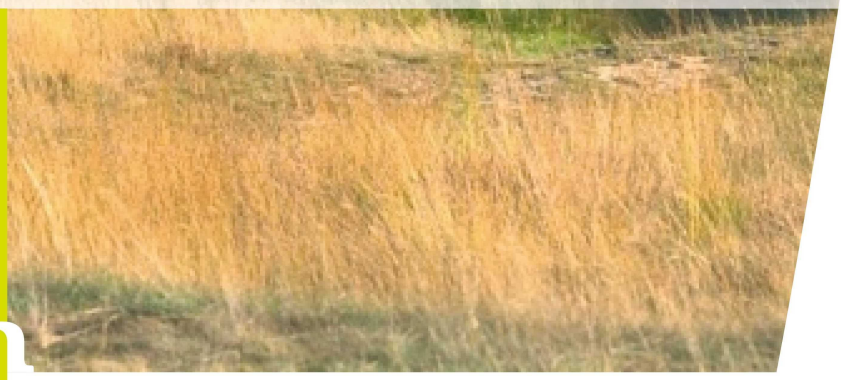
Biodiversity: how much is left?

The Natural Capital Index framework (NCI)

The Natural Capital Index framework (NCI), developed as a contribution to the implementation of the Convention on Biological Diversity (CBD), was designed to answer the questions 'How much biodiversity remains?', 'What are the causes of loss?' and 'What can we do about it?' for policy-makers and public. This brochure explains the NCI framework, illustrates its use with examples from the Netherlands, and should be able to contribute to the further discussion on biodiversity indicators.



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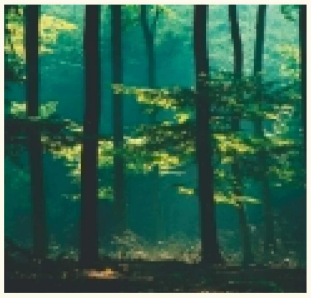
Biodiversity loss

The rate of biodiversity loss has been accelerating rapidly throughout the industrial era. According to the Global Biodiversity Assessment, species are now becoming extinct at 1,000-10,000 times the natural rate. However, extinction is just the final step in a long process of ecosystem degradation, in which a decline in the abundance and distribution of many species is usually accompanied by a rise in the abundance of a few others. Few common species are becoming more common, rare species more rare. This we call the *uniformity process*.



This trend has two main components: i) *loss of habitats*, or 'ecosystem quantity', resulting from the conversion of natural areas to agricultural or urban use and ii) *loss of ecosystem quality* due to factors such as climate change, pollution, habitat fragmentation and over-exploitation (see figures 'past, today and tomorrow'). Here, the grey cutouts illustrate the loss of natural areas to agricultural land or built-up areas, while, in the remaining areas, the decline in ecosystem quality is shown by the decreasing abundance of many characteristic species. Notice the initial increase in the species richness. Species abundance (numbers of one species) of a core set of species has turned out to be a far more sensitive, more measurable and a more accurate indicator of biodiversity loss than the more traditional species-richness indicator.

Process

The Natural Capital Index framework (NCI)

The challenge is to create a tangible, powerful composite indicator that accurately describes the above process for meeting policy requirements. Furthermore, this indicator must be relevant and appealing for policy development, quantitative, sensitive, affordable, measurable and universally applicable. Finally, it should represent the entire ecosystem and must be linkable with socio-economic scenarios to make projections. *For these reasons NCI considers biodiversity as 'natural capital', a 'common resource base' containing all species with their corresponding abundance.*

Given its two main components, as mentioned above, NCI is defined as the product of the size of the remaining area (quantity) and its quality.

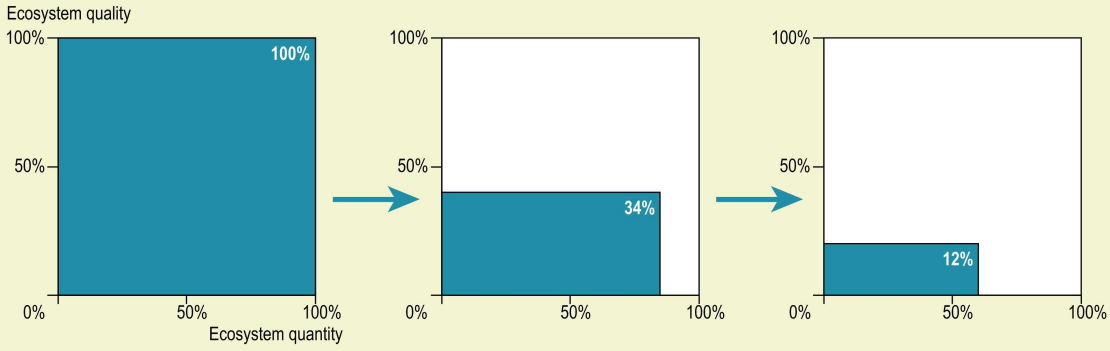
NCI = ecosystem quantity (%) x ecosystem quality (%).

The NCI can be established for natural areas such as forests, inland waters and grasslands, as well as for man-made areas such as agricultural land and urban areas. Ecosystem quantity is calculated as a percentage of the total area (% area of the country or region). Ecosystem quality is calculated by counting the average abundance of a core set of animal and plant species; however, process and structure variables can also be used as quality variables. Quality is defined as the ratio between the current situation and baseline state (percentage of the baseline). The NCI range is from 0 to 100%. The three diagrams 'ecosystem quantity and ecosystem quality' shown below demonstrate how the process of ecosystem degradation can be visualised using the Natural Capital Index. If we assume for a country, for example, that 60% of the natural area remains, with a quality of 20%, the natural capital is 12%. An NCI of 12% means an average abundance of the characteristic species of roughly 12% of the baseline state.

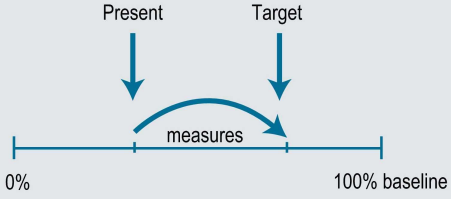
Baselines needed

Ecosystem quality cannot be determined without defining a baseline. Baselines are starting points for measuring change from a certain state or date. They are common practice for such items as medical care, economic development and climate change. Since there is no unambiguous natural baseline point in history, and all ecosystems are also transitory by nature, a baseline must be established at an arbitrary but practical point in time. Because it makes the most sense to show the biodiversity change when human influence was accelerating rapidly, the first CBD Liaison Group on Biodiversity Indicators recommends 'a postulated baseline, set in pre-industrial times' or a 'low-impact baseline' as being the most appropriate. The baseline i) allows aggregation to a high level, ii) makes figures within and between countries comparable, iii) is a fair and common denominator for all countries, being in different stages of economic development, and iv) is relevant for all habitat types. Similarly, agricultural ecosystems are compared with the traditional agricultural state as the baseline, actually before industrialisation of agricultural practices started.

NCI Principle

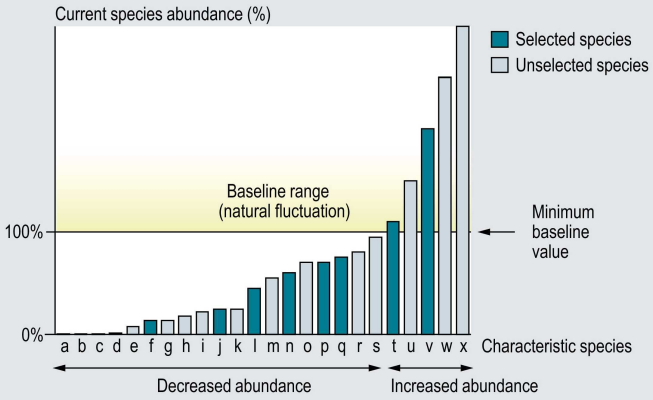


It has to be stressed that the baseline is not the targeted state. Policy-makers choose their ecological targets somewhere on the axis between 0 and 100%, depending on the political balance between social, economic and ecological interests.

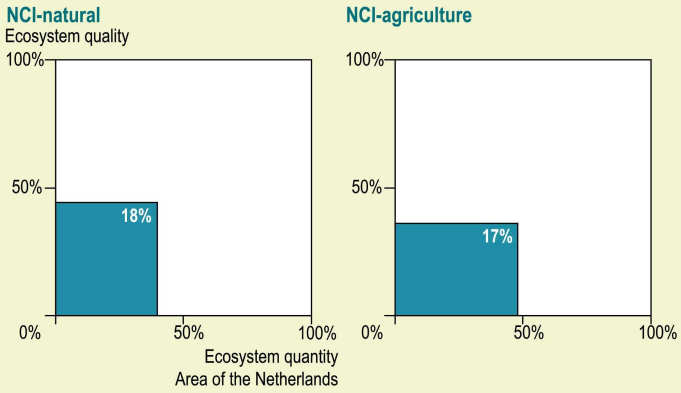


Smart sampling

How can ecosystem quality be determined in a practical and affordable way? It is neither necessary nor possible to monitor all species. A representative cross-section of characteristic species suffices to describe the -above mentioned- uniformity process of the entire ecosystem. For each species, quality is calculated as the ratio between the current state and the minimum baseline value. Ecosystem quality is a function of the abundance of species relative to the baseline. This selection and averaging method is similar to that for economic indicators, such as the retail price index, a representative selection of products monitored in a subset of stores, the so called 'shopping bag'. Subsequently, the changes in prices are also averaged and weighted; this is because a price increase in bread cannot simply be averaged with a price increase in cars.

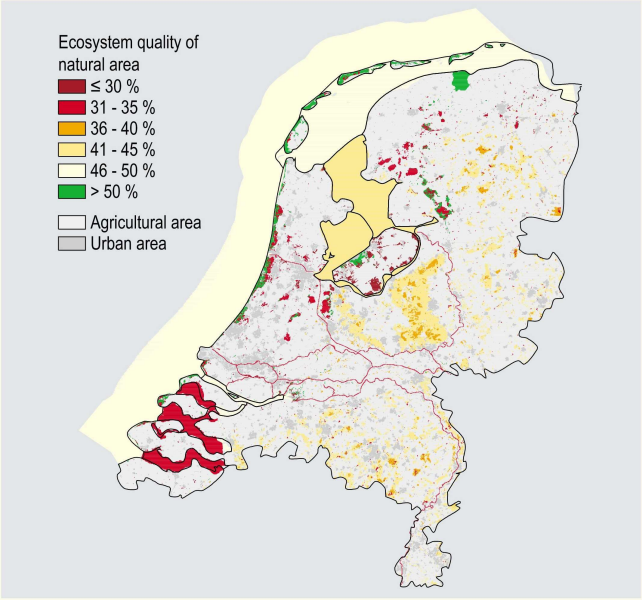


Application



Example: how much Natural Capital is left in the Netherlands?

The quantity of natural aquatic and terrestrial ecosystems in the Netherlands has declined to 40% of its total territory, while the average quality of these ecosystems is estimated at a modest 44%. The resulting NCI of these natural ecosystems is thus 18%, the product of quantity and quality. So roughly speaking, 18% of the average abundance of the characteristic species remains in comparison with the baseline state. The NCI for agricultural land is 17%. Although the indices are similar, the NCI for natural ecosystems is derived from a smaller area of higher quality in comparison with the NCI for agricultural land.

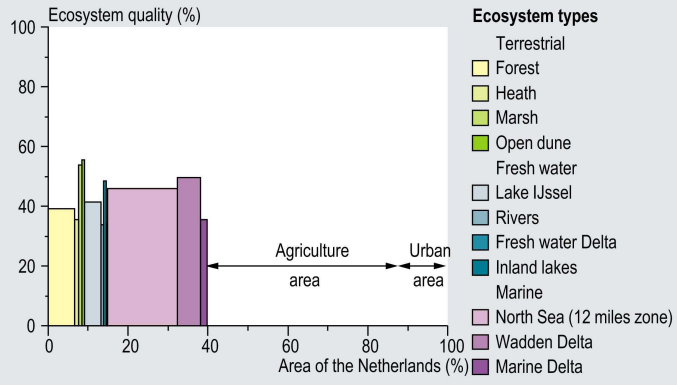


How is Natural Capital distributed?

The distribution of the Natural Capital of *natural ecosystems* is presented here on one comprehensive map. Twenty-two natural ecosystem types are distinguished, including 'marshes in marine clay area', 'forest in higher sandy soil area', dunes, the North Sea (12-mile zone) and fresh-water lakes. The extent of the natural area is determined from land-use maps (resolution of 250 m x 250 m). Ecosystem quality is calculated on a scale for ecosystem types. Agricultural land (48%, white) and urban areas (grey) occupy much of the terrestrial land area. Remaining terrestrial natural ecosystems are small, scattered over the country and fragmented (coloured). The western part of the Netherlands is dominated by estuarine, coastal and aquatic ecosystems. The east consists of forest and heathland on sandy soils. All ecosystems are seriously affected by various pressures and are of medium quality – to be expected in this highly populated and industrialised country. The quality of the marine ecosystems and the coastline is relatively high (>46%), while that of the inland aquatic systems and heathland is lower (<35%).

Share per ecosystem type

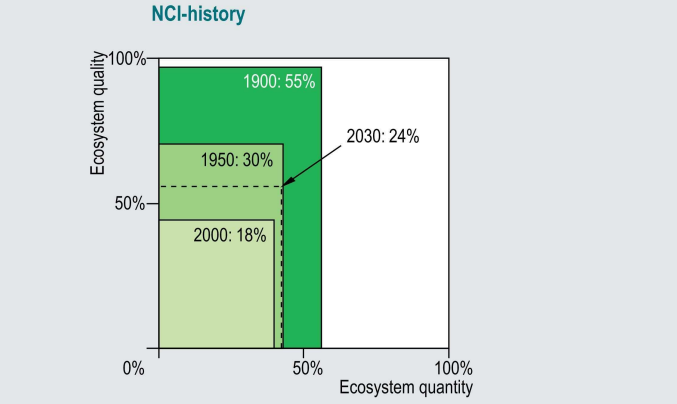
The contribution of the various natural ecosystem types to the Dutch Natural Capital is presented alongside. Quantity and quality are given for each ecosystem type. Marine and large fresh-water ecosystems are very important in the Netherlands, together covering more than 75% of the area of natural ecosystems and displaying medium quality. Forests, heath and inland lakes are examples of smaller areas with a lower quality. In the diagram alongside the x-axis has been enlarged in order to see the contribution of the smaller ecosystem types.

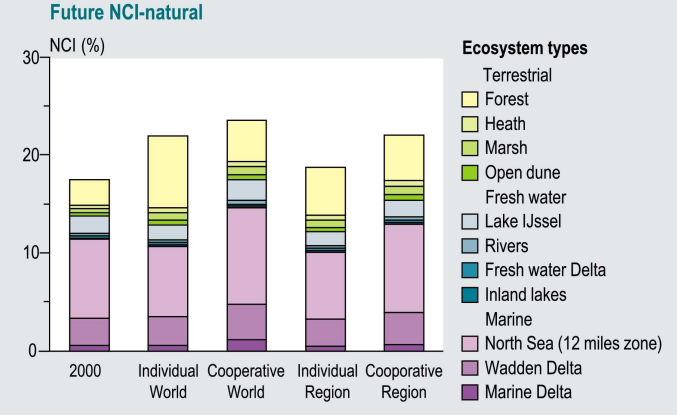


Using NCI to support policy-making

A snapshot of NCI values taken in the year 2000 does not provide sufficient information for policy-makers. What happened in the past, what were the main causes, what will happen in the future, what are potentials, and what can be done to restore biodiversity in an efficient manner? Natural Capital Index time-series were developed and analysed to answer these very questions. Projections for 2030 have been calculated on the basis of policy scenarios reflecting a range of environmental concerns, societal trends and policy options.

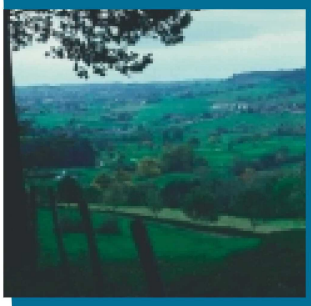
The NCI for Dutch natural ecosystems has declined rapidly in the last hundred years. Much of the area was lost in the first half of the century, while ecosystem quality decreased, especially in the second half of the century. Terrestrial ecosystems have been affected more than aquatic ecosystems. The question now is whether this negative trend will continue. To connect fragmented pockets of natural ecosystems, the Dutch Government is implementing a nature development policy shaped by a national network of linked ecosystems, including the protection and development of specific habitats and species. The protection and restoration of biodiversity in agricultural landscapes is also an aim. With a smart combination of spatial, environmental and management measures the Government expects to slow down biodiversity loss in the Netherlands. This should eventually lead to a reversal of the current negative trend. A scenario analysis shows that the Natural Capital Index may improve from 18% up to 24% over a 30-year period, which represents a significant increase in natural capital.

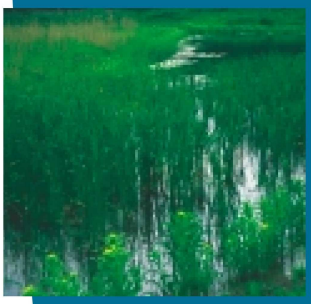


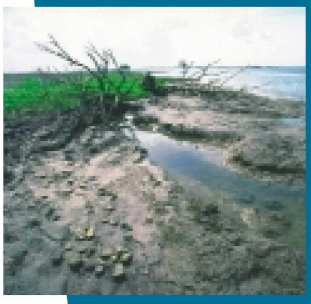


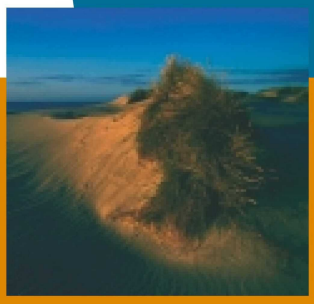
Wide applicability

The NCI is applicable in any country and to all terrestrial ecosystems, agricultural ecosystems, inland waters, marine ecosystems and oceans. If data on quality variables are insufficiently available, a pressure-based NCI could be a useful substitute, assuming that pressures are inversely related to quality. Data on pressures are often more widely available. Several initial exercises have been carried out on variety of spatial scales: globally in UNEP's Global Environmental Outlook, continentally in Europe (pressure-based), and nationally in the Netherlands. Some case studies in developing countries are in preparation.









NCI in a nutshell

- The Natural Capital Index, defined as ecosystem quantity (% area) x ecosystem quality (% baseline), is a practical tool for policy-makers to manage natural resources at the national and international level.
- It describes the uniformity process of biodiversity, which takes place globally.
- It is a simple, powerful indicator of state and change in biodiversity.
- It is universally applicable and still country-specific.
- It is applicable to all scales and for all natural and man-made (agricultural) ecosystems.
- It encapsulates complex biodiversity changes in one score: the average change in abundance of ecosystem-specific species compared to the baseline.
- It can also show detailed figures, depending on the policy issue.
- It answers questions about how ecosystems are performing in general, what the causes of changes are, how ecosystems have been affected by policy and what the effective measures are.
- It can be used in modelling and impact assessments within policy scenarios.
- It can be gradually established, depending on the available capacity, data and resources.
- It can function as society's eyes and ears in protecting the world's natural capital. Indicators such as NCI are indispensable tools for feedback and feed-forward processes of modern society.
- It may help in achieving sustainable development, balancing ecological, economic and societal interests.
- It may be an appropriate tool to evaluate the objectives of the Convention on Biological Diversity for conservation and sustainable use of biodiversity.
- Other indicators, such as the red list of endangered species or species richness, offer additional information permitting complementary analyses.

Background information

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