

Information Sheet on Ramsar Wetlands (RIS) – 2009-2012 version

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Completed in accordance with the *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*, and using further guidance in the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 14, 3rd edition). (4th edition of the Handbook available in 2009).

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Designation date

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Site Reference Number

2. Date this sheet was completed/updated:

Updated, April 2009

3. Country:

Australia

4. Name of the Ramsar site:

The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

Coral Sea Reserves (Coringa-Herald and Lihou Reefs and Cays)

5. Designation of new Ramsar site or update of existing site:

Coral Sea Reserves Ramsar site was originally designated on 21st Oct 2002.
The previous RIS prepared by Wetlands International – Oceania was dated June 2002

This RIS is for (tick one box only):

- a) Designation of a new Ramsar site ; or
b) Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged:

or

If the site boundary has changed:

- i) the boundary has been delineated more accurately ; or
ii) the boundary has been extended ; or

iii) the boundary has been restricted**

and/or

If the site area has changed:

i) the area has been measured more accurately ; or

ii) the area has been extended ; or

iii) the area has been reduced**

**** Important note:** If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

The area of the Ramsar site included in the nomination RIS (2002) was 1,729,200 hectares. During a review of boundaries for Australian marine protected areas that are also listed as Wetlands of International Importance discrepancies were noted. Following the use of more accurate data the area of the Ramsar site has been calculated as 1,728,920 hectares; a difference of 280 hectares.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

The site still meets the criteria that it met on the date of Ramsar listing (2002). The site is also considered to meet two additional criteria (Criteria 1 and 7) that were not recognised in the original nomination (see Item 14).

However there are concerns of possible change in ecological character for some critical ecosystem components discussed below. Without sufficient information for identifying baseline conditions at time of listing and objective Limits of Acceptable Change (Phillips *et al* 2006), the observed changes might not represent changes in ecological character, but are nevertheless identified by scientists as cause for concern (also see Item 26).

- Cover of hard coral, soft coral and sponges, already historically low, suffered substantial declines at both Reserves between the 1984 marine survey (Ayling & Ayling 1985) and the 2003 (Oxley *et al* 2003) and 2004 (Oxley *et al* 2004) surveys. According to Oxley (2004), 65 % of the hard coral cover was bleached in 2004. However the extent of bleaching varied between cays, reef habitats and coral family groups. The survey took place while the bleaching event was underway. Declines were attributed primarily to coral bleaching associated with elevated sea surface temperatures in 1997/1998 and 2002 (Oxley *et al* 2003, 2004), with frequent cyclone disturbance as further impact. The high proportion of juvenile corals in 2007 (Ceccarelli *et al* 2008) was an indication of the early stages of a slow recovery (see Item 26 below). Because of the small size of the reefs, isolation, exposure, low diversity of species (and functional groups), and shortage of reproductively mature colonies, recovery from disturbances is likely to be very slow (Ceccarelli *et al* 2008) and concerns for potential local extinctions of some coral species remains (Oxley *et al* 2004). Further monitoring is required to determine whether the recent losses exceeded the limits of natural variability and perhaps represent significant long-term changes to ecological character.
- Adverse impacts on *Pisonia grandis* forests, from cyclones, dry periods, the cosmopolitan pest scale insects (*Pulvinaria urbicola*) and other defoliators, began prior to Ramsar listing. The scale insect impacts were addressed by Site managers at about the time of Ramsar listing through applying bio-control agents and with some success, but further low-level impacts have since occurred due to herbivorous insects and prolonged dry conditions (Batianoff *et al* 2008). Monitoring, testing and application of bio-control agents, and other mitigation measures are being employed by Site managers where possible.

- Annual monitoring of NE Herald Islet, revealed marked declines in nest counts of frigatebirds (*Fregata minor* and *F. ariel*) and Black noddy (*Anous minutus*) in 1998, with no recovery for several years (Baker *et al* 2003). The frigatebird population has declined from the 1990s (when 3,000 to 3,500 pairs bred each year), to a new level established at around 1,800 annual breeding pairs (1998 to 2007) (Baker *et al* 2008). On NE Herald Islet the Black Noddy population index (nest count) declined from around 20,000 nests (1992-1997) to around 10-15,000 nests (1998-2006), but returned to 22,373 nests in August 2007 (Baker *et al* 2008). The causes for the decline in 1998 have not been tested, but are believed to be related to a complex set of changes to food, suitable nesting habitat, sea surface temperatures and other climatic conditions since the 1997/1998 *El Nino* event (see Congdon *et al* 2007). In contrast, monitoring has shown stable population sizes of nesting Red-footed Booby (*Sula sula*), Masked Booby (*Sula dactulatra*) and Red-tailed Tropicbird (*Phaethon rubricauda*) since monitoring commenced in 1992.

7. Map of site:

Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

- i) a **hard copy** (required for inclusion of site in the Ramsar List): ;

A hardcopy map is appended to this RIS (**Appendix 1, Figures 1-3**).

- ii) an **electronic format** (e.g. a JPEG or ArcView image) ;

The electronic boundary map has been developed by the Australian Government, The Department of Environment, Water, Heritage and the Arts.

- iii) a **GIS file providing geo-referenced site boundary vectors and attribute tables** .

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The Site boundary corresponds to the boundaries of Coringa-Herald National Nature Reserve, and Lihou Reef National Nature Reserve (**Appendix 1, Figures 1-3**).

The boundary of the Coringa-Herald National Nature Reserve component of the Ramsar site is described by a line which extends from 149°00'E, 16°46'S eastward to 149°48'E, 16°46'S, then in a north-easterly direction to 150°12'E, 16°23'S, then eastward to 150°30'E, 16°23'S, then southward to 150°30'E, 16°52'S, then south-westward to 150°05'E, 17°11'S, then westward to 149°00'E, 17°11'S, then north to meet its origin.

The boundary of the Lihou Reefs National Nature Reserve component of the Ramsar site is described by a line which extends from 151°08'E, 17°21'S in a north-easterly direction to 151°54'E, 16°57'S, then eastward to 152°20'E, 16°57'S, then southward to 152°20'E, 17°27'S, then south-westward to 151°08'E, 17°54'S, then north to meet its origin.

8. Geographical coordinates (latitude/longitude, in degrees and minutes):

Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

Coringa-Herald and Lihou Reefs and Cays Ramsar Site lies in the central Coral Sea. Coordinates for the approximate centre of the two components of the Ramsar site are:

Coringa-Herald 149° 49' 14" E, 16° 52' 13" S

Lihou Reef 151° 43' 54" E, 17° 22' 34" S

Coringa-Herald National Nature Reserve (see Fig 2):

Herald Cays, at 16° 58' S, 149° 08' E;
Coringa Islets, at 16° 56' S, 150° 00' E; and
Magdelaine Cays, at 16° 30' S, 150° 17' E.

Lihou Reef National Nature Reserve (see Fig 3):

A horseshoe-shaped line of cays and reefs from
Nellie (No. 9) Cay, at 17° 39' S, 151° 18' E, to
Licklick Cay, at 17° 07' S, 152° 11' E

9. General location:

Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

Coringa-Herald National Nature Reserve is located in the central Coral Sea (Fig. 1), its centre being about 440 km east of Cairns (population approximately 100,000), Queensland. Lihou Reef National Nature Reserve is also located in the central Coral Sea, its centre being about 650 km east-south-east of Cairns and 200 km east-south-east of Coringa-Herald National Nature Reserve. The Reserves lie about 300 km north-east of the Great Barrier Reef. The two reserves are about 100 km apart and together they lie on the Coral Sea Plateau, which is separated from the Great Barrier Reef by an area of deep water known as the Queensland Trough. They are in the Coral Sea Islands Territory, administered by the Commonwealth of Australia (see item 28).

10. Elevation: (in metres: average and/or maximum & minimum)

Wetland habitats within the site are situated between mean sea level and several metres below that. Small vegetated islets and sand cays within the site have an elevation of no more than 5 metres above mean sea level.

11. Area: (in hectares)

The Site boundary corresponds to the boundaries of Coringa-Herald National Nature Reserve (885,249 ha, including a 124 ha terrestrial component), and Lihou Reef National Nature Reserve (843,670 ha, including a 91 ha terrestrial component); thus the collective area of the Site is 1,728,920 (1.7 million) ha. Most of this bounded area is in oceanic depths. The total area of reef- and cay-associated wetland (mostly fringing reef) within the Reserve has not been accurately determined but is estimated to be at least 30,000 ha of which about 5,000 ha is in Coringa-Herald National Nature Reserve and about 25,000 ha is in Lihou Reef National Nature Reserve. For Lihou Reef, this estimate does not include the interior of the enclosed lagoon: the lagoon comprises in the order of 300,000 ha of water of varied depth to 60m.

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

The Site comprises oceanic islet and reef habitats that are representative of the Coral Sea region (in the Northeast Province of Australia's "East" marine bioregion) and that are protected and in near pristine condition. Several islets within the site include undisturbed sand-cay habitat that is used for nesting by the globally endangered and migratory Green Turtle (*Chelonia mydas*), and forest and shrubland that support important breeding populations of terns and other seabirds. Associated coral reef habitats support marine benthic flora and fauna communities that are distinct from those of the Great Barrier Reef, and may provide links for species exchange between Pacific Ocean reefs and the Great Barrier Reef. The site also supports decapod crustacean, sponge and hydroid faunas that are relatively rich in species number, and feeding habitat for migratory shorebirds and seabirds.

13. Ramsar Criteria:

Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

The site still meets the five criteria that it was recognized to have met on the date of Ramsar listing (2002), and according to expert views it also meets two additional criteria (Criteria 1 and 7) that were omitted in the original nomination.

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

The Coringa-Herald and Lihou Reefs and Cays Ramsar Site includes several representative examples of Ramsar wetland Type C (coral reef), particularly the sub-type “shelf-edge oceanic coral reef”, and the largest and least disturbed examples of this sub-type in the “Northeast” Provincial bioregion. The 2,500km² Lihou Reef formation is the largest of its type in the Northeast Provincial bioregion. The reef communities within the Ramsar Site are also considered to be in near-pristine condition with minimal evidence of disturbance by humans or of coral predators that occur in nearby reef systems such as the Great Barrier Reef. They appear to play some function as a “stepping stone” for the linking of species between the Great Barrier Reef and Pacific Ocean reefs. The Coral Sea reef communities display distinct differences to those of neighbouring bioregions. The Site also includes the only forested reef cays in the bioregion, making it an outstanding breeding site for several key waterbird species.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Green Turtle (*Chelonia mydas*) is listed as Vulnerable under Australian national legislation (*Environmental Protection and Biodiversity Conservation Act 1999*), is classified as Endangered in the IUCN Red List, and is protected under the *Convention on the International Trade of Endangered Species of Wild Animals* (CITES) to which Australia is a Party. Hawksbill Turtle (*Eretmochelys imbricata*), also listed as Vulnerable under the Australian EPBC Act, and classified as Critically Endangered in the IUCN Red List, has been sighted within the Reserves but has not been observed nesting (Environment Australia 2002c).

Fairy Tern (*Sterna nereis*) is listed as Vulnerable under the IUCN Red List. Fairy Terns have been sighted at the Coringa-Herald National Nature Reserve, however they are not considered common to the site (Phillips et al. 2006).

Scientific name	Common name	IUCN	CMS	CITES	National status
<i>Chelonia mydas</i>	Green Turtle	Endangered	I	I	Vulnerable
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Critically Endangered	I	I	Vulnerable
<i>Sterna nereis</i>	Fairy Tern	Vulnerable			

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Formal inventories of wetland biodiversity in the Coral Sea are incomplete, however, in view of the type of environment normally associated with isolated oceanic reefs, the Site can be considered a 'hotspot' of biological diversity (Ramsar Convention 2002) within the Coral Sea. As the only fully protected reefs in the "Northeast" provincial bioregion, several species appear to be successfully conserved here and the site is regarded as a potentially important source of larval recruitment to reefs "downstream" that are not protected. The limited scientific investigations of the site to date have recognised a moderately large number of marine species, including:

- 29 waterbird species (as defined by Ramsar, Environment Australia 2002c; see **Appendix 2**)
- At least 390 species of coral reef fish (at least 54 families); including 342 species at North-East Herald Cay (Oxley et al 2003) and 390 species at Lihou Reefs (from the combined species lists of Ayling & Ayling 1985 and Oxley et al 2004)
- 128 decapod crustaceans (includes some terrestrial species; Environment Australia 2002c)
- 745 marine molluscs (118 families, including 87 of gastropods - many of commercial value, Environment Australia 2002c)
- 140 scleractinian (hard) corals (Ceccarelli *et al* 2008), including 42 Genera in 14 Families (previously surveys over smaller areas found only 99 species; Oxley *et al* 2003)
- 55 species of hydroid (representing 14 families; Environment Australia 2002c)
- 10 holothurians (Ceccarelli et al 2008)
- starfishes, brittle stars, feather stars, sea urchins
- At least 66 species of marine algae on NE Herald alone (Millar 2001).

Furthermore, nine of the decapod crustaceans seem to be undescribed (thus potentially endemic to the Site), and 17 of the decapod crustaceans and nine of the hydroids are not yet found elsewhere in waters associated with the Australian continent (Environment Australia 2002c).

Species richness of hard corals here is less than at Pacific Ocean (beyond the Coral Sea) and outer Great Barrier Reef locations, but comparable to other isolated tropical oceanic reefs in Australian waters (Ceccarelli *et al* 2008). The presence of Pacific Ocean corals lends support to the suggestion that the Coral Sea reefs provide stepping-stones for the dispersal of species between the Great Barrier Reef and Pacific Ocean reefs (Ceccarelli *et al* 2008).

The marine benthic communities of the Reserves show distinct differences from those of the Great Barrier Reef. In particular, the sessile benthic communities, though varied, are dominated by turf algae, encrusting coralline algae, *Halimeda* (a calcified green algae) and sponges, with far less hard coral cover than reef communities of the Great Barrier Reef (Ceccarelli *et al* 2008; ANPWS 1989a, b; Byron *et al* 2001). The number of algae species is likely to be much higher than currently recorded (Millar 2001).

Bêche-de-mer populations in the Coringa-Herald Reefs have remained healthy, amidst declining populations and catch rates at nearby Coral Sea reefs outside the Ramsar site that are under heavy fishing pressure (Hunter *et al* 2002). This reflects successful protection at the Site, and increases the importance of the Site to regional *Holothurian sp.* stocks and biodiversity.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

The sandy cays of the site support important isolated breeding colonies of Green Turtle (*Chelonia mydas*). It breeds on sandy islets of the Coringa-Herald cluster and on 11 cays of Lihou Reef. Nesting turtle data provided by Harvey *et al* (2005) indicates annual census numbers ranging from 12 – 1393 across the 1991-2 to 2001-2 breeding seasons. For Chilcott Islet, North-East and South-West Herald Cay and South-West Coringa Islet, across the period 1991-2 to 2003-4 (no survey in 1992-3), a total

of 6,193 turtles were recorded, at the major nesting sites, over the 173 nights of recording. The nesting population of Green Turtles within the site has genetic affinities to the Great Barrier Reef and Torres Strait populations (Environment Australia 2002c), but with sufficient differences to be regarded as a separate genetic breeding stock or 'management unit' (Moritz *et al* 2002). Movements of this highly migratory species between these locations have been confirmed in tagging studies (Harvey *et al* 2005). The nesting sites are especially important because they are almost totally free from disturbances such as artificial lighting, human beach use, pollution, feral animals and boat traffic compared to many nesting sites of the Great Barrier Reef. The site therefore provides reference (control) areas to aid determination of the impacts of such disturbances on breeding success within the overall population.

The site includes the only forested cays in the Coral Sea Islands Territory, and supports breeding colonies of 14 seabird species, 12 of which (including boobies, frigatebirds, tropicbirds and terns) are defined by Ramsar as waterbirds. Most breeding commences at the end of the cyclone season in March-April and continues during the cooler months. The colonies are important to the ecological balance of the Coral Sea region (Environment Australia 2002c), the seabirds gathering from an extensive oceanic 'catchment'. Some of the species have an extensive distribution outside of Australian waters, but are uncommon within Australia and the site contains a significant proportion of the Coral Sea's breeding populations. The Herald Cays breeding population exceeds 500 pairs of Red-tailed Tropicbird (*Phaethon rubricauda*) – being the largest-known breeding population of this species in the Coral Sea and eastern Australia, and the second largest in Australia after Christmas Island, Indian Ocean (Baker *et al* 2008; Royal Geographical Society of Queensland 2001, p. 70).

At least eight species of migratory shorebird, such as Pacific Golden Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*) use the site's reefs and cays as migration stop-over areas, although in very small numbers (Environment Australia 2002c).

Reefs, islands and associated habitats in the site provide the only habitat for a diverse community of sedentary reef-inhabiting animals within an extensive area of deep ocean, and many of these species will depend on these isolated habitats to complete their whole life cycle. Conceivably, the reefs also provide rare shelter for some oceanic species during severe storms.

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

The total number of waterbirds that use North-East Herald and South-West Herald Cays for breeding has exceeded 20,000 each year since monitoring commenced in 1992 (Royal Geographical Society of Queensland 2001, Baker *et al* 2008), although numbers of Black Noddy and Frigatebirds declined after 1998.

These numbers do not include populations that may occur on other cays in the site. Terns have not been fully surveyed at the site but are likely to total several tens of several thousands; the population of breeding Black Noddy (*Anous minutus*) alone is in the order of tens of thousands with about 20,000 nests reported in *Pisonia* forest at NE Herald each year between 1992 and 1997 (Baker *et al* 2008) and 37,000 nests in 1984 (Royal Geographical Society of Queensland 2001, p. 71). Other breeding populations recorded at North-East Herald, which contribute to the total, include Least Frigatebird *Fregata ariel* and Great Frigatebird *F. minor* (combined numbers exceed 1400 pairs, Baker *et al* 2008), Red-footed Booby *Sula sula* (about 150 pairs in *Argusia* shrubland and 1000 pairs in the *Pisonia/Cordia* forest) and Red-tailed Tropicbird (exceeding 500 pairs; Royal Geographical Society of Queensland 2001, pp. 70-71; Baker *et al* 2008).

Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

At least 390 species of coral reef fish (at least 54 families); including 342 species at North-East Herald Cay (Oxley *et al* 2003) and 390 species at Lihou Reefs (from the combined species lists of Ayling &

Ayling 1985 and Oxley *et al* 2004) occur at the Site. Surveys of cryptic fauna would likely reveal a much higher estimate of species richness. The fish fauna includes a very diverse range of morphologies, reproductive types and life strategies, made possible by the diversity of reef geomorphological zones, habitat types and niches at the Site. Life forms and life strategies among these species include benthic, demersal, pelagic, herbivorous, omnivorous, predatory, planktivorous, scavenging, symbiotic, live-bearing, egg-releasing, hermaphroditic protogyny and protandry. Several of these groups are present in high abundance, indicating a high level of biological diversity in the fish fauna. The fish communities of the Coral Sea Reserves in turn support a diverse and complex range of other ecosystem components and processes, such as multiple food webs, re-cycling and breakdown of coralline materials, algal grazing, symbiotic relationships, etc.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Stocks of food fishes and several invertebrate species of commercial value to nearby fisheries depend on the site to complete their whole life cycle of feeding, shelter, spawning and larval settlement. The site is also likely to be important to supply of larval recruits to other reefs “downstream” where valuable fisheries exist. It can be assumed that the productive shallow waters of the site’s reefs and lagoon support populations of prey species for pelagic and oceanic predators and also act as aggregation areas for oceanic and migratory species such as Yellow-fin tuna (*Thunnus albacares*) and Big-eye tuna (*T. obis*), target species in Australia’s Eastern Tuna and Billfish Fishery. The Ramsar site provides the only full protection of reef fish stocks within the “Northeast” Provincial Bioregion.

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Coringa-Herald and Lihou Reefs and Cays Ramsar Site lies within the “Northeast” Provincial Bioregion, in Australia’s “East” Marine Region.

b) biogeographic regionalisation scheme (include reference citation):

Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0. (Commonwealth of Australia, 2006), and 2005 National Benthic Marine Bioregionalisation of Australia (Heap *et al* 2005).

Note: The “Marine Ecoregions of the World” (MEOW) classification system adopts Australia’s IMCRA Version 4.0 regionalisation, and refers to Australia’s IMCRA “Northeast Province” as the “Coral Sea Ecoregion” which is grouped within the “Southwest Pacific” Province, which is part of the “Central Indo-Pacific” Realm (Spalding *et al* 2007).

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Geomorphology: The dominant feature of the site is a series of oceanic islets and associated coral reefs which occur on the Coral Sea (Queensland) Plateau, one of the largest carbonate platforms in today’s oceans.

Coringa-Herald National Nature Reserve includes three separate platform reef systems, each at a different stage of reef formation. Islets and cays supported by these reefs are the Herald Cays (South-West Cay, North-East Cay), Coringa Islets (Chilcott Islet, South-West Islet) and Magdelaine Cays (North-West Islet, South-East Cay). The islets and cays are composed of sand, rock and coral rubble and range from 16 to 37 ha in area. These cays have formed inside coral reefs that are fully exposed to the influences of oceanic currents and swells.

Lihou Reef National Nature Reserve protects the largest reef structure in the Coral Sea (Environment Australia 2002c): an incomplete loop with 18 small sand cays along its edge. The cays extend from Nellie Cay in the far south-west, eastward to Licklick Cay in the far north-east, thence westward to Juliette Cay. Lihou Reef is separated from the Coringa-Herald system by deep ocean.

Geomorphological categories of oceanic reef structure that have been identified in both Reserves include deep terrace, outer slope, intertidal reef flat, sub-tidal reef flat, sub-tidal patch reef flat, enclosed lagoon, drowned bank, and bank-reef-to land (cays and islets). Additional categories identified in the Lihou Reef NNR include reef pass, tidal patch reef, inner slope, and deep lagoon (Millennium Coral Reef Mapping Project, in Phillips *et al* 2006, pp 15-20).

Geology: The wetlands are made up of coralline reef materials on a carbonate oceanic platform (The Queensland Plateau). The reefs are likely to have formed since the last ice age, keeping pace with the rising sea levels (Environment Australia 2002c).

Climate: Due to the tropical location and the oceanic influence, there is little variation in daily or annual temperatures at these Reserves. Data from Willis Islets, approximately 50 km north-west of Magdelaine Cays, indicate mean daily temperatures during the two hottest months (December, January) range from a minimum of 25°C to a maximum of 31°C; for August, the coldest month, these data are 22°C and 26°C respectively (Bureau of Meteorology 2009). Mean annual rainfall is 1125 mm (Bureau of Meteorology 2009) with 68% falling from January to April (Royal Geographical Society of Queensland 2001). Wind energy and direction have a critical influence on sediment transport dynamics, cay location on reefs, and the distribution and growth of flora. South-east winds and swells predominate over the Coral Sea from March to November (windiest from April to September). Summer (December to March) is the period of north-west monsoons and cyclones when destructive impacts from wind and swells can occur (Proh 1995; Royal Geographical Society of Queensland 2001).

Hydrology: The oceanic location of the site dominates the hydrological forces affecting the reef. Tidal range is approximately 2 m. Although the information on oceanic currents in this area remains limited, there is evidence that westward currents operate for most of the year, bringing propagules and larvae from islands of the western Pacific to the Coral Sea. During June to September northward currents dominate and may assist the dispersal of biota and nutrients from the Great Barrier Reef to the Coral Sea (Brinkman *et al* 2001; Smith 1994).

Water Quality: The waters are a mix of warm, moderately saline equatorial water and cooler, more saline sub-tropical water. The salinity is constant at about 35.2 parts per thousand. The characteristics of salinity and temperature of the water are believed to be important to coral development.

Sediments and Soils: Biogenic reef substrates form the basis to the reef habitats, with a dominant cover of algal turf (a closely cropped ‘lawn’ of barely visible algae), coralline algae (resembling calcareous rocks) and *Halimeda*, a genus of calcified green algae. *Halimeda* “skeletons” and foraminifera “tests” also form a dominant source of material in sediments of the back-reef areas (Ceccarelli *et al* 2008). Biogenic calcareous sands contribute to the formation of sand cays and islets on several reefs. The calcareous soils on vegetated islands are classified as “Inceptic Coral Calcarosols” (Batianoff *et al* 2008) under the Australian soils classification nomenclature (McKenzie *et al* 2004).

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

The Coral Sea Islands Territory is situated in an oceanic environment, remote from coastal influences. Located in the tropical western Pacific Ocean, the site is dominated by warm oceanic water, climate and weather conditions (see section 16 above). The calcareous sediments of these reefs are primarily derived in-situ from biogenic origins.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

The site comprises mostly isolated oceanic wetlands (coral reefs) with only small scattered islets of dry land. The islets are low (not exceeding 5 m above mean sea level) with limited freshwater lenses fed by direct overhead rainfall, and no upstream surface or groundwater sources. Some islets have sufficient freshwater to support vegetation.

19. Wetland Types**a) presence:**

Circle or underline the applicable codes for the wetland types of the Ramsar “Classification System for Wetland Type” present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp • Ts • U • Va •
Vt • W • Xf • Xp • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

b) dominance:

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

Wetland habitat types occurring within the Site have not all been adequately mapped to determine area of extent, but they are likely to occur in approximately the following order of dominance:
C,E.

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

Vegetation occurs on all Coringa-Herald cays except North-West Cay (currently 12 families and 17 species, excluding 2 species presumed locally extinct sometime between 1997 and 2006-07; Batianoff *et al* 2008), and on five of the Lihou cays (Turtle Islet and Georgina, Nellie, Lorna and Anne Cays: 7 plant species). These are all littoral (shoreline) and/or oceanic island plant species distributed widely on shores comprised mainly of calcareous sands; and they depend on oceanic currents, wind and/or sea-bird vector dispersal across the Australian, Melanesian and Pacific islands (see Batianoff *et al* 2008). Although these are not wetland plant communities, some are crucial roosting or nesting habitat for key wetland species such as waterbirds (particularly seabirds), and may provide shade and temperature stability over some incubating clutches of sea turtle eggs.

Vegetation such as *Pisonia* forests, *Argusia* shrubs and/or other herbs and grasses occur here and provide important roosting and nesting for wetland birds (mostly seabirds). Grassland and herbfield communities occur in both Reserves; dominant grass species are *Lepturus repens*, *Stenotaphrum micranthum* and *Sporobolus virginicus*. Shrubland (open-scrub) of *Argusia argentea* occurs on the vegetated Coringa-Herald cays and low closed-forest of *Pisonia grandis*, with some *Cordia subcordata*, to 10 m height occurs on North-East (Herald) Cay and South-East (Magdelaine) Cay (Batianoff *et al* 2008; Environment Australia 2002c; Royal Geographical Society of Queensland 2001).

The marine habitats present in the shallower areas of both Reserves are front (windward) reef slopes, exposed reef crests/rims, reef flats, back (leeward) reef crests, back reef slopes, reef shoals, and inter-reef channels. Reef benthos is dominated by turf algae, encrusting coralline algae, *Halimeda* (a calcified green algae) and sponges, with far less hard coral cover than reef communities of the Great

Barrier Reef or Pacific Ocean (Ceccarelli *et al* 2008; Byron *et al* 2001; Oxley *et al* 2003, Oxley *et al* 2004).

Marine algal communities are a major ecological feature of the site, frequently covering a greater area than the corals, although these are mostly small plants, turfs or encrusting forms. During a 1997 preliminary survey of marine algae of North East (Herald) Cay, 66 species were recorded, though this is expected to be only a fraction of the total present. Forty-one species of red algae, 23 of green algae and 2 of brown algae were recorded. *Halimeda* spp., a calcified green algae of warm seas, is a prominent feature of the benthic habitat. The near absence of brown algae is unusual for what appears to be a typical reef environment (Environment Australia 2002c). Only a few plants of the seagrass *Halophila ovalis* have been seen in benthic surveys (A. Ayling, pers comm. 2009). Reef platforms containing vegetated islands in the Western Pacific often support seagrasses in greater abundance and species numbers (Coles and Kuo, 1995; Coles and Lee Long, 1995) but seagrass growth here may be limited by the exposed nature of these reefs.

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

The *Pisonia grandis* forest ecosystem is relatively uncommon, both in Australia and globally, despite having an extensive Indo-Pacific geographical range. *Pisonia grandis* forests have been cleared throughout much of their range. Remaining examples are known from only 44 of about 950 islands within the Great Barrier Reef region and the species is rare on reef islands in the north of this region where it does not generally form monospecific stands. The *P. grandis* forests of Coringa-Herald NNR are therefore of intrinsic value as well as playing a significant role as habitat for nesting waterbirds (seabirds).

Sandy islets of the Coringa-Herald Reserve support important stands of the littoral shrub *Argusia argentea*, and plants of the tree *Cordia subcordata*, which have been extensively cleared throughout much of their range and are listed as listed on the IUCN Redlist as Lower Risk/Least Concern (IUCN 2008).

Two plant species *Digitaria ctenantha* (an annual tropical grass) and *Ximenia Americana* (a shrub or small tree) were previously recorded in surveys up to 1997, but not found on any vegetated cay during the 2006–07 Coringa-Herald surveys and are now considered locally extinct from CHNNR (Batianoff *et al* 2008).

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Threatened species. The Green Turtle (*Chelonia mydas*) population at the site (see item 12) is part of a regional population that extends to the Great Barrier Reef, Torres Strait and New Caledonia. However, the sea turtles using the Coral Sea Reserves also display genetic distinctions sufficient to be regarded as a separate genetic breeding stock or ‘management unit’ (Moritz *et al* 2002).

Other noteworthy fauna.

Three non-colonial waterbirds—Eastern Reef Egret (*Egretta sacra*), Buff-banded Rail (*Gallirallus philippensis tournelieri*) and Purple Swamphen (*Porphyrio porphyrio*)—breed at the site (Royal Geographical Society of Queensland 2001).

Non-waterbirds that use the site include 60,000 to 130,000 breeding pairs, annually, of Wedge-tailed Shearwater *Puffinus pacificus* (Royal Geographical Society of Queensland 2001).

The marine faunal assemblage of the site is distinctive in several ways: sponges (family Spongiidae) form an important part of the reef fauna and often are more abundant than coral, in marked contrast to the shallow reef areas of the Great Barrier Reef; hard corals cover a relatively small proportion of reef area compared to the hard corals of the Great Barrier Reef and other sites in the western Pacific; the decapod crustacean and hydroid faunas are relatively rich; and some species of fish that are common in the Site are rare or absent from the Great Barrier Reef, and vice versa.

The presence of Pacific Ocean corals lends support to the suggestion that the Coral Sea reefs provide stepping-stones for the dispersal of species between the Great Barrier Reef and Pacific Ocean reefs (Oxley *et al* 2003; Ceccarelli *et al* 2008). The dominant hard corals of the site are *Acropora palifera*, *A. humilis* and *Poecilopora* spp. and the dominant soft corals are *Sarcophyton* sp.

Commonly occurring sponges in the site's large and spectacular sponge gardens include *Thorecta* n. sp., *Polyfibrospongia flabellifera*, *Phyllospongia* n. subsp., *Carteriospongia lamellosa*, *Carteriospongia* n. sp., and *C. pennatula*. *Phyllospongia pennatula*, which had not been collected since 1889, is common at Chilcott Islet. Two species of marine mollusc, *Rissopsis typica* and *Cypraea childreni*, are quite common at the site despite being rare over much of the rest of their range (Environment Australia 2002c).

The families of fishes represented by the largest number of species are the Labridae (wrasses), Pomacentridae (damselfishes), Acanthuridae (surgeonfishes), Chaetodontidae (butterfly fishes), Serranidae (cods and coral trout), and Scaridae (parrotfishes) (Environment Australia 2002c, Oxley *et al* 2004). Damselfish, followed by wrasses and surgeonfish, were also the most abundant in surveys of Coringa-Herald reef front habitats (Ceccarelli *et al* 2008). Blacksaddle coral trout *Plectropomus laevis* densities at the Coringa-Herald (Ceccarelli *et al* 2008) and Lihou Reefs (Oxley *et al* 2004) Reserves are over twice as high as on outer-shelf Great Barrier Reef (GBR) sites, but other large coral reef serranids (keystone food fishes) are less dense here than in the Great Barrier Reef and Pacific Ocean reefs. Excavating scarids (parrot fishes) and the Maori wrasse are also far less dense here than in the GBR or at Elizabeth and Middleton Reefs in the northern Tasman Sea (Ceccarelli *et al* 2008).

The Site supports at least ten species of holothurians, which are important components of commercial fisheries that exist in the surrounding reefs and neighbouring regions. Protection afforded by the Reserves appears to be successful, and makes these populations potentially important sources for larval recruitment and replenishment to the nearby fished reefs (Oxley *et al* 2003, 2004; Ceccarelli *et al* 2008).

Gastropods which are valuable in the ornamental shell trade (spider conchs *Lambis* spp., baler shells *Cymbium* sp., cone snails *Conus* spp. and cowries *Cypraea* spp.) or for medicine (cone snails) are present in high abundances, and may also be important sources of larval recruitment to other fished reefs in the region (Ceccarelli *et al* 2008).

23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

Many ships have been wrecked on Lihou Reef, and documented wrecks date from the 1890's onward. The wreck of the *Coringa Packet*, lying off Chilcott Islet in the Coringa-Herald National Nature Reserve, is dated at 1845. Shipwrecks located within the Reserves are protected under the *Historic Shipwrecks Act 1976* if they are more than 75 years old.

Guano mining occurred on Chilcott Islet in the 1860s-70s and some relics remain.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

No.

If Yes, tick the box and describe this importance under one or more of the following categories:

- i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:
- ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:
- iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:
- iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

a) within the Ramsar site:

The Ramsar Site comprises two separate National Nature Reserves that are owned by the Commonwealth Government of Australia. The Reserves and surrounding oceanic waters lie within the Coral Sea Islands Territory of Australia.

b) in the surrounding area:

Oceanic waters surrounding the Reserve are within the Economic Exclusion Zone of Australia.

25. Current land (including water) use:

a) within the Ramsar site:

The Site is used for nature conservation and scientific research; also some recreational diving. There is no resident human population on the site although there is a manned weather station at Willis Island, outside of the Site, 50km north-west of the Magdelaine Cays.

b) in the surroundings/catchment:

Surrounding areas support the commercial Coral Sea Fishery and the Eastern Tuna and Billfish Fishery, which are managed by the Australian Fisheries Management Authority. Dive- and fishing-based tourism and recreation also occur, but on a limited scale due to the distance from centres of human population.

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

a) within the Ramsar site:

Being a remote protected area, the site receives minimal direct threats from human activity. Apparently there are no exotic mammal species since the Black Rat (*Rattus rattus*) (1940s to 1991) was eradicated, and mining for guano (1860s-70s on Chilcott Islet) has long ceased. The site is now subject to infrequent and largely benign visitation by humans. Human influences on or external to the site which have potential to adversely affect its ecological character include general marine pollution, oil spills associated with shipwrecks, impacts of anchoring and diving, disturbance to seabird and turtle breeding colonies, and introduction of exotic insect species. Increased availability of new

technology may contribute to increases in frequency and type of human use at the site, despite the current quotas and restrictions on visitation and use.

Terrestrial invertebrates such as ants, scale insects, hawk-moths and mealy bugs influence the health of key vegetation communities (especially *Pisonia grandis* and *Cordia subcordata*) and thus affect the health of nesting and roosting seabird populations at the Site. The natural dynamics of these damaging insect populations operates via a complex interplay of natural and immigrant predator-prey, parasitoid-host populations, competition, plant resilience and prevailing climatic factors. Although biological controls, using natural predator and parasitoid species, have been temporarily successful in treating some damaging outbreaks in the *Pisonia* forests (eg, Smith & Papacek 2002; Smith *et al* 2004), potential exists for future damaging outbreaks to occur on the two remaining forested islets (NE Herald and SE Magdeline Cay). Additional threats from defoliators such as hawkmoths, *Hippotion velox* (Fabricus) and *Theretia* sp. (Smith *et al* 2004) and mealy bugs *Ferrisia malvastra* (Freebairn 2007), requires ongoing monitoring and strict quarantine procedures for the islets (eg, Smith *et al* 2001; Greenslade and Farrow 2008, Batianoff *et al* 2008).

Some natural factors such as these have impacted the site's ecological character prior to, and since Ramsar listing. The former 16 ha *Pisonia grandis* forest (seabird roost habitat) on South-West Coringa Islet was extensively damaged by cyclonic activity during the 1980s, and finally reduced to herbfield by an outbreak of the cosmopolitan scale insect *Pulvinaria urbicola* between 1991 and 2000. Prolonged dry periods have been identified as contributors to further stress, and thus vulnerability to insect attacks, on the remaining *Pisonia* forests (Batianoff *et al* 2008). An exotic ant (*Tetramorium bicarinatum*) which farms the urbicola scale insect was baited in 2001. However this ant remains abundant and may exacerbate any future resurgence of scale insect on remaining forests, and may also pose some threat to other invertebrates and to ground nesting seabirds (Freebairn 2007).

Erosion and destabilisation of the fringing *Argusia* shrubland on North East (Herald) Cay has compromised this windbreak protecting the *P. grandis* forest. Some forest areas have already been destroyed and a potential outcome is the gradual replacement of forest with grassland. This vegetation loss would have implications for the terrestrial ecology of the cay, particularly the composition of the nesting seabirds, and the hatching success and sex ratios of breeding Green Turtles (Royal Geographical Society of Queensland 2001).

For seabirds in this region, the key vulnerabilities to climate change are clearly identified as the predicted increases in sea surface temperature and changes to the major seasonal-scale weather patterns that influence circulation and upwelling, such as the ENSO (Congdon *et al* 2007). Potential impacts from predicted sea level rise and changes in the frequency and intensity of tropical storms and cyclones are also recognized, but not as well understood (Congdon *et al* 2007).

Global sea temperature rises and increased frequency and strength of cyclonic activity associated with climate change are particular ongoing sources of adverse impact on coral reef habitats and associated communities at the Site, as they are on other reefs in the region. Cyclones have been suggested as possible causes of drastically reduced coral cover and consequent fish abundance and species richness, particularly on the exposed reef crest and front slope (Ayling & Ayling 1984; Royal Geographical Society of Queensland 2001). Repeated incidences of pan-tropical coral bleaching (Fig. 4) associated with elevated sea-surface temperatures (notably in 1998 and 2002), has had significant impacts on total live hard coral cover, triggering some concerns for possible local extinctions of the less abundant species (Oxley *et al* 2003, Oxley *et al* 2004).

Ultimately the health of other faunal components of the coral reef communities is dependant on the continued formation and structural integrity of the hard coral habitats. The ability of these particular coral reef communities to recover from climatic impacts is limited because of the relatively low species richness (and functional diversity), small reef sizes, and remoteness from other sources of larval recruitment (Ceccarelli *et al* 2008). The current shortage of reproductively mature corals and of

Acropora corals in particular is a concern for recovery of coral cover, even in the absence of further impacts (Ceccarelli *et al* 2008).

Crown-of-thorns Starfish *Acanthaster planci*, have been observed within the Site, however they do not currently occur in numbers sufficient to cause disturbance to the indigenous reef fauna (Royal Geographical Society of Queensland 2001). There is no recorded history of disturbance by other coral predators, eg, the predatory marine snail *Drupella cornis*.

b) in the surrounding area:

As described above, global climatic changes (with increased cyclonic activity, increasing sea surface temperature anomalies and sea level rise) that affect regional coral communities are important concerns to the ecological character of the Site. Adverse climate impacts in neighbouring areas may have additional impacts on larval recruitment to the Site given the connectedness of the Site's flora and fauna via oceanic currents.

27. Conservation measures taken:

a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:

In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

The Site is composed of the Coringa-Herald National Nature Reserve, and Lihou Reef National Nature Reserve, and its boundary corresponds to the boundaries of these national nature reserves.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ; Ib ; II ; III ; IV ; V ; VI

c) Does an officially approved management plan exist; and is it being implemented?:

Coringa-Herald National Nature Reserve, and Lihou Reef National Nature Reserve, were proclaimed in August 1982 (Commonwealth of Australia 1982) and the first management plans were implemented in 1989 (ANPWS 1989a,b). Management of the Reserves is currently subject to provisions of the federal *Environmental Protection and Biodiversity Conservation Act 1999*.

Given the close proximity of the Reserves, the similar nature of the threats they face and their management arrangements, the second management plans for the Reserves were combined into one document in 2001 (Environment Australia 2002c). The Coringa-Herald National Nature Reserve and Lihou Reef National Nature Reserve Management Plan expired on 4 September 2008. Until a new management plan is in place, the Reserves are being managed under interim management arrangements. These interim management arrangements for the area maintain the level of protection afforded to this area by the previous management plan.

The strategic objectives of the Plan are: to protect, preserve and manage the natural and cultural values of the Reserves; to protect key breeding and nesting habitat for listed species such as Green Turtle and seabirds; to manage the Reserves as a reference site for scientific research and long-term monitoring; to allow for limited and appropriate public access to the Reserves for education and enjoyment; and to manage the Reserves as part of a comprehensive, adequate, and representative system of marine protected areas.

Activities such as scientific research, dive charter tours and other commercial activities are managed by use of permits. A limit of 10 commercial tours per year, with up to 30 passengers per tour, has been set. Visitor logbooks are maintained at the Reserves to monitor use of the Site. Commercial and recreational fishing, fish-feeding, camping on the islets, bio-prospecting and operations for the recovery of minerals are not permitted during the period of the Plan. Staff of the Australian Government Department of Environment, Water, Heritage and the Arts undertake an average of one

management patrol per year to the Reserves, generally using Royal Australian Navy patrol boats or Customs vessels for transport and support.

d) Describe any other current management practices:

Resource limitations and the remoteness of this site mean research, monitoring and management responses are constrained and often opportunistic. Nevertheless strategic review of management needs and resource allocation at the site is ensuring a mix of ongoing monitoring across several elements, combined with active management responses to the more urgent conservation issues. Scientific studies have also recommended ongoing monitoring, strict quarantine procedures for the islets and pre-testing of the impacts of biological control agents (BCA's) before decisions on implementing any BCA's and vegetation (eg, Smith *et al* 2001; Freebairn 2007; Greenslade and Farrow 2008).

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

The Reserves are being managed under interim management arrangements until the third management plan is developed.

29. Current scientific research and facilities:

e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

In the Lihou Reef National Nature Reserve the Australian Bureau of Meteorology operates an automatic weather station on Turtle Islet, and a solar powered navigation beacon is established at the eastern tip of Lihou Reef. After the pending removal of the Department of Environment, Water, Heritage and the Arts equipment storage facility from NE Herald Islet, no other permanent structures will exist at the Site.

Due to the remote oceanic location and exposed nature of the islets, research opportunities are limited and no permanent field station exists at the Site. However, the remoteness and undisturbed condition of the site presents a valuable 'control' site for monitoring of changes in other reef systems in this and neighbouring regions, including the Great Barrier Reef to the west. The site has been visited by a number of scientific expeditions, notably three in the early 1960s, and a multi-disciplinary scientific expedition organised by the Royal Geographical Society of Queensland which visited the Herald Cays and surrounding reef in June 1997. Since 1979, a number of marine surveys have been conducted on a primarily opportunistic basis in conjunction with the regular management/monitoring patrols, including dedicated marine surveys in 1984 (Ayling and Ayling 1985), 1997 (Byron *et al* 2001), 2003 (Oxley *et al* 2003), 2004 (Oxley *et al* 2004) and 2007 (Ceccarelli *et al* 2008).

A systematic tagging program for Green Turtle, in collaboration with the Queensland Parks and Wildlife Service, operated from 1991 to 2005. The monitoring program had two components: monitoring of nesting activity, tagging and measuring of turtles; and determining the hatching success of stock from the previous nesting survey. The life history of turtles is such that impacts on populations can only be determined from long-term monitoring (20+ years). With a nesting interval of four to eight years, inter-season tag returns are just becoming apparent, and additional years of monitoring are required to obtain results from the effort expended in previous years (Harvey *et al* 2005; Environment Australia 2002c).

A monitoring program, which is essential to enable assessment of impacts on the stability of the region's seabird populations, focuses on the following breeding species: Least Frigatebird *Fregata ariel*, Great Frigatebird *Fregata minor*, Red-footed Booby *Sula sula*, Brown Booby *Sula leucogaster*, Masked Booby *Sula dactulatra*, Black Noddy *Anous minutus*, and Red-tailed Tropicbird *Phaethon rubricauda* (see Baker *et al* 2008).

Destructive infestations of scale insect on *Pisonia* forests in the 1990s, and more recent impacts by hawk moths and mealy bugs have been addressed through a strategic program of biological control

testing and application, which commenced in 2001. Vegetation and terrestrial invertebrate surveys, monitoring, research and biological control activities are being implemented where possible, to help improve management responses to any further impacts of terrestrial invertebrates on key vegetated habitats.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

Due to the remote oceanic location, the site is not suitable for a substantial visitor education program. However, education aspirations are included in the Management Plan and signs and other interpretive material exist at the site. Detailed information on the Reefs, including the Management Plan and photographs, and the brochure, is available here:

<http://www.environment.gov.au/marinereserves/coralsea/index.html> (Environment Australia 2002c).

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

The reefs of the Site, with their spectacular and unusual topographic features, great variety of marine life and world-renowned reputation for extreme clarity of water, are a prime diving venue. Snorkeling and bird watching also occur. Charter tours visit the Reserves under permit issued by the Australian Government Department of Environment, Water, Heritage and the Arts. A limit of 10 commercial tours per year, with up to 30 passengers per tour, has been set under the previous management plan and current interim management arrangements. Estimated numbers of visitors to the Reserves have ranged from 100 to 200 per year over the last 15 years, with no discernible upward trend (Environment Australia 2002c). The remote oceanic location and high cost of gaining access provide a natural limit to visitor numbers, however the increased availability of new technology may contribute to increases in frequency and type of human use at the Site.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

The Reserves are situated in the Coral Sea Islands Territory and within the Australian Exclusive Economic Zone, which is under the jurisdiction of the Commonwealth Government of Australia; functional jurisdiction lies with the Director of National Parks, The Department of the Environment, Water, Heritage and the Arts, Canberra.

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

The Reserve is managed by the Marine Protected Areas Section, Marine and Water Division, Department of the Environment, Water, Heritage and The Arts, Australia, GPO Box 787, Canberra ACT 2601, Australia. Contact: Mr Neil Gemmell, Marine Parks Australia, Tropical Operations and Transition, Ph: (02) 6274 2772

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

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Appendix 1: Waterbird Species Recorded from the Coral Sea Reserves Ramsar Site

(* Species listed under migratory bird agreements between Australia and Japan/China)

(B = Breeding, X = Present but not breeding, – = Not recorded)

Sources: ANPWS 1989a,b; Royal Geographical Society of Queensland 2001; Weston *et al.* 1991.

Species	Coringa-Herald NNR	Lihou Reef NNR
Red-tailed Tropicbird <i>Phaethon rubricauda</i>	B	-
*Masked Booby <i>Sula dactylatra</i>	B	B
*Red-footed Booby <i>Sula sula</i>	B	B
*Brown Booby <i>Sula leucogaster</i>	B	B
Little Black Cormorant <i>Phalacrocorax sulcirostris</i>	X	
Australian Pelican <i>Pelecanus conspicillatus</i>	-	X
*Great Frigatebird <i>Fregata minor</i>	B	X
*Least Frigatebird <i>Fregata ariel</i>	B	B
*Eastern Reef Egret <i>Egretta sacra</i>	X	-
Australian White Ibis <i>Threskiornis molucca</i>	-	X
Buff-banded Rail <i>Gallirallus philippensis tournelieri</i>	B	B
Purple Swamphen <i>Porphyrio porphyrio</i>	B	-
*Bar-tailed Godwit <i>Limosa lapponica</i>	X	-
*Little Curlew <i>Numenius minutus</i>	-	X
*Whimbrel <i>Numenius phaeopus</i>	X	X
*Grey-tailed Tattler <i>Heteroscelus incana</i>	X	X
*Ruddy Turnstone <i>Arenaria interpres</i>	X	X
*Great Knot <i>Calidris tenuirostris</i>	-	X
*Sharp-tailed Sandpiper <i>Calidris acuminata</i>	X	-
*Pacific Golden Plover <i>Pluvialis fulva</i>	X	X
Silver Gull <i>Larus novaehollandiae</i>	-	X
Crested Tern <i>Sterna bergii</i>	B	-
*Black-naped Tern <i>Sterna sumatrana</i>	X	B
*Little Tern <i>Sterna albifrons</i>	-	B
Fairy Tern <i>Sterna nereis</i>	X	-
*Bridled Tern <i>Sterna anaethetus</i>	X	-
Sooty Tern <i>Sterna fuscata</i>	B	B
*Common Noddy <i>Anous stolidus</i>	B	B
Black Noddy <i>Anous minutus</i>	B	B