Section 4: Climate change – impacts and adaptation

Co-ordinators: Bruce Dinwiddy (UKOTCF Council) & Deborah Procter (Climate Change Advisor, JNCC)

Recent years have seen increasing attention paid to climate change issues, particularly at policy level. Some in the conservation community feel that this has distracted from the essential work required to reduce (and ultimately halt) biodiversity loss, whether the survival of species, the protection of habitats, or the maintenance of the integrity and function of ecosystems. Furthermore, particular attention seems to have been paid to climate change mitigation, and measures to reduce greenhouse gas emissions. Whilst hugely important at a global scale, local implementation of such measures seems rather less important for small island communities; whilst they may be disproportionately threatened by the impacts of climate change, the contribution that they make to emissions is (in a global context) very small.

The perceived distraction from biodiversity loss is particularly ironic, given that the environmental threat posed by climate change (and the required responses) are closely linked in many ways to the assets and services provided by biodiversity. The Climate Change session at the Making the Right Connections conference chose to focus, in particular, on the links between climate change and biodiversity. This included the impacts, for example, of rising temperatures and other phenomena on wildlife, and the role of species as indicators of climate change. It also included the role of biodiversity in adaptation to climate change, noting (for example) the need to maintain the important function of natural ecosystems in coastal protection against storm surges, and in other contexts.

The session was coordinated by Bruce Dinwiddy (UKOTCF Council, and Governor of the Cayman Islands when Hurricane Ivan struck in 2004, so well acquainted with the effects of severe climate events) who provided a brief introduction, and Deborah Procter (Climate Change Advisor, JNCC) who provided general background. There followed presentations relating experiences of climate change impacts, adaptation and some aspects of mitigation, in South Georgia and the South Sandwich Islands, Guernsey, and Cayman (linked to a regional initiative for all five Caribbean UKOTs). A lively, open discussion then took place, drawing together aspects of the experiences presented and challenges for the future.

Deborah Procter (L) and Bruce Dinwiddy chair discussions on Darren Christie's (R) presentation. Photo: Mike Pienkowski/ Rob Thomas

(Photos of authors in this section by Rob Thomas & Mike Pienkowski, unless otherwise indicated)

Framework Document: Climate change – impacts and adaptation

Co-ordinators: Bruce Dinwiddy (UKOTCF Council) & Deborah Procter (Climate Change Advisor, JNCC)

Dinwiddy, B. & Procter. D. 2010. Framework: Climate change – impacts and adaptation. pp 138-139 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

This Framework Document sets the scene for the following individual contributions to, and discussion arising from, the Climate Change session. The importance of climate change as a driver of biodiversity loss is noted, as is the need for mitigation, adaptation and planning in response. The links between adaptation measures and the natural environment are emphasised, types of adaptation are summarised, and a few key information sources are listed.

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Climate change is one of the six main direct drivers of biodiversity loss identified in the *Millennium Ecosystem Assessment* (MA). The insidious effects of climate change range across the globe and have been documented at a variety of temporal and spatial scales. Changes in the timing of flowering of plants, emergence of insects and the migration routes of birds and mammals are all well documented and have been linked to changes of climate. The climate changes observed are extremely likely to have been, and continue to be, driven by anthropogenic inputs.

There are three top level responses to climate change needed to benefit the natural environment:

- urgent mitigation of climate change to minimise impacts on the natural environment;
- active adaptive conservation management to enhance the functional resilience of current and future ecosystems; and
- planning to cope with changes to ecosystems when major changes are unavoidable.

These mirror the universal needs of society and across sectors. The needs of and contribution from biodiversity and geodiversity need to be recognised as part of that universal response.

Impacts

Alongside direct measurement of variables such as temperature and atmospheric composition, records of biological phenomena (like those noted above) have provided important evidence of the reality of recent, rapid climate change trends. Impacts on biodiversity provide some of the most potent tools for raising awareness (at all levels of society) of climate change, and on-going monitoring of such impacts yields important data for tracking its effects. Research leading to better understanding of biodiversity impacts allows for increasingly reliable predictions to be made, feeding into the development of appropriate adaptation measures, with socio-economic as well as environmental benefits.

Mitigation

Mitigation measures to reduce the effects of

key anthropogenic drivers of climate change are increasingly urgently needed. Actions taken at a local level in small island communities all have value, in demonstrating political will, encouraging the development of new technologies, and sending messages to other key actors. However, it will be measures taken by large nations and (in a concerted fashion) across regions that will have the greatest significance in reducing climate change impacts in small nations. In part, this is the rationale behind the focus of the discussion part of this session on adaptation rather than mitigation.

Adaptation

The natural environment has a role to play in climate change adaptation, i.e. there are positive links between biodiversity conservation action and mechanisms put in place to cope with climate change (e.g. coral reefs and coastal protection, forests and flood defence). Some adaptation strategies could have a negative effect on biodiversity (e.g. concrete structures at the coast). On top of all of this there are the direct effects of climate change on biodiversity (e.g. establishment of invasive aliens, changes in species migration routes).

Different Types of Adaptation (Source: IPCC 2001)

Anticipatory Adaptation - Adaptation that takes place before impacts of climate change are observed. This is also referred to as proactive adaptation.

Autonomous Adaptation - Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. This is also referred to as spontaneous adaptation.

Planned Adaptation - Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Reactive Adaptation - Adaptation that takes place after impacts of climate change have been observed.

Resources

The following are some useful information sources:

Brown, N. (2008). *Climate Change in the UK Overseas Territories: An Overview of the Science, Policy and You.* Peterborough, UK: Joint Nature Conservation Committee. www.jncc.gov.uk/page-4374

IPCC [Intergovernmental Panel on Climate Change] website: http://www.ipcc.ch/

MA [Millennium Ecosystem Assessment] website: http://www.millenniumassessment.org/en/index.aspx

McWilliams, J.P. (2009). Implications of climate change for biodiversity in the UK Overseas Territories. *JNCC Report No. 427* www.jncc.gov.uk/page-4602

Petit, J. & Prudent, G. (2008). *Climate Change and Biodiversity in the European Union Overseas Entities*. UICN, Brussels. www.reunion2008.eu/pages/en/en-publication.html

Procter, D.A. & Fleming, L.V., editors. 1999. *Biodiversity: The UK Overseas Territories.* Joint Nature Conservation Committee, Peterborough, UK. www.jncc.gov.uk/page-3045

Tompkins, E.L., Nicholson-Cole, S.A., Hurlston, L-A., Boyd, E., Brooks Hodge, G., Clarke, J., Gray, G., Trotz, N. & Varlack, L. (2005) *Surviving climate change in small islands: a guidebook.* Tyndall Centre for Climate Change Research, UK. http://www.tyndall.ac.uk/publications/surviving.pdf

Walling, L.J. (2008). *Climate Change in the UK Overseas Territories: Guidance for Biodiversity Conservation and Management in a Changing Climate in the UK Overseas Territories.* Peterborough, UK: Joint Nature Conservation Committee. www.jncc.gov.uk/page-4374

Introduction

Bruce Dinwiddy (UKOTCF Council)

Dinwiddy, B. 2010. Introduction to Climate Change Session. pp 140-141 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Bruce Dinwiddy, UKOTCF Council. bruce.dinwiddy@zen.co.uk

Good afternoon, everyone, and welcome to our first afternoon session.

Among those of you who attended the conference in Jersey, there may be one or two who recall that in the closing session one of the participants rose to his feet and commented that there was an important sleeping dog which had not barked during that conference, though it would undoubtedly bark a great deal more loudly in the future. The sleeping dog was global warming and its impact on climate change; and, yes, the person who made that brief intervention was me!

Little did I guess, nearly three years ago in Jersey, that I would be invited to be a coordinator of a session on climate change at this the next Forum conference. Even less, would I ever have guessed that we would be meeting here in the Westin Casuarina, where my wife and I lived for six weeks in September/October 2004 in the aftermath of Hurricane Ivan, the biggest storm to strike Grand Cayman in living memory, after which our house next door was temporarily uninhabitable. It's very good to be here again, hopefully early enough in the 2009 hurricane season to escape, this week, anything remotely resembling Ivan!

As most of you will be well aware, there's been a marked rise in tropical storm activity in the Caribbean during the past 40 years, with a 75% increase in the number of category 4 and 5 hurricanes. It's now generally accepted that this is at least partly related to rising temperatures during the same period.

But the effects of global warming are increasingly worrying in all the Overseas Territories and other entities represented at this conference. For my own part, I first became concerned about the impact of global warming in the UKOTs some 12 years ago, when I saw at first-hand the effect even at that time of slowly rising sea levels in the British Indian Ocean Territory (which is even lower and flatter than Grand Cayman!). Just a year or two later, the corals in BIOT were severely bleached by a sudden rise in sea surface temperatures, which destroyed some 80% of live coral to a depth of 30 metres.

Happily, after the sea temperatures dropped back to nearer their historic levels, most of the coral revived much more quickly than was initially feared. But this bleaching episode was a portent of the sort of thing we must expect to see much more widely, and often irreversibly, as sea and air temperatures continue to rise.

We must of course recognise that the peoples of the Overseas Territories collectively make a virtually negligible contribution to global warming, and their governments effectively have no voice in international efforts to address it. I would maintain that every one of us has a responsibility to reduce or mitigate as far as possible our individual carbon footprint. But that is not our topic this afternoon. Our key starting-point is that, whatever their peoples and governments do in mitigation, the OTs are extremely vulnerable to the effects of climate change generated by human profligacy elsewhere in the world.

Hence, we shall focus this afternoon essentially on impacts and on practical adaptation. I personally have no special expertise in these matters. But I'm fortunate to have as my fellow-coordinator Deborah Proctor, Climate Change Adviser to the Joint Nature Conservation Committee, which has already done some very valuable work in this field, with particular reference to the UK Overseas Territories. Deborah will set the scene for us, outlining the links between climate change and biodiversity conservation. We shall then hear presentations from Darren Christie, on the threats from climate change in South Georgia, and from Andrew Casebow, a study of experience in Jersey.

We were also looking forward to a presentation from Dr Neville Trotz of the Caribbean Community Climate Change Centre in Belize. Dr Trotz was going to tell us about the DFID-funded £300,000 programme, through CCCCC, for the development and implementation of climate change adaptation strategies in the five Caribbean Overseas Territories. Very disappointingly, he has been unable to attend the conference, and we shall therefore rely on representatives from the individual territories to relate their experiences of the '5Cs' project.

We hope that many of you, not just from the Caribbean, have useful experience that you can share with us this afternoon. There will be opportunity for a few questions after each presentation, which should take us to tea-time around 3 o'clock. We are aiming to break at that point for about 15 minutes, and then to return for a more general discussion which will allow us to frame some material for the conference conclusions.

So much for general Introduction. I thank you for your attention; and, rather than invite questions at this point, I would like now to give the floor to my colleague Deborah Procter.

Climate change and biodiversity conservation - impacts and adaptation

Deborah Procter (Climate Change Advisor, JNCC)

Procter, D. 2010. Climate change and biodiversity conservation - impacts and adaptation. pp 142-144 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

The natural environment is an integral part of the climate system; it is both affected by and affects climate globally and locally. A considerable body of theory on climate change adaptation has been and is being developed. The real challenge is to put into practice developing theories and concepts, and to build on lessons learnt from such action.

It is important to determine the risks and opportunities for biodiversity conservation from mechanisms put in place to address climate change over the short to medium term. This requires a balanced consideration of social, economic and environmental issues. Although biodiversity and climate change policy could result in win-win solutions, in some cases difficult trade-offs will be required. We need to determine what trade-offs we are prepared to accept for biodiversity. The ecosystem approach provides a sound mechanism to inform the development of climate change policies, thereby stressing the interactions between societal choice, economic valuation, incentives, ecosystem function and thresholds, and to strengthen the case for sustainable adaptation and mitigation measures.

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Introduction

Our understanding of recent and current trends in climate change, and predictions of likely future trends, are steadily improving. This enhanced understanding is exemplified by the work of the Intergovernmental Panel on Climate Change, and its recent Fourth Assessment Report (IPCC 2007). Amongst other trends, a pattern of increasing global average surface temperature has emerged. In its Third Assessment Report in 2001, the IPCC estimated that this represented a warming of around 0.6°C in the preceding 100 years. The Fourth Assessment Report revised this to 0.74°C in the preceding 100 years, and more recent estimates place the figure closer to 0.8°C. This trend in increasing global average surface temperature is predicted to continue. Depending on atmospheric greenhouse gas concentrations, further warming of between 1.8°C and 4°C is anticipated by the end of the century.

Other phenomena related to climate change include sea-level rise and changes in ocean chemistry. Globally, the sea's level has risen by about 20cm since 1900. The rate of increase seems to be accelerating; it was of the order of 1.8 mm/year after 1961, but has risen to nearer 3.1 mm/year since 1993 (IPCC, 2007). Changes in atmospheric gases caused by human activities since 1750 have led to a general acidification of the oceans. The global average pH level has already fallen by 0.1 units, and models suggest a further decrease in global oceanic surface pH levels of between 0.14 and 0.35 units between now and the end of the century (IPCC 2007).

Adaptation

A considerable body of theory on climate change adaptation has been and is being developed. The real challenge is to put into practice developing theories and concepts, and to build on lessons learnt from such action. The natural environment is an integral part of the climate system; it is both affected by and affects climate globally and locally. As well as signalling the impacts of climate change, biodiversity needs to be factored into (and, importantly, can contribute to) adaptation.

A key international instrument in this area is the UN Framework Convention on Climate Change (UNFCCC). Much of this is concerned with mitigation, but adaptation and the role of the natural environment are also given consideration. For example, Article 2 states that the ultimate objective of the convention is to stabilize greenhouse gases *'at a level that would prevent dangerous anthropogenic interference in the climate system'*. It then asserts that *'Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change'*. Article 4 includes as a commitment by all Parties that they shall: *'Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods.'* Clearly, consideration of the underlying ecosystems is crucial to successful adaptation in all these sectors.

Biodiversity

Biodiversity is intimately connected to climate change adaptation in at least three ways:

1. Components of biodiversity can play a significant role in strategies for societal adaptation to climate change, and are particularly important for reducing the vulnerability of the poor and disadvantaged. Examples include the role of biodiversity in coastal protection, e.g. by mangroves. This includes reducing the impacts of extreme events, and research suggests that older, more established mangroves are potentially most effective in this role. Fisheries, which mangroves also underpin in some situations, by providing important nursery grounds, provide another example of the value of biodiversity to human livelihoods. Further examples of important roles of biodiversity in human affairs, and significant to climate change adaptation, include aspects of watershed management and consolidation of soils, and the relationship between these and (for example) agriculture.

2. Many of the strategies adopted for societal adaptation, especially those dependent on engineering and technology, can have significant negative impacts on biodiversity, and these will differ between sectors. Examples include aspects of coastal flood risk management (e.g. by so-called hard defences) and the impact of activities such as dredging.

3. The components of biodiversity are themselves subject to considerable impacts from climate change. There is, therefore, a need for adaptation strategies within the conservation sector, both to conserve biodiversity for its own sake, and to maintain the role of biodiversity in societal adaptation. There is a wide range of relevant considerations in this area. These include the role of protected sites and other aspects of land management, both for maintaining biodiversity and enhancing the permeability of landscapes (i.e. facilitating changes in species distributions in response to climate change, preferably without enhancing the spread of damaging invasive species). Also, consideration is required of the appropriate form of intervention to maintain diversity at a range of biological scales (genetic, species, biotope, etc).

The Ecosystem Approach

There has been much discussion in recent years of the Ecosystem Approach, and this provides a useful tool to support the development of strategies to address the management and conservation of biodiversity in the context of climate change adaptation. One key principle of the Ecosystem Approach is the conservation of ecosystem structure and functioning in order to maintain ecosystem services, and this is clearly complementary to the aims of climate change adaptation.

Related concepts, including the principles of sustainable development, also emphasise the need for integrated solutions. This is complementary both to the Ecosystem Approach and to the aims of climate change adaptation, for example, in stressing the need to develop strategies that serve to support social, economic and environmental considerations.

Conclusion

Climate change is already having measurable impacts on ecosystems and on biodiversity more generally, and these are expected to grow. Adaptation in the biodiversity conservation sector is required, not just to achieve the conservation of biodiversity for its own sake, but to maintain the role of biodiversity in contributing to societal adaptation. Adaptation to climate change is a relatively new field, and the available literature is limited. Very few adaptation strategies have actually been implemented, but those that have tend to rely on technological and engineering measures. The limited evidence to date suggests that although technological and structural adaptation measures will be required, biodiversity will also play a vital role in adaptation to climate change.

It is important to determine the risks and opportunities for biodiversity conservation from mechanisms put in place to address climate change over the short to medium term. This requires a balanced consideration of social, economic and environmental issues. Although biodiversity and climate change policy could result in win-win solutions, in some cases difficult trade-offs will be required. We need to determine what trade-offs we are prepared to accept for biodiversity. The ecosystem approach provides a sound mechanism to inform the development of climate change policies, thereby stressing the interactions between societal choice, economic valuation, incentives, ecosystem function and thresholds, and to strengthen the case for sustainable adaptation and mitigation measures.

References

IPCC (2007) *Climate Change 2007*. Comprising four parts:

- Working Group I Report: *Climate Change 2007: The Physical Science Basis.*
- Working Group II Report: *Climate Change 2007: Impacts, Adaptation and Vulnerability*.
- Working Group III Report: *Climate Change 2007: Mitigation of Climate Change*.
- The Synthesis Report: *Summary for Policymakers*

Available on-line at: http://www.ipcc.ch/index.htm

South Georgia: Threats posed by climate change, and mitigations

Darren Christie (Environment Officer, Government of South Georgia and the South Sandwich Islands)

Christie, D. 2010. South Georgia: Threats posed by climate change, and mitigations. pp 145-150 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

South Georgia is dominated by huge glaciers, ice caps and snowfields, which cover about 75% of the island in the austral summer. In winter, the island is entirely covered in snow. Of the 25% of the island that is free of permanent ice, only 8% is vegetated. Nonetheless, the island supports important biodiversity, including 30 million pairs of seabirds. Three key climate change threats have been identified: glacial retreat, increased vulnerability to species invasions (in part, linked to glacial retreat) and oceanographic changes. The mainland is effectively subdivided into smaller "mainland islands" by glaciers. As well as providing South Georgia with much of its natural character, these act as barriers to species dispersal, protecting the south coast against the spread of invasive species (notably reindeer, Norway rats and house mice) present elsewhere on the island. However, glaciers are retreating at an increasing rate, potentially exposing new sites to species invasions. In combination with increasing temperatures that may independently render new sites favourable for alien species, this substantially increases the threat; South Georgia has recently been identified as the most vulnerable island in the sub-Antarctic to alien species invasions. In this context, biosecurity measures become increasingly important, and are being addressed at a number of levels. The precise effects of global warming on oceanographic processes are difficult to predict. However, sea temperatures, the presence or absence of sea ice, and ocean current dynamics can be linked (for example) to the abundance of krill, which has the potential to impact substantially on South Georgia penguin populations. It seems likely that, with globally increasing temperatures, important food chains could be disrupted.

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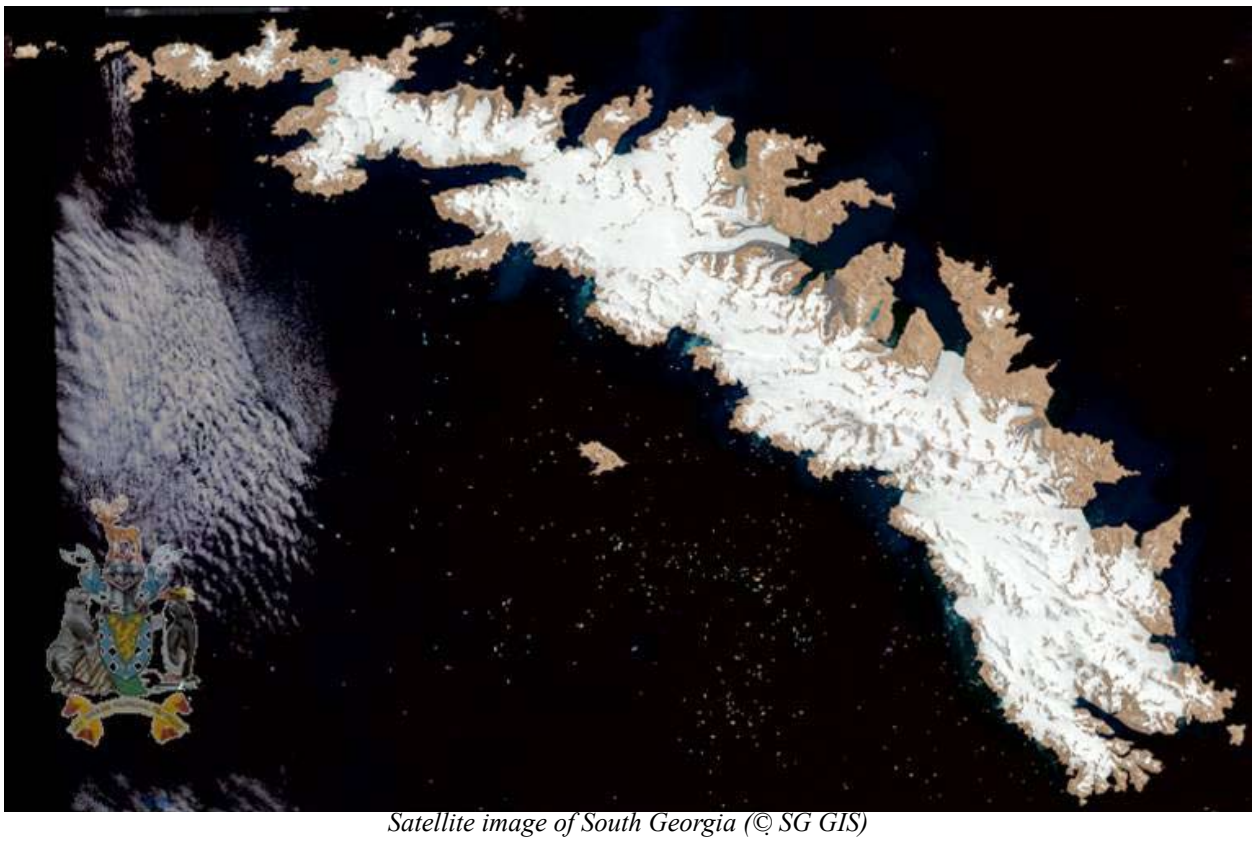
Location

The Sub-Antarctic island of South Georgia is a long and narrow crescent, some 170 kilometres long and varying from 2 to 40 kilometres wide. Two mountain ranges (Allardyce and Salvesen) provide its spine, rising to 2,934 metres at Mount Paget's peak. Huge glaciers, ice caps and snowfields cover about 75% of the island in the austral summer; in winter, the island is entirely covered in snow. Of the 25% of the island that is free of permanent ice, only 8% is vegetated. However, the island is home to an estimated 30 million pairs of seabirds, notably penguins, albatrosses and petrels, and over 6 million seals.

South Georgia lies from 35.47' to 38.01' west and 53.58' to 54.53' south within the Polar Front, being surrounded by the ice-cold waters that flow up from Antarctica. The tip of South America, Tierra



Satellite image of South Georgia (© SG GIS)

del Fuego is 2,150 kilometres to the west. The Falkland Islands are closer, but still 1,390 kilometres away to the west. The mountain ranges and the precipitous southern coast shield the northern facing bays from the fierce prevailing winds and depressions that roar in from the Drake Passage to the West, and Antarctica to the South.

Threats

Three key threats have been identified as being posed by climate change:

1. Glacial Retreat
2. Increased vulnerability to invasion
3. Oceanographic changes

1 - Glacial Retreat

Mainland South Georgia is effectively subdivided into numerous smaller "mainland islands" by glaciers, which act as natural barriers to the spread of seeds, animals and disease, both alien and native. At present, glaciers protect a safe haven along the south coast, free of the worst invasive species as described below. Glaciers are retreating at an increasing rate. Their effectiveness as a barrier is declining, and the safety of the south coast is under threat. Only 8% of South Georgia is vegetated, so those areas free of invasive species are vitally important.

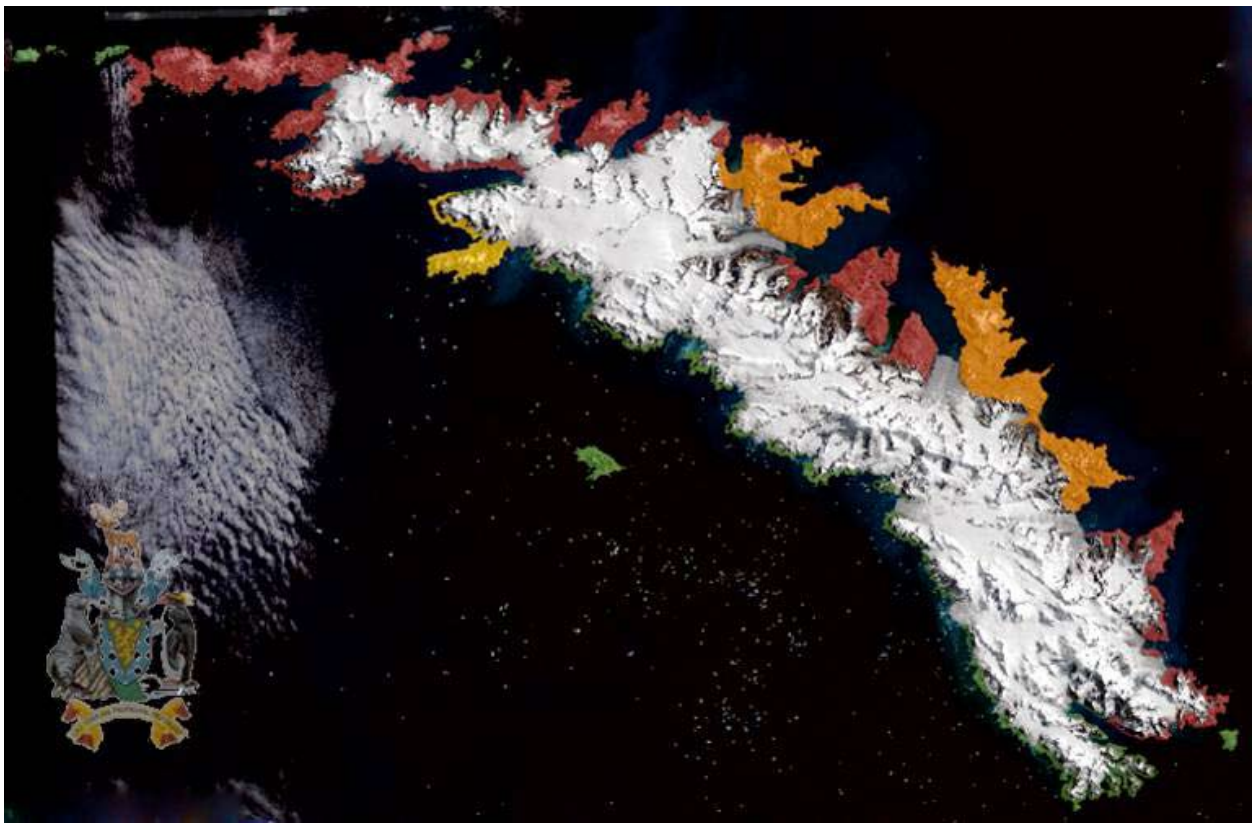
There are numerous introduced alien species on South Georgia, but three in particular are of particularly devastating consequence:

Reindeer *Rangifer tarandus*

There are two reindeer herds on South Georgia, introduced in the early 20th century for sport hunting and subsistence. The combined affected area of both herds is approx 313km^2, or 20% of the total snow free area of South Georgia. The Barff herd occupies all accessible areas, the Busen herd has recently expanded to graze 88% of the accessible terrain, with the herd likely to expand to fill 100% over the coming years. The reindeer occupy the most extensive and species rich vegetated areas of South Georgia.

Norway rats *Rattus norvegicus*

Rattus norvegicus is the only rat species on the island, and occupies the entire north coast of the island, and the top northwest part of the south coast. This represents 66% of the coastline, but somewhere in the order of 75% (possibly more) of the snow-free land area of the island. Rats have had a serious detrimental impact on the endemic South Georgia Pipit *Anthus antarcticus*, the world's only Antarctic songbird, which now only survives in rat-free areas. Diving petrel numbers are significantly reduced in rat-infested areas.

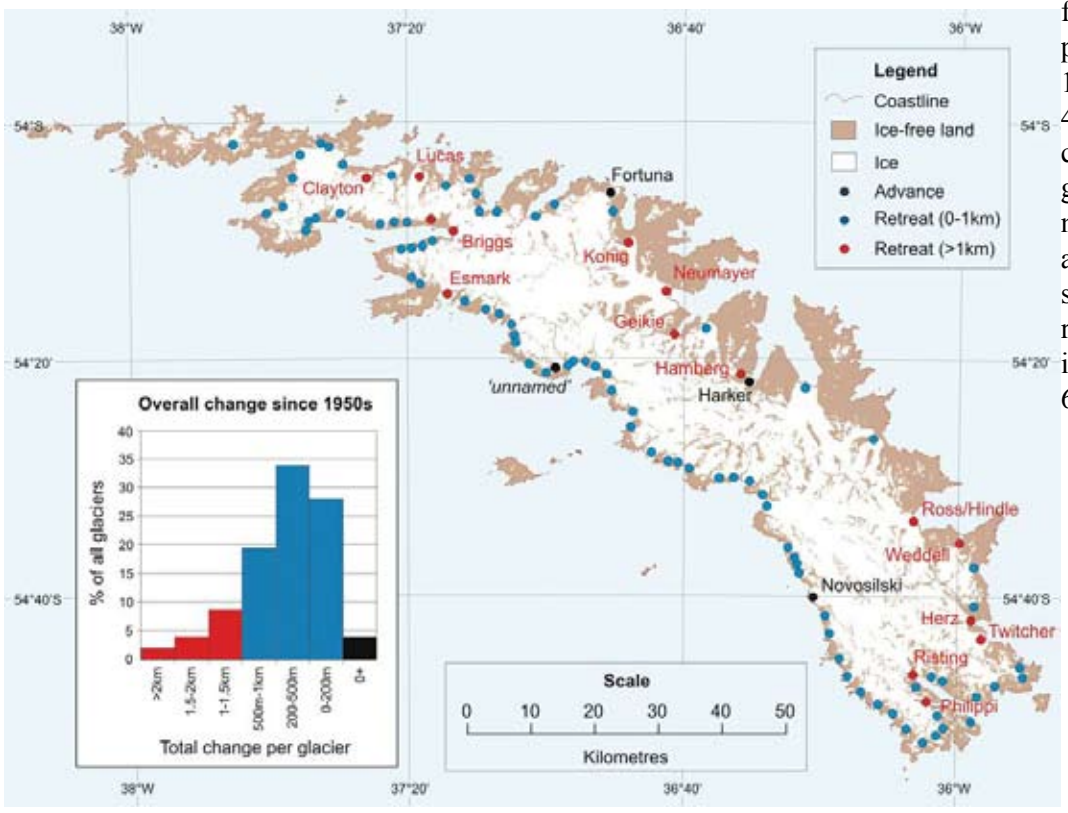


Distributions of alien, invasive species:red = rats; orange = rats+reindeer; yellow = mice; green= free (© SG GIS)

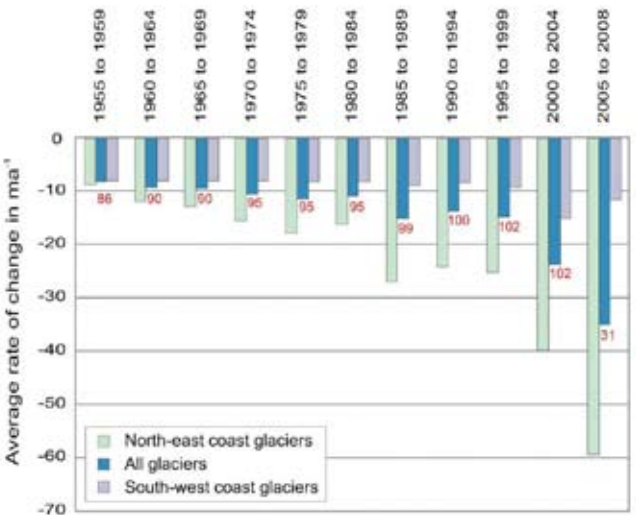
House mice *Mus musculus*

Mice occupy the area of Cape Rosa/North side of Queen Maud Bay. They exist here in the absence of rats. It is unknown if they are in rat-infested areas but suppressed to undetectable levels. The area occupied by mice is <60km^2. Their impact is unknown, but is likely to be detrimental.

Current studies estimate that 97% of South Georgia's marine glaciers have retreated in the past 50 years. The majority have retreated by about 500m, but one notable glacier has retreated over 4km. The rate of retreat is also increasing, with averages from <10m per year in the 1950s to almost 40m per year currently. If glaciers on the north east coast are considered separately, the rate of change is between 60m-400m per



Change in Glacier length since the 1950s. Names relate to significant glaciers which have retreated >1km since 1950 (Cook et al, submitted Oct 2008)



Mean rates of change across all glaciers since 1955. Number of glaciers contributing to average is shown in red. (Cook et al, submitted Oct 2008)

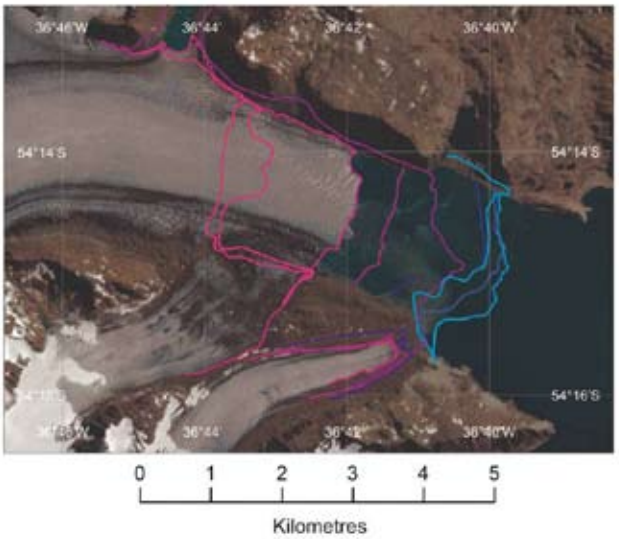
year. Those on the south coast are retreating at a rate of approx 10m per year.

Mitigation against the affects of glacial retreat

Cessation or reversal of retreat seems unlikely; indeed the rate of decline seems to be accelerating. There is limited time available before some previously safe areas are opened up to invasion by introduced species. Eradication of major invasive threats is being considered.

The Government of South Georgia (GSGSSI) produced a feasibility study for the eradication of rats in 2007. The South Georgia Heritage Trust are currently fundraising for an island-wide eradication of rodents, and are actively working towards the first stage of the project.

GSGSSI have stated their intent to remove one reindeer herd in their management plan, and options are currently being considered.



Neumayer Glacier front positions since 1955 (Cook et al, submitted Oct 2008)

2 - Increased Invasiveness and vulnerability to Invasion

Globally, the presence of invasive introduced species is considered the single greatest threat to the biodiversity of island ecosystems (Wittenburg & Cock 2001). The presence of invasives on an island makes it more vulnerable to new invasions (e.g. high association between reindeer grazing and spread of introduced grass *Poa annua*). Consequently, South Georgia has recently been identified as the single most vulnerable island in the sub-Antarctic to alien invasion (Frenot *et al.* 2005).

The location of South Georgia below the Antarctic Convergence creates an extreme, cold environment that limits the establishment of aliens. As the climate warms up, the risk of a new establishment increases. Already present ("harmless") aliens may become invasive, as may native species.

Mitigation

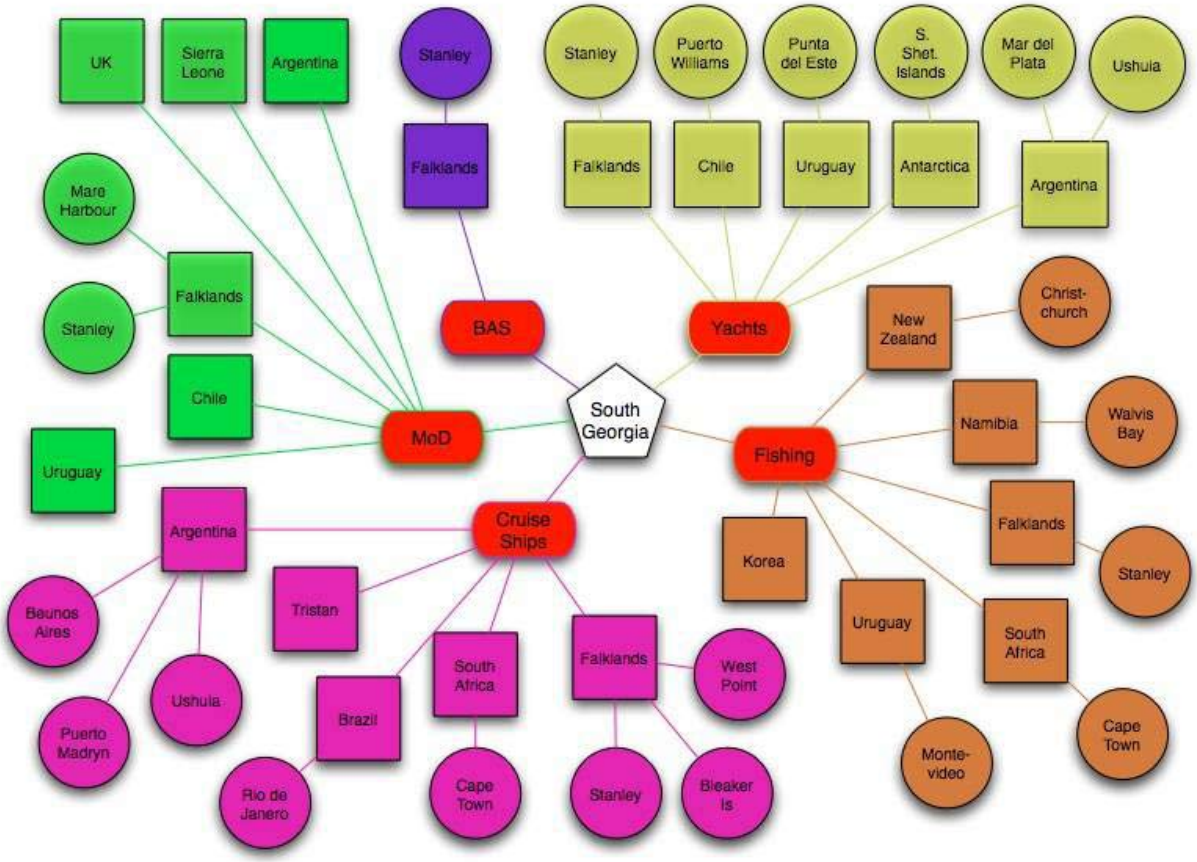
Biosecurity - South Georgia has no airstrip, so all transport is by sea. Shipping data were analysed to identify main vector routes. Individual biosecurity plans were produced, and are now in place for all vector routes.

Any expeditions must produce their own biosecurity plans, in order to demonstrate awareness of the issues. A permit will not be awarded unless plans are approved.

Biosecurity is being incorporated into new South Georgia legislation, which is under review.

A dedicated biosecurity facility has been built at South Georgia (funded between OTEP, GSGSSI and the South Atlantic Invasive Species Programme (SAISP)), but puts emphasis on pre-border procedures due to lack of capability and manpower on the island.

Response plans and monitoring systems are under development, in order to efficiently respond to a new incursion or reinvasion. Bird Island, as a key site,



Vector routes

already has plans in place.

Royal Botanic Gardens Kew and Buglife were commissioned to do a baseline survey of invasive species, in December 2008 to January 2009, paid for by South Atlantic Invasive Species Programme. This is a key project to the future management of the island.

3 - Oceanography: Sea Surface Temperature

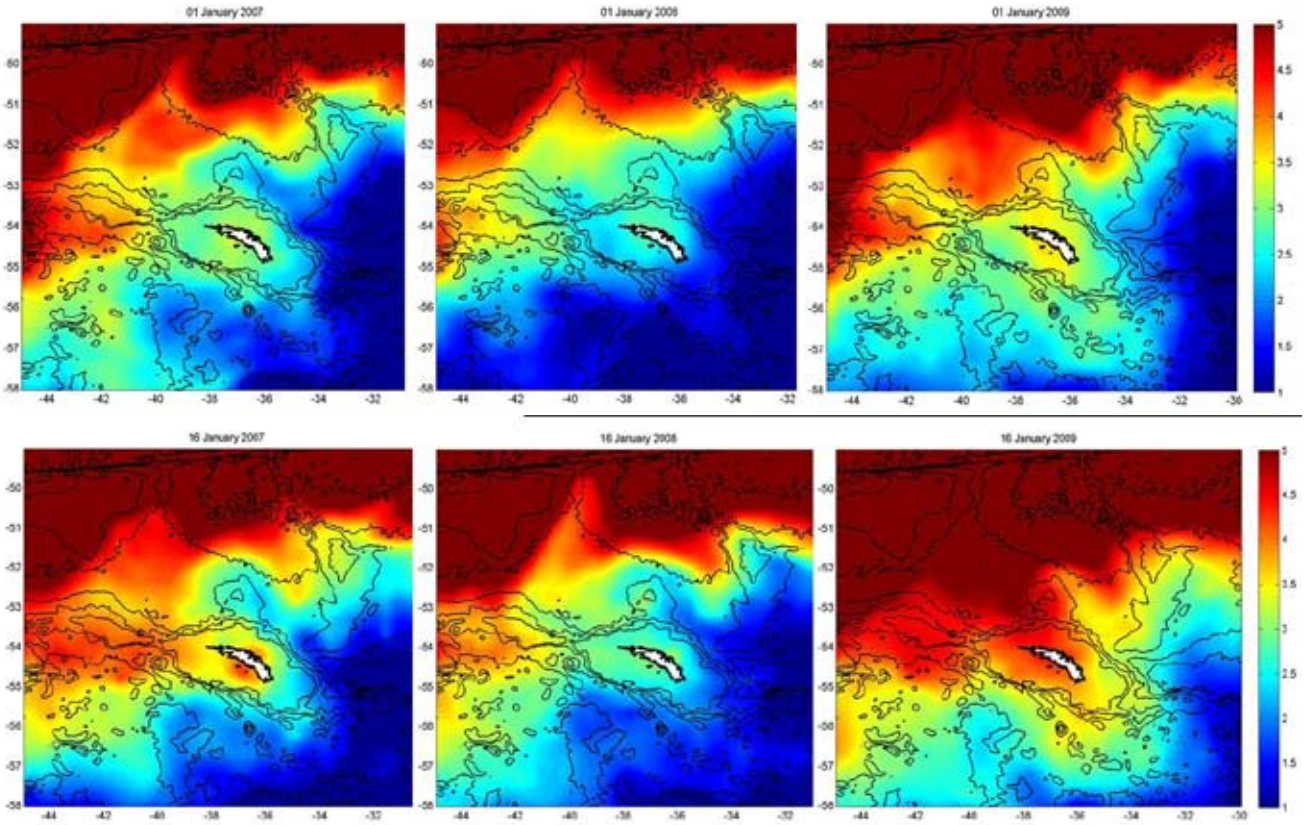
January 2009 saw a near 100% Gentoo penguin chick mortality along the NE coast of South Georgia. This is not unprecedented; similar events have been recorded 4 times in the past 20 years and are associated with poor krill availability.

The abundance of krill around South Georgia varies between years. The variation in krill abundance is thought to be linked to fluctuations in average annual temperature, and the dynamics of the ocean currents in the Scotia Sea. Warmer winters result in less sea ice development, and this feature is linked to years with low krill abundance. The presence of sea ice is key to the volume of krill found around South Georgia, as South Georgia's stock of krill is not self-sustaining; krill may be spawned much further south, possibly in the Bellingshausen Sea (Agnew 2004). Periods of poor krill abundance appear to correlate with fluctuations of Sea Surface Temperature (linked to El Nino events) (Trathan & Murphy 2002) and are on a 3-4 year cycle. Reduced levels of krill biomass are associated with periods of anomalously warm sea temperatures (Trathan *et al.* 2003). 2009 saw extremely high sea temperatures around South Georgia.

Whilst this appears to be a natural fluctuation, it seems likely that, with globally increasing temperature changes, events such as this may become more frequent. Any movement of Antarctic Circumpolar Current to the South would have devastating consequences for South Georgia. The effects of global warming on oceanographics are not well known.

Mitigation

Global warming is a phenomenon that is unlikely to be reversed in the foreseeable future. However, to be forewarned is to be forearmed; studying ecosystem interactions around South Georgia, and projecting forward any fluctuations in the system, may give an idea of what is to come. Where possible, lobbying for greenhouse gas emission



Plots of Sea Surface Temperature, 2007 - 2009

reductions would seem desirable, with potential for using South Georgia as an example of dramatic consequences.

South Georgia can also lead by example; in December 2008, the islands hydroelectric power scheme came online. The 200kw turbine output displaces 153m^3 of fuel per year, representing a reduction of 410,040kg of carbon a year.

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South Georgia hydroelectric scheme, 200kw output displacing 250m^3 of diesel a year - active since December 2008

Climate Change: A Case Study in Guernsey

Andrew Casebow (States of Guernsey)

Casebow, A. 2010. Climate Change: A Case Study in Guernsey. pp 151-154 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

The UK Channel Island of Guernsey provides an excellent example of the impact of climate change on a small island community. Comprehensive meteorological records that have been kept in Guernsey for more than 150 years show that recent years have been the hottest in the entire instrumental record. Whilst the mean daily air temperature over the past 16 years has been, on average, 0.9^{o}C hotter than a 30 year mean of the years 1961 – 1990, the maximum daily temperature has increased by twice that amount, or 1.8^{o}C higher than the 30 year mean (1961 – 1990), and summers are becoming considerably drier.

The changes in temperature are having a significant impact on wildlife, be it on land or in the sea. One of the most eye-catching changes is the fact that spring flowers are now blooming much earlier. Some daffodil cultivars, which used to be exported and sold on the London market in time for Easter, are now in blossom in the island before Christmas. On average, spring flowering wild plants are blossoming some three weeks earlier than they did only 21 years ago. Changes caused by warming temperatures have been recorded in migrating and nesting birds, in the leafing of trees, the flight time of moths and insects, in over-wintering birds and insects, and in the movements of fish, plankton and intertidal species that live along the shoreline.

The book *Planet Guernsey* has detailed many of the changes that are taking place in Guernsey and is being used as a template for other similar books alerting local communities to the changes that are occurring in their own localities.

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Background

Aspects of climate change in Guernsey, including the historical context, evidence for and impacts of recent trends, and predictions for the future, were recently collated in the book Plant Guernsey (Casebow, 2007). This publication provides a model of the information that can be brought together for one small island, and is available on-line through the website of the Société Guernesiaise: www.societe.org.gg/planetguernsey/index.html. A few key aspects are summarised briefly below.

Introduction

Guernsey is an island in the English Channel between France and England, being situated in the Bay of St Malo and with the Cotentin Peninsula of France clearly visible. It was joined to France until about 8,000 years ago but was cut off as the sea-levels rose following the end of the last glaciation.

The Channel Islands provide an excellent example of how the climate has changed over past millennia. The sea-level has risen and fallen on numerous occasions in the past as the Northern Hemisphere has undergone successive glaciations, with intervening interglacial periods. Wave-cut beaches and notches in the sea-cliffs, fossilised cliffs and ancient raised beaches dot the landscape. These are all visible remnants of past interglacial periods, while during the long intervening glacial periods the sea-level around the coast fell by up to 120 metres as water was locked into ice.

As temperatures warmed at the start of our present interglacial period, the natural vegetation of the islands changed from cold tundra to grass, and then pine and birch woodland. As the islands' climate warmed and stabilised, the dominant species of trees changed from pine and birch to hazel and oak. Gradually, flowering plants replaced plantains, which provided much of the pollen found in the peat deposits laid down some 10,000 years ago. Alderney and Guernsey, the northernmost Channel Islands, were cut off from France first, which is probably why there are no snakes, moles or squirrels in Guernsey. By the time that Jersey, further to the south, was cut off, these animals had moved north and colonised it. Hence, climate change and its influence on the natural history of the islands are not new phenomena.

Climate change in Guernsey

Climate change of the sort that we are now witnessing, caused by mankind's emissions of carbon dioxide and other 'greenhouse' gases, is a new phenomenon. Again, Guernsey can provide an excellent case study, showing the impact of global warming on the environment. Comprehensive air temperature and rainfall records have been kept in Guernsey since 1843. La Société Guernesiaise has wildlife records from the Victorian period. Whilst climate records tell their own story, it is difficult to differentiate between changes in wildlife that are caused by climate rather and those that arise from another factor, such as the intensification of agriculture. Unfortunately, phenological events such as first flowering dates or the date of arrival of migrant species, were not widely recorded; our knowledge is now largely due to the quite recent efforts of individual enthusiasts.

The hottest years in the entire instrumental record (of more than 150 years) were in 1998 and 2005. The years 2002, 2003 and 2004 were, respectively, the 3rd, 4th and 5th warmest in the record. Some 16 of the last 20 years have been the hottest on record. It is thought that, without the extra carbon dioxide and other greenhouse gases that have been released into the atmosphere, the earth's temperature would have actually have been cooling slightly in recent years.

If we look at long-term average temperatures in Guernsey, and compare the 30-year period 1961-1990 with 1971-2000, there have been very significant changes. The annual average temperature in the 30 years 1961-1990 was 10.8^{O}C, whilst the average for 1971-2000 was 11.1 ^{O}C. You might think that this is not a great change, but the base period (1961-1990) provides a 30 year average, and there is a 20 year overlap in the years, so the difference has occurred in only 10 years. The change in the temperature in the different seasons is also quite apparent.

The average daily temperature in Guernsey for the three winter months of December, January and February has increased from 6.5 ^{O}C to 6.9 ^{O}C (again the 30 year mean), and for the three spring months of March, April and May has increased from 8.9 ^{O}C to 9.3 ^{O}C. This represents an average increase of 0.4 ^{O}C in both the winter and the spring temperatures in Guernsey, in just 10 years. In the summer months, the mean temperature has increased by 0.3 ^{O}C, whilst in the autumn months it has increased only by an average of 0.1 ^{O}C.

At the same time, the maximum daily temperatures recorded have been 1.7 ^{O}C to 1.8 ^{O}C higher in the winter, spring and summer, but only 1.2 ^{O}C more in the autumn. Just as significant has been the change in minimum daily temperatures. Those recorded in the winter, spring and summer months were 0.3 ^{O}C - 0.4 ^{O}C higher in the 30-year period ending in 2000 than in the same period ending in 1990. Up until this year, when there was an unusually cold winter with two days of snow recorded, frost had become almost a thing of the past. The last significant snow fall was almost 20 years ago. These warmer winter temperatures have encouraged insects to remain active over winter and some migrant birds to stay and over-winter in the island.

These changes in temperature may seem marginal, but they are having a very significant effect on wildlife, be it on land or in the sea. These impacts are just the 'tip of the iceberg', as the real effects of climate change will undoubtedly become increasingly apparent over the coming years. Let us consider what effects even these small changes have been having already in Guernsey and its surrounding waters.

The effects of climate change in Guernsey

One of the most eye-catching changes is that spring flowers are now blooming much earlier than they did just a few years ago. Daffodils, which used to be exported to England to be sold on the London market in time for Easter, are now in blos-

som before Christmas. Indeed, many of the wild flowers that we normally associate with spring or early summer are in flower by late December. I counted over 20 species of wild flowers in blossom on the coastal footpaths around the southern cliffs of Guernsey last Christmas, and Nigel Jee (who has recorded the flowering dates of all flowers – wild or cultivated – in his extensive garden since 1985) counted many more species in flower in his garden on the west coast.

As the major changes in temperature in Guernsey have been in the winter and the spring, it is not surprising that most of the effects that we see on wildlife come at this time of the year. Wild plants tend to bloom earlier in years when the temperature is warmer during the month or so just before flowering, and we have seen this very clearly in recent years. For instance, the really early spring flowers have been opening further and further in advance of previous records, and many wild flowers now open more than three weeks earlier than they did only 20 years ago.

We walk the coastal footpath every day, and recording the first flowering of the different species of wild plants adds interest to our daily walks. We record the date when we see the first bluebell (in early March this year, some three weeks later than in 2008 due to the cold winter), the first flowering of blackthorn, the first flight of bumble bees, the first butterflies and moths, and the first migrant birds, such as martins and chiffchaffs. Each year, the dates seem to be getting earlier, apart from in 2005 and again in 2008 when the cooler winters set everything back again. Of course, the change in observation dates from one year to the next can be very misleading, and it is only by amalgamating all the information and looking at trends over many years that you can understand what is really happening.

It is tempting to believe that the birds come earlier because they realise that the temperature in Guernsey is higher in a particular year, but (of course) this is not the case. The arrival of many migrant birds, such as swallows, martins, swifts and chiffchaffs, is really dictated by the temperature that they experience in North Africa and Spain before they leave for their long flight to our shores and onwards to England.

The changes are also beginning to disrupt normal patterns of behaviour, where animals and plants normally rely on synchronising their activities. For example, the hatching of young birds is often timed to coincide with periods when a plentiful supply of food is available. If insects are not flying when flowers come into blossom, then pollination is disrupted and the plants may be less successful in setting seed. Likewise, if food (such as moth larvae) is not available when young birds hatch, then the breeding season will be less successful and fewer chicks will be reared. Happily, the warmer winters and springs have favoured the breeding of some of our rarer birds, such as the Dartford warbler, and it has encouraged others such as the little egret to stay and breed in Guernsey. However, future changes in our climate will undoubtedly bring about even greater and probably less welcome changes to our wildlife.

The typical distribution patterns of various Guernsey species are also being affected by climate change. In the sea and on the foreshore, changes are occurring as the water gradually warms. Cold-water plankton are moving northwards and warm-water species are taking their place, but in far less abundance. Sand eels are moving northwards with the cooler water, particularly during the summer, which means that sea birds that rely on them for food must also move. Spider crabs are moving too, and are far less abundant around the island than they once were; instead, they are now found along the Welsh coast further north. Certain species of barnacles are also moving away from Guernsey, and are spreading north and east along the English Channel coast. Even the humble abalone – known as the ormer in the Channel Islands (e.g. see Syvret 2003) – has moved northwards, so that it is now found in Alderney (and in England, where it has been seeded). Fortunately, a viral disease of ormers that occurs in the warmer waters around Jersey has not yet reached Guernsey, just 20 miles to the north. Wading birds that feed along the west coast of Guernsey are becoming fewer in numbers, as they too gradually move northwards and to the east.

The wildlife of Guernsey is perhaps more typical of of France than of England. As a consequence of its geographical position, a number of species are at the northernmost edge of their range in Guernsey, and few are at the southernmost extreme. This means that few species are likely to be lost with the types of changes in distribution reported above, and unless new species are brought to the island by human interaction or are able to swim or fly (or ride the wind), the species mix is unlikely to change significantly. Much will depend on the air

and sea temperatures that we can expect, on the increasing lack of rainfall during the late summer months, on rising sea levels and human intervention. All these factors will influence local habitats (and associated human activities) as well as species.

Key terrestrial habitats that are likely to change are coastal areas and heaths, wetlands, wet meadows, agricultural land and the walls and banks surrounding the traditional small Guernsey fields. The land to the south of the island is mainly a 100m high plateau, with free-draining, deep loamy soils that are ideal for agriculture, whilst the land to the north tends to be low-lying with impeded drainage. Streams course from the plateau down to the sea in steep-sided wooded valleys, whilst in the north they meander across the wet marshy land before again discharging into the sea. However, in many cases, land in the north is below sea level and flooding is only prevented by high sea walls and by pumped drainage. These areas are therefore very susceptible to rising sea levels and also to flooding from heavier rainfall, particularly during the winter months.

Farming in the island is mainly focused on dairy production – with the iconic Guernsey breed of dairy cow – and other cattle rearing. The increasing frequency of summer drought is changing farm practice, as conserved feed, such as hay and silage, has to be fed to cattle during the mid-summer period as well as during the winter. However, grass keeps growing throughout the winter, which means that, when soil conditions permit, animals are housed and fed on conserved feeds for a shorter period during the winter months. Heavier rainfall during the winter and a dramatic reduction in rainfall during the summer and early autumn (by a predicted 60%) will have a considerable effect on wetland and wet meadow habitats.

Guernsey fields are typically very small and divided by earth banks, covered in indigenous grass and wild flowers. These features, which are so characteristic of the island's landscape, have changed little over the past 100 years. The best of the field banks are probably typical of the dry meadows that might have existed in the south of the island prior to the intensification of agriculture. As such, they are a wonderful resource, although in recent years they have been increasingly invaded by bracken. To the north of the island, on the wetter land, dry granite walls are more typical. It is unclear how climate changes will affect these banks and walls.

Conclusion

Climate change is interesting at the present time, but it will be a much more serious matter as the consequences become increasingly apparent. We can make educated guesses at what changes will occur in the future, but there will no doubt be some nasty surprises along the way. Unfortunately, by the time that many changes occur, it will be too late to intervene. We are already seeing significant changes in wildlife, but these are as nothing compared with what might happen in the future. Climate change could bring catastrophic changes to wildlife in vulnerable parts of the world, and to our ability as a human race to grow sufficient food to feed the expanding world population will undoubtedly be challenged. Island communities are perhaps most vulnerable to climate change, as many are low-lying and reliant on importation of resources such as food and energy.

In the words of the Joni Mitchell song (for those who like me are old enough to remember it): "You don't know what your got 'til it's gone!"

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Climate Change: A Cayman Perspective

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Hurlston-McKenzie, L.-A. 2010. Climate Change: A Cayman Perspective. pp 155-156 in *Making the Right Connections: a conference on conservation in UK Overseas Territories, Crown Dependencies and other small island communities, Grand Cayman 30th May to 5th June 2009* (ed. by M. Pienkowski, O. Cheesman, C. Quick & A. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

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In the Cayman Islands, as elsewhere, there is an increasing awareness of the threats posed by climate change. Storms (hurricanes) have been of greatest concern, requiring property and beach protection to be enhanced through the application of expert judgement and experience. This is of particular concern in the Cayman Islands, where 80-90% of the population live on or near the coast, alongside critical infrastructure. Measures previously taken for coastal defence are now questioned (including the placement of seawalls and the design of breakwaters). Alternative coastal protection measures are being implemented, such as mangrove restoration, but (initially) on a rather experimental basis. It is yet to be determined how successful these attempts will be, in terms of mangrove survivorship and development, and selection of appropriate sites.

Related concerns focus on storm water management and flood control. Changes in building practice are evident, notably through the raising of structures (perhaps reflected in the greater number of steps in front of modern public buildings, as well as by increasing prevalence of houses on stilts). These are underpinned by greater attention to climate change in the planning stage, including through risk assessments and hazard mapping, integration of climate change considerations into EIAs, and modification of building codes.

The tourism sector is increasingly considering the need for adaptation to climate change, in a range of ways. Much of the Seven Mile Beach tourism infrastructure is now being redeveloped, and is being set further back from the beach, behind a line of vegetation, and the turtle farm (closed by hur-

Mangrove restoration: Left: Post-Ivan, South Sound, with Corporate Social Project Teams, District MLAs and wider community using Hessian bags; Right: more recent, DOE's Mangrove Restoration Project utilizing the REEFBALL technology from the Reefball Foundation in conjunction with NMBCA (Neotropical Migratory Bird Conservation Act) enabled the successful re-planting of Red Mangrove saplings in the South Sound area and the Cayman Islands Sailing Cub shoreline. The programme was initialized in 2006 and is continuing. Out of around 800 reefballs containing up to four propagules each, an estimated 75 reefball pots were lost in subsequent storm seasons.

ricane impacts) has been relocated. Other climate change impacts, such as coral bleaching, threaten to affect tourism negatively. The introduction of aviation taxes and carbon levies related to climate change would also affect the economics of tourism. For such reasons, the tourism sector is investigating diversification of its activities and approach, including to reduce pressure on natural resources.

Various activities are underway that will contribute to a greater preparedness for climate change in the Cayman Islands, from public outreach and education to a review of Marine Protected Areas, geared towards ecosystem protection and enhancement. Research and monitoring programmes are contributing to a greater understanding of climate change and its impacts, The priority is to make the islands as resilient as possible. Relevant initiatives include the Grand Cayman Development Plan; Disaster Risk Management Framework; National Conservation Bill; Coastal Zone Management Plan and others. It is gratifying that improved early warning systems have reduced the loss of life during extreme storm events in recent years.

Despite the relevant progress, the Cayman Islands do not yet have a comprehensive national climate change policy, but they are part of the Enhancing Capacity for Adaptation to Climate Change (ECACC) project. Funded by the UK Government's Department for International Development, this three-year project aims to assist the Caribbean UKOTs to build local capacity to plan and implement measures to adapt to climate change, in the context of their national development planning processes. It is expected that by the end of the project all participating UKOTs will have developed a National Climate Change Adaptation Strategy and initiated the implementation of this. The project will also enhance UKOTs' capacity to engage with regional and international climate change programmes, and to benefit from and contribute to the work of relevant regional institutions, including the Caribbean Community Climate Change Centre (CCCCC), through which the project is implemented. ECACC was officially launched at a workshop in November 2007, hosted by the Cayman Islands and attended by representatives from each of the other Caribbean UKOTs involved in the project (Anguilla, Montserrat, British Virgin Islands, Turks and Caicos Islands).

Flood control is ever-growing problem as low-lying areas continue to be converted/filled, often without adequate environmental scrutiny (EIAs). (Ramsar Convention Wise Use principles are not formally entrenched in local physical development planning). There is minimal use of EIAs and the challeng of integrating climate-change into EIA processes. Insurance is already a core ingredient of risk management and resiliency in the Cayman Islands. Modifications to building practices and regulations ma be of some help.

Discussion

Discussion following Deborah Procter's presentation

Q: Does UK manage to obtain sufficient information from the Overseas Territories?
A: Information is patchy, being relatively good for the Caribbean, BIOT and BAT.

Sarah McIntosh (CANARI) stated that CANARI reports in 3 areas: trends & scenarios, terrestrial and marine. She felt that Caribbean UKOTs need to combine their voice with other SIDSs (Small Island Developing States).
A: The EU meeting in Réunion provided an opportunity for the EU to hear one voice from its Overseas Countries and Territories. Regional contexts are also important, where UKOTs work with neighbours, especially when responding at wider international venues eg on the Convention on Biological Diversity (CBD).

Discussion following Darren Christie's presentation

Q: What is known about the South Sandwich Islands?
A: Since they are 4-5 days away by boat, and there is only one Environment Officer on South Georgia, no work has been done on them recently. The last information dates back to the early 1990s.

Q: Why were reindeer herds not removed from South Georgia a long time ago?
A: This is basically because there have been only three Government officers, and an Environment Officer for only the last 3 years. £6m has been used to clean up whaling stations, and other priorities have been the hydro project and albatross protection. Basically, government is resource-limited. Data on reindeer are now being compiled in order to defend the position when culling starts.

Q: Is the large fur seal population is a problem? This is estimated to have risen from a few hundred to as many as 6 million.
A: One difficulty is that no-one knows whether this increased population is high, as compared to previous (unexploited) levels, nor whether the seals are displacing the bird colonies.

Q: The example of South Georgia is interesting, in that UK Government funding for UKOTs is usually linked to local populations, and more widely to problems such as poverty alleviation. Where, therefore, can a budget be found for work on South Georgia? Who can make the necessary decisions? How can these islands best argue for funds, for example, to solve the reindeer problem?
A: The islands essentially pay for themselves through fisheries and tourism, and the FCO has met half the costs of the research station. Reserves are finite, and much money has been spent on asbestos removal. Not having a resident population is undoubtedly a disadvantage.

General discussion

Deborah Proctor introduced the discussion, suggesting that it might initially focus on local knowledge, partner links, and actions, particularly in the Caribbean.

Sarah McIntosh (CANARI) provided an extensive list of Caribbean studies from modelling to communications research. However, studies are disaggregated and duplication stretches resources, especially when considering the economic impacts of climate change.
Deborah Procter highlighted the need for integration, especially with the social sciences (e.g. on how the Cayman Islands response to hurricanes is linked to the business sector).

Q: Are the effects of climate change on biodiversity well understood across all groups? Even if there is good knowledge on birds, are there gaps in groups such as microorganisms and fungi?
Deborah Procter highlighted the need for local knowledge, such that people can mitigate impacts, and suggested that it is not necessary to know every species in order to protect them.

Deborah Procter emphasised the need to work in partnerships, and asked what are the best ways to work together? Islands in the Caribbean have large populations and many are close together, while dependencies such as Guernsey are physically closer to the UK.
Andrew Casebow stated that, on Guernsey, groups of interested people make a difference, through constant letters to the media and local action.

Deborah Procter agreed that a strong base of local action can be very valuable.

Q: The local partnership approach used in England allows local government to work with other partners (including NGOs) to generate a structured response to climate change, through steps (e.g. level 1- contact meetings, level 2 - asking whether systems are fit for purpose? etc). Could similar approaches be followed in the UKOTs, to simplify activity and provide benchmarks for progress over time?

Steven Mendes (Department of Environment, Montserrat) commented that Montserrat lost its capital 'city' because of the volcanic eruption, and redevelopment involves major issues including water holding capacity. An advisory committee has not yet been mobilised, but stakeholder exercises and outreach strategies are underway and the possible need to occupy protected areas has to be considered.

Deborah Procter stressed the need to combine work in the territories with the project on Enhancing Capacity for Adaptation to Climate Change (ECACC) and to consider how to integrate climate change impacts with redevelopment.

Samia Sarkis (Department of Conservation Services, Bermuda) stated that Bermuda is not part of ECACC. Bermuda National Trust commissioned an impact report on the island which has been passed to the House of Assembly. A lot of information was put together, including a prospective national energy plan. The report came about because the Trust wanted money to counter invasive species and was concerned over airport expansion and power needs.

Chris Tydeman (Herpetological Conservation Trust) felt that the DEFRA Chief Scientist's reports to CBD have poor input from UKOTs, and that UKOT feedback to the EU delegation is not considered as part of the EU feedback. The International Panel on Climate Change (IPCC) data is dated because of peer review, and is anyway always conservative. He highlighted the need for rapid assessment and appropriate feedback.

Deborah Procter said it is true that adaptation to climate change is a low level element of the UN Framework Convention on Climate Change process. It is a work in progress. The IPCC peer review process creates a monolith organisation. A technical ad hoc group has been funded by DEFRA in UNFCCC. Broader partnerships are required across the territories as a whole to ensure representation.

Anna Balance (DFID) said it would be helpful to know what sort of information and what sort of UKOT representation is needed..

Deborah Procter identified the following points to take forward from the Climate Change session:

1. There is a need for local knowledge in each territory (e.g. at Department of Environment level) which is fed back to the UK.
2. There is need for local partnerships, to apply pressure on territory governments, and to share experience and understanding regionally, in order to integrate climate change considerations into development policy.
3. There is a need for rapid assessment of impacts from climate change.