Australian Government
Director of National Parks

Christmas Island National Park
Climate Change Strategy
2011–2016

Christmas Island National Park

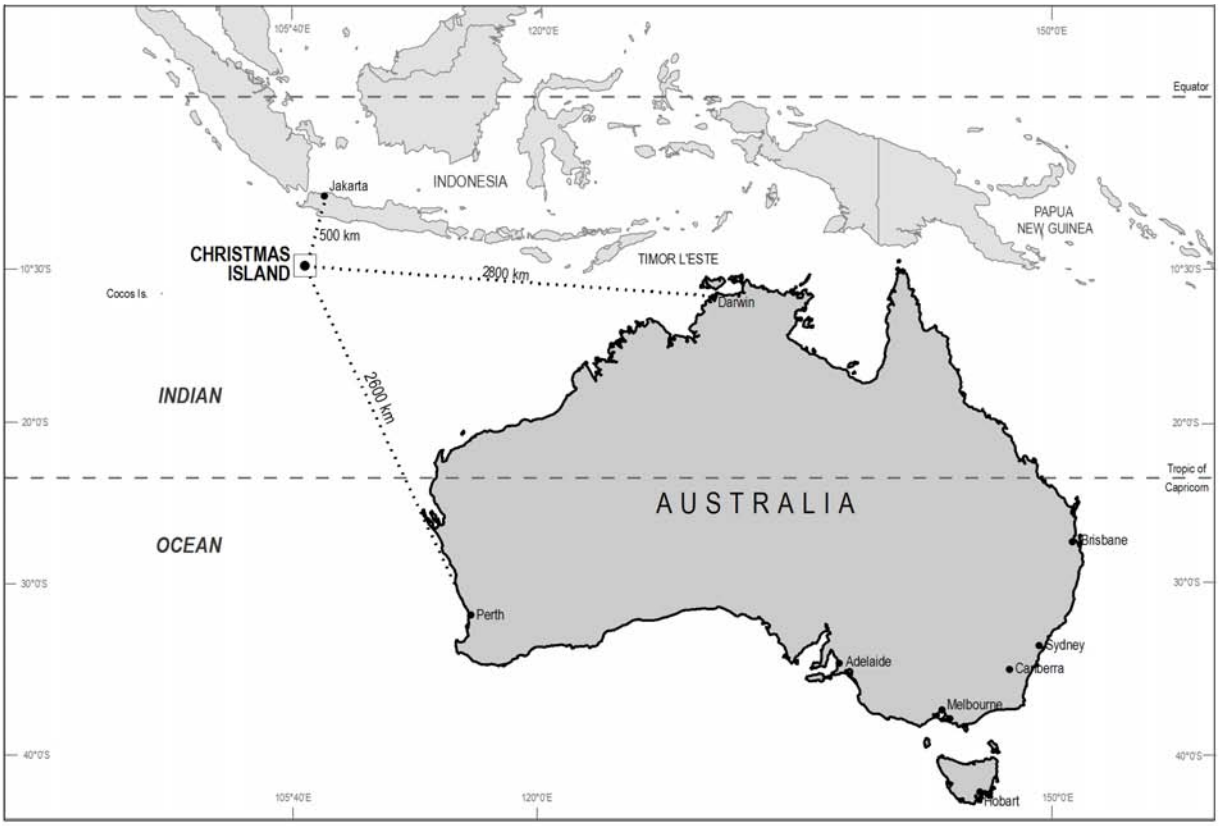
Climate Change Strategy 2011–2016

1. Background

The Intergovernmental Panel on Climate Change Fourth Assessment Report concluded that human induced climate change is expected to have a discernable influence on many physical and biological systems. The resilience of many ecosystems is likely to be exceeded over the course of the twenty-first century and approximately a quarter of all plant and animal species are likely to be at increased risk of extinction if increases in global average temperature continue to match current projections (IPCC 2007).

The Territory of Christmas Island is located in the Indian Ocean approximately 2,800 kilometres west of Darwin, 2,600 kilometres north-west of Perth and 500 kilometres south of Jakarta (Figure 1) (Director of National Parks 2002). The island covers an area of approximately 135 square kilometres and has 73 kilometres of coastline. Christmas Island National Park covers approximately 85 square kilometres (63 per cent) of the island. The park includes a marine area where the terrestrial area of the park adjoins the sea. The marine area extends 50 metres beyond the low water line. The park's marine area covers approximately 2.1 square kilometres and the Territory of Christmas Island water extends 12 nautical miles from the island's shore.

Figure 1: Location of Christmas Island



Christmas Island is characterised by a series of terraces that rise to an inland plateau approximately 250 to 300 m above sea level. The island has a number of unique ecological characteristics, as well as features common to other oceanic islands. Characteristics of Christmas Island's ecosystems include a relatively high proportion of endemic terrestrial species, evolutionary isolation until relatively recent human arrival, native species that have evolved with few competitors, and many species with small population sizes. These characteristics make the island's ecosystems and species of high conservation value but also highly vulnerable to environmental changes, particularly from invasive species, habitat clearing, fragmentation and degradation and climate change.

The island's terrestrial fauna is dominated by ecologically important and diverse land crabs, with red crabs being the island's dominant keystone species. Christmas Island is one of the world's significant seabird islands with more than 100 seabird species recorded, including eight species and one endemic subspecies that breed on the island. The threatened Abbot's booby (*Papasula abbotti*) and Christmas Island frigatebird (*Fregata andrewsi*) have their only nesting habitat in the world on Christmas Island. There are also seven endemic land birds.

The island is also important for other terrestrial fauna species. Of the six recorded native reptile species five are endemic, however these are in decline. Five native endemic land mammals have been recorded. Four are extinct and Murray's pipstrelle bat (*Pipistrellus murrayi*) was once widespread but is now presumed extinct.

The island's remoteness, climate and the influence of land crabs have resulted in the development of distinct tropical forest vegetation. This includes some tropical forest species that have evolved to be taller and larger than examples of the same species found elsewhere.

The island's and park's relatively simple but largely intact fringing coral reefs and waters support a number of marine species typical of Indian Ocean tropical reefs. The recorded marine species diversity includes 88 coral species, over 600 fish species and two vulnerable marine turtles, the green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*), are found in the park's waters. Green turtles occasionally nest on Dolly Beach within the park.

The Christmas Island National Park Climate Change Strategy 2011-2016 recommends the preliminary adaptation, mitigation and communication actions that are required to manage the consequences of climate change and reduce the carbon footprint of the park. The strategy is consistent with the Parks Australia Climate Change Strategic Overview 2009-2014 and the policies and actions of the Christmas Island National Park Draft Management Plan 2011-2021 which is currently being finalised.

Climate change is a long–term issue and this strategy is a 'first step' to what must be a long–term and enduring response. This strategy is an adaptive tool subject to ongoing review, and management responses will be amended to take account of improvements in the understanding of the implications of climate change for the park.

2. Regional climate change projections

The projected effects of climate in the Indian Ocean Territories region include sea level rise, an increase in air and sea temperatures, increase in ocean acidity and changes in the frequency and intensity of extreme weather events. A summary of these effects specific to Christmas Island are provided in Table 1 (uncertainties shown in brackets).

Table 1: Climate change scenarios for Christmas Island

Climate change factor	Baseline (1975-2004)	2030 scenarios	2070 scenarios
Sea level rise [a]	0	+17cm +14cm[d]	+50cm +40cm[d]
Annual average temperature b	Max 26°C Min 17°C	+0.2°C (±1.6°C) +0.6°C[d]	+0.7°C (±4.8°C) +1.8°C[d]
Annual average days >35°C a	3 days	4-6 days	4-18 days
Annual average days with very high or extreme forest fire danger[b]	9 days	9-11 days	10-15 days
Annual average sea surface temperature		+0.6°C[d]	+1.2°C[a] +1.8°C[d]
Annual average rainfall b, c	1,241mm 2,154mm[d]	-13% (±7%) b	-40% (±20%) b
Annual average potential evaporation b	-	+1% (±8%) b	+2% (±24%)
Extreme weather events a	-	Increasing periods of drought and increasing frequency and intensity of storm activity	
Ocean acidity			pH value is projected to decrease by 0.2[a] to 7.92[d]
CO_2 concentration b	353ppm	+165ppm	+365ppm

a Hyder 2008
b CSIRO 2007
c Bureau of Meteorology 2010
d AECOM 2010

3. Impacts of climate change on Christmas Island National Park

Christmas Island National Park contains both marine and terrestrial environments that are expected to face impacts from climate change. The key threats of climate change to the park include an increase in the frequency of high intensity storm events, sea level rise and changes in rainfall patterns (Hyder 2008). There is a degree of uncertainty regarding how some of these projections of climate change will specifically affect the natural, cultural and economic values of Christmas Island National Park. However, based on regional climate change projections the following impacts are likely.

Sea level rise and increased frequency of high intensity storm events

While Christmas Island is characterised by its terraces, flat, low lying areas are at risk of sea level rise caused by increases in global average sea level. Any change in mean sea level, combined with the effects of storm surge, is likely to have a significant impact on a range of species living on these sites (Hyder 2009). It is unknown whether coral in the fringing reef will be able to grow fast enough to keep pace with sea level rise.

While Christmas Island is not officially considered to be a cyclone prone location (AECOM 2010) projections suggest there will be fewer cyclones overall, but predict an increase in the frequency of high intensity cyclones. This may result in canopy loss and tree fall. Canopy gaps can take up to 10 years to close. Following Cyclone Rosie in 2008, canopy damage, tree fall and seabird chick mortality was recorded. As Abbot's booby only nest in tall emergent trees in the rainforest of Christmas Island any canopy damage or tree fall caused by high intensity cyclones will directly impact the breeding success, and potentially lead to species extinction (AECOM 2010).

Wave action caused by intense cyclone activity may also lead to physical damage to coral, as occurred in 2007 and 2008. The north coast of Christmas Island is especially vulnerable as its higher strata plate corals are more susceptible to wave damage than other corals. Increased wave action and storm surges associated with intense storms may reduce the ability of coral reefs to function as feeding and breeding grounds for fish, crab and turtle species.

A deterioration of coral reefs and increased storm surges may also result in inundation of turtle nesting habitat at Dolly and Greta beaches (Hyder 2008). Coupled with any rise in sea level this may lead to increased erosion at these sites.

Changes in rainfall patterns

While future changes to rainfall patterns in Christmas Island National Park are uncertain, a decrease in annual average rainfall and an increase in air temperature and evaporation may impact many of the island's habitats and species (Hyder 2008). The red crab migration is triggered by the arrival of the first rains of the wet season and the crabs will be sensitive to any change in the timing of the wet season and any reduction in rainfall (AECOM 2010).

Impacts of adjacent oceanic ecosystems

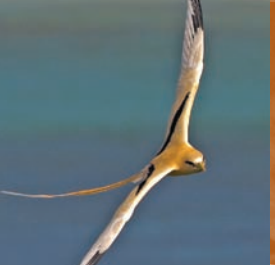
A projected rise in sea surface temperature (SST), coupled with doldrum conditions, has the potential to cause mass fish kill events and coral bleaching. A rise in SST may also lead to increased coral disease such as white syndrome and pink spot (AECOM 2010).

Rises in sea level, ocean acidification and SST may adversely affect marine food chains. Increased SST and changes to mixing depth may alter productivity which is likely to be significant for higher trophic level fish species, including manta ray (*Manta birostris*), and the whale shark (*Rhincodon typus*), both of which feed on plankton, small fish and squid (Hyder 2008). Seabirds are entirely dependent on the ocean for food, and temperature and current changes at lower trophic levels may alter the abundance and distribution of small pelagic fish, which form the staple food source of many native seabird species. Breeding success of seabirds has been positively correlated to incidence of cold water upswelling which results in rich food resource. Any significant changes to currents and SST from projected climate changes may therefore alter seabird breeding success.

Changes to prevailing currents due to increasing SST may impact the recruitment of land crab larvae while increasing sea temperatures may directly impact on land crab larvae development (Hyder 2008). Increases in temperatures and SST may skew the sex ratios of green and hawksbill turtle hatchlings towards females with potential implications for the future abundance of turtle populations in the region (Hyder 2008).

One of the effects of increased CO_2 in the atmosphere is an increase in ocean acidification which will impact the ability of marine organisms to develop their calcium carbonate shell. Specifically for Christmas Island National Park, the surrounding coral reefs may not be able to maintain their structural integrity and therefore their ability to provide habitat for other marine species (Hyder 2008, AECOM 2010).

Biodiversity impacts and arrival of new species



Higher annual average temperatures are likely to affect triggers for life cycle events, population ecology and the occurrence of suitable habitats for a range of species. Climate change will impact on the ecology of individual organisms that will ultimately lead to changes in populations. Dunlop and Brown (2008) identified four main outcomes that might be expected from populations in response to the effects of climate change. These outcomes are not mutually exclusive as a number of the factors may occur together within a population. They are:

- survival within the current distribution (although there may be changes in abundance, behaviour or habitat)
- evolutionary adaptation to enable survival (this may be at a genetic, species or population level)
- changes in population distribution
- extinction.

Climate change is likely to change the species composition of communities and ecosystems. Invasive species such as the yellow crazy ant (*Anoplolepis gracilipes*) may be favoured by changed conditions in temperature and rainfall, especially if coupled with human disturbance or further introduction of non-native species. Conditions which favour the crazy ant will lead to negative effects to land crabs, other animals and the forest structure (AECOM 2010).

Increased levels of atmospheric CO_2 may lead to increased photosynthesis in plants which can impact the level of plants water efficiency and the amount of biomass produced. Differences in individual species responses to increased CO_2 have the potential to alter species interactions and ecosystem structures (Hyder 2008). An increase in atmospheric CO_2 may enhance mangrove growth at Hosnie's Springs however this will also be limited by water availability.

Buildings and infrastructure

Parks Australia buildings and infrastructure are subject to potential climate change impacts such as increases in high intensity cyclones, erosion, and corrosion as a result of increased temperatures and humidity. Infrastructure may also be impacted by structural fatigue resulting from the intensity of storm events. These impacts are likely to lead to a reduced asset life and an increase in maintenance requirements (AECOM 2010). Currently, no buildings on Christmas Island are designed to cyclone ratings (AECOM 2010) which leaves them further prone to the adverse impacts of increased high intensity storm activity. Higher temperatures are likely to increase the demand for energy and water for cooling systems.

4. Recommended management actions

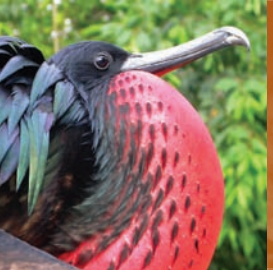
The recommended management actions align with the five objectives of the Parks Australia Climate Change Strategic Overview 2009-2014 outlined below.

1. To understand the implications of climate change.
2. To implement adaptation measures to maximise the resilience of our reserves.
3. To reduce the carbon footprint of our reserves.
4. To work with communities, industries and stakeholders to mitigate and adapt to climate change.
5. To communicate the implications of, and our management response to, climate change.

4.1 Understand the implications of climate change

A good knowledge of the implications of climate change is essential to enable us to prepare and implement an effective response. Given the uncertainties of climate change at a local scale, and our current knowledge gaps, the task of improving our understanding will be an on-going effort. Understanding how various natural and cultural elements of the landscape may respond to changing conditions, and designing long term research and monitoring programs that inform management responses are priorities.

Recommended management actions		Timeframe
4.1.1	Identify critical knowledge gaps in baseline data and identify priorities for further research or integrated monitoring programs to study the causes and effects of landscape and ecosystem change.	By 2012
4.1.2	Continue to partner with research institutions on projects that target identified knowledge gaps and improve understanding of the resilience of species and communities in the park.	Ongoing
4.1.3	Work with partners to develop spatial information systems that assist in predictive modelling of climate change impacts on the distribution and abundance of vulnerable species and communities (including invasive species) under different scenarios.	Ongoing
4.1.4	Continue existing long term monitoring programs, including the Island Wide Survey, for significant fauna species expected to be impacted by climate change. This may include red crab, crazy ant and biodiversity monitoring, as well as monitoring of coral reef ecosystems.	Ongoing
4.1.5	Once priority research and monitoring has commenced (Action 4.1.1), identify a set of baseline parameters (climatic, geomorphological, hydrological and ecological) to effectively monitor the effects of climate change.	By 2012
4.1.6	Establish and implement a monitoring program for parameters identified in Action 4.1.5 that are not already targeted in existing long term monitoring programs. Methods used to monitor the effects of climate change must have appropriate sensitivity to detect changes. The monitoring program should have explicit measures for communicating outcomes between land managers, researchers and the general community.	By 2013
4.1.7	Continue to improve the technical capacity of park staff to monitor and understand climate change impacts, and to adapt and respond appropriately (e.g. GIS, remote-sensing and field monitoring skills).	Ongoing



4.2 Implement adaptation measures to maximise the resilience of our reserves

The condition of the natural and cultural values of the park is dependent on the rate of climate change itself and the resilience of the park to cope with this change. A focus of park management is to reduce the impact from invasive species. This will maximise the resilience of species and communities to adapt to the additional challenges brought about by climate change. The park needs to be managed using an ecosystem-based approach (rather than single species), in partnership with park neighbours, to maximise opportunities for changes in the distribution of species or populations.

Recommended management actions		Timeframe
4.2.1	Continue to implement the existing strategic weed and feral pest monitoring and control programs to maximise the resilience of species and habitats in the park.	Ongoing
4.2.2	Identify species and habitats where impacts from feral pests, weeds, and high visitation rates are likely to be exacerbated by climate change and revise management programs accordingly.	By 2012
4.2.3	Through monitoring threats to the rainforest and wetlands, determine whether the risk of fire increases over time. Subject to the assessment of fire threat, develop fire management strategies to reduce the likelihood and impacts of fire and fire management activities on forest ecosystems	Ongoing
4.2.3	Work with relevant stakeholders and organisations to develop partnerships and whole-of-government approaches for implementing and addressing island-wide conservation issues and other issues of mutual interest, for example coordination of data, fire, weed and feral management. The Christmas Island Regional Recovery Plan (in development) will be a key tool in achieving this.	Ongoing
4.2.4	Continue collaboration with relevant land planning agencies to protect park values from external pressures from neighbouring land.	Ongoing
4.2.5	If parts of the landscape are changing in ways that are of concern, the Director, in consultation with relevant stakeholders, will decide on further monitoring requirements, and whether protective, rehabilitation or adaptation measures are feasible. If cost effective, appropriate actions will be implemented.	Ongoing

4.3 Reduce the carbon footprint of our reserves

The park adopts environmental best practice principles for resource use and management of waste products in the park. These principles are consistent with the need to conserve the park's natural and cultural resources, and meet broader commitments to reduce greenhouse gas emissions, reduce water use and minimise the potential impacts associated with waste management.

Park operational activities such as transport, electricity generation and use, development of new infrastructure and waste management all contribute to the park's carbon footprint. Land management activities such as revegetation projects, fire management and pest management also have implications for the carbon cycle. It is necessary to better understand the impact of land management activities (including carbon sequestration) on the size and nature of the park's carbon footprint to allow performance to be holistically measured and improved over time. Careful management of these activities can help to reduce overall emissions.

Parks Australia will aim to reduce greenhouse gas emissions from park operational activities (such as energy use, transport and waste management) to 10 per cent below 2007-08 levels by mid 2015.

Recommended management actions		Timeframe
4.3.1	Undertake a carbon emissions audit (consistent with ISO14064-1) that considers energy use, waste, water and support infrastructure (e.g. insulation) across all buildings, vehicles and equipment used in the park.	By 2013
4.3.2	Identify actions to reduce the carbon footprint of park operations and the level of carbon emission reduction associated with each mitigation action, for example: • transitioning park buildings to renewable energy sources such as solar energy • transitioning existing electric hot water systems to more efficient systems (e.g. solar hot water, gas, efficient heat pumps) as replacement becomes necessary • installing energy efficient light fixtures and light-controlling devices (e.g. motion sensors) in all park facilities • investigate and implement ways to minimise vehicle energy use • establishing guidelines to formalise waste reduction strategies into standard park practices (e.g. reducing consumption, printing double sided).	Ongoing
4.3.3	Work with partners to improve quantification of the carbon cycle as it relates to the management of fire, vegetation, sol and invasive species in the park.	By 2014
4.3.4	Based on the quantification of the carbon cycle of land management activities (Action 4.3.3), refine weed, feral pest and fire management regimes to reduce the carbon footprint of the park and maximise carbon retention in natural vegetation.	By 2015
4.3.5	Further investigate opportunities for the Christmas Island Minesite to Forest Rehabilitation Program to off set carbon emissions and participate in carbon trading schemes.	Ongoing

4.4 Work with communities, industries and stakeholders

The Christmas Island community and a number of businesses rely on Christmas Island National Park to attract tourists and provide essential ecosystem services. Climate change will have an impact on these communities and industries and they will need to mitigate and adapt to the changes. The park will work with local communities and stakeholders to identify and support proactive measures to reduce the negative impacts of climate change and to adapt where climate change induced impacts are unavoidable. The increase in frequency and intensity of extreme weather events will necessitate the development of risk control measures to protect life, infrastructure and the natural and cultural values of the park.

Recommended management actions		Timeframe
4.4.1	Continue to work with the Christmas Island residents, and other park stakeholders (e.g. commercial tour operators) to promote renewable energy projects.	Ongoing
4.4.2	Continue to employ Christmas Island residents in climate remediation activities through the Christmas Island Minesite to Forest Rehabilitation Program (subject to program agreements with the Department of Regional Australia, Regional Development and Local Government).	Ongoing
4.4.3	Investigate opportunities to assist tourism businesses dependent on the park to adapt their business to the impacts of climate change.	Ongoing
4.4.4	Participate in emergency response planning and operations as part of the emergency management committee for Christmas Island.	Ongoing
4.4.5	Conduct an infrastructure risk assessment to identify assets at risk from climate change impacts and extreme weather events. Assessment should recommend assets requiring upgrading, relocation or those unsuitable in the future climate change environment.	By 2013

4.5 Communicate the implications of, and our management response to, climate change

Climate change is a global issue affecting all aspects of our community and it is vital we share our knowledge with stakeholders, government bodies and the general public. This will ensure that stakeholders and the public are informed about potential climate change impacts and the management directions that are being taken. This will also help ensure that efforts between government agencies, scientific researchers and the community are well coordinated.

Recommended management actions		Timeframe
4.5.1	Liaise with Parks Australia and the Department of Regional Australia, Regional Development and Local Government to ensure that communications messages regarding climate change are consistent and that agencies work together to develop and implement climate change strategies, and climate change communications plans.	Ongoing
4.5.2	Support the maintenance of publicly available information on the Parks Australia website for climate change policies, strategies and other documents relevant to the park.	Ongoing

5. Implementation and review

The Christmas Island National Park Climate Change Strategy 2011-2016 will be implemented over a five year period. While the strategy is consistent with the Christmas Island National Park Draft Management Plan 2011-2021 (under development), implementation of the recommended management actions is subject to budgetary and resource constraints. The strategy will be reviewed on a rolling basis to take account of new information or changes in policy directions.

6. Bibliography

- AECOM Australia Pty Ltd 2010. *Indian Ocean Territory Climate Change Risk Assessment* (2010 Update Version). Report to the Attorney-General's Department, June 2010, Canberra, Australia.
- Bureau of Meteorology 2011. *Summary of statistics Christmas Island Aero.* http://reg.bom.gov.au/climate/averages/tables/cw_200790.shtml Viewed 25/1/11.
- Director of National Parks 2002. *Christmas Island National Park Management Plan 2002.* Commonwealth of Australia, Canberra, Australia.
- Director of National Parks 2009. *Director of National Parks - Annual Report 2008-09.* Commonwealth of Australia, Canberra, Australia.
- Dunlop, M. & Brown, P.R. 2008. *Implications of climate change for Australia's National Reserve System: A preliminary assessment.* Report to the Department of Climate Change, February 2008, Canberra, Australia.
- Hyder Consulting Pty Ltd 2008. *The Impacts and Management Implications of Climate Change for the Australian Government's Protected Areas.* Report to the Department of the Environment, Water, Heritage and the Arts and the Department of Climate Change, Canberra, Australia.
- Intergovernmental Panel on Climate Change (IPCC) 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* IPCC, Geneva, Switzerland.
- Maunsell Australia Pty Ltd 2009. *Climate Change Risk Assessment for the Australian Indian Ocean Territories.* Report to the Attorney-General's Department January 2009, Canberra, Australia.

Prepared by: Director of National Parks

Note: This strategy sets out the preliminary actions and tools necessary to manage the consequences of climate change at Christmas Island National Park. While the Australian Government is committed to acting in accordance with the strategy, the attainment of objectives is subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the strategy due to changes in knowledge and policy direction.

This plan should be cited as:

Director of National Parks 2011. *Christmas Island National Park Climate Change Strategy 2011-2016.* Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australia.

This strategy is available from the Department's web site at environment.gov.au/parks/climate.html