

Indicator name			Version
NB14: Natural Capital Asset Index			29/03/16
Indicator type:	Risk/opportunity	Impact	Action
		X	
SCCAP Theme	SCCAP Objective	CCRA risk/opportunity	
Natural Environment	N2: Support a healthy and diverse natural environment with capacity to adapt	Cross cutting	

### At a glance

- Nature provides services that underpin ecosystems and sustain our lifestyles
- These free services of nature are not accounted for; therefore are undervalued and being degraded or lost
- 'Natural Capital' provides a means to account for nature within a national balance sheet and capture the contribution of services provided in national accounts
- The impacts of climate change constitute a threat to Scotland's natural capital
- Scotland's Natural Capital Asset Index developed by SNH is an attempt to quantify changes in its natural capital

Latest Figure	Trend
Not applicable	No significant change (2000 – 2010), following a significant decline from the 1950s to the 1990s

### Why is this indicator important?

Natural capital can be defined as 'the stock of natural systems, or 'ecosystems', which yields a flow of valuable services into the future' (Blaney, 2012a). The Economics of Ecosystems and Biodiversity (TEEB) report (2010) showed the importance of natural systems to economic development and the value of nature to people (Scottish Government, 2013). The concept of natural capital provides a means to measure the benefits accruing from nature.

Internationally there is considerable concern that the value provided by nature and ecosystem services that underpin standards of living is not being adequately captured by markets. This can lead to undervaluation, degradation and loss. Natural capital is particularly important to Scotland, as it is believed to generate a national competitive advantage in key sectors such as food and drink and tourism (Scottish Government, 2013).

Climate change has been identified as a future threat to Scotland’s natural capital (Blaney, 2012a).

The Natural Capital Asset Index (NCAI) has been developed by Scottish Natural Heritage (SNH) since 2009, and aims to guide sustainable economic growth through management that protects and builds natural capital for continued use into the future. It describes changes across Scotland’s ecosystems since 2000. An indicative backwards projection of the index has been produced back to 1950 (Scottish Government, 2013).

The NCAI can be used to assess changes in natural capital over time, the success of strategy in the past and to inform future strategy. The NCAI should reflect the ability of Scotland’s ecosystems to cope with a range of pressures, including climate change. A decline in natural capital would be expected if ecosystems were unable to cope with pressures such as a changing climate. The NCAI can be used to assess changes in natural capital over time, the success of strategy in the past and to inform future strategy.

A number of countries are interested in investigating moving beyond the use of GDP to measure their economic success (Blaney, 2012a). The use of a National Capital Asset Index (NCAI) is one measure that can be used to capture the value of ecosystem services. Scotland is the first country in the world to publish such a detailed attempt to measure changes in its natural capital based on an evaluation of ecosystem service potential (Blaney, 2012a).

### What is happening now?

The latest figure (2011) for Scotland’s NCAI is an Index of 98. As can be seen from the table below, which sets this figure in a ten year context, Scotland’s natural capital score has been stable over the last decade (SNH, 2012c). Although there was a slight increase in the NCAI score in the mid part of the decade, in recent years a decline to year 2000 levels means overall there is no significant change in natural capital for the decade.

Year	NCAI
2000	100
2001	100
2002	100
2003	100
2004	100
2005	101
2006	102
2007	102
2008	101
2009	101
2010	100
2011	98

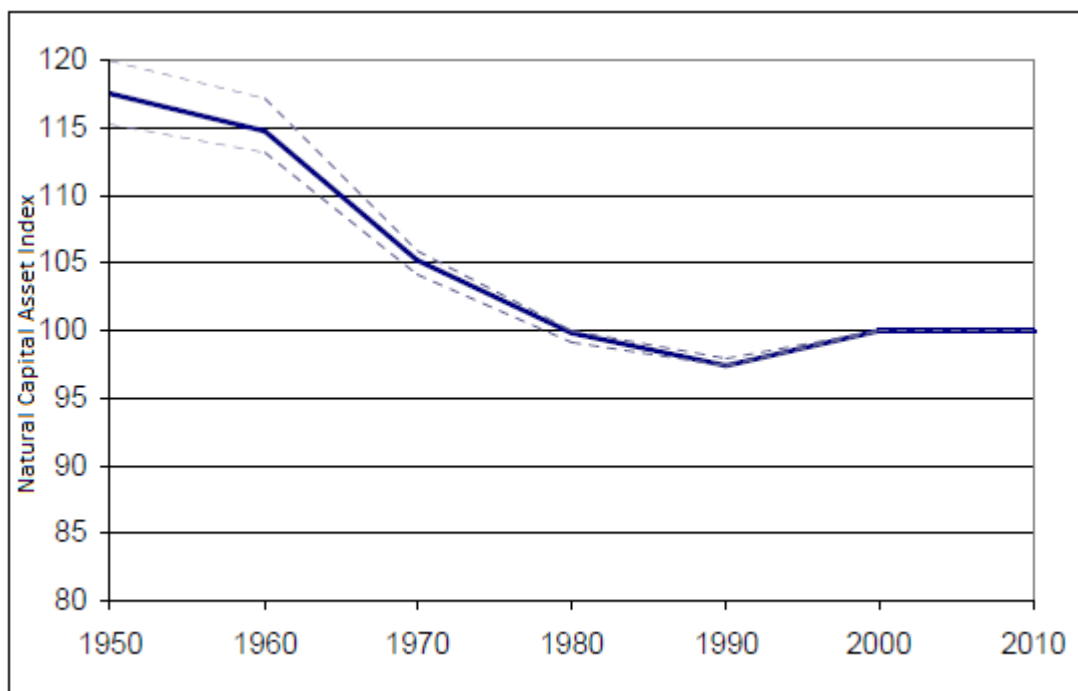
**Table 1: Natural Capital Asset Index for Scotland, 2000–2011**

Source: SNH 2012c.

The NCAI is an aggregate index produced from an analysis of the ecosystem area and ecosystem quality of seven broad habitats. Natural capital provides ecosystem services that for the purposes of the NCAI are divided into 3 main categories: provisioning services; regulation and maintenance services; cultural services (Blaney, 2012a).

## What has happened in the past?

Providing a historical context spanning several decades enables a better understanding of the current level of natural capital (see Figure 1). A back-casting of the index to 1950 shows a significant decline in Scotland's natural capital from 1950 to 1990, especially during the 1960s and 1970s. It is important to note that the backcasted index is not directly comparable to the NCAI proper (2000 onwards) due to very limited data being available prior to 2000 (see Methodology for details). The biggest declines were seen in moorland and grassland ecosystems (Blaney, 2012a). There was a slow recovery in natural capital during the 1990s but this has levelled off since 2000.



**Figure 1: Changes in Scotland's NCAI 1950-2009\***

Source: SNH, 2012c

\*Note: dotted lines represent estimated error margin due to limited data available for 1950-2000.

This trend is consistent with the UKNEA (2011) (cited in Scottish Government, 2013), which highlighted the way Scotland's natural environment has changed since 1950. While food production from agriculture has significantly increased, there have been declines in air, water and soil quality and other ecosystem services, especially those with lower market value or lower visibility (2020).

## What is projected to happen in the future?

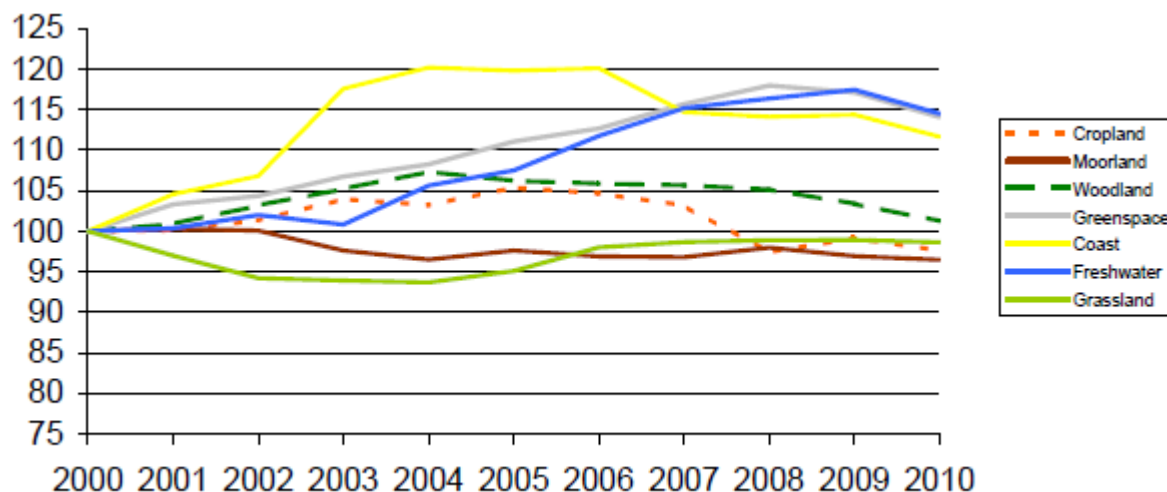
'Scotland's Biodiversity Strategy, The 2020 Challenge for Scotland's Biodiversity' (Scottish Government, 2013) aims to ensure all habitats in Scotland begin to recover from past degradation. Peatlands are an especially important focus of attention as they play a critical role in storing carbon and have international conservation significance. Particular future threats to Scotland's natural capital include invasive non-native species as well as climate change (Blaney, 2012a).

The NCAI methodology (described in Table 4 below) is being revised and further developed prior to the next release in November 2015. The seven broad habitats used to date will be replaced by EUNIS Level 2 habitats. These are part of the European Nature Information System (EUNIS) developed by the European Environment Agency (EEA, 2015).

## Patterns of change

### 2000 - 2010

During the decade 2000–2010, three broad habitats (greenspace, coast and freshwater) showed clear improvements in NCAI, whilst moorland showed a steady decline. Cropland and grassland showed a slight decrease and woodland a slight increase in NCAI. See Figure 2 below for details in changes in NCAI for each broad habitat type.



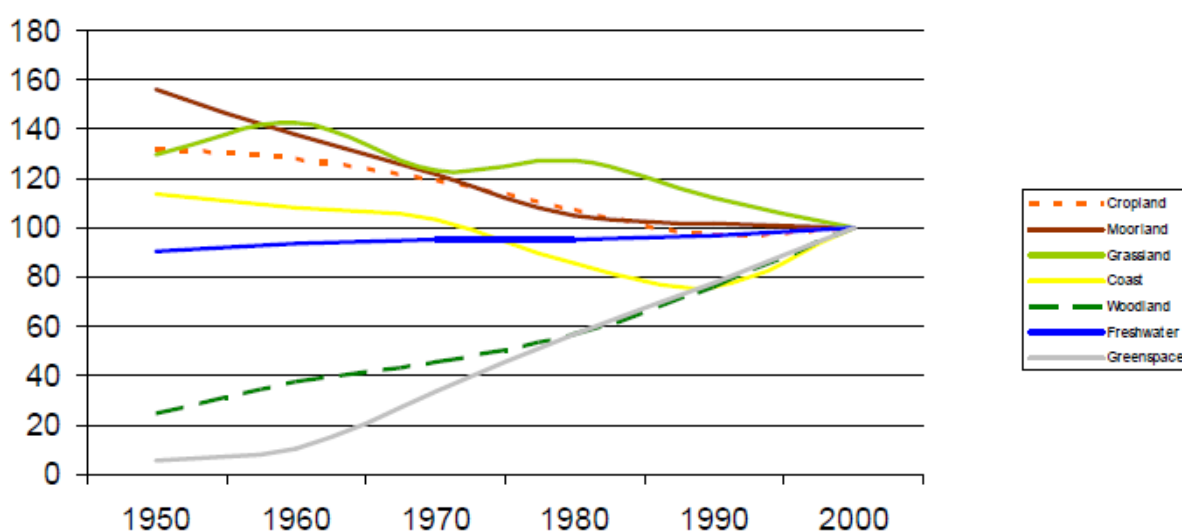
**Figure 2: NCAI for each broad habitat 2000-2010**

Source: SNH, 2012c

### 1950s – 1990s

From the 1950s to the 1990s, although most ecosystems declined in natural capital, the overall fall was particularly driven by changes in moorland and grassland during this period (SNH, 2012c).

Cropland and coastal habitats also declined until the 1990s, when they started to show improvements. Woodland on the other-hand showed a rapid rise in natural capital throughout the period, as did urban greenspace. Freshwater habitats had a slower upward trend in natural capital. Figure 3 maps these trends in relation to one another.



**Figure 3: NCAI backcasting by broad habitat**

Source: SNH, 2012c

### Ecosystem service analysis

As well as identifying trends in the NCAI across different broad habitat types, it is possible to identify trends in the potential delivery of the different types of ecosystem services (provisioning; regulating and maintaining; cultural). SNH (2012c) note that the provisioning and cultural service potential of Scotland's ecosystems has increased over the decade, but the regulating and maintenance service potential has fallen. This could be a cause for concern as maintenance services fundamentally support the delivery of other services, so there may be a 'lagged decline' in other natural capital factors.

For data tables showing details of NCAI values for each habitat type see [www.snh.gov.uk/docs/A698120.pdf](http://www.snh.gov.uk/docs/A698120.pdf)

### Interpretation of indicator trends

The NCAI is not designed to provide an absolute measure of the 'amount' of Scotland's natural capital, but a picture of relative change over time and the drivers of that change (Albon et al, 2014). Also, there is no specific target. The base year is 2000 (with an Index of 100) but this is not intended to reflect the state of the environment at that point in time. It is the long term trend in the NCAI, and the drivers behind it, that are important. SNH (2012b) suggest that a change in the index of 5% or more, consistently over a period of a few years, should be interpreted as being significant i.e. a real change in natural capital. SNH (2012c) note that drivers of change may include differences in the area of different broad habitat categories, although it is unlikely that this would change much over the short-term e.g. the period of a decade (exceptions being forestry and farmed lands).

#### 2000 – 2010

In the NCAI Technical Document (SNH, 2012c) SNH interpret the trends and underlying drivers for each broad habitat category as follows:

- **Cropland:** The rising NCAI for cropland in the early part of the decade was explained by reduced fertiliser use, an increase in the area of land managed under agri-environment schemes and increases in bird and butterfly populations. The decline in the second half of the decade was explained by a reduction in the area of set-aside, fodder crops and mixed farming; falling livestock grazing; an increase in invasive species; a decline in the species richness of improved grasslands; and a loss of hedgerow length and quality.
- **Moorland:** The moorland NCAI fell in the early part of the decade and remained variable. The decline was explained by persecution of birds of prey, the encroachment of bracken, reduced carbon sequestration and a loss of plant biodiversity. Later, an increase in the number of designated heathland sites in favourable condition and in venison production caused an increase in natural capital, but this was off-set by a decline in red grouse populations and moorland grazing, as well as a decline in the condition status of designated bog sites.
- **Grassland:** The NCAI of grassland fell during the first part of the decade due to grassland being used for more intensive agricultural purposes. The subsequent partial recovery in natural capital resulted from an increase in the area of grassland and condition of designated sites, along with rising bird populations.
- **Coastal habitats:** The initial improvement in the NCAI of coastal habitats was owing to the increased quality of bathing water and a reduction in the amount of beach litter. However, later in the decade these began to regress, along with declining populations of coastal birds. Invasive species also became an increasing problem and the NCAI therefore declined.
- **Woodland:** The NCAI for woodland rose in the first part of the decade then fell. Improvements in carbon sequestration, timber production, the number of designated woodland sites in favourable condition and increases in the area of broadleaved woodlands, certified forests and woodland bird populations caused the initial increase. The subsequent

decline was caused by a reduction in the level of carbon sequestration as replanting did not keep pace with harvesting, tree disease outbreaks and a decline in woodland bird populations.

- **Freshwater:** The increase in the NCAI of freshwater was driven by improvements in water quality, ecological diversity, the condition of designated sites and in the size of salmon catches.
- **Urban greenspace:** Reasons for the increase in the NCAI for urban greenspace included a decrease in background nitrogen dioxide levels, an increase in urban food production and the creation of green networks.

### 1950s – 1990s

SNH (2012c) provide the following interpretation of NCAI backcasting trends between the 1950s and 1990s:

- **Cropland:** Croplands show a declining NCAI due to the loss of hedgerows and farmland birds and an excess of nitrogen applications which negatively impacted on ecological functioning. Since the 1990s the decline has levelled off and this may be due to agri-environment schemes and the use of set-aside, as well as legislation which has reduced the amount of nitrogen applied to farmland.
- **Moorland:** The rapid decline in the moorland NCAI is due to the encroachment of bracken on heather moorlands and peatland drainage.
- **Grassland/Woodland:** The decline in grassland and concurrent rise in woodland natural capital since the 1960s was largely driven by afforestation of grassland. The increase in woodland NCAI is also attributed in part to improved quality across all ecosystem service categories, resulting from a shift to more broadleaf planting from the 1980s along with increased timber production from earlier planting.
- **Coastal habitats:** Due to pollution, coastal habitats NCAI declined until the 1990s, when improvements in bathing water quality and in ecological status led to an improvement.
- **Freshwater:** The gradual rise in the freshwater NCAI hides a mixed picture for this habitat during this period. An increase in the area of freshwater habitat and chemical improvements from the 1980s benefited some species; however other native species declined and in particular there was a rise in invasive species.
- **Urban greenspace:** The greenspace NCAI increased due to the establishment of formal recreation areas and Local Nature Reserves, along with more gardens associated with increasing urbanisation.

SNH (2012c) note that 'What is also clearly observed is that given a fixed (or even declining) resource, we can manage the ecosystem to deliver a net increase in ecosystem service potential, and so improve Scotland's natural capital. This is most clearly demonstrated through the improvement of Scotland's coastal and freshwater ecosystems, where pollution controls have increased the functioning of these ecosystems.....It is also clear that funding sensitive land management on cropland and moorland over recent decades has halted a fairly rapid decline in natural capital'.

### Limitations

While the NCAI can demonstrate the impacts of human activity on the natural environment (although it cannot distinguish between anthropogenic and non-anthropogenic driven change), it cannot always show the impact of individual policies on natural capital. Also, it is not sensitive to how changing levels of natural capital might result in ecological thresholds or 'tipping points' being crossed. Close to such thresholds a small difference in natural capital as measured in the NCAI could have a disproportionately large impact on ecosystem services. A small loss in natural capital that results in a threshold being crossed could result in ecosystem collapse and loss of services; equally a small gain

might result in a dramatic improvement (Albon et al, 2014).

A further limitation is that the NCAI only considers terrestrial habitats; for example, marine habitats are not included. The index doesn't currently incorporate indicators for air, water and soil quality (SNH, 2012c)

In composite indicators such as the NCAI, significant detail can be obscured in the overall headline figure. The NCAI can be broken down into different habitats to provide a more detailed picture. The overall index should therefore be interpreted with this in mind.

Quality indicators have been chosen for use in the NCAI based on their relevance and regularity of data collection. In the majority of situations the availability of data has been limited and proxy indicators have therefore been used. In some cases extrapolation has been utilised where data is not collected annually (SNH, 2012c)

In 2014 SNH published a systematic evaluation of Scotland's Natural Capital Asset Index (Albon et al, 2014). It assessed the proportion of indicators to be fit-for-purpose as low (<30% for all Broad Habitats) however a large number were considered to be possibly fit-for-purpose. Albon et al (2014) reported that concerns with indicators that were possibly fit-for-purpose were often centred upon the extent to which changes in the indicator reflected changes in the asset. Thus, indicators were often marked as not fit-for-purpose where change in the indicator was believed to be influenced by factors other than the asset, the data was not sensitive to change, or an indicator was extrapolated for more than five years. The exclusion of not fit-for-purpose indicators from the index resulted in little difference to decadal trends but there were sometimes considerable differences in the magnitude of fluctuations.

In the NCAI the contribution of Broad Habitats to the delivery of ecosystem services was weighted, with the weightings sometimes based upon 'expert' opinion (due to a lack of quantitative data). Albon et al explored the impact of a radical change in the weightings used in the original method. In general they found that decadal trends concurred regardless of the weights. However, for some Broad Habitats the size of the relative change was considerably different. As a result they felt it could be difficult to make decisions about management intervention and policy development if the assumptions underlying the 'expert' weightings were viewed as contentious.

Albon et al concluded that many of the NCAI indicators measure ecosystem service flows, but few are able to detect change in the potential capacity (productivity) of natural capital assets to deliver ecosystem services. They say that 'the NCAI is a useful aggregate measure of ecosystem service flows rather than a reflection of changes in the condition of the asset (stock) and its capacity to sustain the flow of a suite of services. The risk is that the NCAI fails to detect deleterious change in the natural capital stocks, and the threat of collapse in services' (Albon et al, 2014, p.ii). Suggestions are made of ways to overcome this limitation, in particular the linking of NCAI with Scotland's Ecosystem Health Indicators. For further information see Albon et al (2014).

The 2015 version of the NCAI will build on the recommendations of the systematic evaluation carried out by the James Hutton Institute (Albon et al, 2014) and reflect input from stakeholders. A number of improvements will be evident, and the index is designed such that continuous improvements can be made.



## References

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## Further information

## Acknowledgements

Suzanne Martin (RBGE/CXC) contributed as a lead author to this indicator.

Paul Watkinson (SNH) reviewed and provided guidance. Mary Christie (SNH) also provided guidance.

SNH developed the NCAI and carried out all the analysis described herein.



## Appendix One: Indicator metadata and methodology

**Table 1: Indicator metadata**

	Metadata
<b>Title of the indicator</b>	Natural Capital Asset Index (NCAI)
<b>Indicator contact:</b> Organisation or individual/s responsible for the indicator	Ruth Monfries (Royal Botanic Garden Edinburgh/CXC)
<b>Indicator data source</b>	SNH Natural Capital Asset Index
<b>Data link:</b> URL for retrieving the indicator primary indicator data.	<a href="http://www.snh.gov.uk/docs/A698120.pdf">www.snh.gov.uk/docs/A698120.pdf</a>

**Table 2: Indicator data**

	Indicator data
<b>Temporal coverage:</b> Start and end dates, identifying any significant data gaps.	2000-2011 (and 'backcasting' 1950-2000)
<b>Frequency of updates:</b> Planned or potential updates	A revised version of the NCAI will be released in November 2015. Thereafter it may be revised annually or even continuously as new data becomes available.
<b>Spatial coverage:</b> Maximum area for which data is available	Scotland
<b>Uncertainties:</b> Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Lack of data – use of proxy indicators and extrapolation
<b>Spatial resolution:</b> Scale/unit for which data is collected	Broad habitat type
<b>Categorical resolution:</b> Potential for disaggregation of data into categories	Broad habitat types, ecosystem service type
<b>Data accessibility:</b> Restrictions on usage, relevant terms & conditions	Publically available, free of charge

**Table 3 Contributing data sources**

Contributing data sources
Data sets used to create the indicator data, the organisation responsible for them and any URLs which

provide access to the data.

Data sources for each area of broad habitat are detailed in 'SNH's Natural Capital Asset Index' (Blaney, 2012b). This can be accessed here: <http://www.snh.gov.uk/docs/A958906.pdf>

A number of indicators are used to assess changes in the quality of each broad habitat type, or the ability of each habitat to provide ecosystem services. They have varying data sources.

**Table 4 Indicator methodology**

### Indicator methodology

The methodology used to create the indicator data

The index is based upon on the 'Natural Capital Index Framework' developed by the Netherland's Environment Agency (ten Brink, 2007). The index is formed by multiplying the ecosystem area by ecosystem quality (for each ecosystem).

Seven ecosystems are identified. These are comprised of 'broad habitats' (used within the Countryside Survey and the UK National Ecosystem Assessment):

1. Coast – dunes, cliff, beach and tidal mud flats
2. Freshwater - lochs, rivers and fens
3. Cropland - arable land and improved grazing
4. Woodland – woods/forests, including commercial forestry
5. Greenspace – urban parks, gardens, etc.
6. Grassland – rough/semi-natural grasslands
7. Moorland - heather moor, montane and peatland/bog.

The area of each broad habitat is calculated using the data sources noted in the section above.

The Scottish index builds upon the approach of the Netherland's Environment Agency by applying weightings to each broad habitat type to reflect the ability of each habitat to deliver ecosystem services. The weightings were decided upon using a range of sources of information including SNH experts, a survey of external scientists, and the Scottish Recreation Survey and Omnibus Survey (see Appendix 2, SNH, 2012c). The weightings were as follows:

Habitat type	Weight
Freshwater	5.0
Coastal	2.1
Woodland	2.0
Moorland	1.9
Rough grassland	1.7
Urban greenspace	1.7
Cropland	1.0

Indicators are used to quantify changes in the quality of each broad habitat. In total over one hundred and ten quality indicators are used. The indicators utilise data relating to, for example, bird and butterfly populations, site condition monitoring, pollution, as well as other physical measures, such as the amount of pesticide use and timber production. The quality indicators are used to represent each of the three key ecosystem services identified by the European Environment Agency's

Common International Classification for Ecosystem Services:

- Provisioning e.g. food, water, fibre
- Regulating and Maintenance e.g. fresh water regulation, pollination, carbon sequestration
- Cultural e.g. recreation, cultural heritage, well-being

The choice of quality indicators is based on the relevance and regularity of the collection of indicator data. In the majority of situations data availability has been limited and indicators are proxies for change in ecosystem service potential. In some cases extrapolation has been used where data is not collected annually. Where there are multiple indicators (in most cases) these are weighted based on data quality and relevance to the ecosystem service. The weightings within the NCAI have been calculated by use of the expert judgement of SNH specialist advisors for each of the broad habitats as well as from surveys of external experts and the Scottish public. Most of the indicators used are already existing, publically accessible indicators.

The above approach was used to calculate NCAI scores for each year from 2000 – 2010. The same approach but using half the number of indicators, many of which are different from those used in the 2000-2010 analysis, were used to produce an estimate of NCAI scores casting back from the 1990s to the 1950s.

After releasing the index in pilot form in 2011 SNH further refined the methodology and data

For a full explanation of the methodology see the NCA Index Technical Document - [www.snh.gov.uk/docs/B1070304.pdf](http://www.snh.gov.uk/docs/B1070304.pdf)