

Scotland's Natural Capital Asset Index

Information Note – Updated 2018

We introduce the concept of 'capital' (Section 1), and present the latest results from Scotland's Natural Capital Asset Index (Section 2). We also set out a formal definition of natural capital (Section 3) and explain how the Natural Capital Asset Index monitors change at a national level (Section 4).

1 What is capital?

Until the eighteenth century, 'capital' meant money advanced by owners to establish a business. But Adam Smith's seminal *The Wealth of Nations*, published in 1776, prompted a shift in meaning. Smith regarded capital as also including machines, buildings, land and labour. The narrow monetary meaning of capital has been further broadened over the past 250 years and economists now refer to '**capital**' as a **stock of any productive source**. The word has been attached to virtually every asset that could conceivably affect production.

Included in this plethora, 'natural capital' is therefore the productive elements of nature. The Five Capitals Model characterises natural capital as the basis for economic development (**Figure 1**). According to this, maintenance of all five capitals is important for sustainable development, and the maintenance of natural capital is fundamental.

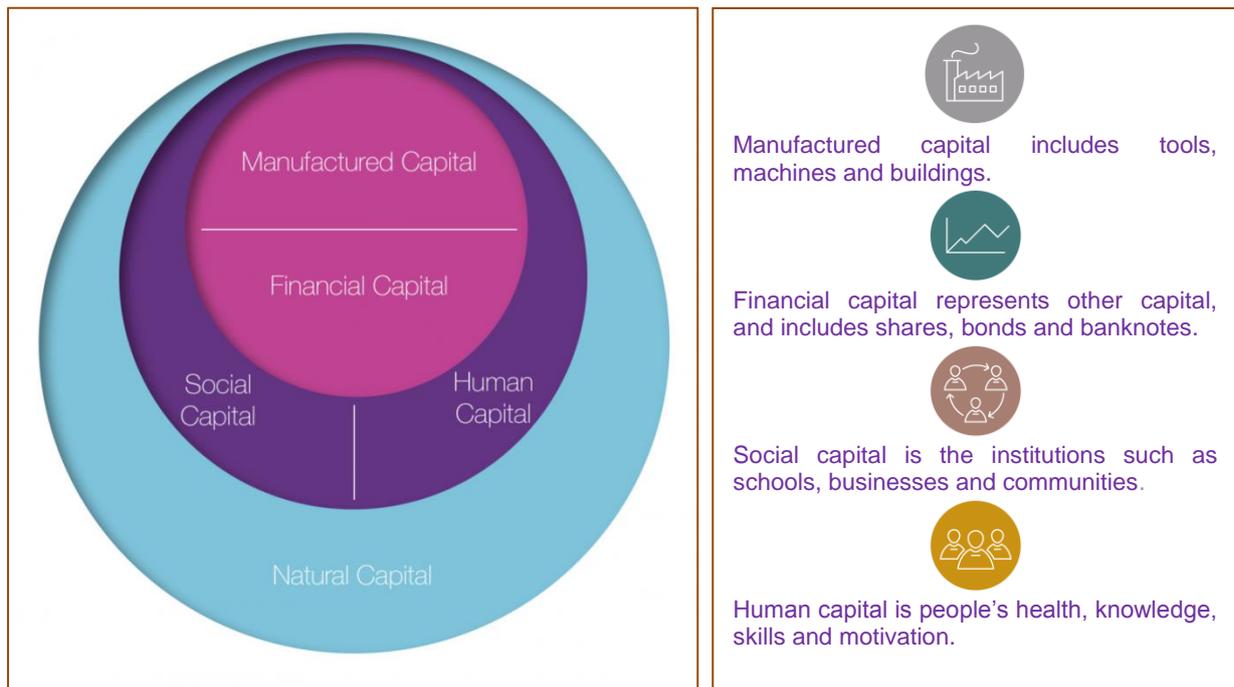


Figure 1: The Five Capitals Model (source: [forum for the future](#))



2 Latest results from the NCAI

The Natural Capital Asset Index (NCAI) is a composite index, based (i.e. equal to 100) in the year 2000. **Figure 2** shows trends up to 2016 for Scotland's habitats, published April 2018.

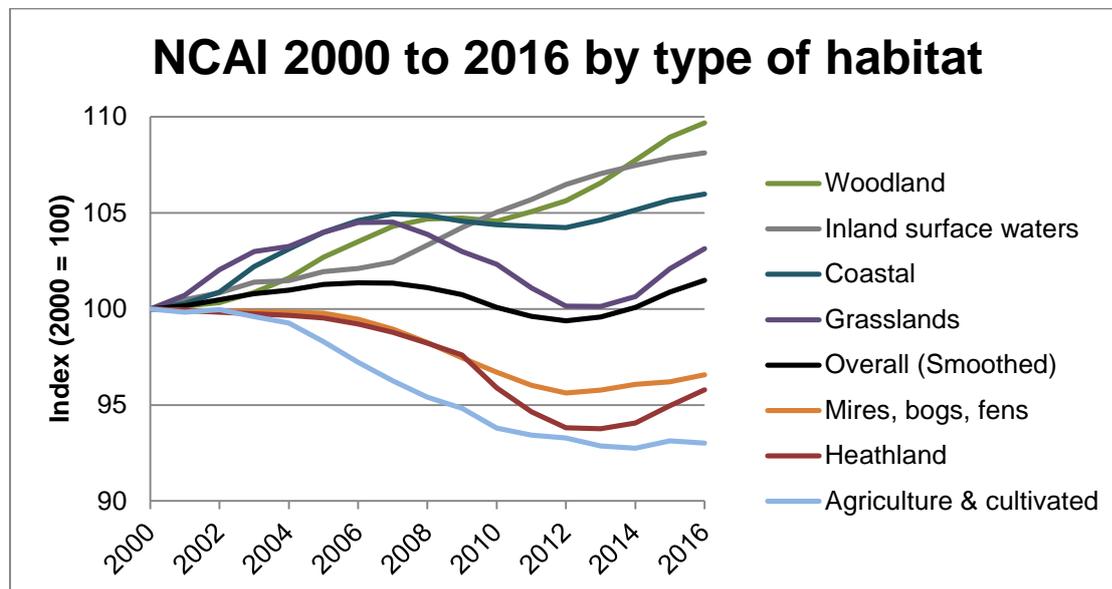


Figure 2: NCAI 2000 to 2016, by type of habitat

Woodland

- Significant increase in quantity of broadleaved deciduous woodland
- Some evidence of quality improvements, for instance in the area of certified forests and prevalence of woodland birds
- However, designated natural features have deteriorated throughout the period

Inland surface waters

- Improvements in the 'ecological status' of rivers and lochs
- Pollution (e.g. nitrates) less widespread in rivers
- Decline in designated natural features to 2009 but has remained stable since then.

Coastal

- Improvement in designated natural features
- Similar upturn in bathing water quality

Grasslands

- Designated natural features deteriorated until 2011, but recovery in recent years
- Reduction in cattle and sheep numbers

Mires, bogs, fens

- Decline in designated natural features, though slight improvements have occurred in the past few years
- Decline in many upland birds
- We have limited knowledge about quantity and quality change for upland habitats

Heathland

- Decline in designated natural features to 2010 but significant improvement since then
- Decline in upland birds, such as curlews and golden plovers

Agriculture & cultivated

- Increased use of pesticides, although this trend may be reversing.
- Historical downward trends are driven by habitat extent loss.
- Some increase in farmland birds, such as goldfinches and great tits

Overall

- Good progress with many habitat types overall but declines in some components such as the quality of designated woodlands and upland bird populations.

Figure 3 presents trends up to 2016 for the different broad types of ecosystem service.

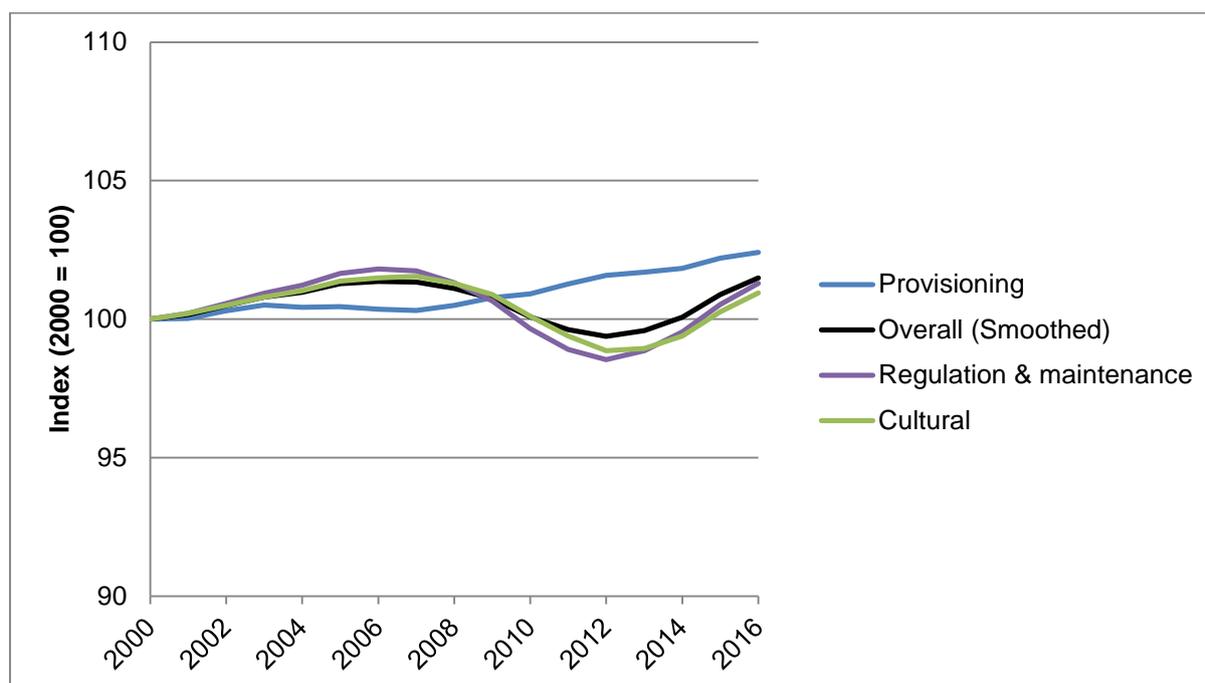


Figure 3: NCAI 2000 to 2016, by type of ecosystem service

Provisioning ecosystem services include: grass for livestock; dairy products; timber; soft fruits; wild salmon and venison; and freshwater for drinking. In general, Scotland’s potential to deliver these services appears to have increased, most notably with respect to freshwater. However, increases in pesticide use could indicate that our ability to produce crops in the future were compromised due to their effects on pollinators. We do not have many indicators for provisioning ecosystem services in the NCAI. The main reason for this is that current flows of outputs are an imperfect guide of potential to maintain flows into the future as they may not reflect the underlying health and quality of the asset providing the service.

Regulation & maintenance ecosystem services include: climate regulation; natural flood protection; pollination; and soil formation. Scotland’s potential to deliver these services in 2016 is quite similar to that in 2000 but with a distinct improvement to 2007, decline to 2012 and partial recovery in the past few years. This was the broad pattern of the condition of grassland and heathland designated sites, for instance.

Cultural ecosystem services include: watching wildlife; recreational fishing; symbolic species and landscapes; and information for education. The trend is almost identical to that for regulation & maintenance services. This is not a coincidence, as habitats in good condition are likely to be able to deliver a range of both of these types of ecosystem service. For instance, habitats better able to regulate erosion and air quality are likely to be more attractive for recreational visitors.

The overall NCAI is coupled most closely with trends in regulation & maintenance services. Evidence and expert judgement suggest that this type of ecosystem service is of most importance to Scotland; it makes the greatest contribution to human wellbeing.

3 What is natural capital?

‘Natural capital’ expresses how and why nature is useful for humans. More formally, **‘natural capital’ can be defined as the environmental resources (e.g. plants, animals, air, water, soils) that combine to yield a flow of benefits to people.** These benefits embrace the full range of gifts from nature, which go far beyond what is bought and sold in markets.

The relationship between natural capital and human wellbeing is illustrated in **Figure 4**: natural capital delivers flows of so-called ‘ecosystem services’, which include food, water, protection from natural hazards such as floods, and opportunities for recreation. Most ecosystem services are a result of the combination of natural capital with other forms of capital (manufactured, social, human and financial). For example, crops grown on farms are usually processed, transported and sold in supermarkets. Ecosystem services contribute to human wellbeing. They do this in myriad ways, from providing sustenance and security, to aiding physical and mental health, to providing a pleasant place in which to live.

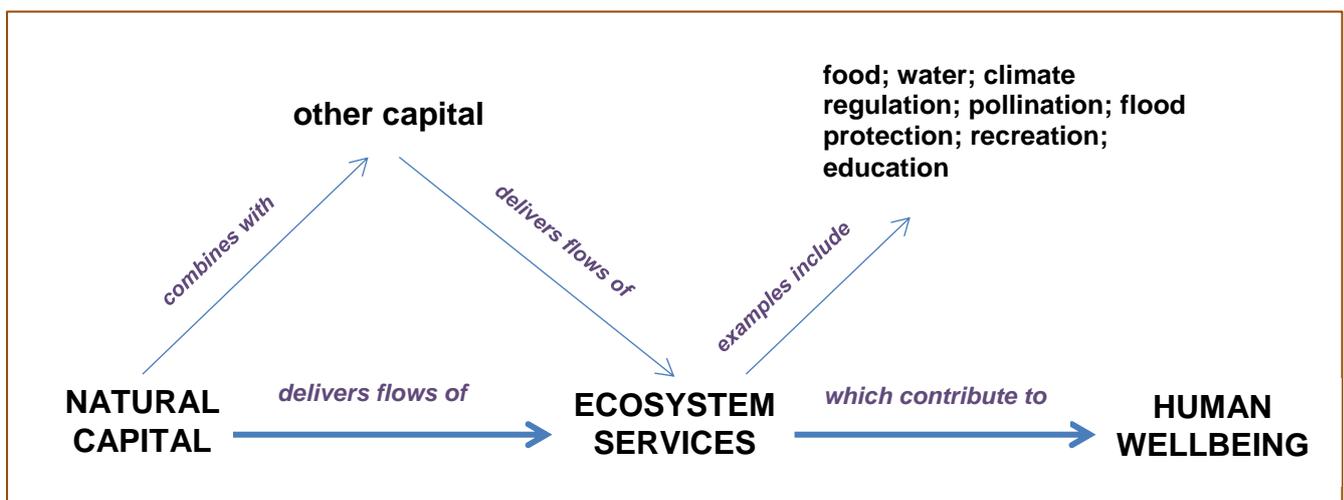


Figure 4: Natural Capital, Ecosystem Services and Human Wellbeing

A company’s overall wellbeing might be hinted at by its annual flow of profits, but a thorough evaluation is best achieved with reference to its balance sheet of assets. Analogously, our assessment of nature’s ability to contribute to human wellbeing focusses on stocks of natural capital assets rather than annual flows of ecosystem services. The latter may in some instances be a symptom of environmental degradation. For instance, a spike in flows of timber (an ecosystem service) might be a symptom of unsustainable deforestation, leaving nature’s balance sheet damaged in the longer-term.

There are a number of pressures on nature due to human activity, including climate change and invasive non-native species. The need for constant economic growth is an overriding pressure, especially where the economic contribution of nature itself is not visible.

By framing nature as natural capital - describing nature in terms of its value for humans - we risk ignoring its inherent or intrinsic value. This is a real danger if accompanied by a denial that nature has any inherent value separate from its benefits for humans. (In much the same way, invoking ‘human capital’ is dangerous if associated with any suggestion that humans are valued *only* insofar as they contribute to economic productivity.)

4 Monitoring natural capital change

In Scotland, we have been monitoring natural capital for a few years. Our objective is to ensure that the benefits of nature for people - all the ways in which ‘natural capital’ contributes to our wellbeing - are adequately recognised and protected in the face of the range of pressures.

There is no common unit by which to compare all of our natural capital assets: relevant units include number of species, levels of pollution, or soil carbon. Some of the benefits from natural capital assets can be expressed in common monetary units, but others cannot. Faced with such practical difficulties, what can we do to meaningfully monitor natural capital assets in a way that can help to guide policy? How might we prioritise action for one asset over another?

The pragmatic option used by our NCAI is to use habitats as units of natural capital. Each habitat ‘unit’ in Scotland has a unique potential to deliver a range of ecosystem services, and we describe this potential in a matrix, using a scale of zero (no relevant potential) to five (maximum relative potential). **Figure 5** illustrates the principle.

	Ecosystem Service 1	Ecosystem Service 2	Ecosystem Service 3	Ecosystem Service 4	Ecosystem Service n	
Habitat 1	1	1	1	0	0	<p><u>Ecosystem Service Potential</u></p> <p>0 = No relevant potential</p> <p>1 = Low relevant potential</p> <p>2 = Relevant potential</p> <p>3 = Medium relevant potential</p> <p>4 = High relevant potential</p> <p>5 = Maximum relevant potential</p>
Habitat 2	1	1	1	2	0	
Habitat 3	0	1	0	0	0	
Habitat 4	0	0	4	5	5	
Habitat n	0	1	3	0	0	

Figure 5: Habitats’ potential ability to deliver flows of ecosystem services

By also taking account of the land cover share for each habitat¹, and assessing each ecosystem service’s importance, the NCAI models each habitat’s relative contribution to human wellbeing in Scotland. Methods used include a mixture of public surveys, peer-reviewed evidence, and expert judgement. However, this whole exercise is fraught with complexity, and we do not claim to have reached a single correct answer. We do not yet have equivalent information for the marine environment, and the NCAI covers only land-based natural capital.

The NCAI model’s logic is outlined in **Figure 6**. It involves the application of what we understand about our habitats’ capacity to deliver flows of ecosystem services. This capacity fluctuates over time due to change in habitat quantity and quality. The NCAI applies to the years 2000 to 2016, and *quantity* is tracked over this period using what we know about land cover change in Scotland.

¹ E.g. per **Figure 3**, if ‘Habitat 2’ is more widespread in Scotland than ‘Habitat 1’, overall it will have a greater potential to deliver ‘Ecosystem Service 1’.

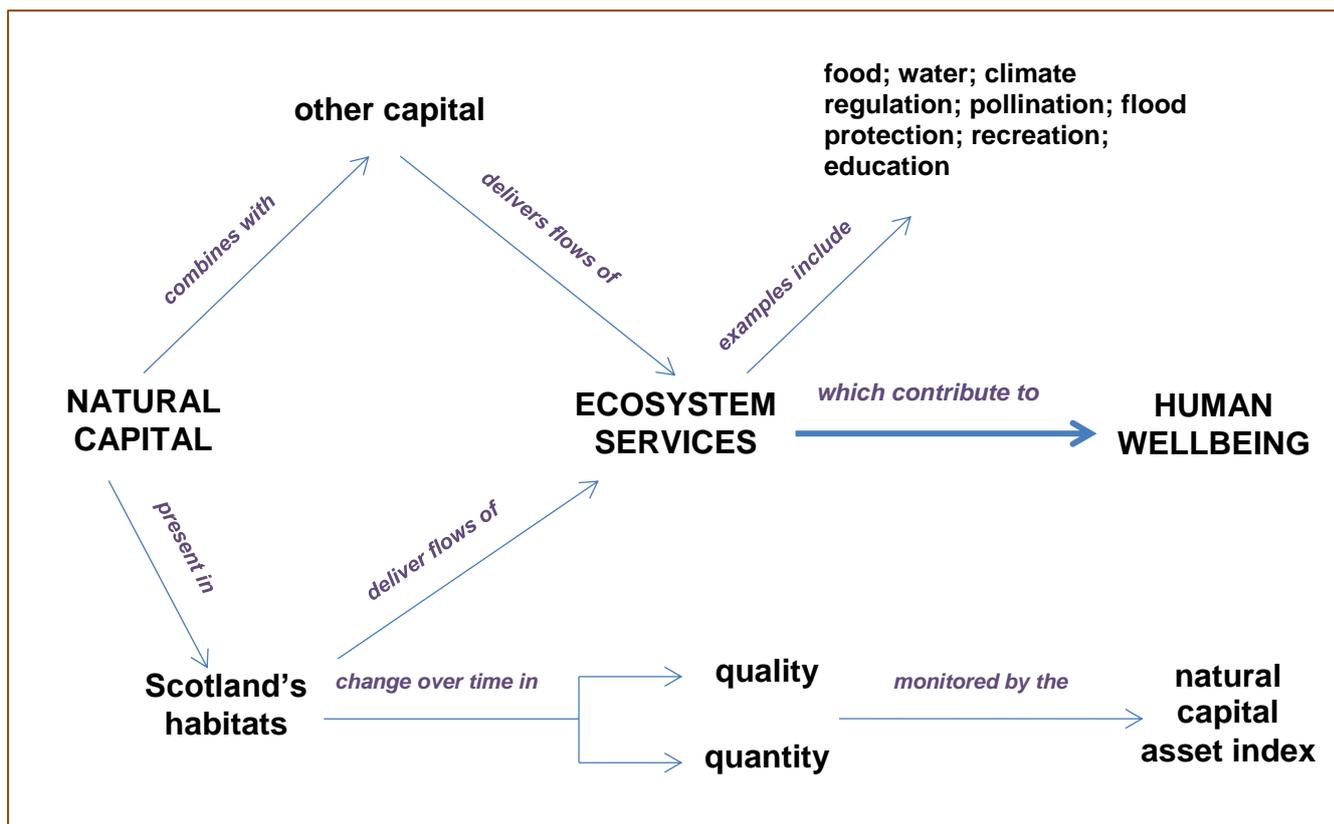


Figure 6: Scotland's habitats and the Natural Capital Asset Index

Some 38 separate indicators are used to track change in habitat quality. By 'quality' we mean habitats' ability to deliver ecosystem services now and into the future. Non-renewable assets, such as oil and gas, are not included in the NCAI: we do not have indicators tracking the known reserves of non-renewables. **The focus for the NCAI is on renewable assets, which offer their gifts for free and in perpetuity - but only so long as they are used sustainably.** If renewables become too depleted they will become non-renewables, and the only question at this point is how quickly their stock is exhausted.

Criteria to assess whether indicators are suitable for the NCAI model include: the year that data were first available (ideally, since 2000); how frequently data are updated (ideally every year); and the extent to which the indicator provides information about the state of habitat.

An ideal indicator will tell us about the state of a particular habitat, as this gives us the best idea about capacity to provide ecosystem services into the future. We have a number of such indicators in the NCAI, such as the designated natural feature indicators. Where we do not have ideal indicators we sometimes use indicators of pressures (e.g. pesticide use) or flows of ecosystem services (e.g. cereal yields). The use of imperfect indicators is okay so long as we are comfortable that there is some correlation with the state of the habitat, and hence reflects the habitat's ability to deliver ecosystem services into the future.

A list of the 38 indicators used is shown in **Table 1**. Where available, a hyperlink to the original data is included².

² Please contact us if you would like data for the other indicators.

Pollution: orthophosphate at safe level	Greenespace - provides a space to relax
Coastal bathing water quality (guideline and mandatory)	Grassland Site Condition (favourable condition)
Woodland bird index	Greenespace -attractive green areas
Wintering waterbird index	Cereal yield
Coastal Site Condition (favourable condition)	Bare fallow/set-aside area
Use of marked coastal paths	Fertiliser use (inverse)
Raw water quality: nitrates in rivers at safe level	Greenespace - 'strongly agree' quality reduced in last five years (inverse)
Raw water abstractions (inverse)	Pesticide use (inverse)
River water quality (% unpolluted sites)	Farmland bird index
Freshwater Site Condition (favourable condition)	Total number of different bird species counted
Wild salmon and grilse - rod & line	Agri-environment area
Upland bird index	Butterflies - generalists
Mires/bogs/fens Site Condition (favourable condition)	Visual influence of built development (inverse)
Adult red grouse density	Area of grass cut for hay
Area of certified forest	Number of livestock units
Woodland Site Condition (favourable condition)	Temperate shrub heathland Site Condition (favourable condition)
Net annual change in carbon in woodlands	Outdoor visits per week (one or more)
Urban birds	Greenespace - place for children to play
Montane Site Condition (favourable condition)	Water Framework Directive - good or better ecological status

Table 1: The 38 'quality' indicators used by the NCAI

Some indicators are used widely, while others much more narrowly by the NCAI. For example, the 'net annual change in carbon in woodlands' indicator is applied to just one ecosystem service (climate regulation) in one habitat (woodland). Conversely, the 'upland bird index' applies to a range of upland habitats (bogs, heathland, montane), and is an indicator for a number of ecosystem services.

Full details about how each indicator is applied, and trends between 2000 and 2016, are shown in the Excel-based NCAI model, available from our website:

<https://www.nature.scot/professional-advice/planning-and-development/industries-reliant-nature/valuing-our-environment>

tom.mckenna@snh.gov.uk
Scottish Natural Heritage
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Scottish Natural Heritage
Great Glen House
Leachkin Road
Inverness IV3 8NW

www.nature.scot



Scottish Natural Heritage
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