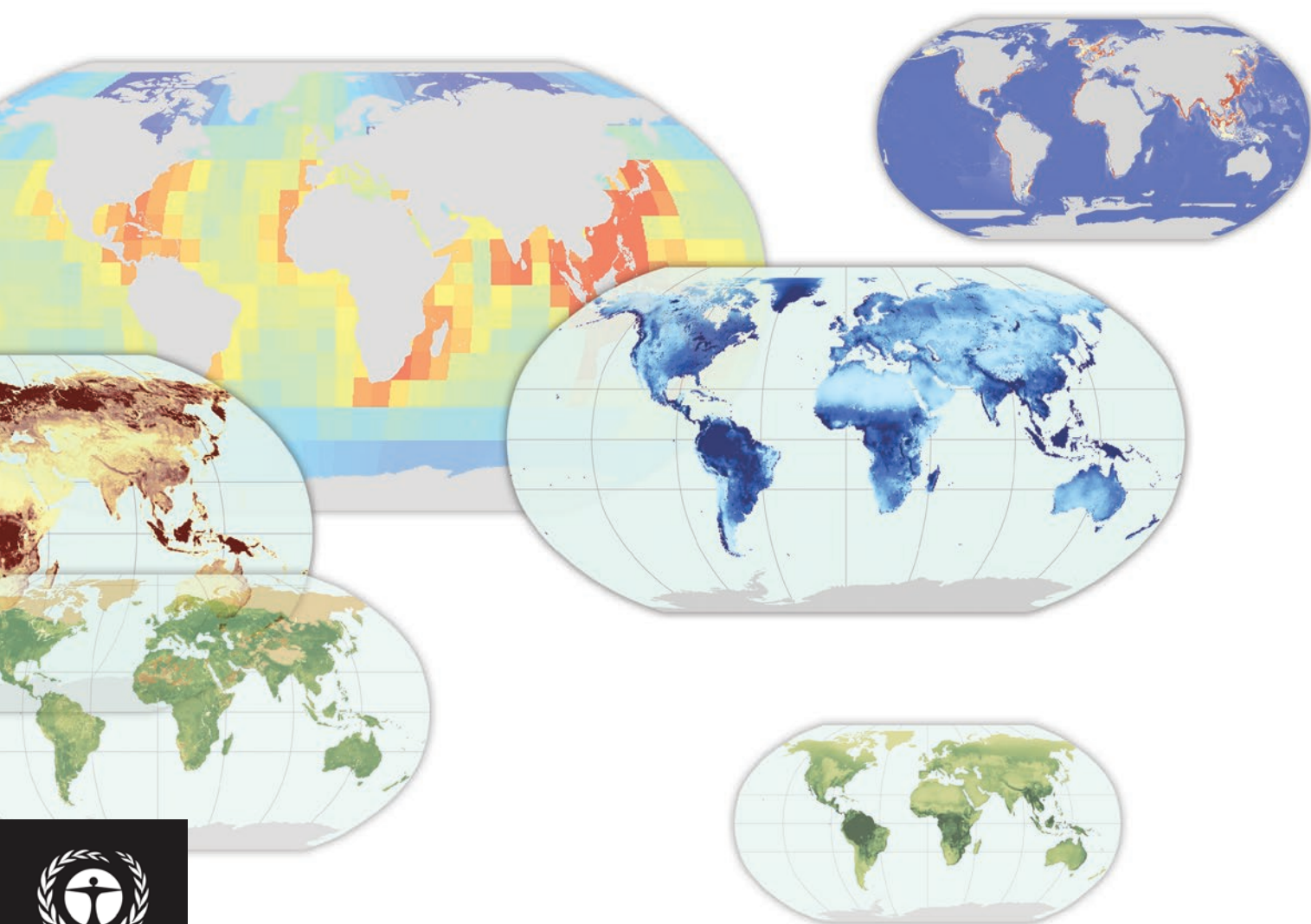

Towards a global map of natural capital: key ecosystem assets



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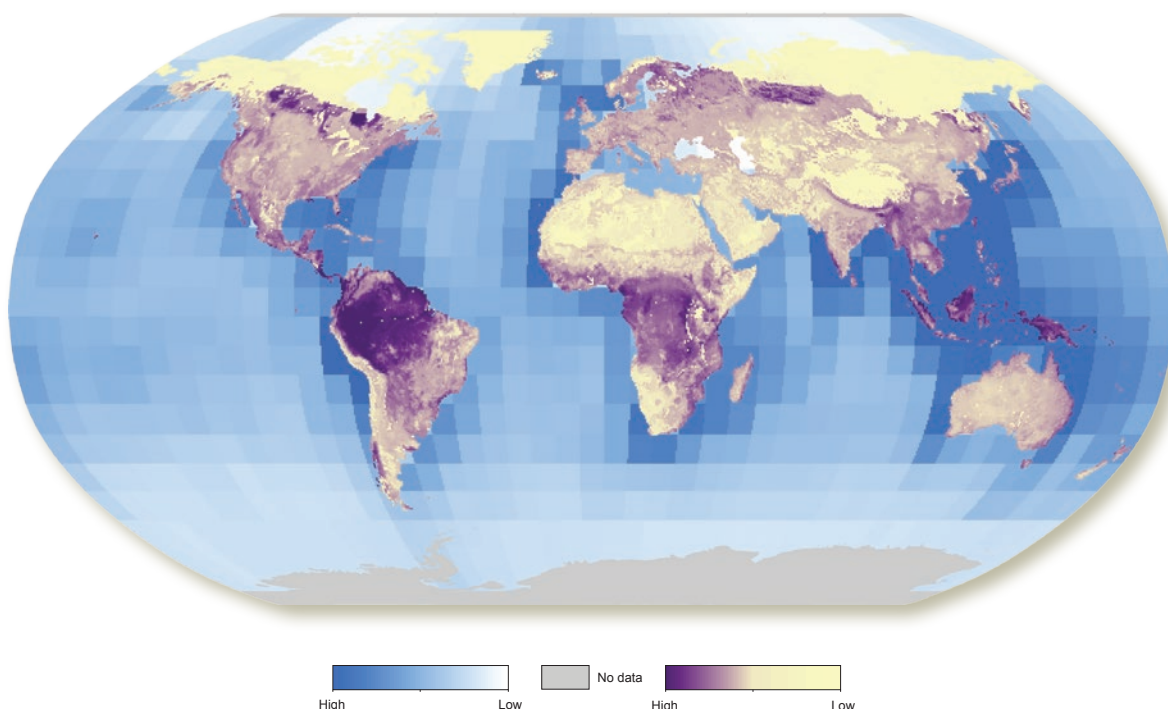
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Summary

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- ◆ Natural capital is fundamental to human well-being, underpinning the global economy.
- ◆ Natural capital comprises both ecosystem assets (such as fresh water) and natural resources (such as fossil fuel deposits). This report presents the first attempt to give an overview of the global distribution of ecosystem assets.
- ◆ Ecosystem assets have the capacity to generate a basket of ecosystem services, and this capacity can be understood as a function of the extent (quantity) and condition (quality) of the ecosystem.
- ◆ The report builds on a considerable body of work in the fields of natural capital accounting and the mapping of ecosystem services. In particular, it draws on the UN Statistics Division's System of Environmental-Economic Accounting (SEEA) and its Experimental Ecosystem Accounting approach, as well as the work by many other researchers.
- ◆ The composite map of ecosystem assets is produced by combining a number of existing global spatial datasets to produce a map for both terrestrial and marine realms. The individual datasets represent fresh water resources, soil quality for plant growth, terrestrial carbon, terrestrial and marine biodiversity, and marine fish stocks.
- ◆ The individual datasets used here represent a physical assessment of ecosystem assets. The challenges of providing a monetary valuation of those assets are discussed, but this valuation is not undertaken here.
- ◆ Marine ecosystem assets are concentrated in Southeast Asia and along coastlines (especially the west coasts of South America, Africa and Europe) while terrestrial ecosystem assets have concentrations in the equatorial regions and parts of Canada and Russia.

- ◆ Broken down by asset type, fresh water resources are unevenly distributed throughout the world, with striking quantities in Greenland, the west coast of North America, much of South America, the Congo basin, Madagascar, and large areas of South and Southeast Asia. Good soil quality for plant growth can be found on all continents. Global terrestrial organic carbon stocks are high in tropical and boreal forest regions, with stocks in the tropics being predominantly found in vegetation, and stocks in the boreal regions being predominantly in soils. There are extensive areas of largely intact biodiversity in the tropical rainforests in the proximity of the equator.
- ◆ Mapping ecosystem assets at a global level has inherent biases. For example, a relatively low value at a global level does not mean that a given area is not nationally or locally important for well-being or economic activity. In addition, the ecosystem assets mapped differ with regard to the scope of their beneficiaries. Fresh water resources, soil quality and marine fish stocks are significant for economic use in national and local contexts, while carbon and biodiversity values are likely to extend beyond a single country or region.
- ◆ This is an initial study which demonstrates that it is possible to map ecosystem assets at the global scale. There are some obvious gaps in our mapping, for example in ecosystem functions such as coastal protection and cultural/aesthetic values. These and other ecosystem assets should be included in future mapping of global ecosystem assets.
- ◆ Ecosystem assets represent only a part of natural capital. In order to produce a comprehensive global map of natural capital, the full array of ecosystem assets and natural resources need to be mapped.



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- ◆ Further work could include:
 - ◆ Undertaking spatial analysis of the change in ecosystem asset distributions over time.
 - ◆ Investigating natural capital distribution at national and sub-national scales. This can inform decision-making by providing useful insights on the synergies and trade-offs between asset types.
 - ◆ Undertaking monetary valuations of ecosystem assets and exploring ways of representing these values spatially.

1. Introduction

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The concept of natural capital, which has its theoretical origins in the environmental economics of the 1990s, has experienced increased interest following the publication of the Millennium Ecosystem Assessment and the development of the ecosystem services approach. In recent decades we have learned more about the ways in which nature provides vital life-support functions upon which we depend for our survival. The problem we face is that natural capital has been harvested or degraded at a rate that threatens to undermine both well-being and future economic growth (UNEP, 2007). Natural capital may be transformed to other types of capital, but even manufactured capital is formed from the resources found in nature.



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The growing recognition that the environment plays a fundamental role in determining global economic outputs and human well-being has led to a range of responses, one of which is the integration of the value of natural capital into policy and decision making. As a consequence, governments around the world are grappling with how to better measure the success of their economies. Work is being carried out by the World Bank, OECD, UN, EEA and others on developing methods to incorporate natural capital into national accounts.

There is a considerable body of work in the fields of natural capital accounting and the related area of mapping of ecosystem services. This pilot project builds on these foundations to develop the first global map of the ecosystem stocks of natural capital. The global map combines layers of key ecosystem assets into a composite map covering both terrestrial and marine ecosystems. More specifically, the underlying layers are fresh water resources, soil quality for plant growth, terrestrial organic carbon, terrestrial and marine biodiversity, and global fish catch (as a proxy for marine fish stocks).

Sections 2, 3 and 4 of this report set the context by defining natural capital and ecosystem assets; providing an overview of relevant policy drivers and activities of key actors; and giving a brief summary of approaches for physical and monetary assessment of natural capital and a discussion of the utility of mapping natural capital. Section 5 presents the results of the pilot study, comprising individual maps for key ecosystem assets and a composite map. Section 6 concludes with some reflections on the outcomes of the study and the next steps for developing the mapping of natural capital.

2. Defining natural capital and ecosystem assets

Classical economists of the 19th century such as Ricardo and Faustmann were already treating natural resources as capital in economic theory, while modern thinking begins with Hotelling's work on non-renewable resources (Fenichel & Abbott, 2014). The natural capital concept, as understood here, was popularised in the early 1990s and was born out of theoretical advances to bridge the gaps between economics and ecology (Voora & Venema, 2008). In the 'capital approach', the traditional definition of capital as manufactured factors of production, such as machinery and roads, is extended to include further capital types, like human, social and natural capital (Neumayer, 2003). A large body of work has applied the capital approach to sustainability to assess whether different types of capital are substitutable and whether critical natural capital (unsubstitutable by definition) exists (Atkinson & Pearce, 1995; Ekins, 2001; Costanza & Daly, 1992).

There are various definitions of natural capital, all of which describe natural capital as underlying human well-being. An early, influential definition by Daly (1994) describes natural capital as the "stock that yields a flow of natural services and tangible natural resources". Similarly, OECD (2007) defines natural capital as "the natural assets in their role of providing natural resource inputs and environmental services for economic production". A UNEP definition (2012) emphasizes specific components: "Natural capital includes land, minerals and fossil fuels, solar energy, water, living organisms, and the services provided by the interactions of all these elements in ecological systems". In the System of Environmental-Economic Accounting (SEEA) framework, natural capital is used to refer to all types of *environmental assets*, the naturally occurring living and non-living components of the Earth, constituting the biophysical environment (European Commission *et al.* 2013). SEEA Experimental Ecosystem Accounting provides a definition for a subset of natural capital by defining *ecosystem' assets* "as spatial areas containing a combination of biotic and abiotic components and other characteristics that function together" (European Commission *et al.* 2013).

¹The most widely used definition of an ecosystem is that adopted by the Convention on Biological Diversity (CBD) that defines ecosystem as a "dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (CBD, 1992, Article 2).

Natural Capital

Environmental Assets:

Ecosystem Assets

- ◆ Biodiversity - the stock of plants (including trees) & animals (including fish), fungi & bacteria (e.g. for food, fuels, fibre & medicine, genetic resources for developing new crops or medicines, or as a tourism asset etc.)
- ◆ Soils for producing crops (note that the crops themselves, i.e. the commercial seeds & livestock, are better considered a produced asset in this instance)
- ◆ Surface fresh waters (e.g. for drinking water, hydropower, watering crops, washing etc.)
- ◆ The store of organic carbon (held in terrestrial plants & soils, as well as in marine organisms)
- ◆ Landscapes (in terms of aesthetic values for enjoyment, including tourism use)

Natural Resources

- ◆ The recoverable stock of fossil fuels (i.e. coal, oil & gas)
- ◆ The recoverable stock of minerals (including metals, uranium etc)
- ◆ Aggregates (including sand)
- ◆ Fossil water stores (i.e. deep underground aquifers replenished over centuries)
- ◆ Deep ocean stores of carbon
- ◆ Land (i.e. space for activity to take place)
- ◆ Ozone layer (protective value)
- ◆ Solar energy (i.e. as a source of energy, including plant growth)

Figure 1: Natural capital: examples of ecosystem assets and natural resources

As illustrated in Figure 1, our definition of natural capital is equivalent to SEEA's definition of environmental assets. That is to say, natural capital is made up of ecosystem assets and natural resources. Used in this way, natural capital includes natural resources such as minerals and energy,

The distinction between stocks and flows, i.e. between ecosystem assets and ecosystem services, is crucial to the approach at hand. Figure 2 provides a visualization of the role of assets relative to services: ecosystem assets are the stocks that enable the flow of ecosystem services. Services in turn yield

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