



Mapping Natural Assets and Urban Resilience:

Canada's experience with cadastre integration for ecological infrastructure management

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International Workshop

Technical Assistance for Cadastre Integration,
Natural Resources Valuation And Resilient Planning In Cities
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Content 目录

1. General context of natural resources and urbanization in Canada
2. The importance of ecosystem services and assets
3. Review common approaches to value them
4. Provide examples of implementation by municipalities
5. Propose a way forward to systematize the management of cadastral-type information.

1. 加拿大自然资源和城市化的整体背景
2. 生态系统服务和资产的重要性
3. 常见的估值方法回顾
4. 市政当局的实施范例
5. 地籍类型信息管理系统化的前进方向。



Introduction 导言

- Canada's natural resource wealth and urban planning context:
- 加拿大的自然资源财富和城市规划背景:
 - Canada's economy is dependent on its national resource wealth.
加拿大的经济依赖于国家资源财富
 - Canada's cities and towns tend to sprawl and remain low-density.
加拿大的城镇趋于无序扩张，但密度较低
- Integrating cadastral data with natural asset valuation is necessary for sustainable urban planning
- 将地籍数据与自然资产评估相结合是可持续城市规划的必要条件
- Arguably, this is a role for the environmental-economic accounting
- 可以说，这是环境经济核算的作用:
 - Land accounts are a gateway to spatial planning
 - 土地核算是空间规划的入口。
 - Ecosystem accounts, being spatially explicit, are required to track ecological assets
 - 生态系统账户若想要追踪生态资产，那它必须具有空间明确性。



Footprint of contiguously settled areas

18,435 km²
2020

+465 km²
Since 2010

Role of ecosystem accounting in spatial planning

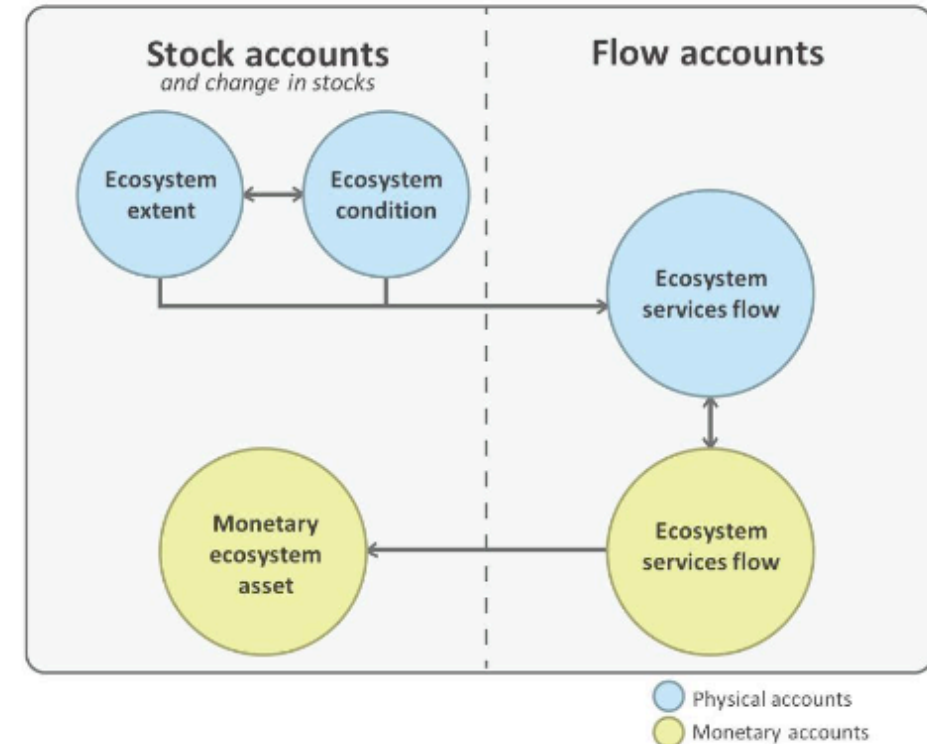
空间规划在整合自然资源方面的作用

The development of environmental-economic accounts and the mapping of ecosystem assets may offer municipalities a tool for spatial mapping and valuing natural assets.

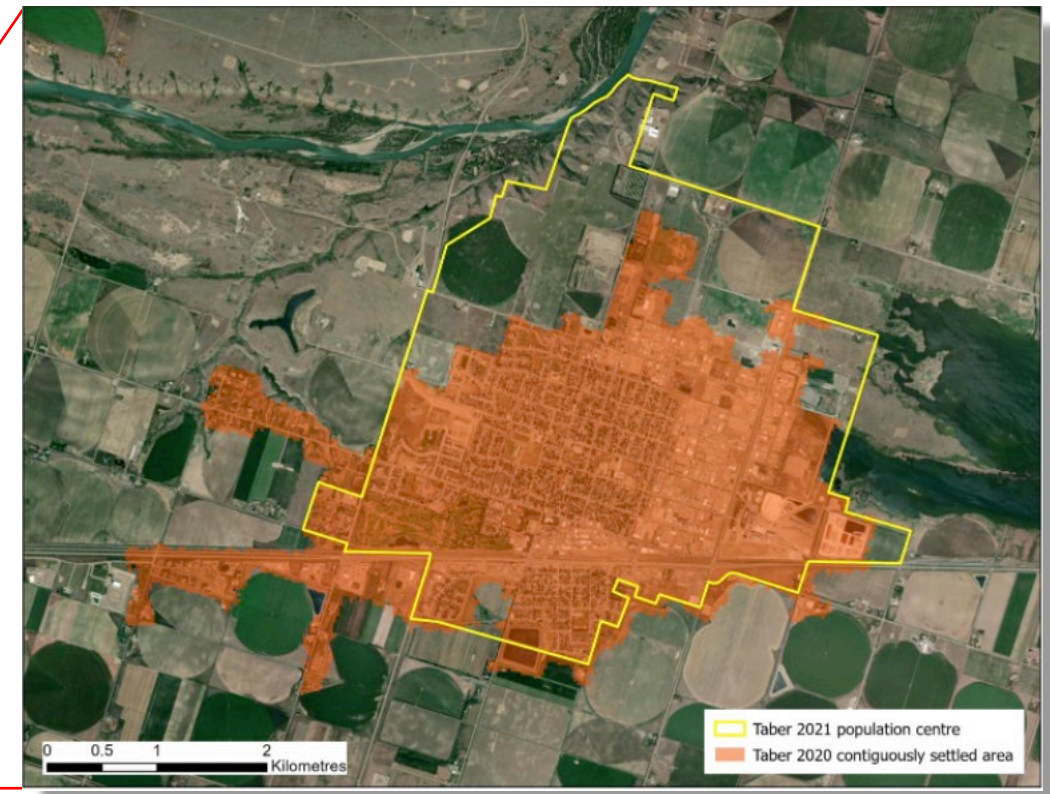
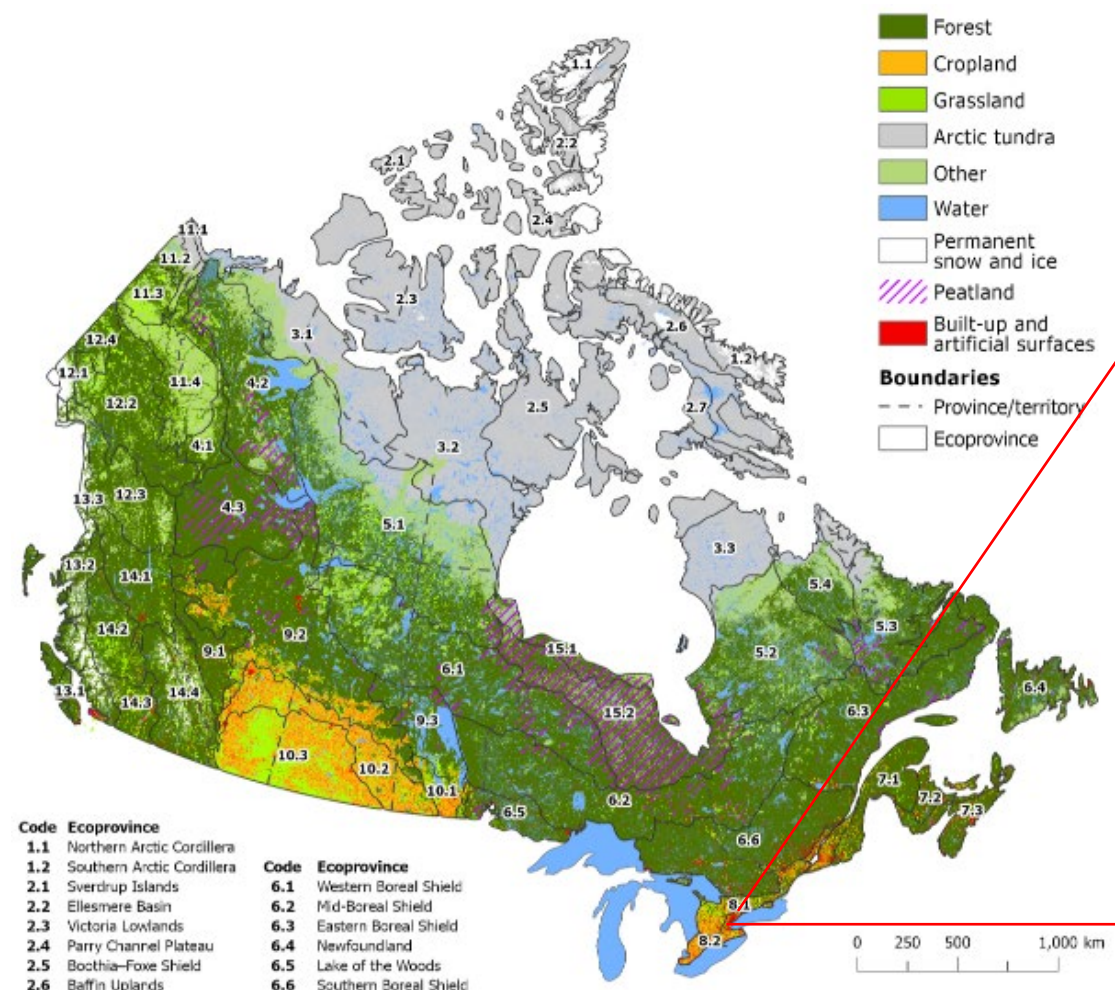
编制环境经济账户和绘制生态系统资产图作为市政当局用于绘制自然资源的空间图并对其进行估值的工具。

- Ecosystem accounting provides a structured framework for incorporating ecological data into spatial planning.
- 生态系统核算为将生态数据纳入空间规划提供了一个结构化框架。
- By quantifying both the monetary and non-monetary value of natural assets, ecosystem accounting can help planners balance economic development with environmental conservation.
- 通过量化自然资源的货币和非货币价值，生态系统核算可帮助规划者平衡经济发展与环境保护。

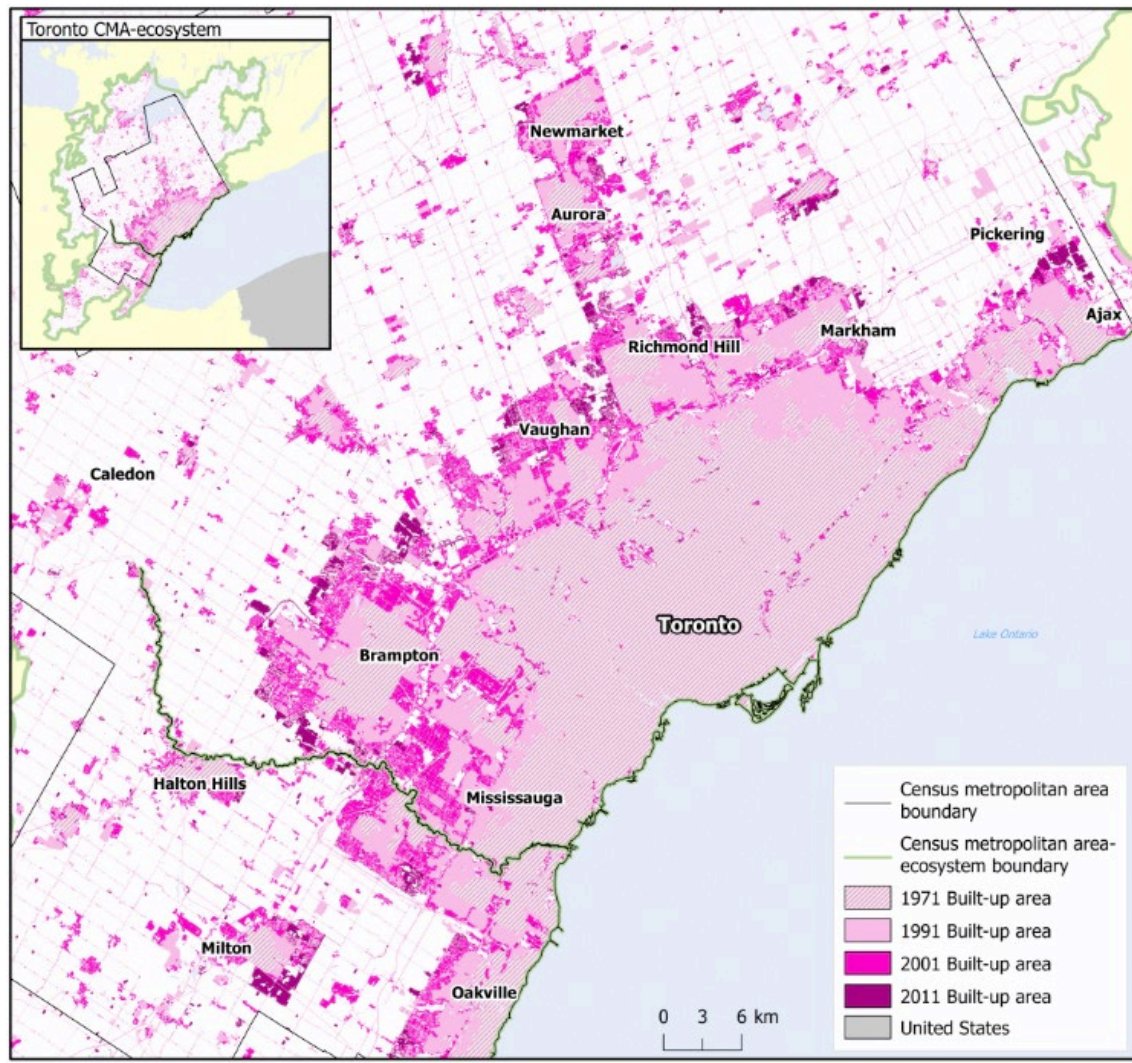
Figure 2.2: Connections between the ecosystem accounts



Role of land and ecosystem accounting in spatial planning 土地和生态系统核算在空间规划中的作用

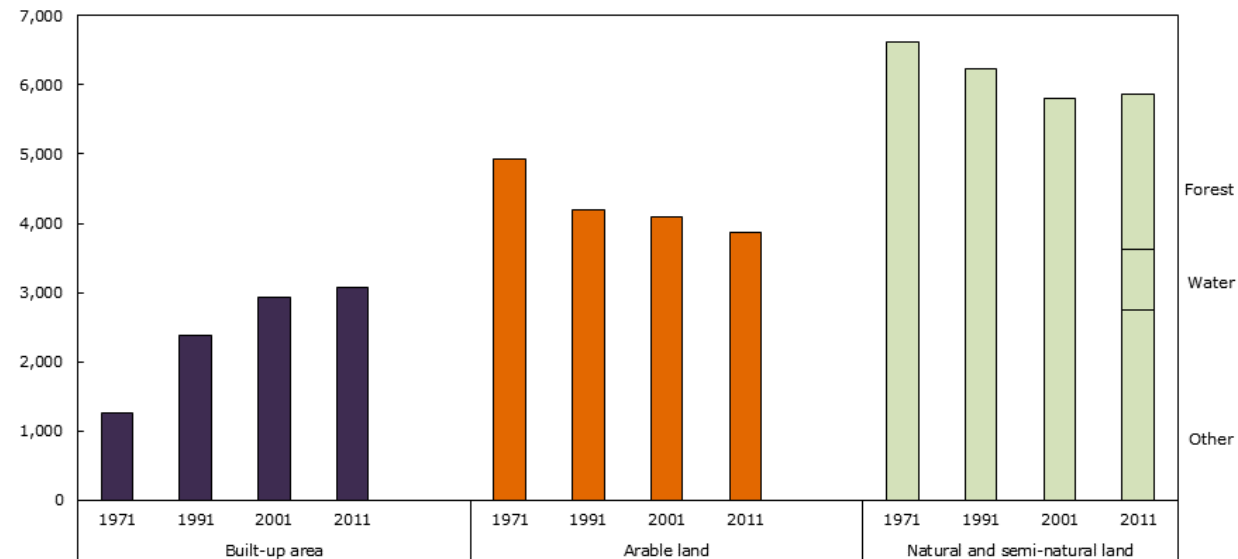


Role of land and ecosystem accounting in spatial planning 土地和生态系统核算在空间规划中的作用



Land cover and land use, Toronto census metropolitan area-ecosystem (CMA-E), 1971, 1991, 2001 and 2011

square kilometres



	Total built-up area ¹		Arable ²	Natural and semi-natural ³
	Settled	Roads	square kilometres	
	Opening stock 1971	850	418	4,930
Land lost to settled area	-961	-448
Balance of change ⁴	1,409	403	-102	-300
Closing stock 2011	2,260	821	3,867	5,866
... not applicable				

Natural Resource Valuation 自然资源评估

Monetary Valuation Approaches 货币估值方法:

- 1. Market Pricing:** Uses existing market prices to value assets and services that are bought and sold.
市场定价: 利用现有市场价格对买卖的资产和服务进行估值
- 2. Cost-Based Methods:** Includes replacement cost, mitigation cost, and damage cost avoided methods.
基于成本的方法: 包括重置成本法、减轻损失成本法和避免损失成本法。
- 3. Revealed Preference Methods:** Such as hedonic pricing and travel cost method, which infer values based on people's behavior
揭示偏好法: 如特征价格法和旅行成本法, 根据人们的行为推断价值
- 4. Stated Preference Methods:** Includes contingent valuation and choice modeling, which use surveys to ask people their willingness to pay for specific ecosystem services.
陈述偏好法: 包括或有估值和选择建模, 这种估值方法利用调查询问人们为特定生态系统服务付费的意愿。

Non-Monetary Valuation 非货币估值:

- 1. Qualitative Assessments:** Involves stakeholder consultations, expert judgment, and participatory approaches.
定性评估: 涉及利益相关者咨询、专家判断和参与式方法。
- 2. Quantitative Indicators:** Uses biophysical indicators like biodiversity indices, water quality measures, and habitat condition assessments.
定量指标: 使用生物物理指标, 如生物多样性指数、水质测量和栖息地状况评估。
- 3. Multi-Criteria Analysis:** Combines various criteria, both qualitative and quantitative, to assess ecosystem services.
多重标准分析: 结合各种定性和定量标准来评估生态系统服务。

Natural resource valuation applied to municipal planning in Canada 将自然资源估值应用于加拿大市政规划

• Municipal Natural Asset Initiative (MNAI)

- Supports municipalities in incorporating **natural assets** into asset management frameworks.
- Focuses on **valuing natural assets** like forests, wetlands, and rivers for their role in **infrastructure services**, such as stormwater management and flood mitigation.
- Helps local governments recognize the **financial value** of ecosystem services, promoting sustainable urban planning.

• 市政自然资产倡议 (MNAI)

- 支持市政当局将**自然资产**纳入资产管理框架。
- 重点**评估**林地、湿地和河流等**自然资产在基础设施服务**（如雨水管理和洪水缓解）中的作用。
- 帮助地方政府认识到生态系统服务的**经济价值**，促进可持续城市规划。

• CSA Standard W218:23 for Natural Asset Inventories:

- Aims to establish a **national standard** for cataloging natural assets in urban planning.
- Facilitates the **inventory and valuation** of natural assets by standardizing methodologies.
- Supports **integration** with municipal infrastructure planning, enhancing the understanding of natural assets' contributions to economic resilience and environmental health.

• 加拿大标准协会 (CSA) 自然资产清单标准 W218:23:

- 旨在为城市规划中的自然资产编目制定**国家标准**。
- 通过标准化方法促进自然资产的**清查和估值**。
- 支持与市政基础设施规划**相结合**，提高人们对自然资产对经济韧性和环境健康所作贡献的认识。

Examples of Municipal Natural Asset Management

市政自然资源管理的范例

- **Town of Gibsons, BC 不列颠哥伦比亚省吉布森斯镇**

- First municipality in Canada to recognize natural assets in financial planning
- 加拿大首个在财务规划中承认自然资源的城市
- One of Gibsons' most important natural assets is the Gibsons Aquifer
- 吉布森斯最重要的自然资源之一是吉布森斯的含水层

- **Nanaimo, BC 不列颠哥伦比亚省纳奈莫**

- Nanaimo uses the Corporate Asset Management System to map, track, and manage the city's assets, including natural assets.
- 纳奈莫市使用企业资产管理系统来绘制、跟踪和管理城市资产，包括自然资源。
- Ex.: Buttertubs Marsh Conservation Area (BMCA), which has been valued for its role in stormwater management and other ecosystem services.
- 例如：Buttertubs 沼泽保护区 (BMCA)，该保护区因其在雨水管理和其他生态系统服务方面的作用而受到重视。

Examples of Municipal Natural Asset Management

市政自然资源管理的范例

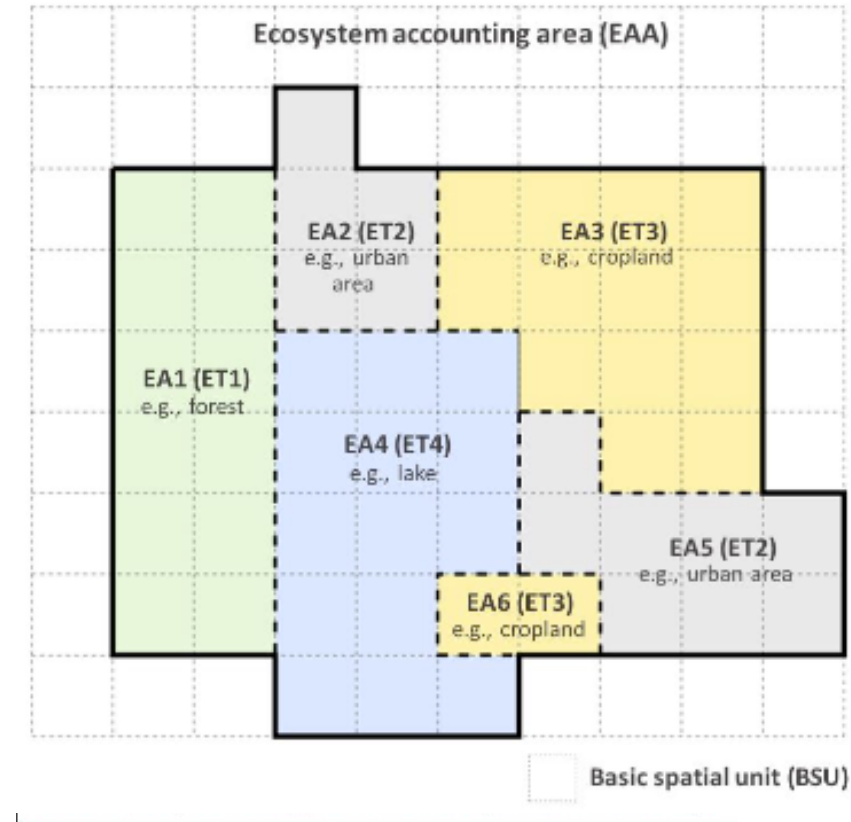
- **Saskatoon, MB 萨斯卡通**

- Saskatoon has developed a Natural Asset Management Framework to guide its efforts in managing natural assets
- 萨斯卡通制定了自然资源管理框架，并用该框架指导其管理自然资源的工作
- Ecosystem services are valued at \$48.2M per year
- 生态系统服务的价值为每年 4820 万美元

From the municipal to the national: A statistical accounting approach 从城市到国家：统计核算方法

- There is a need to link this local spatial information to national economic statistics
- 将这些地方空间信息与国家经济统计数据联系起来是必要的
- The process do to so is now an international statistical standard: The SEEA-EA
- 这个过程现已成为一项国际统计标准：环境经济核算体系-生态系统核算 (SEEA-EA)
- At the core of the SEEA-EA, the Basic Spatial Unit (BSU) SEEA-EA 的核心是基本空间单元 (BSU)
 - A BSU is a small, defined spatial area used in a GIS, that represents a specific type of land cover or ecosystem type
 - BSU 是地理信息系统中使用的一小块确定的空间区域，代表特定类型的土地覆被或生态系统类型
 - Allows to track ecosystem assets, and support the modelling of ecosystem services
 - 可追踪生态系统资产，支持生态系统服务建模

Figure 3.4: Applying a grid based BSU to delineate EA





Case Study: A National Register of Ecosystem Assets

案例研究：国家生态系统资产登记册

Reference :Jonathan Whiteley, François Soulard, 2022, "A Register of Ecosystem Assets for Canada", Statistics Canada, paper presented to the 28th meeting of the London Group on Environmental Accounting, <https://seea.un.org/events/london-group-environmental-accounting-28th-meeting>

Statistics Canada is creating a **Register of Ecosystem Assets (REA)**

加拿大统计局正在创建**生态系统资产登记册 (REA)**

1. Support the integration of multiple variables for the same Basic Spatial Units.
支持整合同一基本空间单元的多个变量。
2. Allow the aggregation by standard and non-standard geographies at a range of scales
允许在一系列范围内按标准和非标准地域进行汇总
3. Provide authoritative delineation of ecosystem assets for the purpose of compiling ecosystem accounts
为编制生态系统账户提供权威的生态系统资产划界



Case Study: A National Register of Ecosystem Assets

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- **The REA should have the following core elements REA应包括以下核心要素:**
 1. A standard spatially-referenced grid covering all of Canada (incl. marine areas)
覆盖加拿大全境（包括海洋区域）的标准空间参照网格
 2. Each grid cell linked to standard geographical units used for dissemination by the NSO
每个网格单元都与NSO发布的的标准地理单元相关联
 3. Each grid cell is assigned to an ecosystem type, according to a standard classification.
根据标准分类法，每个网格单元都被归入一种生态系统类型

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Cell = Basic Spatial Unit (BSU)

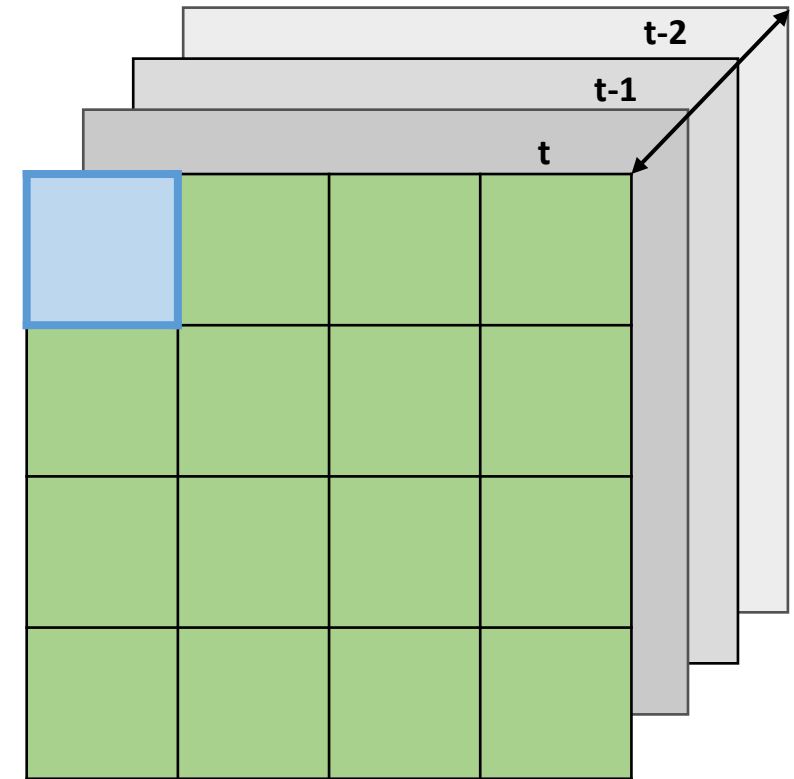
单元 = 基本空间单元 (BSU)

1. Basic attributes 基本属性:
 - Unique ID 唯一 ID
 - Position (e.g., centroid) 位置 (如中心点)
 - Dimensions (size) 尺寸 (大小)
2. Geography IDs (lowest level in hierarchies)

地理标识 (层次结构中的最低一级)

 - Standard Census of population geographies 标准人口地理普查
 - Ecological land classification(s) 生态用地分类
 - Drainage area classification(s) 排水区分类
 - Marine bioregions (TBD) 海洋生物区 (待定)
 - Others. 其他
3. **Ecosystem Type 生态系统类型**

Time 时间



Space 空间

GEO_ID	Latitude	Longitude	Size
0001			
0002			

Ecosystem Table

GEO_ID	Date	ECO_ID / Depth	Ecosystem Type	...
0001	2016			
0001	2021			
0002				
0002				

Geography Table(s)

ID	Date	SGC	DR	ELC	Marine	...
0001	2016					
0001	2021					
0002	2016					
0002	2021					

Conclusion 结论

• Challenges with Cadastral Systems in Canada 加拿大地籍系统面临的挑战

- Cadasters in Canada are limited and fragmented, especially in terms of their coverage of natural resources and ecosystems.
- 加拿大的土地清册有限且分散，尤其是在自然资源和生态系统的方面。
- This restricts their use in comprehensive natural resource valuation and management, particularly within urban areas.
- 这限制了它们在自然资源综合评估和管理中的应用，尤其是在城市地区

• Challenges with the Register of Ecosystem Assets 生态系统资产登记册面临的挑战

- Tracking ecological data over the entirety of Canada is challenging
- 跟踪整个加拿大的生态数据具有挑战性
- Producing time series of changes in assets is an added difficulty
- 制作资产变化的时间序列使得难度加大。

• Valuation Issues 估值问题

- Difficulty in quantifying intangible ecosystem services and therefore assets
- 难以量化无形生态系统服务，因此难以量化其资产。

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Thank you
for you
attention

谢谢