EXECUTIVE SUMMARY

The Great Barrier Reef World Heritage Area (World Heritage Area) is of international importance to seabirds and shorebirds, providing breeding and roosting habitat, feeding grounds and migratory pathways to at least 23 seabird species and 32 shorebird species. Large populations of these species on the Reef are monitored under the Great Barrier Reef Coastal Bird Monitoring Strategy. The surveys are largely coordinated and developed through the Great Barrier Reef Day-to-Day Management Programme (DDM) and the data are collated into the Coastal Bird Atlas (the Atlas). The Atlas is managed by the Queensland Environmental Protection Agency (Queensland EPA) and currently contains over 60,000 records. It is considered to be a highly valuable long term dataset that will help to determine the long term spatial and temporal patterns of seabirds (and to some extent shorebirds). The Atlas also contains some records of birds from other parts of Queensland.

To date, analyses have been conducted on Atlas data of some key breeding sites of the Great Barrier Reef (Michaelmas Cay, Heron Island, the Swain reefs and Raine Island), which have revealed significant declines in populations of some of the most common seabird species (Turner et al. 2006). Wider analysis of the Atlas and other related databases is required to determine whether this trend extends throughout the World Heritage Area. In addition, seabirds have been identified as a highly vulnerable species group under a changing climate (Congdon et al. 2007).

The Australian Government, through the Great Barrier Reef Marine Park Authority (GBRMPA), is implementing the *Great Barrier Reef Climate Change Action Plan 2007-2012*. This plan aims to target science to inform current management knowledge gaps, build resilience of the Reef ecosystem, identify adaptation strategies for industries and communities, and mitigate climate footprints. As part of the Action Plan, the 'Seabird and Shorebirds in the Great Barrier Reef World Heritage Area' project has been established to determine the temporal and spatial patterns of the observed bird declines and to define the knowledge gaps and information required to guide appropriate management strategies to improve seabird and shorebird resilience in a changing climate.

A workshop was held on 15 July 2008 and was organised by the GBRMPA and supported by the Queensland EPA. It was attended by members of the GBRMPA, the Queensland EPA, and academics, consultants and community groups in the World Heritage Area and Queensland with a history of interest in coastal birds.

The workshop had one overarching question: How can analysis of the Coastal Bird Atlas guide the management of seabirds and shorebirds in the Great Barrier Reef World Heritage Area in a changing climate? The primary objectives of the workshop was to determine the analysis possibilities of the Atlas database and other related datasets and to establish key data analysis questions to forecast estimated impacts of climate change on seabird and shorebird species and habitat areas.

The workshop was not an analysis of the current status of seabirds and other birds within the World Heritage Area, or a prediction of the future of seabirds in a changing climate. That information is already publicly available on the GBRMPA website (Turner et al 2006 and

Congdon et al 2007). This workshop was to look at what data within the Atlas could build on our current knowledge.

Workshop participants were allocated to three discussion groups:
1) Seabird island habitat (nesting and roosting);
2) Seabird foraging grounds and dispersal patterns; and
3) Shorebirds roosting and feeding habitats.

Each of the three groups discussed the viability of the Atlas and other datasets in addressing four key management themes:
1) What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?
2) What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?
3) What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?
4) What are the critical research and monitoring priorities that will address management needs in the face of climate change, to conserve bird populations in the Great Barrier Reef World Heritage Area?

The results of these discussions included a list of questions addressing each theme, an assessment of the viability of the Atlas in answering the question and a list of additional datasets that could be linked the Atlas to answer a wider range of questions. The Atlas was considered adequate to answer a large range of questions, and, with the help of additional datasets, it is likely that the analysis of the Atlas will be able to detect whether seabird declines are occurring throughout the Great Barrier Reef World Heritage Area. The questions listed during this workshop will inform the development of the brief for the Atlas analyses.

Specific recommendations arising from this project include:

- The brief for the analysis of the Atlas can be divided into three sections:
    1. Seabird island habitat – nesting and roosting
    2. Seabird foraging and dispersal patterns
    3. Shorebird roosting and feeding habitats

- The four key management themes can be further adapted to each section, and used to guide analysis and interpretation.

- The GBRMPA could seek to establish links to the custodians of the other datasets identified in this workshop, so that they can be made available to the personnel conducting the analyses. The centralisation of this task will avoid lengthy procedures and circumvent potential reluctance to share data.

- Once data analysis begins, there should be a collaborative process between the GBRMPA and those analysing the data, as the extent of opportunities and limitations in the data become more evident. There should be enough flexibility in the terms of reference to allow changes, additions or deletions to the original questions guiding the analyses.

- A reporting mechanism should be established whereby consistent data analysis occurs on a regular basis. For this to occur, the initial analysis and interpretation of the Atlas should be presented in a simple and repeatable format.

- The identification of further priorities for future research should be encouraged throughout the initial analysis of the Atlas.

Emerging research using the Atlas has shown that seabird populations can respond to precursors of major climatic events. Giving priority to analyses and further research that can further reveal the predictive potential of seabird trends will provide a valuable tool in the quest to understand and mitigate the effects of climate change.

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BACKGROUND

The Great Barrier Reef (the Reef) is of international importance to seabirds, providing breeding and roosting habitat, feeding grounds and migratory pathways to at least 23 seabird species and 32 shorebird species (Hulsman et al. 1996). It is estimated that between 1.3 and 1.7 million birds breed on the Reef's islands and cays, comprising over 25 percent of Australia's breeding seabird populations, and approximately 50 percent of the global population for some species.

Most land birds, shorebirds and seabirds using or overflying the Great Barrier Reef World Heritage Area (World Heritage Area) are protected under various pieces of legislation including the *Environment Protection and Biodiversity Conservation* (*EPBC*) *Act 1999*, the *Queensland Nature Conservation Act 1992*, the *Great Barrier Reef Marine Park Act 1975*. In addition a number of national strategies and international agreements, treaties and conventions have been developed to protect migratory species and key habitats.

A coastal bird atlas was developed to collate and record information about seabirds, shorebirds and other birds dependant on the coast and islands of Queensland. The Atlas was formalised and coordinated for many years by Paul O'Neill of the Queensland Environmental Protection Agency (Queensland EPA) as part of the Great Barrier Reef Day-to-Day Management Programme (DDM). He developed the data sheets and recording rules (O'Neill and White 2001).

Coastal bird populations vary between sites and years depending on migration patterns, environmental conditions and the general condition of the populations themselves. This variability means that intensive long-term monitoring is required to identify changes in the populations. This has led to the development of the Coastal Bird Monitoring Strategy (Turner 2002). The strategy is implemented by the DDM Programme for the World Heritage Area and the data is collated into the Coastal Bird Atlas (the Atlas). The Atlas is managed by the Queensland EPA and currently contains over 60 000 records.

Detailed information exists only for some sites on the Reef. Recent analyses at key sites (Michaelmas Cay, Heron Island, the Swain reefs and Raine Island) have revealed significant declines in populations of some of the most common seabird species (eg: Batianoff and Cornelius 2005, Dyer et al 2005, Congdon et al. 2007) which raises concerns regarding the threatening processes acting on these populations. This indicates the need for a wider analysis to determine whether this trend extends throughout the World Heritage Area and further into the Coral Sea and southern Queensland. Further important information on the status and trends of seabird populations on the Reef are summarised in the State of the Reef Report (Turner et al. 2006). A bio-geographical analysis of Queensland seabird populations was conducted with some of the Atlas data by Hulsman (Hulsman 1997). The recent seabird chapter in the 'Climate Change and the Great Barrier Reef: A Vulnerability Assessment' suggests seabirds are highly vulnerable under a changing climate (Congdon et al. 2007).

All three documents were sent to workshop participants prior to the workshop as background reading so the workshop could concentrate on the question of how the Atlas data could be analysed. In particular, the aim was to determine the possibilities for analysis of the Atlas database and other related datasets and to establish key data analysis questions to forecast estimated impacts of climate change on seabird and shorebird species and habitat areas.

The Australian Government, through the Great Barrier Reef Marine Park Authority (GBRMPA), is currently implementing the *Great Barrier Reef Climate Change Action Plan.* This Action Plan outlines a coordinated response to the threat of climate change for the Great Barrier Reef. As part of the Action Plan, the potential impacts of climate change on seabirds and shorebirds are being examined.

This workshop was convened to discuss the current status of coastal birds in the World Heritage Area and their vulnerability to the impacts of climate change. In particular, the aim was to determine the possibilities for analysis of the Coastal Bird Atlas database and other related datasets and to establish key data analysis questions to forecast estimated impacts of climate change on seabird and shorebird species and habitat areas.

COASTAL BIRD ATLAS AND COASTAL BIRD MONITORING STRATEGY

Kees Hulsman, John Olds and Noleen Kunst outlined the early development, more recent history and functioning of the Coastal Bird Atlas.

Kees Hulsman outlined the origins of the database, including an overview of the people involved and the evolution of its structure between 1985 and 1997. The dataset originated when the late Terry Walker (MAFRI/DoE) initiated the compilation of a database on Queensland seabirds, collating census data from the existing literature and meticulously cross-checking the reliability of the records. He and Brian King (Queensland Parks and Wildlife) independently collected census and breeding data of Coral Sea and Great Barrier Reef islands and cays, and Brian King compiled biogeographic information which identified concentrations of species and colonies at the northern and southern ends of the Great Barrier Reef (King 1993, Hulsman et al. 1996). After Terry Walker's death in 1992, Kees Hulsman (Griffith University) converted the database from its original format (FoxPro) to Microsoft Access (for its compatibility with Arc GIS software), redesigned the proforma and removed the terrestrial bird and shorebird information (the location of which is currently unknown). The reliability of the southern data still requires checking, as there is evidence to suggest that occupancy rates of nests may have been overestimated, leading to population overestimates (e.g. wedge-tailed shearwaters).

Terry Walker's data was central to the structure of the database and additional fields were added subsequently. The addition of a 'comments' field allowed further fields to be included when information was collected and included consistently. GBRMPA site and island codes were used to ensure consistency and compatibility, and site information was enhanced by Hopley's Great Barrier Reef database and Royal Australian Navy maps. Essentially, the database was designed to answer the following questions:

- What is the spatial and temporal distribution and abundance of seabird species and colonies at different spatial scales such as local, regional and national?
- What are the preferences for geographic location latitudinally along the Great Barrier Reef or longitudinally across the continental shelf?
- What are the preferences for island type?
- Over what time-scale does spatial distribution of colonies change?
- What are the trends in population size at local, regional and national scales for some species?
- What is the relative importance of breeding colonies of each species at different spatial scales, including national and international levels?
- Is it possible to identify potential source and sink populations of each species?
- What are the source populations?
- What are the sink populations?
- What are the threats to viability of seabird colonies?

Problems still inherent in the database were the lack of consistency in census effort and methods, the variability in the training levels of census personnel, the lack of consistent inclusion of habitat data, and its lack of compatibility with some other important databases (e.g. the Birds Australia Bird Atlas), the lack of data on disturbance and mortality, and the lack of a formalised definition of the word 'coastal' (John Olds, pers. comm.).

A workshop in 1999 standardised data collection into estimates of breeding effort (as opposed to breeding success). A Coastal Bird Monitoring Strategy was developed following the workshop to guide the minimum priorities for data collection. Since 1991 most data in the

Coastal Bird Atlas has been collected by Queensland Parks and Wildlife Staff in the Day to Day Management Program after training filling in the standard data sheets, and with the guidance of the Monitoring Strategy.

Since 2001, archival records from a number of observers have been standardised and entered into the Coastal Bird Atlas in its current format, allowing the growth of the database from 9 000 in 1991 to approximately 60 000 records. While the Coastal Bird Atlas can be analysed to yield breeding effort and adult numbers, throughout the Great Barrier Reef, the most consistent dataset in the Coastal Bird Atlas is from Michaelmas Cay. Some data from Southeast Queensland, the Gulf of Carpentaria and the Coral Sea are in the database.

Little analysis of the database has occurred but some data has been examined from four locations in some detail by QPWS staff and university researchers. They indicate declines in seabirds at Raine Island, Michalmas Cay, the Swains Reefs and the Capricorn Bunker Group (Turner et al 2006).

Important information is also collected and contributed by independent research projects, volunteer and community groups (e.g. Birds Australia and the Australasian and Queensland Wader Studies Groups). Comprehensive information allowing detailed analysis and conceptual modeling is only available for a limited number of species and colonies. Recently, the seabird data in the Coastal Bird Atlas was loaded into the EPA's wetlands information page (EPA 2007), which makes it directly available to the EPA. Additionally, the Coastal Bird Atlas was recently used to inform a number of issues under the Queensland EPA State Coastal Planning Policy.

The data in the Coastal Bird Atlas is primarily from the World Heritage Area, with some additional data from the Coral Sea and southern Queensland. Some shorebird data is included, but the expectation that the Shorebird Studies Groups were collecting the important shorebird data led the Coastal Bird Atlas to focus on seabirds. Much of the data was collected through annual or opportunistic surveys that varied in their timing relative to peak breeding times.

Noleen Kunst spoke of the new online system being developed – Wetland Information Capture (WIC) - which allows submission and editing of wetland data. Some of the wetland attributes contained in the system include information on disturbance, flora and fauna, water quality, etc. The proforma can be used offline and uploaded once a connection is possible. Users must have membership, and a screening and validation process is in place for the data. External and internal experts are invited to check the data, and wildlife organisations will be approached for collaboration. The Coastal Bird Atlas proforma needs to be updated from its original version and used in hard copy by recorders of data. Phase 2 of WIC is expected to be finalised in September 2008, by which time a usable form will be ready. A new GIS interface – Wetland Maps – will add to the WIC.

CURRENT STATUS OF SEABIRD RESEARCH

Brad Congdon outlined the results of current research undertaken using the Michaelmas Cay data from the Coastal Bird Atlas. This dataset, comprising monthly counts of all species in five breeding stages, was used to examine the impacts of a range of environmental and anthropogenic parameters (primarily of different climate patterns) on seabird breeding participation. The results of short-term studies examining the potential influence of these same environmental parameters on seabird food availability and chick growth were also presented.

Evidence shows that climate variability affects seabirds at two temporal scales: within seasons (manifesting as day-to-day sea surface temperature (SST) variation) and between seasons (more specifically associated with El Niño events). Food availability of particular species decreases with increasing SST, regardless of prevailing El Niño conditions: above a certain temperature, chick growth ceases (Erwin and Congdon 2007). Additionally, El Niño years are generally associated with decreased food availability relative to 'normal' years. This research found that the intensity of an El Niño year could be predicted from breeding participation of certain species in the preceding breeding season, suggesting that these species were responding to precursors up to a year in advance of an El Niño event being registered. Further investigation showed that the number of breeding pairs was independently correlated with both thermocline depth and productivity levels during this pre El Nino period.

Exactly how thermocline depth changes influence seabird breeding participation is currently unknown. However, the thermocline is used by subsurface fish predators that drive small prey fish close to the surface, making them accessible to feeding seabirds. This suggests a close relationship between thermocline changes, food availability and El Niño events. Cyclones occurring in sensitive stages of the breeding cycle resulted in devastating short-term effects, confirming previous research (King et al. 1992).

However, further studies showed that breeding participation in the three main species at Michaelmas Cay following cyclones was not related to the presence of these intense low pressure systems. This suggests thatthe immediate impacts of cyclones not reflected in long-term population changes. Furthermore, there was no relationship between breeding participation and cay size, area of vegetation or available nesting habitat, but this analysis was based on only seven data points and
so must be interpreted cautiously.

At Michaelmas Cay potential smaller-scale anthopogenic effects associated with tourism and fisheries were also identified for some species. The relative importance of these effects requires further clarification. Related research in the Southern Great Barrier Reef, not connected to the Coastal Bird Atlas, using in situ temperature/depth loggers and satellite imagery suggests that changes in SST directly affect seabird prey species accessibility. Initial radio tagging satellite telemetry and provisioning studies also indicate that wedgetailed shearwaters undergo duel foraging cycles. During a cycle, parents alternative foraging locally when, during which time they feed all food obtained to their chicks, and then spending 8-10 days on extended voyages to more productive feeding grounds in order to build up body fat reserves. This research shows that shearwaters use this foraging strategy to access highly predictable areas of high productivity outside the Great Barrier Reef, and that the productivity of these locations is likely related to both SST and bathymetric patterns (Congdon et al. 2005). This suggests that for some species at least, successful breeding may be totally dependent on adults being able to access important feeding areas both to the north and south of the Great Barrier Reef region (e.g. Coral Sea seamounts).

Brad Congdon's seabird research project incorporates the following aims:

1. Examine the generality of these results for other species;
2. Identify species- & location-specific magnitude of effect and functional relationships for both the within- & between-season impacts of climate variability;
3. Identify the relative importance of other potential stressors in the system such as cyclones, fishing & tourism, and
4. Identify potential plasticity of response by the birds.

WORKSHOP OBJECTIVES: CLIMATE CHANGE FOCUS AND MANAGEMENT THEMES

The Australian Government, through the GBRMPA, is implementing the Climate Change Action Plan 2007-2012. Seabirds have been identified as being highly vulnerable to the potential consequences of climate change (Congdon et al. 2007). As part of the Climate Change Action Plan, the seabird and shorebird project aims to:

1. summarise the current state of knowledge of seabird and shorebirds and their vulnerabilities to climate change impacts;
2. identify effective adaptive management options that will build the resilience of these species groups; and
3. coordinate an inter-agency approach to implement future management strategies.

The overall aim of this workshop was to consider how can analysis of the Queensland Coastal Bird Atlas (and other bird databases) guide the management of seabirds and shorebirds in the World Heritage Area and Queensland in a changing climate? The primary goal of the workshop was to develop key research questions to inform the brief for data analysis of the Coastal Bird Atlas and other datasets. In identifying the questions with which to guide data analysis, the focus should remain on issues of climate change and adaptive management.

We need to determine how to interpret the Coastal Bird Atlas data to assist understanding of:

1. Seabird food availability and other issues at sea;
2. Seabird nesting and roosting issues on islands;
3. Shorebird feeding and roosting issues, and
4. The actual and potential impacts of climate change.

To assist the prioritisation of research questions generated through discussions during the workshop, the participants were assigned to three groups as follows: 1) Seabird island habitat (nesting and roosting); 2) Seabird foraging grounds and dispersal patterns; and 3) Shorebirds roosting and feeding habitats. Each of the three groups discussed the applicability of the Coastal Bird Atlas and other datasets in addressing four key themes, as outlined below (Table 1).

1.1.1 Key Management Themes

1. What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?
2. What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?
3. What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?
4. What are the critical research and monitoring priorities that will address management needs in the face of climate change, to conserve bird populations in the Great Barrier Reef World Heritage Area?

Table 1. Four key management themes used to guide group discussions in identifying key research questions for the Coastal Bird Atlas.

	Specific questions	Priority (high, medium, low)	Feasibility of using the Coastal Bird Atlas (Yes/No)	Other data sources that could be considered
Theme 1 – What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?				
Theme 2 – What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?				
Theme 3 – What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?				
Theme 4 – What are the critical research and monitoring priorities that will address management needs in the face of climate				

change, to conserve bird populations in the Great Barrier Reef World Heritage Area?				

WORKSHOP PROCEEDINGS AND OUTCOMES

PRE-WORKSHOP QUESTIONNAIRE SUMMARY

To guide the setting of discussion groups and management themes during the workshop, a questionnaire was prepared and sent to participants. Eight participants returned completed questionnaires. The answers to the questions were collated, summarised and rephrased for ease of comprehension and consistency of presentation. They represent a range of options and opinions presented for discussion during the workshop.

1. Should we confine our analysis to the Great Barrier Reef or include the Gulf, Torres Strait, South East corner and Coral Sea (we have some data from all these areas)?

Focus of the Great Barrier Reef, where data quality and quantity is best;
Data quantity and quality is best for the Great Barrier Reef, but analysing data from other areas is important and brings to light where data gaps exist;
As the majority of shorebirds are migratory and pass through this region on their way to and from their breeding grounds, any analysis should recognise this, and
Examine data from all areas, and consider data sharing with other agencies and groups (DEWHA, ABBBS, Shorebirds 2020, etc.).

DRAFT

2. Please list and/or provide details of any private or public data sources you are aware of that would be useful in the production of a review on the status of seabirds and shorebirds in the Great Barrier Reef World Heritage Area and Queensland?

Coastal Bird Atlas , QPWS;
WildNet, EPA/QPW;
Wedge-tailed shearwaters and noddy tern data – Capricorn-Bunker Group;
Atlas of Australian Birds (Birdata), Birds Australia;
Queensland Wader Study Group Database;
Townsville Region Bird Observers Club (TRBOC) records;
Other regional Bird Observers Clubs;
Burdekin Dry Tropics Natural Resource Management (BDTNRM) Board have a database of Townsville City Council Local Government (LG) region for shorebirds developed in 2008;
Brad Congdon – JCU Cairns recent reports linking climate change to common MARINE PARK species;
Burrage: Corella early 90s article on physical oceanography, and
Bluelink, CSIRO: 15 year hindcast of Coral Sea circulation, Satellite ocean colour and SST time series.

3. In your opinion, what are the key outcomes of a review of the bird data? Compile a 'wish list' of what information you want to see that may assist you in the management or understanding of birds in the Great Barrier Reef (or Queensland). These can then be used to prioritise research ideas and objectives during the workshop.

Presence and absence data for coastal and offshore sites;
Review of the data sheets used, including about new direction in field recording and an update of the Queensland EPA Coastal Bird Atlas (maybe dedicated staff to ensure data entry on a regular basis);
Roosting, feeding and breeding areas for prominent species;
Establish trends (will be difficult) by area and species;
Migratory routes;

Establish vulnerability indices for species by taking into account ecology (especially feeding and breeding), geographical distribution, key threats and threatening processes and projected effectiveness of any conservation measures provided;
Use in implementing coastal management and identifying coastal development impacts;
Areas of conflict between human and bird activities;
A correlation of all existing data – across all research/Agency boundaries, and
Tracking and correlating with environmental data.

4. In your opinion, what are the critical questions that need to be asked in the light of available data you are familiar with?

Identifying which data is up to date and accurate;
Distribution sites for nesting, roosting and identifying site locations seasonally for threatened shorebirds;
Population declines overall in THE MARINE PARK from Raine Island to Lady Elliot are now well documented for several species – is there some regional commonality, apart from 'big picture' global warming impacts on availability of food sources?;
Correlating with environmental data to see if there is a predictable response;
Assessing the quality of existing species knowledge to understand species vulnerability to potential threats, and
How to monitor regularly – efficiently and effectively at reasonable cost.

5. What critical information gaps do you see as hindering the successful production of such a review?

Local knowledge – specific location data;
Insufficient quality of existing monitoring programs;
Underfunding of research into basic population dynamics of seabirds, and
Effective networking.

WORKSHOP PROCEEDINGS

Workshop participants gathered on 15 July 2008, at the Arcadia Surf Lifesaving Club on the Strand in Townsville. The morning was dedicated to a number of presentations detailing the beginnings and recent history of the Coastal Bird Atlas, results of emerging research on seabirds, and the potential use of the Coastal Bird Atlas in addressing questions of seabird vulnerability to climate change. The afternoon sessions comprised whole group and small working group discussions focusing around the four key management themes (Table 2).

Table 2. Workshop agenda

Item	Workshop Component	Presenters
Workshop start: 9.00am		
1	Introduction and housekeeping	Lyndall Harvey (C&R)
2	Welcome	Julia Playford (EPA)
3	Introduction	Round-table
4	History of the Coastal Bird Atlas	Kees Hulsman (GU)
5	Recent history of the Coastal Bird Atlas	John Olds (QPW)
6	Overview of the Coastal Bird Atlas	Noleen Kunst (EPA)
7	Current Status of Seabird Knowledge and Research in Queensland	Brad Congdon (JCU)
Morning Tea: 10.30-10.50		
8	Climate Change Objectives	Katrina Goudkamp (GBRMPA)
9	Workshop Objectives; four key management themes for Seabirds and Shorebirds in the Great Barrier Reef World Heritage Area	Malcolm Turner (Day-to Day-Management, GBRMPA)
10	Whole group session to explore issues of data integrity and linkages to additional bird data sets and other data to inform climate change predictions	
Lunch: 12.30-1.30pm		
12	Smaller group sessions - each group will discuss the four key management themes and consider the four management criteria Group 1 – Seabird island habitat (nesting and roosting) Group 2 – Seabird foraging grounds and dispersal patterns Group 3 – Shorebirds roosting and feeding habitats	
Afternoon tea: 3.00-3.30pm		
13	Whole group discussion: Each group present their results and invites contributions from the other groups. The outcome will be a compilation of a prioritised list of research questions	
Finish: 5pm		

WORKSHOP OUTCOMES

1.1.2 Group Discussion Results

The four management themes were discussed within the context of each of the three small groups. Priorities were not given for many of the themes, but the results of the three discussion groups highlight which topics were considered most important, and the extent to which the Coastal Bird Atlas can be used to answer these questions. The following sections outline the questions raised during the discussions, including priorities for future research (Section 3), and how these questions and priorities can be analysed using the Coastal Bird Atlas and other databases (Section 4). A complete list of additional databases compiled during the workshop is included in Section 5.

KEY DATABASE ANALYSIS QUESTIONS

From the small group discussions and outcomes tabled above, it was possible to distil the results into key analysis questions for which the Coastal Bird Atlas can be used. Some questions require other existing datasets (see Section 5) to be linked to the Coastal Bird Atlas.

SEABIRD ISLAND HABITAT – NESTING AND ROOSTING

1.1.3 What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?

What is the total number of all seabird species on islands today?
What is the spatial distribution of all species today?
What has been the temporal variability in the presence or absence of all species?
What is the abundance of all species today?
What is the importance / rank of each site for each species today?
What has been the temporal variability in numbers?
What is the rate of change in numbers over time?
What are the peak breeding times for each species?
How variable is the peak breeding time for each species?

1.1.4 What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?

How do cyclones affect the seabirds? How is nesting affected by cyclones?
What is the relationship between weather patterns and species presence/absence or abundance?
What is the relationship between vegetation patterns on the islands and species presence/absence or abundance?
What is the relationship between shoreline changes on the islands and species presence/absence or abundance?
What is the relationship between predation levels on the islands and species presence/absence or abundance? (e.g. seagulls)
What is the relationship between the size of the reefs surrounding the islands and species presence/absence or abundance? (potential feeding area)

1.1.5 What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?

What is the relationship between the magnitude and changes in seabird populations and:

- seagulls as pest species?
- pest predators?
- pest invertebrates?
- invasive weeds?
- scale on vegetation?

What are the impacts of climate change on island vegetation?
What is the relationship between seabird populations and tourist visitation?
What are the impacts of Indigenous egg collection?
What are the positive and negative effects of management and monitoring planning on seabird populations?
What are the positive of negative effects on seabird populations associated with island developments?

1.1.6 **What are the critical research and monitoring priorities that will address management needs in the face of climate change, to conserve bird populations in the Great Barrier Reef World Heritage Area?**

Identify numbers and changes in numbers;
Identify key breeding times for species and locations at present;
Data mining and interpretation to verify if real change is occurring over time;
Document and list the shortfalls in the available data;
Develop future monitoring strategy to allow the detection of changes;
Use the Coastal Bird Atlas to identify 'most important' species and locations (e.g. Great Barrier Reef has the most important wintering site for roseate terns in the world – how does this compare in importance to the presence of Herald petrels, which may be at the limits of their range?), and
Develop ecosystem models in preparation for possible human intervention in response to climate change.

SEABIRD FORAGING AND DISPERSAL PATTERNS

1.1.7 **What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?**

Are resources (food, shelter, etc) sufficient to sustain seabird colonies?
Has the resource base changed over time?
Are the patterns observed in the previous two analyses consistent across species?
Are there relative changes in the spatial distribution and temporal dynamics of resources?

1.1.8 **What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?**

How do physical and chemical oceanographic parameters affect seabird colonies and species?

1.1.9 **What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?**

How do fisheries interact with seabird resources?
How are changes in water quality affecting resources used by seabirds?

1.1.10 **What are the critical research and monitoring priorities that will address management needs in the face of climate change, to conserve bird populations in the Great Barrier Reef World Heritage Area?**

Tagging studies to determine foraging patterns and ranges;

Defining the critical thresholds below which resources are no longer sufficient to sustain seabird populations;

Defining the relationship between resource availability and chick survivorship, and

Finding the links between oceanographic parameters, resource availability and seabird populations to allow predictions of how changes in oceanographic parameters will affect seabird populations.

SHOREBIRD ROOSTING AND FEEDING HABITATS

1.1.11 What is the abundance and the temporal and spatial distribution of birds in the Great Barrier Reef World Heritage Area?

Can the database reveal presence/absence of species on State, regional and local scales?
Which species are present?
Where are the concentrations of shorebirds?
What is the abundance of shorebirds on the Great Barrier Reef as a % of the flyway or national abundance?
What is the presence / absence or abundance of 'important' species (e.g. those listed in JAMBA, CAMBA, ROKAMBA, EPBC, NCA, etc)?
What is the presence / absence or abundance of resident vs. migratory species?
What are the movement patterns of migratory shorebirds on the Great Barrier Reef?
What are the seasonal and long-term trends in shorebird populations? How important are Great Barrier Reef islands for staging migrations (perhaps detected vertically as annual peaks in numbers)?
What are the key sites on the Great Barrier Reef for shorebirds, as identified in the Coastal Bird Atlas?
Where are the gaps in habitat mapping relevant to shorebirds in the Great Barrier Reef? What's the best algorithm for mapping habitats important to the conservation of shorebirds for planning purposes?
Where are the feeding and roosting sites of shorebirds on the Great Barrier Reef?
How can data to answer these questions be directed to the appropriate people?

1.1.12 What are the natural environmental processes affecting bird populations in the Great Barrier Reef World Heritage Area?

How does the distribution of physical and chemical parameters affect the distribution of shorebirds?
What are the effects of ENSO years on shorebird populations
What are the effects of seagrass dynamics on shorebird populations?
What are the effects of storms and cyclones on shorebird populations?
What are the effects of predation on shorebird populations?
What are the effects of changes in SST on shorebird population trends?

1.1.13 What are the local and regional climate change impacts and other human activities affecting bird populations in the Great Barrier Reef World Heritage Area?

What are the impacts on shorebirds of tourism, especially boating and the recreational use of beaches by people and motor vehicles?
What are the impacts on shorebirds of development and population increase?
What are the impacts on shorebirds of habitat loss?
What are the likely impacts on shorebirds of sea level rise?
What are the impacts on shorebirds of feral animals and domestic pets?
What are the impacts on shorebirds of pollution from all sources?
What are the impacts on shorebirds from marine debris?
What are the impacts on shorebirds from recreational fishing?
What are the impacts on shorebirds from dredging?
What are the impacts on shorebirds water quality decline?

1.1.14 What are the critical research and monitoring priorities that will address management needs in the face of climate change, to conserve bird populations in the Great Barrier Reef World Heritage Area?

Establish future monitoring programs with an emphasis on monitoring key sites, to provide viable data for analysis (e.g. trend analysis);
Establish monitoring programs that differentiate between breeding effort and breeding success;
Establish link between monitoring of shorebirds on the Great Barrier Reef and in other areas of the Queensland coast;
Predict impacts of climate change on key shorebird feeding areas;
Link wetlands data to Coastal Bird Atlas;
Evaluate the importance of 'survey notes' to add value to records (more training of field observers?);
Discuss necessary changes to the pro forma to better capture shorebirds;
Determine mitigation methods against identified impacts;
Determine data collection needs to enable climate change impact predictions;
Establish links to community based monitoring programs, and
Explore the use of Statutory Zoning Plans for shorebird (and seabird) management (current effectiveness, potential improvements) and other Statutory Tools.

FUTURE REPORTING OPTIONS

Reporting options for seabirds include:
Annual reports of Coastal Bird Atlas data (similar to marine wildlife stranding reports produced from StrandNet) (e.g. EPA 2008);
Summary report of all information collected to date (e.g. Chatto 2001);
Annual web-based updates and summaries;
Regular peer-reviewed publications.

ANALYSIS OF THE COASTAL BIRD ATLAS

While a number of questions can be answered using the Coastal Bird Atlas alone, the majority were seen to require additional data from other bird and non-bird databases. Some questions could be answered using only a selection of Coastal Bird Atlas sites for which counts are sufficiently regular and consistent. Questions are considered even if the Coastal Bird Atlas cannot be used at all, as they are still considered pertinent for a holistic approach to addressing the management themes.

GROUP 1: SEABIRD ISLAND HABITAT – NESTING AND ROOSTING

Issues relating to the island habitats of nesting, roosting and breeding seabirds were discussed. The Coastal Bird Atlas offers a large number of possibilities for island habitat analyses, as observations and records are collected directly from the islands themselves (Table 3). Other databases to complement seabird analyses were suggested, especially with regards to exploring the influence of environmental and human factors on seabird populations.

Table 3. Outcomes of group discussion – Group 1: Seabird Island Habitat – Nesting and Roosting (High priority in bold)

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
1	**1.1. What has been the temporal variability in numbers?**	**Yes – selective sites**	
	1.2. What is the total number of all seabird species on islands today?	Yes	
	1.3. What is the spatial distribution of all species today?	Yes	
	1.4. What has been the temporal variability in the presence or absence of all species?	Yes	
	1.5. What is the abundance of all species today?	Yes	
	1.6. What is the importance / rank of each site for each species today?	Yes	
	1.7. What is the rate of change in numbers over time?	Yes – selective sites	
	1.8. What are the peak breeding times for each species?	Yes – can be extrapolated from sites with single annual records using chick age classes	

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
	1.9. How variable is the peak breeding time for each species?	Yes – can be extrapolated by using chick age classes	
2	**2.1. How do cyclones affect the seabirds? How is nesting affected by cyclones?**	**Yes, at a few sites**	- Meteorological data - Cyclone tracks since 1967 (JCU)
	2.2. What is the relationship between weather patterns and species presence/absence or abundance?	**Unsure**	- Meteorological data
	2.3. What is the relationship between vegetation patterns on the islands and species presence/absence or abundance?	**Yes**	- Queensland Herbarium data - QPW island and weed data Aerial photos
	2.4. What is the relationship between shoreline changes on the islands and species presence/absence or abundance?	Yes	- Aerial photos - Satellite photos - JCU data (Scott Smithers) - UQ data for Capricorn Bunker Gp - both current and historic spatial data
	2.5. What is the relationship between predation levels on the islands and species presence/absence or abundance? (e.g. seagulls)	Yes	
	2.6. What is the relationship between the size of the reefs surrounding the islands and species presence/absence or abundance? (potential feeding area)	Yes, but this is only relevant for species foraging close to islands	- ReefBase - ReefGIS
	2.7. How does the distribution of breeding raptors affect the distribution of seabird species?	Yes	- Raptor nest database
3	**3.1. What is the relationship between the magnitude and changes in seabird populations and:** **- seagulls as pest species?** **- pest predators?** **- pest invertebrates?** **- invasive weeds?** **- scale insects on vegetation?**	**Yes**	- NRM data of QPW - DPI data - Qld Herbarium data - Annual reports and Parks information

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
	3.2. What are the impacts of climate change on island vegetation?	**Unlikley - only if vegetation notes were recorded**	
	3.3. What are the positive and negative effects of management and monitoring planning on seabird populations?	**Yes**	- Management plans - Assets register - Annual reports
	3.4. What are the positive of negative effects on seabird populations associated with island developments?	Yes	- Management plans - Assets register - Annual reports
	3.5. What is the relationship between seabird populations and tourist visitation?	Yes, but limited to sites with known historic tourism use patterns	- CAPS data - Permit databases
	3.6. What are the impacts of Indigenous egg collection?	No, as level of take not known	
	3.7. What are the impacts of recreational activities on seabird populations?	No, as historic recreational use patterns not known	- Management plans for each area / island - Assets register - Annual reports
4	**4.1. Identify numbers and changes in numbers**	**Yes – partially but at many key sites**	
	4.2. Identify key breeding times for species and locations at present	**Yes**	
	4.3. Document and list the shortfalls in the available data.	**Yes**	
	4.4. Use the Coastal Bird Atlas to identify 'most important' species and locations (e.g. Great Barrier Reef has the most important wintering site for roseate terns in the world – how does this compare in importance to the presence of Herald petrels, which may be at the limits of their range?)	**Yes**	- Worldwide/ international databases
	4.5. Data mining and interpretation to verify if real change is occurring over time.	Yes	
	4.6. Develop future monitoring strategy to allow the detection of changes.	Yes	

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
	4.7. Develop ecosystem models in preparation for possible human intervention in response to climate change.	Yes	- Geomorphology and vegetation databases

GROUP 2: SEABIRD FORAGING GROUNDS AND DISPERSAL PATTERNS

The options for using the Atlas to detect patterns in seabirds 'at sea' were discussed. Because Atlas data is collected on islands and cays, there is no information about the patterns of dispersal and behaviour of seabirds over their foraging ranges. The most important use of Atlas data for seabirds 'at sea' is in using presence/absence and abundance data as a proxy to infer resource availability within foraging range of each survey locations (Table 4). It was agreed that further research to identify and quantify foraging ranges is crucial to understanding the potential impacts of climate change on seabird populations. Also of great importance is establishing links between oceanographic features, resource availability and seabird population characteristics, as this will then allow the construction of predictive models based on changes in oceanographic parameters.

Table 4. Outcomes of group discussion – Group 2: Seabird Foraging Grounds and Dispersal Patterns (High priority in bold)

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
1	**1.1. Has the resource base changed over time?**	**Yes – disappearance/ appearance of colonies or breeding peaks over time can indicate presence or absence of resources**	**1.2. Has the resource base changed over time?**
		Yes – Using count data where possible, with the caveat that data needs to be standardised to allow comparisons	
	1.2. Are resources (food, shelter, etc) sufficient to sustain seabird colonies?	**Yes – presence / absence data as proxy for resource availability**	
	1.3. Are the patterns observed in 1.1. and 1.2. consistent across species?	Yes – species composition data as proxy to infer resource base	
	1.4. Are there relative changes in the spatial distribution and temporal dynamics of resources?	Yes – only partially where abundance data is available and can be standardised for sampling effort. Seasonality can be inferred from breeding peaks.	
2	**2.1. How do physical and chemical oceanographic parameters affect seabird colonies and species?**	**Yes. It is more important to look for persistent oceanographic features than**	- Oceanographic databases (SST, productivity, etc)

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
		long-term averages (e.g. in upwellings)	
3	**3.1. How do fisheries interact with seabird resources?**	**Yes - partial**	- Fisheries catch and bycatch information - Customs / Coastwatch vessel traffic data
	3.2. How are changes in water quality affecting resources used by seabirds?	**Yes - partial**	- Water quality monitoring information - River plume history
4	**4.1. Tagging studies to determine foraging patterns and ranges.**	**Yes – Coastal Bird Atlas can help prioritise species or colonies for tagging**	
	4.2. Finding the links between oceanographic parameters, resource availability and seabird populations to allow predictions of how changes in oceanographic parameters will affect seabird populations.	Yes, if linked with foraging and resource use studies	
	4.3. Defining the critical thresholds below which resources are no longer sufficient to sustain seabird populations.	May assist	
	4.4. Defining the relationship between resource availability and chick survivorship.	May assist	

GROUP 3: SHOREBIRD ROOSTING AND FEEDING HABITATS

The use of the Coastal Bird Atlas in detecting patterns and trends in shorebirds was discussed. As the Coastal Bird Atlas contains little or incomplete shorebird data, it was agreed that it will probably only be useful in conjunction with other more comprehensive shorebird datasets (Table 5, see Section 5 below). However, given the use of nearshore areas by shorebirds, using other datasets will provide a large range of possibilities for analyses.

Table 5. Outcomes of group discussion – Group 3: Shorebird Roosting and Feeding Habitats (High priority in bold)

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
1	**1.1. Can the database reveal presence/absence of species on State, regional and local scales? Which species are present? Where are the concentrations of shorebirds?**	**Yes, but only if combined with other data bases**	- All other shorebird databases[1]
	1.2. What is the abundance of shorebirds on the Great Barrier Reef as a % of the flyway or national abundance?	Yes, only if combined with other data bases	- All other shorebird databases
	1.3. What is the presence / absence or abundance of 'important' species (e.g. those listed in JAMBA, CAMBA, ROKAMBA, EPBC, NCA, etc)?	**Yes, only if combined with other data bases**	- All other shorebird databases - International shorebird databases
	1.4. What are the seasonal and long-term trends in shorebird populations? How important are Great Barrier Reef islands for staging migrations (perhaps detected vertically as annual peaks in numbers)?	**Yes – only some places**	- All other shorebird databases
	1.5. What are the key sites on the Great Barrier Reef for shorebirds, as identified in the Coastal Bird Atlas?	**Yes**	- All other shorebird databases
	1.6. What is the presence / absence or abundance of resident vs. migratory species?	Yes	- All other shorebird databases
	1.7. What are the movement patterns of migratory shorebirds on the Great Barrier Reef?	for some areas and only if combined with other data bases	- All other shorebird databases
	1.8. Where are the gaps in habitat mapping relevant to shorebirds in the Great Barrier Reef? What's the best algorithm for mapping habitats important to the conservation of shorebirds for planning purposes?	No	- All other shorebird databases - Ozestuaries - Tidal range data - Seagrass extent
	1.9. Where are the feeding and roosting sites of shorebirds on the Great Barrier Reef?	Yes - partial	- GIS layers - All other shorebird databases
	1.10. How can data to answer these questions be directed to the appropriate people?	No	

[1] See Section 5.1.

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
2	2.1. How does the distribution of physical and chemical parameters affect the distribution of shorebirds?	**Yes - partial**	- All other shorebird databases - Ozestuaries - Tidal range data - Seagrass extent - Water quality databases
	2.2. What are the effects of ENSO years on shorebird populations	**Yes - partial**	- All other shorebird databases - Meteorological data
	2.3. What are the effects of changes in SST on shorebird population trends?	**Yes - partial**	- All other shorebird databases - Oceanographic / SST data
	2.4. What are the effects of seagrass dynamics on shorebird populations?	Yes - partial	- All other shorebird databases - Seagrass maps (DPI)
	2.5. What are the effects of storms and cyclones on shorebird populations?	Yes - partial	- All other shorebird databases - Meteorological data
	2.6. What are the effects of predation on shorebird populations?	Yes - partial	- All other shorebird databases
3	**3.1. What are the impacts on shorebirds of tourism, especially boating and the recreational use of beaches by people and motor vehicles?**	**Not by itself, other shorebird data is required**	- Specific research data
	3.2. What are the impacts on shorebirds of development and population increase?	Not by itself, other shorebird data is required	- Specific research data
	3.3. What are the impacts on shorebirds of habitat loss?	Not by itself, other shorebird data is required	- Specific research data
	3.4. What are the likely impacts on shorebirds of sea level rise?	Not by itself, other shorebird data is required	- Specific research data
	3.5. What are the impacts on shorebirds of pollution from all sources?	Not by itself, other shorebird data is required	- Specific research data
	3.6. What are the impacts on shorebirds of feral animals and domestic pets?	Not by itself, other shorebird data is required	- Specific research data
	3.7. What are the impacts on shorebirds from marine debris?	Not by itself, other shorebird data is required	- Specific research data

Theme	Specific questions	Feasibility of Coastal Bird Atlas	Other data sources that could be considered
	What are the impacts on shorebirds from recreational fishing?	Not by itself, other shorebird data is required	- Specific research data
	What are the impacts on shorebirds from dredging?	Not by itself, other shorebird data is required	- Specific research data
	What are the impacts on shorebirds water quality decline?	Not by itself, other shorebird data is required	- Specific research data
4	**4.1. Establish future monitoring programs with an emphasis on monitoring key sites, to provide viable data for analysis (e.g. trend analysis)**	**Yes**	
	4.2. Predict impacts of climate change on key shorebird feeding areas.	**Not by itself**	
	4.3. Establish monitoring programs that differentiate between breeding effort and breeding success.	Not by itself	
	4.4. Establish link between monitoring of shorebirds on the Great Barrier Reef and in other areas of the Queensland coast.	Yes	
	4.5. Link wetlands data to Coastal Bird Atlas.	Yes	
	4.6. Evaluate the importance of 'survey notes' to add value to records (more training of field observers?)	Yes	
	4.7. Discuss necessary changes to the pro forma to better capture shorebirds.	Yes	
	4.8. Determine mitigation methods against identified impacts.	Unsure	
	4.9. Determine data collection needs to enable climate change impact predictions.	Yes, with other data	
	4.10. Establish links to community based monitoring programs.	Yes	
	4.11. Explore the use of Statutory Zoning Plans for shorebird (and seabird) management (current effectiveness, potential improvements) and other Statutory Tools.	Unsure	

ADDITIONAL DATASETS

The following additional bird-related datasets were identified as potential sources of useful data to integrate with the Coastal Bird Atlas for analysis and to inform future management of seabirds and shorebirds.

BIRD-RELATED DATASETS

Coral Sea data
- Annual surveys since 1992
- Nests for 2 species
- Total counts for 2 cays
- 4 breeding classes

Atlas of Australian Birds – Birds Australia
- Not independent of Coastal Bird Atlas
- Fixed area counts
- Fixed time counts
- Useful terrestrial bird data relative to coast
- Accessible data

Australasian Wader Studies Group (AWSG)
- Specialist group of BA

Queensland Wader Study Group (QWSG)
- Involved in AWSG research
- Includes additional QWGS counts – monthly counts at key roost sites, access a key factor
- High tide counts each month
- Not always every site each month
- Intensive studies

Brad Congdon research, JCU Cairns
- 3 year intensive studies

Shorebirds in Moreton Bay (EPA/QPWS)

Sunshine Coast seabird data

Townsville Region Bird Observers Club (TRBOC) / Burdekin Dry Tropics (BDT) data – provided to WildNet, QWSG etc

Wetlands International
- Shoalwater Bay study, Swains Reefs Roseate Tern project
- Should be included in the Coastal Bird Atlas
- Some mark recapture data not included in Coastal Bird Atlas

Banding / mark-recapture data QWS

Other EPA data

Australian Bird and Bat Banding Scheme (ABBBS) data
- Banding, but not mark-recapture data

EPA red-tailed tropicbird data from Raine Island

CSIRO?

Pelagic seabirds

Coral Sea cay data?

Silver-eye data, maybe others

Whitsunday beach stone-curlew data

Moreton Bay curlew census

Impacts of 4WD on shorebirds

OTHER DATASETS

Some additional non-bird related datasets may also provide invaluable data linkages.

1.1.15 Physical, Chemical, Climatic and Oceanographic Data

Meteorological data – BOM
Oceanographic databases
AIMS temperature logger data
Tidal range data
AIMS/GBRMPA water quality monitoring data
River plume data
Cyclone tracks since 1967 – BOM and JCU
Spatial data (current and historic)

- Aerial photographs
- Satellite photographs
- JCU spatial data
- Coral reef mapping data – NOAA
- Ozestuaries

Geomorphological data

- UQ data for the Capricorn-Bunker Group
- Geoscience Australia

1.1.16 Ecological and Habitat Data

Queensland Herbarium data – natives and pests
Raptor nest database
AIMS Long Term Monitoring Program
Specialist reef ecology projects
NRM, QPW and DPI pest data
QPW annual reports
International seabird, shorebird, protected and migratory species databases
Seagrass and other benthic habitat maps

1.1.17 Socio-Economic Data

Tourism – CAPS data
Permit databases
Tourist operator logbooks
Management plans for specific areas
Assets register
Fisheries CPUE and bycatch data (AFMA / DPI)
Vessel traffic data – Customs, Coastwatch, AMSA and Fisheries

CONCLUSIONS AND RECOMMENDATIONS

The Coastal Bird Atlas analysis questions and future research priorities identified during this workshop will guide further steps in the process of determining the status and trends in seabird and shorebird populations in the World Heritage Area. The key database analysis questions are designed to inform the brief for the analyses and interpretation to be undertaken. The listed priorities for further research will assist the development of projects to enhance the understanding and predictability of trends in seabird populations and their potential responses to climate change and other human pressures.

The Coastal Bird Atlas contains records from a number of locations within the Great Barrier Reef. The quality of these records varies widely between locations, and abundance data for detailed analysis exists only for a handful of sites. Nevertheless, this workshop identified a number of questions that can be answered using presence / absence and breeding effort data throughout the Great Barrier Reef. The use of these data can assist in determining whether seabirds are declining over a larger area than the four major rookeries in which population declines were previously identified.

The structure of workshop discussion groups offers a useful framework for organising the task of preparing terms of reference for analysing and interpreting Coastal Bird Atlas data. Recommendations for preparing the terms of reference follow.

The brief for the analysis of the Coastal Bird Atlas can be divided into three sections:

- Seabird island habitat – nesting and roosting
- Seabird foraging and dispersal patterns
- Shorebird roosting and feeding habitats

The four management themes can be further adapted to each section, and used to guide analysis and interpretation.

The GBRMPA could seek to establish links to the custodians of the other datasets identified in this workshop, so that they can be made available to the personnel conducting the analyses. The centralisation of this task will avoid lengthy procedures and circumvent potential reluctance to share data.

Once data analysis begins, there should be a collaborative process between the GBRMPA and those analysing the data, as the extent of opportunities and limitations in the data become more evident. There should be enough flexibility in the terms of reference to allow changes, additions or deletions to the original questions guiding the analyses.

A reporting mechanism should be established whereby data analysis occurs on a regular basis. For this to occur, the initial analysis and interpretation of the Coastal Bird Atlas should be presented in a simple and repeatable format.

The identification of further priorities for future research should be encouraged throughout the initial analysis of the Coastal Bird Atlas.

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APPENDIX A - PRESENTATION ABSTRACTS AND SUMMARIES

A i) Title: History of Queensland Seabird Database from 1985 - 1997

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Summary

About 1985, Terry Walker (DoE) began compiling and evaluating the census data of seabirds found breeding on islands in the Coral Sea and off the Queensland coast. He began censusing some of the islands himself, targeting gaps in the literature. He created a database of birds that were found on islands in Queensland waters.

While Terry was creating his database, Brian King (DoE) who had censused seabirds on Raine Island and Michaelmas Cay compiled census data on seabirds of the Great Barrier Reef. Brian's work was published in Corella in 1993, two years after his death. Terry died in a boating accident in 1992.

The Department of Environment, Water, Heritage and the Arts set up the walker-Reimer Memorial Fund. Kees Hulsman applied for funds from this fund to continue Terry and Brian's work. Kees opted to use Microsoft Access to create a relational database on seabirds so data from multiple files could be integrated into maps showing spatial and temporal patterns in their distribution and abundance. It was possible to import Access files into Arc Info to generate the maps. Since it was a relational database on seabirds, the records on shorebirds and land birds were separated from the seabird records. These records could have been put in their own files and thus integrated at a latter date, if required, because it was a relational database.

Some of the fields in the database were changed to increase the flexibility of the database. For example the date was placed into three fields rather than one, so an enquiry could be based on day, month or year. The number of eggs and chicks censused were placed in their own fields rather than being left in the 'comments' field.

The seabird database linked four files: Island characteristics (David Hopley's data, JCU), census data), seabird life history characteristics. There was scope to include data on individual islands to show spatial and temporal changes in nesting density of any seabird species breeding on the island, *e.g.* wedge-tailed shearwaters or black noddies on Heron Island.

Thus, the sorts of questions that the seabird database could be used to answer were:

- Spatial and temporal distribution and abundance of seabird species at different spatial scales such as local, regional and national;
- Preferences of species for geographic location latitudinally along the Great Barrier Reef or longitudinally across the continental shelf; preferences for island type *etc.;*
- Trends in population size at local, regional, and national scales for some species;

- The relative importance of breeding colonies of each species at different spatial scales including national and international levels.

It may be possible to identify potential source and sink populations of each species. The database can be used to alert managers to threats to the viability of colonies, but not to identify those threats. So the database could be used to direct where to focus one's research efforts. In sum, it can be a valuable tool to guide management of Coral Sea and Queensland seabirds.

A ii) Title: Coastal Bird Atlas Recent History (1997 to date)

By John Olds
Senior Conservation Officer (Marine)
Conservation Management Branch
Queensland Parks and Wildlife

Summary

This presentation focuses on the most recent information regarding the Costal Bird Atlas, opening with the importance of seabirds and shorebirds in the Great Barrier Reef World Heritage Area, the presentation then delves into the key legislative obligations of management agencies. A brief outline of the Coastal Bird Monitoring Strategy for the World Heritage Area is then provided, followed by some details on the expanded and more recently updated Coastal Bird Atlas including its current and planned availability on the Environmental Protection Agency's website. Finally the presentation discusses some options for reporting/publishing the Coastal Bird Atlas, the alarming decline in some of the key seabird populations in the World Heritage Area and how the EPA is currently using information from the Coastal Bird Atlas to update mapping for Coastal Planning.

A iii) Title: Overview of Coastal Bird Atlas – what data we have, its format and how it works

By Noleen Kunst
Project Manager Wetland Information Capture Project
Environmental Information Systems Unit, Environmental Sciences Division
Environmental Protection Agency (EPA)

DATASETS

Seabird Atlas - 9953 records loaded into WildNet in 1999
Coastal Bird Atlas - 50366 records loaded into WildNet in 2006

WILDLIFE SYSTEMS AND TOOLS

WildNet

WildNet team will load additional Coastal Bird Atlas files when data entry completed and Coastal Bird Atlas form in use.

Wetland Information Capture System WIC – (Refer to handout)

Wetland Inventory Data – Wetland attributes (coordinates, weather etc)
Geology
Fauna
Flora (vegetation structure and plant species)
Water Quality

Phase 1 - Available in June 2008
User registration

Account management
Project management
Site management
Loading data from Wetland Inventory Proforma
Viewing loaded data

Phase 2 - Available in September 2008

Editing and augmenting loaded data
Reporting information
Extracting information
System administration

WIC's wildlife data and site data is stored in various WildNet tables.

Wetland Information Proforma WIP - (Refer handout)

- SmartForm (pdf) developed using Adobe Live Cycle and Adobe Professional
- Allows form customisation – themes and rows
- Field validation in form – mandatory fields, data types and limits
- Allows submission via internet
- Version 2.5 available for the loading of data into WIC

A iv) Title: Current Status of Seabird Knowledge and Research in Queensland

By Brad Congdon
Reader (Ecology)
School of Marine & Tropical Biology
James Cook University

Summarised in detail in:

Congdon BC, Erwin CA, Peck DR, Baker GB, Double MC, O'Neill P (2007) Chapter 14: Vulnerability of seabirds on the Great Barrier Reef to climate change. In: Johnson JE, Marshall PA (eds.) Climate change and the Great Barrier Reef: a vulnerability assessment. Great Barrier Reef Marine Park Authority, Townsville

A v) Title: Climate Change on the Great Barrier Reef: Climate Change Objectives

By Katrina Goudkamp
Project Manager
Climate Change Group
Great Barrier Reef Marine Park Authority

Abstract

Climate change is real and likely to have significant implications for the Great Barrier Reef (the Reef) and its inhabitants, as well as reef dependant communities. The current rates of change to the earth's temperature and atmospheric CO_2 concentrations are unprecedented and are already having an impact on the Reef ecosystem. Mass coral bleaching events have been experienced across the Reef and the frequency of these threatening events is predicted to increase. More recently, ocean acidification has been identified as considerable threat to the long-term survival of coral reefs worldwide, with erosion expected to exceed accretion by 2020. To give the Reef the greatest chance of adapting to a changing climate, the Great Barrier Reef Marine Park Authority has implemented the Climate Change Action Plan. This plan aims to target science to inform current management knowledge gaps, build resilience of the Reef ecosystem, identify adaptation strategies for industries and communities, and mitigate climate footprints.

Like coral reefs, seabirds and shorebirds are identified as highly vulnerable to a changing climate[2]. It is expected that the following list of impacts will have considerable consequences for seabirds and shorebirds, including their critical habitats such as islands, cays and intertidal areas:

- increasing sea surface temperature
- increasing ocean acidification
- changes to large-scale air and ocean circulation patterns (e.g. El Niño Southern Oscillation)
- changes in geomorphology
- increasing sea levels
- changes in rainfall and runoff

As part of the Climate Change Action Plan, the seabird and shorebird project aims to:
1. summarise the current state of knowledge of seabird and shorebirds and their vulnerabilities to climate change impacts;
2. identify effective adaptive management options that will build the resilience of these species groups; and
3. coordinate an inter-agency approach to implement future management strategies.

A vi) Title: The Coastal Bird Atlas Guiding Management

By Malcolm Turner
Manager, Field Operations
Day-to-day Management Program
GBRMPA

Abstract
The Coastal Bird Atlas focuses on recording breeding effort and total numbers of seabirds on islands in the Great Barrier Reef, with records for other coastal birds and mainland sites less systematic. Decent data exists from about the 1970, but is subject to variations in the timing of counts, with monthly counts of Michaelmas Cay the best data. At the four key seabird breeding locations where data has been examined - Raine Island, Michaelmas Cay, the Swain Reefs and Heron Island, serious declines of seabirds have been found.

We need to determine how to interpret the coastal bird atlas data to assist understanding of:
1. Seabird food availability and other issues at sea
2. Seabird nesting and roosting issues on islands
3. Shorebird feeding and roosting issues
4. The actual and potential impacts of climate change

[2] Johnson JE and Marshall PA (editors) (2007) Climate Change and the Great Barrier Reef. Great Barrier Reef Marine Park Authority and Australian Greenhouse Office, Australia

APPENDIX B - WETLAND INFORMATION CAPTURE (WIC) FACT SHEET

Australian Government

Queensland Government

Queensland Wetlands Programme

WETLAND INFORMATION CAPTURE

Queensland Wetlands Programme

In 2003, the Australian and Queensland governments established the Queensland Wetlands Programme to protect wetlands in the Great Barrier Reef catchment and throughout Queensland.

The Programme involves a number of government departments and other key stakeholders and is lead by the Australian Government Department of the Environment and Water Resources (formerly Department of the Environment and Heritage) and the Queensland Environmental Protection Agency (EPA). Implementation of the programme is over five years.

The Programme is funded through the Great Barrier Reef Coastal Wetlands Protection Programme and the Queensland Natural Heritage Trust Queensland Wetlands Programme, with additional contributions from Queensland government. For information on these programmes, please visit the Queensland Wetlands Programme website at www.environment.gov.au/water/wetlands/qwp

The Wetland Information Capture Project (WIC)

A wide range of datasets exist which are relevant to wetland management. However, because of access limitations, incompatible formats and data storage in multiple locations, it is not always easy to find and use these data sets.

The *Wetland Information Capture* project will address these issues by collating and integrating existing and new information from a variety of sources and providing the information in a useable format to end users.

The WIC project is being coordinated by the EPA's Environmental Sciences Division with the involvement of a wide range of stakeholders and potential users.

QLD EPA seagrass monitoring (Moreton Bay)

The final web delivery of the *WIC* system will be in the second half of 2007, with a preceding pilot phase.

How the project works

Existing and new data will be stored in a *Wetland Inventory Database*. One of the key data sets that will be integrated is the wetland mapping layer which is a product of the associated *Wetland Mapping and Classification* project.

Other existing data sets to be integrated relate to planning, administration, biota, hydrology, culture, etc. Sources will include:

- EPA and other State government datasets
- Non-government datasets

New survey data will be captured under six general themes:

- General project and collection information
- Site information (location etc)

Queensland Wetlands Programme

Australian Government

Queensland Government

- Geology (and soils)
- Flora (structure and composition)
- Fauna (composition)
- Water quality

Survey proformas (or data sheets) and other data entry tools will also be developed and trialled as part of the project. These proformas will provide an easy to use system for collecting data electronically either online or offline. They can also be printed and used as hard copy field data sheets.

The content and format of the proformas will be consistent with National databases (such as Australian Wetland Inventory) and Queensland EPA databases (such as WildNet, the EPA's corporate information system for wildlife).

Who can use the Wetland Inventory Database?

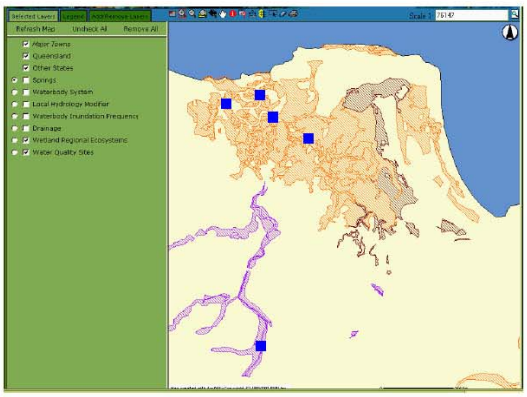
Data integrated by the *WIC* project will be accessible to anyone from the EPA website through *WetlandInfo* and *WetlandMaps*. This will be in the form of mapping layers, raw data, summary data and metadata.

Potential users include Regional Natural Resource Management Bodies, community groups, local government, research organizations, students, and members of the general public with an interest in wetlands.

Anyone who registers as a user will be able to load data into the Wetland Inventory Database. Registered users will also be able to manage their data via a secure logon.

Benefits of the WIC project:

- Greater online access to existing wetland related data (for example, the Coastal Birds Atlas and WildNet)
- Online contribution and download of survey data and metadata
- Validation and verification of data
- Provision of survey proformas, methodologies and support tools
- Provision of a ready-made and maintained database for wetland inventory information



Example output showing wetland regional ecosystems and water quality sites

- Ability to link mapping and survey data
- A data source for planning including tools such as the Decision Support System also developed under the Programme
- Ability to share data (or metadata) with others.

The range of applications for the Wetland Inventory Database will be limited only by the range of data captured. Potential applications include:

- Assess wetland conservation significance
- Refine and improve wetland classification
- Highlight wetlands under threat
- Capture, store and disseminate wetland data
- Reporting resource for sourcing and summarizing data
- Baseline data to develop wetland assessment programs and prioritize further data capture activities

Ultimately, WIC aims to support management of wetlands through better use of information.

For more information on this project contact:

Queensland Environmental Protection Agency
Ph: (07) 3227 8765
E-mail: wetlands@epa.qld.gov.au

Queensland Wetlands Programme