

Finland: Natural asset valuation in municipalities using ecosystem accounting

芬兰：利用生态系统核算对市政当局的自然资产进行估值

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What are ecosystem accounts? 什么是生态系统账户？

- *Ecosystem accounts essentially measure ecosystems and the flows of ecosystem services from these ecosystems into economic and other human activities. Ecosystem accounts, therefore, track the extent (or quantity) and the condition (or quality) of ecosystems.*
- 生态系统账户主要衡量生态系统以及从这些生态系统流向经济和其他人类活动的生态系统服务。因此，生态系统账户可追踪生态系统的范围（或数量）和状况（或质量）。
- *High levels of ecosystem quantity and quality will make ecosystems **resilient*** to perturbations and disturbances and, at the same time, provide **sustainable services**.*
- 高水平的生态系统数量和质量将使生态系统具有抵御扰动和干扰的能力(韧性)*，同时还可持续地能提供(生态)服务。
- *Both ecosystem extent and condition define the **capacity of ecosystems to provide services**. When this capacity is used, ecosystem services flow from ecosystems to humans and deliver **benefits**. When use exceeds capacity, ecosystems are used in an unsustainable way and degrade. (Maes et al. 2018)*
- 生态系统的范围和状况决定了生态系统提供服务的能力。当这种提供生态系统的功能被利用时，生态系统服务就会从生态系统流向人类并带来**益处**。当使用超出其容受力时，生态系统以不可持续的方式被使用并退化。(Maes et al. 2018)

****Resilience** can be defined as the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions.*

韧性可定义为社会生态系统吸收或承受扰动和其他压力的能力，从而使该系统保持在同一稳态，维持其在基本相同的结构和功能。

Or in other words... 或者，换句话说

*Each area of a **particular land cover** or **habitat** can be thought of as an **asset supplying a number of services** that the **economy** and **society** benefit from. For example, food, water or clean air. The ecosystem accounts to monitor **the size and condition of these assets** and also **the quantity and value of the ecosystem services supplied [and used]**.*

每一片特定的土地植被或栖息地都能被视为一种资产，为经济和社会提供多种服务。例如，食物、水或空气净化。生态系统账户监测这些资产的规模和状况，以及其所提供（和使用）的生态系统服务的数量和价值。

(Slightly modified from ONS - Office for National Statistics, UK, 2018).

The System of Environmental-Economic Accounting — Ecosystem Accounting (SEEA EA) (1/2)

- A spatially-based, integrated statistical framework for
 - organizing biophysical information about **ecosystems**,
 - tracking changes in ecosystem extent and condition,
 - measuring ecosystem services,
 - valuing ecosystem services and assets and
 - linking this information to measures of economic and human activity.
- It was developed to respond to a range of **policy demands** and **challenges** with a focus on **making visible the contributions of nature to the economy and people AND better recording the impacts of economic and other human activity on the environment.**
- The SEEA EA complements the measurement of the relationship between the environment and the economy described in the System of Environmental-Economic Accounting 2012—Central Framework (SEEA Central Framework).
- **The SEEA = the SEEA Central Framework + the SEEA EA**, provides a system that complements the System of National Accounts (SNA).

(United Nations et al., 2021)

《环境经济核算体系：生态系统核算》 (SEEA EA) (1/2)

- 基于空间的综合统计框架
 - 组织有关生态系统的生物物理信息、
 - 跟踪生态系统范围和状况的变化、
 - 衡量生态系统服务、
 - 评估生态系统服务和资产，以及
 - 将这些信息与衡量经济和人类活动的指标联系起来。
- 开发该系统的目的是为了应对一系列政策需求和挑战，重点是让人们看到大自然对经济和人类的贡献，并更好地记录经济活动和其他人类活动对环境的影响。
- SEEA EA 是对《2012年环境经济核算体系中心框架》（SEEA中心框架）中所描述的环境与经济之间关系测量的补充。
- SEEA = SEEA 中心框架 + SEEA EA，提供了一个补充国民账户体系（SNA）的系统。

(联合国等, 2021 年)

SEEA EA continues... (2/2)

- The SEEA EA is a system of **an integrated, internally consistent series of accounts**.
- Its design allows **implementation in parts**, i.e., the implementation can be flexible and modular.
- **A progressive and staged development** of the range and detail of the ecosystem accounts is an appropriate implementation strategy.
- The compilation of accounts in monetary terms will require the use of data in physical terms
 - It is recommended that when monetary accounts are released, the associated data in physical terms are also released, for example concerning changes in ecosystem extent and condition.
 - This will aid interpretation and application of the monetary data in policy and decision making.
- **Interpretation and analysis of ecosystem accounting data** is also supported through the **use of other data** such as concerning environmental protection expenditure, industry value added, employment and population.
- Thematic accounts organise data on themes of specific policy relevance

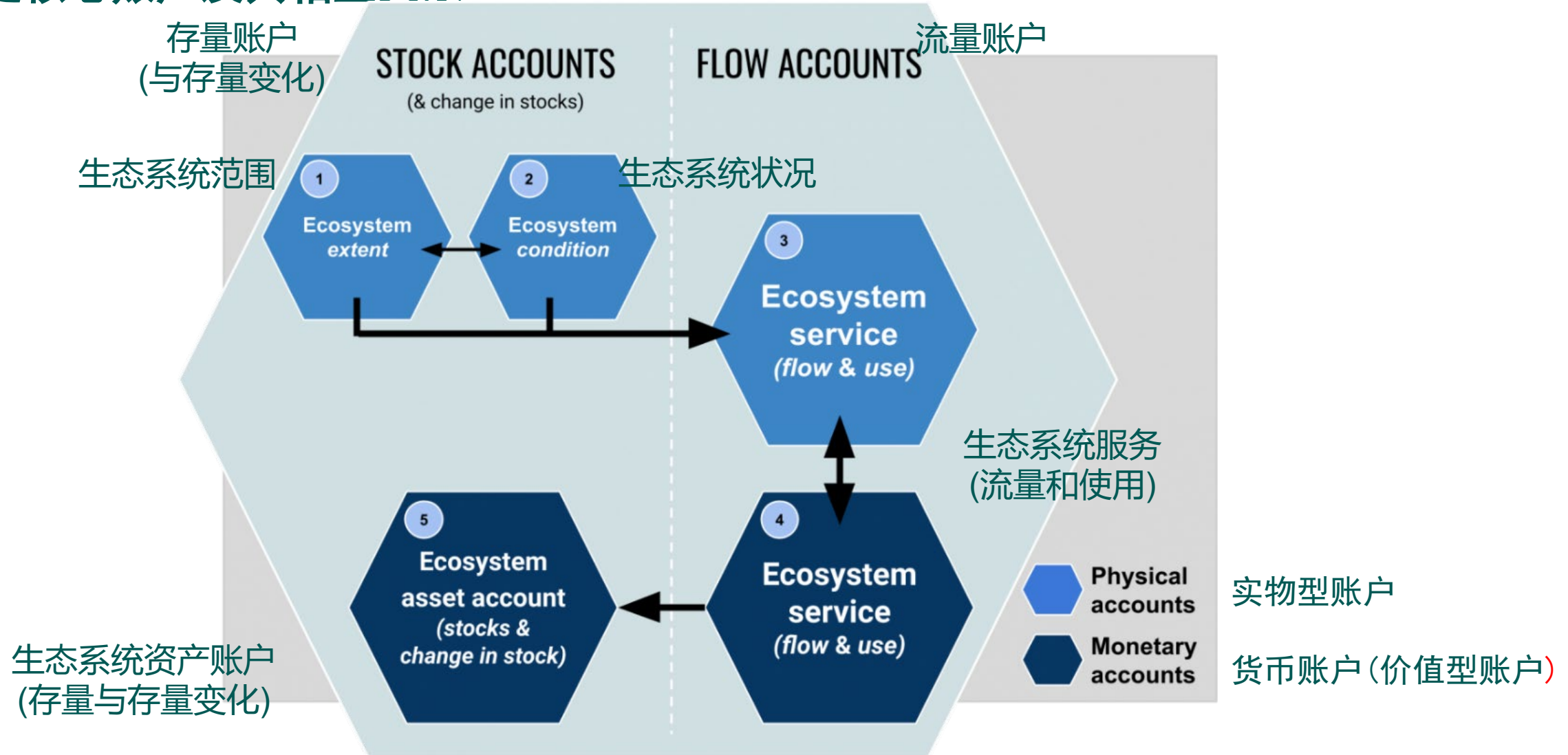
(United Nations et al., 2021)

SEEA EA (2/2)

- SEEA EA 是一个综合的、有内部一致之系性列账户的系统。
- 其设计允许部分地实施，即可以灵活和模块化地实施。
- 分阶段逐步发展生态系统账户的范围和细节是一种适当的实施战略。
- 编制货币账户(价值型账户)需要使用实物型数据
 - 建议在发布货币账户时，同时发布相关的实物型数据，例如生态系统范围和状况的变化。
 - 这将有助于在政策和决策中解释和应用货币数据。
- 生态系统核算数据的解释和分析还可通过使用其他数据来支持，如有关环境保护支出、工业增值、就业和人口的数据。
- 专题账户根据与具体政策相关的主题组织数据

(联合国等, 2021 年)

Core ecosystem accounts and how they relate to each other 生态系统账户之核心账户及其相互关系



Source: United Nations et al. 2021. System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing.

Available at: <https://seea.un.org/ecosystem-accounting>

Monetary ecosystem accounts 货币(价值型)生态系统账户

- Monetary accounts should be viewed as providing only a partial or minimum estimate of the services delivered by the natural environment, as many ecosystem services are likely not captured. The SEEA EA uses the concept of exchange values, adhering to standard economic accounting principles to facilitate comparison with conventional economic and financial data.
- 货币账户(价值型账户)应被视为仅提供了自然环境所提供服务的部分或最低估计值, 因为许多生态系统服务可能未被包含在内。SEEA EA 使用交换价值的概念, 遵循标准经济核算原则, 以便于与常规经济和财务数据进行比较。
- Most services provided by the natural environment are not traded in markets and, therefore, lack established “prices.” Several methods exist to estimate the monetary value of these services. Some of these techniques reveal an implicit price, representing what would be paid if a market for the service existed; these are known as exchange values and are conceptually consistent with output values in the system of national accounts.
- 自然环境提供的大多数服务都不在市场上交易, 因此没有既定的 “价格”。有几种方法可以估算这些服务的货币价值。其中一些方法揭示了一种隐含价格, 即如果服务市场存在, 人们会支付的价格; 这些价格被称为交换价值, 在概念上与国民账户体系中的产出价值一致。
- Non-market valuation techniques, by contrast, aim to capture the full value beneficiaries derive, including what economists call “consumer surplus,” which is typically higher than exchange values. Welfare values are commonly used in the economic assessment of policies or projects.
- 相比之下, 非市场估值技巧旨在评价受益人获得的全部价值, 包括经济学家所称的 “消费者剩余”, 通常高于交换价值。福利值通常用于政策或项目的经济评估。
- When compiling monetary ecosystem service accounts, it is essential to clarify the valuation method employed and to what extent these values are compatible with others.
- 在编制货币生态系统服务帐户时, 必须阐明所采用的估值方法, 以及这些价值与其它价值兼容的程度。

(United Nations et al., 2021)



Biodiversity
生物多样性



Climate change
气候变化



Marine
海洋



Urban
城市

THEMATIC ACCOUNTS

专题账户



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Legislative background 立法背景

- Ecosystem accounting will become obligatory at the national level in the European Union in 2026. Although the national level accounts are beneficial in getting an overview of the trends in ecosystem extent, ecosystem condition and ecosystem services, they do not fulfil the needs of municipal level decision-making. Scale affects the level of detail and that way also usability of data for local needs.
- The general purpose and legislative basis for creating ecosystem accounts are important to understand in municipalities. Ecosystem accounts measure and monitor the contribution of nature to the economy and society in a way that is consistent with economic accounts, which allows more integrated analyses to inform policies (EC News 11 July 2022).
- 生态系统核算将于 2026 年成为欧盟国家层面的义务性规定。尽管国家级核算有利于全面了解生态系统范围、生态系统状况和生态系统服务的趋势，但它们并不能满足市级决策的需求。规模尺度会影响数据的详细程度，进而影响数据对地方需求的可用性。
- 市政当局必须了解创建生态系统账户的一般目的和法律依据。生态系统账户以与经济账户一致的方式衡量和监控大自然对经济和社会的贡献，从而可进行更综合的分析，为政策提供依据（欧共同体新闻，2022 年 7 月 11 日）。

Why urban/municipal ecosystem accounts? 为什么采用城市/市政生态系统账户?

- Urban green and blue spaces are crucial components of urban ecosystems, providing numerous ecosystem services that are important for human well-being and environmental sustainability.
- The planning, conservation, and management of urban green and blue spaces are instrumental in the transition towards sustainable urban planning.
- Ecosystem accounts can support strategic municipal planning and policy-making, facilitating the integration of biodiversity, ecosystems, and ecosystem services into development planning and decision-making.
- 城市蓝绿空间是城市生态系统的重要组成部分，它们提供众多生态系统服务，对人类福祉和环境可持续性至关重要。
- 城市蓝绿空间的规划、保护和管理有助于过渡至可持续城市规划。
- 生态系统账户可支持战略性市政规划和决策，促进将生物多样性、生态系统和生态系统服务纳入发展规划和决策。



Earlier municipal ecosystem accounting pilots in Finland

芬兰早期的市政生态系统核算试点项目

- Co-creation with municipalities in the implementation of urban ecosystem accounting approaches, targeted at local policy needs and critical issues.
- 针对地方政策需求和关键问题，与市政当局共同创建城市生态系统核算方法。
- Testing the suitability of different existing spatial datasets and methods for the purposes of urban ecosystem accounting:
- 测试现有不同空间数据集和方法是否适用于城市生态系统核算：
 - To compile an ecosystem extent account following SEEA-EA standard and EU ecosystem typology:
 - 按照 SEEA-EA 标准和欧盟生态系统类型，编制生态系统范围账户：
 - Pirkkala: Urban green and forest extent.
 - 皮尔卡拉：城市绿地和森林范围
 - Helsinki: Urban green extent (originally forest ecosystem extent).
 - 赫尔辛基：城市绿地范围（原为森林生态系统范围）
 - Tampere: Complete ecosystem extent.
 - 坦佩雷：完整的生态系统范围



Earlier municipal ecosystem accounting pilots in Finland

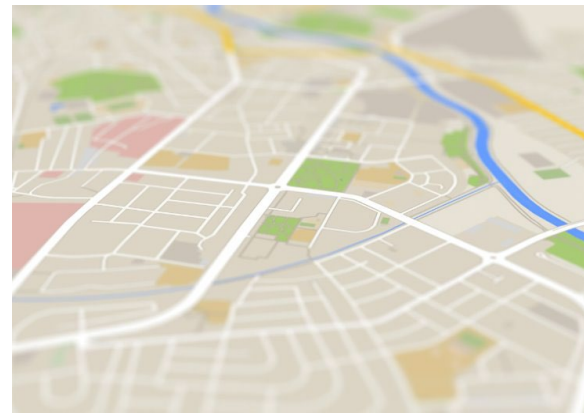
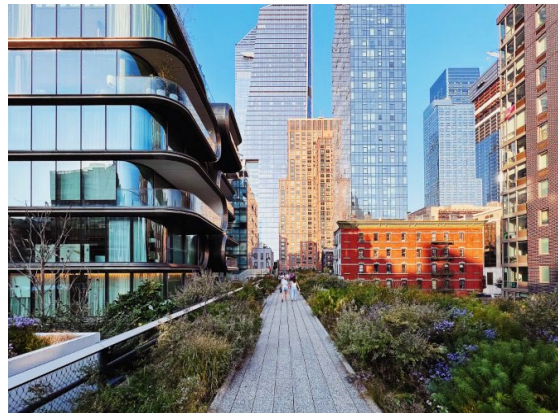
芬兰早期的市政生态系统核算试点项目

- To compile physical and monetary accounts of ecosystem service supply and use:
- 编制生态系统服务供应和使用的实物和货币账户：
 - Pirkkala: The educational and recreational value of green areas, using PPGIS surveys.
 - 皮尔卡拉：利用公众参与地理信息系统（PPGIS）调查研究绿地的教育和娱乐活动价值。
 - Helsinki: The value of nature-based recreation in green areas, using movement, visitor counter and survey data.
 - 赫尔辛基：利用运动、游客计数器和调查数据，研究绿地中以自然为基础的娱乐活动的价值。
 - Tampere: The value of green areas in mitigating stormwater runoff.
 - 坦佩雷：绿地在减少暴雨径流方面的价值。



Extent of ecosystem types 生态系统类型的范围

- In municipal ecosystem accounting, both urban and rural areas are included if the municipal borders define **the accounting area**. To obtain a comprehensive understanding of urban ecosystems, ecosystem type classification needs to be adapted, as urban green spaces can consist of a mosaic of smaller features and areas that are not in a natural state. Almenar et al. (2023) provide a descriptive list of urban green space types that can be used in ecosystem accounting.
- 在市政生态系统核算中，如果市政边界定义了**核算区域**，则城市和农村地区都包括在内。为了全面了解城市生态系统，需要对生态系统类型分类进行调整，因为城市绿地可能由较小的地貌和非自然状态的区域拼凑而成。Almenar 等人（2023）提供了一份可用于生态系统核算的城市绿地类型描述性清单。
- Previous municipal ecosystem accounting projects in Finland have tested urban and municipal ecosystem extent accounts, yielding valuable information. In the current project, an ecosystem extent account has been developed for the city of Espoo.
- 芬兰先前的城市生态系统核算项目对城市和城市生态系统范围账户进行了测试，并获得了宝贵的信息。在当前的项目中，已为埃斯堡市建立了生态系统范围账户。

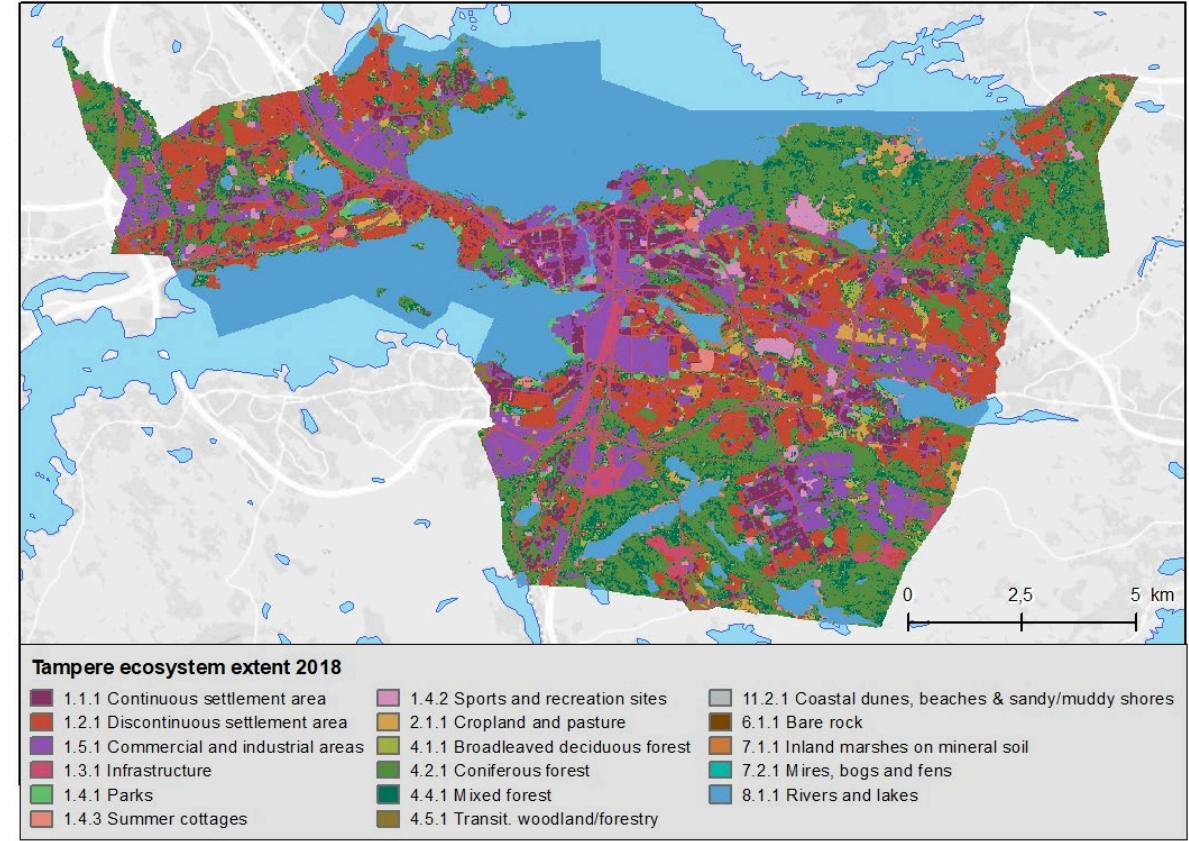
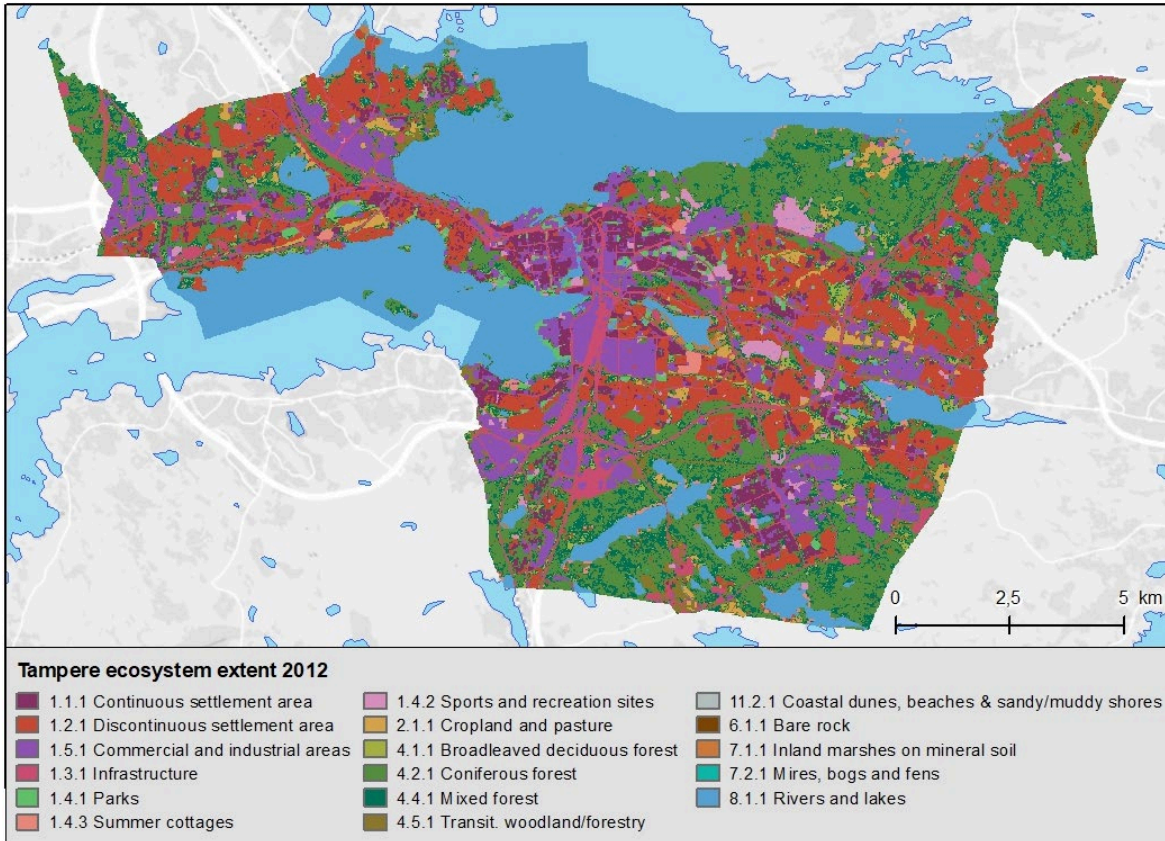


Extent of ecosystem types 生态系统类型的范围

- The maintenance level of public properties is a topical issue in Espoo, as the value of public green spaces and green infrastructure for enhancing biodiversity is increasingly recognised. The importance of meadows and open spaces, among others, could support arguments for lower maintenance levels of open areas within urban settings.
- 在埃斯堡，公共绿地和绿色基础设施在提高生物多样性方面的价值日益得到认可，因此公共财产的维护水平是一个热门话题。草地和开放空间等的重要性可以支持降低城市开放区域维护水平的论点。
- The city of Espoo has compiled extensive and detailed GIS datasets over several decades and utilising this data for ecosystem accounting would highlight the value of biodiversity and the aesthetic elements of nature. Piloting ecosystem accounting is further **supported by recent action plans** in Espoo, including the Action Programme for Biodiversity 2021–2030, the Action Plan for Climate Change Adaptation 2022–2025, and Espoo's Action Programme for Meadows and Open Areas 2021–2031.
- 数十年来，埃斯堡市已编制了大量详细的 GIS 数据集，利用这些数据进行生态系统核算将突显生物多样性的价值和大自然的美学元素。生态系统核算试点工作还得到了埃斯堡**近期行动计划的进一步支持**，包括《2021-2030年生物多样性行动方案》、《2022-2025年适应气候变化行动计划》以及《2021-2031年埃斯堡草地和开放区域行动方案》。

City of Tampere: ecosystem extent account 2012-2018 (1/2)

坦佩雷市：2012-2018 年生态系统范围账户 (1/2)



Opening extent of each ecosystem type in hectares
每个生态系统类型的期初范围 (单位: 公顷)

Closing extent of each ecosystem type in hectares
每个生态系统类型的期末范围 (单位: 公顷)

Cross-tabulate and calculate ecosystem-type change matrix
交叉列表并计算生态系统类型变化矩阵

Populate the ecosystem extent account table
生成生态系统范围账户表

Condition of ecosystems 生态系统的状况

- Optimal urban ecosystem health and resilience requires the capacity to meet societal demand for ecosystem services while ensuring long-term ecosystem sustainability. This necessitates that monitoring urban ecosystem conditions should provide insights into how biotic and abiotic factors, including human and technology-related variables, affect the resilience and health of the urban ecosystem itself and the interconnected ecosystems on which it relies.
- 最佳的城市生态系统健康和复原力需要能满足社会对生态系统服务的需求，同时确保生态系统的长期可持续性。这就需要对城市生态系统状况进行监测，以便深入了解生物和非生物因素（包括与人类和技术相关的变量）如何影响城市生态系统本身及其所依赖的相互关联的生态系统的恢复力和健康。
- The purpose of urban ecosystem condition accounts is to monitor changes in ecological conditions, similar to other ecosystems, but with attention to attributes, processes, or functions impacting the ecological dimension. A few examples of urban ecosystem condition accounts include:
 - Impervious surface area per inhabitant (percentage of imperviousness).
 - Share of tree canopy cover.
 - Proportion of green spaces and/or green spaces per inhabitant.
 - Fragmentation of the green network.
- 城市生态系统状况账户的目的是监测生态条件的变化，与其他生态系统类似，但要关注影响生态维度的属性、过程或功能。城市生态系统状况账户的几个例子包括
 - 每个居民所占的不透水面的面积（不透水百分比）。
 - 树冠覆盖率。
 - 居民人均绿地和/或绿地比例。
 - 绿色网络破碎化。

Condition of ecosystems 生态系统的状况

- We are piloting ecosystem condition accounts for Pirkkala, focusing on the fragmentation of forest ecosystems, and for Espoo, addressing the connectivity of urban green spaces.
- 我们正在皮尔克卡拉和埃斯波试行生态系统状况账户，前者侧重于森林生态系统的破碎化，后者则针对城市绿地的连通性

* European Commission / Joint Research Centre, 2023



Physical and monetary accounts of ecosystem services

生态系统服务的实物型账户与价值型账户(货币账户)

A terrible sight in the morning in Tampere: the streets are flooded after heavy rains

坦佩雷早上的可怕景象：
大雨过后街道淹水了

At worst, there was up to 70 centimeters of water on the streets.

最严重的时候街道积水可达70厘米

Joona Laukkanen
24.8. 8:37 am

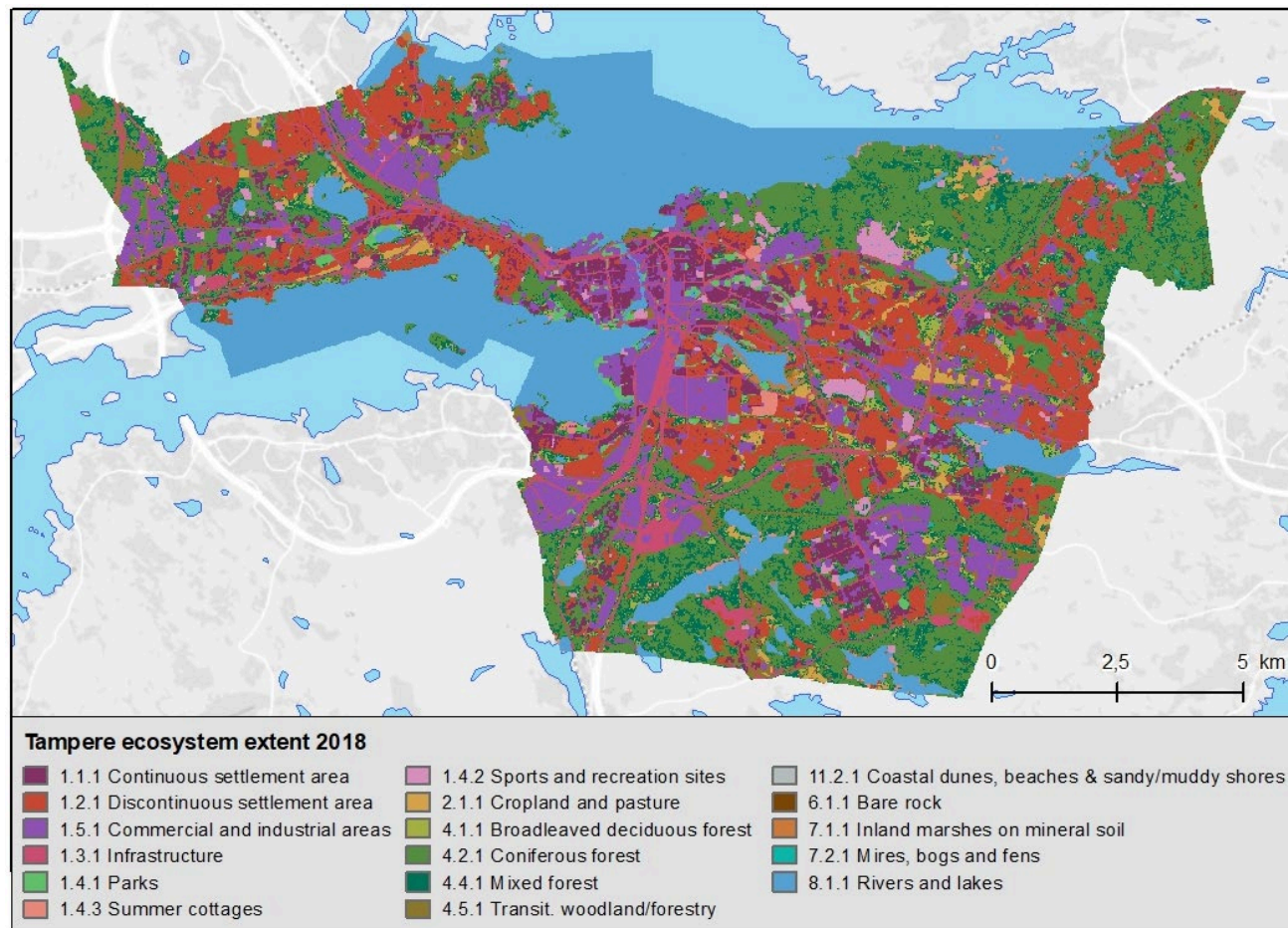
THE CENTER OF TAMPERE flooded on Wednesday morning as a result of heavy rains overnight.

The water rose to a considerable height in the low points of the streets, says **Pauli Keskinen**, fire chief on duty at the Pirkanmaa rescue service, to Ilta-Sanom. Aamulehti was the first to report on the floods.



This is what it looked like on Satakunnakatu in the morning. PHOTO: PIRITTA PALOKANGAS / AAMULEHTI

Runoff retention ecosystem service account in the City of Tampere 坦佩雷市径流截留生态系统服务账户



Ecosystem accounting area:

The watershed covering the core city area of Tampere

生态系统核算领域：
覆盖坦佩雷核心城区的分水岭

City of Tampere: ecosystem extent account 2012-2018 (2/2)

坦佩雷市：2012-2018 年生态系统范围账户 (2/2)

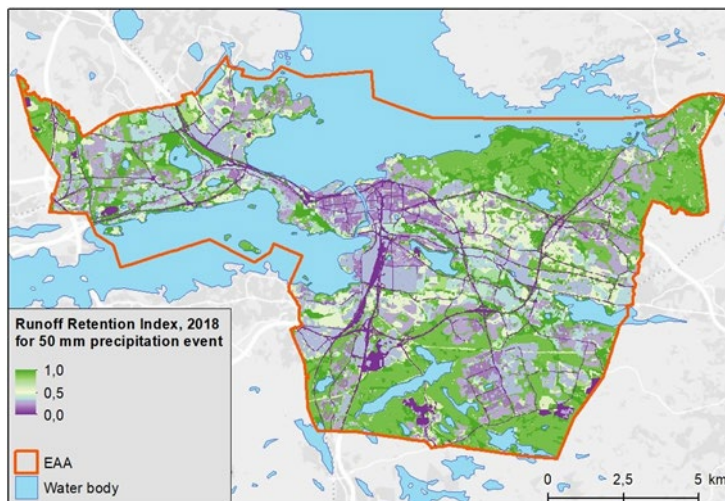
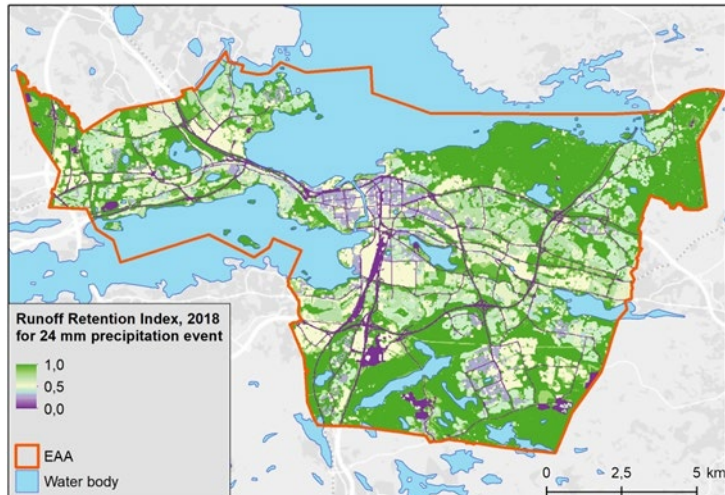
Tampere ecosystem extent account 2018

Ecosystem type, level 3	1.1.1 Continuous settlement area	1.2.1 Discontinuous settlement area	1.5.1 Commercial and industrial areas	1.3.1 Infrastructure	1.4.1 Parks	1.4.3 Summer cottages	1.4.2 Sports and recreation sites	2.1.1 Cropland and pasture	4.1.1 Broadleaved deciduous forest	4.2.1 Coniferous forest	4.4.1 Mixed forest	4.5.1 Transitional woodland/forestry	11.2.1 Coastal dunes, beaches and sandy and muddy shores	6.1.1 Bare rock	7.1.1 Inland marshes on mineral soil	7.2.1 Mires, bogs and fens	8.1.1 Rivers and lakes	Total
Opening extent (2012)	920	2559	1785	1042	166	91	251	235	308	3299	1480	707	1	8	38	6	3991	16889
Additions to extent	21	59	13	48	0	0	8	0	1	1	4	65	0	0	0	0	0	221
Reductions in extent	0	0	0	50	0	0	0	16	5	79	47	24	0	0	0	0	0	221
Net change in extent	21	59	13	-2	0	0	8	-16	-4	-78	-42	40	0	0	0	0	0	0
Closing extent (2018)	941	2618	1798	1040	167	91	259	219	304	3221	1438	747	1	9	38	6	3990	16889

- From 2012 to 2018, a total of 100 ha of cropland, pasture, and forest were converted to impervious ecosystem types (settlements and other artificial areas)
- 从 2012 年到 2018 年，共有 100 公顷的耕地、牧场和森林被转化为不透水的生态系统类型（定居点和其他人工区域）
- These conversions constituted 0.8 % of the total land extent in the ecosystem accounting area
- 这些转换占生态系统核算区土地总面积的 0.8%

Potential runoff retention ecosystem service under two scenarios: Change from 2012 to 2018

Ecosystem types: impervious ecosystem types (continuous and discontinuous urban fabric, commercial and industrial units, sport and leisure areas): +100 hectares (0.8 % of total accounting extent). Built areas in other ecosystem types also increase.

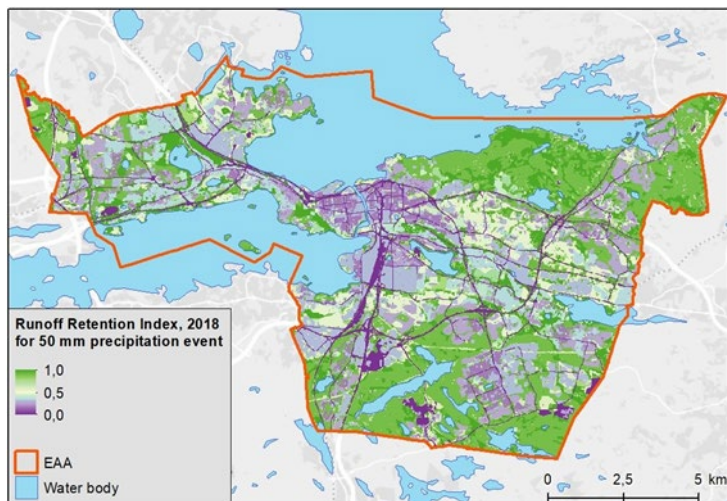
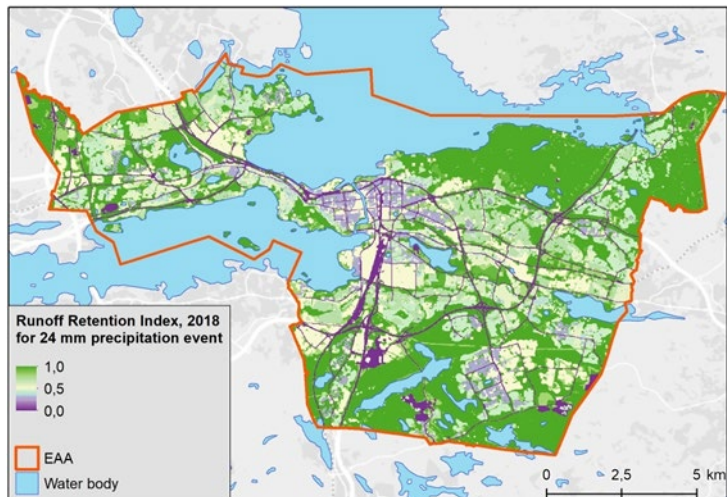


Scenario type	Rain event depth (mm)	Runoff volume change	Runoff retention volume change	Change of building areas that are not flooded if the flood event happens	Building areas benefiting from ES	ES value change	The change in potential damage cost if flood event happens
Ecosystem type change+ building area increase	24 (same as 2012)	1.50%	-0.30%	9.67%	6.03%	6.92%	6.14%
Ecosystem type change+Climate change + building area increase	50	254.50%	77.60%	-6.97%	6.03%	40.33%	231.02%

- Runoff retention ecosystem service's actual use increases due to some new building areas located in pervious ecosystem types
- In addition, the potential damage cost also increases
- The classification of impervious ecosystem types

两种情景下的潜在径流截留生态系统服务：2012 年至 2018 年的变化

生态系统类型：不透水生态系统类型（连续和不连续的城市结构、商业和工业单位、体育和休闲区）：+100 公顷（占总核算范围的 0.8%）。其他生态系统类型的建设面积也有所增加。



情景类型	降雨深度 (毫米)	径流量变化	径流滞留量变化	如果发生洪水事件, 不受洪水影响的建筑区域变化	受益于 ES 的建筑面积变化	ES 价值变化	发生洪灾时可能造成的损失变化
生态系统类型改变 + 筑区面增加	24 (与 2012 年相同)	1.50%	-0.30%	9.67%	6.03%	6.92%	6.14%
生态系统类型改变 + 筑区面增加 + 气候变化情景	50	254.50%	77.60%	-6.97%	6.03%	40.33%	231.02%

- 由于一些新建建筑位于透水生态系统类型中，因此径流截留生态系统服务的实际使用量有所增加
- 此外，潜在的损失成本也会增加
- 不透水生态系统类型的划分

Runoff retention ecosystem service supply and use account in 2012 (baseline rain event) and 2018 (climate scenario)

2012年(基准降雨事件)和2018年(气候情景)的径流截留生态系统服务供应和使用账户

	unit	Economic Unit				Economic Asset															total		
		Industrial Sectors	Commerical sectors	Household	Total	1.1 Continuous settlement area	1.2 Discontinuous settlement area	1.5 Commercial and industrial areas	1.3 Infrastructure	1.4 Parks	1.4 Summer cottages	1.4.2 Sports and recreation sites	2.1 Cropland and pasture	4.1 Broadleaved deciduous forest	4.2.1 Coniferous forest	4.4 Mixed forest	4.5.1 Transitional woodland/forestry	11.2.1 Coastal dunes, beaches and sandy and muddy shores	6.1.1 Bare rock	7.1.1 Inland marshes on mineral soil		7.2.1 Mires, bogs and fens	8.1.1 Rivers and lakes
2012 -24 mm scenario ES supply and use Table																							
Supply																							
Flood mitigation ES: Buidling area benefit from	m2					1,728,266	3,028,677	3,588,091	69,398	2,304	35,998	101,943	373	327	15,492	12,993	20,882	-	0	-	-	8,111	8,612,853
Value of flood mitgation ES	EUR					7,007,856	21,379,483	12,689,194	143,085	10,539	196,992	526,033	4,556	1,896	97,327	73,949	150,770	-	0	-	-	16,162	42,297,841
Use																							
Flood mitigation ES: Buidling area benefit from	m2	2,094,224	1,674,572	4,844,058	8,612,853																		
Value of flood mitgation ES	EUR	6,287,704	6,962,639	29,047,498	42,297,841																		
2018-50mm scenario ES supply and use Table																							
Supply																							
Flood mitigation ES: Buidling area benefit from	m2					1,853,214	3,176,858	3,744,531	75,553	3,884	36,185	119,430	3,258	2,571	21,005	25,875	61,471	-	0	-	-	8,192	9,132,027
Value of flood mitgation ES	EUR					9,267,511	29,564,402	17,121,699	197,434	41,803	343,047	889,002	84,485	80,754	320,243	285,341	1,131,686	-	0	-	-	27,287	59,354,695
Use																							
Flood mitigation ES: Buidling area benefit from	m2	2,176,324	1,782,245	5,173,457	9,132,027																		
Value of flood mitgation ES	EUR	8,362,673	9,658,515	41,333,506	59,354,695																		

The inpretation of the value: if the flood event is happen once per year, this is yearly value. If the flood event happen X time per year, the value need to multilply X. if the flood event happen every X year, the value need to divided by X.

In the supply table, the building area located at "Rivers and lakes" ecosystem types results from the resolution of ecosystem extent data. Theses buiding areas actually lcoated in other ecosystem types but very close to "Rivers and lakes"

Urban heat island mitigation ecosystem service accounts

城市热岛减缓生态系统服务账户

- We are piloting ecosystem services (ES) accounts selected by the participating municipalities, in both physical and monetary terms, aiming to expand the range of example ES accounts and to test the feasibility of methodologies within the Finnish municipal context.
- 基于参与市政当局的选择, 我们正在试行生态系统服务 (ES) 实物和货币账户, 目的是扩大生态系统服务账户实例的范围, 并在芬兰城市范围内测试方法的可行性。
- Shading and cooling provided by green areas are expected to become increasingly important as temperatures rise and the urban heat island (UHI) effect intensifies. Major consequences of UHI include increased energy consumption, deteriorating water and air quality, and associated environmental and public health challenges. UHI heightens the risk of heat-related mortality and morbidity by contributing to respiratory difficulties, heat cramps, exhaustion, and non-fatal heat strokes. Children, the elderly, and individuals with pre-existing health conditions are particularly vulnerable.
- 随着气温的升高和城市热岛效应 (UHI) 的加剧, 绿地提供的遮阳和降温功能预计将变得越来越重要。UHI 的主要后果包括能源消耗增加、水和空气质量恶化以及相关的环境和公共卫生挑战。UHI 会导致呼吸困难、热痉挛、疲惫和非致命性中暑, 从而增加与高温相关的死亡和发病风险。儿童、老人和已有健康问题的人尤其容易受到影响。

Urban heat island mitigation ecosystem service accounts

城市热岛减缓生态系统服务账户

- We are piloting the urban heat island mitigation service account in both Tampere and Espoo, as both cities have identified this ecosystem service as a priority under the pressures of climate change and rising temperatures. We quantify and map the cooling effects provided by green spaces, reviewing and selecting the most appropriate methods for mapping UHI mitigation by blue-green areas, considering data availability in the EA context. The creation of the physical account is conducted using GIS-based modeling.
- 我们正在坦佩雷和埃斯堡试行城市热岛缓解服务帐户，因为这两个城市都已将该生态系统服务确定为气候变化和气温上升压力下的优先事项。我们对绿地提供的降温效果进行量化并绘制地图，审查并选择最合适的方法绘制城市蓝绿区域的 UHI 缓解图，同时考虑到 EA 环境中的数据可用性。我们使用基于地理信息系统的建模方法创建了实物型账户。
- One method for monetarily valuing local climate regulation services is calculating the avoided energy costs. In the case of air-cooling ecosystem service, the valuation methods are associated with the reduction of impacts on human health during extreme weather events, particularly heat (NCAVES and MAIA, 2022). Thus, avoided healthcare costs represent a clear monetary valuation method.
- 对当地气候调节服务进行货币估值的一种方法是计算能避免的能源成本。就空气冷却生态系统服务而言，估值方法与减少极端天气事件（尤其是高温）对人类健康的影响相关（NCAVES 和 MAIA，2022 年）。因此，避免的医疗成本是一种明确可用的货币估值方法。
- Additionally, we conduct field temperature measurements in representative areas of urban green spaces, near water, and built-up zones—to validate the analysis results.
- 此外，我们在城市绿地、水域和建筑密集区的代表性区域进行了实地温度测量，以验证分析结果。



Recreational ecosystem services accounts

休闲生态系统服务账户

- Physical and monetary accounts for recreational ecosystem services are being developed for Pirkkala and Tampere. This was initially trialed in Pirkkala in a previous project. Recreational service usage data, along with the information required for monetary valuation, was collected through a voluntary GIS survey in Pirkkala in the summer of 2022, and this survey will be repeated. The ecosystem service supply data for the recreation account is determined in collaboration with the municipalities, based on their interest in specific ecosystem types (including all or selected ecosystem types).
- 为皮尔克卡拉和坦佩雷制定娱乐生态系统服务的实物和货币账户正在进行。此前的一个项目已在皮尔克卡拉进行了初步试验。2022 年夏季，通过在皮尔克卡拉进行自愿性的 GIS 调查，收集了娱乐服务使用流量的数据以及货币估值所需的信息，并将在当前项目中再次进行调查。娱乐账户的生态系统服务供应数据是根据合作的市政当局其对特定生态系统类型（包括所有或选定的生态系统类型）的兴趣决定的。
- Monetary ecosystem service accounts are quantified using the travel cost or time cost model for recreation, or the benefit transfer method. 生态系统服务货币账户采用旅行成本、娱乐时间成本模型或效益转移法进行量化。
- Physical and monetary accounts for urban runoff retention service were developed for Tampere in an earlier project. In the current project, all three ecosystem service accounts (runoff retention, urban heat island mitigation, and recreation) are examined together to refine results further and produce a combined valuation of ecosystems.
- 在早期项目中，为坦佩雷开发了城市径流滞留服务的实物型和货币账户。在当前项目中，所有三个生态系统服务账户（径流截留、城市热岛缓解和娱乐）都将一起进行研究，以进一步完善结果，并对生态系统进行综合估值

Ecosystem asset accounts 生态系统资产账户

- Ecosystems can be viewed as assets, meaning they are systems that can regenerate and provide services over time, depending on their health or condition (Hein et al., 2016). In the international SEEA EA, ecosystem assets are typically valued using the net present value of the expected future flow of ecosystem services.
- 生态系统可被视为资产，这意味着它们是可再生的系统，并可根据其健康或状况在一段时间内提供服务（Hein et al., 2016）。在国际 SEEA EA 中，生态系统资产通常使用预期未来生态系统服务的流量的净现值进行估值。
- A core aspect of asset accounting is tracking changes in asset value over a specific accounting period. Ecosystem degradation refers to a decline in the value of an ecosystem asset during this period, linked to a reduction in its condition (UN, 2021). Similarly, changes in asset value, due to factors like enhancement, degradation, or conversion, depend on how these changes affect expected future returns (UN, 2021).
- 资产核算的一个核心方面是追踪特定核算期内资产价值的变化。生态系统退化是指在此期间生态系统资产价值的下降，这与其状况的降低有关（UN, 2021）。相似地，由于增强、退化或转换等因素造成的资产价值变化取决于这些变化如何影响预期的未来回报（UN, 2021）。
- If the extent of an ecosystem asset stays constant over an accounting period, changes in the flow of ecosystem services might result from price fluctuations or changes in condition (either degradation or enhancement).
- 如果生态系统资产的范围在核算期内保持不变，那么生态系统服务流量的变化可能来自价格波动或状况变化（退化或增强）。
- The account records the opening and closing values for each ecosystem asset—calculated from the combined values of relevant ecosystem services—and shows the impacts of enhancement, degradation, conversions, re-evaluations, or other changes. 该账户记录每个生态系统资产的期初和期末价值（根据相关生态系统服务的综合价值计算得出），并显示增强、退化、转换、重估或其他变化的影响。

Our publications 我们的出版物

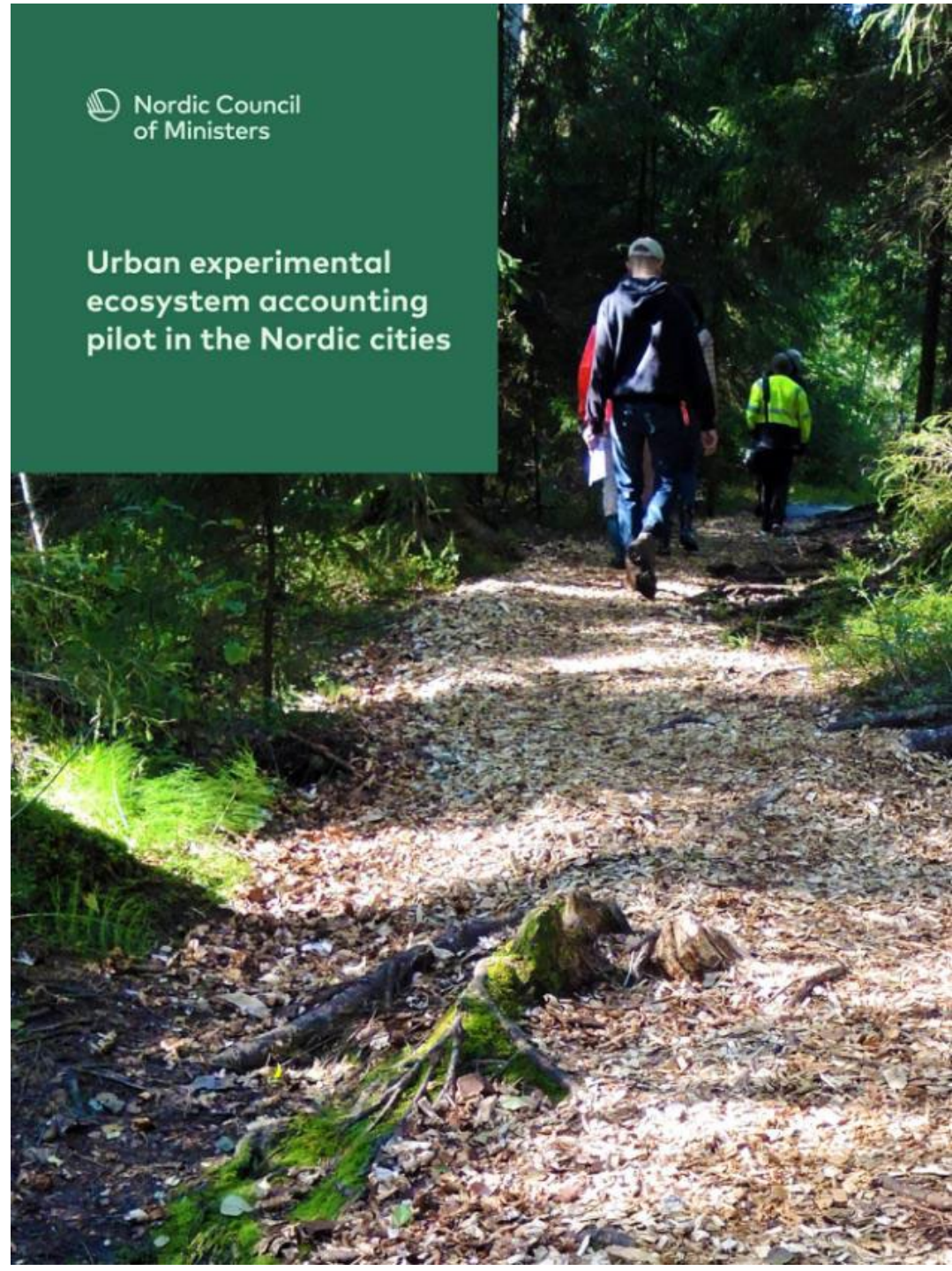
*Kopperoinen L, Barton DN, Costadone L, Hurskainen P, Kruse M, Lai T-J. 2022. Urban experimental ecosystem accounting pilot in the Nordic cities. **

- *Nordisk verktygslåda: <https://pub.norden.org/nord2022-025/>*
- *Ecosystem Accounting Pilot: <https://pub.norden.org/temanord2022-557/>*

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*<https://doi.org/10.1016/j.ecoser.2023.101576> **

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