9th Conservation Workshop for the Fauna of Arabia

ورشة صون
حيوانات شبه الجزيرة العربية

Protected Area Systems in the Arabian Peninsula

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Environment & Protected Areas Authority

Proceedings of the

9th Conservation Workshop for the Fauna of Arabia:

Protected Area Systems in the Arabian Peninsula

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Organised by the Breeding Centre for Endangered Arabian Wildlife
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Introduction

The Ninth Annual Conservation Workshop for the Fauna of Arabia was held at the Breeding Centre for Endangered Arabian Wildlife (BCEAW) in Sharjah, UAE, from the 3rd to the 5th of February 2008. This important regional forum is hosted by the Environment and Protected Areas Authority (EPAA) of the Government of Sharjah, under the patronage of His Highness Sheikh Dr Sultan bin Mohammed al Qassimi. The workshop series has grown in both scope and size since its inception in 2000, with a total of 84 registered delegates attending from seven countries in the Arabian Peninsula in 2008.

Workshops 1 to 7 assessed the conservation status of a range of regional taxonomic groups, from large mammalian carnivores, through to freshwater fishes. Last year the 8th Workshop focused for the first time on protected areas (Oryx 41(2): 132-133), following earlier workshop recommendations that the identification and protection of suitable habitats was of over-arching concern throughout the Arabian Peninsula. The interest generated by discussions in 2007 made it clear that protected area planning and management was an important unifying theme for species conservation in the region.

This, the 9th Workshop, continued the focus on protected areas in sessions facilitated by Philip Seddon and Mike Knight.

Executive Summary

Protected Areas in the Arabian Peninsula

The sessions on the evaluation and development of Protected Areas (PA) networks in the countries of the Arabian Peninsula had four core objectives, each one forming a sub-theme for the workshop:

(1) to review the current status of PA and PA systems in the Arabian Peninsula;

(2) to undertake a formal evaluation of PA management effectiveness;

(3) to identify priority sites for the development of Transfrontier Conservation Areas (TFCAs);

(4) to raise awareness of the implications of global climate on species conservation and PA creation and management in the region.

Theme 1: Review of regional protected area status

It became apparent in the 2007 workshop that protected areas networks are well advanced in some countries within the Arabian Peninsula, while other countries are in the process of planning for protected area creation. Consequently there are now a number of high profile success stories, highlighting a variety of successful approaches to protected area creation and management. But equally important, there are cases where the goals of an area or a network have not yet been achieved. This variation provides opportunities to identify common regional problems. The first part of this process was a series of country reports, in which representatives reviewed the status of protected areas in their country. Reports were presented for Jordan, Saudi Arabia, Yemen, Oman, Kuwait, and for four sites in the UAE (Dubai, Sharjah, Abu Dhabi and Fujairah). Some common issues emerged, including the need for high-level political support and interagency involvements at all stages of protected area creation and management; the value of making explicit linkages with appropriate and sustainable commercial activities; the importance of law enforcement; and the critical need to engage meaningfully with local communities.

Recommendations:

- PA authorities must act swiftly to secure sites of biological importance that are of sufficient size to preserve critical ecological processes;
- Ideally PAs will not be isolated by surrounding development, but will be linked, where possible, to other protected sites;
- PA authorities must ensure that they have a clear mandate to manage areas under their control, and that such areas are clearly delineated, fully protected under national legislation, with adequate enforcement of conservation regulations;
- The highest level of political support is necessary to protect sites against the pressures of incompatible uses proposed or supported by other government agencies, such as resource extraction, or infrastructural or tourism development.

Theme 2: Evaluation of protected area management effectiveness

This sub-theme sought to identify more specifically those common limiting factors, obstacles and needs relating to protected areas in the region through the application of a formal tool to evaluate protected area management effectiveness. Following a general introduction to the IUCN WCPA (World Commission on Protected Areas) Evaluation Framework working groups applied the WWF Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) questionnaire to selected sites throughout the Arabian Peninsula. In total 10 protected areas were evaluated by the delegates, comprising sites in Jordan, Saudi Arabia, Yemen, Oman, and the UAE. Some key points emerged: Currently the region's protected areas face a number of environmental pressures, including overgrazing, wood-cutting, poaching, and other forms of unsustainable resource use, however, future threats will come primarily from development that is incompatible with protected area conservation objectives. Such pressures include mining, unregulated nature-based tourism, urban sprawl, and infrastructural expansion, particularly of roads networks. In addition, while there is a strong focus on the biological components of areas, there has been much less attention paid to the socio-economic aspects of protected area management. As a consequence many reserves find themselves in unresolved conflict with local communities, and lacking the necessary information, understanding or mechanisms to engage locals in area management. Other problem areas include: lack of clear land tenure; lack of clear authority to prevent incompatible development in and around reserves being sanctioned by other land management agencies; the small size and lack of connectivity between sites, which tend to be isolated in the landscape, with barriers to the natural dispersal of animals.

Recommendations:

- PA managers and management agencies should be aware that while current problems facing PAs are primarily environmental, future threats come from development;
- Greater attention must be given to socio-economic issues relating to PA management, including social research to guide management plans;
- Every PA needs a comprehensive, current management plan that clearly outlines specific objectives that take into account the role of an individual PA within a PA network, and which consider both current conditions and the possibility of future change;
- PA authorities should ensure that each PA has full legal protection, legal mechanisms for resolving land tenure or resource use disputes, and a clear mandate to set and implement site management;
- Each PA needs to have sufficient and suitably trained staff whose performance is subject to at least annual review against explicit work plans set against PA objectives.

Theme 3: Prioritization of Transfrontier Conservation Areas

Cross-border cooperation emerged as an important theme in the 2007 workshop and the intention in 2008 was to keep this concept alive by identifying and prioritizing some key sites in which real progress could be made. Delegates proposed three sites in which the ecological needs of high-profile charismatic species encompass key habitats and ecological processes, providing natural and ecologically meaningful cross-boundary linkages. For each site a number of vital attributes, such as the presence of globally significant wildlife populations, and their associated determinants and threats, were identified. Potential partner nation representatives were urged to use the workshop as an incentive to progress cross-border cooperation. It is strongly believed that with even only one high-profile Transfrontier Conservation Area (TFCA) as a successful model of regionally relevant cross-boundary arrangements, wider interest and support for the concept will be generated.

Three case studies were discussed:

Region	Partners	Focal Species	Ecosystem
Rub al Khali	UAE, KSA, Oman	Arabian oryx	Desert
Arabian Gulf	KSA, Kuwait, Bahrain, Qatar, UAE	Dugong	Marine
Hawf Region	Yemen, Oman	Arabian leopard	Montane

Recommendations:

- There is general consensus for the need for some transfrontier arrangements;
- Need to maintain open dialogue between national conservation authorities and foster a continued willingness to further engage in these discussions;
- The discussions on TFCA type arrangements for the entire Arabian Peninsula are unique in that a regional approach is being taken as opposed to a case-by-case situation as elsewhere;
- Best to focus any proposed TFCA around a prime conservation issue (one that catches all), such as the Arabian leopards, oryx and dugong conservation issues (see table above).

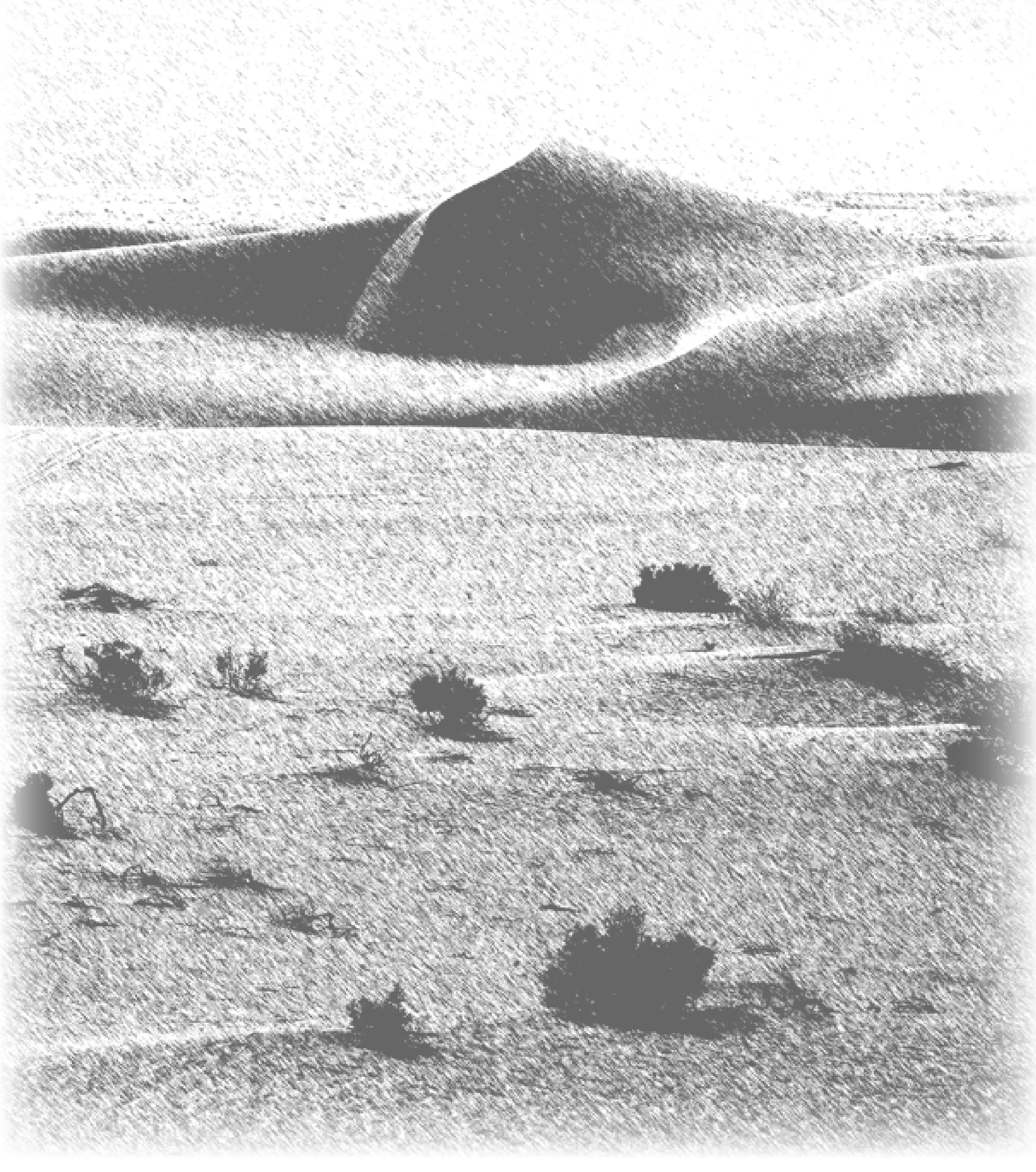
Theme 4: Overview of the implications of climate change predictions

The existence of a greenhouse effect due to anthropogenic emissions of greenhouse gases is now well established scientifically, and is gaining wide acceptance as a fact in the public mind. As the predictive models of global climate change are refined, it has become apparent that under most scenarios there are significant climatic changes forecast for the Arabian Peninsula. Over the entire region temperatures will increase, extreme weather events will become more frequent, and for all but the southeastern areas, rainfall will decrease. Clearly, this will have major ramifications for already arid and hyper-arid regions, and major consequences for protected areas and the species they encompass. Protected area networks will enhance the natural resilience of species to climate change in four ways: through the protection of climate refugia, where favourable habitat will persist or develop as the climate changes; by conserving large-scale migration corridors; with the maintenance of viable populations to enable adaptation, with reserve networks that cover a diversity of habitats and gradients of climate; and in reducing threatening processes at the landscape level, by preventing land clearing and intensification of use next to reserve boundaries. To achieve this regionally there is an agreed need for national policies on climate change to include protected area management and the national and regional coordination of threat management across land management agencies.

Recommendations:

- Threat Management must be coordinated across land management agencies;
- There is a need for national policies on climate change that include Protected Area management;
- Transboundary and Bioregional approaches will enable full physical variation of natural environments to be included in landscape planning;
- There is a need for regional coordination of responses that include Transboundary Protected Area Systems Plans.

Protected Area Systems on the Arabian Peninsula



Theme 1

Review of current protected area status in the region

Objective: To derive a current picture of the status of Protected Area (PA) sites and networks, or planning for such networks, within selected countries of the Arabian Peninsula.

Specific aims: To use the experience of countries with established areas to:

- Identify the key requirements for successful PA creation
- Highlight critical elements in PA planning and development

In this way it was intended to provide concrete, regionally relevant guidelines for those countries or agencies within countries that are about to embark on PA network planning and establishment.

Process

Delegation representatives from selected countries were asked to report on the status of PA(s) in their country, or a PA under their specific management.

Results

Detailed reports were received for PA networks in:

Saudi Arabia (Ahmed Boug)

Under its National PA System Plan the Kingdom of Saudi Arabia has the aim of placing 10% of the country under some form of protection, with the ambitious goal of creating a network of 62 terrestrial and 13 marine reserves. To date there are 15 PAs in Saudi Arabia, constituting ~4% of the total land area, with 20 more in early stages of planning by the NCWCD, and another 22 with partner agencies. Early goals of having <105 PAs were revised following opposition by local communities to site protection, and the integrity of even some long-established areas is still being threatened by unresolved land access, tenure and management disputes. (see http://www.ncwcd.gov.sa/English/ for details).

Yemen (Abdul Karim Nasher)

PA network development in Yemen proceeds under a number of plans, including the National Biodiversity Strategy and Action Plan (1996), the Protected Area and Coastal Zone Management Plan, and the Socotra Conservation and Development Plan. To date only a few PAs have been officially established. Sites vary widely in their level of management, with some enjoying comprehensive management and land use control plans, while others operate essentially without recent plan. As in Saudi Arabia, conflict with local communities is a critical issue hampering effective PA management. Other problems include: insufficient and inadequately trained staff, inadequate site funding, unsustainable natural resource use, and a lack of visitor management. (see http://www.parks.it/world/YE/Eindex.html for details of specific sites).

Additionally, workshop attendees were directed to information for sites in:

Jordan

PA network planning is well advanced in Jordan, with seven established PAs: Shaumari, Azraq Wetland, Muj (Ibex Reserve), Dana, Rum, Ajloon, and Dibeen (see Seddon 2008 for details of tourism related activities in these sites in Jordan). (See http://www.rscn.org.jo/ for details of the role of The Royal Society for the Conservation of Nature in Jordan; see http://www.parks.it/world/JO/Eindex.html for details of specific sites).

Oman

The Omani environment is characterized by the various features of biological diversity, and wildlife species are protected in their natural habitats including the Arabian Oryx, Arabian gazelle, Reem gazelle, turtles, wolves, wild cats, and birds and other animals and plants through laws and regulations as a legal framework, which provides protection to these components and their habitats. Up to 14 nature reserves have been proposed in the various Sultanate regions, and currently there are four protected areas, accounting for 9.6% of the total land area of the country. Oman has also set up two marine protected areas. (see http://www.parks.it/world/OM/Eindex.html for details)

Kuwait

Management of Protected Areas in Kuwait fall under the remit of the Protected Areas Division, together with the Wildlife Development Division and the Marine Organism Monitoring Division; these form part of the Living Resource Department of the Environment Public Authority (EPA) of Kuwait. This Division specializes in the following:

- the selection and establishing of sites and provision of the necessary utilities, and to run them in cooperation with other concerned bodies;
- overseeing scientific and recreation activities within PAs;
- monitoring and conserving the biological elements within PAs;
- preparing and implementing restoration programs for endangered species within the Kuwaiti environment within the boundaries of selected PAs;
- cooperating and coordinating with regional, national and international organizations in PA management.

According to the data provided by the World Database on Protected Areas, in Kuwait there are one National Park, 3 Marine Parks, 14 Nature Reserves, one Scientific Reserve, one Wildlife Nature Reserve, two Parks, and four other Protected Areas. (see http://www.parks.it/world/KW/Eindex.html for further details)

Four PAs within the United Arab Emirates were reviewed:

Dubai: ***Dubai Desert Conservation Reserve*** (Greg Simpkins)

With a total area of 225km^2 the DDCR constitutes ~4.7% of Dubai's land area. The site started originally as the 27km^2 Al Maha ecotourism site, but was expanded after a 2001 environmental audit that also saw the creation of a Dubai Conservation Board, representing all stakeholder agencies. The goal for the site is the management of a permanent internationally recognized PA, accessible to visitors but within which natural and cultural heritage is protected. With ~200,000 visitors per annum, the key challenge is to manage tourism impacts. The area is supported by the Dubai Government, sponsored by Emirates Airlines, and additionally benefits from a "green tax" to visitors.

Abu Dhabi: ***Sir Bani Yas Wildlife Reserve*** (Jeremy Anderson)

The aim for this island site is the creation of a 50km^2 natue reserve containing only native species, with extensive planting and irrigation that will reduce naturalness but support wildlife. A management plan is being produced, recognizing the need to create effective partnerships with key stakeholders, the importance of clear site ownership and management authority, and the use of controlled commercialization to meet site objectives. The island is important as a migrating bird stopover and is a potential introduction site for Arabian oryx, although the carrying capacity of the island may prevent the establishment of a self-sustaining population of oryx.

Fujairah: ***Wadi Wurayha Project*** (Christophe Tourenq)

This project considers the creation of Fujairah's first terrestrial PA (the emirate has four small marine reserves dating from 1995). The 113km^2 Wadi Wurayha site has permanent water and is therefore already a tourism attraction. In 2005 approval was given for site surveys and the development of protection proposals. The idea of a PA has high (70%) local support, but to date the wadi has no formal protection and faces pressures from develpment, poaching, quarrying, and water abstraction.

Sharjah: ***Wasit Nature Reserve*** (Dirk Heinzelman)

This urban site was first proposed for protection 2004, comprising 2.5km^2 of wetland known to be important as a bird sanctuary. Ongoing urbanization reduced this area by half as residential development encroached. Effective protection was achieved through fencing, but the site is now completely surrounded by development. The aim is to restore the ground water aquifer and plant communities to the benefit of native bird species, however the PA faces a number of legislative challenges, not least of which is the need for approval from the Directorate of Town Planning.

Recommendations

The presentations and associated discussions highlighted a number of imperatives for PA creation in the region, with specific lessons for countries currently and about to develop new PA sites.

- There is a sense of urgency as potential PA sites are being lost forever to urban development; this is particularly of concern in the United Arab Emirates where the pace of development is unprecedented and land area very limited.
- Sites may by necessity be small, although the aim should be to secure as large a site as possible. To some extent small size can be offset by connectivity between sites to ensure that key ecological processes are sustained. Whatever the size and degree of isolation, boundary integrity is essential
- Political support at the highest levels is imperative to protect a site against incompatible uses. Gaining this support will require a "champion" to undertake active lobbying of decision makers, along with the development of interagency involvement, and fostering of local community support, this last may be gained through support of sustainable use of natural resources, such as controlled grazing zones.

- A clear mandate and firm support policy is essential, and will work with effective PA legislation and enforcement of laws to protect the integrity of a site.
- Funding needs may be through innovative partnerships, including explicit links to commercial activities where appropriate, although the PA authority must retain ultimate control of the type and scale of any commercial activity within a site.
- Planning should be based on sound biological information and consider climate change. Managers will have to face a lack of resources and capacity, and should realise that many decisions are based on values rather than sound data.

Theme 2

Evaluating the management effectiveness of protected areas

Objective: To evaluate the management effectiveness of selected established protected areas in the Arabian Peninsula

Specific aims: Using the WWF Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Evaluation Framework to undertake an assessment of the management effectiveness of selected protected areas in countries of the region with a long history of PA creation and management in order to identify common issues relating to protected area management, specifically:

- Highlight successful management approaches
- Identify limiting factors, obstacles and needs
- Introduce delegates to a PA management assessment tool
- Encourage delegates to think about factors limiting management effectiveness within their own PA networks

Overview of evaluation frameworks

Management effectiveness evaluation is defined as the assessment of how well protected areas are being managed, i.e. the extent to which management is achieving the goals and objectives of a site (Hockings et al. 2006). A framework for management effectiveness was developed by the IUCN World Commission for Protected Areas in 2000 (Hockings et al. 2000) in order to provide a standardised approach to assessing protected area management effectiveness. It is based on the idea that management effectiveness involves six elements within a management cycle: context, planning, inputs, process, outputs and outcomes.

Where are we now? The **context** element considers an area's status and threats. It provides the relevant background information required for planning and implementation, so understanding context is an essential first step.
Where do we want to be and how will we get there? Evaluation of **planning** relates to design issues, legal status and land tenure, protected area systems, and management planning.

What do we need? **Inputs** are those resources necessary to ensure effective management; evaluation of inputs considers what resources are needed, and whether and how appropriately these are being devoted to management.

How do we go about management? Assessment of management **process** considers whether the best systems and standards of management are being followed and whether agreed policies and procedures are in place.

What did we do and what products or services were produced? **Outputs** are a measure of whether managers have achieved what they have set out to do

What did we achieve? Assessment of **outcomes** concerns whether management has achieved the objectives of the protected area, and is thus of vital importance because it measures whether management is maintaining an area's core values.

Introduction to RAPPAM

WWFs RAPPAM methodology is based on the evaluation framework developed by the IUCN World Commission on Protected Areas (WCPA), and is designed for broad level comparisons among a number of protected areas (Ervin 2003). It is an appropriate tool for determining the common threats facing protected areas within a particular region or country, and can shed light on infrastructural and management capacity, the urgency of required actions, the overall level of integrity, and the adequacy of policy. It takes the form of a series of questions grouped under 7 topics: background information, pressures and threats, context, planning, inputs, processes, outputs (see Appendix 3 for summary of questionnaire). Clearly these relate closely to the management elements outlined in the general IUCN WCPA framework. The recommended way to administer the RAPPAM questionnaire is within a participatory workshop involving protected area managers, administrators, researchers, planners and other stakeholders. Participants discuss the questions and agree upon the answers. Simple analysis of results enables some general patterns to be revealed.

Methods

The delegates were divided into five working groups, and each group was provided with the following: an instruction sheet; copies of the 15 questions (1 for each PA assessed); details and information for the PAs to be assessed. Each group nominated: PA leaders (to provide information and answer questions); a lead questioner (to read and interpret each question); a recorder (to write down answers and complete questions); others (to ask for details/clarification; review information). Roles were revised for each new area assessed. Groups aimed to complete two PA evaluations in the time available.

Following the completion of evaluations, groups were assigned to one of the five core elements (see table below) to calculate scores for each component and enable comparisons across protected areas. Because the focus was on the identification of regionally important common issues, and to facilitate candid evaluations, individual protected areas were assigned a code and not identified by name or country.

Group	Element	Topic	Question
Group 1	Pressures and Threats	Pressures and Threats	2
Group 2	Context	Biological importance	3
		Socio-economic importance	4
		Vulnerability	5
Group 3	Planning	Objectives	6
		Legal security	7
		Site design and planning	8
Group 4	Inputs	Staffing	9
		Communication and information	10
		Infrastructure	11
		Finances	12
Group 5	Processes	Management planning	13
		Management decision making	14
		Research, evaluation, and monitoring	15

Calculating scores for each Pressure and Threat

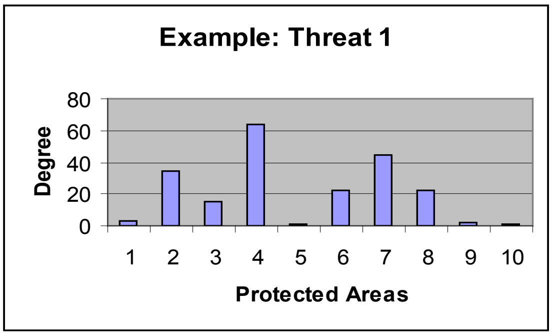
Scoring for Question 2 was as follows:

Extent	Impact	Permanence
Throughout = 4	Severe = 4	Permanent = 4
Widespread = 3	High = 3	Long term = 3
Scattered = 2	Moderate = 2	Medium term = 2
Localized = 1	Mild = 1	Short term = 1

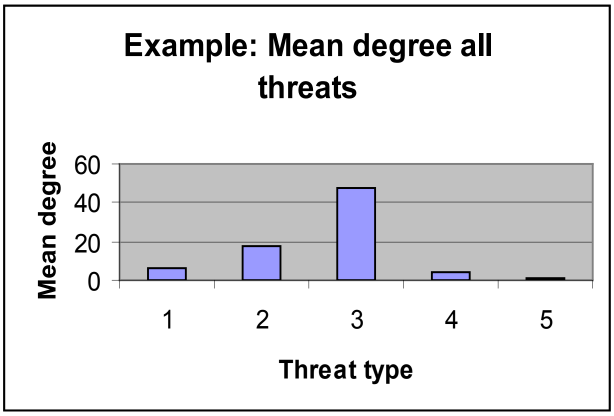
- The degree of each threat and pressure is the factor of all three elements.
- E.g., a pressure that is widespread (3), has a moderate impact (2), and has a short term recovery period (1), would have a degree of 6 (3x2x1)
- Each threat and pressure will have a degree of between 1 (1x1x1) and 64 (4x4x4)

Analysis of Pressures and Threats

1. For each individual Pressure and each Threat, groups calculated the degree for each PA and plotted the degree for each specific Pressure and Threat for each PA (note: these are not presented here but were used for the calculation of mean degree score across all PAs ((2) below).



2. For all Pressures and all Threats, groups calculated the mean degree for each selected principal Pressure and each Threat across all the PAs , by summing the degrees and dividing by the number of PAs, then plotted the mean degree for each Pressure (1 graph) and each Threat (1 graph).

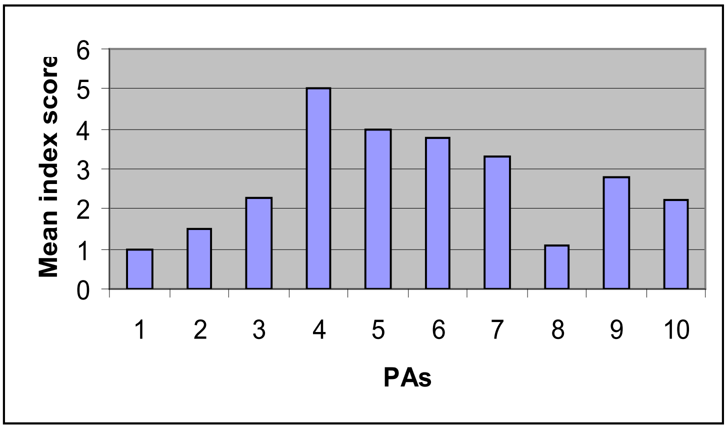


Calculating scores for Context, Planning, Inputs and Processes

Scoring was as follows for Questions 3-15 (see Appendix for details of each question):
Yes = 5 Mostly yes = 3 Mostly no = 1 No = 0

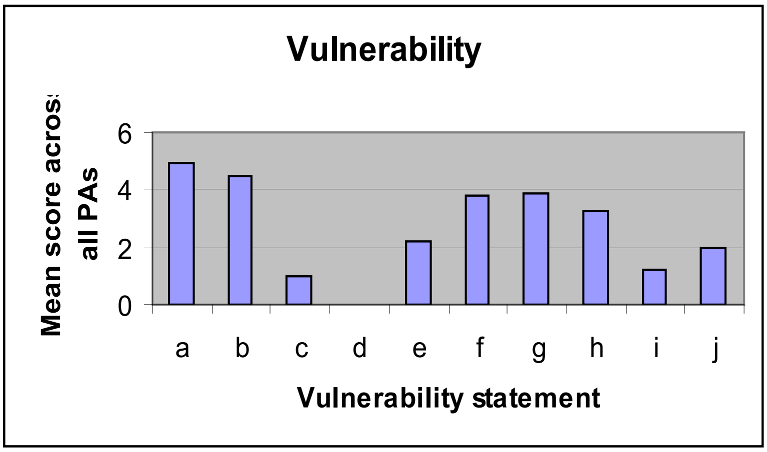
Analysis

1. Groups calculated scores for each PA for each statement a – j (or a-e for Questions 6-15) to derive an index of importance for each topic of each element, e.g. analysis for Context: Question 5 would yield an index of Vulnerability for each PA (mean of a-j scores). Index scores were then plotted.



E.g.: The element Context would yield one graph each for Biological, Socio-economic, and Vulnerability topics

2. Groups then compared the mean scores across PAs for each specific statement of a given topic, e.g. Vulnerability statements a – j, and plotted to identify the most common vulnerabilities



E.g. in the sample graph above: in general over all PAs in the region, illegal activities are hard to monitor (a), whereas bribery and corruption is uncommon (c)

Results

A summary of only key findings is presented. It is recognised that this PA evaluation workshop was not able, in the limited time available to provide any definitive picture of the status of management effectiveness of protected areas across the Arabian Peninsula. However, some general principles and commonalities are identified.

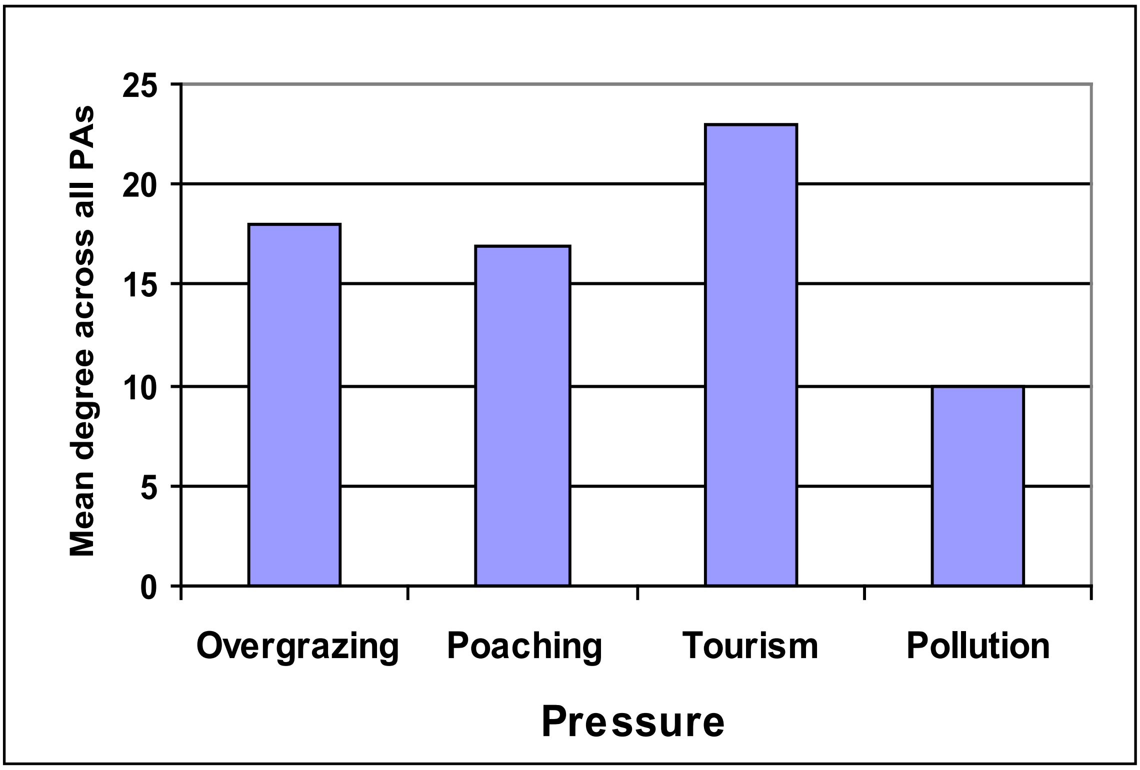
A total of 10 protected areas was assessed, providing a representative range of habitats and regional coverage. Individual protected areas are not identified by name.

Pressures and Threats

<u>Pressures</u>

Four key common pressures were identified from a wider list of nine across all 10 PAs. These are overgrazing, poaching, tourism, and pollution.

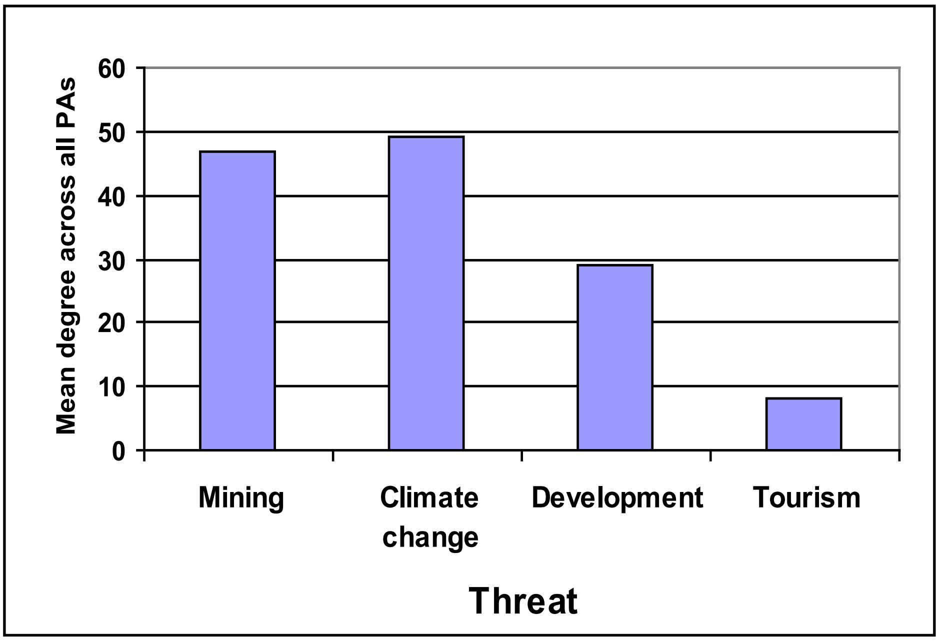
Over all areas, tourism, comprising inappropriate activities and developments associated with recreational use of a PA, was considered to be of the greatest significance, followed by overgrazing and poaching, with pollution of least concern.



<u>Threats</u>

Four key common threats were identified from a wider list of 14 across all 10 PAs. These are mining, climate change, development, and unsustainable tourism.

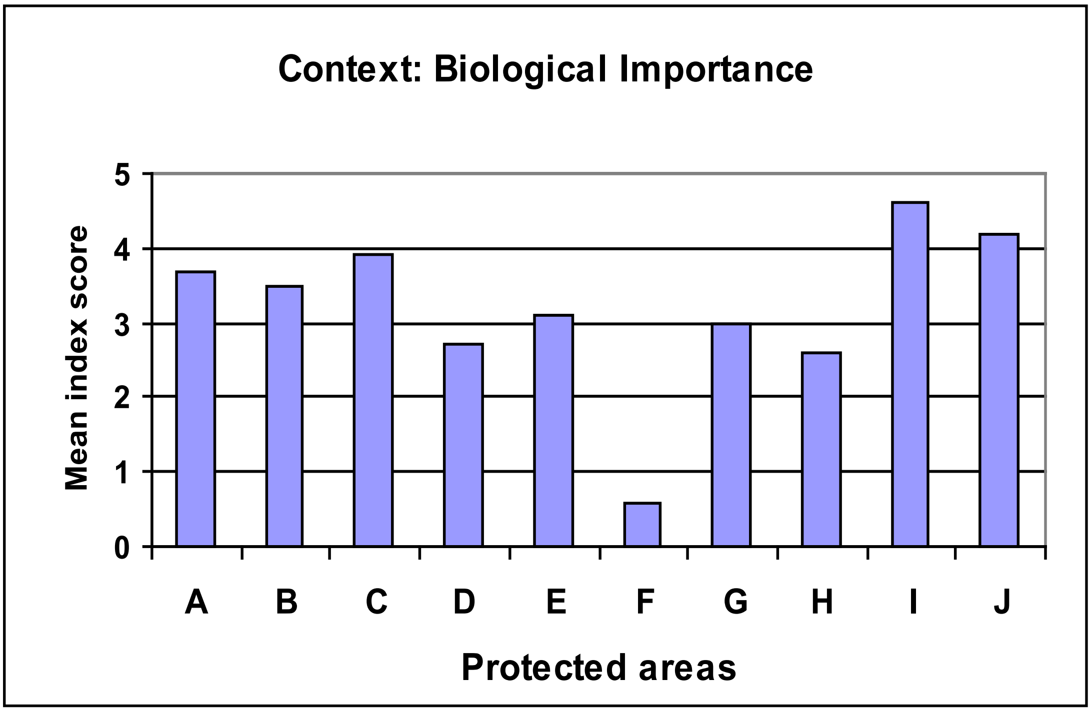
Over all areas mining, the extraction of natural mineral resources, and climate change impacts were considered to be of the greatest significance, followed by development, with unsustainable tourism of least concern.



Context

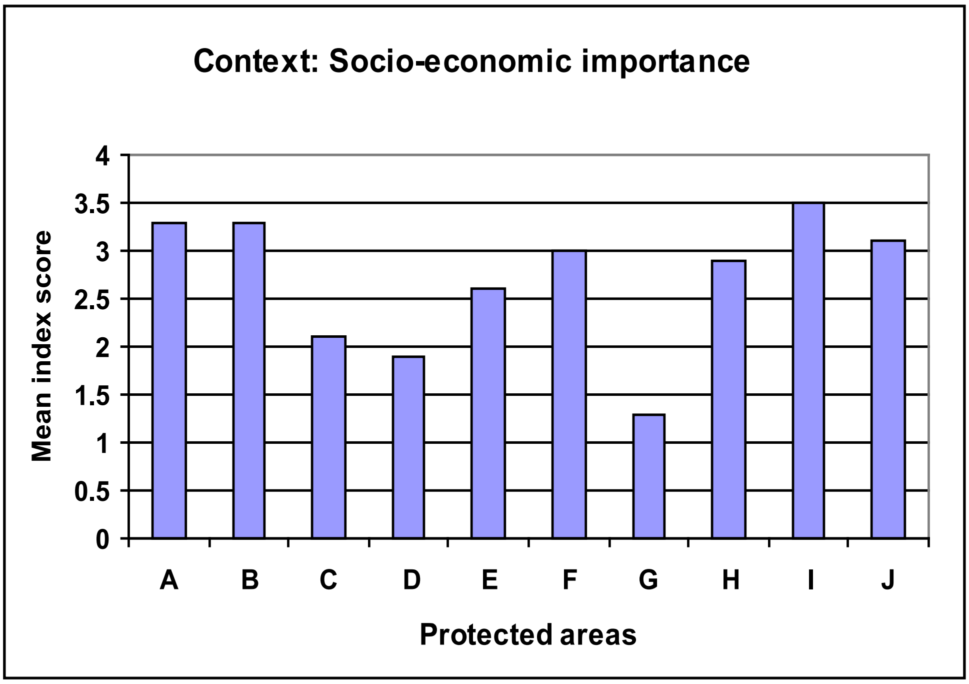
Biological Importance

There was a wide variation in the mean index scores for biological importance across the 10 PAs, with the lowest score being assigned to area F due to the area having been compromised by overgrazing.



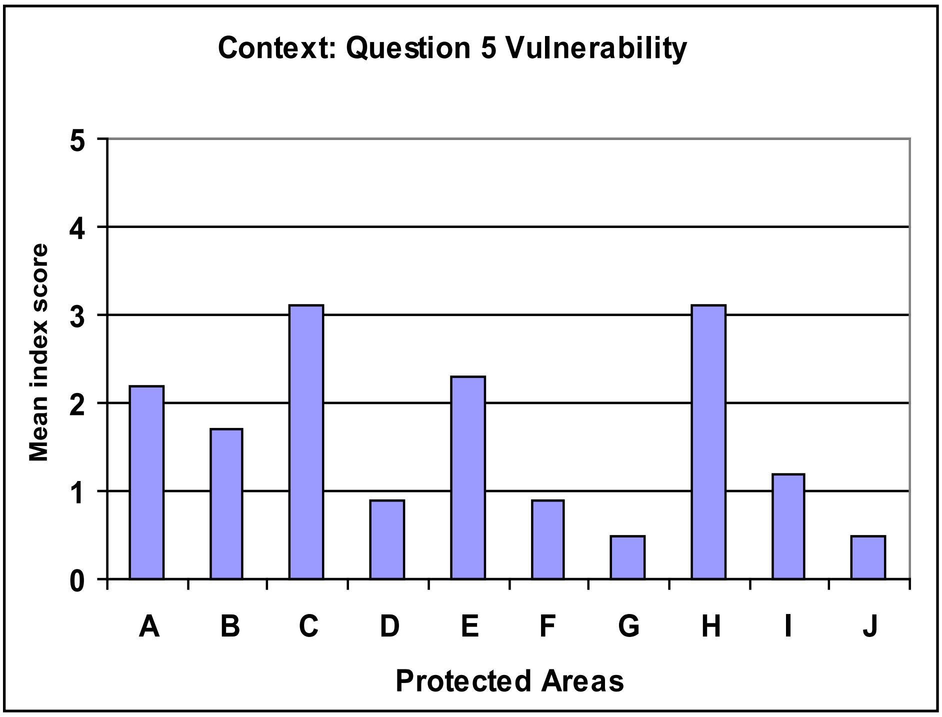
Socio-economic Importance

As with biological importance, mean index scores for socio-economic importance varied widely across the 10 PAs, the lowest score was assigned to area G due to the effects of unsustainable tourism.

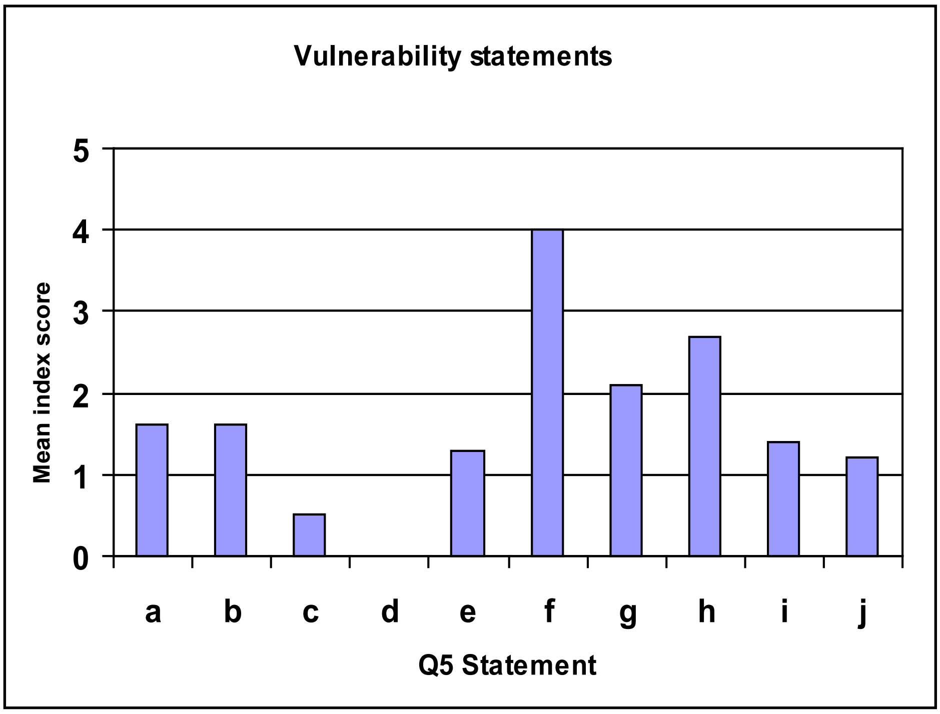


Vulnerability

Vulnerability is assessed as the mean index score for 10 statements which provide a measure of risk to the PA, or the degree to which PA objectives may be compromised due to external factors. With relatively low risks to PAs in the region due to bribery, corruption, civil unrest, or political instability, in general the 10 PA assessed had low mean index scores. Higher scores for some areas, e.g. C, E, H, were due to illegal use of natural resources.



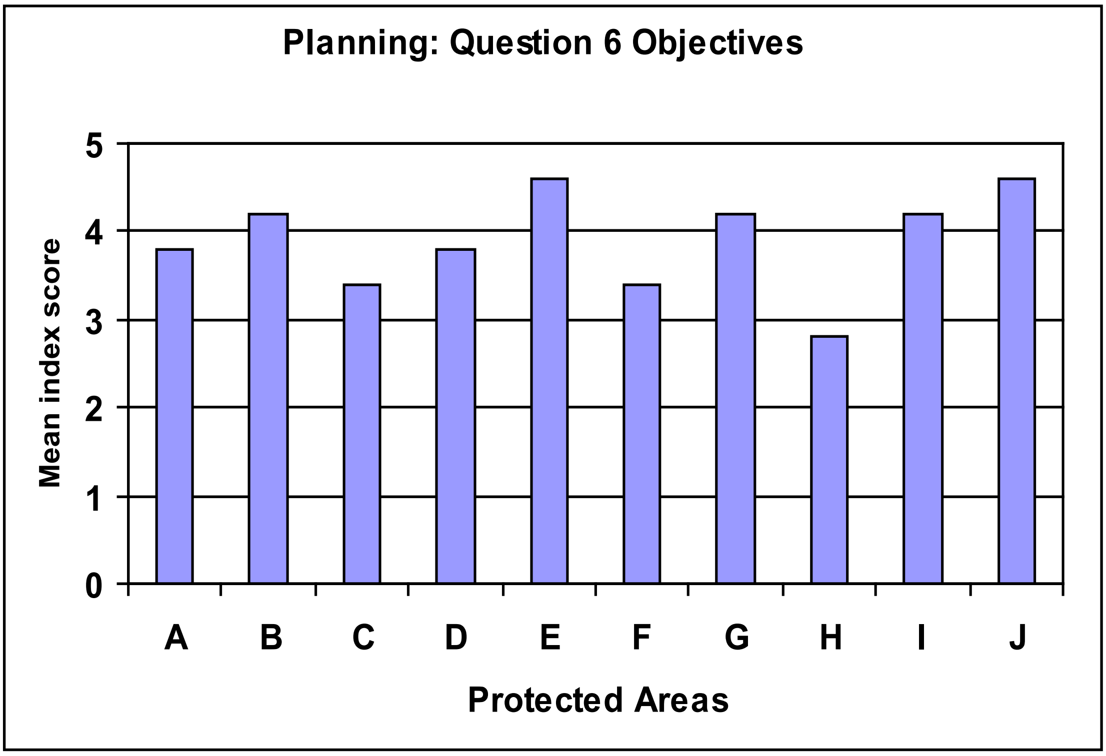
The greatest source of vulnerability in the 10 PAs arose due to demands (statement h) for high market value (statement f) PA resources and ease of access for illegal activities (statement g).



Planning

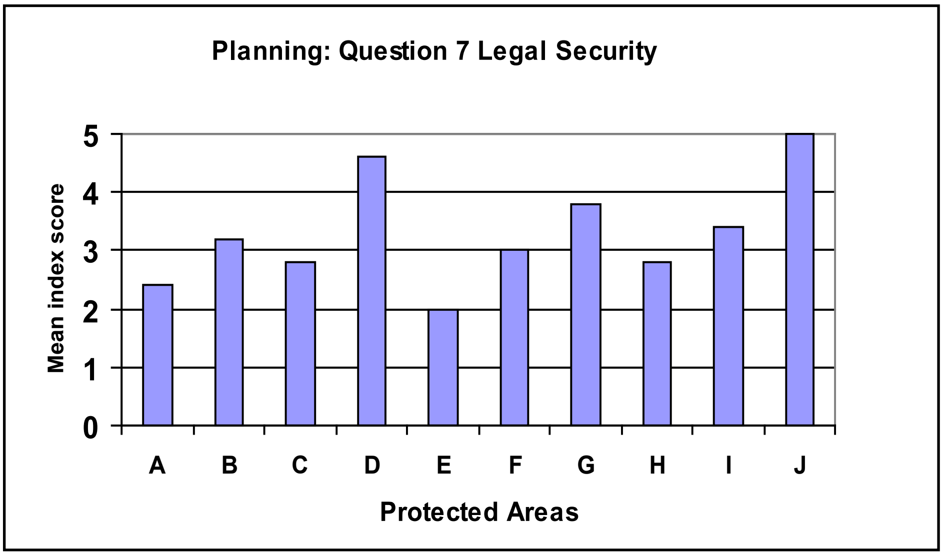
Objectives

The five statements relating to Objectives assess the degree to which the objectives of a PA are appropriate to protect and maintain biodiversity, and are being met by plans, policies and administrators, and supported by local communities. Consistent high mean index scores indicate that across the 10 PAs assessed objectives are generally appropriate and are being met.



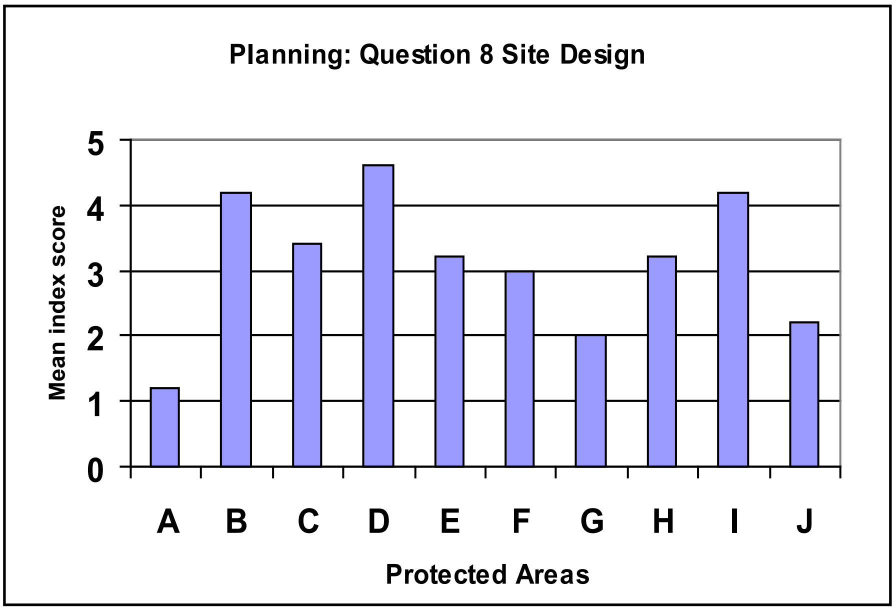
Legal Security

Legal security issues are concerned with the level of long-term protection afforded a PA in terms of boundary demarcation, land tenure, law enforcement and local community conflicts. The wide variation in mean index scores between the 10 PAs indicates significant differences in legal standards between areas. Some sites in particular, such as A, and E, have relatively low legal security, but overall in the region legal security is not a general concern.

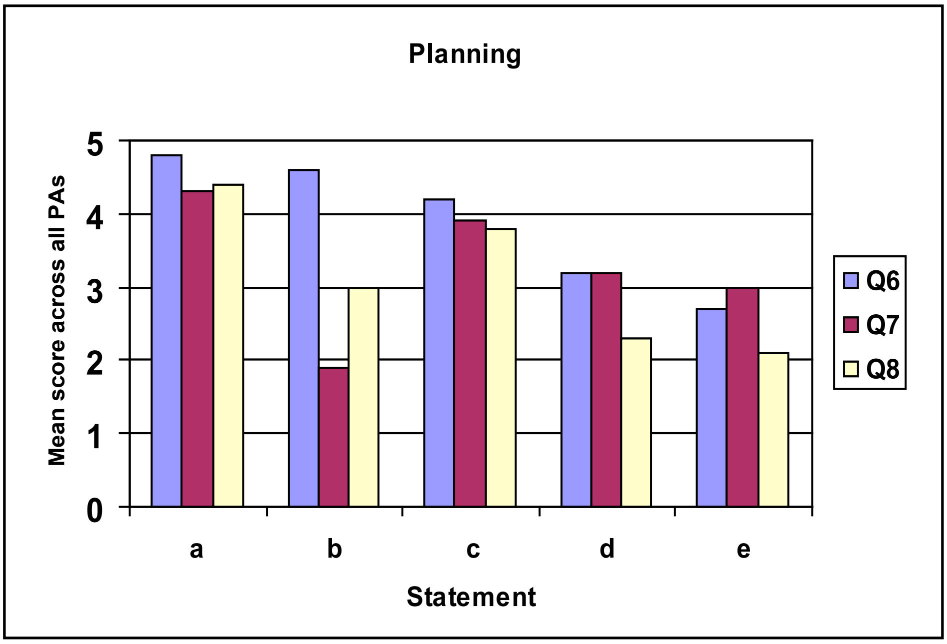


Site Design and Planning

Site design issues include evaluation of the adequacy of PA layout and configuration, zonation and surrounding land use. Again a wide variation in mean index scores is evident, with some sites, A and perhaps G, suffering from inadequate zoning and incompatible development in adjacent areas.



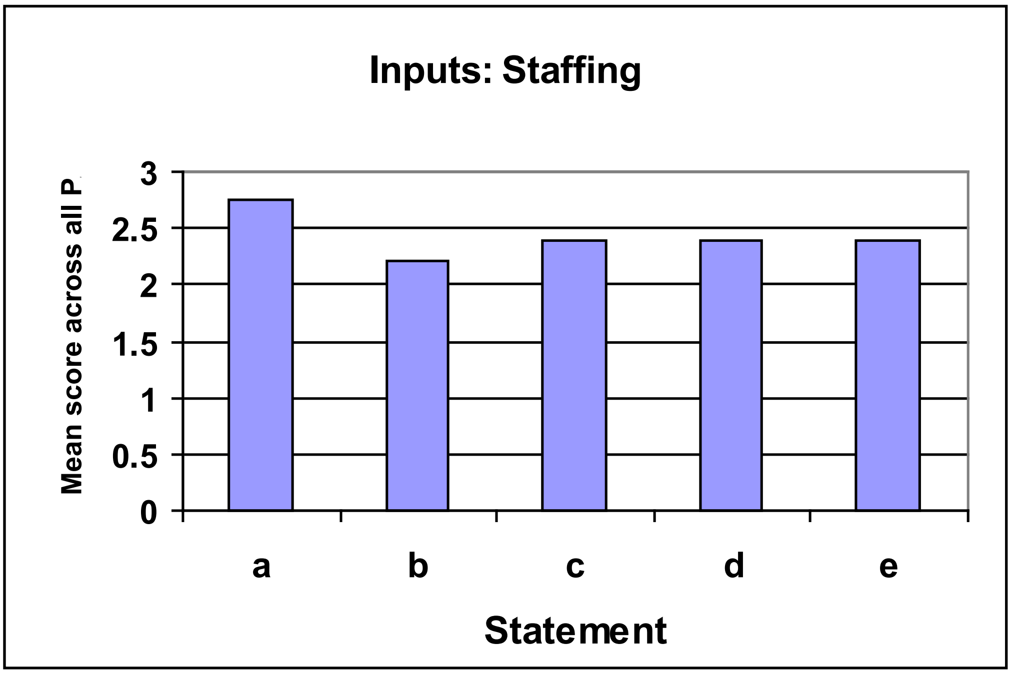
Compiled mean scores across all PAs for each of the specific statements in questions 6 (Objectives), 7 (Legal Security), and 9 (Site Design), highlight general concerns over ongoing disputes regarding land tenure (7b), the threat of development near PA boundaries (8d), and a lack of linkages between a PA and other protected land (8e) indicating the isolation of PAs in a landscape of development.



Inputs

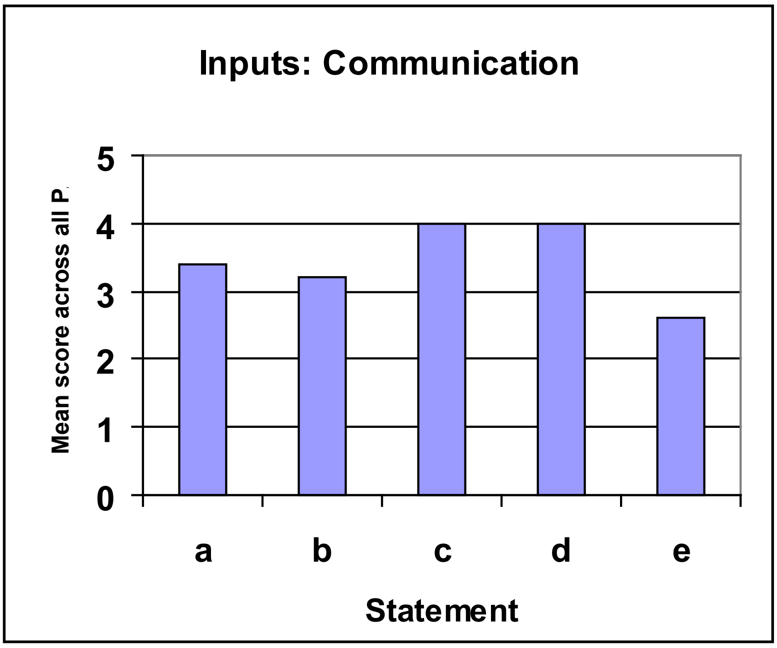
Staffing

Staffing problems constituted one of the most significant areas of weakness in management effectiveness over all the PAs assessed. Mean scores across all 10 PAs highlights several general features of PA staffing in the region. Firstly that while staffing levels are adequate (statement a), staff lack the requisite skills to perform their duties (b), are not getting maximum benefits from training (c), are not subject to regular performance reviews (d), and possibly as a consequence there are some staff retention problems (e).



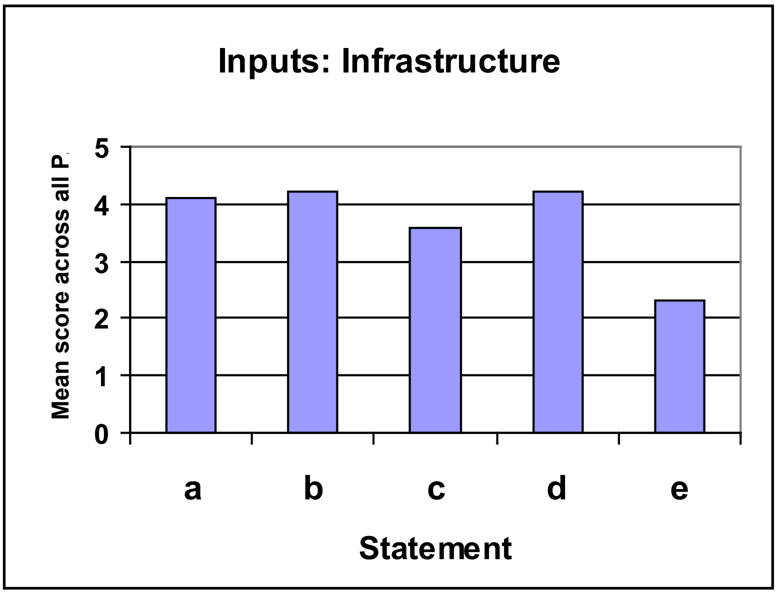
Communication

In terms of communication, across all PAs there was generally adequate means to communicate (statement a), good means to collect (c) and to analyse (d) data, but some need for the compilation of more data on ecological and socio-economic aspects (b). The greatest area of weakness was a lack of effective communication with local communities (e).



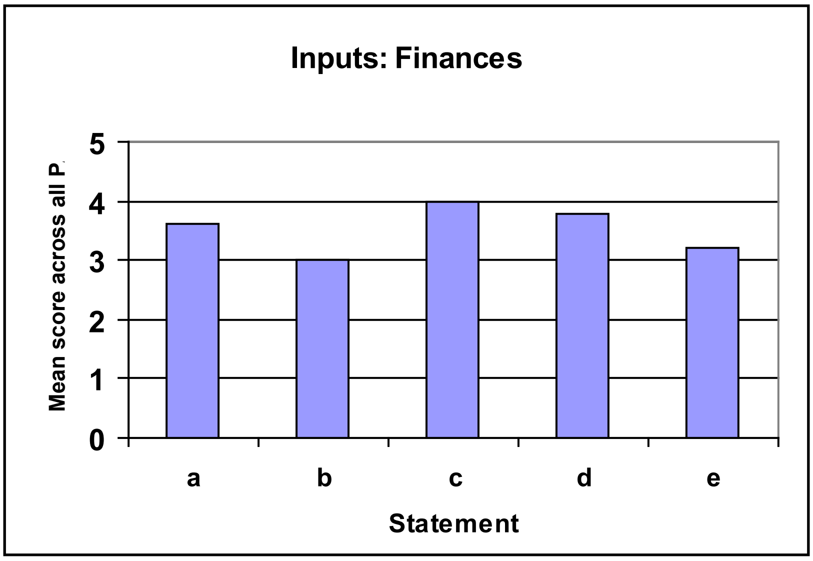
Infrastructure

Generally, PAs in the region have no problems with transportation (statement a), field equipment (b), staff facilities (c), or maintenance (d). However, in general facilities for visitors are not appropriate (e) for the level or type of use. This may arise due to tourism being managed by outside agencies with little or no control by PA authorities.



Finances

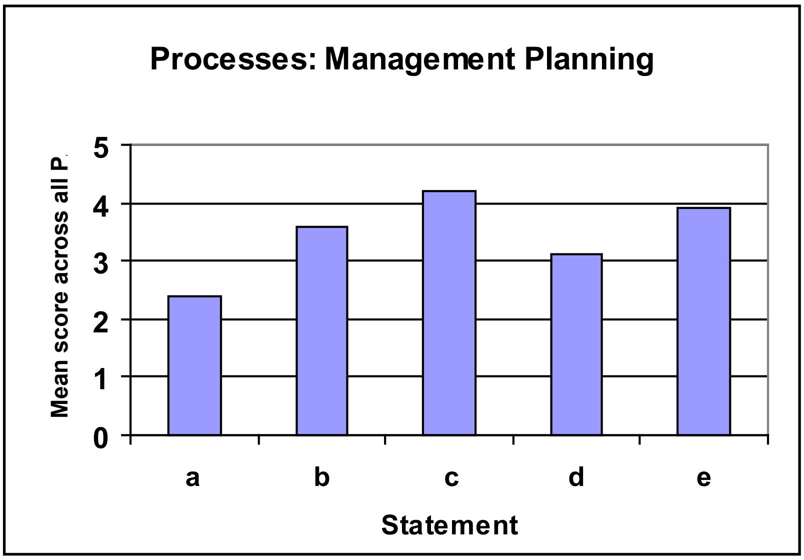
As expected within the relatively wealthy countries of the Arabian Peninsula, financial support and management of PAs was generally adequate, with only some uncertainty in some areas over financial security over the next five years (statement b) and beyond (e).



Processes

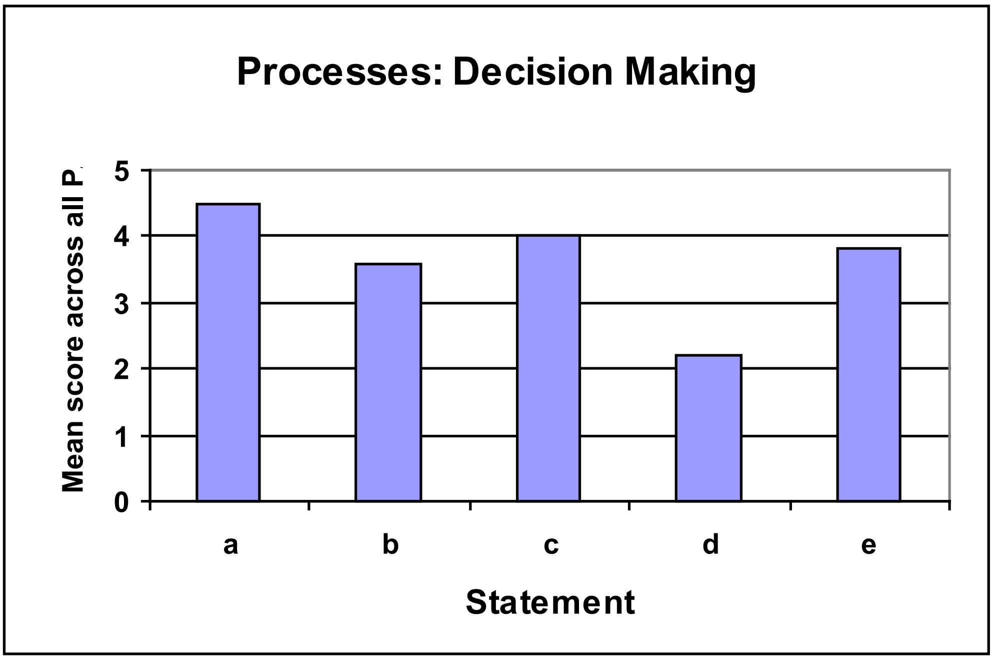
Management Planning

Over all PAs there was general concern over the lack of comprehensive, recent written management plans (statement a), and a lack of detailed work plans (d).



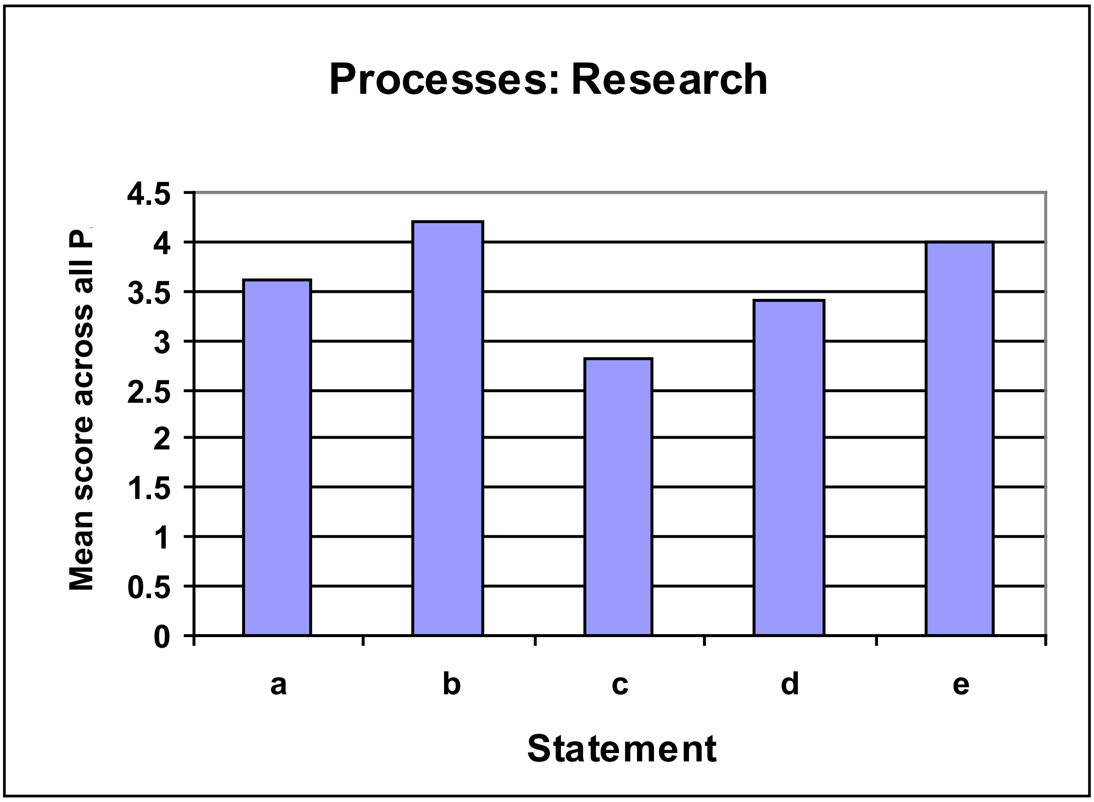
Management Decision Making

PAs in the region benefit from clear internal organisation (statement a), transparent decision making (b), effective collaboration (c), and effective communication (e). However, there is a significant lack of meaningful participation by local communities in decisions that affect them (d).



Research, Evaluation, and Monitoring

All aspects of research and monitoring appear to be well supported within the region, with research on ecological issues being particularly strong (statement b). One area of slight weakness however, is inadequate research focus on key social issues of importance to a given PA (c).



Summary of key points arising from the analysis

Pressures and Threats

- Primary threats facing PAs in the Arabian Peninsula are overgazing and poaching, unregulated tourism and pollution.
- Threats to regional PAs come more from development

Context

- While there is a current strong emphasis on the biological importance of PAs, and associated information and issues, generally within the region here has been inadequate attention given to socio-economic issues.

Planning

- PA objectives are often framed after PA creation, rather than as part of the wider strategic design of a rational PA network
- Significant and widespread problems arise due to legal shortfalls, such as a lack of clear land tenure and conflict with local communities, compounded by a lack of clear authority over management of a PA in the face of incompatible development and usage.
- Site connectivity is poor, with PAs tending to be isolated in the landscape; this isolation creates significant barriers to the natural dispersal of biotic elements.

Inputs

- Regionally many PAs face a capacity shortage, with a lack of sufficient skilled staff and suitable staff training opportunities.
- There is a need for staff performance reviews against clear work plans that address PA objectives.
- Visitor infrastructure is often inadequate for the type and scale of tourism activities areas may experience.
- While funding is generally adequate, longer-term financial security is necessary.

Processes

- Comprehensive, up to date management plans may sometimes be lacking, and where plans do exist, not infrequently they fail to adequately address either current or changing circumstances.
- There is a clear lack of social research to inform and guide PA management

Other points raised in discussions

- It is critical that local communities are engaged meaningfully in all aspects of PA management, for example, hunters are a particularly important stakeholder group.
- There is a general problem of low public awareness of conservation issues, with the result that PAs are not well supported
- Many PAs are unable to compete with other land uses in terms of economic value; there is a significant difference between economic versus conservation values.
- It is vital that tourism is eco-tourism in the true sense of the term, with activities that are compatible with PA objectives.
- There is a need for regional conservation planning.
- Clear land tenure and authority is essential.

Recommendations

- PA managers and management agencies should be aware that while current problems facing PAs are primarily environmental, future threats come from development.
- Greater attention must be given to socio-economic issues relating to PA management, including social research to guide management plans
- Every PA needs a comprehensive, current management plan that clearly outlines specific objectives that take into account the role of an individual PA within a PA network, and which consider both current conditions and the possibility of future change.
- PA authorities should ensure that each PA has full legal protection, legal mechanisms for resolving land tenure or resource use disputes, and a clear mandate to set and implement site management.
- Each PA needs to have sufficient and suitably trained staff whose performance is subject to at least annual review against explicit work plans set against PA objectives.

Theme 3

Prioritization of Transfrontier Conservation Areas

Compiled by

Mike Knight

Objective: The focus of this section of the workshop was to discuss the potential for transfrontier conservation in the Arabian Peninsula, drawing upon the background presented in the 2007 workshop, and experiences gained in southern Africa.

Specific aims: In addition, it was hoped to further explore the theme by identifying regional conservation issues that may be supported by transfrontier cooperation, and identify and prioritise possible areas for such a relationship.

Background

The establishment of TFCAs or Transfrontier Parks (TFPs) is an exemplary process of partnerships between governments, NGOs, communities and the private sector. Such protected areas have become an important conservation tool with a total of 169 such areas world-wide. Southern Africa alone has a total of 21 existing and potential TFCA examples.

Two basic types of transfrontier arrangements exist as defined below:

- A **TFCA** refers to a cross-border region where the conservation status of the various areas differs. These areas may include private game reserves, communal natural resource management areas and even hunting concession areas.
- A **TFP** is established when the authorities responsible for areas (where the primary focus is wildlife conservation and which border on one another across international boundaries), formally agree to manage those areas as an integrated unit according to a joint management plan.

The **key objectives** of TFCA/TFPs include:

- Fostering trans-national collaboration and co-operation among the Parties which in turn facilitates effective ecosystem management in the TFCAs area.
- Promoting alliances in the management of biological natural resources (in fragmented and transformed landscapes) by encouraging social, economic and other partnerships among the Parties, including the private sector, local communities and non-governmental organisations.
- Exchanging technical, scientific and legal information resources for the joint management of the ecosystem.
- Enhanced ecosystem integrity and natural ecological processes across international boundaries and striving to remove artificial barriers impeding the natural movement of wildlife.

- Establishing and maintaining a sustainable sub-regional economic base through development frameworks, strategies and work plans.
- Fostering regional socio-economic development by the development of trans-border eco-tourism.
- Ecological viability is the chief generator of security for community level enterprises that stem from protected areas and channel benefits directly to local people.

Benefits that could arise from TFCA/TFP arrangements include the:

- Promotion of international co-operation, through a shared vision.
- Enhanced environmental protection at the ecosystem and landscape level.
- Facilitation of focused research.
- Possible generation of socio-economic benefits to local and national economies.
- Ensures cross-border control of potential threats.
- Creation of larger areas to maintain minimum viable populations of large ranging species.
- Facilitates more effective reintroduction programs by providing more space and opportunities.
- Joint control of invasive and damage causing species.
- Possible improvement of the ecotourism potential of the area.
- Combination and rationalization of personnel training, law enforcement and environmental education programs.
- Improved management of species of special concern.

To achieve the **best practice** would require the following important activities:

- Identification and promotion of a common vision and values.
- Involvement and creation of benefits for local peoples.
- Building and maintenance of local and national political support.
- Coordinated planning and development of the conservation area.
- Striving for funding sustainability.
- Learning through constant monitoring and evaluation of progress against targets.
- Effectively dealing with tensions and threats as quickly as possible.
- Promotion of coordinated activities through written agreements.

How to begin the process

This requires the following key steps:

- The fundamental first step is the need to identify a relevant conservation theme and compile a motivation.
- This is then followed by the joint development of a descriptive memoir, leading to a TFCA project plan.
- Then address all opportunities and constraints associated with the project. This can be addressed by exploring the values, political, social, technological economic, environmental and political attributes (referred to as V-STEEP) associated with the area and project.
- Outline the main organisational and funding requirements to be successful.

The key milestones that would be required towards the establishment of a transfrontier conservation area include:

- A demonstrated political will and full support by the relevant conservation agencies.
- A multi-laterally developed memorandum of understanding (MoU) between the countries.
- Delivery of a signed MoU.
- Development of an international treaty on the establishment of the TFCA and appointment of an independent coordinator team.
- Signing of the Treaty by the cooperating states, and implementation of a joint management board.
- An official launching ceremony.
- Implementation of accepted conservation and economic principles to develop a sustainable TFCA.

However, with all these cooperative relationships, they start small and progressively increase in complexity and involvement as:

1. **No cooperation:** The least desired state.
2. **Communication:** The initial stages required in sharing ideas and developing trust.
3. **Consultation:** Greater sharing of ideas.
4. **Collaboration:** Undertaking joint projects with a common goal and some sharing of resources.
5. **Coordinated planning:** Towards furthering effectiveness and use of resources.
6. **Full cooperation:** The ideal state of affairs.

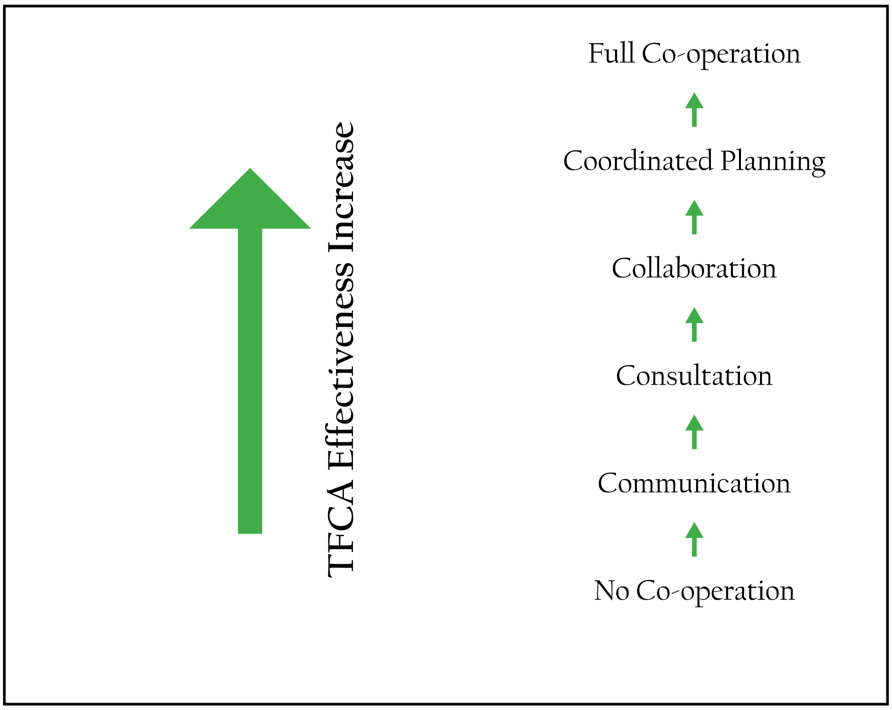
Some potential difficulties

Some common generic problems to emerge from the TFCA processes include:

- Conflicting or incompatible national legislation.
- Conflicting organisational policies.
- Religious, cultural, political and language barriers.

- Differing levels of competency, commitment and availability to resources.
- Technical incompatibilities such as in communication or GIS support systems, to name a few.
- Disparate stages of economic development between country partners which may place a different emphasis and importance on resource utilisation and resource protection.

These difficulties can only be overcome with the desire to achieve a common goal, supported by open discussion, debate and compromise.



Effectiveness of the TFCA improves with the progression as per the arrow.

Overall conclusions

- TFCAs and TFPs will only be successful if there are clear objectives for their establishment, a national willingness, with clearly defined benefit streams.
- The protection of biodiversity and the ecological patterns and processes defining it, must be the major outcome of the TFCA process.
- On the ground co-operation between conservation bodies and the generation of a flow of downstream benefits to surrounding communities are paramount to the TFCA's success.

Report on group discussions on Transfrontier PAs

Potential sites

The following potential areas for some TFCA type arrangement were identified:

Countries	Reserve/Park	Biological focus
Oman/Yemen	Hawf	Arabian leopard
Saudi Arabia/Yemen	Farasan Islands & mountains	Island-marine-mainland
Saudi Arabia/UAE/Oman	Umm al Zummoul	Arabian oryx
Jordan/Saudi Arabia	Hisma	Arabian oryx
Egypt/Saudi Arabia		Marine & coastal
Saudi Arabia/Bahrain/Qatar/ UAE		Dugong & marine complex

Three areas were chosen as offering potentially the most import sites (indicated in yellow), in addition to having quite different ecological focus areas. The areas were discussed in groups to establish, through consensus:

- The potential vision for the conservation area.
- Setting the context for the area.
- A list of vital attributes, with their determinants and constraints for each area.

This was aimed at establishing some preliminary debate and understanding around where a TFCA could be established, the rationale behind it, what its prime focus would be and who would be the key partners.

Group 1. (Dugong Conservation)

Qatar/Saudi Arabia/Bahrain/UAE

The focus of this potential TFCA was enhancing dugong conservation.

<u>Vision:</u>
To conserve the internationally important dugong population and its required habitats.

<u>Context (general picture of the areas current status and make up)</u>:

- Estimated dugong population about 3000 (Saudi Arabia – Qatar - Bahrain = << c. 500 animals; UAE-Qatar = 2500). But largely unsure of population status although a Nov 2006 survey was undertaken. Suspicion that the Saudi Arabia – Qatar – Bahrain dugong population may be declining and the UAE-Qatar population increasing.
- World's second largest population of dugongs. The UAE-Qatar population increasing – but needs be confirmed.
- • The Gulf of Bahrain under threat from existing bridge between Saudi Arabia & Bahrain. Another bridge is planned between Qatar and Bahrain which is expected to further exasperate the problem.
- Pollution a major problem in the marine area.
- Three separate marine PAs already exist in the areas.

Vital attributes	Determinants	Constraints
Second largest dugong population in the world	UAE-Qatar-Saudi Arabia marine area considered the most productive marine environment in the Gulf region. Prolific production of sea grass (4 species) (stable foods for dugong). Speculated that UAE/Qatar/ Saudi Arabia coastline largely sheltered from the main current transmitting pollution from Iraq to the main UAE area near Dubai. The UAE/Qatar/Saudi Arabia marine area has less fisheries activities. Communication channels open between these main states given that a Regional Organisation for the Protection of the Marine Environment (ROPME) already exists. In addition the UAE is acting as secretary for the Convention on Migratory Species (CMS) signed by South Asian, Arabian and African countries.	The Gulf of Bahrain has a considerably large fisheries industry Existing and planned bridges, as well as coastline development a major threat. The Gulf of Bahrain also exposed to pollution from major southward moving coastal current. Evidence that increasing salinity levels in the Gulf of Bahrain may be affecting sea grass production more than in the Qatar/UAE coastline. General industrial activities pose a threat given the proposed conservation area would need include the entire Qatar coastline.

<u>Comments:</u>

- Further the existing communication channels, especially the ROPME.
- Developing a CMS wildlife agreement would be relevant.
- Create a corridor between the northern and southern areas to allow free flow between regional dugong populations.
- Urgent need for a marine spatial planning study for the area.

Group 2. (Arabian leopard conservation)

Yemen – Oman

This potential TFCA would enhance Arabian leopard conservation.

Vision:
To conserve a representative and viable population of free-living Arabian leopard through a transfrontier arrangement

Context (general picture of the areas current status and make up):

- Leopard population suspected to move over the Yemen – Oman border.
- Mountainous habitat largely protected species.

Vital attributes	Determinants	Constraints
A protected area on the Yemen side exists with an existing leopard population. Documental information on leopards exists for the Oman side.	Existing institutional arrangements with Yemen PA in place as basis, although no PA on Oman side. Available prey base for leopards.	Communities in place. No PA on Oman side. Law enforcement lacking in Yemen PA.
Natural prey base of Nubian ibex exists in the transfrontier area.	Sufficient and diverse vegetation and habitats to support ibex population.	Hunting of ibex on Yemen side. Overgrazing by stock and habitat degradation threatening natural habitat and prey base. Fence close to ocean could contain some movement of ibex.
Mist/cloud forest habitat.	Monsoon conditions.	Climate change impacts. Grazing by livestock threatening grazing. Timber cutting & uncontrolled land use a threat
Single social (tribal) unit spanning border	Historical connections and intermarriage. Greater possibility for acceptance across border.	Artificial boundary.

Comments:

- Need to officially approach relevant conservation agencies to engage on possible transfrontier arrangement. Work towards a MoU.
- Need to undertake feasibility studies on:
  - Awareness programmes around leopard-ibex conservation
  - Exchange information – (Yemen's documentation and camera trapping info from Oman)
- Undertake joint surveys. A potential survey to be undertaken in Yemen. Possibly invite Omani representative to attend.

Group 3. (Arabian oryx conservation)

Saudi Arabia/Oman/UAE

This potential TFCA would be focused on enhancing the conservation of a viable population of Arabian oryx.

Vision:
To conserve a viable free-ranging population of Arabian oryx in harmony with socio-economic and cultural values through a cooperative transfriontier arrangement

Context (general picture of the areas current status and make up):

- UAE has a 10,000 km^2 fenced PA (Umm al Zummoul) focused on Araban oryx conservation.
- Oman has no adjacent protected area.
- Saudi Arabia has a designated no hunting zone as a precursor to population protection.

Vital attributes	Determinants	Constraints
Empty Quarter is within the historic habitat used by oryx.	Biodiversity and ecosystem able to support free-ranging oryx.	Double security fence along UAE border. Hunting on Oman side and illegal activity in Saudi Arabia given no active law enforcement in the designated no hunting area. Overgrazing by domestic stock and uncontrolled oryx in UAE PA. Threat of development & mining. Unsustainable use of natural resources in area. Droughts and climate changes would impact on a contained oryx population if restricted in this drought prone environment. Variation in PA management effectiveness between national conservation agencies. Given resource limitations (capacity and financial)
Shared cultural values for conservation between states.	Same historic back ground (same tribal affiliations).	Changing traditional practices of moving from camels to sheep and goats. International boundary and restricted movement compounding issue. Change in values between areas.
Flag-ship species already present	Endangered species provides a focal rallying point. Cultural value. Empty Quarter has huge international appeal	Change in values

Comments:

- Potential areas of concern need to be defined in the context of providing sufficient habitat (inclusive of drought years) to support a viable free-ranging oryx population.
- Need to officially approach the relevant conservation agencies to engage on possible transfrontier arrangement. Work towards a MoU.

Recommendations

- There is general consensus on the need for some transfrontier arrangements.
- Need to maintain this open dialogue between national conservation authorities and foster a continued willingness to further engage in these discussions.
- The discussions on TFCA type arrangements for the entire Arabian Peninsula are unique in that a regional approach is being taken as opposed to a case-by-case situation as elsewhere.
- It is considered best to focus any proposed TFCA around a prime conservation issue (one that catches all), such as the Arabian leopards, oryx and dugong conservation issues.
- These discussions are preliminary, but important in that potential partners are engaging with each other. Need now take the next step of more formal discussions. Important that the process does not stop here.

Theme 4

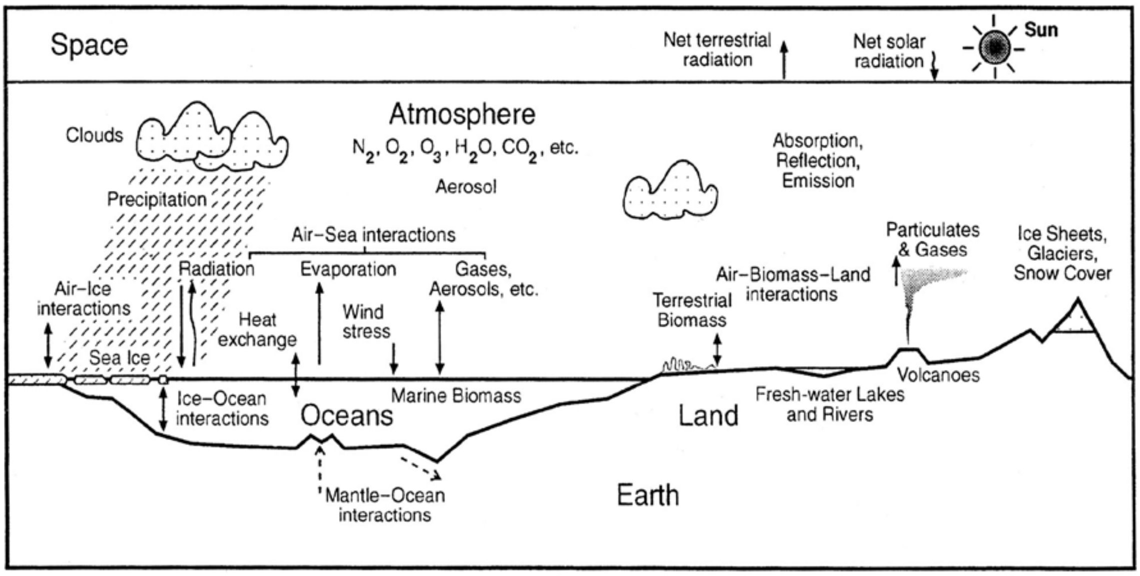
Global Climate Change: regional predictions, biological consequences, and implication for protected areas

Summary by

Philip Seddon & Yolanda van Heezik

The Greenhouse Effect

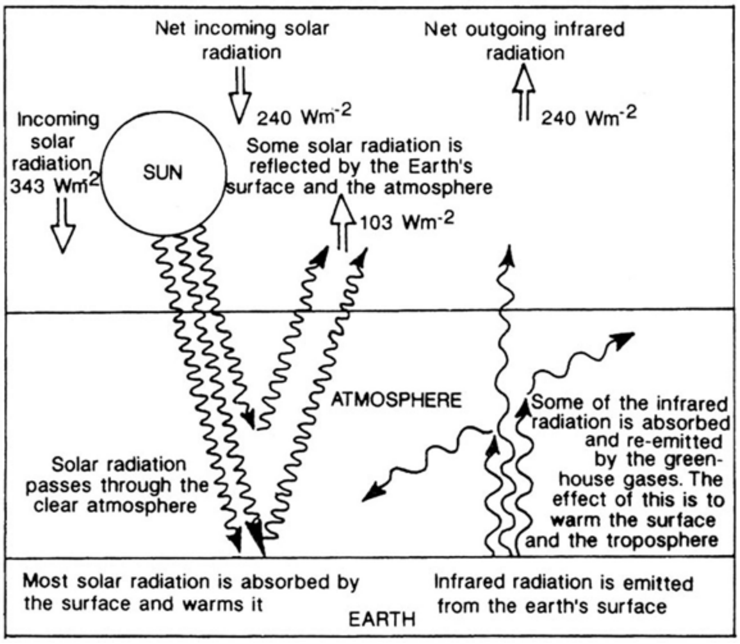
Solar radiation bombards the earth. Incoming radiation includes short wavelength ultraviolet radiation. A portion of this energy is reflected back into space by the atmosphere, but a large proportion penetrates the atmosphere to reach the earth's surface. This is largely absorbed, resulting in surface warming.



Generalised climate system to show the interaction between the principal components of the ocean-atmosphere systems (Pickering and Owen 1997)

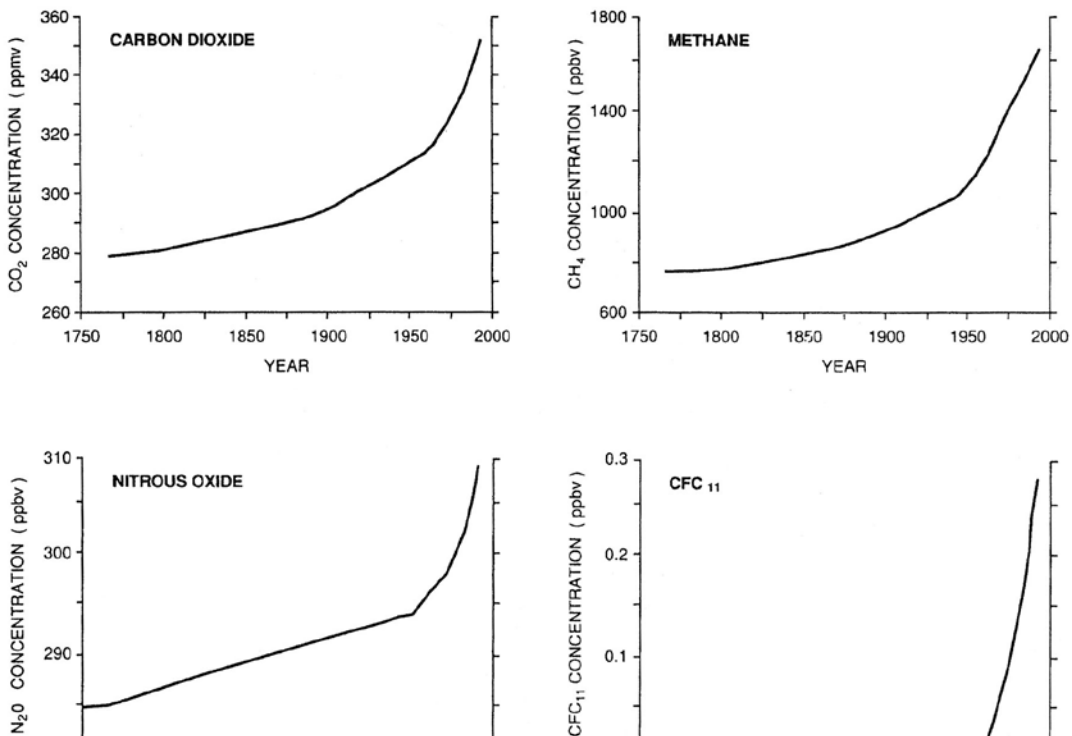
Much of the absorbed radiation is eventually re-radiated, but about 70% of this energy is in the form of longer wavelength infrared radiation. On its way out this radiation enters the atmosphere; some escapes to space but much of it is reflected back to earth, further warming the surface. The absorption of long wavelength radiation in the atmosphere is due to a number of so-called greenhouse gases.

The greenhouse gases are water vapour, carbon dioxide (CO_2), methane (CH_4), the chlorofluorocarbons (CFCs), ozone (O_3), nitrous oxide (N_2O) and about 15 others. The molecules of these gases absorb long wavelength energy radiated from the earth and reflect it back to the surface



Long-term radiative balance of the atmosphere

Water vapour is the principal greenhouse gas: the amount is determined by global climate and is virtually unaffected on a global scale by human activities. The other gases are referred to as greenhouse emissions: CO_2 is the single most important emission and accounts for about half the warming. Methane and CFCs are next most important in terms of amounts and warming, although both have a much greater capacity to absorb infrared radiation than CO_2.



Changes in the atmospheric concentrations of greenhouse gases

CO_2

In 1850 the concentration of CO_2 in the atmosphere was around 280 ppm. The Industrial Revolution massively accelerated the burning of fossil fuels and started a steady increase in atmospheric CO_2.

The present concentration of CO_2 is 350 ppm, and this is increasing at a rate of ~0.4% per annum. Fossil fuel burning releases ~6 billion tons of carbon as CO_2 per year, while burning and clearing of forests causes the carbon pool held in trees to be released.

Annually between 1 and 3 billion tons of carbon are transferred from trees to the atmosphere.

Methane

A molecule of methane has ~11 x more global warming potential than a CO_2 molecule, and rates of increase in methane are four times that of CO_2. Meaning that methane has the potential to become the principal greenhouse gas in the next 50 years.

Methane comes from a number of sources, both natural, e.g. bogs, wetlands, oceans, and anthropogenic, e.g. mining, rice paddies, landfills, sewerage treatment, animal wastes. Cows alone release 1,000 million tonnes of methane into the atmosphere annually.

Termites too are a surprisingly major methane producer – there are estimated to be 250,000 billion termites worldwide, inhabiting 2/3 of the land area and emitting 200 million tonnes of methane.

Climate Sensitivity

Estimates of the potential rates of temperature rise due to increasing CO_2 are derived from a class of models known as General Circulation Models. GCMs are far from perfect due to the complexity of the data and interactions they attempt to simulate. GCMs are currently unable, for example, to produce CO^2 scenarios to explain past climatic events. The standard experiment involves doubling the amount of CO_2 in the atmosphere, and estimating the temperature rise. This is an entirely realistic scenario given that it is estimated that CO_2 could reach double current levels sometime between 2025 and 2050. The present models estimate a 3.5-4.5^{o}C increase with doubled CO_2, compared with a natural variation over ~200 years of 0.5-1^{o}C.

Under a 4x CO_2 scenario, models indicate that changes would start to occur in deep ocean circulation, possibly resulting in increased anoxic conditions and marine extinctions.

Remember that such estimates are of the average global temperature – warming could be 2-3x higher than the global mean in the higher latitudes, and less than the mean near the equator.

Ocean Thermal Delay

The oceans are a heat buffer; it takes longer to warm the oceans than it does to warm the atmosphere, and this delay may mean that it takes 10-50 years before full warming takes effect. Because of this delay, regardless of future emissions, equilibrium calculations suggest we are committed to 0.5-1,7°C warming.

However, there remain many unknowns, For instance, today's trends are either reflection of low climatic sensitivity and a short ocean thermal delay, or high climatic sensitivity and a long thermal delay.

Uncertainty and controversy

The entire endeavour of predicting global responses to levels of atmospheric gases is fraught with uncertainty, including:

- Ignorance of the effects of sources and sinks for carbon;
- Future emission rates;
- The effect of warming due to greenhouse gases other than CO_2;
- The amount of CO_2 that is able to accumulate in the upper atmosphere;
- The extent of changes to ice sheets;
- The contribution of natural greenhouse effects due to non-anthropogenic sources.

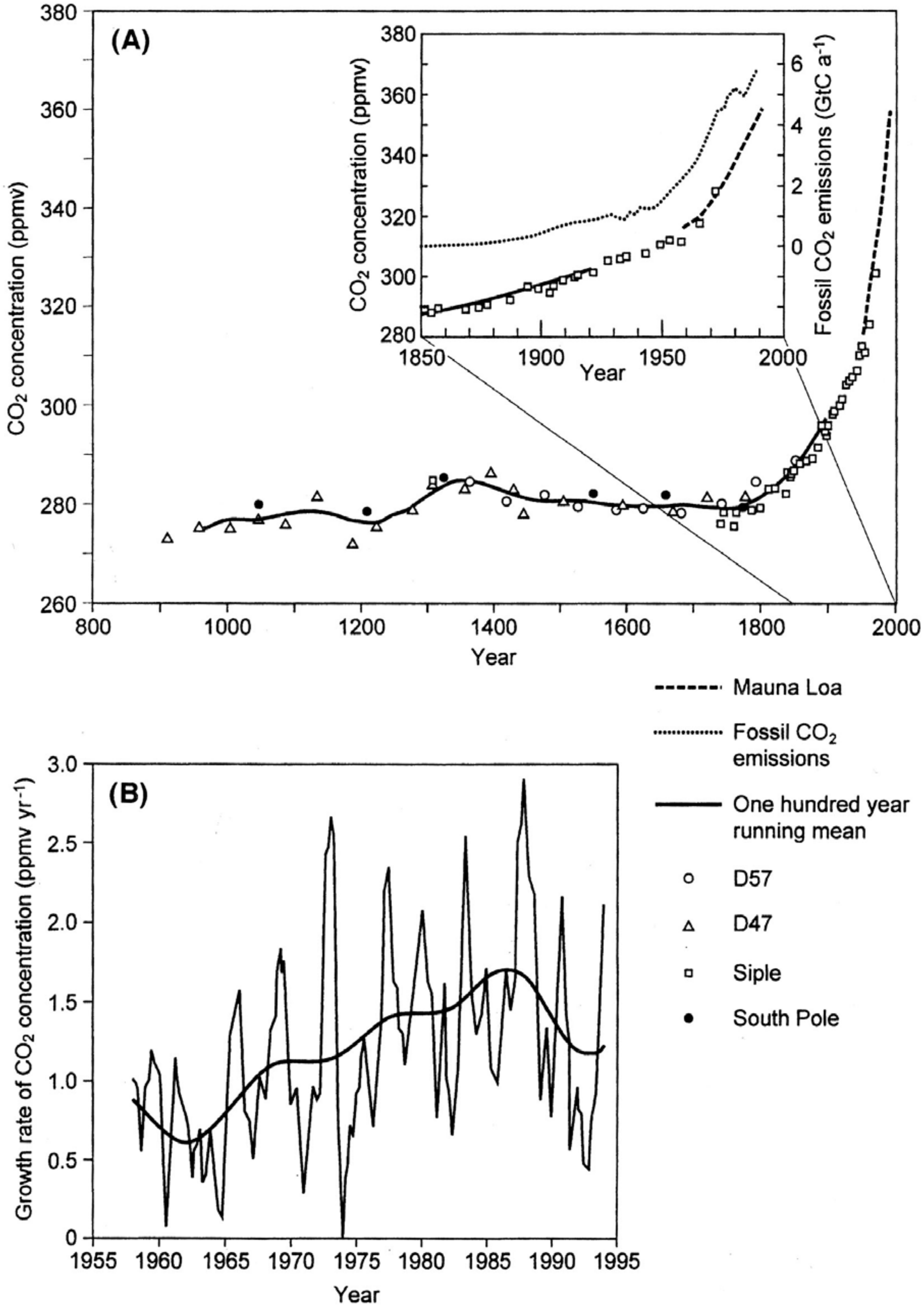
Gradually however, the models are being refined and the various predictions are starting to agree with each other and with observed and measured changes. There remains nevertheless, a small but sometimes vocal minority that deny that global warming is even happening.

The principal argument mounted against the existence of human induced global warming is that any trends we are seeing in average world temperature may be merely natural fluctuations, and that the world's climate has fluctuated many times in the past.

Today's Global Warming: The Evidence

Is CO_2 really increasing?

A long-term series of CO_2 concentration, from pre-industrial times to the present, has been based on analysis of air trapped in ice cores, and since the 1950s, from precise and accurate measurements of atmospheric concentration. The long-term rise in atmospheric CO_2 closely follows the increase in anthropogenic CO_2 emissions (figure below).



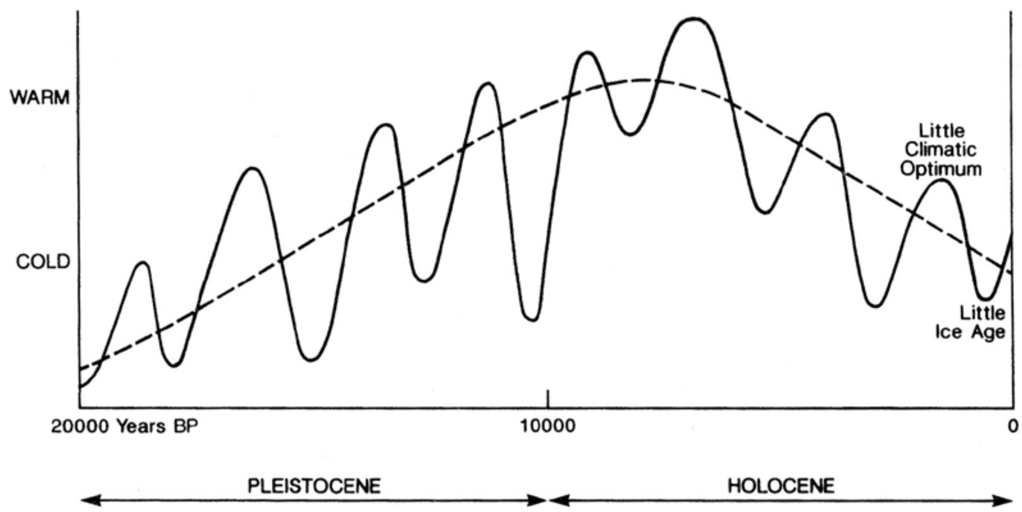
(A) CO_2 concentrations over the past 1,000 years from ice core records, and isnce 1958, from Mauna Loa, Hawaii, measurement site.

(B) Growth of CO_2 concentrations since 1958 at the Mauna Loa site.

Are global temperatures really increasing?

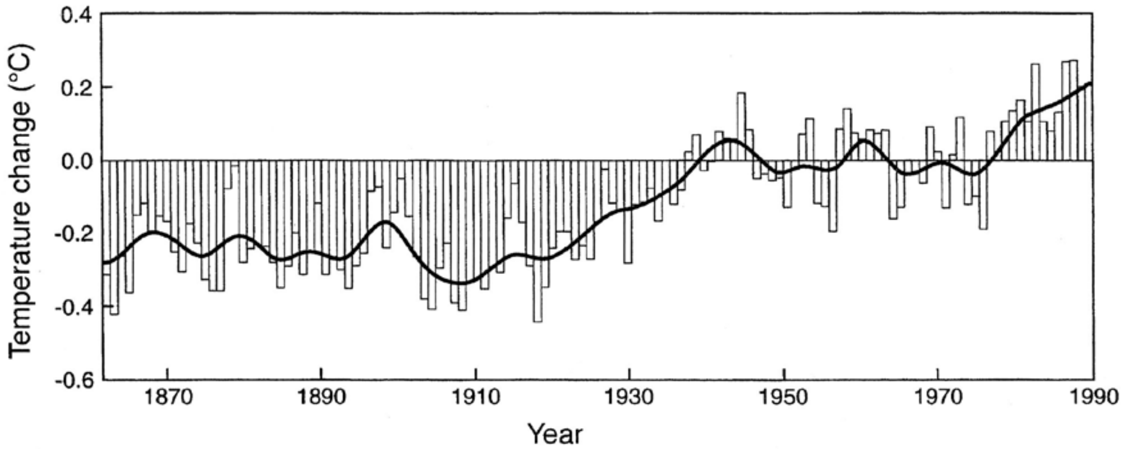
Prehistoric temperature fluctuation

The earth has experienced at least six major global ice ages throughout geological time. The most recent of these started some time between 2.5 and 1.6 million years ago, and extreme cold conditions extended up until about 10,000 years ago. The present Ice Age is referred to as the Quaternary period, during which global climate has fluctuated between glacial stages and relatively warm stages. The figure below shows the variation in relative temperature during the last 20,000 years. It is apparent from this that we are actually in an icehouse world, experiencing a warm interglacial period. Natural causes of global climate change include: tectonic and volcanic activity; sunspot activity; catastrophic events, such as large meteor impact.

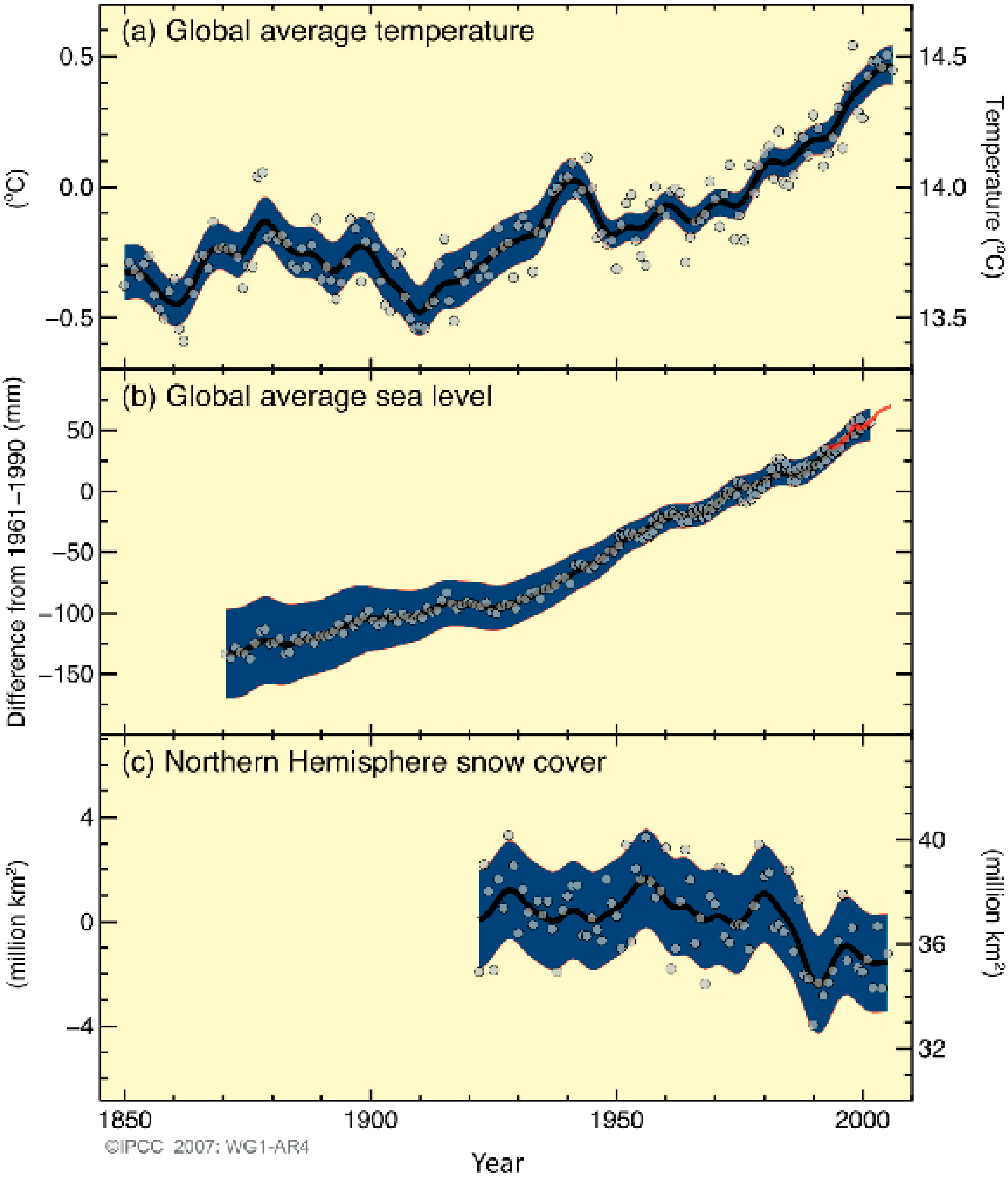


Historic global temperature change

Since the late 19th Century there has been an increase in mean global surface temperature of about 0.3-0.6°C (graph of change expressed as deviation from average of period 1961-90). Since the start of instrumental climate recording in 1860, recent years have been the warmest on record, despite the global cooling effect of events such as the Mount Pinatubo eruption. Nigh-time temperatures over land have increased more than daytime temperatures, and warming has been greatest over mid-latitude continents in winter and spring.



Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c)



The Predicted Global Physical Effects

Global Mean Temperature

It is estimated that global mean temperature will increase by 0.3°C per decade – a rate greater than that seen over the last 10,000 years. By 2100 the mean annual global surface temperature will have increased by 1-3.5°C.

Sea Level Rise

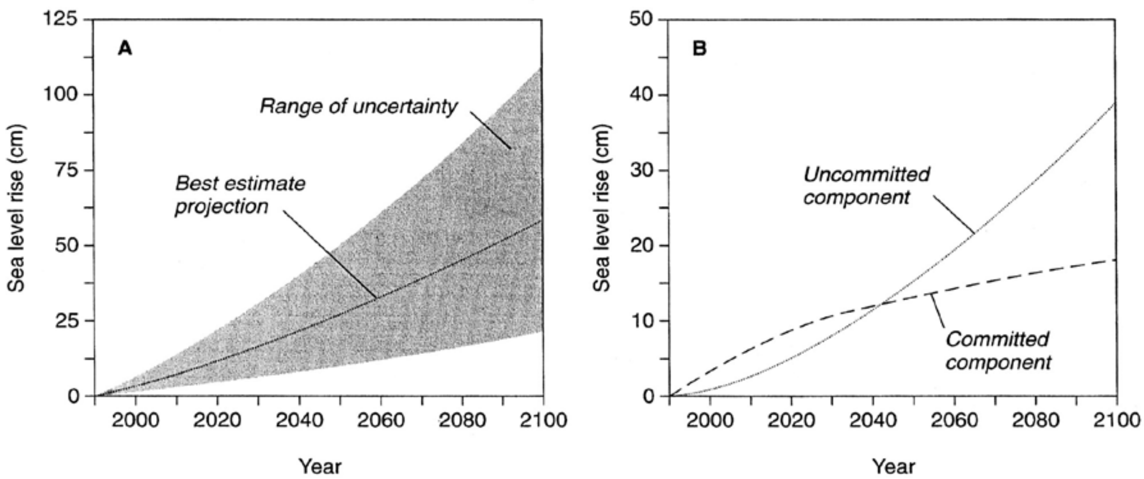
Global mean sea level is expected to rise by about 6cm per decade, mainly due to thermal expansion of the oceans, and the melting of some land ice. By 2100 the global mean sea level will have risen by 15-95 cm. Sea level rise will result in inundation of low lying areas, increased coastal erosion, and increased impact and frequency of storm surges.

Precipitation

Warmer means wetter, with an increase in evaporation. But rather than a simple direction change to being drier or wetter, there is expected to be a change in the distribution of precipitation. Rainfall will increase in the low and high latitudes, but will decrease at mid-latitudes. Run-off and aquifer recharge rates will decline in dry areas, and the frequency of droughts will force a major change in the distribution of agricultural areas.

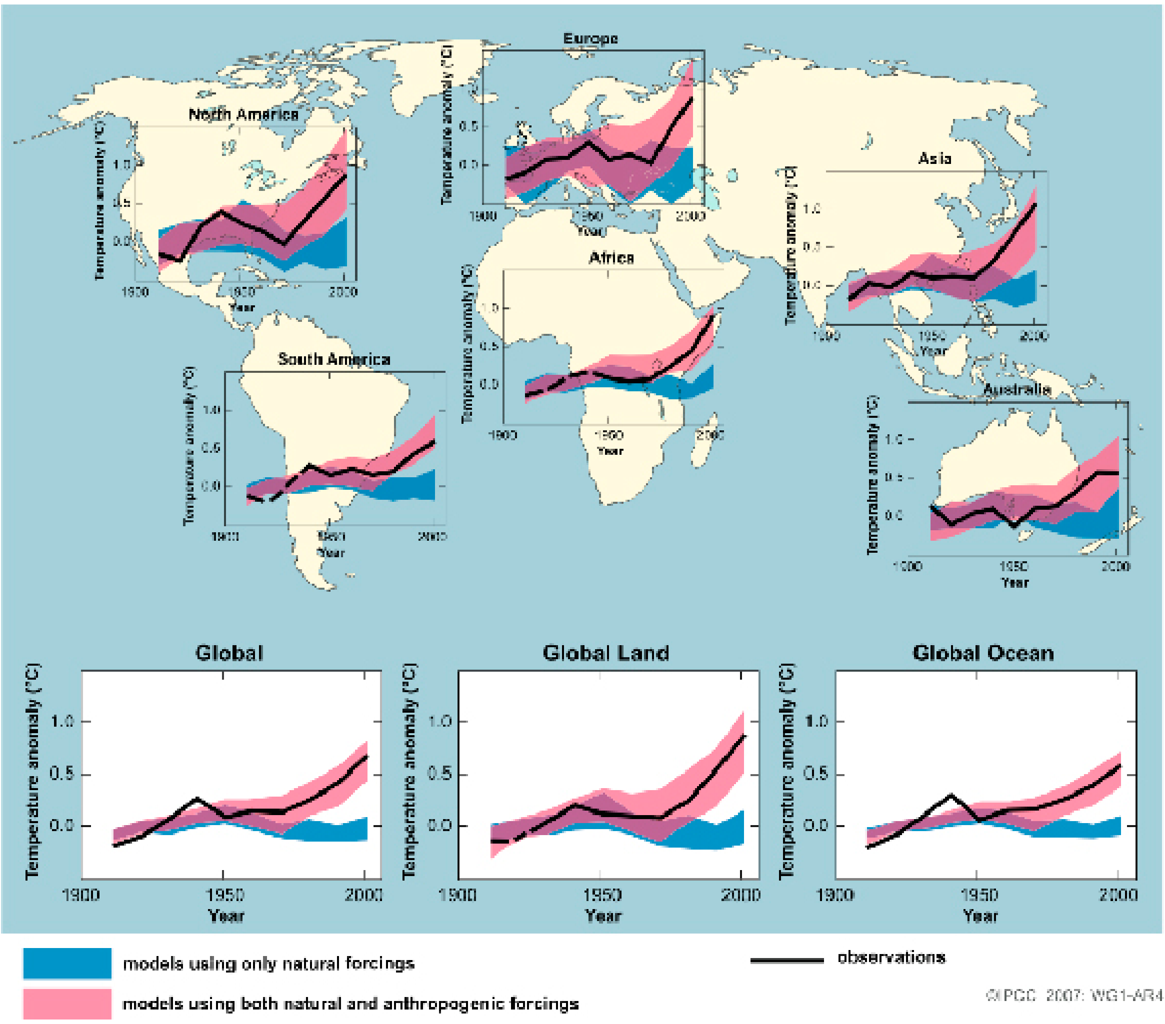
Weather Anomalies

There is predicted to be an increase in the frequency of extreme weather events, such as storms. This is because a warmer earth results in less vigorous ocean currents due to warming near the poles, and consequently a change in circulation patterns.

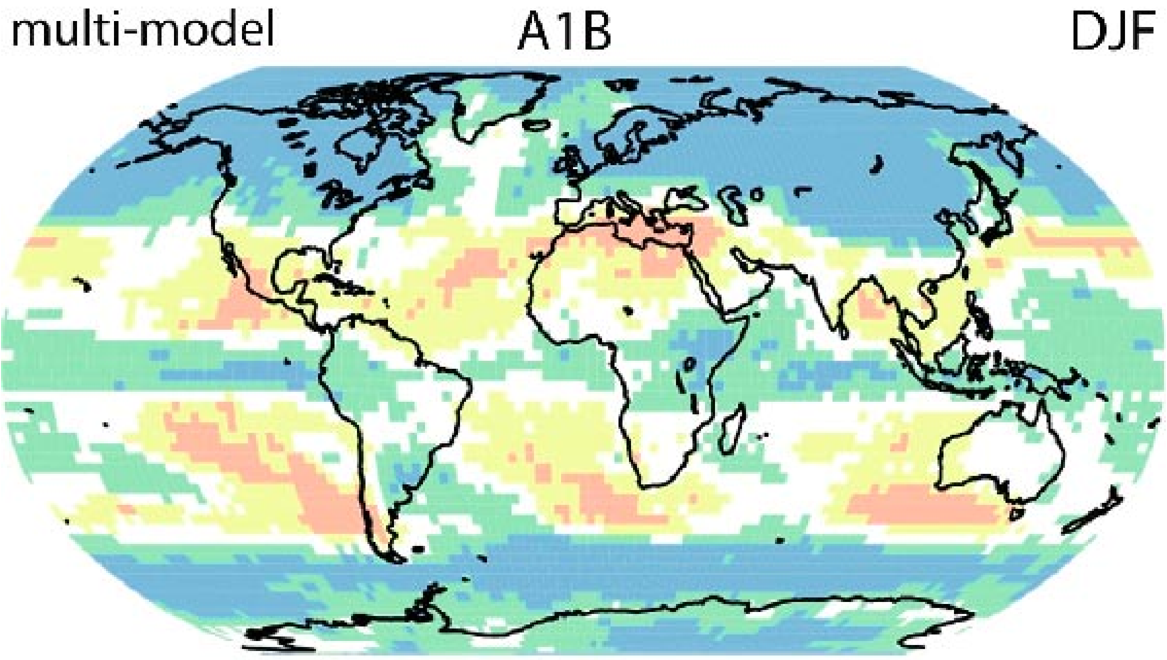


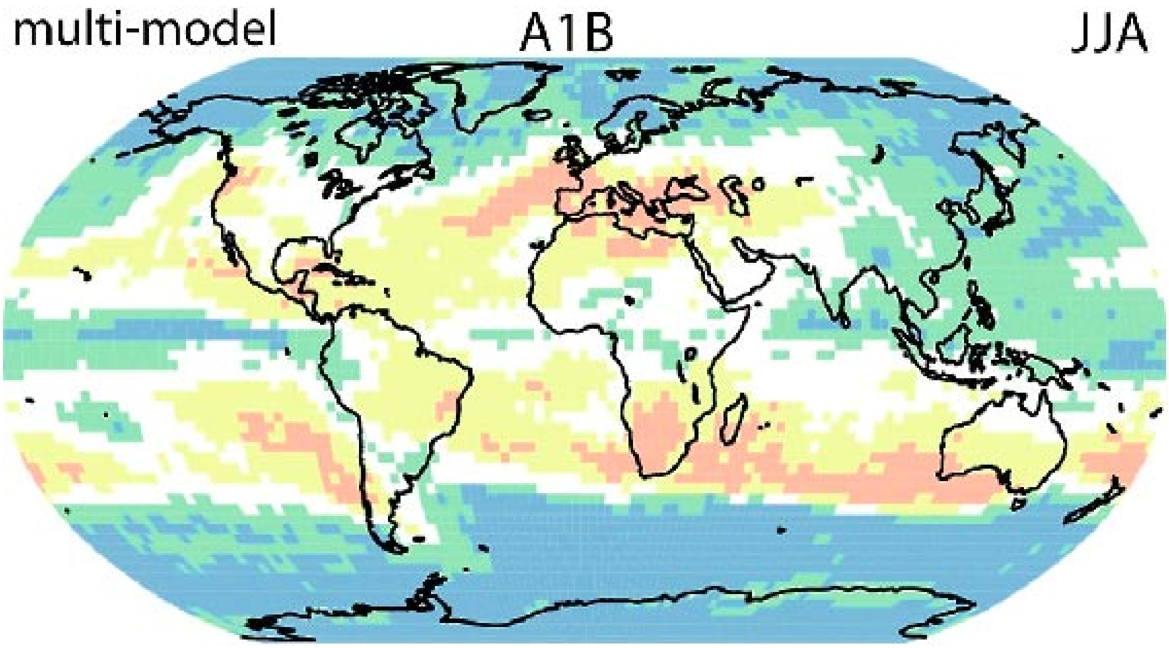
Intergovernmental Panel on Climate Change (PCC) predictions of sea level rise

Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906 to 2005 (black line) plotted against the centre of the decade and relative to the corresponding average for 1901–1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5–95% range for 19 simulations from five climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5–95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings.

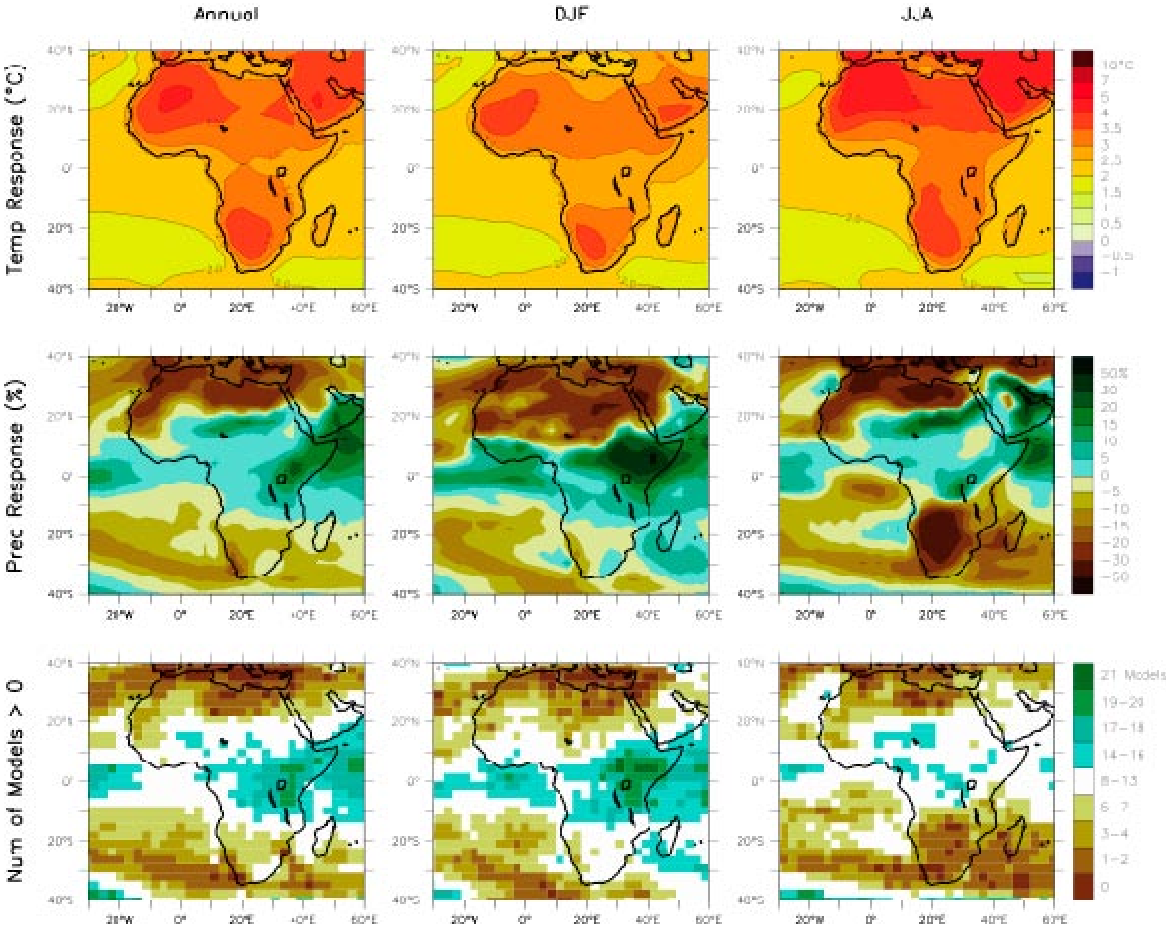


Blue and green areas on the map are by the end of the century projected to experience increases in precipitation, while areas in yellow and pink are projected to have decreases. The top panel shows projections for the period covering December, January and February, while the bottom panel shows projections for the period covering June, July and August.

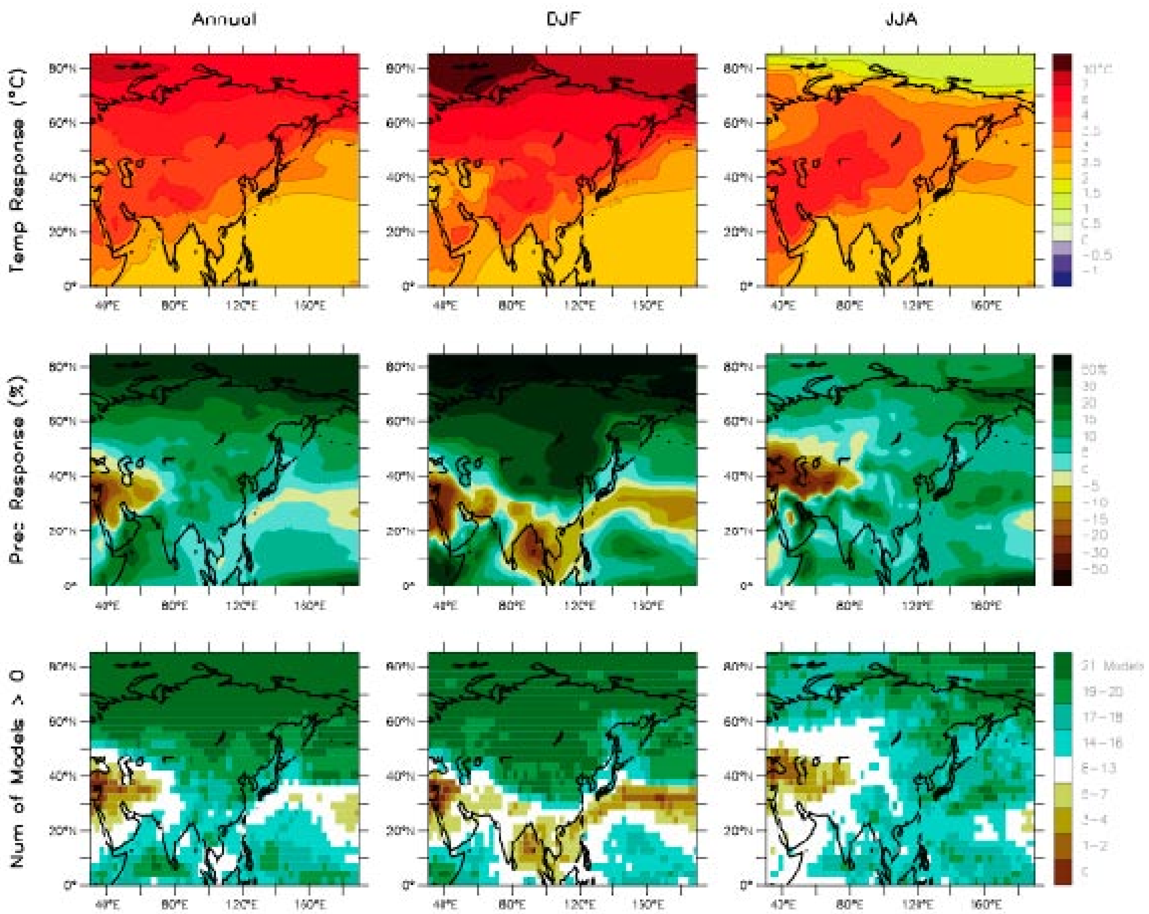




Temperature and precipitation changes over Africa from the MMD-A1B simulations. Top row: Annual mean, DJF and JJA temperature change between 1980 to 1999 and 2080 to 2099, averaged over 21 models. Middle row: same as top, but for fractional change in precipitation. Bottom row: number of models out of 21 that project increases in precipitation.



Temperature and precipitation changes over Asia from the MMD-A1B simulations. Top row: Annual mean, DJF and JJA temperature change between 1980 to 1999 and 2080 to 2099, averaged over 21 models. Middle row: same as top, but for fractional change in precipitation. Bottom row: number of models out of 21 that project increases in precipitation.



Impacts of global warming on species and communities

Over the last 100 years the Earth has warmed 0.3 – 0.6˚C. The challenge is to predict the effects of human-induced climate and atmospheric change on species and on communities.

Predictions fall into four broad categories:

1. Effects on physiology: i.e., metabolic and developmental rates in many animals, processes such as photosynthesis, respiration, growth and tissue composition in plants.
2. Effects on distributions: Species are expected to move upwards in elevation or pole-wards in latitude.
3. Effects on phenology: i.e., life cycle events triggered by environmental temperature cues - potential decoupling of phenological relationships between species.
4. Effects on competitive and other interactions between species.

Changes in plant physiology, productivity and growth

Photosynthesis and hence plant growth and productivity are affected by both temperature and CO_2 concentration. Elevated CO_2 levels stimulate growth. Tree ring records show that in both hemispheres increased growth rates have been occurring since the mid-19th century.

CO_2 enrichment and photosynthetic pathways

Plant species with different photosynthetic pathways may respond differently to climate change, and gain competitive advantages depending on local conditions.

1. C_3 photosynthesis: photosynthetic rates may be enhanced by increased CO2. Plants that respond to elevated CO2 levels produce tissue with lower nutrient concentrations. Herbivores must consume more tissue to acquire sufficient protein and other nutrients for growth and development, and may grow more slowly and suffer higher mortality.
2. C_4 photosynthesis: involves four carbon acids, and has been retained in a wide range of species including some crops. C_4 plants are much more effective than C_3 plants at reducing carbon dioxide concentrations around a leaf, which is advantageous within dense stands of vegetation in warm climates where carbon dioxide is considered limiting. C4 plants tend to found in warm or hot environments, such as prairies and savannahs.
3. Crassulacean acid metabolism (CAM) is another kind of photosynthesis. Water efficiency of CAM plants is higher than that of C4 plants, and twice as high as C_3 plants, consequently CAM photosynthesis is usually associated with plants that grow in hot dry habitats with unpredictable rainfall (succulents). CAM plants should be the best survivors in land areas that become drier.

Changes in species abundance and distribution

Organisms may respond to an environmental challenge by moving elsewhere, remaining where they are and risking extinction, or adapting to changes.

Plant migration and climate change

The difficulty of establishing new populations – dependent on propagule pressure and frequency. Repeated opportunity may be crucial to a species' ability to shift its range, but people have modified the landscape in ways that reduce such opportunities.

Human activities have profound effects: (1) they accelerate the migration of some species; (2) they cause fragmentation of habitats, and (3) they profoundly alter disturbance regimes. By carving up landscapes with roads, buildings and agricultural land, people reduce the availability of suitable habitat, reduce the number of populations in a metapopulation, and depress dispersal rates and rates of population growth, thus decreasing the probability of a successful migration.

Examples of distribution/abundance changes attributable to climate change

Climatic regimes influence species' distributions, often through species-specific physiological thresholds of temperature and precipitation tolerance. Recent research has documented many shifts in distribution of a wide range of taxonomic groups over many latitudes that can be explained most parsimoniously by a correlation with a recent climate change, especially when the shift has been either towards the poles or upwards in elevation.

Arctic, Antarctic and alpine plants

Distributions of the only two native vascular plants in Antarctica. Antarctic pearlwort and Antarctic hair grass, which are limited in their abundance by temperature and water supply, have shown dramatic increases in numbers at many locations between 1964 – 1990 as a result of greater seed germination and seedling survival. Over this period there have been a series of warm summers, and winter temperatures have also increased substantially.

There have been widespread increases in shrub abundance in the Arctic in the last 50y, mainly due to the growth and expansion of alder, but also to some extent willow and birch.

In mountains, climate changes more rapidly with elevation than it does with latitude, so rapid changes are expected in montane communities. Montane plants were surveyed on 26 mountain summits in the Swiss Alps and compared to historical records of their distributions. The relationship of species richness to elevation showed a pronounced shift to higher elevations over the past 40 to 90 years. For 9 species the rate of upward shift was 1 – 4 m per decade.

Flying insects

A survey of 35 non-migratory European butterfly species found that the ranges of 22 (63%) have shifted northwards by 35 – 240 km this century, with only two species (3%)

having shifted south. Two-thirds of the species showing extensions of their northern boundaries had southern boundaries that remained stable, thus effectively expanding their range.

In other arthropods recent range shifts have serious implications for human health: increases in mosquito-borne diseases have been reported in the highlands of Asia, Central Africa and Latin America. Malaria is a growing threat in some areas as is Dengue Fever in others. However, a rise in severe malaria cases in East Africa was not related to temperature and rainfall patterns, but could be better explained by economic, social and political factors.

Marine species

Changes in the distribution and abundance of several taxa off the coast of California have been documented over the last few decades. The surface waters of the California current warmed by 1.2 – 1.6°C between 1951 and 1993: this was accompanied by a 70% decline in zooplankton abundance, possibly because increased surface temperatures reduced the upwelling of cold nutrient-rich waters to the surface. One of the top predators of the system, the sooty shearwater, suffered a 90% decline in abundance off western North America between 1987 and 1994.

A 50% decline in the population of emperor penguins in Terre Adelie in the Antarctic over the last 50y, was attributed to decreased adult survival during the late 1970s, which correlated with an abnormally warm period of reduced sea ice extent. Abundance of krill, the prey of emperor penguins, is influenced by sea ice extent and sea surface temperatures.

Terrestrial vertebrates

In the UK breeding ranges of birds in 1968-72 were compared with ranges in 1988 – 1991. Of 59 species occupying southern Britain, the northern boundary of their ranges shifted an average of 19 km to the north. Birds confined to the north (42 spp) showed little change in the southern boundary of their ranges, showing that northern and southern boundaries are not equally sensitive to climate change.

Warming climate allows the northward expansion of the red fox *Vulpes vulpes*, which outcompetes the arctic fox *Alopex lagopus*.

None of the ecological studies reviewed here can demonstrate that climate change CAUSED the recent changes in species and communities described, however, there is a remarkable consistency on the types and magnitudes of changes observed across multiple studies.

Changes in life cycle timing (phenology): problems of synchrony

The life cycles of many organisms are strongly influenced by temperature and precipitation. Warmer conditions are generally expected to advance events such as flowering and fruiting in plants, and hasten development time in those species that respond to cues such as degree days.

Evidence for advancement of breeding in response to warmer springs

In the UK 74,258 records of breeding performance on 65 bird species collected from 1939 to the present were analysed over the 25 yr period 1971 – 1995. Laying in 20 spp (31%) was earlier by 8.8 days. Another analysis of 36 species of birds over 57 years in the UK found laying date was related to temperature or rainfall for 31 species (86%), and that 53% of species showed long-term trends in laying date over time, of which 37% can be accounted for by changes in climate.

North American squirrels have been show to be evolving in response to climate change. Squirrels in the Yukon in Canada give birth an average of 18 d earlier than they did 4 generations ago: 15% of this shift can be attributed to evolution as opposed to behavioural flexibility. Climate change has led to more food available earlier in spring, therefore early babies are more likely to survive, and because they have a head start and are more independent when winter comes and it's time to store food to survive the winter.

Breeding of amphibians in the UK is also starting earlier: 17 years of data on frogs and newts show that migration of breeding ponds and spawning dates has occurred two to 7 weeks earlier in recent years. In the USA 4 out of 6 amphibians near New York shifted their first calling date earlier by 10 – 14d, correlating with an increase in temperature during 6 months of the year. However, another analysis of the breeding phenology of 4 spp of American amphibians failed to find a consistent trend towards earlier breeding and any relationship between mean air temps and breeding.

Problems of synchrony

Case study: Great tits Parus major in the Netherlands (Visser et al., 1998)

In the Netherlands higher spring temperatures has resulted in an advance in vegetation phenology, which affects the time when arthropod populations start to increase in spring. For Great Tits, the abundance of arthropods at the time of maximum food requirements of their young is a crucial determinant of reproductive success. Therefore, timing of Great Tit nesting should advance as well. This study examined 23 years of data (1973-1995) on annual mean laying dates for first clutches, from a long-term study. Caterpillar peak abundance is well-predicted by temperature. Mean daily temperature increased over the 23 years, therefore, peak caterpillar mass advanced by 9 days.

Laying date did not advance over the years. Why not? Several hypotheses were presented.

The birds have responded to selective pressure to hatch eggs earlier by reducing the interval between the first egg and hatching, due to a reduction in the gap between clutch completion and incubation, with asynchronous hatching of chicks as a possible cost.

In the UK Great Tit population an advancement in laying date was found between 1970 and 1999, attributed to increasing spring temperatures (McCleery & Perrins 1998).

Migration

The timing of bird migration has also changed: In New York records of spring arrivals for 76 species of migratory birds date back to 1903. Over a 90 year period, 39 species arrived significantly earlier, 35 showed no changes, and only two species arrived later.

Decoupling: Adaptation to climate change in a long-distance migratory species (e.g., pied flycatcher *Ficedula hypoleuca*) is constrained by the timing of its migratory journey (Both & Visser 2001). Climate change may advance the phenology of the breeding areas of long-distance migrants, but the timing of the species' migration may be dependent on endogenous rhythms that are not affected by climate change. The pied flycatcher suffers from increased selection for earlier breeding which is hampered by the fact that its spring arrival date has not advanced. Some advancement in laying date has occurred because they normally arrive on their breeding grounds earlier than their average optimal laying date, enabling them to respond to naturally occurring variation in the start of spring. However, the window has become too narrow, so that a significant part of the population is now laying too late to exploit the peak in insect abundance optimally.

Plant-animal interactions, such as pollination and seed dispersal, depend on synchrony between species. Species depend on the appearance of food at critical times. In some systems species will respond to climate change at similar rates and maintain synchrony, whereas in other systems there may be a loss of synchrony.

To summarise

The following situations will become increasingly apparent in the relatively short-term:

1. the extension of species ranges pole-wards or to higher elevations by progressive establishment of new local populations.
2. The extinction of local populations along range boundaries at lower latitudes or lower elevations.
3. Increasing invasion by opportunistic, weedy and/or highly mobile species, especially into sites where local populations of existing species are declining.
4. Progressive decoupling of species interaction (eg., plants and pollinators) owing to mismatched phenology, especially where one partner is cued by daylight (which wont change) and the other partner is cued by temperature.

Community and ecosystem-level changes

Changes in vegetation structure and function can affect the physical properties of the land surface (eg, % of sunlight it reflects), and influence the exchange of CO_2 and other gases (nitrous oxide, methane) between the atmosphere and the biosphere. Thus plants can influence the % of incoming sunlight absorbed at the surface, or the atmospheric concentration of greenhouse gases, and thus the rate and magnitude of climate change.

At an ecosystem level, increased activity of northern vegetation has been detected in measurements of global CO_2 concentration. Seasonal growth of plants results in decreasing atmospheric CO_2 concentration in summer as photosynthetic activity removes CO_2, followed by increasing CO_2 in winter as plants respire and vegetation decays. Since the early 1960s the amplitude of this seasonal CO_2 cycle has increased by as much as 40%, suggesting increased activity of terrestrial vegetation over time.

Growing seasons are longer, resulting in changes in primary productivity: since the early 1980s spring in Europe has advanced by about 6 days and autumn has delayed by 4.8 days, resulting in a 10.8 day extension of the growing season.

Coral reefs are poised near their upper thermal limits, and have undergone mass bleaching when sea temps have exceeded a summer long-term average by more than 1 degree C for several weeks: e.g., in 1998 16% of the world's reef-building corals dies. There have been 6 periods of mass coral bleaching since 1979, and its incidence has increased in frequency and intensity.

Climate change and conservation

Climate responses need to be taken into consideration when:

1. making decisions about where to introduce species.
2. making sure that *in situ* conservation efforts are directed at appropriate sites.
3. recognising that relatively small changes in climate may have a large impact on species reproduction and survival.
4. monitoring invasive species from warmer climates and slow migrations to higher latitudes or elevations.
5. designing reserves and protected areas.

Climate change implications for Protected Areas

Protected Area networks can enhance natural resilience of species to climate change in 4 ways:

1. Identify and protect climate refugia
2. Conserve large-scale migration corridors
3. Maintain viable populations to enable adaptation
4. Reduce threatening processes at the landscape level

1) Identify and protect climate refugia

(refugia = places where favourable habitat persists or will develop as climate changes)
For example: temperate-zone, or even semi-arid plants and trees may persist only in high elevation areas.

2) Conserve large-scale migration corridors

Habitat fragmentation and degradation are significant barriers to species that need to move to new habitats and refugia.

Successful migration requires large-scale connectivity between source and destination.

Requires protection of extensive areas with native vegetation cover.

3) Maintain viable populations to enable adaptation

Replication of habitats in a reserve system is vital to protect multiple source populations, refugia and migration corridors.

Even without climate change, small isolated reserves lose species over time.

Reserve networks should cover diversity of habitats and encompass gradients of climate.

4) Reduce threatening processes at the landscape level

The weaker a system is from multiple threats, the greater the likely impact of additional stresses of climate change.

Precautionary approach requires prevention of land clearing and intensification of use, including areas adjacent to reserve boundaries

Conclusions

Ecologists and PA managers need to understand the rate at which species boundaries can change, and the factors limiting the rate at which geographic range shifts occur, in order to understand how species will respond to climate change. Species may not be immediately forced out of their ranges by climate change: instead inter-specific interactions with competitors and invasive exotic species moving north may be the mechanism of species loss.

Recommendations

- Threat Management must be coordinated across land management agencies
- There is a need for national policies on climate change that include Protected Area management
- Transboundary and Bioregional approaches will enable full physical variation of natural environments to be included in landscape planning
- There is a need for regional coordination of responses that include Transboundary Protected Area Systems Plans

APPENDIX 1

References and wider reading

Theme 1: Review of Current Protected Area Status

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APPENDIX 2

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APPENDIX 3

WWF

Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Methodology

(Adapted from: Ervin 2003)

BACKGROUND INFORMATION

1. BACKGROUND INFORMATION
    a. Name of protected area:
    b. Date established:
    c. Size of protected area:
    d. Name of respondent:
    e. Date survey completed:
    f. Annual budget:
    g. Specific management objectives:
    h. Critical protected area (PA) activities:

PRESSURES AND THREATS

2. PRESSURES AND THREATS

Pressure:
In the past 5 years this activity has:
- ❒ Increased sharply
- ❒ Increased slightly
- ❒ Remained constant
- ❒ Decreased slightly
- ❒ Decreased sharply

The overall severity of this pressure over the past 5 years has been:

Extent
- ❒ Throughout (>50%)
- ❒ Widespread (15-50%)
- ❒ Scattered (5-15%)
- ❒ Localized (<5%)

Impact
- ❒ Severe
- ❒ High
- ❒ Moderate
- ❒ Mild

Permanence
- ❒ Permanent (>100 years)
- ❒ Long term (20-100 years)
- ❒ Medium term (5-20 years)
- ❒ Short term (<5 years)

Threat:

The probability of the threat occurring is:

- ❒ Very high
- ❒ High
- ❒ Medium
- ❒ Low
- ❒ Very low

The overall severity of this pressure over the past 5 years has been:

Extent

- ❒ Throughout (>50%)
- ❒ Widespread (15-50%)
- ❒ Scattered (5-15%)
- ❒ Localized (<5%)

Impact

- ❒ Severe
- ❒ High
- ❒ Moderate
- ❒ Mild

Permanence

- ❒ Permanent (>100 years)
- ❒ Long term (20-100 years)
- ❒ Medium term (5-20 years)
- ❒ Short term (<5 years)

CONTEXT

3. BIOLOGICAL IMPORTANCE
   a. The PA contains a high number of rare, threatened, or endangered species
   b. The PA has high levels of biodiversity
   c. The PA has a high level of endemism
   d. The PA provides a critical landscape function
   e. The PA contains the full range of plant and animal diversity
   f. The PA contributes of the representativeness of the PA system
   g. The PA sustains minimum viable populations of key species
   h. The structural diversity of the PA is consistent with historic norms
   i. The PA includes ecosystems whose historic range has been diminished
   j. The PA maintains the full range of natural processes and disturbance regimes

4. SOCIO-ECONOMIC IMPORTANCE
   a. The PA is an important source of employment for local communities
   b. Local communities depend upon the PA resources or their subsistence
   c. The PA provides community development opportunities
   d. The PA has religious or spiritual significance
   e. The PA has unusual features of aesthetic importance
   f. The PA contains plant species of high social, cultural, or economic importance
   g. The PA contains animals species of high social, cultural, or economic importance
   h. The PA has high recreational value
   i. The PA contributes ecosystem services and benefits to communities
   j. The PA has a high educational and/or scientific value

5. VULNERABILITY
   a. Illegal activities within the PA are difficult to monitor
   b. Law enforcement is low in the region
   c. Bribery and corruption is common throughout the region
   d. The area is experiencing civil unrest and/or political instability
   e. Cultural practices, beliefs and traditional uses conflict with the PA objectives
   f. The market value of the PA resources is high
   g. The area is easily accessible for illegal activities
   h. The is strong demand for vulnerable PA resources
   i. The PA manager is under pressure to unduly exploit the PA resources
   j. Recruitment and retention of employees is difficult

PLANNING

6. OBJECTIVES
   a. PA objectives provide for the protection and maintenance of biodiversity
   b. Specific biodiversity-related objectives are clearly stated in the management plan
   c. Management policies and plans are consistent with the PA objectives
   d. A employees and administrators understand the PA objectives and policies
   e. Local communities support the overall objectives of the PA

7. LEGAL SECURITY
   a. The PA has long-term legally binding protection
   b. There are no unsettled disputes regarding land tenure or use rights
   c. Boundary demarcation is adequate to meet the PA objectives
   d. Staff and financial resources are adequate to conduct law enforcement activities
   e. Conflicts with the local community are resolved fairly and effectively

8. SITE DESIGN AND PLANNING
   a. The siting of the PA is consistent with the PA objectives
   b. The layout and configuration of the PA optimism an conservation of biodiversity
   c. The PA zoning system is adequate to achieve the PA objectives
   d. The land use in the surrounding area enables effective PA management
   e. The PAs linked to another area of conserved of protected land

INPUTS

9. STAFFING
   a. The level of staffing is sufficient to manage the area
   b. Staff have adequate skills to conduct management activities
   c. Training and development opportunities are appropriate to the needs of the staff
   d. Staff performance and progress on targets are periodically reviewed
   e. Staff employment conditions are sufficient to retain high-quality staff

10. COMMUNICATION AND INFORMATION
   a. There are adequate means of communication between field and office staff
   b. Existing ecological and socio-economic data are adequate for management planning
   c. There are adequate means of collecting new data

d. There are adequate systems for processing and analysing data
e. There is effective communication with local communities

11. INFRASTRUCTURE
   a. Transportation infrastructure is adequate to perform critical management activities
   b. Field equipment is adequate to perform critical management activities
   c. Staff facilities re adequate to perform critical management activities
   d. Maintenance and care of equipment is adequate to ensure long-term use
   e. Visitor facilities are appropriate to the level of visitor use

12. FINANCES
   a. Funding in the past 5 years has been adequate to conduct management activities
   b. Funding for the next 5 years is adequate to conduct management activities
   c. Financial man agreement practices enable efficient and effective PA management
   d. The allocation of expenditures is appropriate to PA priorities and objectives
   e. The long-term financial outlook for the PA is stable

PROCESSES

13. MANAGEMENT PLANNING
   a. There is a comprehensive, relatively recent written management plan
   b. There is a comprehensive inventory of natural and cultural resources
   c. There is an analysis of, and strategy for addressing, PA threats and pressures
   d. A detailed work plan identifies specific targets for achieving management objectives
   e. The results of research and monitoring are incorporated into planning

14. MANAGEMENT DECISION MAKING
   a. There is clear internal organization
   b. Management decision making is transparent
   c. PA staff regularly collaborate with partners, local communities, and other organizations
   d. Local communities participate in decisions that affect them
   e. There is effective communication between all level of PA staff and administration

15. RESEARCH, EVALUATION AND MONITORING
   a. The impact of legal and illegal uses of the PA are accurately monitored and recorded
   b. Research on key ecological issues is consistent with the needs of the PA
   c. Research on key social issues is consistent with the needs of the PA
   d. PA staff members have regular access to recent scientific research and advice
   e. Critical research and monitoring needs are identified and prioritised