered or exaggerated by biological processes, they belong to EDS. Otherwise, they are not categorized as EDS. Human behaviors, such as the rampant crimes taking place in between the densely-planted roadside trees, are EDS; while other types of criminal behaviors may not be EDS. Besides, EDS is different from natural disasters largely because EDS includes those negative but not necessarily disastrous events. However, these negative impacts of EDS are often ignored by researchers due to their being relatively less disastrous.

All ecosystem may generate both services and disservices in the same process or with same elements. For example, trees can provide ES such as carbon sequestration and oxygen supply, together with EDS like allergens. As a result, the study on EDS should focus on problems that have happened and threatened human wellbeing. Due to the difficulty of defining the degree of damage caused by EDS, the effects of EDS are mostly assessed according to social factors[10][14], including local cultures, values, aesthetic standards, and norms[25].

2.2 Classification of EDS

Study of EDS typology is essential because different solutions are needed for different types of EDS[6][14]. The categorization of

值，主要分为供给、调节、支撑、文化4个类别[26][28]。这一分类框架可为EDS的分类提供参考。但更多的研究者提出了更具针对性的分类方法。例如，莱蒂马基等人将EDS分为美学问题、安全问题、健康问题、经济问题和移动性问题[6]；弗朗西斯科·J·埃斯科贝多等人则将EDS划分为货币成本、社会公害、环境污染三大类[27]；沙克尔顿等人认为，可以基于EDS起源及其对人类福祉的影响类型构建分类框架[9]。EDS的分类至今尚未形成学术共识，不同的研究需要根据城市特性和场地特征来具体分析分类。

2.3 EDS的层次

EDS一经提出，就处于不断的争议之中。这些争议体现在对EDS不同层面的理解上，主要包含以下三个方面：产生原因（自然状态与人工干预）、发生状态（实际现状与潜在能力），以及影响程度（相对值与绝对值）。

2.3.1 自然状态与人工干预

对于EDS的产生原因，学术界目前存在两种不同的视角。狭义的EDS强调生态系统自身固有的、对人类生活活动造成障碍的属性，仅包括由于自然因素本身的性质所导致的人类福祉损害。而广义的EDS还包括了由人类对生态系统的干扰作用造成的ES减少，以及为了维持某种ES带来的财力损失以及对人类福祉造成的损害。从自然－人类复合影响的角度来看，EDS的产生原因可以从生态功能与人类干预两个维度进行衡量，如表1所示。

2.3.2 实际现状与潜在能力

除了衡量生态功能与人类干预对EDS的影响，还需对EDS现状以及人类对于EDS的潜在期望进行讨论。广义的EDS应包括生态系统潜在价值与未充分体现的应有服务，即因受到阻碍而导致ES没有充分发挥。例如，禁止进入的草坪无法供人野餐游玩，这种限制导致草坪提供的ES减少。绿地系统本应具有多功能特性，既能满足多种人类活动需求，又能承担消解城市雨洪的作用。

2.3.3 相对值与绝对值

EDS的提出以及研究要充分考虑相对值与绝对值的问题，因为任何生态系统都可能同时提供正负服务，因而不能盲目地谈EDS——这也是EDS引发一些学者担忧的原因。莱蒂马基认为，公众的认知和预期是

ES, based on the service values for human wellbeing which includes four categories (supply, regulation, support, and culture)[26][28], can serve as a reference for the categorization of EDS. Besides, researchers have proposed more specific and relevant classifications. For example, Lyytimäki et al. classified EDS from aspects of aesthetic, safety, health, economy, and mobility[6]. Francisco J. Escobedo et al. categorized EDS into three types: economic cost, social harms, and environmental pollution[27]. Shackleton et al. held that the classification framework can be established based on the origin of EDS and its impacts on human wellbeing[9]. Since there is not yet an academic consensus, the classification of EDS needs to be specifically analyzed according to the urban and site features of different studies.

2.3 Levels of EDS

Controversy follows since EDS was proposed. Different opinions reflect varied understanding of EDS through different perspectives, including its causes (natural factors and human intervention), influenced status (actual disservices and latent disservices) and influenced level (relative disservices and absolute disservices).

2.3.1 Natural Factors and Human Intervention

The academia studies causes of EDS from two different perspectives. EDS in a strict sense emphasizes the properties that are intrinsic to ecosystem and have caused dysfunction to human activities. It only includes the damages to human wellbeing resulting from properties of natural factors. In contrast, EDS in a broad sense includes the decrease of ES caused by human intervention, the cost for maintaining certain ES, and the damages to human wellbeing. Moreover, causes of EDS can also be measured from both dimensions of natural factors and human intervention, as is shown in Table 1.

2.3.2 Actual Disservices and Latent Disservices

Apart from the impacts of natural factors and human intervention on EDS, discussions are also needed on current conditions of EDS and human's potential expectation from EDS. EDS in a broad sense should include the potential values of the ecosystem and the due services that have not been fully reflected — namely, ES fails to play its full capacity due to obstructions. For example, an inaccessible lawn will not be ready for picnic and amusement, and so such restriction has decreased the ES provided by the lawn. The green space system should have multiply functions, fulfilling both demands of space for human activities and urban flood control.

2.3.3 Relative Disservices and Absolute Disservices

The proposal and study of EDS need to consider issues of relative and absolute values. Since any ecosystem can simultaneously provide positive and negative services, we should not only talk

生态管理和规划的重要组成部分，社会媒体对生态系统的负面宣传，会引发公众对生态建设的担忧[10][29]。费迪南多·维拉等人认为ES与EDS需要同时计量，但同时指出，“负面服务”的说法相对消极，可能妨碍公众认知，进而对生态保护工作造成负面影响[8]。此外，正因为EDS以对人类福祉的损害为判断依据，其影响程度取决于人类的社会、经济、健康等多方面因素，例如，青少年和老年人对城市绿地的损害因素会有不同的体验[30][31]。

可以看出，如果从相对值与绝对值的角度来研究EDS，那么无论是学者还是大众，都能在生态建设中正确考量EDS的价值与意义，从而使决策更加科学、更具理性。

3 EDS在城市问题诊断中的研究框架

以上述对于EDS的概念认知为基础，本文建议利用EDS的概念及其相关分类构建负面清单，进而用于城市双修等进程中城市问题的诊断。其核心是建立物质空间环境（山体、水体、废弃地、绿地系统、基础设施、公共空间等）与EDS评价之间的关系，并在此基础上判定EDS是否是由于生态系统自身生态功能出现问题所导致：由生态功能问题所导致的EDS大多属于生态修复的范畴；而由非生态功能问题所导致的EDS则大多属于城市修补的范畴。值得注意的是，单纯的生态问题不一定需要修复，只有在生态问题已经造成EDS时才需要设计的介入。

在进行EDS的判定时，还可从空间以及土地利用类型等层面，归纳总结城市双修的核心内容与问题热点区域，进而界定城市双修的范围和重点。通过对EDS的研究，我们可以了解居民对城市生态系统的实际感受，明确生态系统提供社会服务的能力，发现其社会效益的短板，总结提升ES的规划技术手段，并依据不同的产生原因、发生状态和影响程度制定具体的修复方案。概括而言，包含以下三种途径：

1）提升生态系统自身生态功能。EDS，尤其是由生态系统本身功能的问题导致的负面服务，完全可以通过提升其自身功能以及正面服

about EDS while ignoring ES. Lyytimäki held that public awareness and expectation are the important component of ecological management and planning, and the negative reports of ecosystem by social media will worry the public on ecological construction[10][29]. Ferdinando Vella et al. agreed that ES and EDS should be measured at the same time, but they also pointed out, the term “disservice” was so negative that it may hinder public awareness and ecological protection[8]. Besides, as EDS is usually assessed based on damages to human wellbeing, the impacts vary from different social, economic and healthy conditions of human. For example, the youth and the senior might have different experiences about the damages to urban green space[30][31].

In conclusion, if EDS can be studied from perspectives of relative and absolute values, both the scholars and the public will be able to consider the values and meaning of EDS in the process of ecological construction, thus leading to more scientific and reasonable decision making.

3 Research Frameworks of EDS Applied in Urban Problem Diagnosis

Based on the concept and properties of EDS, this paper proposes to set up a negative checklist to diagnose problems for practices in Ecological Restoration and Urban Regeneration. Fundamentally, it is necessary to establish a connection between the physical environment (mountains, water bodies, waste lands, green space systems, infrastructure, public space, etc.) and EDS assessment, based on which we may determine whether EDS is caused by the ecosystem’s own ecological dysfunction. Specifically, EDS caused by ecological functional problems mostly falls into the scope of ecological restoration, while EDS caused by non-ecological functional problems are mainly related to urban regeneration. It is worth noting that only when the ecological problems have caused EDS, should the intervention of design be introduced.

Through the assessment of EDS, we may summarize the core issues and hotspots of urban development from spatial and land-use perspectives to define the scope and focus of Ecological Restoration and Urban Regeneration. By studying EDS, we can acquire local users’ actual perception on urban ecosystem, clarify the capacity of ecosystem to provide social services, identify the weakness of its social benefits, summarize planning and technical strategies to improve ES, and finally develop detailed restoration plans according to different factors, status, and levels of impacts of EDS. In general, there are three approaches:

1) To enhance services. EDS, particularly the disservices caused by the ecosystem itself, can be mitigated by enhancing its

务潜力来削弱EDS。例如在处理黑臭水体问题时，增强其自净能力，正面改善其黑臭现状，即可有效降低EDS。

2）降低负面服务。通过适当地规划或调整生态系统的管理途径，能够最大程度地发挥生态系统的潜在价值。蒂莫西·D·米汉等人认为，通过适当的管理可以降低EDS，促进ES，从而大大提高人类的健康效益[32]，以及包含货币性质和非货币性质的人居体验的社会服务功能。例如湿地景观，尽管其自身生态功能和状态较好，但与其依附相生的蚊虫就是典型的EDS，可以通过系统性设计以及后续维护管理，降低其对人类生活的影响。

3）正负服务博弈。博弈是生态系统管理决策过程中的常见手法，特别是针对某些因生态系统固有属性造成的无法调节的EDS，则应在规划或设计过程中进行决策博弈。比如对于自然保护区的保护，即便对当地居民的生活或交通造成再多不便，也不能改变自然保护的刚性必要。

4 结语

随着我国城镇化进程的持续推进，生态环境问题日益突出，城市生态系统的管理将更为复杂，也更为必要。其主要挑战之一是如何将城市生态系统产出与居民生态预期收益相结合。这需要全面考量ES与EDS的关系，并制定城市生态系统管理以及城市双修的策略。

以此为基础，EDS的研究将具有多维的理论与现实意义：

1）提供看待城市生态问题的新视角，提醒人们关注生态系统建设过程中的不足之处。EDS研究的一大价值就是承认EDS的存在。

2）从社会文化的视角看待生态过程与生态问题，而不仅仅就物质环境论物质环境。

3）提供问题研究与分类的框架，为生态系统修复提供重要依据与途径。

4）更全面地揭示人类世背景下的人地关系，这种关系既包括城镇化对于生态系统的影响，也包括生态系统对人类福祉的影响。

5）从生态系统正负服务的角度为生态建设理论提供重要的修正与

own functions and service potentials. For example, when dealing with the polluted water body, we can effectively reduce EDS by improving its self-purification capacity.

2) To mitigate disservices. By reasonably planning or regulating the ecosystem management approaches, we can maximize the potential values of ecosystem. Timothy D. Meehan et al. believed that, through proper management, EDS can be reduced, while ES can be promoted. Thus, human wellbeing can be significantly improved[32] in both monetary and nonmonetary aspects. Taking a wetland landscape for example, although its ecological system can work well, there might be mosquitoes which are typical EDS. Through systematic design and follow-up maintenance and management, the impacts of mosquitoes on human life can be reduced.

3) Tradeoff between positive and negative services. Tradeoff is a common approach to ecosystem management, especially when confronting EDS caused by some intrinsic properties of the ecosystem. For example, the fundamental demand of natural reserve protection should not be challenged, even if it may cause inconvenience to local people's daily lives and transport.

4 Conclusion

As the urbanization of China continues with increasingly acute ecological and environmental problems, the management of urban ecosystem will be even more complicated and compulsory. One of the major challenges is to ensure the functions of urban ecosystem reach the expected ecological benefits. Full considerations of the relationship between ES and EDS is the first step to initiate appropriate strategies for urban ecosystem management and Ecological Restoration and Urban Regeneration.

Based on the discussion above, the study of EDS will offer multidimensional significances theoretically and practically:

1) It provides a new perspective for examining urban ecological problems and reminds us of potential shortcomings in ecosystem construction. One key value of EDS study is to admit the existence of EDS.

2) It extends the perspectives of examining ecological process and problems, from the physical perspective to broader social and cultural ones.

3) It offers frameworks for problem-oriented research and classification of EDS, and provides important evidence and approaches for ecosystem restoration.

4) It thoroughly reveals the human-land relationship in the Anthropocene context, including the impacts of urbanization on ecosystem and those of ecosystem on human wellbeing.

5) It provides important amendment and supplement for

补充，也为生态系统的科学管护、国土空间格局的优化和生态文明建设的推进提供理论支撑。

EDS研究可以在城市规划中通过布局策略与指导建设，提升生态系统的社会服务功能，从而优化生态系统，为建设“看得见山、望得见水”的城市人居环境提供支撑。与此同时，我们也要意识到，EDS的研究与评估是一个复杂的过程，更多情况下需要各个学科相互协同，但目前国内外的相关跨学科实践仍屈指可数。对EDS影响程度的确定与量化将成为未来EDS研究的重点与难点。一方面，生态系统不断变化，导致EDS也在不断变化，必须采取相应的动态手段。更重要的是，生态变化与经济、社会、文化和技术变化相互交织，受到多方因素的共同影响。此外，目前仍缺少包括度量指标与度量方法在内的相关度量体系，这也将成为未来EDS研究的发展方向。**LAF**

theories related to ecological development through combined consideration of ES and EDS, and offers theoretical support for the scientific management and protection of ecosystem, the optimization of spatial land uses, and the construction of ecological civilization.

EDS research can uplift the social services of ecosystem through offering strategies and construction guidance in urban planning, thus optimize ecosystem and contribute directly to the urban living environment in which “both mountains and waters can be seen.” On the other hand, we should also realize that doing research and assessment of EDS is a complicated process that relies on interdisciplinary collaboration, while related interdisciplinary practice is still quite limited so far. Identification and quantification of EDS’s influence will be the key and challenge to future EDS research. Dynamic study approaches are necessary because ecosystem keeps evolving, so does EDS. More importantly, ecological changes are intertwined with economic, social, cultural, and technological development, and are jointly influenced by multiple factors. As there has not yet been systematic framework of measurement indexes and methods for EDS studies so far, all these will be the directions of future EDS research. **LAF**

REFERENCES

[1] National Bureau of Statistics of the People's Republic of China. (2017). Statistical Communique of The People's Republic of China on the 2001 National Economic and Social Development. Retrieved from http://www.stats.gov.cn/tjsj/zxfb/201702/t20170228_1467424.html

[2] The CPC Central Committee and the State Council. (2015). Opinions of the CPC Central Committee and the State Council on Accelerating the Eco- Civilization Construction. Retrieved from http://www.scio.gov.cn/xwfbh/xwbfbh/yg/2/Document/1436286/1436286.htm

[3] The CPC Central Committee and the State Council. (2016). Several Opinions of the CPC Central Committee and the State Council on Further Enhancing Management of Urban Planning and Development. Retrieved from http://news.xinhuanet.com/ttgg/2016-02/21/c_1118109546.htm

[4] Huang, W. H. (2017). "Ecological restoration and urban renovation," How to deploy? China Construction, (6), 24-25.

[5] Ministry of Housing and Urban-Rural Development of the People's Republic of China. Guiding Views of MOHURD on Strengthening the Work of Ecological Restoration and City Renewal. Retrieved from http://www.mohurd.gov.cn/wjfb/201703/t20170309_230930.html

[6] Lyytimäki, J., Petersen, L. K., Normander, B., & Bezák, P. (2008). Nature as a nuisance? Ecosystem services and disservices to urban lifestyle. Environmental Sciences, 5(3), 161-172.

[7] Lele, S., Springate-Baginski, O., Lakerveld, R., Deb, D., & Dash, P. (2013). Ecosystem services: Origins, contributions, pitfalls, and alternatives. Conservation and Society, 11(4), 343-358.

[8] Villa, F., Bagstad, K. J., Voigt, B., Johnson, G. W., Athanasiadis, I. N., & Balbi, S. (2014). The misconception of ecosystem disservices: How a catchy term may yield the wrong messages for science and society. Ecosystem Services, (10), 52-53.

[9] Shackleton, C. M., Ruwanza, S., Sinasson Sanni, G. K., Bennett, S., De Lacy, P., Modipa, R.,... Thondhlana, G. (2016). Unpacking Pandora's Box: Understanding and Categorising Ecosystem Disservices for Environmental Management and Human Wellbeing. Ecosystems, 19(4), 587-600.

[10] Lyytimäki, J. (2015). Ecosystem disservices: Embrace the catchword. Ecosystem Services, (12), 136.

[11] Gómez-Baggethun, E., & Barton, D. N. (2013). Classifying and valuing ecosystem services for urban planning. Ecological Economics, (86), 235-245.

[12] Calow, P. (1998). Ecological risk assessment: Risk for what? How do we decide? Ecotoxicology and Environmental Safety, 40(1-2), 15-18.

[13] Chen, S., Chen, B., & Fath, B. D. (2013). Ecological risk assessment on the system scale: A review of state-of-the-art models and future perspectives. Ecological Modelling, (250), 25-33.

[14] McCauley, D. J. (2006). Selling out on nature. Nature, 443(7107), 27-28.

[15] Lyytimäki, J., & Sipilä, M. (2009). Hopping on one leg – The challenge of ecosystem disservices for urban green management. Urban Forestry and Urban Greening, 8(4), 309-315.

[16] Dunn, R. R. (2010). Global Mapping of Ecosystem Disservices: The Unspoken Reality that Nature Sometimes Kills us. Biotropica, 42(5), 555-557.

[17] Ayres, R. U., & Kneese, A. V. (1969). Production, Consumption, and Externalities. The American Economic Review, 59(3), 282-297.

[18] Balmford, A., & Bond, W. (2005). Trends in the state of nature and their implications for human wellbeing. Ecology Letters, 8(11), 1218-1234.

[19] Zhang, W., Ricketts, T. H., Kremen, C., Carney, K., & Swinton, S. M. (2007). Ecosystem services and dis-services to agriculture. Ecological Economics, 64(2), 253-260.

[20] Dobbs, C., Escobedo, F. J., & Zipperer, W. C. (2011). A framework for developing urban forest ecosystem services and goods indicators. Landscape and Urban Planning, 99(3-4), 196-206.

[21] Bastian, O., Haase, D., & Grunewald, K. (2012). Ecosystem properties, potentials and services — The EPPS conceptual framework and an urban application example. Ecological Indicators, (21), 7-16.

[22] Power, A. G. (2010). Ecosystem services and agriculture: tradeoffs and synergies. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 2959-2971.

[23] Swain, H. M., Boughton, E. H., Bohlen, P. J., & Lollis, L. O. (2013). Trade-offs among ecosystem services and disservices on a Florida Ranch. Rangelands, 35(5), 75-87.

[24] Chapin, F. R., Zavaleta, E. S., Eviner, V. T., Naylor, R. L., Vitousek, P. M., Reynolds, H. L.,... Diaz, S. (2000). Consequences of changing biodiversity. Nature, 405(6783), 234-242.

[25] Wenny, D. G., DeVault, T. L., Johnson, M. D., Kelly, D., Sekercioglu, C. H., Tomback, D. F., & Whelan, C. J. (2011). Perspectives in ornithology the need to quantify ecosystem services provided by birds. Auk, 128(1), 1-14.

[26] Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics, 63(2-3), 616-626.

[27] Escobedo, F. J., Kroeger, T., & Wagner, J. E. (2011). Urban forests and pollution mitigation: Analyzing ecosystem services and disservices. Environmental Pollution, 159(8-9), 2078-2087.

[28] Wallace, K. J. (2007). Classification of ecosystem services: Problems and solutions. Biological Conservation, 139(3-4), 235-246.

[29] Lyytimäki, J. (2014). Bad nature: Newspaper representations of ecosystem disservices. Urban Forestry and Urban Greening, 13(3), 418-424.

[30] Chan, K. M. A., Satterfield, T., & Goldstein, J. (2012). Rethinking ecosystem services to better address and navigate cultural values. Ecological Economics, 74(1), 8-18.

[31] Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. Ecological Economics, 68(3), 643-653.

[32] Meehan, T. D., Werling, B. P., Landis, D. A., & Gratton, C. (2011). Agricultural landscape simplification and insecticide use in the Midwestern United States. Proceedings of the National Academy of Sciences of the United States of America, 108(28), 11500-11505.