Indicators and trends

Monitoring climate change adaptation

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Indicator name				Version
NB6a/NB17a: Numbers and breeding success of seabirds				**21/06/18**
Indicator type:	**Risk/opportunity**	**Impact**	**Action**	
		X		

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Climate Ready Natural Environment	N2: Support a healthy and diverse natural environment with the capacity to adapt	BD9: Changes in species migration patterns

At a glance

- Migration patterns are changing as a result of climate change. Continuing change will affect species interactions within ecosystems.
- Scotland has a network of designated sites to help conserve its internationally important breeding seabird population. Changing migration patterns may result in a need for changes to the designated site network to ensure continued protection.
- This is a Scottish Biodiversity indicator that measures long term trends in the numbers and shorter term fluctuations in breeding success of seabirds.

Latest Figure	Trend
Breeding numbers of seabirds in Scotland: (2016) 62% of the 1986 baseline Breeding success of seabirds in Scotland: N/A	Mean numbers of breeding seabirds in Scotland: declined (overall decline of 38% between 1986 and 2016) Mean breeding success of seabirds in Scotland: declined

Why is this indicator important?

Scotland is internationally important for its twenty four species of breeding seabirds, hosting most of the UK population (SNH, 2018). Climate change is considered to be the principal driver of declines in seabird populations. Warmer winter sea temperatures in the North Sea have affected the food chain: changes in the species composition and abundance of plankton have had a detrimental effect on sandeel (the major food source for most seabirds) numbers and quality (Daunt et al, 2013). Breeding phenology of seabirds is changing; some species are breeding later and some earlier. This is causing a temporal mismatch between prey availability and the breeding season. This de-synchronisation of interactions between species can disrupt the functioning of ecosystems (Daunt et al, 2013).

Scotland has a network of fifty Special Protection Areas currently designated for their seabird populations. Regionally, Orkney and Shetland are particularly important, hosting the largest seabird colonies. This current network may have to change in future, for instance if specific sites lose the seabird populations they are designated for they may become redundant. New species using Scotland for part of their migration pattern may create opportunities for the establishment of new designated sites. Management of the designated site network will therefore have to include monitoring of changes in seabird population numbers and distribution to ensure the network remains effective. Changes in the numbers or distribution of seabird populations may impact on land management in some areas (Brown et al, 2012).

This indicator includes data for sixteen species of seabird, out of the twenty-four that breed in Scotland regularly. It measures both the numbers of breeding seabirds and breeding success (each of these metrics is based on 12 species, for which sufficient data is available), to help us understand whether climate change is impacting upon the numbers of existing migratory seabird populations in Scotland. Breeding success measures the number of chicks surviving to fledging. It tends to vary far more year to year than seabird numbers, and is a good indicator of within season effects, whereas population numbers are likely to change slowly over time. It is a Scottish Biodiversity Indicator and the information provided is drawn from Scottish Natural Heritage (SNH) analyses of these indicators and underpinning data (SNH, 2018).

Seabirds are a good indicator of the overall status of marine environments and, because they breed on land, can be monitored relatively easily. All of the species included in this indicator are Red or Amber listed as Birds of Conservation Concern; European shag, Arctic skua, Atlantic puffin, black-legged kittiwake and herring gull are Red listed (Eaton et al, 2015; cited in SNH (2018).

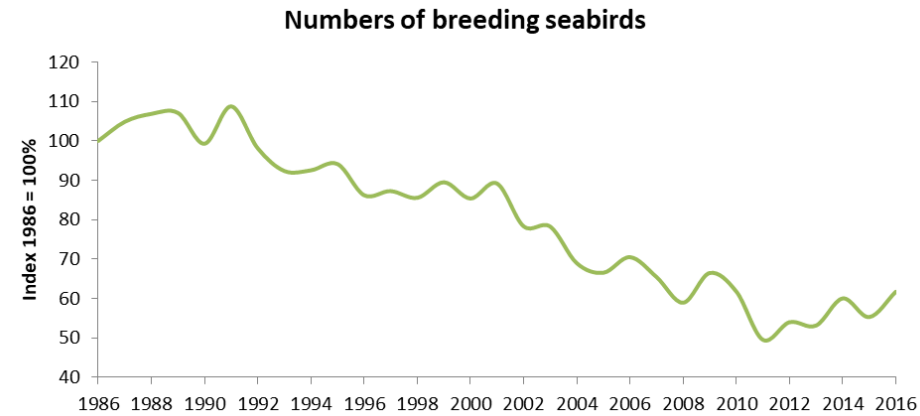
Related Indicators:

NB6b/NB17b: Numbers of wintering water birds

What is happening now?

Numbers of breeding birds
Between 1986 and 2016, after peaking in 1991, mean numbers of breeding seabirds declined steadily until 2011, when numbers were 50% below the 1986 level. Subsequently there has been a slight recovery. In 2016, breeding numbers were 62% of the 1986 level.
Breeding success
The mean breeding success of 12 breeding seabird species has declined (SNH, 2018).

The indices of numbers of breeding birds and breeding success are shown in Figure 1.



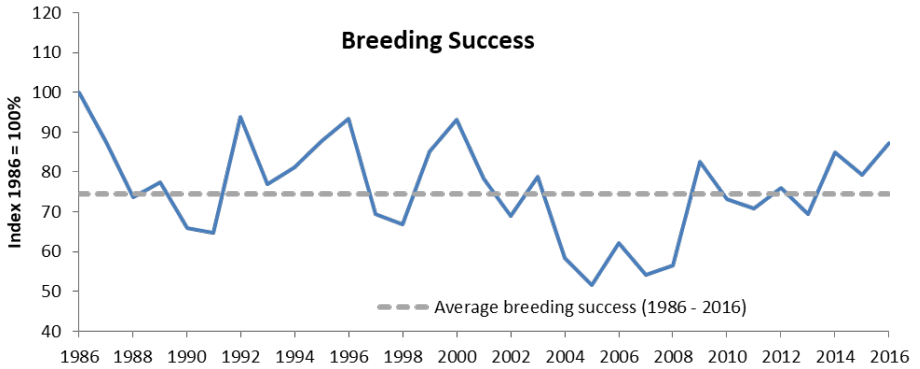


Figure 1: Numbers of breeding seabirds and breeding success of seabirds in Scotland, 1986-2016 (Source: SNH, 2018 (based on data provided by JNCC))
Note: Axes are not scaled to zero.

Table 1 shows the trends in numbers and breeding success for the individual species for which data is available.

Table 1: Changes in numbers and breeding success of Scotland's seabirds (1986-2015)

Species	Seabird numbers	Breeding success
Arctic skua	Decline	Variable, poor years becoming more frequent since late 1990s
Arctic tern	Decline	No clear trend
Atlantic puffin	n/a	Variable, declining overall
Black guillemot	No clear trend	n/a
Black-legged kittiwake	Steady decline	Sustained decline; some better years since 2009
Common gull[1]	Decline since 2005	No clear trend
Common tern	Decline since mid-1990s	No clear trend
European shag	Decline	n/a
Great black-backed gull	Decline since 1999	n/a
Great skua	n/a	No clear trend
Common guillemot	Relatively stable but regionally variable	Steep decline 2003-2007, slight improvement since
Herring gull[1]	Decline	No clear trend

Little tern	No clear trend; marked variation between colonies	n/a
Northern fulmar	Relatively stable; slight decline since 2006	Decline, now more variable
Northern gannet	n/a	Apparent increase
Sandwich tern	Decline, then more stable	No clear trend

[1] Coastal colonies

Source: JNCC, 2016

What has happened in the past?

Scotland hosts the majority of the UKs seabirds. Over much of the 20th century seabird populations in the UK overall increased in numbers, with a 55% increase recorded between the late 1960s and the late 1990s, although for some species numbers had peaked before the end of the century. Except for the black guillemot, all species have declined more rapidly in Scotland than in the UK overall (Daunt et al, 2013).

What is projected to happen in the future?

As the climate changes, the species composition of Scotland's seabird population is likely to change. Many seabird species in Scotland are at the southern edge of their range and northwards range shifts are expected. Some species that currently breed in Scotland may move to new locations and new species move in as the climate becomes more suitable.

The Marine Climate Change Impacts Partnership (MCCIP) paper 'Impacts of climate change on seabirds' (Daunt et al, 2013) provides more detail on projected climate change impacts. Potential impacts include:

- Climate projections indicate that by 2100 the UK climate will no longer suit Arctic skua and great skua, while breeding colonies of black guillemot, common gull and Arctic terns will be restricted to Shetland, Orkney and the northernmost tip of mainland Scotland.
- More frequent extreme weather events may impact breeding habitat and foraging conditions, causing increased mortality of both adult birds and chicks. Further climate-driven changes in prey availability or quality may significantly affect seabirds.
- Jellyfish have recently increased in abundance in UK waters. This has been linked to both climate change and overfishing. Jellyfish compete directly with seabird prey such as sandeels for planktonic food and could therefore have a detrimental impact on availability of prey for seabirds (Purcell et al, 2007, Brotz et al, 2012, cited in Daunt et al, 2013).
- Ocean acidification may adversely affect the food chain (Heath et al, 2012, cited in Daunt et al, 2013).
- Climate change may increase the risk of disease (Lafferty, 2009, cited in Daunt et al, 2013).
- Effects of pollutants may be increased by climate change.
- Sea level rise (especially in the Southern North Sea) will directly affect ground-nesting birds; it may be possible to mitigate this by creating new nesting habitat upshore (Solomon, 2007, cited in Daunt et al, 2013).
- Marine renewables may impact seabirds through collision and displacement. Range shifts may put future breeding sites close to renewable energy developments (Masden et al, 2010; Langton et al, 2011, cited in Daunt et al, 2013).

Patterns of change

Numbers of breeding birds
There is considerable variation in the trends among the 12 species assessed for breeding numbers. Arctic skua has experienced the largest decline, 77% since 1986. Common tern is the only species to have increased numbers in 2016, at 159% of the 1986 level, after a long trend of declining numbers.

Breeding success
Across the time series since 1986, breeding success has varied among the 12 species assessed. In 2016 it was above the long-term average for six species (Arctic tern; black-legged kittiwake; common tern; little tern; northern gannet and Sandwich tern), while two species (Great skua and herring gull) had lower breeding success. The other four species (Arctic skua; Atlantic puffin; Guillemot and Northern fulmar) were around the long-term average.

There is significant regional variation in seabird numbers and breeding success across Scotland, with the Northern Isles seeing the most serious declines.

Average winter sea surface temperatures (SST) in the North Sea have increased by around 1°C since the early 1980s, altering the food chain to the detriment of seabirds (van Deurs et al, 2009, cited in Daunt et al, 2013). However currently climate impacts are much weaker in other UK seas such as the Irish Sea (Lauria et al, 2012, 2013; cited in Daunt et al, 2013)

Interpretation of indicator trends

The reasons behind declines in seabird numbers and breeding success are complex, involving a combination of changing food availability, climate change and the impact of non-native species (Foster & Marrs, 2012).

SNH (2018) link the large declines in numbers of Arctic skua to the declining availability of sandeels around their Northern Isles breeding stronghold, together with increased predation from great skua (Meek et al, 2011; cited in SNH, 2018).

Some species that have seen a declining trend in numbers may now be stabilising at a lower level (compared to the 1986 baseline). Research by Foster et al (2017) indicated a link between fishery landings and gull numbers; whereby a steep decline was followed by stabilising of numbers on the Isle of Canna. Given the increase in seabird populations over much of the 20th century (see 'What has happened in the past?' above), these lower numbers may be more typical of population sizes prior to the increases from the 1960s (SNH, 2018).

Some scavenging species have benefitted from discards from fishing vessels; it is thought this may have led to populations of great skua and northern fulmar increasing beyond a level that can be sustained by natural food sources (Tasker & Furness, 1996, cited in Daunt et al, 2013). Discards have been reduced as a result of measures to conserve fish stocks and scavengers such as great skua have had to find other sources of food, including predation of other seabirds (Votier et al, 2004, cited in Daunt et al, 2013). The 2013 reform of the EU Common Fisheries Policy, which banned the discarding of fish at sea, is likely to increase the pressure on scavenging species (Bicknell et al, 2013, cited in Daunt et al, 2013).

MCCIP (Daunt et al, 2013) provide more detailed information on these and other factors, including:

- Disturbance by coastal leisure and recreation activities and the offshore renewables industry

- Seabird by-catch by long-line fisheries
- Contamination by oil spills
- Marine litter ingested by surface feeders

Information is also available on the major threats to specific migratory seabird species:

Fulmar: predation by brown rats and American mink; changes in food supply; long-line fishing (Tasker, 2007 in Foster & Marrs, 2012).

Arctic skua: depredation by great skuas; sandeel scarcity; breeding habitat loss; human persecution (Furness, 2007 in Foster & Marrs, 2012).

Kittiwakes: food shortage; climate change; localised predation (Heubeck, 2007 in Foster & Marrs, 2012).

Arctic tern: food availability (mainly small shoaling fish and sandeels); presence of non-native predatory mammals (Craik, 2007 in Foster & Marrs, 2012).

Common guillemot: oiling; overfishing of sandeels; climate change; disturbance to colonies (Harris and Wanless, 2007 in Foster & Marrs, 2012). On the Isle of May it has been noted that the failure of guillemots to breed was due to the lower quality (energetic value) of sandeels rather than fewer fish being brought into the colony (Wanless, 2005 in Foster & Marrs, 2012).

Limitations

Sufficient data is available to identify trends in breeding numbers for 12 of 24 species, and breeding success for 12 species.

References

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Further information

See references above.

Acknowledgements

This is a Scottish Biodiversity Indicator and the information provided is drawn from SNH analysis of the data (SNH, 2018). Simon Foster (SNH) provided the data and interpretation of trends. The underpinning data is from the Seabird Monitoring Programme. The species trend data provided in Table 1 is from the Joint Nature Conservation Committee's 'Seabird Population Trends and Causes of Change: 1986-2015 Report' (JNCC, 2016).

Suzanne Martin (RBGE) contributed content to the 2016 version of this indicator.

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	NB6a/NB17a: Numbers and breeding success of seabirds
Indicator contact: Organisation or individual/s responsible for the indicator	Ruth Monfries (Royal Botanic Garden Edinburgh/ClimateXChange)
Indicator data source	Seabird Monitoring Programme JNCC; also published as a Scottish Natural Heritage Biodiversity Indicator https://www.nature.scot/scotlands-indicators-birds
Data link: URL for retrieving the indicator primary indicator data.	http://jncc.defra.gov.uk/smp/

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	1986 to 2016
Frequency of updates: Planned or potential updates	Annual
Spatial coverage: Maximum area for which data is available	Scotland (UK)
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	
Spatial resolution: Scale/unit for which data is collected	Individual seabird colonies (representative sample of)
Categorical resolution: Potential for disaggregation of data into categories	By species
Data accessibility: Restrictions on usage, relevant terms & conditions	Free and publicly available

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.
UK Seabird Monitoring Programme (JNCC) (http://jncc.defra.gov.uk/page-1550). JNCC reports on seabird population trends as an Official Statistic.

Table 4 Indicator methodology

Indicator methodology The methodology used to create the indicator data
The UK Seabird Monitoring Programme collects data from a sample of colonies around Scotland (and the rest of the UK).