Natural Capital Committee

The Natural Capital Committee's advice on an environmental baseline census of natural capital stocks:
an essential foundation for the government's 25 Year Environment Plan

September 2019

Contents

Background

The Natural Capital Committee's (NCC) '*How to do it: a natural capital workbook*' sets out that before making decisions, a starting point has to be set by understanding the baseline position of natural capital assets.[1] This point was reiterated in the NCC's fifth annual report stating that "…*the (25 Year Environment) Plan needs rigorous scientific and economic assessment of the status of our natural capital assets."[2]* And again in the sixth annual report making it clear that: "*Defra should be tasked with delivering an environmental census to establish a robust baseline against which to measure progress towards the 25 YEP goals.*"[3]

In May 2019, the previous Defra Secretary of State, Michael Gove, requested that the NCC provide detailed advice on a cost-effective approach to an environmental census which integrates existing data, including the indicator framework,[4] and increases citizen engagement with the environment. This paper sets out the NCC's response to that request[5] in two sections. The first section provides a summary of the NCC's advice and recommendations. The second section presents more detailed advice split into seven sub sections : i) integrating existing data and addressing data gaps ; ii) coordinating the census; iii) cost effectiveness ; iv) citizen science ; v) timescale for delivery ; vi) spatial coverage and vii) integrating natural capital data projects with the census baseline - with underpinning evidence set out across the four annexes.

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[1] Natural Capital Committee, *How to do it: natural capital workbook, version 1* (2017): https://www.gov.uk/government/groups/natural-capital-committee#publications

[2] Natural Capital Committee, *Annual Report 2018 Fifth report to the Economic Affairs Committee* (2018): https://www.gov.uk/government/publications/natural-capital-committees-fifth-annual-report

[3] Natural Capital Committee. *Annual Report 2019 Sixth Report to the Economic Affairs Committee of the Cabinet* (2019): https://www.gov.uk/government/publications/natural-capital-committees-sixth-annual-report

[4] Defra, *Measuring environmental change: outcome indicator framework for the 25 Year Environment Plan* (2019): https://www.gov.uk/government/publications/25-year-environment-plan

[5] This advice also addresses several points, detailed in a further letter from the previous Defra SoS, Michael Gove: that all measurements should be taken over the course of one year, in order to set a baseline and determine change; how spatial coverage might differ between assets; how monitoring could fill the gaps in the indicator framework; how robust baseline data can be delivered (to work on a national scale, trialling new methods), and the time and effort that might go into analysing data.

1. Summary of the NCC's advice/ guiding principles

The NCC's advice is clear: **a comprehensive, England-wide environmental census of the stock of natural capital assets is urgently needed to establish a baseline against which progress towards the environmental goals articulated in the 25 Year Environment Plan (25 YEP) can be measured. This is critical in determining whether the environment is improving, static or deteriorating further.** Progress **cannot be measured until a baseline is established - the Indicator Framework fails to provide the necessary data.** The baseline census should focus on identifying and measuring the extent and condition of the stock of natural capital assets across England. The assessment of pressures, and the associated goods and services provided by natural capital assets should be carried out as a separate exercise**.**

Key points

Integrating existing data and addressing data gaps

1. The NCC has undertaken an assessment of the 25 YEP Indicator Framework and an initial, high level review of existing datasets to consider the suitability of these datasets for the baseline measurement. This assessment reveals a distinct lack of robust baseline against which to assess changes in the environment.
2. Existing datasets/monitoring programmes, including those used in the Indicator Framework, at best only provide a partial measure of several key assets, and often lack England wide coverage and a common baseline collection date.
3. The government should urgently address this through a comprehensive review of available data ahead of the proposed 2020 census. This should include reviewing existing monitoring programmes to ensure they are fit for purpose in terms of sampling, what is being measured, the spatial scale used and affordability. The census should not duplicate existing work programmes. Where existing datasets are suitable they should be synchronised i.e. aligned to a common starting point for inclusion in the 2020 census. Setting data standards for data collection could enable a large amount of planned data collection to be used in the census.
4. New data collection should be targeted on the data gaps highlighted by the NCC, including soils, marine, biodiversity, ecological communities and urban areas; and further areas identified by the government. The NCC is concerned that a rigorous gap analysis of environmental data does not exist.

Coordinating the census

5. Clear leadership is needed to gather good quality, accurate data. The NCC has considered several approaches for coordinating data collection/integration of datasets. In line with

recent recommendations from the National Audit Office,[6] which advocates setting clear leadership for data collection, the NCC recommends that a single governing body or group should be charged with coordinating the census. The NCC does not believe it should be the responsibility of any one government department or NGO.

Cost effectiveness

6. If the government is serious about its objective of leaving the environment in a better state for the next generation then it must sufficiently resource the development of a comprehensive baseline of natural capital assets against which to assess progress. The costs of establishing such a baseline are likely to be modest but should not be a barrier and in any case are negligible when set against the far more significant costs of further deterioration of our environment.

7. The baseline census should be designed in a way that minimises costs and considers environmental data needs across government. This can be done by establishing clear leadership to ensure a joined up approach in environmental asset data collection, thereby preventing the current large scale duplication and waste of public funds, as well as utilising new technologies.

Citizen science

8. The NCC's view is that a citizen science element to developing the environmental baseline is an incredibly powerful way for key stakeholders and the public to engage with the environment and enable millions of citizens to be involved in some aspect of the collection and analysis of environmental data. The measurement process should aim to become a global exemplar for citizen engagement with the environment.

9. The NCC has identified a need to ground truth current data, for example habitat data collected by satellites, to improve the accuracy of this technology and provide a more complete understanding of land cover.

10. New data collection should also allow for data-capture resulting from the use of emerging technologies (e.g. Sentinel satellites and Landsat imagery, and smart phone apps) and by doing so encourage as wide a participation as possible in collecting this data including landowners, school children, public bodies and National Parks.

Timescales for delivery

11. The need for Government to commit to and address the lack of a baseline is pressing. Eight years have passed since the government made the commitment in the 2011 Natural

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[6] NAO, *Challenges in using data across government* (2019): https://www.nao.org.uk/report/challenges-in-using-data-across-government/

Environment White Paper, *The Natural Choice*, "*to be the first generation to leave the natural environment of England in a better state than it inherited.*"[7] There is now an urgent need for the government to commit to measuring changes in the environment. Progress cannot be measured until a baseline is established.

12. The government's first 25 YEP Progress Report provides little assessment of whether the natural environment has improved. Instead it focuses on a long list of actions, which emphasises this problem[8]. The environmental baseline census must begin in 2020 to prevent incentivising the degradation of assets ahead of baseline measurements being taken.

13. Based on the NCC's initial analysis of existing data, it appears that the majority of the required data will already be collected in 2020. For some assets there will be existing, historic time series data that can be used to inform the baseline. This demonstrates that it would be plausible to gather all necessary data through a combination of integrating existing datasets and developing new datasets – including through citizen science, within one calendar year i.e. 2020.

14. Following the initial baseline census in 2020, the process should be repeated every five years. This does not imply resetting the baseline every 5 years – the proposed interval is to enable a clear periodic understanding of trends in England's natural capital assets.

15. The full baseline assessment should be supplemented by annual monitoring, assessment and reporting on the state of the environment, and presented in the government's annual 25 YEP Progress Report.

Spatial coverage

16. The Committee has undertaken an initial review of the spatial scale used in existing monitoring programmes. The choice of a reasonable spatial scale to record natural capital assets at is one of the biggest challenges for the census. The government should ensure that the measurements taken are detailed enough to support the establishment of asset registers for landowners, businesses and local authorities.

17. The comprehensive review of available data, to be undertaken by government, should include an assessment of the spatial scale available against each asset. The spatial configuration of assets has a substantial consequence for decision making because it influences the benefits and regulatory function the asset provides.

18. Where possible, piloting approaches for data collection should inform the scale at which the census is collected. The scale should be sufficient to support both the scaling up and down of the data for multiple uses.

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[7] https://www.gov.uk/government/publications/the-natural-choice-securing-the-value-of-nature

[8] The NCC produced an advice paper in September 2019 detailing its views on the first 25 YEP Progress Report, including its failure to provide an assessment of progress due to the absence of a baseline against which progress can be measured, and the limitations of the Indicator Framework.

Integrating other natural capital data approaches with the baseline

19. Following discussions with the Office for National Statistics (ONS), the NCC recommends that the census should be designed and carried out in a way that it enables enhancements to the ONS natural capital accounts in terms of: i) the physical natural capital estimates and spatial data disaggregation ambitions, as set out in its 2020 roadmap;[9] and ii) further detailed work on different approaches to the valuation of natural capital assets.

20. The government should consider integrating other environmental data gathering projects, including, for example the Environmental Land Management (ELM) baselining exercise and the development of legally binding targets for the 25 YEP with the census.

21. The data should be collected in such a way that it enables HMT Green Book economic analyses of investments needed to maintain the stock of England's natural capital assets, and investments required to enhance natural capital and evaluate the benefits it provides.

2. Developing an environmental baseline census – detailed advice

This section set out the NCC's detailed advice and recommendations on the key principles for delivering an environmental baseline census. This advice is split across seven sub sections : i) integrating existing data and addressing data gaps ; ii) coordinating the census; iii) cost effectiveness ; iv) citizen science ; v) timescale for delivery ; vi) spatial coverage and vii) integrating natural capital data projects with the census baseline.

i. Integrating existing data and addressing data gaps

The NCC has undertaken an assessment of the 25 YEP indicator framework[10] (see **Annex 1 for a summary)** and an initial, high level review of existing datasets[11] to consider the suitability of these datasets for the baseline measurement.

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[9]https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/methodologies/uknaturalcapitalinterimreviewandrevised2020roadmap

[10]Defra, *Measuring environmental change: outcome indicator framework for the 25 Year Environment Plan* (2019): https://www.gov.uk/government/publications/25-year-environment-plan

[11] Some of the datasets assessed have been published in Natural Capital Committee, *How to do it: natural capital workbook, version 1 page 26-27* (2017): https://www.gov.uk/government/groups/natural-capital-committee#publications. Other datasets include those collected by government, government agencies, non-government organisations and the private and third sectors.

This assessment unravels a distinct lack of robust baseline against which to assess changes in the environment. It reinforces the NCC's assessment in the sixth annual report that "…*these proposed indicators will not achieve the intended outcome, which is to measure progress or help achieve the ten goals set out in the 25YEP*." The NCC also advised that "*very few of the indicators focus on natural capital assets which underpin the essential flows… and those that do are insufficient*."[12] In terms of the indicator framework, less than 20% of the 66 proposed indicators provide a measure of natural capital assets, of these only four are currently published with the rest requiring further development. Even then, these are partial measures, for example the data included for air, water, species, ecological communities, land and coasts only measure parts of the asset because of either spatial coverage or data deficiency. This leaves gaps across all of the main assets, with some critical assets such as soils having no measurements at all. It is concerning that a detailed gap analysis does not currently exist.

Other existing datasets could provide partial measures of assets. For example, there are multiple collected datasets for species. However, this data is not without issues. In particular, there is a lack of join up and coordination in the way this data is collected, and much of the data to date has been collected on different spatial scales with different levels of detail. The use of some of this data in the baseline census is not impossible but it will require coordination and the filling of data gaps.

The analysis of the existing datasets has informed the NCC's advice on the level of additional natural capital asset data needed to develop a comprehensive environmental baseline. One way to organise the baseline data collection could be to allocate it across eight themes (or 'chapters') with a focus on collection by asset type (a detailed example of this approach is provided **in Annex 2**). The eight themes could cover:

- Atmosphere;
- Freshwater;
- Soils;
- Ecological communities;
- Land and coasts;
- Species;
- Urban natural capital assets and;
- Oceans.

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[12] Natural Capital Committee. *Annual Report 2019 Sixth Report to the Economic Affairs Committee of the Cabinet* (2019): https://www.gov.uk/government/publications/natural-capital-committees-sixth-annual-report

The NCC has assessed how the baseline asset data for each of eight proposed thematic chapters could support in measuring the progress of the ten 25YEP goals, **in Annex 3**.

Previous reports e.g. the IPBES Global Assessment on Biodiversity and Ecosystem Services[13] and the National Ecosystem Assessment[14] have carried out large scale environmental monitoring, which included incorporating existing datasets. It is likely that these projects could have some useful recommendations which would be pertinent to the design of the census.

Recommendations:

1. **The government should launch a comprehensive review of available data, including a robust gap analysis, ahead of the 2020 census. This should include reviewing existing monitoring programmes to ensure they are fit for purpose in terms of sampling, what is being measured, the spatial scale used and affordability. The census should not duplicate existing work programmes. Where existing datasets are suitable they should be synchronised for inclusion in the 2020 census.**

2. **New data collection should be targeted on data gaps highlighted by the NCC, including soils, marine, biodiversity, ecological communities and urban areas. These existing data-gaps should be supplemented with new data, including data collected by the public. It should also allow for new data-capture resulting from the use of emerging technologies (e.g. Sentinel satellites and Landsat imagery, and smart phone apps) and encourage as wide a participation as possible in collecting this data including the public, landowners, school children, public bodies and National Parks.**

3. **Setting data standards for data collection could enable a large amount of planned data collection to be used in the census.**

4. **The data should be collected in such a way that it enables an economic analysis of investment needed to maintain the stock of our natural capital assets, and investment to enhance natural capital and the benefits it provides.**

5. **All data used in the census should be referenced using a standard Ordnance Survey grid, date stamped and be freely available.**

6. **New data collection should employ methodologies which are relatively simple to use and yet provide robust data. Previous large scale monitoring programmes should be reviewed for lessons learned ahead of designing the census.**

7. **The census should focus on identifying the stock of natural capital assets across England. The assessment of the associated goods and services provided by the natural capital assets is carried out as a separate exercise.**

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[13] IPBES, *Global Assessment Report on Biodiversity and Ecosystem Services* (2019): https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services

[14] http://uknea.unep-wcmc.org/

ii. Coordinating the census

Clear leadership is needed to gather good quality, accurate data. The NCC has considered several approaches for coordinating data collection/integration of datasets, and advises government to consider a single governing body or group being charged with coordinating the census. The NCC does not believe it should be the responsibility of any one government department or NGO. Establishing a governance group aligns with the recent recommendations from the National Audit Office report[15] which advocates setting clear leadership for data collection. This approach is beneficial because each government department or NGO could be heavily involved with devising the metrics and their measurement, but the organisation and report assimilation would be independent. Representatives from the NCC should be part of the governance group and will be able to assist in establishing the scope and scale of the census.

All information should be captured in a centralised, open-source database and web-portal that could be managed by Defra. Data used in the census should be referenced using a standard Ordnance Survey grid, date stamped and be freely available. A key output should be an accessible web-based and published report detailing the main findings plus a summary for policy makers. The data should also be sufficient to support economic cost-benefit and other analyses of the effect of investments in maintaining and enhancing natural capital. The open access database should be designed in a way which considers all of the uses for the data, including any which are unintended. The dataset should not incentivise the degradation of assets or allow natural capital assets to be perceived as hazards, for example the location of street trees being used by insurance companies when assessing home insurance. There could also be human rights issues associated with information being displayed about individuals' landholdings.

One approach could be to explore a census pilot where small scale local projects undertake full baselining activities of the natural capital assets in a defined area, similar to what has been done in the marine context for the North Devon Marine Pioneer.[16] This could be supplemented with a national project aimed at piloting the collation of all asset data in 2020. The review of the pilot activities would inform future fuller census activities.

Recommendations:

8. **A governance group should be set up to lead and coordinate the overall effort. This should be established now and should be tasked with the following:**
   1) **Defining the assets to be included;**
   2) **The body responsible for each asset;**
   3) **The scale at which information about each asset will be collected;**

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[15] NAO, *Challenges in using data across government* (2019): https://www.nao.org.uk/report/challenges-in-using-data-across-government/

[16] SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).

4) **Who will be involved in collecting information for each asset; and**

5) **That overall an integrated systems-based analysis is achieved.**

9. **The government should explore the potential for a census pilot, subject to timings, where a small scale local project undertakes full baselining activities of the natural capital assets in a defined area.**

iii. Cost effectiveness

If the government is serious about its objective of leaving the environment in a better state for the next generation then it must urgently establish a comprehensive baseline against which to assess progress of our natural environment. Building a credible baseline of natural capital assets will require the appropriate level of investment from the government. There will most likely be modest costs associated with building a baseline of natural capital assets related to accessing existing datasets (including the need to purchase intellectual property rights), collecting data where there are gaps, supporting the necessary governance group and creating or adapting a database to store the collected information. The costs of establishing such a baseline **should not be a barrier** and in any case are negligible when set against the far more significant costs of further deterioration of our environment. The baseline census has the potential to address multiple environmental data needs across a range of policy areas, including but not limited to:

- Providing data for the Office for National Statistics natural capital accounts;
- Providing a baseline for the Office for Environmental Protection to inherit a workable framework to hold government to account;
- Be part of the datasets required for developing 25 YEP targets;
- Providing a baseline to measure the success of public goods policies (such as the future Environmental Land Management Scheme) and;
- Providing the baseline of the habitat and natural capital conditions where development is to take place, and providing baseline information of the area where the compensation and investment aspect of the net gain policy is to take place.

Recommendations:

10. **The government should design baseline census in a way that minimises costs and considers environmental data needs across government. This can be done by integrating and 'synchronising' existing datasets; and establishing clear leadership to ensure a joined up approach in environmental asset data collection, thereby preventing the current large scale duplication and waste of public funds.**

11. **The government should then focus on filling the gaps in the data, incurring only incremental costs in doing so by making the most use of new technologies (Earth Observations, drones, Artificial Intelligence etc.).**

iv. Citizen science

The NCC's view is that a citizen science element to developing the environmental baseline is an incredibly powerful way for key stakeholders and the public to engage with the environment and enable millions of citizens to be involved in some aspect of the collection and analysis of environmental data. The last illustration of citizen science on this scale was the pioneering land use survey carried out under the leadership of Professor Dudley Stamp in the 1930s.[17] The creation of the census could draw on projects similar to this, such as the Countryside Survey[18] for methodologies and lessons learned.

Citizen science is also an excellent way to ground truth new technologies which are collecting environmental data. Ground-truthing offers a means to increase confidence in, and possibly add granularity to, data collected over a wider scale or using imprecise assessment tools. For example, citizens could be asked to verify satellite identified habitats, or could use censors to monitor local air quality to supplement national database datasets. The use of smart phones and portable cameras opens up a wealth of data which could assist the census, for example, there are mobile apps already available to track invasive species[19] and plastic pollution.[20]

Recommendations:

The measurement process should aim to become a global exemplar for citizen engagement with the environment, and for ground-truthing existing data. For example, the aspiration should be for:

12. **Every school in England to participate (which directly links back to aspirations outlined in the 25 YEP). It should be part of their science coursework – data collection, capture, its analysis and display;**
13. **Every landowner and land-manager to be encouraged to contribute census data, and;**
14. **Every National Park to participate (the output from this baseline work should be directly linked to the National Parks review).**

v. Timescale for delivery

Eight years have passed since the Government made the commitment in the 2011 Natural Environment White Paper, *The Natural Choice*, "*to be the first generation to leave the natural*

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[17] https://digimap.edina.ac.uk/webhelp/environment/data_information/dudleystamp.htm

[18] https://countrysidesurvey.org.uk/

[19] https://www.gov.uk/government/news/new-app-to-report-asian-hornet-sightings

[20] https://plasticpatrol.co.uk/download-our-app/

environment of England in a better state than it inherited."[21] There is an urgent need for the government to commit to measuring change in the environment. Progress cannot be measured until a baseline is established.

The required baseline, which must be based on an integrated assessment so assets can be compared spatially and temporally, does not exist. Whilst numerous, distinct datasets have been collected by government agencies (for example, the those brought together in the indicator framework), local authorities, research centres, academia and NGOs over many years, there is no single year or common spatial scale for these datasets.

As a result, it is currently impossible to judge whether the 25 YEP objective and goals are being met. The government's first 25 YEP Progress Report fails to provide an assessment of whether the natural environment has improved. Instead it focuses on a long list of actions, which emphasises this problem.[22] The NCC has provided an assessment of how the baseline census asset data could support measuring progress against the 25 YEP goals **in Annex 3.**

Based on the NCC's initial analysis of existing data, it appears that the majority of the required data will already be collected in 2020. Therefore preparation should focus on filling gaps, for example soils and marine, as a matter of urgency. All of the necessary data should be collected within one calendar year. The NCC recognises that for some assets it will be possible to build on existing and established time series data. This would build a systematic and integrated record and allow the temporal comparison of all of England's natural capital assets. The need for Government to commit to and address the lack of a baseline is pressing. It must begin in 2020 to prevent incentivising the degradation of assets ahead of a baseline measure being taken.

Recommendations:

15. **The government should urgently establish the baseline census in 2020. Following this initial census, the process should be repeated every five years. The same methodology should be employed, with measurements made in the same locations. This does not imply resetting the baseline every 5 years – the proposed interval is to enable a clear periodic understanding of trends in England's natural capital assets.**
16. **The full baseline assessment should be supplemented by annual monitoring, assessment and reporting on the state of the environment, and presented in the government's annual 25 YEP Progress Report.**

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[21] Defra, *The natural choice: securing the value of nature* (2011): https://www.gov.uk/government/publications/the-natural-choice-securing-the-value-of-nature

[22] The NCC produced an advice paper in September 2019 detailing its views on the first 25 YEP progress report, including its failure to draw on robust data on all elements of the environment due to absence of a baseline against which progress can be measured and drawbacks associated with Defra's Indicator Framework.

vi. Spatial coverage

The Committee has undertaken an initial review of the spatial scale used in existing monitoring programmes. This can be found **in Annex 4**.

Choosing a reasonable spatial scale to record natural capital assets at is one of the biggest challenges for the census. It is important that the measurements taken are detailed enough to support the establishment of asset registers including for landowners, businesses and local authorities. At the same time as being scaled up to provide a national picture. However, working at the national scale alone is not appropriate for an environmental baseline census of assets. The spatial configuration of assets has a substantial consequence for decision making because it influences the benefits and regulatory function the asset provides.[23] The measurements should follow an agreed full spatial coverage for the different asset types across all of England and not just focus on priority areas. The scale used for individual measurements should enable a systems-based and integrated approach to be taken in the data analysis.

One approach could be to trial the collection of data for a given asset at a defined spatial scale, e.g. the water asset at hydrologically representative unit scale covering the entire river basin district level. The trial could then be built on by adding in other assets, for example land cover. Piloting activities will be constrained by timing; the census should be undertaken in 2020. Other projects such as the 25 YEP Pioneer Projects[24] could be assessed for their approaches, for example, the North Devon Marine Pioneer has already begun baselining activities.[25] Terrestrial datasets should resolve to a common spatial unit, determined via trials. Data collection for the marine asset is unlikely to match the same scale as the terrestrial data gathering. For marine the scale should be set by trialling data collection for the components of this asset, ensuring the data is fit for purpose, a common sense rule that should be echoed within the terrestrial data gathering exercise. The long term goal could be for interactive well designed maps displaying the stock of each asset.

Recommendations:

17. **The comprehensive review of available data (to be undertaken by government) should include an assessment of the spatial scale available against each asset.**

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[23] Mace, G. et al. *Towards a risk register for natural capital, Journal of Applied Ecology* (2015): http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12431/full

[24] Defra, *A Green Future: Our 25 Year Plan to Improve the Environment* (2018): https://www.gov.uk/government/publications/25-year-environment-plan

[25] SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).

18. **Piloting approaches for data collection should inform the scale at which the census is collected. Where the timing is inappropriate other projects should be assessed for their approach to collecting baseline data.**
19. **The scale should be sufficient to support both the scaling up and down of the data for multiple uses.**
20. **A common spatial unit i.e. the river basin or catchment should be aspired to, it is for government to set the appropriate scale.**

vii. Integrating natural capital data projects with the baseline census

There are environmental data projects across government and elsewhere which would benefit from the proposed natural capital baseline measurement. These include the Office for National Statistics (ONS) natural capital accounts, developing legally binding 25 YEP targets and potentially the Environmental Land Management schemes (ELMs).

ONS natural capital accounts

In 2011 the government committed to working with the Office for National Statistics (ONS) and Defra to incorporate natural capital into the UK Environmental Accounts by 2020. The 25 YEP reiterated this commitment, and the ONS recently published an updated road map to 2020.[26] To date, natural capital accounts for several broad habitats, as well as for aggregate UK-wide accounts, have been published and are being regularly updated. The updated road map aims both to improve existing statistics and to develop accounts for the whole suite of broad habitats.

The ONS natural capital accounts will be developed beyond 2020. Data from the census could directly feed into the development of the ONS accounts for multiple reasons. The baseline would provide one data source for ONS to base their valuations on. The current valuations have to use multiple, sometimes conflicting, datasets; because the responsibility for habitats is shared there is no one simple dataset per habitat type. The baseline would fill gaps in the data and temporal gaps for the ONS accounts. Soil, for example, is a big gap for the ONS accounting but any dataset would need to include usage of the soil for the ONS to be able to value it. Temporally, the baseline could provide data on urban gardens so the ONS can enrich their dataset on urban greenspace. The baseline data has the possibility of improving the way the ONS value assets by basing their valuations on data rather than income. For example, the ONS currently estimate the value of both fishing and farming industries by using the income, this means it is not possible to understand the sustainability of using natural capital assets. The baseline could include data on human infrastructure, this would assist the ONS in creating recreation values for accessibility to green space.

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[26] ONS, *UK Natural Capital: interim review and revised 2020 roadmap* (2018): https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/methodologies/uknaturalcapitalinterimreviewandrevised2020roadmap

ELMs

The baselining needs for the ELMs are yet to be confirmed. It is clear, however, that the census presents opportunities for utilising the data collection methods proposed for the census, in particular citizen science, to address possible data needs for ELMs baselining. The census and ELM baselining exercises should be integrated where possible in order to utilise available resources – for example, citizen scientists delivering appropriate data – and deliver good value for money. Weaknesses in the current Countryside Stewardship baselining provide a good starting point for this integration, presenting opportunities such as where citizen science could be used to assess features for historic environment, and where geospatial and/or other methods could be used for assessing which fields to select for tackling run-off.

Recommendations:

21. **The census should be designed and carried out in a way that it enables enhancements to the ONS natural capital accounts in terms of the physical natural capital estimates and spatial data disaggregation ambitions, as set out in its 2020 roadmap; and further detailed work on different approaches to the valuation of natural capital assets.**
22. **The government should consider the scope to integrate a wide range of environmental data needs into the baseline census, including for ELMS and developing 25 YEP targets.**
23. **The baseline census data should be collected in such a way that it enables HMT Green Book economic analyses of investments needed to maintain the stock of England's natural capital assets, and investments to enhance natural capital and the benefits it provides.**

Annex 1: NCC summary assessment of the Indicator Framework

This table displays the NCC's high level assessment of the indicators which measure all or part of natural capital assets included in the Indicator Framework. The assessment of indicators relevant to each goal of the 25 YEP has been structured against the natural capital assets measured– this underpins the NCC's advice in Annex 2 and 3. The remaining indicators (from the Indicator Framework) have not been included either because they do not measure natural capital assets, or the indicator requires significant further development and would therefore not be ready for the 2020 census.

Natural Capital Asset	25 YEP plan goal		Dataset (Indicators) [27]	Dataset currently published or under development.	Comments
Atmosphere	Clean Air	A3	Concentrations of fine particulate matter (PM2.5) in the air	Currently published annually	This is a good measurement. However, more metrics are needed to provide a full picture of atmosphere.
		A4	Rural background concentrations of ozone (O3)	Indicator not published but interim indicator in place. Further work is required to develop an England-level indicator	This metric provides partial picture because it does not measure across the whole monitoring network.
		A5	Roadside nitrogen dioxide (NO2) concentrations	Indicator not published but interim indicator in place. Further work is required to develop an England-level indicator	This metric provides partial picture because it does not measure across the whole monitoring network.
Freshwater	Clean and Plentiful water	B3	Water tests meeting good status	Indicator not published but interim indicator in place. Interim shows trends	The indicator will only provide a partial picture if the data is not gathered in line

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[27]Defra, *Measuring environmental change: outcome indicator framework for the 25 Year Environment Plan* (2019): https://www.gov.uk/government/publications/25-year-environment-plan

				in the status of river water bodies in England. Data are published every 3 or 6 years	with a baseline i.e. all condition data for all water types should be collected at the same points in time.
		B4	Condition of bathing waters	Currently published annually	The indicator will only provide a partial picture if the data is not gathered in line with a baseline i.e. all condition data for all water types should be collected at the same points in time.
Oceans	Thriving plants and wildlife	C4	Diverse seas: condition of seafloor habitats	This indicator is not available for reporting in 2019. The assessments to be used in the indicator are due to be published later in 2019	If this measures the extent of seafloor habitat then this metric is measuring part of the ocean asset. The wording needs clarifying to make this clear.
	Using resources from nature more sustainably and efficiently	C11	Productive seas: status of sensitive fish and shellfish stocks	Indicator not published, further work is required. Analytical methods and some data are available	Abundance, distribution and condition of commercial fish species is a partial measure of the species and ecological communities asset.
Species and Ecological Communities	Thriving plants and wildlife	D1[28]	Quantity, quality and connectivity of habitats	Indicator not published, further work required	If this measures extent of habitat each year then it is a measure of an asset if recorded at the appropriate scale i.e. not just nationally. However if it is only reporting the change in habitat then it is not measuring the asset. If the metric is amended to clarify what it will measure then it could be included. There should be

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[28] Indicator currently and publication date unknown, there is a risk this indicator won't be published in time for the census.

				greater clarity in which habitats are to be included, for example coasts.
	D2	Extent and condition of protected sites – land, water and sea	Indicator not published but interim indicator in place. Interim shows the extent of protected areas (D2a) and condition of SSSIs (D2b) in England. Data for this interim indicator are published annually	Measuring extent of protected sites is a partial measure towards ecological communities.
Using resources from nature more sustainably and efficiently	D3[29]	Area of woodland in England	Currently published annually	This is a partial asset measure but it would need synchronising with the census. Improvements to the data collection could be made, for example, it uses National Forest Inventory Data to provide an estimate of woodland cover rather than an actual figure. It also fails to include woodlands below 0.5ha in size and trees outside of woodland so the full extent of the asset is not measured. An investment in Earth Observations would be sensible. Partial measure towards ecological communities.
Thriving plants and wildlife	D4	Relative abundance and/or distribution of widespread species	Indicator not published but interim indicator in place. Interim shows trends in the populations of breeding wild birds,	This indicator needs clarification on which species, for example, the wording doesn't specifically state it is terrestrial only but no freshwater or marine species are

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[29] Indicator D3 overlaps with the asset Land.

				widespread butterflies and bats in England.	included. In theory this could be a partial measure towards species and ecological communities.
		D6	Abundance and distribution of priority species in England	Indicator not published but interim indicator in place. Interim shows trends in the relative abundance and distribution of priority species in the UK. The development of an indicator for England is in progress	This indicator needs clarification on which species are being measured. In theory it could be a partial measure towards species and ecological communities.
Soils	Using resources from nature more sustainably and efficiently	E1	Area of productive agricultural land	Currently published annually	This indicator is a partial measure towards ecological communities but it fails to make use of the CEH Crop map[30] or new Earth Observation techniques. New data could improve the measurement.
Land	Enhancing beauty, heritage and engagement with the natural environment	G2[31]	Condition of heritage features including designated geological sites and scheduled monuments	Indicator not published: some data are available (e.g. SSSI condition assessments and scheduled monuments at risk) but the indicator needs some further development	The wording of this metric needs clarifying, if it measures the extent of features it could partially measure the soil/ sub-soil asset.

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[30]https://data.gov.uk/dataset/fb19d34f-59e6-48e7-820a-fe5fda3019e5/crop-map-of-england-crome-2018

[31] Indicator G2 overlaps with the assets Freshwater and Marine.

Annex 2: Thematic/chapter based framework for organising and collecting baseline census data

This annex provides a thematic/chapter based framework for organising and collecting the baseline census data by asset type (eight are proposed), and includes the NCC's high level assessment of existing datasets, including the Indicator Framework.

Chapter 1: Asset – Atmosphere

To include quality of air across the UK, hotspots of pollution; maps displaying seasonality of pollution; etc.

There are high quality datasets published on air quality and emissions but they are lacking in local detail to provide the full picture of the extent and condition of the atmosphere stock. The available data is split across core government, government agencies, and the private and third sectors. Organisations such as the Centre for Ecology and Hydrology (CEH)[32] and Open Air Laboratories (OPAL)[33] have previously used citizen science to gather local data on air quality.

Some of the government collected data has been selected in the 25 YEP indicator framework. However, only three of the seven proposed indicators[34] assess the stock of atmosphere as an asset, namely;

• Concentrations of fine particulate matter (A3);

• Rural background concentrations of ozone (A4), and;

• Measuring roadside nitrogen dioxide concentrations (A5).

Two of these indicators only provide a partial assessment. This is because the indicators only report concentrations in specific places rather than across the whole monitoring network (and therefore England as a whole). The other four air indicators in the indicator framework are measurements of emissions (e.g. pressures) rather than measurements of clean air (e.g. asset).

The current monitoring network was created to ensure compliance with the Air Quality Directive[35], therefore it is designed to capture information for the air pollutants that impact public

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[32] https://www.ceh.ac.uk/citizen-science

[33] https://www.opalexplorenature.org/airsurvey

[34] Defra, *Measuring environmental change: outcome indicator framework for the 25 Year Environment Plan,* pages 23-35 (2019): https://www.gov.uk/government/publications/25-year-environment-plan

[35] 2008 Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations in outdoor air of major air pollutants that impact public health

health. The current monitoring network is quite large, comprising of 285 fixed point samplers. However the network is actually comprised of several smaller networks each collecting data for different pollutants. The air monitoring programme is also supplemented by air quality modelling to reduce the number of monitoring locations, improve coverage and produce scenarios. This makes using this data difficult to assess the extent and condition of the whole asset because the data is lacking in local detail. This issue has been raised elsewhere e.g. the Office for Statistics Regulation recently highlighted the need for better access to more detailed, local air quality data and encouraged Defra to bring locally collected data from other organisations into the measurements.[36]

The Defra published '*Air pollution in the UK 2017*'[37] may contain enough detail about the atmosphere to set a baseline measure without additional data capture. The NCC recommends assessing the existing air quality network to see if is capable of measuring the whole asset. This could include air concentration data of the following:

- $PM_{2.5}$ and PM_{10};
- Heavy metals;
- Oxides of sulphur;
- Oxides of nitrogen;
- Ozone;
- Methane;
- Ammonia;
- Non-methane volatile organic compounds and;
- Carbon monoxide.

As some air concentration data is modelled, government should investigate if these models are good enough to account for the local variations in air concentrations of major pollutants, especially at the rural scale. Reviewing the appropriate combination of modelling and data collection should be undertaken.

The NCC recommend that the Government should explore:

- If the existing air quality monitoring networks are equipped to assess the whole asset and how this can be supplemented by locally collected data;
- The appropriate mix between monitoring and modelling and whether additional parameters to those listed above should be included;

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[36] Office for Statistics Regulation, *Statistics on air quality and emissions of air pollutants (produced by the Department for Environment Food and Rural Affairs)* (2019): https://www.statisticsauthority.gov.uk/wp-content/uploads/2019/07/Assessment-report-Defra-Air-Quality-and-Emissions-statistics.pdf

[37] Defra, *Air pollution in the UK 2017* (2018): https://uk-air.defra.gov.uk/library/annualreport/

- New technologies (e.g. hand-held devices) and citizen science projects which could help to enrich the coverage of the existing air quality network and;
- Interactive maps displaying variations in air quality across England.

Chapter 2: Asset – Freshwaters

To include rivers, groundwaters and wetlands; rivers/bathing waters etc., water quality, quantity and flow.

The EU Water Framework Directive[38] has provided a strong legislative foundation for ample data collection on freshwater. Much of this data could contribute to the census where they are a measurement of the extent or condition of the asset. The Environment Agency (EA) publishes data[39] on water quality, water resources and flooding by waterbody and catchments. Other datasets include the Countryside Survey[40], UK Lake Portal,[41] and National River Flow Archive.[42] Data held by the Freshwater Habitats Trust[43] and by Natural England should be explored. Water data can be supplemented by citizen science programmes, for example the Thames Waterblitz run by Earthwatch.[44] Consideration could also be given to use of the effluent discharge data from the water companies and industry.

A high level analysis of the Indicator Framework is presented in Annex 1. To summarise, some of these indicators will only provide a partial picture if the data is not gathered in line with a baseline i.e. all condition data for all water types could be synchronised and collected at the same points in time. It is unclear from the indicator framework whether the indicator '*Quantity, quality and connectivity of habitats'* will be measure the extent of all water assets, for example wetlands and small waterbodies. Although this data is gathered by other government agencies the wording of the indicator could include more detail on the size and types of habitats to be included. As water quality is already covered by the '*Water tests meeting good status'* it is unclear why the indicator '*Health of freshwaters assessed through fish stocks*' has been devised. An amendment to this indicator could measure part of the freshwater asset if it provides a metric of fish stocks, rather

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[38] The 2000 Water Framework Directive (2000/60/EC) established a framework for the protection of inland surface waters, estuaries, coastal waters and groundwater: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060

[39] https://ckan.publishing.service.gov.uk/publisher/environment-agency

[40] https://countrysidesurvey.org.uk/

[41] https://eip.ceh.ac.uk/apps/lakes/index.html

[42] https://nrfa.ceh.ac.uk/

[43] https://freshwaterhabitats.org.uk/projects/waternet/

[44] https://freshwaterwatch.thewaterhub.org/group/thames-blitz

than fish stocks as a proxy for water quality. The indicator framework does not provide detail of which widespread species will be measured and whether this includes water dwelling species, again the wording should be improved to provide clarity.

To create a baseline for freshwater consideration could be given to including the following measurements;

- Extent of all water types including standing water, rivers, streams, groundwater,
- Condition (stock) of freshwater invertebrates, plants, fish and diatoms in the water bodies

The NCC recommend that:

- There should be a concerted effort to combine and publish all the existing data into a baseline measurement for 2020 and;
- New technologies (e.g. Earth Observations) and citizen science should be considered to enrich the existing data. Citizen science, for example, is already used to gather data on water condition in the River Thames catchment. It has complemented government (EA) collected data by filling gaps in spatial and temporal coverage, as well as gaps in waterbody size and type.[45] This approach could be expanded to fill geographical gaps in data collection.

Chapter 3: Assets – Soils and peatlands

To include maps detailing type of soils, their condition and extent, depth and quality of soils/peats. These would build upon the current soils maps originally produced by the Soil Survey using government resources and now run as commercial business by Cranfield University.[46] This chapter should also include assessment of diversity and distribution of micro and macro soil fauna.

Some data on aspects of soil health are already published including through the Global soil Biodiversity Atlas,[47] the UK Soil and Herbage Pollutant Survey,[48] and the identification of contaminated land by local authorities.[49] However, these do not provide a complete picture of

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[45] Hadji-Hammou, J., Loiselle, S., Ophof, D., and Thornhill, I., *Getting the full picture: Assessing the complementarity of citizen science and agency monitoring data* (2017):
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0188507

[46] https://www.cranfield.ac.uk/case-studies/research-case-studies/national-soil-map

[47] ESDAC, *Global Soil Biodiversity Atlas* (2016): https://esdac.jrc.ec.europa.eu/content/global-soil-biodiversity-atlas

[48] Environment Agency, *UK Soil and Herbge Pollutant Survey* (2007):
https://www.gov.uk/government/publications/uk-soil-and-herbage-pollutant-survey

[49] See
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/313964/geho0109bpha-e-e.pdf

England's soils. One option would be to undertake an England-wide measurement of soil carbon. Carbon is the primary metric to target to begin the process of improving soils; it is central to soil function as it sustains biological activity while providing nutrition and conditions for crop growth. This would also be in line with the work being undertaken by the Scottish and Welsh Governments where soil carbon is being used as an ecosystem health indicator[50] and a wellbeing indicator respectively.[51]

In addition, consideration should be given to undertaking a measurement of soil invertebrates that are known to be essential for good soil health. For example, there are citizen science initiatives run by OPAL and the Natural History Museum to survey earthworms.[52] These have achieved a reasonably broad coverage across the UK and these approaches could be used in a re-sampling exercise.

Despite the inclusion of Healthy Soils as a headline indicator, the 25 YEP Indicator Framework does not detail what this indicator will include, stating that data is lacking and the indicator requires further development.[53] The NCC recommend that in developing and adding to the soil metrics proposed in the 25 YEP indicator framework,[54] consideration be given to the following metrics to form a baseline data for this asset:

- Bulk density – for soil structure, compaction, water storage (flood risk) and risk of nitrous oxide production (an important greenhouse gas);
- Soil pH – important for biomass production, water quality and biodiversity;
- Soil organic carbon – measured to 15 cm - important for carbon sequestration, crop nutrition and soil stability;
- Soil N – important for biomass/crop production and potential risk to water quality, nitrous oxide production and plant biodiversity;
- Soil P – important for biomass / crop production and potential risk to water quality.

[50] https://www.environment.gov.scot/our-environment/state-of-the-environment/ecosystem-health-indicators/condition-indicators/indicator-7-soil-carbon/

[51] https://gov.wales/well-being-wales

[52] https://www.opalexplorenature.org/results/soil

[53] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802094/25-yep-indicators-2019.pdf

[54]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/802094/25-yep-indicators-2019.pdf

The Countryside Survey used a similar set of indicators to those above.[55] We recommend that a systematic approach should be used to develop the baseline. The Land Use/Cover Area frame Survey (LUCAS) for the soils of the EU adopts a similar set of indicators giving confidence that this is the correct approach.[56] Tools for farmers to assess their soils in situ have also been developed by a range of extension services such as the US Department of Agriculture. Within the UK, the Agricultural and Horticulture Development Board has produced a suite of protocols under its Great Soils programme which should be explored for inclusion in the baseline measure.[57]

When designing new approaches for measurement of soil quality, Government should explore newly emerging spectral methods.[58] These are rapid and require minimal processing, hence do not incur excessive cost. They can operate from the soil ped scale (i.e. hand grab sample) to determine chemical properties, through to the field scale with drones, and satellite imaging to identify specific crops in fields. More thinking is also required to assess whether these methods could be utilised using new technologies such as smartphone apps with Global Positioning System (GPS) tagging since this would be ideal for citizen science activities. Farmers, land managers and agronomists may also collect relevant data which could be explored and incorporated in the census, and may be amenable to these new data collection technologies.

The NCC recommends that:

- There should be a concerted effort to develop a suite of metrics to deliver a baseline assessment of soil type, condition and extent;
- Existing datasets should be integrated into a single, open access database;
- Government should explore new technologies and monitoring methods in order to collect information.

Chapter 4: Asset – Ecological communities, land and coasts

To include maps to show extent of different major landcover classes e.g. coniferous forests, deciduous woodlands, natural grasslands, heathlands, croplands (and type of crops), improved and semi-improved grassland and hedgerows (quality and extent). In cities and peri-urban areas

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[55] The Countryside Survey (CS) is an 'audit' of the natural resources of the UK's countryside and has been conducted in 1978, 1998 and 2007. The CS soil component measured: carbon content, bulk density, pH, nitrogen, mineralizable N (i.e. that potentially available for plant uptake), Olsen P (determines phosphate release from soil), and metals (primarily the toxic elements).

[56] https://ec.europa.eu/jrc/en/publication/lucas-soil-largest-expandable-soil-dataset-europe-review

[57] https://horticulture.ahdb.org.uk/publication/soil-assessment-methods-0

[58] Spectroscopy is a method for accurate analysis of multiple soil content properties and can be implemented both rapidly and inexpensively. See e.g. Rothamsted Research, A global spectral library to characterize the world's soil (2016): https://www.rothamsted.ac.uk/soil-spectral-lab

landcover classes should include density and types of trees in cities and greenspaces (extent and landcover composition). In coastal areas it should include intertidal extent and substrate type (rock, sand, mud), and condition of saltmarsh, rocky and sandy coastline, estuaries and sand dunes.

Many datasets assess the extent and condition of different land cover types, for example:
- CEH Land Cover Map;[59]
- CEH Crop Map;[60]
- Countryside Survey;[61]
- National Forest Inventory;[62]
- Protected areas data;[63]
- UK Biodiversity Indicators;[64]
- UK Biodiversity Action Plan (UKBAP);[65]
- UK National Ecosystem Assessment and[66];
- Ordnance Survey hedgerow data[67].

Private sector organisations collect data in this space, for example Bluesky National Tree Map[68]. Detailed land cover data can be collected by citizen science projects, for example the Sylva Foundation British Woodlands Survey[69]. However, many of these datasets are often fragmented and focus on individual land types rather than a more systematic sampling at a regular interval.

It is unlikely the 25 YEP indicators would provide a full measure the of land cover and near shore cover asset. The Framework fails to define which habitats will be included in the habitat metric i.e. near shore cover. Area of woodland uses fails to include woodlands below 0.5ha in size and trees outside of woodland so the full extent of the asset is not measured. The metrics fail to draw on

[59] https://www.ceh.ac.uk/services/land-cover-map-2015

[60] https://data.gov.uk/dataset/fb19d34f-59e6-48e7-820a-fe5fda3019e5/crop-map-of-england-crome-2018

[61] https://www.countrysidesurvey.org.uk/

[62] https://www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/

[63] http://publications.naturalengland.org.uk/category/10001

[64] https://www.gov.uk/government/statistics/biodiversity-indicators-for-the-uk

[65] https://jncc.gov.uk/our-work/uk-bap/

[66] http://uknea.unep-wcmc.org/

[67] https://www.ordnancesurvey.co.uk/about/news/2016/new-hedges-data-layer.html

[68] https://www.bluesky-world.com/ntm

[69] https://sylva.org.uk/bws

Earth Observation datasets, for example the Crop Map of England, CEH Land Cover map (2015). The indicator '*Relative abundance and distribution of species'* could provide a partial picture for the extent of some land types but the indicator framework fails to provide detail on which species would be included.

The NCC recommend that:

- The extent and condition of all land cover classes should be measured as a priority;
- Existing data is standardised, compiled into one open access database;
- Maps are produced showing the extent of the assets and;
- New technology, such as the application of Earth Observations, should be investigated and used to gather information.

Chapter 5: Asset – Species

To include details on extent, distribution and diversity of important species, populations and communities of rare, iconic and endangered wildlife (terrestrial and marine). This chapter should also include data on diversity and distribution of important function species (e.g. pollinators). In marine environments it should include species, populations or communities of seagrass, saltmarsh and dune vegetation, and intertidal invertebrates.

Many datasets exist which show the extent and distribution of many different species. Often these datasets are collated by NGOs and are separated into species groups, for example Butterfly Conservation[70], Bat Conservation Trust[71], and Royal Society for the Protection of Birds[72]. Local and county recorders collect data on various species and some of the data is hosted in larger datasets, for example iRecord[73] and the National Biodiversity Network[74]. Citizen science in this area is well developed, for example, OPAL[75] have run several initiatives aimed at recording wildlife and pollinators. And iRecord have developed a mobile app[76] for volunteers to record species data anywhere. Organisations in the private sector performing Environmental Impact Assessments[77] will be collecting data which could be useful.

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[70] https://butterfly-conservation.org/

[71] https://www.bats.org.uk/

[72] https://www.rspb.org.uk/

[73] https://www.brc.ac.uk/irecord/

[74] https://nbn.org.uk/

[75] https://www.opalexplorenature.org/

[76] https://irecord.org.uk/app/

[77] https://www.gov.uk/guidance/environmental-impact-assessment

There is little detail in the indicator framework on which species will be included in the metrics. The Framework metrics only cover the condition of some habitats and fail to mention which species will be recorded for each habitat. Many of these metrics are still in development and this means there is a large gap in actual data gathering in this area.

The NCC recommend that:

- Exploring different approaches to gathering the data needed: trend data can be used where the date and spatial resolution fits in with the census. One approach could be to ask each specialist group to measure the extent and abundance of their top ten species. Although this method would not capture all species, it could form an appropriate census of wildlife;
- Setting agreed data standards for the collection of wildlife data across the sector and adding to a central open access database and;
- Prioritisation be given to the data gaps in this area, for example, numbers of invertebrate species.

Invasive species, pests and pathogens could form a subchapter under this heading, however they are a pressure on our assets rather than an asset themselves. A measure of the extent and abundance of these could follow after the original census has been undertaken.

Chapter 6: Assets – Urban natural capital

Data on urban green spaces and other urban assets is often collected by the Local Authority managing the space, although for different reasons. For example, local Tree Wardens[78], part of The Tree Councils volunteer network, keep datasets of the trees they are custodians of. Some local authorities have developed their datasets further by using tools such as iTree.[79] London, for example, have used this tool to value their urban forest[80]. Data is also widely collected by other agencies including volunteer groups, neighbourhoods and individuals. None of the indicators in the indicator framework explicitly mention urban data.

It is unlikely that ecological measures alone would be suitable in the urban space. Government should consider including data on crime rates, litter and accessibility to fully appreciate the condition of these assets.

The NCC recommend that:

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[78] https://www.treecouncil.org.uk/Take-Part/Tree-Wardens/Tree-Wardens

[79] https://www.itreetools.org/

[80] https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/valuing-londons-urban-forest

- A full urban and peri-urban asset dataset at the metropolitan, city, town, village scale is gathered which includes information on the human population;
- Effort should be made to include existing data by setting the appropriate data standards and adding data it to a centralised database and;
- Trial cities are explored where the local authorities compile their own asset census, for example with Oxford City and neighbouring District Councils. The Pioneer Projects in the urban space, for example Manchester[81], are used to inform the approach if appropriate.

Chapter 7: Asset – Oceans

This is one of the most difficult categories of assets to measure due to the practicalities of data collection, and the highly dynamic (spatially and temporally) nature of many marine assets. Benthic (seabed) habitats however can be assessed in discrete, spatially-bound, service providing 'units' using a combination of hydrographic data, sediment sampling and biological surveys. In assessing the offshore marine environment, priority should be given to establishing a baseline measure of their extent and condition. Assessments of benthic habitats have targeted Marine Protected Areas (MPAs), mainly only providing spatial coverage of those sites and with a focus on the designated features of interest within them.[82] This means that assessments of assets across the broader marine environment, such as the asset register undertaken by the North Devon Marine Pioneer, rely on proxy measures which introduce increased uncertainty into the assessments and limit their spatial and temporal resolution. A report on the Marine Pioneer notes that there remains a lack of confidence in the baseline data that can inform on the extent of the habitat natural capital assets.[83]

The NCC recommends that the European University Information System (EUNIS) should be used to provide appropriate units for assessing marine benthic habitats. This system has already used by government in marine protected area designations, and in benthic habitat assessment for the North Devon Marine Pioneer. [84] The 25 YEP indicator framework currently only suggests covering the condition of some habitats, and fails to mention which components will be recorded for each habitat. Following the EUNIS approach, benthic habitat classifications would be disaggregated to ensure vegetated habitats and biogenic reefs are adequately assessed along with different types of sediment and hard rock.

The NCC recommends that all existing marine data should be compiled into one available dataset, and any private companies or organisations collecting marine data (including for Environmental

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[81] https://naturegreatermanchester.co.uk/project/urban-pioneer/

[82] SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).
[83] SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).

[84] SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).

Impact Assessments) should be encouraged to publish their data with open access. Collecting data on marine assets requires significant investment to fill the gaps in data, and any exercise which would attempt to build a comprehensive seabed map should be funded as a priority. A 2016 report concluded that a UK national seabed mapping programme could deliver significant returns on investment, [85] citing the returns forecast for the Irish INFOMAR programme.[86]

There are several clear gaps in the assessment of marine assets which could be addressed by the census. Ocean colour measured through satellite observations and integrated across annual cycles could provide an indication of productivity of phytoplankton – a key pelagic functional group, as a partial proxy for the phytoplankton asset.[87] Species populations of the following marine assets (as key functional and wildlife species) are currently sampled with insufficient spatial and temporal coverage to provide a baseline for the census: phytoplankton, zooplankton, benthic invertebrates, fish, sea mammals and seabirds.[88] Significant further investment would be required to enable an offshore baseline census that is comparable to the proposed land-based census.

The NCC recommends distinguishing coastal habitats, which interact with the ocean but are not permanently submerged, from fully marine (subtidal) habitats. This acknowledges that coastal habitats are part of both terrestrial and marine ecosystems, and that coastal habitats are already mapped and monitored within the same national-scale programmes as terrestrial habitats.[89] Presuming that coastal habitats will continue to be monitored as part of terrestrial programmes, it is important that the full extent (to the low tide mark) is recorded. Assessment of their condition should take account of their function as an integral part of the marine environment, for example the role of saltmarshes in providing a refuge for juvenile fish.

The NCC recommend that:

- In assessing the offshore marine environment priority should be given to establishing a baseline measure of the extent and condition of benthic habitats, with the European University Information System (EUNIS) being used to provide appropriate units for assessment;

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[85] Cefas, Eunomia, *UK National Seabed Mapping Programme – Scoping Study* (2016): https://www.maritimeuk.org/media-centre/publications/uk-national-seabed-mapping-programme-scoping-study/

[86] PwC, *INFOMAR – External evaluation* (2016): https://www.dccae.gov.ie/en-ie/natural-resources/publications/Pages/Infomar.aspx

[87] Valente et. al, *Stochastic models for phytoplankton dynamics in Mediterranean Sea (2016)*: https://www.sciencedirect.com/science/article/pii/S1476945X15000744

[88] See SWEEP, *North Devon Marine Pioneer Report 2: A Natural Capital Asset and Risk Register* (2019).

[89] Natural England, *Coastal Habitats* (accessed September 2019): http://publications.naturalengland.org.uk/category/43007

- All existing marine data should be compiled into one available dataset, with any private companies or organisations collecting marine data encouraged to publish their data with open access;
- Efforts to build a comprehensive seabed map should be funded as a priority;
- Assessments should distinguish coastal habitats from fully marine (subtidal) habitats.

Annex 3: Measuring progress of 25 YEP goals with baseline census data

Table 1: 25 YEP goals -indicative baseline asset data and metrics

The table below indicates how the baseline asset data for each of eight proposed thematic chapters (see Annex 2) could support in measuring progress against the ten 25YEP goals. The table also provides a suggested list of annual metrics or trends which could to assess progress towards each goal (which the baseline data provided by the census could support). The list of annual metrics is not exhaustive and could be used in conjunction with some of the indicators from the Indicator Framework.

25 YEP Goal	Suggested annual metrics	Relevant census chapters/themes for baseline asset data (as detailed in Annex 2)
Clean air	• The area of England in which all of the air quality objectives are met. • The percentage of the population living in areas in which all of the air quality objectives are met. • Impacts on human wellbeing. • The amount of air pollution from agriculture.	Baseline data from chapters 1, 4 and 6 would support the annual metrics.
Clean and plentiful water	• The percentage of water bodies, by type, meeting at least good ecological status under the Water Framework Directive (WFD). • The number of individual parameters meeting, at least good status under the WFD. • Bathing waters meeting at a minimum sufficient status under the Bathing Water Directive.	Baseline data from chapters 2, 3, 4 and 7 would support the annual metrics.

	• The percentage of water bodies where abstractions are not having an adverse impact. • Average per capita consumption. • Percentage of marine water area (of all seas not just marine protected areas) meeting at least Good Environment Status under the Marine Strategy Framework Directive for Descriptor 5 Eutrophication is minimised; Descriptor 8 Concentration of contaminants give no effects; Descriptor 9 Contaminants in seafood are below safe levels; and Descriptor 10 Marine litter does not cause harm. • Impacts on human wellbeing.	
Thriving plants and wildlife	• Percentage of marine waters water area meeting at least 'Good Environment Status' under the Marine Strategy Framework Directive for: Descriptor 1 Biodiversity is maintained; Descriptor 2. Non-indigenous species do not adversely alter the ecosystem; Descriptor 4. Elements of food webs ensure long-term abundance and reproduction; Descriptor 6. The sea floor integrity ensures functioning of the ecosystem; Descriptor 7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem. • Reverse the decline in soil carbon content especially in arable systems. • Reduction in number of erosion incidents (N.B. Needs infrastructure for monitoring).	Baseline data from chapters 2, 3, 4, 5, 6 and 7 would support the annual metrics.

	• No net increase in the area of soils sealed under infrastructure. • Amount of vegetation cover in upper catchments.	
Reduced risk of harm from natural hazards such as flooding	• The number of properties at a given level of flood risk e.g. annual probabilities of flooding of 3%, 1% and 0.5% by type of flooding fluvial, pluvial, sea. • The number of people living in areas where water supply is stressed. • The extent and composition of habitats and natural features which act as natural defences flooding.	Baseline data from chapters 2, 3, 4, 6 and 7 would support the annual metrics.
Using resources from nature more sustainably and efficiently	Building on descriptors for Good Environment Status under the Marine Strategy Framework Directive: • Descriptor 3. The population of commercial fish species is healthy. • Descriptor 9. Contaminants in seafood are below safe levels. The indicators should be broader to include the breadth of commercial seafood species: • Percentage of marine waters water area where populations of all commercial seafood species are healthy and at levels that could produce their maximum sustainable yield. • Contaminants in seafood are below safe levels.	This would be possible using baseline data from chapters 2, 4, 5 and 7.

	• Location, extent and composition of habitats. • Quantity of soil carbon and soil fauna.	
Enhanced beauty, heritage and engagement with the natural environment	• The extent, configuration and condition of green and blue space in urban and peri-urban areas. • How many people have access to it. • Impacts on human wellbeing.	Baseline data from chapters 1, 2, 4, 5, 6 and 7 would support the annual metrics.
Mitigating and adapting to climate change	• Extent and species composition of habitat types involved in carbon sequestration and storage such as forests, woodlands, trees, peatlands, wetlands, coastal saltmarshes and seagrass beds, phytoplankton production, seabed carbon, and carbon flows into the seabed or offshore into deep water. • Quantity and rate of turnover of stored carbon in soil, peatlands, and other land cover classes and marine storage areas.	Baseline data from 1, 2, 3, 4, and 7 would support the annual metrics.
Minimising waste	• The average amount of waste produced per person. • Recycling rates per person. • The percentage of waste that can be reused or recycled. • The amount of waste by disposal route.	Baseline data from chapters 2, 6 and 7 would support the annual metrics.

	• Percentage of area of beaches contaminated by marine litter including plastics and microplastics. • Percentage of marine waters, sediments and species contaminated by presence of microplastics. • Reduction in packaging across consumer and industrial supply chains.	
Managing exposure to chemicals	• Human exposure to toxic chemical groups. • Presence of toxic chemicals in the environment (oceans, soil, air).	Baseline data from chapters 1, 2, 3, 4, 6 and 7 would support the annual metrics.
Enhancing biosecurity	• The impact of plant and animal disease and invasive species outbreaks. • The extent of plant and animal pest and diseases and invasive species. • The number of new outbreaks. • The number of interceptions. • Condition of habitat. • The Percentage of marine waters meeting at least 'Good Environment Status' under the Marine Strategy Framework Directive for: Descriptor 2. Non-indigenous species do not adversely alter the ecosystem.	Baseline data from chapters 2, 4, 5, and 7 would support the annual metrics.

Annex 4: Spatial scales used in monitoring programmes

Table 2: Spatial scales of other monitoring programmes

Title	Number of Units	Detail	Examples and links
Local Scale (e.g. point data detailing species presence/absence)		Historic and present data referenced by a set of coordinates for individual species locations. For example, GPS. [Large UK datasets containing this information e.g. National Biodiveristy Network; Global Biodiversity Informatics Facility (GBIF)].	Surveys which have used this approach: Botanical Society of Britain and Ireland Distribution Database, iRecord (CEH), Ancient Tree Hunt
Regional scale e.g. detailing area of extent	13 National Parks, >4000 SSSIs	The boundary of distribution of species, population or community and/or size/extent of protected areas, water bodies, woodland, land use, heritage features, scheduled monuments, Area of Natural Beauty, Site of Special Scientific Interest, Marine Protected Areas or National Park.	Surveys which have used this approach: Extent of protected sites, condition of SSSIs, Area of Productive Agricultural Land in England, IUCN red list, British Woodland Survey, Environment Agency river basins

National Scale (e.g. England or UK)	1	Abundance of biological records at the England or UK scale, collated datasets from national schemes to local data centres.	Surveys which have used this approach: Bat Conservation Trust, British Trust for Ornithology, Butterfly Conservation, CEH, Defra, JNCC, Rothamsted Research, RSPB.
Grid-based (500x500km, 100x100km, 10x10km)	500x500 = 4 100x100 = 59 10x10 = 3000	Ordnance survey National Gird divides the country into 500km and 100km grid squares by letter and 10km grid squares by number.	Surveys which have used this approach: Ash dieback in the wider environment
2kmx2km	~150,000	Higher resolution grid squares for more detailed distribution species mapping.	Surveys which have used this approach: Botanical Society of Britain and Ireland, Forestry Commission Statistics (grid squares are used to predict forest cover for rest of GB)

1kmx1km	~300,000	Higher resolution grid squares for detailed species distribution data, can involve walking fixed length transects within the grid squares.	Surveys which have used this approach: concentrations of fine particulate matter in the air, Bees, Wasps & Ants recording society, Hoverfly recording scheme, Biological Records Centre (CEH and JNCC), UK butterfly monitoring scheme, National Biodiversity Network, Countryside Survey – Field Survey
1mx1m		Highest resolution for detailed surveys on earthworms, pollinators and plants.	National Tree Map

Vice counties	133 areas	Roughly equal size covering the whole of Britain, fixed regardless of political reorganisation.	Boundaries map
Fixed point sampling		A network of fixed monitoring points.	Surveys which have used this approach: Automatic Urban and Rural Network (air quality)
EUNIS habitat classification		The EUNIS habitat classification is a comprehensive pan-European system to facilitate the harmonised description and collection of data across Europe through the use of criteria for habitat identification. It is hierarchical and covers all types of habitat from natural to artificial, from terrestrial to freshwater and marine.	EUNIS habitat classification

Mapping is based on linking the non-spatially descriptive EUNIS habitat information with spatially explicit information (described in ETC/BD, 2018). |
| **Administrative Geography** | 151 upper tier (county and unitary) authority areas | National and local government, multi-layered and subject to periodic changes. Sets out planning policy for the area and determines how land will be used, including what will be built and where. Used for provision of many other environmental services | https://www.ons.gov.uk/ methodology/geography/ |

	(Local Authorities)	at the local level (e.g. greenspace, waste, AQ, flood authorities, etc.). Prepared through consultation with stakeholders and published online. Long term (5+ years).	ukgeographies/administrativegeography
UK Electoral Geography		Electoral system including European and UK parliament, devolved and regional governments, local authorities.	https://www.ons.gov.uk/methodology/geography/ukgeographies/ukelectoralgeography
ONS Census Geography	Variable	Output Areas (OA) – built from clusters of adjacent postcodes, generated after data collection. Designed to have similar population sizes and be as socially homogenous (based on tenure of housing and dwelling type). Divided rural/urban with approximately regular shapes. Minimum size 40 households and 100 residents, recommended size 125 households. Not fixed, can be modified between censuses. And Super Output Areas (SOA) standard unit for presenting local statistical information. Designed to improve the reporting of small area statistics and are built up from groups of OA.	https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeography
Health Geography	NHS England = 14, STPs = 44, CCG = 207	Based on the organisation of the NHS.	https://www.ons.gov.uk/methodology/geography/

Eurostat	NUTS = (12,37 and 139) LAU = (415 and ~10,000)	Nomenclature of Territorial Units for Statistics (NUTS) and two Local Administrative Unit (LAU) layers. NUTS are amended periodically, LAUs are amended annually as administrative boundaries change. NUTS = Government office regions, counties and groups of unitary authorities. LAU = local authority districts, electoral wards.	https://www.ons.gov.uk/methodology/geography/ukgeographies/eurostat
Postal Geography	1.3m (UK)	Postcodes as the geographic reference.	https://www.nomisweb.co.uk/census/2011/postcode_headcounts_and_household_estimates
Local Enterprise Partnerships	38 areas	Local Industrial Strategies. Long term (5+ years). Sets out plans for economic growth in an area.	https://www.lepnetwork.net/
Regional Flood and Coastal Committee Areas (RFCC)	12 areas	No plans/publications are required. Established by EA with members appointed by Lead Local Flood Authorities, all meetings are open to the public.	https://www.gov.uk/government/publications/regional-flood-and-coastal-committees-map

River Basin Districts	9 areas	River Basin Management Plans updated every 6 years, managed by EA. Set out how organisations, stakeholders and communities will work together to improve the water environment.	https://www.gov.uk/government/publications/river-basin-district-map
Catchment Partnerships	89 areas	Catchment Plans updated annually, produced by varied partnership (EA heavily involved in most cases). Establishes a strong framework for collaborative working to deliver integrated catchment management.	https://www.gov.uk/government/publications/catchment-partnerships-in-operation-list-and-map
Water Company Areas	25 areas	Water Resource Management Plans & Drought Management Plans, published every 5 years. Produced by Water Companies. Set out the long term (25 years) view for water resources or drought in the Water Company areas, setting out supply and demand balance.	https://www.ofwat.gov.uk/households/your-water-company/map/
Marine Plan Areas	10 areas (areas 10 & 11 are merged)	Marine Plan reviewed every 3 years, 10 year outlook. Led by MMO. Sets out future development plans and informs sustainable use of resources. Prepared through consultation with stakeholders and published online.	https://www.gov.uk/government/publications/marine-plan-areas-in-england

National Character Areas	159 areas	These broad divisions of landscape form the basic units of cohesive countryside character, on which strategies for both ecological and landscape issues can be based.	https://data.gov.uk/dataset/21104eeb-4a53-4e41-8ada-d2d442e416e0/national-character-areas-england
Biogeographic areas	13 areas	The divisions are based on National Character Areas grouped together based on data volume and satellite coverage.	To be published with Living England maps (Natural England)