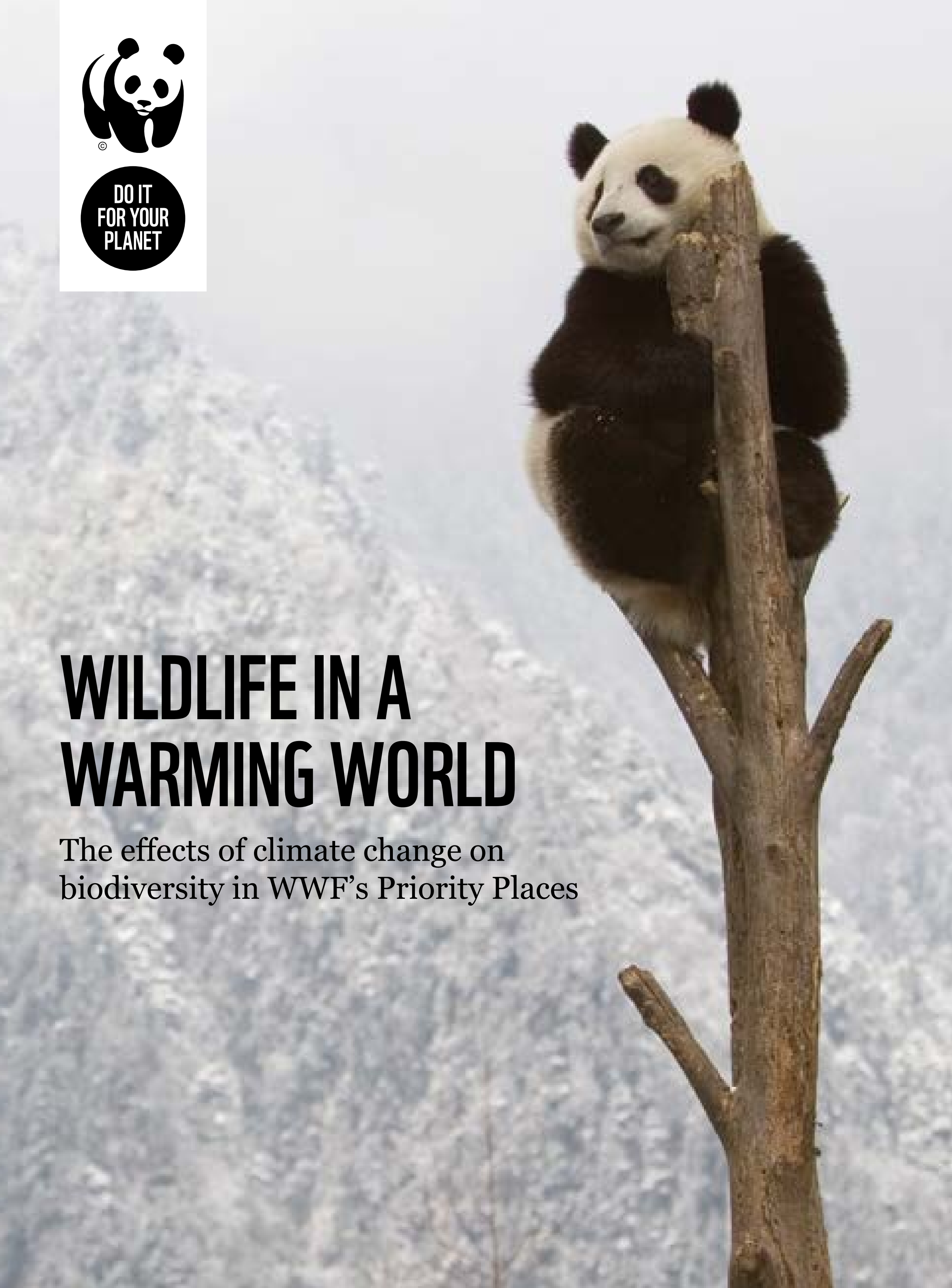

DO IT FOR YOUR PLANET

WILDLIFE IN A WARMING WORLD

The effects of climate change on biodiversity in WWF's Priority Places

Acknowledgements

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About WWF-UK
At WWF, we want a world with a future where people and wildlife can thrive. We're finding ways to help transform the future for the world's wildlife, rivers, forests and seas in areas we regard as particular priorities. We're pushing for the reduction in carbon emissions needed to avoid catastrophic climate change. And we're pressing for measures to help people live sustainably, within the means of our one amazing planet.

CONTENTS

EXECUTIVE SUMMARY

Manmade climate change is real, it's happening now, and it's among the greatest challenges we face on planet Earth.

Many decades of burning fossil fuels, coupled with rampant deforestation, are having an undeniable impact on our home.

In all regions of the world we're seeing yesterday's theoretical dangers becoming today's new reality: the effects of global warming are already measurable, they're bad, and they're going to get worse.

From rising sea levels to retreating glaciers, from increasingly frequent and severe extreme weather events to warmer oceans, the environmental consequences of higher global temperatures are playing themselves out around us. Meanwhile, human societies – particularly in the developing world – are already counting the cost. In some areas, food security is diminishing, water resources dwindling and there have been increases in heat-related deaths.

Even with the commitment shown by the nations of the world in reaching the Paris Agreement on climate change in 2015, we can expect a lot more damage from climate change in future.

And there's something else we may see too: these environmental impacts leading to enormous losses of biodiversity on every continent and across all species groups.

This report summarises a ground-breaking research project from WWF, which we carried out in partnership with experts from the Tyndall Centre for Climate Change at the University of East Anglia. Our findings result from the most comprehensive global analysis to date of projected changes in the climatic ranges of plants and animals, and they paint a startling picture of the link between global temperatures and the status of wildlife and ecosystems around us.

The research looks at the projected impacts of a range of warming scenarios on different species groups in 35 'Priority Places' for conservation. These regions contain some of the richest and most remarkable biodiversity on the planet, including many iconic, endangered and endemic species. While the results vary, some key themes emerge:

- **Today's extremes are tomorrow's new normal**
  Extreme hot and dry years in the past have often led to significant population declines. In many Priority Places, average seasonal temperatures are projected to exceed those only previously experienced in the very hottest of the last 50 years – in some cases this could happen as early as 2030. This is likely to occur even

  if average global temperature rises are kept to 2°C above pre-industrial levels. Maximum temperatures far higher than past extremes, lower rainfall and longer droughts are also expected in many places.

- **We'll need stronger climate mitigation efforts if we're to avoid severe loss of biodiversity**
  While the Paris Agreement aims to limit the average global temperature rise to well below 2°C (aiming for 1.5°C), current national climate pledges set us on a course to around 3.2°C of warming, and 'business as usual' would mean a rise of 4.5°C. As the temperature rises, so does the proportion of species at risk. With 4.5°C of warming, almost 50% of the species currently found in Priority Places are at risk of local extinction – but if temperature rises are limited to 2°C this risk is halved, underlining the importance of urgent action to cut greenhouse-gas emissions.

- **Even a 2°C rise will lead to widespread biodiversity losses**
  Even with an average global temperature rise limited to 2°C, many Priority Places are projected to lose a significant proportion of their species as the climate becomes unsuitable for them. Under a 2°C scenario, almost 25% of species in Priority Places are at risk of local extinction. Plants are projected to be particularly badly hit, because they are often unable to adapt quickly enough to a changing climate – which in turn may have a knock-on effect on other species that depend on them.

- **Dispersal can make a massive difference**
  To survive, plants and animals confronted with climate change need to adapt within their environment, or move elsewhere. Some species may be able to survive by tracking their favoured climatic conditions and dispersing into new areas. However, this movement poses significant challenges as suitable habitat to move into may not exist, or may already have been converted into agriculture or another land-use incompatible with that species' survival, and there may also be barriers to dispersal such as mountain ranges. So there's a huge amount of work to do on the ground to realise its potential benefits for biodiversity. Without the ability to disperse, the proportion of species exposed to local extinctions at a 2°C global temperature rise increases from 20% to around 25%. Under a worst-case scenario of no dispersal at 4.5°C, that figure jumps from 40% to 50%.

- **Conservation efforts are crucial**
  Climate change adds to the existing pressures – such as habitat loss, poaching and unsustainable harvesting – that are already putting species populations under huge strain. Redoubled local conservation efforts will be needed to strengthen species' resilience to climate change, to protect and restore biological corridors that support dispersal, and to secure those areas that will remain as suitable habitat – known as 'refugia' – even as temperatures rise.

Biodiversity has intrinsic value, and the loss of wildlife from the world's most remarkable natural places impoverishes us all. In some instances, there are clear economic and social implications – the local extinction of charismatic species can wipe out potential wildlife tourism opportunities, while an endemic plant that fails to keep up with a rapidly changing climate may take with it a potential medical breakthrough.

But the costs of biodiversity loss on the scale we could be seeing over the coming decades go far beyond this. This is not simply about the disappearance of certain species from particular places, but about profound changes to ecosystems that provide vital services to hundreds of millions of people. If we're to avoid this, we need a concerted global response that centres on four things:

We must cut global greenhouse-gas emissions

- We need deep cuts to global greenhouse-gas emissions, consistent with and improving on the pledges already made under the Paris Agreement. There's no way this can be achieved without a rapid phase-out of fossil fuels – particularly coal, but also oil and gas.

Conservation planning needs to consider climate change

- Conservation planning needs to be based on projected future climatic conditions, with a particular focus on notably vulnerable or resilient areas. An emphasis on aiding species dispersal is critical; as is the promotion of green development that doesn't put extra pressure on wildlife populations as the effects of a warmer climate worsen.

Further research is essential

- We need to recognise that this area of study is relatively new: alongside on-the-ground action, scientists must keep on with their efforts to deepen our understanding of the changes we can expect to see – and we need to base our policies on the growing knowledge base they're creating.

Awareness is key

- Finally, people need to know and people need to care. Everyone has a role to play in spreading the word and getting involved.

THE FUTURE OF BIODIVERSITY IS IN OUR HANDS. WHAT HAPPENS NEXT IS UP TO US.

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2°C TEMPERATURE RISE

If the global temperature rise is limited to 2°C, less than 25% of species in Priority Places are at risk of local extinction.

50% SPECIES LOSS

If global temperatures rise by 4.5°C, almost 50% of species in Priority Places are at risk of local extinction.

FUTURE EXTREMES

Even with the emissions cuts pledged under the Paris Agreement, temperatures that were extreme in the past are set to be the new normal in all Priority Places.

PRESERVING HABITATS

With a 2°C global temperature rise, 56% of the area of Priority Places would remain climatically suitable for species, up from 18% with a 4.5°C rise.

DISPERSAL CAN HELP

At a 2°C global temperature rise, the risk of local extinction decreases from around 25% with no dispersal to 20% if species can move freely.

WARMING WORLD

Temperature increases have been observed for all seasons across all WWF Priority Places over the past 50 years.

KNOCK-ON EFFECTS

More than 50% of plants could be lost in some areas with higher temperature rises, which would have damaging effects for many other species.

THE RESEARCH

Climate change is not a uniform phenomenon across the globe. Whichever way it progresses over the next century, its extent and effects will vary locally: some regions will warm more quickly than others, some habitats will be more severely affected than others, some species will be better able to tolerate a warming climate than others, and so on.

Our analysis targets WWF's 35 Priority Places around the world. We performed detailed studies on each using climate and then biodiversity modelling. These Priority Places comprise a huge range of geographies, climates, habitats and ecosystems, and each one is particularly rich in biodiversity. From the Amazon to the Namibian desert, from the Himalayas to the Mediterranean, each is unique; while together they reflect the sheer breadth and variety of life on Earth.

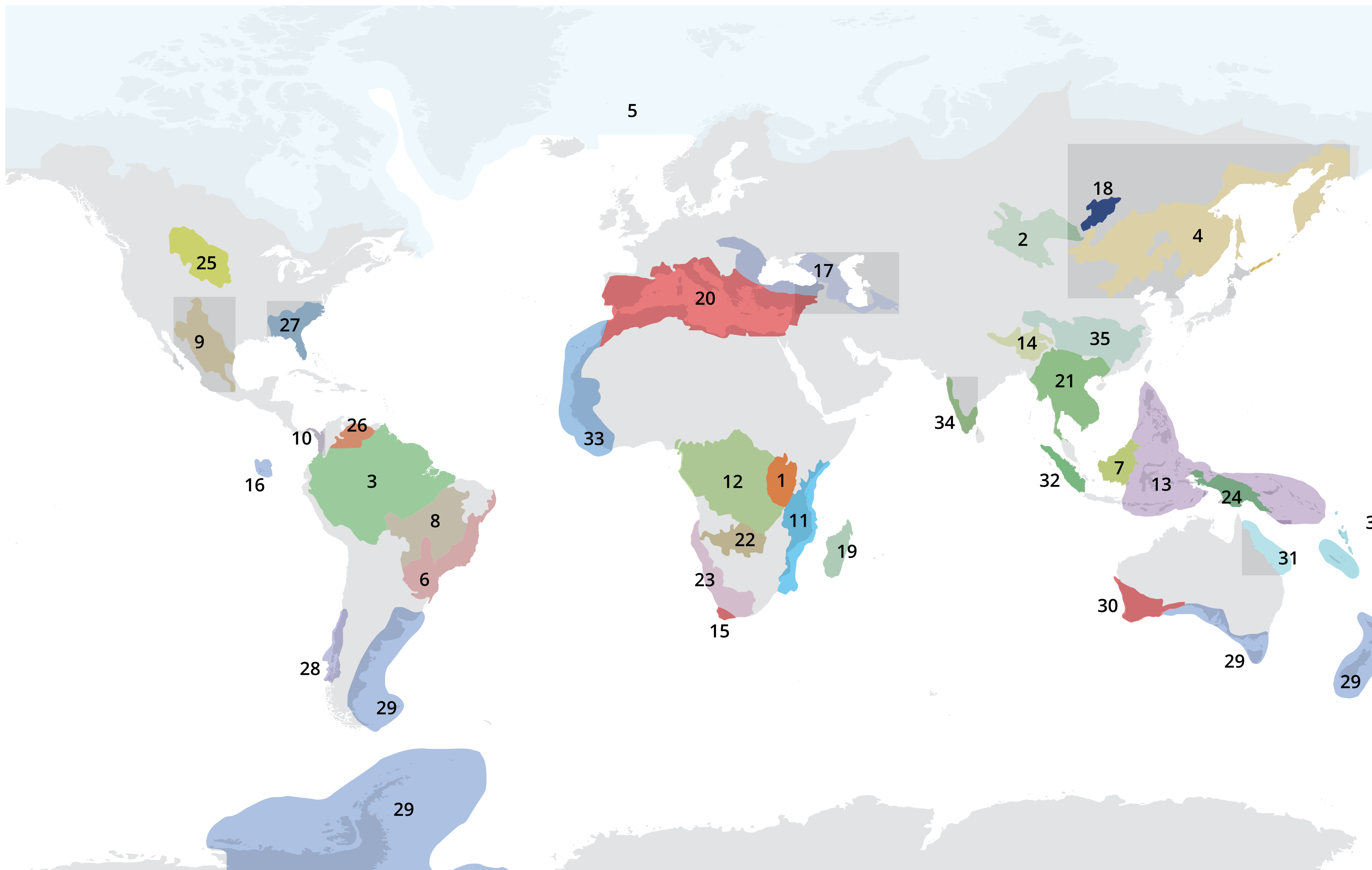
Biodiversity, too, is almost infinitely varied. Our projections break it down into five species groups: plants, mammals, birds, amphibians and reptiles. Each species is modelled separately, and in many Priority Places, levels of climate-related risks vary widely between groups. The detail of how, where and to what extent individual species are vulnerable to climate change will be an essential consideration in action plans for the future.

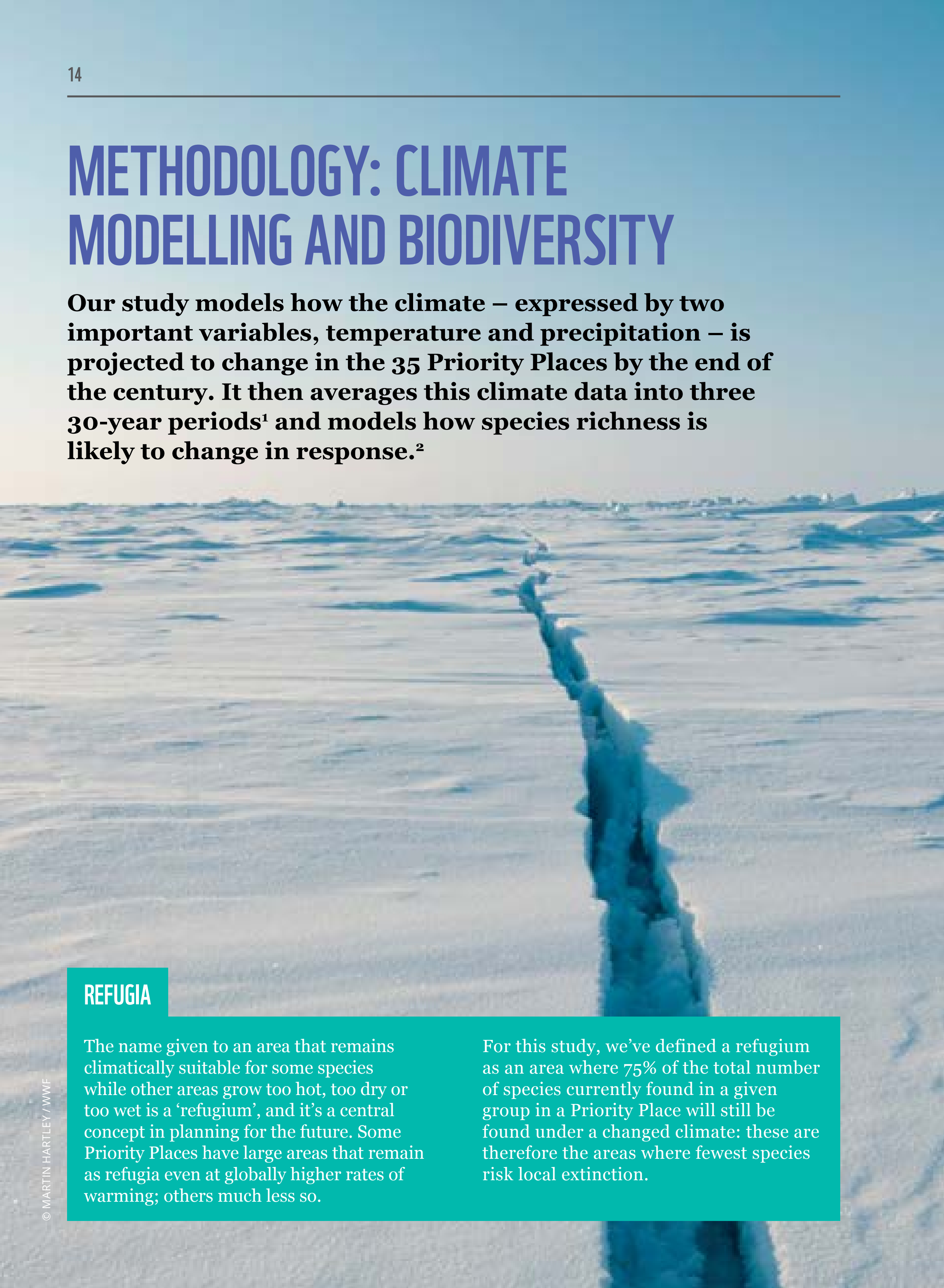
There's another important reason why our research has this localised focus. The overriding message of the data is that we need to cut global carbon emissions as far and as fast as we possibly can. But, due to inertia in Earth's climate system and our historical emissions, the planet will be warming to some extent whether we like it or not. In fact, we are already seeing this change, with the last three years being the hottest on record. We need to take practical action to prepare for it. The detail of the results for each Priority Place helps us identify where the regional priorities are, and how we can best direct our efforts to prepare for the localised changes a warming climate will bring.

WWF PRIORITY PLACES

WWF's Priority Places are 35 regions that contain the world's most exceptional ecosystems and habitats. These regions have been scientifically identified as being home to irreplaceable and threatened biodiversity, and/or present an opportunity to conserve the largest and most intact representation of their ecosystem.

1	African Rift Lakes Region
2	Altai-Sayan Montane Forests
3	Amazon Guianas
4	Amur-Heilong
5	Arctic Seas
6	Atlantic Forests
7	Borneo
8	Cerrado-Pantanal
9	Chihuahuan Deserts
10	Choco-Darien
11	Coastal East Africa
12	Congo Basin
13	Coral Triangle
14	Eastern Himalayas
15	Fynbos
16	Galapagos
17	Greater Black Sea Basin
18	Lake Baikal
19	Madagascar
20	Mediterranean
21	Mekong Complex
22	Miombo Woodlands
23	Namib-Karoo-Kaokoveld
24	New Guinea & Offshore Islands
25	Northern Great Plains
26	Orinoco River & Flooded Forests
27	South-eastern Rivers & Streams
28	Southern Chile
29	Southern oceans areas
30	South-west Australia
31	South-west Pacific
32	Sumatra
33	West Africa Marine
34	Western Ghats
35	Yangtze Basin





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METHODOLOGY: CLIMATE MODELLING AND BIODIVERSITY

Our study models how the climate – expressed by two important variables, temperature and precipitation – is projected to change in the 35 Priority Places by the end of the century. It then averages this climate data into three 30-year periods[1] and models how species richness is likely to change in response.[2]

REFUGIA

The name given to an area that remains climatically suitable for some species while other areas grow too hot, too dry or too wet is a 'refugium', and it's a central concept in planning for the future. Some Priority Places have large areas that remain as refugia even at globally higher rates of warming; others much less so.

For this study, we've defined a refugium as an area where 75% of the total number of species currently found in a given group in a Priority Place will still be found under a changed climate: these are therefore the areas where fewest species risk local extinction.

This method is based on our assumption that ecological systems are largely resilient to temperature and precipitation changes that lie within the bounds of recently experienced natural variability.

First, we examined the natural variability in the climate for each of the Priority Places over two historical 30-year periods (1961-1990 and 1984-2013). Assessing changes in seasonal temperature, precipitation, wet day frequency and cloud cover gave us a base range against which to assess future changes – and allowed us to observe how temperatures are already increasing in the Priority Places.

We then modelled three alternative climate scenarios over the century[3] – and hence different global average temperature rises:

- A 2°C rise, the upper temperature limit of the Paris Agreement.[4]
- A 3.2°C rise, an assessment of the first set of Paris Agreement pledges.
- A 4.5°C rise, corresponding to a business as usual scenario, where no further efforts are made to curb emissions and concentrations of greenhouse gases continue to increase unchecked.

We then took biodiversity data from the Wallace Initiative Phase II, which has modelled the potential impacts of climate change on nearly 80,000 species of plants, birds, mammals, reptiles and amphibians.

By combining observed species distribution data[5] with research on how each of these species will be affected at different temperature increases, we've been able to project an indication of how biodiversity may change in each Priority Place under the climate scenarios listed above.

This summary report contains a synthesis of results from the terrestrial part of 33 Priority Places to explore general trends for the five species groups as the climate changes. In underlying research we also looked at the marine part of eight Priority Places – two of which are solely marine, and six of which have both a marine and terrestrial part.

DISPERSAL AND ADAPTATION

While collective global action on climate is essential, localised efforts to help species survive in changing conditions will also make a big positive difference, and can help reduce local extinction rates.

As climatic conditions change, some species may evolve and adapt to new environmental conditions while others will adapt by moving their ranges into areas that are more suitable for their continued survival. For example, higher altitudes tend to be cooler: as the temperature warms, some mammals gradually move out of the lowlands into the hills to track their preferred climate; or birds travel longer distances to new areas where previously they would have struggled to thrive. Such movement, or dispersal, is an important natural adaptation strategy, and it could also be supported by human effort.

[1] 2011-2040, 2041-2070 and 2071-2100.

[2] In methodological terms this study on how species respond to a changing climate uses bioclimatic modelling, as opposed to mechanistic models or traits-based analysis.

[3] The scenarios were based on different representative concentration pathways (RCPs) for greenhouse gases (these were used by the IPCC in its fifth Assessment Report (AR5)) and drew on 21 global circulation models from the CMIP5 framework (Coupled Model Intercomparison Project Phase 5).

[4] The Paris Agreement aims to hold the global temperature rise to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C.

[5] At a spatial resolution of 20km x 20km.

However, having the potential to move into a new area isn't the same as actually getting there. That depends on the existence of viable ecological corridors linking the habitats – and today, habitat fragmentation is occurring at unprecedented rates. As for the habitats themselves, they depend on ecosystems maintaining their viability in the face of increasing pressure from unsustainable resource exploitation, infrastructure, rising populations, unsustainable development, and a host of other threats including climate change itself.

In conservation terms, the challenge is to look at each region in individual detail and decide where and how action on the ground can make the greatest contribution to maintaining biodiversity – to open wildlife corridors, to restore and conserve habitats, to make sure that other environmental threats are mitigated as far as possible. Our data mapping exercise has provided material to help guide these efforts.

For each global temperature scenario, we've looked at two alternatives in each Priority Place. The first doesn't make any allowance for dispersal – it assumes the species are unable to move from their current location. The second assumes that dispersal can take place at natural rates with no manmade (e.g. cities) or geographical (e.g. mountain ranges) barriers to impede this movement; and assumes there are suitable habitats to move into with adequate food to eat. The difference between these alternatives enables us to see the benefit that adaptation efforts to facilitate dispersal can bring.

The significance of dispersal varies widely from region to region. In some it makes little difference where species cannot move quickly. Elsewhere it appears that mammal or bird species would be able to cope with some amounts of warming provided they can disperse. In some rare cases, they might even increase in numbers if they can colonise areas previously hostile to them where there will now be suitable habitat and food.

Dispersal, though, is a gradual process and species' ranges may only change by a few kilometres per decade or less. The two projections show no difference for plants, reptiles and amphibians as their typical dispersal rate only allows them to move by a distance that is smaller than the cell size in our study (20km x 20km). While there can be movements, they would be relatively small compared to birds and mammals, meaning reptile and amphibian populations are more likely to be 'overtaken' by changes in their environments. If the current habitats for these species become climatically unsuitable, we might have to translocate populations of threatened species to refugia as a last resort, which is likely to be costly and difficult. In many regions plant species face the greatest losses as the climate warms, compared to animals.

RESEARCH LIMITS

For each of our species groups a single dispersal rate is used. In reality some species will disperse faster or slower than the rate assumed. For example, some plant seeds that are dispersed by wind might be able to disperse much faster, while a tree that only fruits every five years will not be able to disperse as fast.

Our analysis looks at readily available climate data, including average temperature and precipitation. However, it does not include climate impacts such as sea-ice and permafrost dynamics, as these do not occur in every Priority Place. This means that our analysis of the polar regions does not fully reflect the reality of these places.

We know how natural systems have responded to the variability in temperature and precipitation historically and we assume that this provides some information on future impacts. However, higher latitudes also typically experience larger inter-annual temperature fluctuations than many temperate and tropical regions – that is, larger regional warming is needed for the new temperature to exceed historical extremes. For example, in the Arctic average seasonal surface temperature can vary between 1.6°C and 4.3°C depending on the season. This means that species vulnerability based on comparing temperature envelopes may be underestimated in these areas. While the species may have experienced comparable temperatures before, past extremes did not create the consistent low-ice conditions that will severely constrain Arctic marine life in the future.

Our results focus on how species groups are likely to respond to climatic factors alone.[6] The results don't attempt to show how factors that don't relate to climate, such as disease or human-induced habitat loss, may also weaken or strengthen the resilience of species as temperatures rise.

For example, Javan rhinos in the wild have been pushed to the brink by many factors, from habitat loss and fragmentation to excessive hunting. Today, only a single, small population exists and is threatened by invasive species, disease and inbreeding depression. Without more effective conservation measures, breeding populations may reach a point where their ongoing viability is in doubt – but that's before we even consider climate change. Clearly, a small population with a limited gene pool will be less able to cope with increasing pressures in its environment than a larger, genetically diverse one.

As for interactions with other species groups, in certain regions a high proportion of mammals and birds are physiologically capable of tolerating higher temperatures. However, in those same regions there may be a projected loss of a quarter of all plant species in the event of a global average 2°C rise – and in many regions this proportion goes above 50% at higher temperatures. A change on this scale will have a significant effect on habitats: species groups may lose plants they depend on for food so may need to switch from their preferred diet, or they may find plants they use for shelter disappear, so even though they might be able to cope with the warmer climate, their long-term survival is by no means certain.

Similarly, the climate-linked disappearance of an apex predator could unbalance a complex food web beneath it, with a whole range of knock-on effects. Or, by contrast, warmer temperatures could open some regions to new species that join the long-time inhabitants in competition for limited food resources, driving out weaker rivals. Projections of this kind are beyond the scope of our research – but they do suggest that our figures are on the conservative side.

Our research contributes to a growing evidence base on how species will be affected by climate change. Because there are other ways to assess species vulnerability to climate change, the results of this research should not be used in isolation. We recommend they are used in conjunction with other species-specific studies.

[6] There are three primary methods for assessing species' vulnerability to climate change: correlative, mechanistic and trait-based. We've used correlative species distribution modelling to produce these results. The assumptions and limitations of this method are discussed in the literature, e.g. Elith & Leathwick 2009 and references therein.

FINDINGS

There are two different ways of interpreting the results of our research.[7]

On the one hand, the data shows the regional impacts of global warming. We can see to what extent the range of species in each Priority Place is threatened under different climate scenarios, and we can see the potential benefits that regional adaptation to allow natural dispersal can bring. This provides crucial background for planning how and where we can most effectively devote resources towards conservation and adaptation.

At the same time, these local results combine to paint a larger global picture. While the 35 Priority Places are all very different, the collected results reveal some striking trends. They add powerful evidence that we urgently need global action to mitigate climate change.

PRIORITY PLACES: SNAPSHOTS

The next pages show a summary of our findings for eight of the 35 Priority Places, selected to provide a snapshot of the potential impacts for a diverse range habitats across the globe. While local conditions, topographies and species vary widely, the results make it clear that a changing climate poses a severe threat to biodiversity all over the world.

[7] A synthesis of our research and findings has been peer reviewed and published in the scientific journal *Climatic Change*.

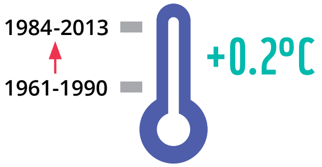
AMAZON AND GUIANAS

The Amazon's ecosystems host around 10% of all known species and play a crucial role in regulating the global climate.

Habitat: Tropical rainforest, flooded forest, rivers

Climate: Hot tropical equatorial climate year-round. Average temperatures projected to equal or exceed historical extremes by the 2020s.

Average regional temperature increase:



OUTLOOK

The Amazon is highly vulnerable to climate change. Even a 2°C rise would make the new average temperature hotter than previous extremes, and would threaten more than one-third of species in all groups in the absence of dispersal. A business as usual scenario would see this figure rise to around two-thirds. Plants fare badly across the board, while amphibians suffer the worst of all.

Adaptation efforts are critical here for birds and mammals, which could escape many of the worst effects of climate change if they are able to move to cooler areas – the Andes remain a refugium even at higher temperature rises. Connectivity needs to be at the centre of conservation plans.

Figure 1: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal ('+' indicates a possible increase in richness due to colonisation by other species).

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	43	43	59	59	69	69
Birds	37	+	51	+	64	13
Mammals	36	0	50	10	63	30
Amphibians	47	47	62	62	74	74
Reptiles	35	35	48	48	62	62

PLANTS

The Amazon is home to as many as 80,000 plant species, many of which are endemic to the region. These help regulate the global climate and local water cycles, and sustain the rainforest's rich animal life. They also provide food, fuel, shelter and medicine for people, including the 350 indigenous ethnic groups who live in the Amazon. Many modern medicines derive from rainforest plants, so the loss of plant biodiversity could deprive us of future medical breakthroughs. Even the lowest temperature rise modelled sees more than 4 in 10 of all plant species at risk of local extinction by the end of the century, while under current emission pledges we can expect around 6 in 10 to disappear.

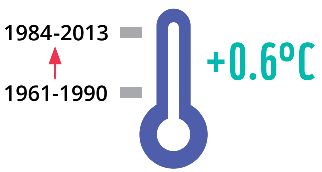
AMUR-HEILONG

The huge steppes and temperate forests of this remote north-east Asian region shelter endangered species including tigers and Amur leopards.

Habitat: Taiga, temperate forest, steppe grasslands, wetlands

Climate: Varied, with seasonal averages ranging from 15°C to -20.5°C. Half the region is covered by permafrost. A 2°C global rise would see average temperatures between June and November become higher than current extremes.

Average regional temperature increase:



OUTLOOK

Adaptation is the name of the game in Amur-Heilong. In theory at least, resident mammal and bird species should be physiologically capable of dispersing: the question is whether we can maintain the necessary connectivity between habitats in this vast region. If we can't, then at currently pledged levels we risk losing a third of its mammals and nearly a fifth of its bird species. Climatic trends are already reshaping migration routes for large populations of species such as the Mongolian gazelle.

Despite the relatively lower vulnerability of Amur-Heilong's animals, adequate habitats remain critical – and the change in plant species distribution is likely to affect existing habitats significantly.

Figure 2: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal ('+' indicates a possible increase in richness due to colonisation by other species).

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	20	20	32	32	42	42
Birds	14	+	18	+	24	+
Mammals	20	+	33	+	48	14
Amphibians	11	11	23	23	46	46
Reptiles	6	6	11	11	18	18

KOREAN PINE

Korean pine is a particularly important tree in the region, and provides a habitat for prey species for tigers and leopards. However, climate modelling suggests that Korean pine stands will be replaced by oak and elm across large areas, particularly in north-east China. Some range contraction (12-44%) has also been projected by the 2030s. There's some chance that the species may be able to extend its range north, but it will depend on soils and the dispersal rate. Korean pine trees are long-lived, but environmental stress can lead to reduced cone formation and increase the risk of loss due to disturbance (e.g. fire, insects).

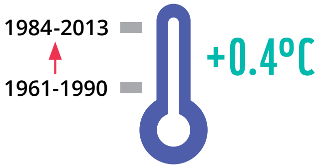
COASTAL EAST AFRICA

The coastal regions of east Africa are among Africa's most biologically diverse areas. But uncontrolled resource extraction, industrial agriculture and swift population growth already threaten biodiversity there.

Habitat: Savannah woodland, lowland forest, mangroves, coral reefs

Climate: Hot. Average temperatures projected to equal or exceed historical extremes by the 2020s and greatly exceed them by the end of the century. More droughts projected in future.

Average regional temperature increase:



OUTLOOK

Coastal east Africa is highly vulnerable to climate change. Even at a global rise of 2°C, the area is projected to become climatically unsuitable for more than 25% of the biodiversity across most species groups, with only reptiles faring slightly less badly. If global temperatures increase further, the situation quickly becomes worse: a 4.5°C rise would see about 7 out of 10 amphibians, 6 out of 10 birds, 4 out of 10 reptiles and more than half of all mammal species analysed seriously threatened unless extensive adaptation efforts are made. In either case, 56% of plant species are at risk of local extinction. This would cause a radical change in habitats in almost all areas that would be likely to affect other species groups.

As for marine biodiversity, rising water temperatures will make conditions less suitable for many species and may lead to coral bleaching. Other species are expected to colonise the area, leading to some changes in ecosystems. In some areas of the world marine turtles are already altering their migratory routes and nesting sites: it remains to be seen how far this will enable them to keep up with continuing change.

Figure 3: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling the risks both with dispersal and no dispersal.

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	29	29	45	45	56	56
Birds	34	7	50	17	62	30
Mammals	33	6	45	6	51	5
Amphibians	40	40	59	59	69	69
Reptiles	22	22	33	33	42	42

AFRICAN ELEPHANT

Water is crucial for African elephants. They need to drink 150-300 litres per day, as well as using it for playing and bathing. Hotter temperatures and less rain – as well as a projected increase in periods of severe drought – will have a direct effect on elephant numbers. Populations are limited by water availability and fodder – they may have to compete with humans as well as each other as these resources become scarcer – and calf mortality increases in times of drought.

Elephants have some adaptive capacity, although it's not clear how far they'll be able to keep up with the changing conditions. They behave differently when temperatures rise, eating less and resting more, spending more time in the water and shade to cool down.

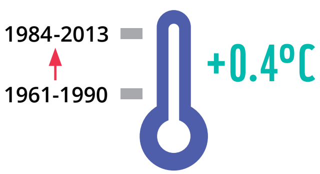
MADAGASCAR

Millions of years of isolation have mapped a unique evolutionary path for the plants and animals on the island of Madagascar – but they still face the threat of global climate change.

Habitat: Rainforest, tropical dry forest, deserts, plateaux, mangroves, coral reefs

Climate: Mostly hot, but widely varied conditions from deserts to rainforests. Temperatures have been stable in the past, meaning a rise of only 0.6-1°C will be enough for historical extremes to become the norm. Drier and less cloudy seasons are projected.

Average regional temperature increase:



OUTLOOK

Even if the global temperature rise is limited to 2°C, Madagascar is projected to become climatically unsuitable for more than a quarter of species across all groups. In the no dispersal business as usual scenario, this figure rises to well over half, with every single group severely threatened. Dispersal will help birds and mammals to some degree, but widespread policy interventions will be required to maintain the viability and connectivity of key habitats.

Geographical variation plays an important role. Generally speaking, rising temperatures will initially have more impact in the drier southern part of the island than in the wetter forests of the north. As temperatures continue to rise, this spreads into other areas, with central parts potentially becoming unsuitable for more than three-quarters of mammal species modelled.

Figure 4: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal.

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	25	25	42	42	54	54
Birds	28	14	44	28	57	40
Mammals	30	7	46	13	57	18
Amphibians	31	31	47	47	58	58
Reptiles	28	28	43	43	55	55

LEMURS

Lemurs are found only in Madagascar. A 2015 study projected that 60% of the 57 species modelled would have their ranges reduced by a substantial amount (average 56.9%) by warming of 2-4°C.[8] A minority – nine species – could see their range increase, while the rest are likely to remain stable.

Three areas were identified as particularly important refugia for lemurs: the Masaloa Peninsula, around the Mangoky river, and an area in the north-west including Ankarfantsika.

[8] *Shifting ranges and conservation challenges for lemurs in the face of climate change*, Jason L Brown and Anne D Yoder, Ecology and Evolution, vol 5 issue 6.

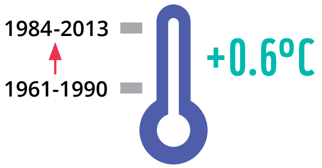
MEDITERRANEAN

More than 300 million visitors each year put enormous strain on the remaining resources of this unique sea where three continents meet: it's a region that the Intergovernmental Panel on Climate Change has identified as a climate impact hotspot.

Habitat: Ocean, coastline, Mediterranean and other forest, mountains

Climate: Warm summers, mild winters, with future averages quickly expected to surpass past extremes. Most climate models project less precipitation and cloud cover in all seasons, making severe droughts more likely and increasing forest fire risk.

Average regional temperature increase:



OUTLOOK

The Mediterranean is vulnerable even at lower levels of climate change: if the rise is constrained to 2°C, almost 30% of most species groups are at risk, and more than a third of all plants. If the world doesn't meet that limit, the situation becomes bleaker still: under currently pledged emissions reduction levels more than half of all plant species and a third to a half of other species groups are projected to disappear. At business as usual levels, on average around half of the region's biodiversity will be lost.

Mammals and birds can adapt to some degree if they are able to disperse – but this is a major challenge in a region where habitats have already suffered significant degradation and fragmentation.

Figure 5: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal.

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	36	36	55	55	69	69
Birds	21	10	35	22	49	36
Mammals	29	16	45	30	60	45
Amphibians	26	26	43	43	57	57
Reptiles	16	16	30	30	43	43

MARINE TURTLES

The Mediterranean is important for three species of marine turtle: the leatherback, green and loggerhead. They're seriously threatened by climate change. The main issues are feeding and breeding grounds.

Breeding could be affected in two ways. First, the temperature of the sand where turtles lay their eggs is a factor in the sex of the turtles that hatch. Typically, males come from eggs in the lower, cooler part of the nest: increased temperatures may result only in female hatchlings or, above a certain point, in none surviving at all. While female turtles may change nest depth in response, it isn't known whether this will be enough to compensate for the warming sand.

Second, climate change brings rising sea levels, higher tides and more extreme weather events. These can alter or destroy turtle nesting sites, which are already rare and fragile, and could lead to local extinctions where breeding is no longer viable.

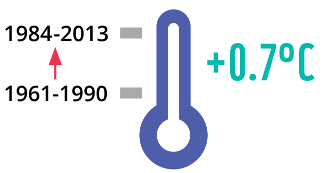
MIOMBO WOODLANDS

The Miombo woodlands cover much of central and southern Africa. This 2.4 million sq km region is sparsely settled by subsistence farmers. But with a swiftly growing population, it's one of the Priority Places that's most vulnerable to a changing climate.

Habitat: Tropical and subtropical grasslands, savannahs, shrublands

Climate: Widely varied, from humid to semi-arid and tropical to temperate. More frequent extreme weather events and greater rainfall variability is expected to result in limited woodland productivity and degradation of water resources.

Average regional temperature increase:



OUTLOOK

Even a 2°C global rise will cause severe harm to wildlife in the Miombo woodlands, and the higher projections are disastrous across all species groups. Such high impacts also strongly suggest that the ecosystem as a whole will be severely affected, potentially causing species further problems even if they remain suited to the climate itself.

Groundwater will become increasingly important in the region's rangelands, as it directly affects wildlife populations – the 14,600 sq km Hwange National Park already relies on pumped waterholes to sustain more than 45,000 elephants, so strategic placement and management of boreholes will be critical. Wildlife connectivity routes between limited refugia are also fundamental to future conservation, so key biodiversity areas and important bird areas are already being prioritised.

Figure 6: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal.

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	47	47	69	69	81	81
Birds	48	34	72	62	86	77
Mammals	45	35	67	56	80	68
Amphibians	54	54	79	79	90	90
Reptiles	50	50	69	69	81	81

AFRICAN WILD DOG

African wild dogs are heat-sensitive, typically hunting in the cooler periods of the day – so hotter days potentially mean shorter hunting periods and less food, which has the knock-on effect of reduced pup survival. A 2°C increase would contract its range, while current climate pledges could see it disappear from the region almost entirely. Wild dogs live in highly social packs and are susceptible to various diseases – climate change may increase the spread of some wildlife diseases.

Wild dog populations are in decline globally. As conflict for natural resources, including water and land, increases due to climate change, species like African wild dogs are likely to face even more pressures in their struggle to survive.

SOUTH-WEST AUSTRALIA

The south-western tip of Australia is one of the most biodiverse regions on the continent, with many endemic species. It's also one of the most vulnerable places in our study as global temperatures continue to rise.

Habitat: Mediterranean forests, woodland, scrub

Climate: In general, the region has a cool Mediterranean climate, with high rainfall and summer drought. Increased drying is projected in all seasons.

Average regional temperature increase:

1984-2013

1961-1990

+0.3°C

OUTLOOK

Even if the global mean temperature rise is constrained to 2°C, south-west Australia is projected to become unsuitable for 30-60% of species across all groups. Currently pledged levels of emissions see half of all birds and reptiles, two-thirds of mammals, and nearly 80% of amphibians disappear. For plants, the figure at this level is 60%, which would radically change ecosystems across the region. A business as usual scenario could be devastating for all species groups. Dispersal would improve matters slightly for birds and mammals, but even with maximum dispersal the number of species projected to disappear remains shockingly high.

Sadly, Australia has already seen the world's first extinction of a mammal species probably due to climate change: the island-dwelling Bramble Cay melomys, a rodent, has been completely wiped out from its only known location following a series of floods linked to rising sea levels.

Figure 7: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal.

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	41	41	60	60	74	74
Birds	29	18	47	35	63	53
Mammals	47	33	67	53	81	71
Amphibians	58	58	78	78	89	89
Reptiles	38	38	55	55	71	71

ROCK WALLABY

Australia's unique rock wallabies prefer rugged terrain, and have feet that are specially adapted to grip rock rather than dig into soil. They live in rocky areas with caves and crevices where they can shelter from climatic extremes – but in general terms they're threatened by a warming climate. They're flexible eaters, consuming a wide range of shrubs, grasses and herbs. But their small size and high metabolism means that rock wallabies need high-quality food to survive. The structure of the vegetation they require will change as temperatures rise: as Australia's interior becomes increasingly arid, rock wallaby populations are expected to become limited to coastal areas.

Rock wallabies live in colonies of 5-100 individuals. Habitat connectivity allows these groups to disperse and mix to keep a healthy gene pool. But some researchers fear that increasing population fragmentation is limiting genetic variability, reducing the ability of this species to cope with a changing climate.

YANGTZE

Few regions in the world have changed faster than the richly diverse and complex Yangtze: unprecedented development and urbanisation present a serious conservation challenge.

Habitat: Mountains, forests, river, wetlands

Climate: Warm summers and cold winters are the norm. By mid-century, historical high temperatures are expected to become the new average for all seasons, while climate models generally project that most seasons will become wetter.

Average regional temperature increase:

1984-2013
1961-1990
+0.3°C

OUTLOOK

The Yangtze appears moderately vulnerable to lower levels of climate change, with the impacts becoming increasingly severe at and above current pledges. If unrestricted dispersal can take place, mammals and birds fare reasonably well. However, unrestricted dispersal in this fast-developing region is a challenge – and without it, the numbers change markedly, showing around one in three mammal and bird species threatened at currently pledged levels. Plants look set to face greater threats, which could have a knock-on effect on other species groups if habitats and the availability of food plants are significantly altered. Even a 2°C rise puts almost a quarter of plants at risk, and this rises to half of all plant species at business as usual levels.

Figure 8: Percentage of species projected to be at risk of local extinction by the 2080s. The chart shows three different global climate change scenarios, modelling risk both with dispersal and no dispersal ('+' indicates a possible increase in richness due to colonisation by other species).

	Global climate change scenario					
	2°C		3.2°C		4.5°C	
Species group	No dispersal	With dispersal	No dispersal	With dispersal	No dispersal	With dispersal
Plants	23	23	37	37	50	50
Birds	21	2	33	8	44	16
Mammals	23	+	36	+	46	6
Amphibians	18	18	29	29	41	41
Reptiles	15	15	23	23	32	32

GIANT PANDA

Current giant panda habitats will become warmer and drier as global temperatures rise (except for a few areas which may become wetter), which is likely to make areas north of their current range more suitable for habitation in future.

However, the bamboo on which they depend almost exclusively for their diet is unlikely to keep pace with a shift to higher latitudes and elevations. Along with further habitat fragmentation and reduced dispersal, this could have serious consequences. Pandas – already notoriously slow breeders – may delay breeding or pause the development of embryos if they're not getting enough nutrition.

Another factor is that a warming climate in China may open higher elevations to agriculture, putting giant panda habitats under increased pressure.

GLOBAL OUTLOOK

As we've seen, WWF's Priority Places reflect the amazing diversity of our planet. Each has its own character, its own species, its own adaptation needs, and its own outlook.

That said, it's only when we compare trends across them all that the size and scope of the climate challenge facing the international community becomes clear.

The datasets we've produced allow us to compare the change in which locations will have suitable climate conditions and the knock-on effects across all of the Priority Places, and to assess what global warming will mean for global biodiversity.

This means there are two ways of looking at the overall results under different scenarios: we can look at the percentage of species within the different groups projected to disappear from Priority Places, and we can also look at the amount of climatically suitable space – refugia – projected to remain within them. In other words, we can see how habitats will change along with the biodiversity that depends on them.

The most important findings can't be repeated often enough: global biodiversity will suffer terribly over the next century unless we do everything we can – we must keep average global temperature rises down to the absolute minimum and through our conservation efforts we have to facilitate regional species adaptation. The more we look into the detail, the clearer this fact becomes.

THE BENEFITS OF MITIGATION

A species is considered at risk from climate change in a Priority Place if the climate is projected to become unsuitable for it to persist there. Cutting greenhouse gas emissions – and hence limiting the rise in global temperatures – reduces the projected local extinction of species from Priority Places enormously. If the world continues on the business-as-usual pathway, and species are not able to disperse freely, then nearly half (48%) of all species groups across the Priority Places become vulnerable to local extinction. However, if we keep greenhouse-gas emissions low enough to stay on the 2°C pathway, the proportion of all species groups across the Priority Places that become vulnerable to local extinction is halved to just under a quarter (24%).

As things stand, current country pledges to cut greenhouse-gas emissions under the Paris Agreement suggest something between these two outcomes: a 3.2°C rise in global temperatures would see around 37% of all species groups across the Priority Places becoming vulnerable to local extinction.

THE BENEFITS OF DISPERSAL

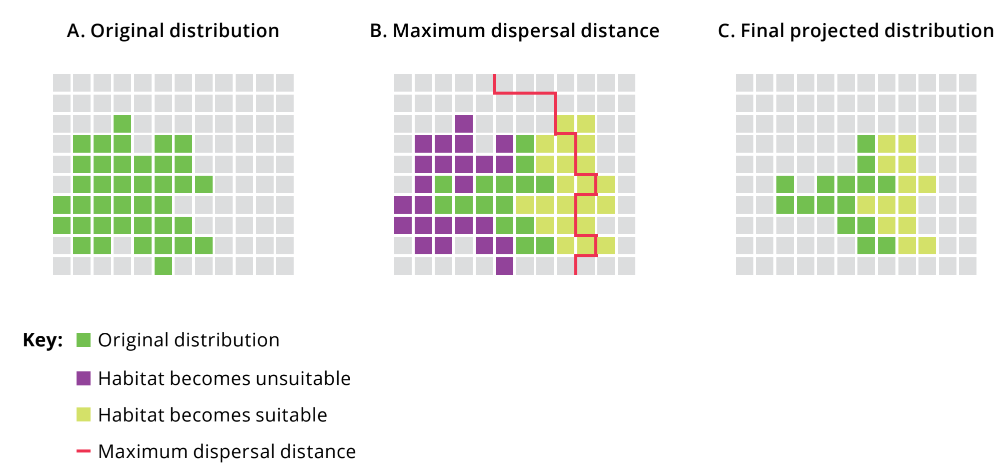
The mitigation figures above come with a big caveat: they assume that species are unable to adapt to the new temperatures by naturally dispersing fast enough to track their preferred climate.

If we use the model which incorporates this potential species dispersal, the importance of adaptation becomes clear. For example, if species can adapt by spreading unaided then the business-as-usual climate case leaves two-fifths (40%) of all species groups across the Priority Places vulnerable to local extinction, down from 48% with no dispersal.

Likewise if the temperature rise is restricted to 2°C and dispersal can take place, the proportion of all species groups across the Priority Places projected to become vulnerable to local extinction is reduced to less than one-fifth (19%), from a no-dispersal level of 24%.

Creating viable ecological corridors is a huge conservation challenge in increasingly fragmented landscapes, and this so-called 'optimal dispersal' is unlikely to be achieved. And as we have said before, it is harder for slower-moving species groups such as plants, amphibians and reptiles to disperse. Our results show that dispersal has little effect on these species groups because the size of the grid cells used in the study is larger than the average distance these species disperse.

Figure 9: How we model dispersal. Species live where the climate is suitable for them to survive (A). As conditions warm, new areas may become suitable and areas previously suitable may become too hot (B). Species may not be able to colonise all the new suitable area if the climate moves faster than they can disperse into it (C).



Figures 10 and 11 show the difference that both mitigation of greenhouse gases and on-the-ground dispersal make to future biodiversity across the Priority Places. The worst-case scenario – of no mitigation and no dispersal – is the red dot at the top right of figure 10.

These charts also include an additional scenario with a 2.7°C temperature rise – which is the lower projected temperature rise based on countries delivering their initial pledges under the Paris Agreement.

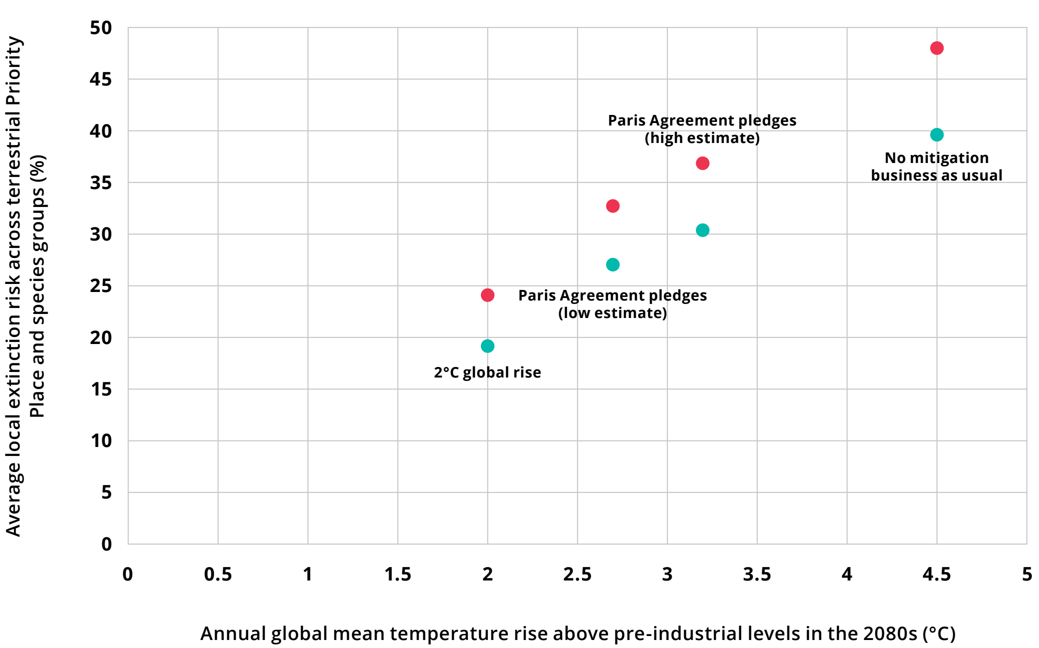
REFUGIA: WHAT WILL REMAIN?

Looking at future refugia areas under different climate scenarios is an alternative way of quantifying the benefits of dispersal and mitigation – and as with biodiversity, both have a significant influence on the projected results.

We've analysed how much of the area of each Priority Place remains a refugium under different climate change scenarios, and synthesised the results in figure 11 below.

Figure 10: The average (across species groups and Priority Places) percentage local extinction risk projected under different climate scenarios. The benefits of mitigation can be seen moving to the left (lower temperature rise) and the benefits of dispersal by comparing blue dots to red dots.

Key: ● Without dispersal ● With dispersal



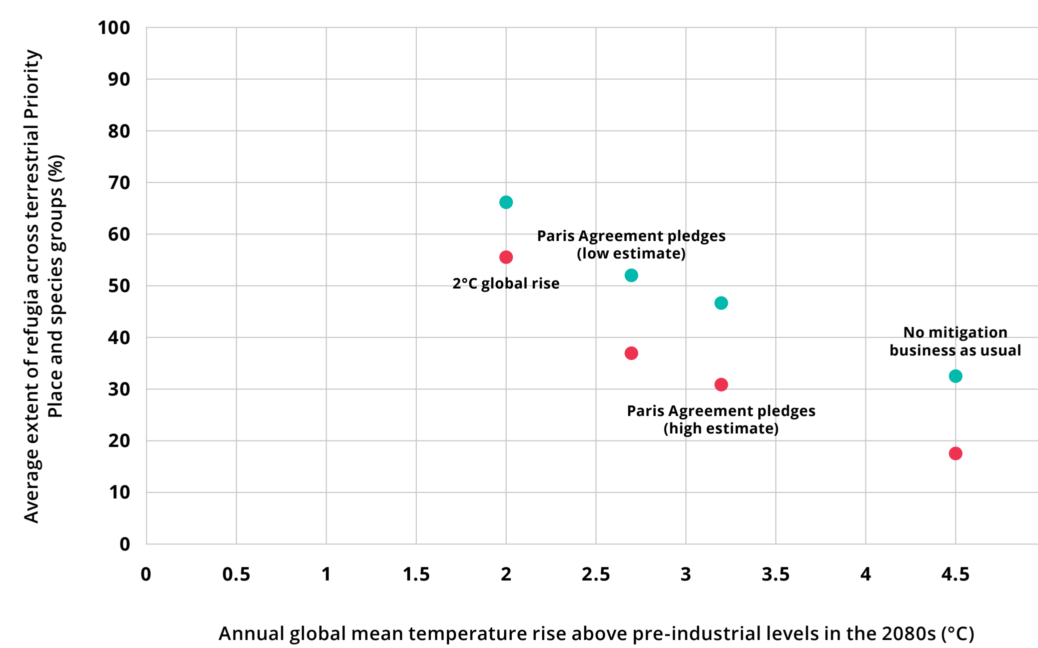
As we can see, a warming climate greatly reduces the remaining areas of refugia. Under the no mitigation, business as usual projection, and with no adaption by dispersal, then the average area of each Priority Place remaining as a refugium is less than a fifth (18%).

However, keeping to a 2°C rise means this figure increases dramatically – even in the absence of dispersal, over three times more area (56%) acts as a refugium.

If species are able to disperse naturally then there are also significant benefits. With dispersal, the no-mitigation business as usual projection shows that refugia persist over one-third of the area (33%), while in the 2°C case it increases to two-thirds (66%).

Figure 11: Persistence of refugia in Priority Places with and without adaptation to allow dispersal. The figure shows the average (across species groups and Priority Places) percentage of the area of a Priority Place that is projected to act as refugia under different climate scenarios.

Key: ● Without dispersal ● With dispersal



CLIMATE CHANGE AND CONSERVATION ACTION

WWF is already working on projects all over the world to adapt to rising temperatures.

TAKING CARE OF THE TURTLES

One of the biggest dangers facing the seven species of marine turtle is the loss of their nesting sites: without anywhere to lay their eggs, they can't reproduce. As waters warm and sea levels rise, high tide marks get higher – and in many instances this threatens to flood traditional turtle nest sites.

WWF is working to conserve marine turtles along the coast of east Africa by monitoring their nesting sites, and translocating them to safer higher ground where necessary. We also plant trees near beaches to keep sand temperatures cooler.

BOOSTING BHUTAN'S PROTECTED AREAS

More than half the land in Bhutan is protected for nature – the highest proportion in Asia. But the country's natural resources are still threatened by climate change, rapid modernisation and a growing population. WWF and the government of Bhutan have created an innovative funding approach called 'Bhutan for Life' to maintain and manage the country's parks and wildlife corridors in perpetuity.

We're supporting this effort through a partnership we've created with Columbia University's Center for Climate Research. We're developing information about climate risk to enable informed management of Bhutan's national park system. Our partnership's emphasis on practical application brings science out of the laboratory and into the field.

REBUILDING REEFS IN BELIZE

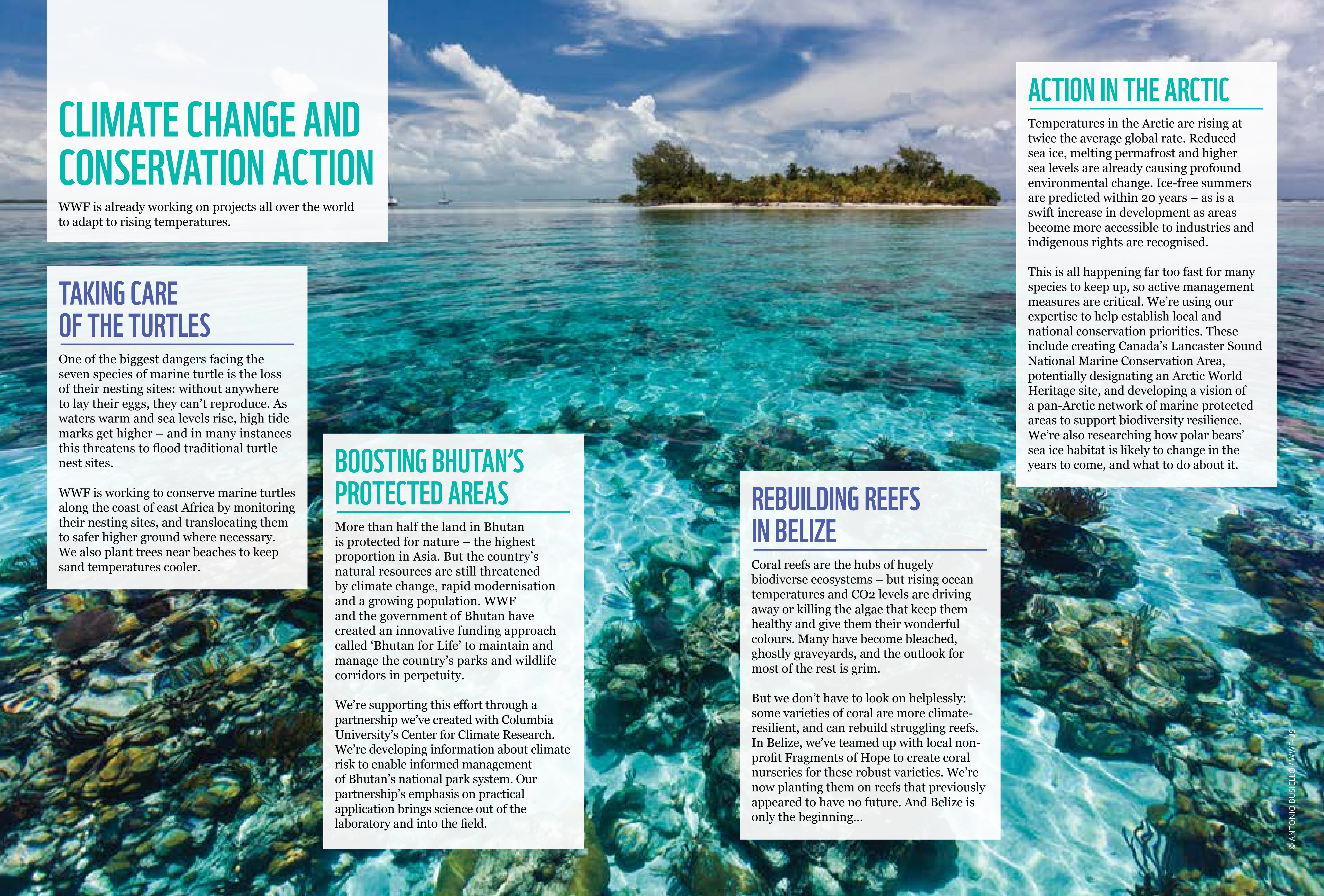
Coral reefs are the hubs of hugely biodiverse ecosystems – but rising ocean temperatures and CO2 levels are driving away or killing the algae that keep them healthy and give them their wonderful colours. Many have become bleached, ghostly graveyards, and the outlook for most of the rest is grim.

But we don't have to look on helplessly: some varieties of coral are more climate-resilient, and can rebuild struggling reefs. In Belize, we've teamed up with local non-profit Fragments of Hope to create coral nurseries for these robust varieties. We're now planting them on reefs that previously appeared to have no future. And Belize is only the beginning...

ACTION IN THE ARCTIC

Temperatures in the Arctic are rising at twice the average global rate. Reduced sea ice, melting permafrost and higher sea levels are already causing profound environmental change. Ice-free summers are predicted within 20 years – as is a swift increase in development as areas become more accessible to industries and indigenous rights are recognised.

This is all happening far too fast for many species to keep up, so active management measures are critical. We're using our expertise to help establish local and national conservation priorities. These include creating Canada's Lancaster Sound National Marine Conservation Area, potentially designating an Arctic World Heritage site, and developing a vision of a pan-Arctic network of marine protected areas to support biodiversity resilience. We're also researching how polar bears' sea ice habitat is likely to change in the years to come, and what to do about it.



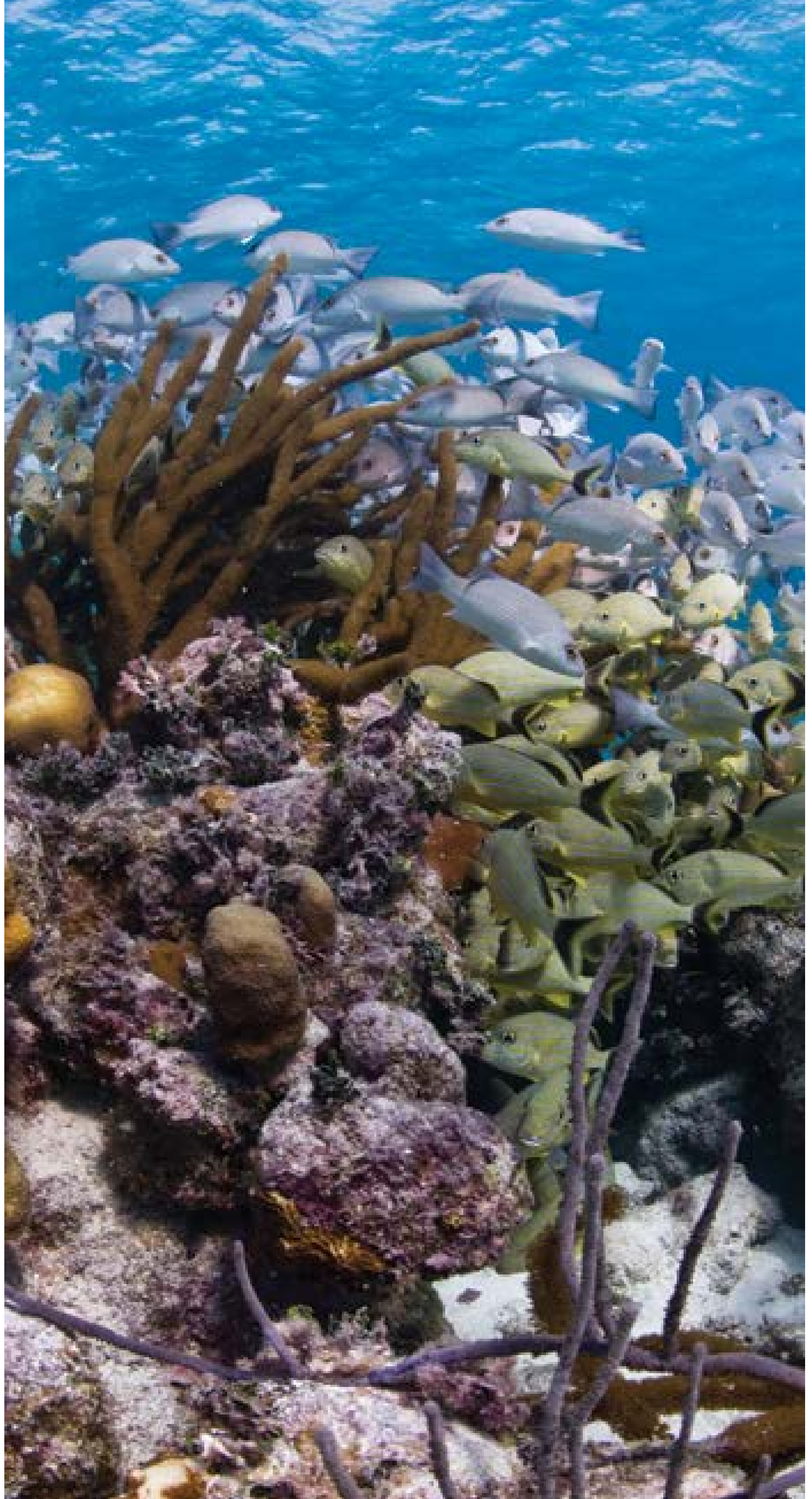
CONCLUSIONS

Climate change will inevitably affect biodiversity all over the planet in the course of the century. That's a given. What's less certain at this stage is how much harm it will ultimately cause – and that's something that we can and must influence.

The most important thing the world can do is to keep global temperature rises to a minimum by doing everything possible to reduce the greenhouse gases in the atmosphere. Put simply, we have to stop burning fossil fuels. A couple of degrees may not sound like a huge margin, but the projected harm to biodiversity increases enormously between the rise targeted under the Paris Agreement (well below 2°C and aiming for 1.5°C), and a business-as-usual projection of 4.5°C.

If species are able to disperse unimpeded, then a 2°C rise would see around two-thirds of our Priority Place areas remaining as climatic refugia – but a 4.5°C rise would reduce this to just one-third.

Mitigation really matters. However, even under a best-case mitigation scenario, significant areas of the world will still become climatically unsuitable for many species. So it's vital to ensure that we take a strategic approach to the challenge of localised adaptation, as this too has a critical role to play in maintaining biodiversity.



RECOMMENDATIONS

DIRECT REGIONAL ACTION

In every Priority Place, we must work to increase the extent and integrity of protected areas and establish movement corridors to connect protected areas and climate refugia. Future protection will need to account for and respond to climate change if it is to contribute to a restoration of nature. We may need to create new nature reserves in areas currently outside the ranges of some species, to act as future climate refugia and to increase connectivity between fragmented populations. And we'll need to create or strengthen buffer zones around existing habitats to ensure populations are robust and ready to withstand growing climatic pressure.

Wildlife will have to be allowed adequate space to roam. International borders will inevitably be crossed, so conservation plans will need to be approached multilaterally.

Refugia are particularly important: we're gaining a better long-term understanding of which areas in our Priority Places are the most significant for climate-linked conservation. This information has to inform priorities for future land-use planning. Activities that would have a negative impact on important habitats must be avoided.

In cases where a species faces a high risk of local extinction, we may need to consider translocating individuals and sub-populations to climatic refugia as a last resort.

MORE DATA, BETTER SCIENCE

We're improving our knowledge all the time, and more data will become available as the effects of climate change play themselves out.

It's essential that we continue to scrutinise the way species and ecosystems respond to extreme events and climate variability, as well as monitoring other important indicators such as disease. The more we understand about the changes that are taking place around us, the better able we'll be to deal with them. Localised vulnerability assessments and other targeted research will enable us to plan more effectively what actions to take in preparation for future developments. The feedback loops between species range shifts, ecosystem functioning, food security and the climate need more research, but they're becoming clearer all the time, and this is a growing source of knowledge we have to build on.

We also need to collect weather data in areas where it's not yet available: while the Priority Places give a useful focus to our work, the issues they bring to light don't simply stop at their borders. The climate challenge we face affects the entire globe and doesn't sit within neatly designated areas on a map, so we need ultimately to ensure that we have enough data to act on in an informed basis across the whole world.

THE HUMAN DIMENSION

It's about more than wild animals and plants: people are directly affected by climate change too, and their responses could increase pressure on biodiversity that's already being weakened by climatic factors. There's still plenty to learn on this front, but there's a lot we can do to reduce the negative consequences of human actions.

As communities face increasing climate-related hardships along with a host of other challenges, they may change their behaviours in ways likely to have an increasingly negative impact on wildlife. Agriculture, inefficient land use and poorly planned development can all cause habitat loss and fragmentation, often harming ecosystem services. Conflict between people and wildlife is also on the rise as habitats are encroached on for agriculture and settlement and human populations increase. It's likely that this conflict will increase further as natural resources such as water, fodder and prey become scarcer. This could result in increased crop and livestock predation by wild animals, and more wild animals killed by humans in response.

Communities need to be given support and incentives to conserve the natural heritage around them. Much can be done to promote more sustainable farming practices such as agroforestry, whether the aim is to increase yields or reduce ecosystem damage. It's also essential that local wildlife adaptation efforts don't come at the expense of the needs of local communities. Alternative livelihoods need nurturing and promoting, from artisan crafts to low-impact forestry and wildlife tourism.

SPREAD THE WORD, BUILD CAPACITY

The challenges ahead are way too big for any one group to deal with – and we all have a shared responsibility to care for our one planet. From global unions and national executives right down to individual communities and grassroots activists, everyone has a role to play in the struggle to preserve Earth's biodiversity for our children and grandchildren.

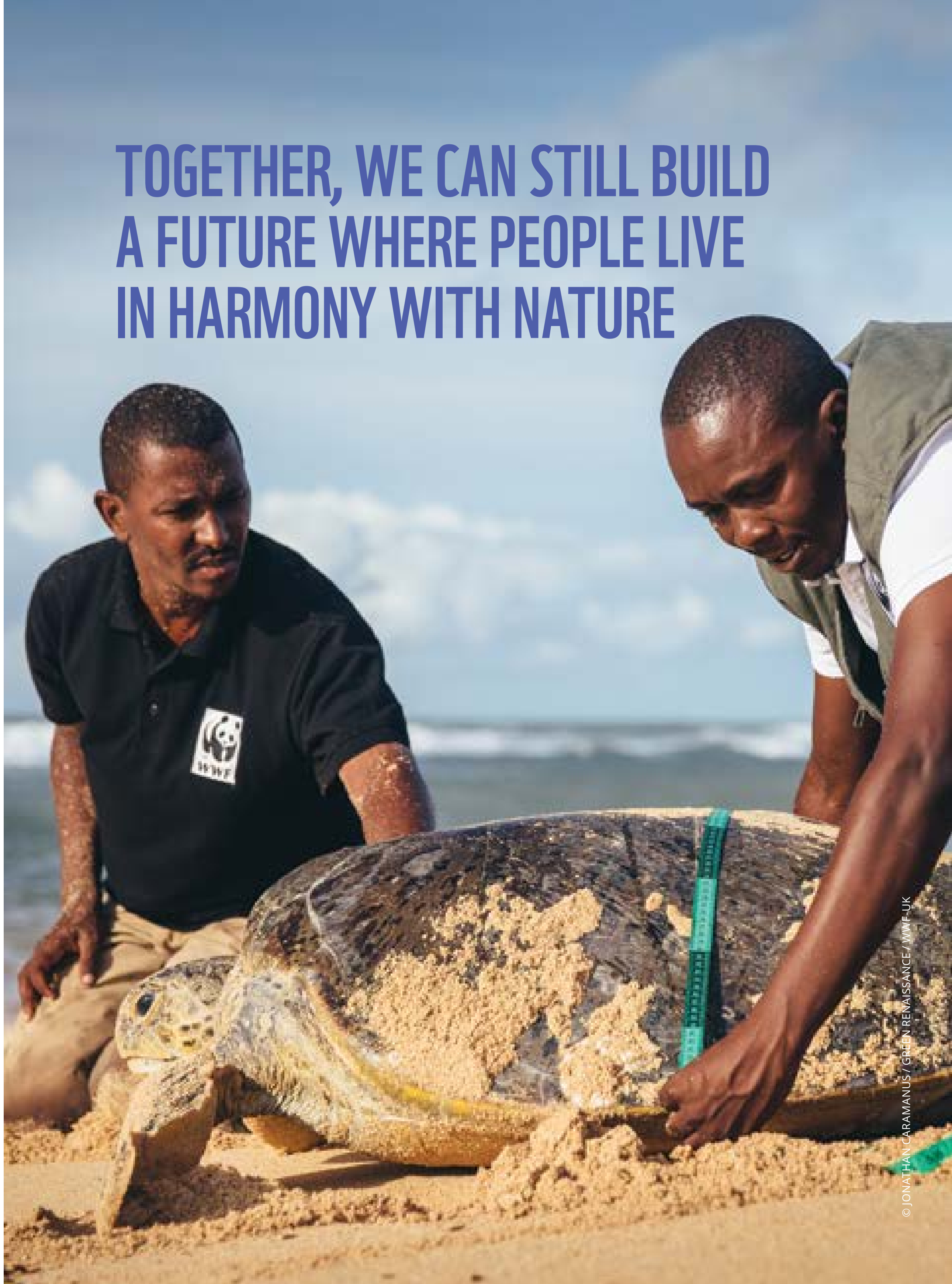
All adaptation is local and is best planned and implemented at the local level. So alongside international efforts to mitigate global temperature rises as far as possible – this is where the front line will be. But governments have a critical role too, supporting and enabling policies that allow meaningful change; and coordinating landscape-level initiatives – and governments listen to their citizens.

If we are care about our amazing planet, then we simply can't ignore the issues of climate change and biodiversity loss. Now is the time to build understanding, capacity and commitment among colleagues, supporters, decision-makers and hands-on doers the world over. Now is the time to get serious. Together, as a species, we can do this.

CLIMATE CROWD

WWF Climate Crowd (wwfclimatecrowd.org) is a new initiative to rapidly crowdsource large amounts of data on how vulnerable communities are affected by changes in weather and climate, how they're coping with these changes, and what negative impacts their responses might be having on biodiversity. We're currently collaborating with a growing number of partners to collect and analyse this data, and to develop and support solutions to help communities adapt to rapid change.

TOGETHER, WE CAN STILL BUILD A FUTURE WHERE PEOPLE LIVE IN HARMONY WITH NATURE



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