



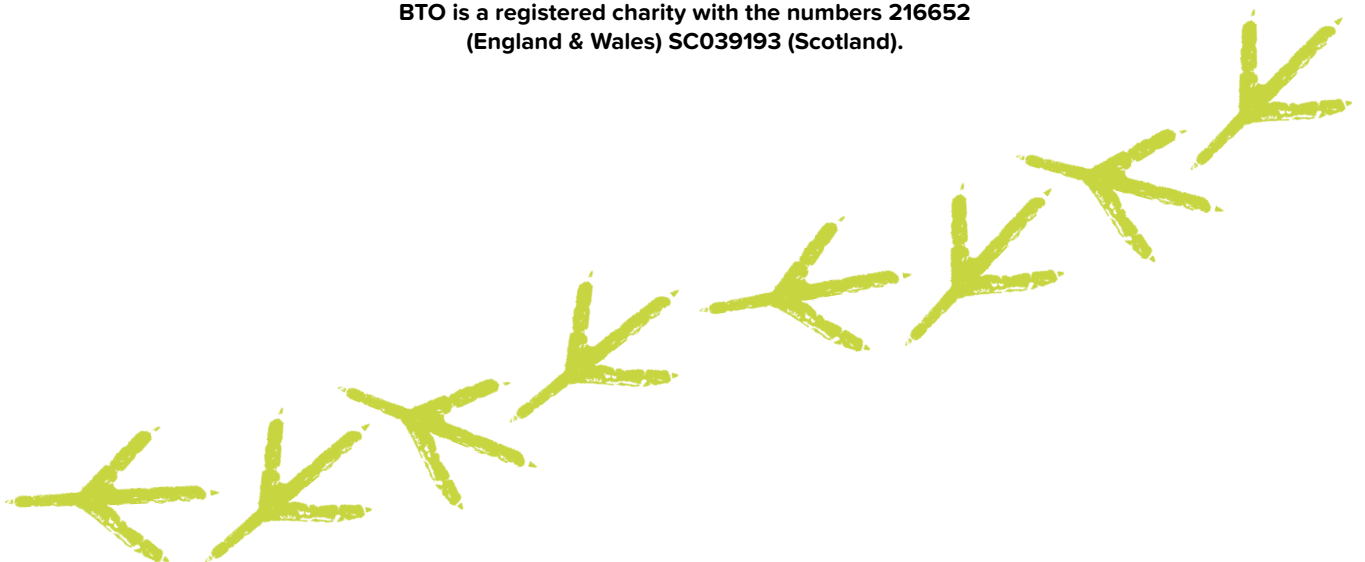
What's Under Your Feet? Information pack

What impact is climate change having on British bird populations? And what can you do to help? Find out more in this information pack, which supports our What's Under Your Feet? citizen science campaign.

The information in this pack has been written for the Pod by the British Trust for Ornithology (BTO) to help young people learn about climate science.



BTO is a registered charity with the numbers 216652 (England & Wales) SC039193 (Scotland).



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Climate change in the UK

Throughout history our climate has changed many times due to natural causes, but now global temperatures are rising at an unnaturally fast rate. This is extremely likely to be caused by increased greenhouse gas emissions, mainly from burning fossil fuels.

- ▶ In the UK, the temperature has risen by almost 1°C over the past 40 years. That might not sound like much but after ice ages it took about 5,000 years for the temperature to increase by 4 – 7°C.
- ▶ The weather in the UK is predicted to continue getting hotter, with more rain in the winter and unpredictable weather in the summer. Extreme weather events like storms, floods and droughts are all likely to increase.
- ▶ Species have already been affected by climate change and many are moving to cooler places or changing the timing of important events in their lifecycle.

If carbon emissions are not reduced in the UK, the temperature is likely to increase by another 2°C in the next 30 years.

Birds

How does the climate affect birds?

Birds, other animals and plants have evolved over thousands of generations to survive and reproduce best in the conditions they are living in.

The changing climate has direct and indirect impacts on each species: some species of birds have moved north to get to cooler temperatures; and events that usually happen in the spring are happening earlier each year as temperatures rise – flowers are blooming earlier, insects are appearing earlier and birds are breeding earlier.

Moving north

- ▶ Over the past 40 years, a bird in the UK would have had to move northwards by about 100 miles in order to keep living at the same temperature. On average birds have only moved about 20 miles which might be a sign that they are not be able to keep up with the changing temperature.
- ▶ Species that already live in the coldest places in the UK – such as Snow Buntings and Ptarmigans, which live high up on Scottish mountains – are more likely to come under threat in the future, as they have nowhere colder to go.

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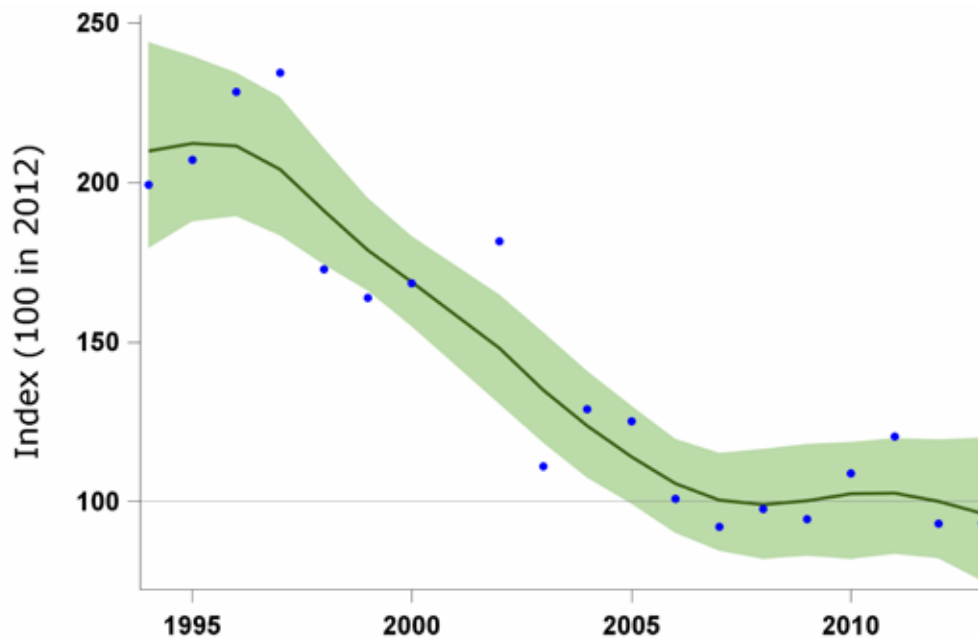
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Breeding earlier

- ▶ A bird would have to lay its eggs two weeks earlier now than it did 40 years ago in order to keep laying eggs at the same temperature, but on average, birds are only breeding about a week earlier.
- ▶ Hungry chicks need a lot of food to survive and insects are an important food source for most species. There can be quite a brief period when insects are abundant - caterpillars are a favourite food for many chicks and don't spend long as caterpillars before turning into butterflies and moths.

This makes the timing of egg laying important. Chicks may have lower survival chances if there isn't a match between when they need the most food and when there are most insects around. Insects are appearing almost two weeks earlier than they did forty years ago and most bird species aren't keeping up. This might be causing population decline in some birds, particularly in species like Pied Flycatchers that spend the winter in Africa and migrate to the UK to breed in the spring and summer. They may be finding it harder than other species to keep up with the changing timing of spring.

BBS UK 1994-2013 Pied Flycatcher



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What can we do for species under threat from climate change?

We can reduce the impacts of climate change by providing protection and safe habitats for animals to live in. The more we know about which species are under threat from climate change, the more we can do to protect them.

Some projects have already started to try to protect birds from climate change:

- ▶ **New reedbeds:** Reedbeds are wet grasslands that are amongst the most important habitats for birds in the UK. Many reedbeds are coastal and are under threat from rising sea levels caused by climate change. Therefore, inland reedbeds are being created to provide protected habitats for Bitterns and other reedbed species.
- ▶ **Protecting bogs:** Slowing the drainage of water from bogs prevents the bogs from drying out during warmer summers. This helps protect the bog insects that need moist ground to survive, and the bird species, such as Golden Plovers, that rely on these bog insects for food

Soil invertebrates

Climate change and soil invertebrates

Soil invertebrates are found all over the world, in all sorts of climates. Each species has adapted over a long time to live successfully in its own conditions – species survive best when living at a certain temperature and a certain amount of rainfall.

Climate change will bring higher temperatures and, in the UK, it is likely to lead to increases in rainfall particularly in the winter. This will affect the soil invertebrates and in turn, the creation of soil and how much food is available for invertebrate-eating birds and mammals.

If we can find out how and why soil invertebrate numbers differ across different parts of the country, we will be able to better predict the effect of climate change. Knowing which species are most threatened by climate change will help us decide how best to protect them.

What is an invertebrate?

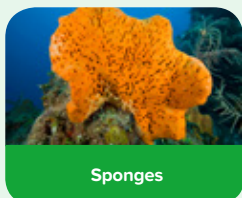
Animals can be split into two groups: invertebrates (animals with no backbone) and vertebrates (animals that have backbones).

- ▶ **Invertebrates:** Insects, worms, octopus and jellyfish and others. Most of the invertebrates you see in everyday life are small, like spiders and flies, but not all – giant squids can grow to be over 18 metres long!
- ▶ **Vertebrates:** Mammals, birds, reptiles and fish and others.

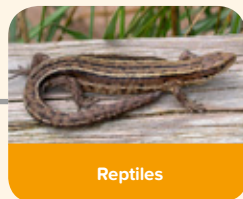
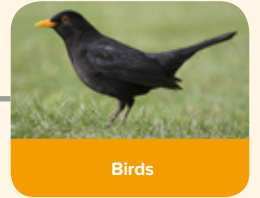
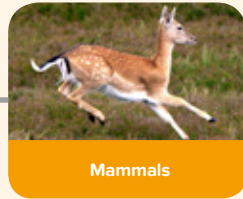
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Invertebrates



Vertebrates



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Why are soil invertebrates important?

Soil is full of invertebrates like worms, beetles, snails, slugs and woodlice. In the UK there are 27 different species of earthworm, about 35 species of woodlice and around 3,000 different beetle species! We know of over 350,000 beetle species worldwide but that's probably much less than half of the beetle species that actually exist.

Soil invertebrates are really important:

- ▶ **Soil creators:** Many invertebrates, including earthworms, woodlice and beetles play a big role in making soil.
- ▶ **Nature's recyclers:** They break down dead plants and animals, releasing the nutrients so plants can use them again. Without soil, the land would just be covered in bare rocks.
- ▶ **Food:** Soil invertebrates are food for many birds – you can often see blackbirds and robins with worms in their beaks on their way to feed their chicks. They are also food for many mammals such as hedgehogs, moles and badgers.

In some places there are lots of soil invertebrates and in others there are very few. It is likely that the type of soil and the weather affects their numbers.

What's so special about soil?

Soil provides water and nutrients for plants, which allows them to grow. This is important because plants are the beginning of all food chains: animals eat plants to gain energy and in turn are eaten by other animals.

Nutrients

The three most important soil nutrients for plants are nitrogen, phosphorus and potassium.

- ▶ Plants store these nutrients in their cells where they perform vital roles and keep the cells working properly.
- ▶ Plants have tough cell walls so it can be difficult to get these nutrients out when the plants die, but soil invertebrates are good at doing this. With the help of bacteria and fungus, they break down dead plants and turn them into soil, releasing the nutrients so that living plants can reuse them.

Water

- ▶ Soil also absorbs water, preventing it from draining away immediately after rain. This means that plants have a fairly steady supply of water from the soil.

Growth

- ▶ Soil gives plants something to hold onto and dig their roots into, allowing them to grow upwards without falling over.

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Soil invertebrates and birds

One of the most important ways in which climate change will affect birds is by changing how much food is available for them. Many birds rely on earthworms and other soil invertebrates for food, which are likely to be sensitive to changes in temperature and rainfall. Populations of many bird species which rely on soil invertebrates, such as the Mistle Thrush, are declining in the south, but increasing in the north of the UK.

Is this because their food is declining in the south, perhaps because summer weather is hottest and driest in the south?

By mapping the abundance of soil invertebrates in school playing fields across the country, we will be able to find out how invertebrate numbers are linked to weather. This will help us find out whether food declines could explain recent bird population declines, and make better predictions about how birds might be affected by climate change in the future.

Change between 1994-96 and 2007-09

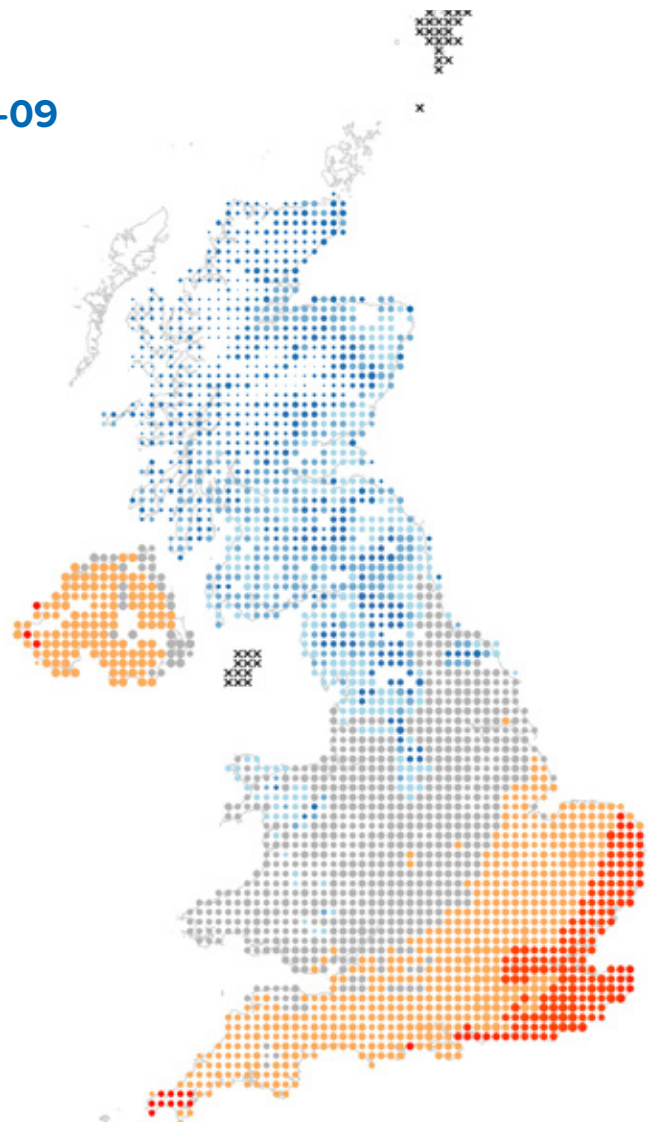
Mistle Thrush *Turdus viscivorus*

Density (birds/km²)

- > 18
- 9 – 18
- 4.5 – 9
- 2.25 – 4.5
- 1.12 – 2.25
- 0.56 – 1.12
- 0.28 – 0.56
- 0.14 – 0.28
- 0.07 – 0.14
- 0 – 0.07

Relative change in density

- > 75%
- 50% to 75%
- 25% to 50%
- -25% to 25%
- -50% to -25%
- -75% to -50%
- < -75%
- x insufficient data



This image can be downloaded from:

<http://jointhepod.org/resources/resource/418>

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Why do birds migrate?

Not all of the birds that we see in Britain live here all the time; some only visit during the winter months, whilst we only see others during the summer. Some don't stay here at all but just pass through on their way to somewhere else. All of these birds are migrating birds and they have lots to teach us about the impact of climate change on wildlife.

What do we mean by 'migration'?

Swallows are one of our best known migrants while Blue Tits are one of our best known residents. Migrating birds visit Britain from all corners of the globe. Britain and Ireland provide summer breeding grounds for birds who spend most of their winters much further south - like the Swallow, Swift, Cuckoo and warbler family.

Meanwhile, for birds that usually live further north, our relatively mild winters offer shelter. And in spring and autumn, Britain and Ireland offer a staging post where long-haul travellers (like many wading birds that live on river estuaries) from just about every corner of the globe can rest and feed – fuelling up for the next stage of their journey. So we are ideally placed to study migration.

What we have learned from monitoring bird migration?

British scientists have been fitting rings on birds to track their movements for more than a century. The uniquely numbered metal rings are fitted to the leg of a bird so we can see where that bird has been if it is spotted elsewhere.

Using this approach, an amazing picture of bird movements has emerged, with birds ringed in Britain being found on almost every continent around the world. For example, there have been discoveries of Manx Shearwater that were ringed on Skomer off the coast of Wales being recovered on the East Coast of South America. And a Lapwing ringed in Lincolnshire was recovered in Central Russia.

Some of the journeys the birds are making are huge. The longest recorded migration is for an Arctic Tern that was ringed as a chick on Anglesey in Wales, and was subsequently found on a beach in Australia, 18,000 kilometres away.



The blue dots on this map represent locations where a bird ringed in Britain has been recovered

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A warmer haven in winter

But why do some birds undertake such massive journeys? Our winter visitors tend to breed much further north and east and come here to enjoy the relatively mild conditions of British winter, escaping the prolonged snow cover and freezing temperatures that they would have to endure if they stayed put.

A good meal for chicks in spring and summer

Spring and summer visitors tend to come here to breed. Many of these birds spend the winter in tropical Africa where there is little change in the seasons and a constant food supply. This is fine for a single adult bird that only has to think about feeding itself, but when there are several hungry mouths to feed it's harder. But here in Britain we have a burst of new caterpillars and insects each spring. So, it makes sense to fly north, tap into this bounty to give your chicks the best start in life, and head south again when resources start to dwindle.

It means many of these summer visitors are able to raise more than one brood per year, with some even managing three. This just wouldn't be possible if they remained in Africa. It is not only the birds that feed on bugs and insects that come here during the summer months. The Arctic Tern is a fish-eating bird and along with other species that share the same diet, it also comes here to take advantage of the fish-breeding season.

What have we learnt so far?

We've got good information about how our migrants are doing in the UK through long running monitoring like the BTO's Breeding Bird Survey and Bird Atlas 2007-11. Ringing and Nest Recording provide us with lots of details about their life cycle. But we lack vital information in a number of important areas.

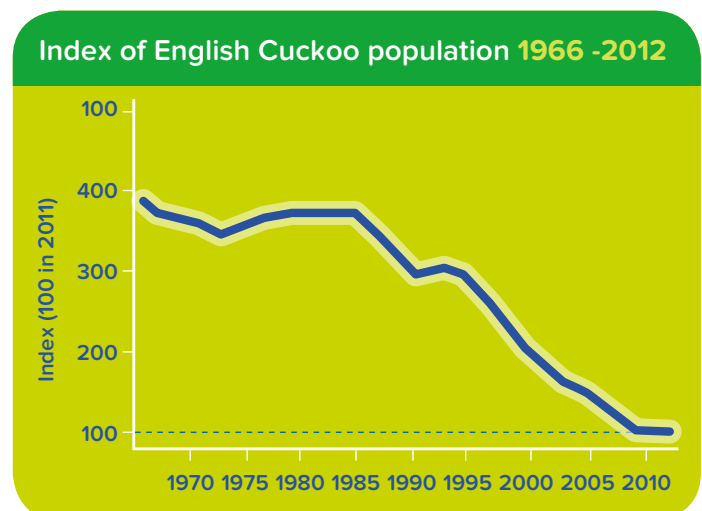
Over 30 of the species of migrating bird that breed in the UK spend their winters in Africa. Two-thirds of these species are declining in population - in other words, there aren't as many of them as there used to be. Many of those showing the most dramatic declines are long distance migrant landbirds such as Cuckoos. These are the birds that we are most concerned about and are listed as being endangered. The good news is that there are action plans in place to try and help at least some of these birds.

But the graph above shows information collected by volunteers contributing information to the BTO's Common Bird Census (CBC) and Breeding Bird Survey (BBS). The decline in the population of the Cuckoo over the last 40 years has been very severe.

Just ringing these birds won't tell us all we need to know about the reasons for this decline. For that we need more sophisticated tools such as satellite tags.



Starlings from northern Europe come to Britain for our mild winters



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Why tag Cuckoos?

Cuckoos are the smallest African migrant bird we can track with a satellite tag. The BTO's Cuckoo Satellite Tracking Project is helping us to understand more about the challenges that migrating birds face as our climate changes.

What tagging is teaching us

Until recently we didn't know very much at all about the migration of Cuckoos. So in 2011 the BTO started tagging them to study their journey and find out about the challenges they face. To date, the BTO has tagged 47 birds. In spring 2014 they were still following 17 Cuckoos - one of which, Chris the Cuckoo, has provided data since he was tagged in 2011. So that's 30 birds that have been lost so far - it matches the 63% decline in population we've recorded more generally since the 1970s. Cuckoos tagged in the UK spend the winter in central Africa. For the first time this project has allowed us to follow Cuckoos to their wintering grounds which seem mainly to be in and around the Congo rainforest. Understanding where Cuckoos winter could be an important factor in determining the causes for their decline.

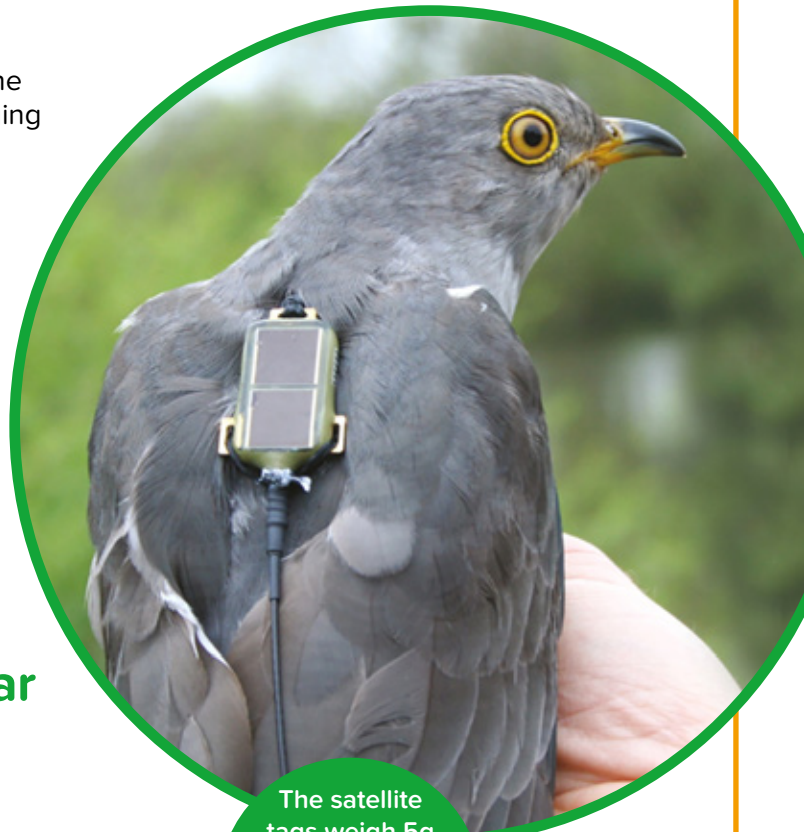
Here's what we've learnt so far by tracking the birds...

Cuckoos are early birds

We have discovered that Cuckoos leave the UK much earlier than we thought. The earliest departure date so far has been 3rd June and in each year over 50% of our tagged Cuckoos have left the country by the end of June, much earlier than expected!

'British' Cuckoos are actually African birds

We've found that Cuckoos arrive in Britain towards the end of April and beginning of May and many leave again during June. This means that Cuckoos only spend a small percentage of the year here. Chris the Cuckoo spends roughly 47% of his time in Africa, 38% of his time on migration and just 15% in Britain!



The satellite tags weigh 5g and cost £2,500 each - they are placed on the backs of the birds

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Many routes out of the UK

Our Cuckoos head out of the UK in a variety of directions, some due east across the North Sea to the Netherlands and Belgium while others head south across the English Channel into France.

Two main migration routes

We always thought Cuckoos went back to Africa on a route that started east and then south down over Italy. And the satellite tracking has confirmed this for some birds. But two Cuckoos from the first year went west via Spain, showing us a brand new migration route that had a stopover site north of Madrid.

European stop-over sites

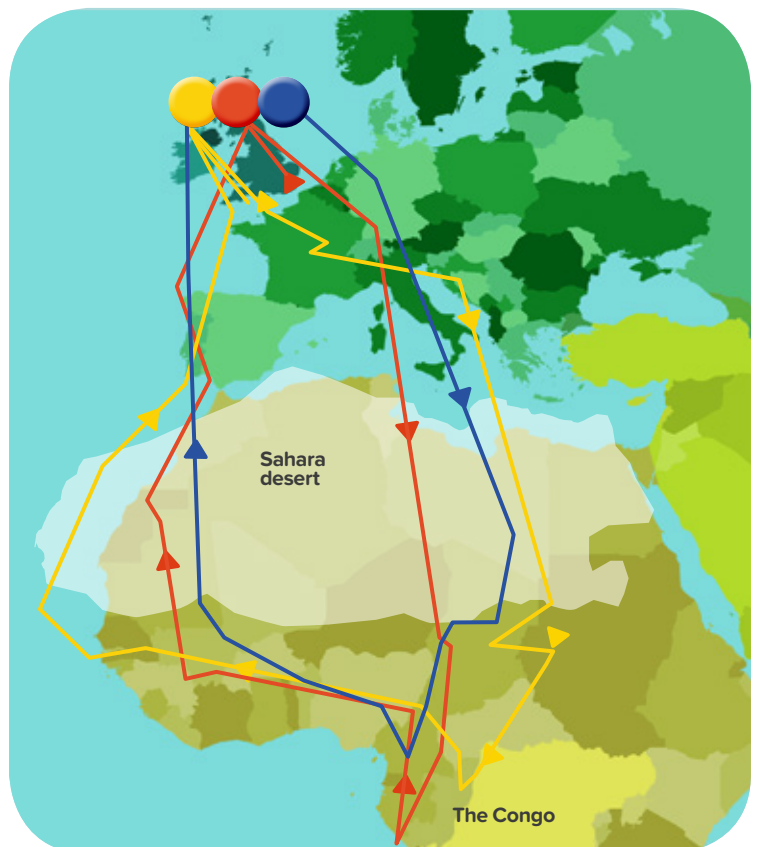
Stop-over sites are where the birds stop to eat and refuel. These places are often areas rich in food so the birds can fatten up for the journey ahead. Many of our Cuckoos have spent time near the River Po in Italy, confirming this is a very important place for British Cuckoos. Stopping here to refuel allows them to cross the Mediterranean Sea and the Sahara desert at its widest point. But could they be experiencing problems here?

Return routes to Europe and African stop-over sites

We thought that Cuckoos returned to the UK by flying straight back north across the Sahara from the Congo. But now we know that they fly into west Africa first. This information suggests that there are good reasons why Cuckoos visit west Africa on their way back. Are they experiencing problems here? This aspect of their journey could be a pinch point in their success. Understanding more about the location of important stop-over feeding sites could be another crucial part of the conservation of this species.

How long do the migration journeys take?

Our Cuckoos take just under two months to complete the spring migration from their wintering locations to the UK. This is compared to the four or so months it takes them to reach their wintering locations in Africa on their autumn migrations. The timing of their arrival back in the UK is important as they need to find a mate and ensure there is plenty of food at the time when youngsters hatch and are reared by host species.



The circular southward and northward migration routes taken by Chris, David and BB in 2013/14

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What's causing the population to decline?

Having followed Cuckoos over a number of years we are beginning to gather a wealth of data about the difficult points during the Cuckoo's annual cycle. Knowing where the birds are struggling (and dying) will allow us to understand the causes of their decline and will help us to look after the Cuckoos in the future. In some years some birds have set off only to return northwards soon after, retracing their steps. This is presumably because they could not find food and were returning to areas where they know there is some. This is likely to be a survival mechanism.

Continuing to tag

Tagging more birds, and following them for a number of years, will allow us to answer new questions. Our studies need to be long-term so we can see the fuller picture of how the Cuckoos behave. Short-term studies are less reliable for this. For example the habitats that were used in the Congo basin by English and Scottish Cuckoos in the first two years are not the same habitats being used in later years. A short-term study wouldn't have picked this up.

By studying over a longer period, we can see whether birds that do 'unusual' things (e.g. winter in a different place to the other birds) survive better or worse than others. It will help us to understand what sort of behaviour influences the population numbers. And we can also investigate other possible factors such as increasing age, and environmental factors such as in the timing and amount of rainfall in both European and African stopovers.

What happens next?

There is a lot more to be done to fully understand Cuckoo migration: we need to study the same birds in different years (currently only Chris has been tracked in four years of the project). We need to assess the effects of weather conditions. And we need a bigger sample of birds from different regions to look at the routes taken, at whether the host parent species has any effect on migration, the timings and routes taken by younger birds and females, and much more.



Find out more about the Cuckoo Satellite Tracking Project – and don't forget to sign up to our What's Under Your Feet? campaign too.