Article title: Publicly available data sources to compile an urban natural capital account according to the SEEA EEA: A London case study
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Professor Dan Osborn, Editor-In-Chief,
UCL Open: Environment

28th August 2020

Re. Submission of manuscript, 'Publicly available data sources to compile an urban natural capital account according to the SEEA EEA: A London case study'.

Dear Prof Dan Osborn,

We are writing to submit our manuscript, 'Publicly available data sources to compile an urban natural capital account according to the SEEA EEA: A London case study', by Emily Northridge, Mikaël J. A. Maes and Ben Milligan for consideration for publication in *UCL Open: Environment*. Our manuscript explores whether existing publicly available data sources on London's natural capital are sufficient to compile an inclusive natural capital account according to the United Nations System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA EEA) framework. This is particularly relevant as more and more organisations seek to develop standardised environmental accounts to encourage sustainable land use choices and improve management of the natural environment and associated benefits, including in urban areas such as London.

In light of this attention, our manuscript is one of the first systematic assessments of publicly available data sources relevant for natural capital accounting in London, United Kingdom. We critically analysed publicly available data sources and found at least 66 data sources relevant for compiling an urban natural capital account for London. However, our analysis also showed that it was not possible to compile an inclusive natural capital account for London for each year consistent according to the SEEA EEA framework. This was mainly because of issues related to temporal inconsistencies, land cover classifications and key non-publicly available data sources. Our paper highlights the need for renewed collaboration across disciplines and sectors to develop better publicly available data sources underpinned by a cohesive classification framework for urban areas.

We confirm that this manuscript has not been previously published elsewhere and is not under consideration by any other journal. All authors have approved this manuscript and agree with its submission to *UCL Open: Environment*. We look forward to hearing from you soon.

Yours sincerely,

Ms Emily Northridge, Mr Mikaël J. A. Maes and Dr Ben Milligan

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Publicly available data sources to compile an urban natural capital account according to the SEEA EEA: A London case study

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ABSTRACT

Government organisations and other public sector bodies are compiling standardised environmental accounts to encourage more sustainable land use choices and improve management of the natural environment and associated benefits. While the United Nations System of Environmental-Economic Accounting Experimental Ecosystem accounting (SEEA EEA) provides such as framework, practical challenges remain in particular decision-making contexts. In urban areas, natural ecosystems have unique challenges because of anthropogenic pressures, providing a mix of ecosystem services (ES) that may be valued differently compared to non-urban natural ecosystems due to people's proximity to these. It is unknown whether existing publicly available data sources for urban areas are compatible with the SEEA EEA framework and if these sources are sufficient for the development of an inclusive natural capital accounts. Here, we explore whether an inclusive urban natural capital account that includes a broad range of ES can be compiled from publicly available data sources for Greater London between 2007 and 2018. We showed that it was not possible to compile an inclusive urban natural capital account for London per year consistent with the SEEA EEA framework because of issues with (1) temporal inconsistencies, (2) land cover classifications and (3) lack of public access to certain data sources. Greater collaboration between institutions and other organisations could support our understanding of linkages between ecosystem extent, condition and ES flows. Overall, our findings suggest the need for renewed efforts to develop a cohesive source of publicly available data, which could be supported by making interdisciplinary work standard practise.

Keywords: Natural capital, environmental accounting, ecosystem accounting, ecosystem services, urban, London, United Kingdom, SEEA, SEEA EEA

1 INTRODUCTION

Natural capital describes those parts of the natural environment that are capable of contributing to human health and well-being (Natural Capital Committee [NCC], 2013). The benefits that flow from natural capital assets are known as ecosystem services (ES) and are classified into three distinct categories, i.e. (1) provisioning services which include all physical products that we take from the environment, (2) regulating services which maintain environmental processes and sustain the biophysical environment, and (3) cultural services which are the non-material amenities that people gain from interacting with ecosystems (Haines-Young and Potschin, 2018). Some sources recognise a fourth ES category, i.e. supporting services which are defined as the services that maintain earth's conditions so that all other ES can flow (Millenium Ecosystem Assessment [MEA], 2005). Degradation of nature—on which society and the economy as a whole depends upon—in favour of land uses which produce marketable goods has resulting in a 60% decline in ES productivity compared to 50 years ago (MEA, 2005). Identifying the value that natural capital gives to a country is crucial to understand its contributions to human health and well-being and preventing further losses (Stiglitz et al., 2010).

Global commitments are being made by decision-makers to include the value of natural capital into (inter)national accounting practices and GDP calculations—for example, United Nations (UN) Sustainable Develop Goal Targets 15.9 and 17.19 and Aichi Biodiversity Target 2 (CBD, 2010; UN, 2015). The European Union's Biodiversity Strategy posits to 'integrate ecosystems and their services into national and EU accounting and reporting systems' (EC, 2011), and the United Kingdom's (UK) 25 Year Environment Plan states to use 'natural capital approaches to help encourage better uptake of natural capital reporting, standards and accounting across government and business' (Department for Environment, Food & Rural Affairs [Defra], 2018). On a city level, the Greater London Authority (GLA) made commitments to 'promote a natural capital accounting framework for London' (GLA, 2018). Although institutional commitments have been made to account for natural capital across all levels of governance, accounting for the ES flowing from natural capital in terms of national wealth is so far not globally practised.

The UN collaborated with national statistical offices and a wide range of other organisations to develop a statistical framework for valuing natural resources and land in a way that is compatible with the System of National Accounts (SNA). The System of Environmental-Economic Accounting Central Framework (SEEA CF) is a statistical framework that sets standardised concepts, definitions, classifications and accounting rules to enable countries to produce transnationally comparable statistics on their environmental-economic system (UN, 2014a). However, the contribution of most regulating and cultural ES, as well as certain provisioning ES, are currently unrecognised within the SEEA CF. The System of Environmental-Economic Accounting Experimental Ecosystem Accounting framework (SEEA EEA) presented efforts to account for the complete environmental-economic system (UN, 2014b) and is compatible with the structure of the SEEA CF. It enables decision-makers to better understand the value of their natural capital assets and improve decision-making beyond environmental policies (Vardon et al., 2017). So far, more than 24 countries have compiled SEEA EEA accounts, even though all vary in scope and resolution (Hein et al., 2020). Meanwhile, experts engaged in extensive discussions and testing of concepts to further advance the SEEA EEA, and a revised SEEA EEA is expected to be completed in 2021 (UN, 2020, 2019).

The UK Office for National Statistics (ONS) has worked with Defra, using the SEEA EEA framework, to develop accounts for the value of urban natural capital assets. This has resulted in a growing range of work focusing on understanding the value of urban natural capital in the UK (EFTEC, 2017; ONS, 2019; Vivid Economics, 2017). These urban environmental accounts are useful for understanding the value of urban natural capital. However not all were compiled in a way consistent with the SEEA EEA framework. Here, we explore whether it is possible to (1) compile an urban natural capital account according to the SEEA EEA framework from publicly available data sources for London and (2) use of the SEEA EEA framework to capture the value of individual ecosystem assets at a reasonable spatial granularity in an urban context.

2 METHODS

We identified publicly available data sources relevant to compile an urban natural capital account according to SEEA EEA through reports and studies using the Google Scholar search engine and government open data records. The ecosystem accounting area considered in this analysis is Greater London (UK), which is defined here as the 32 London boroughs and the City of London. We contacted experts and organisations that deal with environmental data sources or have expertise in environmental accounting for input; we specifically contacted Defra, Geofabrik, Greenspace Information for Greater London (GiGL), the Ordnance Survey (OS), Sustain and Thames Water. We only included publicly available data sources if these sources were published between 2007 and 2018. We did not seek to make a definitive statement on the number of publicly available data sources, because there are privately-owned data sources that might be available after usage is granted by the data owner. We also included publicly available data sources with only partial spatial or temporal cover for Greater London and gathered information for each mapped data source, if applicable, on authorship, update frequency, spatial extent, unit or resolution, data format (e.g. raster, vector format), licensing or usage restrictions and historic data availability (ESM Appendix, Table 1 and 2).

2.1 ECOSYSTEM EXTENT

Land cover classifications described in the SEEA CF and SEEA EEA bring about issues when developing an urban natural capital account. For example, the land cover class ‘artificial surfaces’ is useful when assessing urban areas on a national and international scale; however, this land cover class may not useful when developing a natural capital account on an urban scale because it may exclude smaller green spaces. The land cover classifications from the SEEA CF and SEEA EEA were either (1) too detailed for use as a land cover classification in an urban context or (2) not applicable to the area of Greater London (e.g. mangroves). The SEEA framework aims to be comprehensive, meaning it accounts for all land cover classifications within the ecosystem accounting area. Considering the issues with land cover classifications from the SEEA CF and SEEA EEA in an urban context, we therefore used the land cover classifications from these frameworks to develop a simplified urban land cover classification (Figure 1) (UN, 2014a, 2014b). We excluded the following land cover classes from our analysis: barren land, coastal water bodies, mangroves, permanent snow and glaciers, sea and sparsely vegetated areas. We also added two land cover classes specifically for data sources without identifiable land covers (i.e. unspecified green and blue space) (Figure 1). This is consistent with suggestions from SEEA experts to define urban land cover based on (1) natural and semi-natural land covers which more or less retain natural features and (2) urban green and blue land covers which are embedded in the built-up urban area and are significantly altered or managed to be

classified as a natural or semi-natural land cover (Wang et al., 2019). Finally, we identified all publicly available data sources that provide spatially explicit land covers based on our urban land cover classification per year. We classified data sources which did not specify a year when created in our results as unclassified (U).

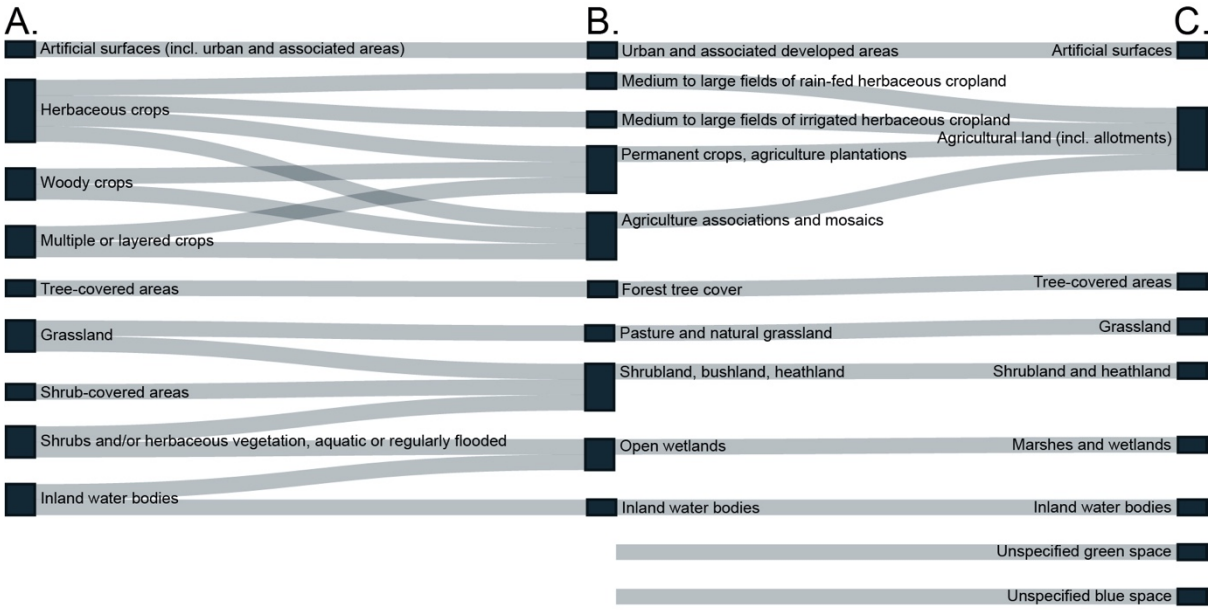

Figure 1. Connecting different land cover classifications. Overview and connections between the (A) land cover classification based on the System of Environmental-Economic Accounting Central Framework (SEEA CF), (B) land cover/ecosystem functional unit classes from the System of Environmental-Economic Accounting Experimental Ecosystem Accounting and (C) our simplified urban land cover classification (UN, 2014a, 2014b). Our urban land cover classification did not include the following land cover classes: barren land, coastal water bodies, mangroves, permanent snow and glaciers, sea and sparsely vegetated areas. We also specified two land cover classes specifically for data sources without identifiable land covers (i.e. unspecified green and blue space).

2.2 ECOSYSTEM CONDITION

Although not the only definition, ecosystem condition is broadly defined as the capacity of ecosystems to provide ES (UN, 2014a, 2014b). We identified data sources relevant to ecosystem condition by assessing which ecosystem condition is applicable per year. We classified data sources which did not specify a year when created in our results as unclassified (U). We included publicly available imagery from satellites because this data type can be used for assessing ecosystem extent and condition. Specific wavelengths of satellite imagery, for example, can be used to calculate vegetation indices such as the Normalised Difference Vegetation Index (NDVI). NDVI is based on the process where healthy vegetation absorbs more light in the photosynthetically active region compared to degraded vegetation or non-vegetated area and is therefore a proxy for measuring ecological extent and condition of unspecified green space (Kriegler et al., 1969). Specifically, it can be used to assess vegetation productivity, and in combination with surface land temperature to develop soil moisture indicators (Han et al., 2010; Pettorelli et al., 2005).

2.3 ECOSYSTEM SERVICE FLOWS

We identified publicly available data sources relevant to estimating ES flow from natural capital assets and what ES class it belonged to (i.e. provisioning, regulating or cultural ES). We based classification of ES flows on the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2018). As we do not seek to make a definitive statement of which ES based on CICES are

relevant to urban natural capital accounts, a single publicly available data source was considered sufficient to indicate the possibility to assess a particular ES flow. Several reports have developed urban natural capital accounts in London and the UK (EFTEC, 2017; ONS, 2019; Vivid Economics, 2017a). However, these reports only focus on a limited number of ES flows and do not include the complete list of ES according to CICES. We simply added those ES for which we found publicly available data sources, but we acknowledge that other ES may be relevant to develop an inclusive urban natural capital account. We also did not explore the potential for modelling and other analytical techniques to provide ES unit values and factors.

2.4 URBAN NATURAL CAPITAL ACCOUNTS FOR LONDON

We developed a matrix linking ecosystem extent and condition with ES flows based on similar approach in a scoping study to develop an urban natural capital account for the whole of the UK (ESM Appendix, Table 3) (EFTEC, 2017). This matrix then formed the basis for assessing the possibility to develop an urban natural capital account for London per year.

3 RESULTS

Our analysis found 66 publicly available data sources relevant to compile an urban natural capital account for London based on the SEEA EEA framework. Of these, 29 data sources were relevant to ecosystem extent, 23 to ecosystem condition and 16 to ES flows.

3.1 ECOSYSTEM EXTENT

Our results showed that it is possible to measure ecosystem extent for all 7 land cover classes per year (Figure 2A). However, the overall number of data sources per land cover class was low. A high number of identified data sources did not specify a particular land cover class and were therefore classified as unspecified green or blue space. In addition, certain data sources seemed useful for determining ecosystem extent at first but are not useful after detailed analysis. For example, the global land cover maps from the European Space Agency (ESA) Climate Change Initiative (CCI) identified all 7 land cover classes for all years between 2007 and 2018 (ESA, 2017). However, the coarse spatial resolution (300 m per pixel) of this data source makes it extremely granular for urban ecosystem accounting in Greater London and a large part of London was classified as urban area. Meanwhile, the Land Cover Map released by the UK Centre for Ecology & Hydrology had a detailed land cover classification, but a poor temporal availability (i.e. a land cover classification for the years 2007 and 2015) (CEH, 2017). We therefore identified several data sources with high-quality spatial resolution but low-quality time series to assess ecosystem extent, while one data source had a high-quality time series but a low-quality spatial resolution (Figure 2B).

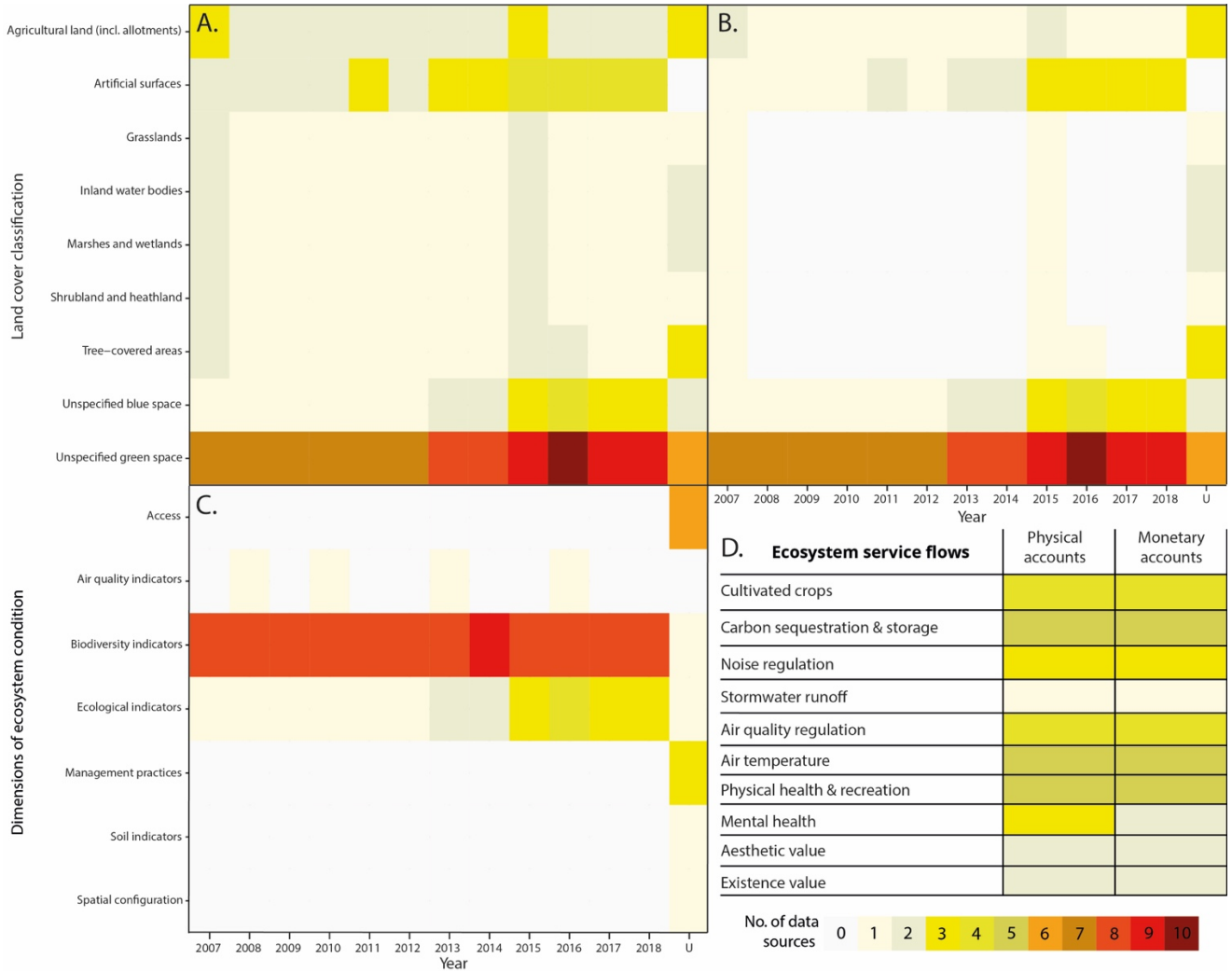

Figure 2. Amount of publicly available data sources on ecosystem extent, condition and ecosystem service flows per year. All identified publicly available data sources for (A) ecosystem extent, (B) ecosystem extent excluding land cover maps from the European Space Agency Climate Change Initiative (ESA, 2017), (C) broad dimensions of ecosystem condition and (D) ecosystem service flows in biophysical and monetary terms. Data sources without an identifiable year were marked as unclassified or 'U'. Data sources without an identifiable urban land cover classification were classified as 'unspecified green space' or 'unspecified blue space'.

3.2 ECOSYSTEM CONDITION

We identified only two broad dimensions of ecosystem condition that can be assessed on a yearly basis based on the identified data sources, i.e. biodiversity indicators and ecological condition (Figure 2C). We also identified that air quality indicators could be assessed for several years (i.e. 2008, 2010, 2013 and 2016) through a single data source called the London Atmospheric Emissions Inventory. All other data sources on ecosystem condition were found to have no identifiable year. However, some experts argue that particular ecosystem extent and conditions indicators may not change that often—particularly in urban areas—suggesting these could be used for multiple years. Some data sources also seemed useful for determining particular indicators of ecosystem condition but were considered less useful after detailed analysis. For example, a large part of the point and polygon species records from GIGL were collected before 2007, and sightings between 2007 and 2018 were often based on observations from volunteers, resulting in varying record counts between London boroughs (GIGL, 2017).

3.3 ECOSYSTEM SERVICE FLOWS

We identified 4, 8 and 9 publicly available data sources relevant to develop provisioning, regulating and cultural ES, respectively (Figure 2D). We found substantially more regulating and cultural ES compared to provisioning ES, which may suggest urban ecosystems are much less important for delivering direct benefits to human health and well-being such as biotic and abiotic goods (e.g. biomass and water), and are more important for delivering indirect benefits to human health and well-being (e.g. noise regulation, air temperature, physical or mental health).

3.4 URBAN NATURAL CAPITAL ACCOUNTS FOR LONDON

By combining all publicly available data sources that identify ecosystem extent, condition and ES flows, we found that it is not possible to develop a physical or monetary natural capital accounts for London for each year between the years 2007 and 2018. However, it was possible to develop a limited urban natural capital account when the year remained unspecified. Although this does not adhere to the strict definition for developing an inclusive natural capital account for London, use of publicly available data on ecosystem extent, ecosystem condition and ES flow with no specified year does enable the development of a limited natural capital account as previous studies have done (EFTEC, 2017; Vivid Economics, 2017a).

4 DISCUSSION

Our results were a first attempt to explore whether the development of an urban natural capital account for London was feasible. Our results showed that it was not possible to compile an inclusive natural capital account for London according to the SEEA EEA framework. We did not find publicly available data for key provisioning, regulating and cultural ES, while we found no data for certain years between 2007 and 2018, indicating that currently only a natural capital account with limited scope and time-coverage was possible. Our paper also highlighted 7 mutually exclusive urban land covers that could be used to create an urban natural capital account for London (excluding unspecified green and blue space). Certain urban land covers are heterogeneous and intensively managed, and therefore these natural or semi-natural land covers might not always be easily categorised into a particular land cover. For example, engineered or designed natural assets such as green roofs and walls can be a mosaic of vegetated and impervious land covers, and are better classified as unspecified green or blue

space as suggested by SEEA experts (Wang et al., 2019). Overall, our results highlighted that a considerable effort is needed to (1) address data gaps on ecosystem extent, condition and ES flows, and (2) improve our understanding of the linkages between ecosystem extent, condition and ES flows as discussed in section 4.1 and 4.2.

4.1 DATA GAPS

Institutions and other organisations need to make a concerted effort to address the data gaps found in this paper. Without addressing these needs, it will remain problematic to develop an urban natural capital account for London according to the SEEA EEA framework. We identified three main reasons for the data gaps related to ecosystem extent and condition, i.e. issues related to (1) temporal inconsistencies, (2) land cover classifications, and (3) lack of public access to certain data sources. Stock take over time, which includes ecosystem extent and condition, is a key component of accounting. Accounts are ideally created based on data sources containing similar sampling approaches at regular time intervals. In our analysis however, 14 out of 29 data sources for ecosystem extent had no identifiable time of sampling, while 2 other data sources from GiGL were sampled before 2007 (i.e. Biodiversity Action Plan habitat data from 1989 and 1995). The remaining data sources for ecosystem extent (i.e. 15 out of 29) were able to cover each land cover annually, but this was dependent on the granular data from the ESA CCI as indicated in Section 3.1 (Figure 2). Some experts argue that ecosystem extent and condition indicators do not change that readily and are burdensome to maintain annually, especially in an urban context. Although this implies a natural capital account would not be fully compliant with the SEEA EEA framework, it does provide a practical solution to a lack of annual data as has been done in previous studies (EFTEC, 2017; Vivid Economics, 2017b).

A number of data sources did not classify urban ecosystems according to a particular land cover, but rather classified spaces based on land uses such as public parks, school grounds or cemeteries. For example, the OS MasterMap Greenspace layer only had one identifiable urban land cover, i.e. agricultural land (incl. allotments), while all other spaces were classified in our analysis as unspecified green space (OS, 2004). Although these data sources were accurate, classification according to land use instead of land cover is not always useful for estimating ecosystem extent. Sometimes land use can infer a particular land cover such as bowling green, which is a close-mown stretch of grassland used for playing particular sports. However, other land uses such as religious grounds or cemetery may have varying land covers such as Abney Park, which is an old forested cemetery, while the old and new Camberwell cemetery consist of well-maintained grasslands. Therefore, land use is not always useful for assessing urban land cover and developing a natural capital account. Certain data sources also require greater detail for use in an urban context. For example, the Land Cover Map from 2007 and 2015 classified pixels according to 21 terrestrial and freshwater habitats outlined by the UK Biodiversity Action Plan (CEH, 2017; Jackson, 2000). However, most of London was classified as a single land cover (i.e. urban land cover), making this data source more useful on a national level but less detailed for identifying smaller areas of natural or semi-natural land cover in London.

Lack of access to certain data sources could address important data gaps for developing a natural capital account for London. For example, the i-Tree Eco London survey was undertaken in 2014 to collect data on single trees and plots of trees in London (Treeconomics London, 2015). The survey

found that London's urban forest comprised of more than 8 million trees and supports valuation of a variety of ecosystem services such a carbon capture and storage, rainwater interception and removal of air pollution (Treeconomics London, 2015). Similarly, private utility companies such as Thames Water and Affinity Water provide Londoners with water and sewerage services, but data on water assets are scarce and often not publicly available. Lack of access to certain data sources makes it difficult for developing an inclusive London's natural capital account. Resolving data privacy issues and making data sources publicly available are a key component for developing an inclusive natural capital account for London according to the SEEA EEA framework.

4.2 LINKAGES BETWEEN ECOSYSTEM EXTENT, CONDITION AND ES FLOWS

Current lack of understanding of the interlinkages between ecosystem extent, condition and ES flows is complicated because these interlinkages are multi-dimensional, multi scale, and non-linear (Mace, 2019). For example, low levels of habitat fragmentation do not necessarily affect pollination services until a tipping-point is reached, after which pollination services reach a alternative stable state (Selkoe et al., 2017). Attempts to connect ecosystem extent and condition to ES flows becomes complicated., suggesting that institutions and other organisations need to cooperate to address these knowledge gaps in the interpretation and use of ecosystem accounts (Maes et al., 2019). This also suggests that communication between institutions and other organisations needs to be facilitated (Maes et al., 2019). For example, both Defra, ONS and GLA are working on the development of urban natural capital accounts. Increased collaboration and sharing practices could enhance overall outcomes for urban natural capital accounting. In 2015, the United Nations Statistical Division (UNSD) in collaboration with the UN Environment Programme, the World Bank and the European Union organised the Forum of Experts in SEEA EEA which was set up to connect stakeholders and share best practices on experimental ecosystem accounting. This Forum seeks to build on existing methods and practices to expand the international framework for environmental-economic accounting. Similarly, Defra in collaboration with different UK research councils organised the Valuing Nature Programme with the aim to fund research and support researchers in making links with policymakers, business and practitioners. It is uncertain however whether sharing platforms such as the Forum of Experts in SEEA EEA or the Valuing Nature Network will bring about improvements in cross-disciplinary communication, research on knowledge gaps, and development of publicly available data sources.

5 CONCLUSIONS

Our findings showed that building an inclusive natural capital account for London was currently not possible with a simplified urban land cover classification based on the SEEA CF and SEEA EEA. A more simplified urban land cover classification was preferred for classifying urban ecosystems and building an urban natural capital account because the land cover classifications from SEEA CF and SEEA EEA were (1) too detailed for practical use in urban areas or (2) simply not applicable to our study area of Greater London. Furthermore, the lack of temporal availability of data sources for all urban land cover classifications further complicates the development of an urban natural capital account for London consistent with SEEA EEA. However, it is argued by some experts that particular ecosystem extent and condition indicators may not change that readily— especially in urban areas —and could be used for multiple years. Based on our findings, we translate the challenges to develop urban natural capital accounts and advance urban research more broadly in two parts:

- Renewed efforts are needed to develop better publicly available data sources. By addressing key gaps such as temporal inconsistencies and lack of public access, more data sources could become available that are publicly accessible and updated annually. This would support researchers and decision-makers in their efforts to develop urban natural capital accounts according to the SEEA EEA framework.
- Publicly available data sources need to be underpinned by a cohesive classification framework, which includes realistic land cover classifications for urban ecosystems. By addressing silo-thinking between academic institutions, decision-makers and the private sector, and making interdisciplinary work standard practice, more cohesive data sources may become available for the development of urban natural capital accounts. This could increase support for including new guidelines in the SEEA EEA guidelines particularly for urban ecosystems, and some of this work is already under way (Wang et al., 2019).

Our paper was framed within the broader discussion on the role of natural capital accounting for urban nature conservation by showing that publicly available data sources were not sufficient to develop an inclusive natural capital accounts for London according to the SEEA EEA framework. Future research could include expanding our analysis for publicly available data sources on ES flows that can be inferred from ES modelling and other techniques, amongst others. The abovementioned steps were suggested to address the challenge of dealing with gaps in the data. Through these steps, researchers and decision-makers are encouraged to contribute to the future management of urban ecosystems and the benefits these can deliver to human health and well-being.

6 ACKNOWLEDGEMENTS

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7 CONFLICTS OF INTEREST

The authors declare no conflicts of interest with this work.

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ELECTRONIC SUPPLEMENTARY MATERIAL

Raw data for answering the methods are available in full in the attached pdf document and can be found in the online version of this article.

Electronic Supplementary Material

Table 1: Overview of publicly available data sources to compile an urban natural capital account for London according to the System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA EEA).

ID	Data type	Data Title	Author	Year applicable													Our urban land cover categories									Ecosystem condition							Ecosystem service flow categories																			
				2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	U	Artificial surfaces	Agricultural land (incl. allotments)	Grasslands	Tree-covered areas	Shrubland and heathland	Marshes and wetlands	Inland water bodies	Unspecified blue space	Unspecified green space	Biodiversity indicators	Soil indicators	Ecological indicators	Air quality indicators	Spatial configuration	Access	Management practices	Biophysical										Monetary									
																																	Provisioning services	Regulating services					Cultural services				Provisioning services	Regulating services					Cultural services			
																																	1.1.1.1	2.1.1.2	2.1.2.2	2.2.1.3	2.2.6.1	2.2.6.2	3.1.1.1	3.1.1.2	3.1.2.4	3.2.2.1	1.1.1.1	2.1.1.2	2.1.2.2	2.2.1.3	2.2.6.1	2.2.6.2	3.1.1.1	3.1.1.2	3.1.2.4	3.2.2.1
																																	Cultivated crops	Carbon sequestration & storage	Noise regulation	Stormwater runoff	Air quality	Air temperature	Physical health & recreation	Mental health	Aesthetic value	Existence value	Cultivated crops	Carbon sequestration & storage	Noise regulation	Stormwater runoff	Air quality	Air temperature	Physical health & recreation	Mental health	Aesthetic value	Existence value
1	report	Natural Capital Accounts for Public Green Space in London	Vivid Economics													■																		■				■	■	■		■		■				■	■	■		■
2	report	A Study to Scope and Develop Urban Natural Capital Accounts for the UK.	Eftec													■										■	■	■		■	■	■	■	■	■		■	■	■				■	■	■		■	■	■			
3	report	Valuing houses and green spaces: Understanding local amenities, the build environmnet and house prices in london.	Duncan Smith (CASA, UCL)				■																																			■										■
4	report	Valuing London's Urban Forest. Results of the London i-Tree Eco Project.	Forestry Commission								■															■								■		■	■	■						■		■	■	■				
5	tool	Outdoor Recreation Valuation Tool (ORVal: Version 2.0)	LEEP at The University of													■															■								■										■			
6	award	Green Flag Award	Keep Britain Tidy													■																■																				
7	article	Research note: Urban street tree density and antidepressant prescription rates—A cross-sectional study in London, UK	Taylor, M., Wheeler, B., White, M., Economou, T. and Osborne, N.			■	■																																	■												
8	data	Water Quality of London's Rivers and Other Waterbodies	Environment Agency										■															■																								
9	report	Reaping Rewards II. Sustain: How much is London Growing	Sustain: the allience for better food and farming								■																						■										■									
11	data	MasterMap: Topography	Ordnance Survey (OS)													■				■			■											■										■								
12	data	MasterMap: Green Space	Ordnance Survey (OS)													■		■							■																											
13	data	Open Rivers	Ordnance Survey (OS)													■																																				
14	data	MasterMap: Water Network	Ordnance Survey (OS)													■																																				
15	data	Open Greenspace: Greenspace site	Ordnance Survey (OS)													■		■							■																											
16	data	Point Species Records: All Taxa Records	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
17	data	Polygon Species Record: All Taxa	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
18	data	Habitat Data	GIGL															■	■	■	■	■	■		■																											
19	data	Open Street Map: Water	Geofabrik													■						■	■																													
20	data	LIDAR data: Composite DSM (Digital Surface Model) and DTM (Digital Terrain Model)	Environment Agency													■																																				
21	data	Landsat- 7: Enhanced Thematic Mapper Plus (ETM+)	NASA and the US Geological Survey	■	■	■	■	■	■	■	■	■	■	■	■		■							■	■			■																								
22	data	Landsat- 8: OLI and TIRS bands	NASA and the US Geological Survey							■	■	■	■	■	■		■							■	■			■																								
23	data	Sentinel-2: Multispectral Instrument (MSI)	European Space Agency (ESA)									■	■	■	■		■							■	■			■																								
24	data	Monitor of Engagement with the Natural Environment (MENE) survey	Natural England			■	■	■	■	■	■	■	■	■	■																								■	■									■	■		
25	report	UK Natural Capital: ecosystem accounts for urban areas	Office of National Statistics (ONS)																														■	■	■		■	■	■				■	■	■		■	■	■			
26	data	Water Extraction Dataset	Environment	■	■	■	■	■	■	■	■	■																																								
27	data	Land Cover Map (LCM) 2007	Centre for ecology and hydrology (CEH)	■													■	■	■	■	■	■	■																													
28	data	Land Cover Map (LCM) 2015	Centre for ecology and hydrology (CEH)									■					■	■	■	■	■	■	■																													
29	report	Developing Estimates for the Valuation of Air Pollution Removal in Ecosystem Accounts	CEH, Eftec and EMRC	■				■				■																									■										■					
30	report	Scoping UK Urban Natural Capital Account- Noise Extension	Eftec and CEH													■																			■										■							
31	report	Scoping UK Urban Natural Capital Account - Local Climate Regulation Extension	Eftec and CEH													■																						■										■				
32	data	WFD River, Canal and Surface Water Transfer Waterbodies Cycle 2	Environment Agency								■																																									
33	data	BAP Habitat Condition and Suitability mapping	GIGL															■	■	■	■	■	■		■	■																										
34	tool	Harvest-Ometer	Capital Growth							■	■	■	■	■	■																		■										■									
35	tool	The Helliwell System	The Aboricultural Association	■	■	■	■	■	■	■	■	■	■	■	■																										■										■	
36	tool	Capital Asset Value for Amenity Trees (CAVAT)	London Tree Officer Association	■	■	■	■	■	■	■	■	■	■	■	■																										■										■	
37	data	Point Species Records: Designated Species Record	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
38	data	Point Species Records: LISI Species Records	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
39	data	Point Species Records: Absent Species Records	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
40	data	Polygon Species Record: Absent Species Records	GIGL	■	■	■	■	■	■	■	■	■	■	■	■											■																										
41	data	Urban Greening Features	GIGL	■	■	■	■	■	■	■	■	■	■	■	■										■																											
42	data	Borough Trees and Street	GIGL		■	■	■	■	■	■	■	■	■	■	■																																					
43	data	Open Space Sites	GIGL	■	■	■	■	■	■	■	■	■	■	■	■			■							■																											
44	data	Open Space Features	GIGL	■	■	■	■	■	■	■	■	■	■	■	■										■																											
45	data	Special Areas of Conservation (SACs)	GIGL													■									■																											
46	data	Special Protection Areas (SPAs)	GIGL													■									■																											
47	data	RAMSAR Sites	GIGL													■						■																														
48	data	National Nature Reserves (NNRs)	GIGL													■									■																											
49	data	Local Nature Reserves (LNRs)	GIGL	■	■	■	■	■	■	■	■	■	■	■	■										■																											
50	data	Sites of Importance for Nature Conservation (SINCs)	GIGL	■	■	■	■	■	■	■	■	■	■	■	■										■																											
51	data	Green Belt	GIGL	■	■	■	■	■	■	■	■	■	■	■	■										■																											
52	data	Open Map Local: Surface Water	Ordnance Survey (OS)													■								■																												
53	data	Open Map Local: Tidal Water	Ordnance Survey (OS)													■								■																												
54	data	Open Map Local: Woodland	Ordnance Survey (OS)													■				■																																
55	data	Open Street Map: Waterways	Geofabrik													■																																				
56	data	Open Street Map: Land use	Geofabrik													■		■	■	■	■				■																											
57	data	Allotment Locations	London Datastore													■																																				
58	data	Sites of Special Scientific Interest Site Units	Natural England													■																■																				
59	data	Open Greenspace: Access point	GIGL													■															■																					
60	data	Local Authority Maintained Trees	London Datastore								■																																									

61	data	Built-up Areas (December 2011)	Office of National Statistics (ONS)					
62	data	London Green and Blue Cover	London Datastore					
63	data	Curio Canopy - London Tree Canopy Cover	London Datastore					
64	data	Land Cover Climate Change Initiative (CCI)	European Space Agency (ESA)					
65	data	Freshwater Fish Counts for all species for all Areas and all Years	Environment Agency					
66	data	Areas of Deficiency in Access to Public Open Space	GIGL					
67	data	Access to garden space	Ordnance Survey (OS)					
68	data	Access to public parks and playing fields	Ordnance Survey (OS)					
69	data	London Atmospheric Emissions (LAEI)	London Datastore					
70	tool	Species Records on UK Biodiversity	NBN Atlas					

Table 2: Description on identified publicly available data sources to compile an urban natural capital account for London according to the System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA EEA).

We included publicly available data sources with partial spatial or temporal cover for Greater London and gathered information for each mapped data source, if applicable, on authorship, update frequency, spatial extent, unit or resolution, data format (e.g. raster, vector format), licensing or usage restrictions and historic data availability.

ID	Data type	Data Title	Author	Date of last update and availability of historic data.	General Description	Spatial Scope	Spatial Units	Land Cover/ Ecosystem Types Included	Ecosytem Spatial Classification Units	Ecosystem Condition Variables	Standardised Classification of ecosystem flows in relation to the latest version of CICES (V5.1).	Ecosystem Services Included	Measurement Units for Ecosystem Service Flows (Biophysical)	Measurement Valuation Approach for Ecosystem Service Flows (Monetary)	Usage restrictions, licensing (e.g. public access, proprietary dataset, etc) and data ownership	Consistency with the SEEA and relevance to London's Account	URL
1	report	Natural Capital Accounts for Public Green Space in London	Vivid Economics	October 2017. Published report, no historic records.	Estimates the economic value of public parks and green spaces in London. Based on secondary datasets.	Greater London: 32 boroughs and the City of London.	Quarter Hectare (unless further funding was supplied by the individual borough).	Studies accessible, public parks, incl. parks and formal gardens, natural and semi-natural urban parks, amenity, outdoor sports facilities and allotments.	Measured in hectares and as a percentage of area of each borough.	NA	Consistent.	Physical health, mental health, recreation, value added to residential property, carbon storage (in soil and then in trees), temperature regulation	Physical stock of carbon in trees and soil.	Avoided healthcare costs, property price comparison, cost of travel (WTP to use), value of carbon in trees (£63/tonne), value of avoiding premature death due to cooler temperatures. DR= 3.5%	Publically Accessible. Data owned by GLA and GIGL.	This account does not follow the SEEA-EEA guidelines as it does not measure stock of different ecosystems (rather land use) and does not account for ecosystem condition. Valuation of carbon storage, at full non-market price, would not meet SEEA criteria. Some welfare rather than exchange values are used to value some services.	http://www.vivideconomics.com/wp-content/uploads/2017/11/Natural-Capital-Accounts-Report-GLA-NT-HLF.pdf
2	report	A Study to Scope and Develop Urban Natural Capital Accounts for the UK.	Eftec	June 2017. Published Paper no historic records.	A scoping account for urban natural capital assets and ecosystems services in the UK.	UK wide urban environments. The London area included within this study is the Built up area of London.	Varied for different locations (depending on size). London was measured using a 500m buffer. The Built up area of London was measured by the ONS Built Up Areas (BUA) data classification with adjustment made to areas of natural capital which are within the surrounds of the BUA (by virtue of using a retractable 500m buffer around the edge of the BUA). It utilised the LCM 2007 which has a spatial resolution of 25m.	Based on the LCM 2007 it included: Coastal margins; Enclosed farmland; Freshwater; Marine; Mountains, moors and heaths; Semi-natural grassland; Woodland; Urban; Park Area (inc enclosed grasslands, arable and horticulture); Trees; Allotments; Lakes/ponds/rivers (inc canals).	1. Extent of natural capital assets within the urban environment. 2. Area of each ecosystem type across all of the urban environments studied.	Suggests using timber biomass, biodiversity abundance, soil carbon content, water quality, connectivity, conservation designations, proximity to population, km of bike routes. Does not gain actual condition data.	Consistent. CICES (V4.3) is used as a checklist.	Food production, global climate regulation, air quality, noise, local climate regulation, physical health from outdoor recreation	Annual kg of produce from allotments, urban woodland CO2 sequestration, tonnes of polllutant captured by urban vegetation, decibel reduction over urban area, degrees of cooling due to urban vegetation, avoided loss of QALY	£ of food per allotment, £ of improved health (£ value of QALY) from pollution reduction, reduced sleep deprivation (£ value of QALY), £ saved on air conditioning and heat related productivity decline, £/tCO2 non-market price, physical health benefits (£ value of QALY).	Report is publicly accessible. Access to utilised datasets is down to the discretion of individual owners. Report and associated research is owned by the UK government (DEFRA).	Written to be consistent with the SEEA guidelines. Some welfare values, rather than exchange values were used. It is a UK wide study so not specifically applicable to an SEEA-EEA account for London.	14143_UrbanNC_Account_FinalReportAugust2017.pdf
3	report	Valuing houses and green spaces: Understanding local amenities, the build environmnet and house prices in london.	Duncan Smith (CASA, UCL)	September 2010. Published paper, no historic records.	How the amount of green space within wards in London affected house prices, whilst taking into consideration other influential factors such as transportation accessibility and housing density. An update.	London's 32 boroughs. Source: Greenspace Information for Greater London (GiGL).	Quarter Hectare (unless further funding was supplied by the individual borough).	Greenspace: Formal green spaces (public gardens, parks), general open spaces (agriculture, allotments, church, greenbelt, landscaping around buildings, metropolitan open Land, public institutions, recreation, sports, reservoir), unattractive open spaces (prison, industrial, sanitation, vacant, wetlands) and additional independent variables (river, canal). Considers gardens.	NA.	NA.	Consistent with V5.1-Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting.	Cultural Services (monetary): Recreational Value. Amenity value.	NA.	Hedonic house pricing. How house pricing is related to physical built environmmet, local neighbourhood (green space) and socio-economic attributes. Presence of a regional park within 600 metres added 1.9-2.9% to house value. Each hectare of formal green space within 1km of housing increases house prices by approximately 0.08%.	Publicly accessible. Data owned by the Greater London Authority (GLA Economics).	Accounts for green space at the same time as considering other socio-economic and built environment factors. However it gives asset value rather than ecosystem service value. Maybe too old.	https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/GLAE-wp-42.pdf
4	report	Valuing London's Urban Forest. Results of the London i-Tree Eco Project.	Forestry Commission	2015. Published Paper based on 2014 survey. This was the first and largest survey of this kind, there are therefore no historic records.	Aims to map forest cover in inner and outer london and value the ecosystem (dis)services that it delivers.	Inner and outer London. Treated separately.	For Inner London: 200 0.04 Ha plots were randomly selected. Then GiGl was used to identify land use and cover. This data was then used to estimate land use and cover across London.	Report focuses on urban forest: a contiguous area with over 10% tree canopy cover	Percentage of inner and outer london classified as forestry (13% and 18% canopy cover).	The condition of trees was assessed as excellent, good, fair, poor or dying/dead.	Provisioning, regulating, supporting and cultural. Consistent with CICES.	Regulating Services (biophysical and monetary): Air pollution removal. Carbon storage and sequestration. Storm water runoff. Temperature control (cooling). Biodiversity (tree diversity). Habitat provision.	Tonnes of pollution removed per year. Tonnes of carbon stored and sequestered. Avoided surface runoff in cubic metres per year. Amount of energy saved from heating per year. Number of tree species and species per hectare. Number of species associated with each london tree species.	Value of removing pollution based on UK social damage cost. Value of stored and sequestered carbon based on the social cost of carbon (SCC). Value of avoided runoff. Value of energy saved on heating per year, value of carbon release avoided (£62/tCO2). Uses the Helliwell System to place a value on the visual amenity provided by trees.	Report and data are publicly accessible. Data is owned by the UK governmnet (Forestry Commission- DEFRA).	Good classification of ecosystem services. Modern. Good valuation methods. I am not sure about the validity of using a sampling method to gain ecosystem coverage data- could not use it to gain stock data. Valuation of carbon storage is not in line with SEEA-EEA. Flood protection values were surprisingly low- may not be accurate. Ecosystem disservice was mentioned: Impact of trees for increased rate in pest and diseases was discussed.	https://www.forestry.gov.uk/london-itree
5	tool	Outdoor Recreation Valuation Tool (ORVal: Version 2.0)	LEEP at The University of Exeter.	2018	Web-based tool that predicts the number of visits to existing and new greenspaces in England, and estimates the welfare value of those visits in monetary terms. It also gives the different land covers (in ha) found in the space.	England	Land Cover is displayed as colour-coded dots located on a 25m grid over recreation sites.	Land cover is based on LCM2007 from CEH.	NA	There are estimated no. of visits per green space, which can tell us something about the functionality of the space.	Consistent with V5.1-Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting.	Cultural services (biophysical and money): recreational value. Amenity Value.	Number of visits per green space is estimated via an econometric model based on data from the last seven years of the weekly monitor of engagement with the natural environment survey.	Estimates the welfare value of visits to greenspaces. The value of the trips is based on the travel cost, in terms of vehicle fuel and travel time.	Version 2.0 is a free web tool. For information on key datasets used by this tool contact Exeter University professors Brett Day or Greg Smith. Data is owned by The University of Exeter.	Useful for cultural services valuation. Good survey techniques. Gived estimate of land cover type within each green space (% managed gress, sports fields, woodland, river etc.) this could be useful in ecosystem stock measurement.	https://www.leap.exeter.ac.uk/orval/version2.0
6	award	Green Flag Award	Keep Britain Tidy	Awards are ongoing.	The Green Flag Award® scheme recognises and rewards well managed parks and green spaces	UK.	Parks that have won awards can be viewed on a vector map.	Parks and Green Spaces: Formal Gardens, Nature Reserves, Cemeteries and Crematoria, University Campuses, Water Parks, retail and leisure destinations, Sites of Special Scientific Interest, Hospital Grounds, Woodlands, Allotments, Churchyards	NA.	It awards spaces that are of good condition based upon 27 different criteria.	NA.	NA.	NA.	NA.	Data is managed by Keep Tidy Britain on behalf of the UK government (Department for Communities and Local Government).	There is no scale of condition, greenspaces either gain an award or they do not. The award requires an average score across the 27 judgement criteria to be reached, therefore, something bad can be compensated for by other positive attributes.	http://www.greenflagaward.org.uk

7	article	Research note: Urban street tree density and antidepressant prescription rates—A cross-sectional study in London, UK	Taylor, M., Wheeler, B., White, M., Economou, T. and Osborne, N.	April 2015. Antidepressant data from 2009 and 2010.	Uses secondary data sources to examine the association between the density of street trees (trees/km street) in London boroughs and rates of antidepressant prescribing	Greater London	NA	It looks particularly at street trees, but does not hold data on its stock.	Uses data for number of street trees per borough from the GLA data store.	NA	Consistent with VS.1-Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting.	Cultural (biophysical): Mental health (more specifically reduction in cases of depression per unit increase in street tree density).	NA	NA	Taylor et al, Landscape and Urban Planning, Volume 136, April 2015, Pages 174-179. The paper was published by Elsevier. It can be purchased or viewed with a journal subscription.	NA	https://www.sciencedirect.com/science/article/pii/S0169204614002941
8	data	Water Quality of London's Rivers and Other Waterbodies	Environment Agency	Condition data is from 2016. Stock data is from The Water Framework Directive 2013-2014 (ID 27). No historic data available.	Breakdown of the waterbodies by ecological status, chemical status, and other classification status in 2016	London	Can be viewed on a vector map.	Waterbodies	Breakdown of the waterbodies by ecological status, chemical status, and other classification status in 2016.	Gives information about the ecological and chemical status of the water (e.g. phosphate and dissolved oxygen). Presence of species (e.g. fish, algae, invertebrates).	NA.	NA.	NA.	NA.	Data is publically accessible under the Open Government Licence. Data is owned by the UK Government (Environmnet Agency).	0	https://data.london.gov.uk/dataset/water-quality-london-rivers-other-waterbodies
9	report	Reaping Rewards II. Sustain: How much is London Growing	Sustain: the allience for better food and farming	2014. Paper shows data for 2013-14. No records before 2013. Research is ongoing. No historic data.	Provides data on urban food growth and productivity.	London	NA.	Agricultural: allotments, farms, home growers and community gardens.	Area of growing space in square metres.	NA.	Consistent with VS.1-Biomass.	Provisional (biophysical and monetary): Food production	Tonnes of produce harvested.	Average productivity per square metre in financial value	Publicly Accessible (Ask for donations). Data is owned by the NGO Sustain.	Only measures the allotments of people who sign up. This may not be good as a stock level however the productivity is an average so could be used in an account for financial value of allotments.	https://www.sustainweb.org/home/download/?email=emilynorthridge%40outlook.com&code=2116553511
11	data	MasterMap: Topography	Ordnance Survey (OS)	No time stamp	The definitive source of highly-detailed geographic data of Great Britain. Layered map.	Great Britain	Polygon, line and point shapefile	Tree-Covered Areas and unspecified blue space	NA	NA	NA	NA	NA	NA	Data is owned by Ordinance Survey (owned by the UK Governemnt-BEIS)		https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
12	data	MasterMap: Green Space	Ordnance Survey (OS)	No time stamp	The definitive source of highly-detailed geographic data of Great Britain. Layered map.	Great Britain	Polygon shapefile	priFunc' features land use, not land type. However, one land use 'allotments' can be used for establishing agricultural areas.	NA	NA	NA	NA	NA	NA	Data is owned by Ordinance Survey (owned by the UK Governemnt-BEIS)	It outlines the uses of greenspace (functions) but does not classify ecosystem type.	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
13	data	Open Rivers	Ordnance Survey (OS)	No time stamp	The definitive source of highly-detailed geographic data of Great Britain. Layered map.	Great Britain	Line shapefile, not polygons	NA	NA	NA	NA	NA	NA	NA	Data is owned by Ordinance Survey (owned by the UK Governemnt-BEIS)		https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
14	data	MasterMap: Water Network	Ordnance Survey (OS)	No time stamp	The definitive source of highly-detailed geographic data of Great Britain. Layered map.	Great Britain	Line shapefile, not polygons	NA	NA	NA	NA	NA	NA	NA	Data is owned by Ordinance Survey (owned by the UK Governemnt-BEIS)		https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
15	data	Open Greenspace: Greenspace site	Ordnance Survey (OS)	No time stamp	The definitive source of highly-detailed geographic data of Great Britain. Layered map.	Great Britain	Polygon shapefile	function' features land use, not land type. However, one land use, i.e. 'allotments' can be used for establishing agricultural areas.	NA	NA	NA	NA	NA	NA	Data is owned by Ordinance Survey (owned by the UK Governemnt-BEIS)	It outlines the uses of greenspace (functions) but does not classify ecosystem type.	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
16	data	Point Species Records: All Taxa Records	GIGL	Records ongoing. Historic data from as far as 1713. Records made between 2007 and 2018, but it could be random.	This is a dataset of all species records that have been recorded. They are mapped as points, where each point represents the 10m or 100m grid square in which the species was observed. These overlap.	Greater London	Each point represents the 10m or 100m grid square in which the species was observed	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types. Count data of tree species in dataset.	NA	Biodiversity can be used as a measure of ecosystem condition.	Consistent with VS.1-Regulation of physical, chemical, biological conditions	Regulating (biophysical): Shows presence of organisms that aid regulatory ecosystem services e.g. pollinators, biological control species	Species presence recorded.	NA.	Data is provided for academic research after an application form has been sent. For other uses see their data access policy (fees may apply). GiGL own their maps and data but also use data owned by others. Owners can opt in or out of GiGL ownership to make their data publically accessible.	Would need to overlap point data over ecosystem map to identify the number of species that are present in each. This would need to be done individually for each of London's Boroughs. Based on records of observations so is susceptible to variable survey intensity and recording practices. The dataset is a compiled from a wide range of data from different years, it is therefore temporally irrelevent.	http://www.gigl.org.uk/data-for-research/
17	data	Polygon Species Record: All Taxa	GIGL	Records ongoing. Historic data from as far as 1713. Records made between 2007 and 2018, but it could be random.	This is a dataset of all species records that have been recorded to a coarse accuracy.	Greater London	Species records have been recorded to a coarse accuracy (1km, 2km or 10km), mapped as squares, where the size of the square represents the recording accuracy.	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types. Count data of tree species in dataset.	NA	Biodiversity can be used as a measure of ecosystem condition.	Consistent with VS.1-Regulation of physical, chemical, biological conditions	Regulating (biophysical): Shows presence of organisms that aid regulatory ecosystem services e.g. pollinators, biological control species	Species presence recorded.	NA.	Data is provided for academic research after an application form has been sent. For other uses see their data access policy (fees may apply). GiGL own their maps and data but also use data owned by others. Owners can opt in or out of GiGL ownership to make their data publically accessible.	The dataset is a compiled from a wide range of sources from different years, it is therefore temporally irrelevent. Based on records of observations so is susceptible to variable survey intensity and recording practices.	http://www.gigl.org.uk/data-for-research/
18	data	Habitat Data	GIGL	Habitat data was collected in 1989 and 1995. No survey data between 2007 and 2018.	Classifies London's opens spaces into habitat types. As some vector shapes had multiple land cover types in one vector shape, it is (sometimes) not spatially explicit per land cover types. Therefore, part of the data would be lost when used for identiying land cover types in London.	Greater London	The dataset is spatially explicit. However, the land cover types are not spatially explicit. Multiple land cover types could have been identified in one vector shape, making the dataset not spatially explicit for different land cover types.	4 woodland types, scrub, 5 grasslands, Ruderal, bracken, tall herbs, heathland, bog, reedswamp, wet marginal vegetation, fen carr, 3 water types, intertidal, saltmarsh, 2 hedge types, bare soil/rock, arable, orchard, vegetated wall, roughland, scattered trees, shrubbery, swamp.	Habitat categories were recorded as an estimated percentage cover and equivalent area within the parcel. Where boroughs funded more detailed survey, a parcel represented a single habitat.	NA	NA	NA	NA	NA	Data is provided for academic research after an application form has been sent provided that the university has a MasterMap Licence. For other uses see their data access policy (fees may apply). GiGL own their maps and data but also use data owned by others. Owners can opt in or out of GiGL ownership to make their data publically accessible.	Data is 10 years old. Only includes data on open spaces that are larger than a quarter hectare.	http://www.gigl.org.uk/data-for-research/
19	data	Open Street Map: Water	Geofabrik	No time stamp	A world-wide geographic data set. The focus is on transport infrastructure (streets, paths, railways, rivers), but it also collects a multitude of points of interest, buildings, natural features and landuse information, as well as coastlines and administrative boundaries. Uses layers of mapping.	Global	Polygon shapefile	Land cover types: river, wetland, reservoir, dock and unspecified blue space.	NA	NA	NA	NA	NA	NA	The map is publicly accessible Data is available to download, there is a service fee for help extracting the OpenStreetMap data required and delivering it into a format suitable for a given project. Data is owned by Geofabrik.		https://www.openstreetmap.org/#map=11/51.4963/-0.1620

20	data	LIDAR data: Composite DSM (Digital Surface Model) and DTM (Digital Terrain Model)	Environment Agency	Data availability is different for different parts of London.	Uses the airborne mapping technique light detection and ranging, which involves using a laser to measure the distance between the aircraft and the ground.	Accurate data is available for 70% of England. Greater London has good coverage.	Available at 4 spatial resolutions of 25 cm, 50 cm, 1 m and 2m	Can identify height of vegetation and therefore may be useful indetermining stock of forest ecosystems.	NA	NA	NA	NA	NA	NA	Open Government License. Data is owned by the U.K. Government.	Raster Data set. Useful that height of vegetation can be determined. Could be used as a broad classification for grassland versus woodlands.	https://data.gov.uk/dataset/80c522cc-e0bf-4466-8409-57a04c456197/lidar-composite-dsm-1m
21	data	Landsat- 7: Enhanced Thematic Mapper Plus (ETM+)	NASA and the US Geological Survey	2018- ongoing. Historic data is available from 1999-2018.	Satellite data- Delivers a continuous, visual global record of the Earth's surface	Global	A spatial Resolution: 30 m (60 m – thermal, 15-m pan)	Can detect unspecified water bodies, unspecified green spaces and artificial surfaces. The images are not detailed enough to allow for more detailed classification of land cover.	NA	Produces red and near infrared images which can be used to calculate a Normalized Difference Vegetation Index (NDVI). This can be used to indicate the health of vegetation (healthy vegetation absorbs more red light).	NA	NA	NA	NA	Landsat data can be freely ordered from three USGS websites. Data is managed by NASA and the U.S. Geological Survey (USGS) it is stored and distributed by the USGS National Satellight Land Remote Sensing Data Archive and is property of the U.S.	Historic data is available. This is useful for tracking land cover change or condition change. Satellite data can be used but, as a raw data product, it needs processing for it to become useful for accounting for individual/specific LCEU categories.	https://landsat.gsfc.nasa.gov/data/where-to-get-data/
22	data	Landsat- 8: OLI and TIRS bands	NASA and the US Geological Survey	From March 2013 onwards.	Satellite data- Delivers a continuous, visual global record of the Earth's surface	Global	A spatial resolution of 30 meters (visible, NIR, SWIR); 100 meters (thermal); and 15 meters (panchromatic).	Can detect unspecified water bodies, unspecified green spaces and artificial surfaces. The images are not detailed enough to allow for more detailed classification of land cover.	NA	Produces red and near infrared images which can be used to calculate a Normalized Difference Vegetation Index (NDVI). This can be used to indicate the health of vegetation (healthy vegetation absorbs more red light).	NA	NA	NA	NA	Landsat data can be freely ordered from three USGS websites. Data is managed by NASA and the U.S. Geological Survey (USGS) it is stored and distributed by the USGS National Satellight Land Remote Sensing Data Archive and is property of the U.S.	Historic data is available. This is useful for tracking land cover change or condition change. Satellite data can be used but, as a raw data product, it needs processing for it to become useful for accounting for individual/specific LCEU categories.	https://landsat.gsfc.nasa.gov/data/where-to-get-data/
23	data	Sentinel-2: Multispectral Instrument (MSI)	European Space Agency (ESA)	Ongoing. Historic data from 2014.	Satellite data that aims to monitor variability in land surface conditions.	Europe	Its optical instrument samples in 13 spectral bands: four bands at 10 metres, six bands at 20 metres and three bands at 60 metres spatial resolution.	Can detect unspecified water bodies, unspecified green spaces and artificial surfaces. The images are not detailed enough to allow for more detailed classification of land cover.	NA	Different bands can be used to calculate a Normalized Difference Vegetation Index (NDVI), Photosynthetically Active Radiation (FAPAR), Leaf Area Index (LAI), Fractional Vegetation Cover, Leaf Chlorophyll Content (LCC) and Leaf Water Content (LWC).	NA	NA	NA	NA	Available to access free of charge after a simple registration process. Data is property of the European Space Agency.	Great resolution. Shows land cover change. Satellite data can be used but, as a raw data product, it needs processing for it to become useful for accounting for individual/specific LCEU categories.	https://sentinel.esa.int/web/sentinel/sentinel-data-access
24	data	Monitor of Engagement with the Natural Environment (MENE) survey	Natural England	Reported on quarterly with annual report updates (based on at least 45,000 surveys per year). Historic reports are available from years 2009 to 2019.	This survey provides trend data for how people use/ interact with the natural environment in England.	England	NA	NA	NA	NA	Consistent with V5.1- Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting.	Cultural (biophysical and monetary): Recreational Value (provides information on type of activity). Amenity value. The data provides information on visit frequency by people to nature, which can be relevant for measuring particular ecosystem services such as physical and mental health, and recreation.	Distance traveled, duration of visit, number of visits.	Amount spent during visits.	Raw data is available under the open governmnet licence from 2009-2016. Data is property of Natural England.	Data is in regards to land use (e.g. park, garden, playing field) and not by ecosystem (e.g. greenspace)- however, visits to forests and parks are recorded seperately. The number of visists to each land use is shown so this could be used to work out visits to ecosystem types (e.g. woodland, beach, river). Not specific to London- shows number of total visits in London but does not split it into land use types (this is only done for England as a whole).	http://publications.naturalengland.org.uk/publication/2248731?category=47018 http://webarchive.nationalarchives.gov.uk/20140605195610/ http://www.naturalengland.org.uk/ourwork/evidence/mene.aspx/#results
25	report	UK Natural Capital: ecosystem accounts for urban areas	Office of National Statistics (ONS)	July 2018. Published paper no historic records.	Ecosystem accounts for the urban environment in Great Britain. This forms part of the UK natural capital account being developed by DEFRA and the ONS. This is the first iteration of the urban ecosystem account.	Great Britain	Varied for different locations (depending on size). London was measured using a 500m buffer. The Built up area of London was measured by the ONS Built Up Areas (BUA) data classification (2011) with adjustment made to areas of natural capital which are within the surrounds of the BUA (by virtue of using a retractable 500m buffer around the edge of the BUA). It utilised the LCM which has a spatial resolution of 25m.	The OS Open Green space map (2017) and the OS Mastermap Topography Layer were used in accordance with a modified version of the ONS BUA map (2011) to calculate the areas of natural land cover described as: natural land cover (e.g. grassland, heath, scrub, coniferous trees); functional green space (e.g. public park, playing field, golf course, allotment); publically accessible green space; blue space (all inland water bodies)	Extent of natural land cover (% and Ha) within urban areas in Great Britain. This is split into type of natural land cover within each country within Great Britain.	Condition was assessed per country by % of parks that hold a Green Flag Award and % of sites of special scientific interest classified at different conditions (favourable, unfavourable and partly or fully destroyed).	They classify ecosystems as cultural, regulating and provisioning. Follows CICES V5.1.	Provisioning: agricultural produce from allotments. Regulating: carbon sequestration, air filtration, noise regulation, urban cooling. Cultural: recreation (day trips by UK residents), aesthetic interactions, physical health, amenity.	Kg of food from allotments, tonnes of CO2 sequestrated by urban woodlands, Ktonnes of fine particlate matter removed by urban vegetation (sulpher dioxide, notrogen dioxide and ozone), aggregate cooling effect in degree celcius, number of buildings benefiting from noise reduction, visits to urban nature, active visits to urban green and blue spaces and associated increase in QUALYs.	Value of food from allotments, carbon price of CO2 sequestrated, avoided health costs from fine particulate matter removal (avoided life years lost, deaths and cardivascular/respiratory hospital admissions), savings from avoided air-conditioning and heat-related productivity loss, value of noise mitigation in terms of avoided loss of QUALYs (due to lack of sleep/annoyance), and adverse health outcomes, expenditure on visits to urban nature, hedonic house pricing.	Report is publicly accessible. Access to utilised datasets is down to the discretion of individual owners. Report and associated research is owned by the UK government (DEFRA).	More consistent with SEEA-EEA in terms of seperation into types of ecosystem service and use of condition measures. Good classification of broad habitats within the UK's urban area (ecosystems not land use/cover) however following this the report reverts to a classification of only green and blue spaces (condition and flow data is not seperated into ecosystems). It is not specific to London (although some datasets utilised are).	https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/ecosystemaccountsforurbanareas
26	data	Water Extraction Dataset	Environment Agency	Last Updated 18/12/2017. Data is available for the years 2000-2015	Estimates water abstractions, from all sources except tidal, and seperated them by purpose and Environment Agency charge region. Relevent information is for the river Thames.	England . There is no detail for Greater London, making it impossible to understand what proportion of water abstraction is from Greater London area.	NA	Data included for the entire catchment area of the Thames. However, no detail on water abstraction for Greater London only.	NA	NA	Inconsistent. Water use is classified as a supporting service.	Regulating (biophysical and monetary): Water provision.	Extraction amount in millions of cubic metres.	NA	Raw data is available under the open government licence. Data is owned by the UK government.	Most of London's drinking water comes from the Thames. This is therefore a good dataset for estimating provisioning services. Shows amount of water extracted for different uses- could therefore represent more than one provisioning service (e.g. public water supply, water for industry, water for agriculture etc.). The Thames subclassification used by this source might include water abstraction from outside the GLA.	https://data.gov.uk/dataset/7619198a-1bbf-4cbc-8014-f6a46edb230e/water-abstraction-data-sets
27	data	Land Cover Map (LCM) 2007	Centre for ecology and hydrology (CEH)	LCM map is for 2007. Another available for 2015.	LCM2007 is derived from satellite images and digital cartography and provides land cover information for the entire UK.	United Kingdom	Polygon shapefile	BHSUB' gives a number of features: grassland, horticultural, types of forests, saltmarsh, health, scrub. Lake and river…	NA	NA	NA	NA	NA	NA	Not publically accessible. Can be requested for academic purposes. Other use purposes may require a fee. Data is owned by natural england.	Good ecosystem classification that is utilised by my other sources. The spatial scale means that the majority of london is classified as "built up area"- this means that if used to make SEEA-EEA accounts much of London's natural capital stock would be excluded. To be relevent fot SEEA-EEA accounting in cities this source needs land cover greater resolution.	https://www.ceh.ac.uk/services/land-cover-map-2007#obtain
28	data	Land Cover Map (LCM) 2015	Centre for ecology and hydrology (CEH)	LCM map is for 2015.	LCM2015 is derived from satellite images and digital cartography and provides land cover information for the entire UK.	United Kingdom	Polygon shapefile	bhab' gives woodland, horticultural, grassland, heath, scurb, but blue space is unspecified.	NA	NA	NA	NA	NA	NA	Not publically accessible. Can be requested for academic purposes. Other use purposes may require a fee. Data is owned by natural england.	Good ecosystem classification that is utilised by my other sources. The spatial scale means that the majority of london is classified as "built up area"- this means that if used to make SEEA-EEA accounts much ofLondon's natural capital stock would be excluded. To be relevent fot SEEA-EEA accounting in cities this source needs land cover greater resolution.	https://www.ceh.ac.uk/services/land-cover-map-2015#obtain

29	report	Developing Estimates for the Valuation of Air Pollution Removal in Ecosystem Accounts	CEH, Eftec and EMRC	Last Updated 2017. Historic data is available for 2007, 2011 and 2015. Projections are given for the year 2030.	A natural capital account of air pollution removal by vegetation in different broad habitat classifications across the UK. Air pollutants included are PM10, PM2.5, SO2, NO2 and O3. Estimates are based on EMEP4UK1 modelling.	United Kingdom	Broad habitat classification is based on the LCM 2007.	Broad habitat classifications included are: woodland; enclosed farmland; semi-natural grassland; mountains, moores and heaths; freshwater; coastal margins; marine; urban	Total area of each broad habitat class in the UK in hectares.	NA.	Consistent with VS.1-Transformation of biochemical or physical inputs to ecosystems	Regulating (biophysical and monetary): Air filtration.	Reduction in pollutant concentration due to vegetation (Units: µg m-3). Pollutants captured by vegetation (Units: ktonne yr-1). Change in mortality and morbidity of UK population as a result of air pollution removal by vegetation (Units: no. of people/year).	Annual value of air quality regulation by vegetation in UK broad habitat types in terms of reduction in cardiovascular and respiratory hospital admissions, life years lost and deaths.	Report is publically accessible. Data is owned by the ONS.	The data is not specific to London however if you knew the stock of London ecosystems you could use the data to work out an estimate for the amount of air pollution removed by them. Same for the monetary value of air pollution removal. Urban areas was used as a broad habitat classification- this is not an ecosystem.	https://www.ons.gov.uk/economy/environmentalaccounts/articles/developingestimatesforthevaluationofairpollutioninecosystemaccounts/2017-07-25
30	report	Scoping UK Urban Natural Capital Account- Noise Extension	Eftec and CEH	Published July 2018. Uses data sourced from different years.	The account shows the significant value provided by the UK's urban woodland in terms of improved amenity and health outcomes due to major road noise mitigation.	United Kingdom's urban areas.	The urban boundary is based on the ONS (2011) Built-Up-Area dataset. The stock of trees/woodland areas are mapped using the Ordnance Survey Master Map (OSMM).	Woodland.	Total area trees/woodland in the UK in hectares.	They give examples of variables that could be used to assess condition of UK urban woodland, however, no data is collected.	Consistent with VS.1-Transformation of biochemical or physical inputs to ecosystems.	Regulating (biophysical and monetary): Noise Mitigation. The additional attenuation of noise by vegetation across the frequency range of human hearing (unit: A-weighted decibels, dBA).	Number of buildings where road noise levels are mitigated urban trees (units: number of buildings).	Amenity value in terms of reduced sleep disturbance and annoyance (units: QUALY). Health value in terms of reduced likelyhood of strokes, dimentia and heart attacks (unit: QUALY).	Report is publically accessible. Access to utilised models, datasets and studies is down to the discression of referenced owners. Data is owned by the UK government (DEFRA).	Monetary valuations are welfare and not exchange values. The data is not specific to London however if you knew the stock of London woodland you could use the data to work out an estimate for the amount of noise mitigated by them- this is only a rough estimate as the methodology has more than one variable. Could repeat methdology for London. Utilises data from more than one year so would not know which year to assign results to.	http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=20027&FromSearch=Y&Publisher=1&SearchText=urban
31	report	Scoping UK Urban Natural Capital Account - Local Climate Regulation Extension	Eftec and CEH	Published June 2018. Uses data sourced from different years.	The study measures the cooling effect provided by environmnetal assets within UK urban areas.	Specific urban areas within the United Kingdom.	The urban boundary is based on the ONS (2011) Built-Up-Area dataset. Blue and green space extent was calculated using OS MasterMap GIS data (only those features that are large enough to have an assumed cooling effect were selected). Buffers were added to account for the assumed distance of the space's cooling effect.	Woodland, park/grassland, gardens (Includes all gardens, defined in OS Master Map as 'mixed surfaces'), rivers/canals, lakes/ponds.	Extent of greenspace and bluespace in GB's city regions (unit: millions of hectares). This is given before and after the size and area buffers have been applied.	No condition variables were measured although some spaces were not included based on assumptions that their condition was not adequate to provide a cooling effect. These were grasslands <200m2, rivers and canals of <25m width and lakes of <700m2. Woodlands were also divided into those of more and those of less than 3ha (significantly different cooling effects).	Consistent with VS.1-Regulation of physical, chemical, biological conditions	Regulating (biophysical and monetary): Cooling effect of natural capital.	Total cooling effect of greenspace and bluespace in each of GB's city regions (unit: degrees Celsius). Findings are based on a five year average (2012-16) number of hot days in each of 7 temperature band (range from 28-34.9 degrees Celcius).	Cooling effect is monetised as the cost savings from air conditioning (units: £, method: based on a model parameterised for the US housing stock) and the avoidance of heat-related labour productivity loss across different work sectors (units: GVA in £, Method from: Costa et al, 2016).	Report is publically accessible. Access to utilised models, datasets and studies is down to the discression of referenced owners. Data is owned by the UK government (DEFRA).	It has specific values for London. The findings are based on data collected in different years, it would therefore be hard to assign the results to a specific year (not useful for tracking hanges over time). Good that the cooling effects of different ecosystems are considered.	http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=20065&FromSearch=Y&Publisher=1&SearchText=urban.com
32	data	WFD River, Canal and Surface Water Transfer Waterbodies Cycle 2	Environment Agency	2014. Based on data from 2013-14. No historic data or updates.	A GIS layer identifying the river waterbodies managed under the Water Framework Directive and any related programmes. This includes canals and surface water transfers which are reported to Europe as artificial rivers.	England	Line shapefile, not polygons	Rivers, canals and surface water.	Map of waterbodies. They are mapped by their centreline- no scale units.	NA	NA	NA	NA	NA	Publically accessible under government open licence. Data is owned by the UK government (environmnet agency).	May be useful in identifying rivers but could not be used in isolation to identify stock of blue space. This is because it gives no indication of the size/width of the waterbodies (identified by their centre line only).	http://environment.data.gov.uk/ds/catalogue/#/7804bf80-d465-11e4-aa9b-f0def148f590
33	data	BAP Habitat Condition and Suitability mapping	GIGL	Launched in 2010. Has same data as Habitat data from GIGL. Therefore, based on surveyed data from 1989 and 1995. No data between 2007 and 2018.	The London Habitat Suitability maps provide a visual overview of the BAP habitat suitability dataset. They help identify areas which would give the best benefit to biodiversity, if used to create nine BAP priority habitats in London.	Greater London	Vector Map- polygons are used to map the condition of BAP habitats that are identified across London.	Similar land covers available as habitat data from GIGL. However, certain vector shapes have multiple land cover types and therefore are not spatially explicit for use in natural capital accounting.	NA	A suite of indicator species and habitat features is used to indicate habitat condition- these change depending on the habitat in question.	NA	NA	NA	NA	Data is provided for academic research after an application form has been sent provided that the university has a MasterMap Licence. For other uses see their data access policy (fees may apply). GIGL own their maps and data but also use data owned by others. Owners can opt in or out of GIGL ownership to make their data publically accessible.	The dataset is a compiled from a wide range of sources from different years, it is therefore temporally irrelevent.	http://www.gigl.org.uk/data-for-research/
34	tool	Harvest-Ometer	Capital Growth	Launched in 2013, has annual data up to current year.	Stores harvest yield data online, and then converts it into a monetary value and meal value based on weight.	London	NA	NA	NA	NA	Consistent with VS.1-Cultivated terrestrial plants for nutrition, materials or energy	Provisional (biophysical and monetary): Food production	Weight of food produced (tonnes).	Value of food grown.	Data can be downloaded for free in report form- these is an option to donate to the Capital Growth Charity in exchange for the data	The dataset relies on growers becoming members and then reporting the weight of their harvest by food type. Not all growers in London are members and therefore this tool does not capture the flow of food coming from the entire agricultureal LCEU in London. Value of food is a good monetary measure for a provisioning ecosystem service flow.	https://www.capitalgrowth.org/the_harvestometer/#how_works
35	tool	The Helliwell System	The Aboricultural Association	Based on an initial publishing in 1984. It has been regularly updated including in the years 2008, 2015 and 2019.	The Helliwell System is a methods used to place a monetary value on the visual amenity provided by individual trees and/or woodland.	Global	NA	Tree-Covered Areas	NA.	NA.	Consistent with VS.1-Physical and experiential interactions with natural abiotic components of the environment.	Cultural (biophysical and monetary): visual amenity provided by tree-covered areas	Point scores are allocated to trees depending on a number of different factors. E.g. tree size, life expectancy, suitability to setting etc. These scores are combined to give an overall comparative score for a tree or woodland.	A value is attached to this overall comparative point score by use of a monetary conversion factor.	NA.	Provides a consistent approach to valuing the visual amenity provided by trees. Regularly updated.	https://www.trees.org.uk/Help-Advice/Public/What-is-the-Helliwell-system-and-how-much-is-a-po
36	tool	Capital Asset Value for Amenity Trees (CAVAT)	London Tree Officer Association	First launched in 2007. Has been regularly updated since then. Last update: June 2018	A tool used to provide a monetary value for the amenity provided by trees.	Global- Widely adopted in the UK	NA	Tree-Covered Areas	NA.	NA.	Consistent with VS.1-Physical and experiential interactions with natural abiotic components of the environment.	Cultural (monetary): replacement value of a single tree and the amenity value of a population of trees.	NA.	A formula uses inputted data to generate the replacement value of one tree or the amenity value of a tree-covered area. Data inputs include: trunk diameter, life expectancy and community index factors.	Tool can be downloaded and used for free.	Provides a consistent approach to valuing the visual amenity provided by trees. Regularly updated.	https://www.ltoa.org.uk/documents-1/capital-asset-value-for-amenity-trees-cavat
37	data	Point Species Records: Designated Species Record	GIGL	Records made between 2007 and 2018, but it could be random.		Greater London: 32 boroughs and the City of London.	Each point represents the 10m or 100m grid square in which the species was observed	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types. Count data of tree species in dataset.	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/

38	data	Point Species Records: LISI Species Records	GIGL	Records made between 2007 and 2018, but it could be random.		Greater London: 32 boroughs and the City of London.	Each point represents the 10m or 100m grid square in which the species was observed	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types. Count data of tree species in dataset.	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
39	data	Point Species Records: Absent Species Records	GIGL	Records made between 2007 and 2018, but it could be random.		Greater London: 32 boroughs and the City of London.	Each point represents the 10m or 100m grid square in which the species was observed	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types.	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
40	data	Polygon Species Record: Absent Species Records	GIGL	Records made between 2007 and 2018, but it could be random.		Greater London: 32 boroughs and the City of London.	Species records have been recorded to a coarse accuracy (1km, 2km or 10km), mapped as squares, where the size of the square represents the recording accuracy.	It is species records and therefore does not identify a particular type of land cover. However, species specialists might be able to attach particular species to particular land cover types.	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
41	data	Urban Greening Features	GIGL	Created in 2013, 'created date' gives indication of when feature was installed. Has installed features from 2007 to 2018.	Shows mainly living roofs installed in London	Greater London	Point shapefile	Unspecified green space'	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
42	data	Borough Trees and Street Trees	GIGL	Created in 2008, 'Date of assessment' gives indication from when tree has been there.	Borough Trees and Street Trees. Incomplete record for certain Boroughs in London.	Restricted to certain boroughs	Point shapefile	Tree-Covered Areas	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
43	data	Open Space Sites	GIGL	SurveyDate' gives an indication of when this site was definitly there. Lots of it was surveyed in 1985.	This dataset provides descriptive information about each open space including name, type, ownership and access information.	Greater London: 32 boroughs and the City of London.	Polygon shapefile	Allotments can be identified in dataset. Everything else is classifed according to land use, instead of land cover. Therefore, 'Unspecified green space"	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
44	data	Open Space Features	GIGL	No time stamp	This is a point and polygon dataset of features and facilities within open spaces.	Greater London: 32 boroughs and the City of London.	Point and polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
45	data	Special Areas of Conservation (SACs)	GIGL	No time stamp		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
46	data	Special Protection Areas (SPAs)	GIGL	No time stamp		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
47	data	RAMSAR Sites	GIGL	No time stamp		Greater London: 32 boroughs and the City of London.	Polygon shapefile	Marshes and wetlands	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
48	data	National Nature Reserves (NNRs)	GIGL	No time stamp		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
49	data	Local Nature Reserves (LNRs)	GIGL	No time stamp		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
50	data	Sites of Importance for Nature Conservation (SINCs)	GIGL	LastModDat' gives an indication of when SINC was definitly there.		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
51	data	Green Belt	GIGL	DateDesignated' gives in indication of when Green Belt site was definitly there.		Greater London: 32 boroughs and the City of London.	Polygon shapefile	NA	NA	NA	NA	NA	NA	NA	NA	NA	http://www.gigl.org.uk/data-for-research/
52	data	Open Map Local: Surface Water	Ordnance Survey (OS)	No time stamp		Great Britain	Polygon shapefile	Unspecified blue space	NA	NA	NA	NA	NA	NA	NA	NA	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
53	data	Open Map Local: Tidal Water	Ordnance Survey (OS)	No time stamp		Great Britain	Polygon shapefile	Unspecified blue space	NA	NA	NA	NA	NA	NA	NA	NA	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
54	data	Open Map Local: Woodland	Ordnance Survey (OS)	No time stamp		Great Britain	Polygon shapefile	Tree-covered areas	NA	NA	NA	NA	NA	NA	NA	NA	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
55	data	Open Street Map: Waterways	Geofabrik	No time stamp		Global	Line shapefile, not polygons	NA	NA	NA	NA	NA	NA	NA	NA	NA	https://www.geofabrik.de
56	data	Open Street Map: Land use	Geofabrik	No time stamp		Global	Polygon shapefile	Land cover types: allotment, forest, grassland, heath and unspecified green space. Also certain land uses were given, not useful for land type.	NA	NA	NA	NA	NA	NA	NA	NA	https://www.geofabrik.de
57	data	Allotment Locations	London Datastore	No time stamp	Allotment locations in Greater London.	Greater London: 32 boroughs and the City of London.	Point shapefile	Agricultural (incl. allotments)	NA	NA	NA	NA	NA	NA	NA	This is not a polygon shapefile, and therefore, does not give the extent of the allotments. OS Open Greenspace does however give the extent. Both datasets overlap well!	https://data.london.gov.uk/dataset/allotment-locations
58	data	Sites of Special Scientific Interest Site Units	Natural England	No time stamp	Dataset of Sites of Special Scientific Interest (SSSI) with a condition variable in the data.	England	Polygon shapefile	NA	NA	Condition categories are: "favourable maintained", "favourable recovered" and "favourable declining", "unfavourable recovering", "unfavourable no change" and "unfavourable declining".	NA	NA	NA	NA.	NA		https://naturalengland-defra.opendata.arcgis.com/datasets/sites-of-special-scientific-interest-units-england

59	data	Open Greenspace: Access point	GIGL	No time series	Data on access points to green space	Great Britain	Point shapefile	NA	NA	Functionality of green space is important in highly populated urban areas, therefore accessibility to green space is also included. This data provides a basic indicator of the accessibility of green spaces within the urban environment.	NA	NA	NA	NA	NA.	NA	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
60	data	Local Authority Maintained Trees	London Datastore	Data is from 2014. However, a remark is made that some data may have been collected before 2014.	A collection of London's tree data into one open source place to get a picture of London's trees.	Greater London, certain borough however did not provide tree data.	Point shapefile	Tree-Covered Areas	NA	NA	NA	NA	NA	NA	NA	NA	https://data.london.gov.uk/dataset/local-authority-maintained-trees
61	data	Built-up Areas (December 2011)	Office of National Statistics (ONS)	2011 Census day	Digital vector boundaries for built-up areas in England and Wales as at 27 March 2011 (Census day).	England and Wales	The built-up area boundaries are generalised and created using an automated approach based on a 50m grid squares.	Artificial sufaces	NA	NA	NA	NA	NA	NA	NA	NA	https://data.gov.uk/dataset/15e3be7f-66ed-416c-b0f2-241e87668642/built-up-areas-december-2011-boundaries-v2
62	data	London Green and Blue Cover	London Datastore	2016	The GLA have produced a dataset that provides a more accurate estimate of the extent of the London's green infrastructure - the city's parks, gardens, trees, green spaces, rivers and wetlands, and features such as green roofs.	Great Britain	NA	Unspecified green and blue space	NA	NA	NA	NA	NA	NA	NA	NA	https://data.london.gov.uk/dataset/green-and-blue-cover
63	data	Curio Canopy - London Tree Canopy Cover	London Datastore	2016	A high resolution map of tree canopy cover for Greater London was produced from aerial imagery using machine learning techniques.	Greater London	25 cm per pixel	Tree-covered areas	NA	NA	NA	NA	NA	NA	NA	NA	https://data.london.gov.uk/dataset/curio-canopy
64	data	Land Cover Climate Change Initiative (CCI)	European Space Agency (ESA)	From 1992 to 2018	Global LC maps at 300 m spatial resolution on an annual basis from 1992 to 2018	Global	Grid file with spatial resolution of 300 m. Therefore, very coarse for use in London.	Artificial surfaces, Agricultural land (incl. allotments), Grasslands, tree-covered areas, shrubland and heathland, marshes and wetlands and unspecified blue space	NA	NA	NA	NA	NA	NA	NA	NA	https://www.esa-landcover-cci.org/?q=node/1
65	data	Freshwater Fish Counts for all species for all Areas and all Years	Environment Agency	Some data was collected already in 1978. The initial version of this dataset was published in February 2016. The dataset is updated quarterly.	Information collected from fisheries monitoring work on rivers, lakes and transitional and coastal waters (TraC). This monitoring work is undertaken by the Environment Agency and by third parties.	Great Britain	Point count with an easting an norting coordinate attached	NA	NA	Freshwater fish counts -> can be used as a biological indicator.	NA	NA	NA	NA	NA	NA	https://data.gov.uk/dataset/f49b8e4b-8673-498e-bead-98e6847831c6/freshwater-fish-counts-for-all-species-all-areas-and-all-years
66	data	Areas of Deficiency in Access to Public Open Space	GIGL	No time series	Areas of Deficiency are defined as built-up areas more than one kilometre actual walking distance from an accessible Metropolitan or Borough SINC.	Greater London	Polygon shapefile	NA	NA	Access	NA	NA	NA	NA	NA	NA	https://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/how-to-buy.html https://digimap.edina.ac.uk/os
67	data	Access to garden space	Ordnance Survey (OS)	Last update May 2020. However, no real time specified in dataset.	Analysis of Ordnance Survey (OS) data on access to private gardens, public parks and playing fields in Great Britain, available by country, region, Local Authority and Middle Layer Super Output Area.	Great Britain	Middle Layer Super Output Area	NA	NA	Access	NA	NA	NA	NA	NA	NA	https://www.ons.gov.uk/economy/environmentalaccounts/datasets/accesstogardensandpublicgreenspaceingreatbritain
68	data	Access to public parks and playing fields	Ordnance Survey (OS)	Last update May 2020. However, no real time specified in dataset.	Analysis of Ordnance Survey (OS) data on access to private gardens, public parks and playing fields in Great Britain, available by country, region, Local Authority and Middle Layer Super Output Area.	Great Britain	Middle Layer Super Output Area	NA	NA	Access	NA	NA	NA	NA	NA	NA	https://www.ons.gov.uk/economy/environmentalaccounts/datasets/accesstogardensandpublicgreenspaceingreatbritain
69	data	London Atmospheric Emissions (LAEI)	London Datastore	Last update is in 2016.	The London Atmospheric Emissions Inventory gives emission estimates of key pollutants (NOx, PM10, PM2.5 and CO2) by source type are included for the base year 2016. Emissions for previous years 2008, 2010 and 2013.	Greater London	Rasterfile	NA	NA	Air quality indicators. Besides the possibility of natural capital assets to regulate air quality (ecosystem service), air quality can also be an indicator of ecosystem condition.	NA	NA	NA	NA	NA	NA	https://data.london.gov.uk/dataset/laei-2008 https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2010 https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2013 https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2016?q=london%20atmospheric
70	tool	Species Records on UK Biodiversity	NBN Atlas	Records go back 100's of years. Most records are publicly available and managed by the Biological Records Centre (BRC). However, other records from outside BRC might be included.	The NBN Atlas is an online tool that provides a platform to engage, educate and inform people about the natural world. It will help improve biodiversity knowledge, open up research possibilities and change the way environmental management is carried out in the UK.	United Kingdom	Point count	NA	NA	Useful for developing biological indicators	NA	NA	NA	NA	Taking the views of the range of NBN members into account the NBN Atlas is open access by default, except in relation to sensitive species which are restricted. Every record that is held on the NBN Atlas is licensed with one of three Creative Commons Licences or an Open Government Licence (OGL).	NA	https://nbnatlas.org

Table 3: Matrix linking ecosystem extent and condition to ecosystem service flows

	Ecosystem service flow									
	Cultivated crops	Carbon sequestration & storage	Noise regulation	Stormwater runoff	Air quality	Air temperature	Physical health & recreation	Mental health	Aesthetic value	Existence value
Ecosystem extent										
Agricultural land (incl. allotments)	■			■			■	■	■	■
Grasslands				■			■	■	■	■
Tree-covered areas		■	■	■	■	■	■	■	■	■
Shrubland and heathland				■			■	■	■	■
Marshes and wetlands				■			■	■	■	■
Inland water bodies				■			■	■	■	■
Ecosystem condition										
Biodiversity indicators	■	■			■					
Soil indicators	■	■		■	■					
Ecological indicators		■	■	■	■	■	■			
Air quality indicators	■	■			■		■		■	
Spatial configuration			■	■	■	■	■	■	■	■
Access							■	■	■	■
Management practices				■	■	■	■	■	■	■