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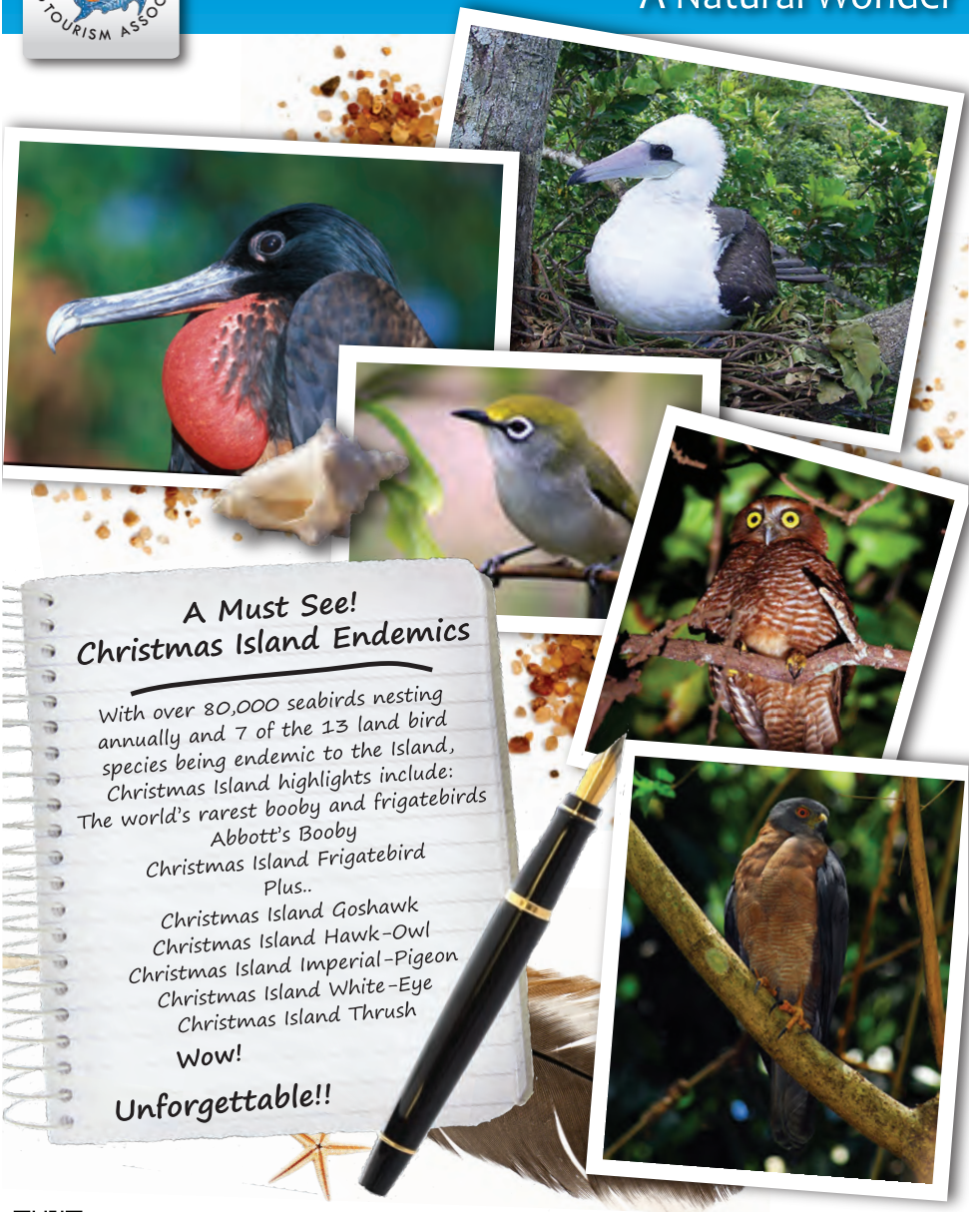
Christmas Island
A Natural Wonder



A Must See!
Christmas Island Endemics

With over 80,000 seabirds nesting annually and 7 of the 13 land bird species being endemic to the Island, Christmas Island highlights include:
The world's rarest booby and frigatebirds
Abbott's Booby
Christmas Island Frigatebird
Plus..
Christmas Island Goshawk
Christmas Island Hawk-Owl
Christmas Island Imperial-Pigeon
Christmas Island White-Eye
Christmas Island Thrush

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Unforgettable!!

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The birds of Christmas Island, Indian Ocean: A review

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Summary. This paper is an account of all known records of birds from Christmas Island in the eastern Indian Ocean. It also includes reviews of the history of the Island's ornithology, its avian biogeography, the taxonomy of selected endemic taxa, population estimates of resident species, and current and past threats to its birds. One hundred and forty-nine species of birds have been recorded from the Island, of which 14 are breeding landbirds, nine are breeding seabirds, 18 are visitors and 108 are vagrant species. The Island has a high degree of endemism and this is expressed in the avifauna through 11 endemic taxa among the 23 breeding species. Biogeographically, Christmas Island is an oceanic island, with breeding and visiting species originating from several sources including South-East Asia, Australia, the Palaearctic, pelagic, and other undetermined sources. Links to the Greater Sunda Islands and Wallacea are very minor. The Island was first occupied by humans in 1888. Since then, three bird species have been introduced (two deliberately) and four have self-colonised. No bird taxa have become extinct locally, despite several extinctions of other endemic and indigenous fauna. However, numerous threatening processes are placing increasing pressure on native birds.

Introduction

The birds of Christmas Island, Indian Ocean, have been reviewed several times, most recently in 2004 (Sharpe 1900; Chasen 1933a; Gibson-Hill 1947; Stokes 1988; Johnstone & Darnell 2004a). Nevertheless, there is still a need to better analyse the status, biogeography and trends of the avifauna, which is highly significant for several reasons: there are seven endemic species, no fewer for instance than countries such as Thailand, Costa Rica or Kenya (cf. Clements 2000); the avifauna includes several globally threatened species; and includes many species that are vagrants to both the nearby Indomalayan biogeographical region and to Australia as a political unit. In addition, Christmas Island is biogeographically unique and poorly studied (James & Milly 2006). Interest in the Island is increasing amongst ornithologists and birders, particularly from Australia, but also globally (see below).

Here we review the birds of Christmas Island, assessing the status of the breeding species and regular visitors, documenting and vetting many additional records of vagrants, and assessing the significance and biogeographical affinities of the avifauna.

Christmas Island

Christmas Island is located in the tropical eastern Indian Ocean at 10°28′S,

105°38′E [Figures 1–2 (p. S49)]. It is located ~2600 km north-north-west of Perth, 2800 km west of Darwin, 350 km south of Java Head in Indonesia, and 980 km east-north-east of the Cocos (Keeling) Islands. It is administered as an external territory of Australia. It is 137 km^2 in area, with 85 km^2 (62%) protected within the Christmas Island National Park. The National Park also extends 50 m seaward of the low-water mark for 46 km (63%) of the coastline (DNP 2002). The Australian Economic Exclusion Zone (EEZ) extends out 200 nautical miles (nm) except near the Indonesian EEZ ~90 nm to the north.

Christmas Island is an isolated oceanic island that has never been connected to another land mass. It rises from an abyssal plain ~5000 m deep, and has no offshore islets. A narrow fringing reef 20–100 m wide and 10–20 m deep completely encircles it before the submerged mountain plunges steeply to 2000 m deep within 5 km of the shore and more gently to 5000 m deep ~30 km away (Gray & Clark 1995). Christmas Island first appeared at the surface as a volcano *c.* 44 million years ago where a coral atoll formed (Nunn 1994; Gray & Clark 1995; Hoernle *et al.* 2011). This was probably 700 km or 15° of latitude farther south than at present, from where it has drifted northwards at a rate of a few centimetres a year (Gray & Clark 1995; DNP 2002). Subsidence of the volcano or the collapse of its caldera and a series of subsequent uplift events, including further volcanic activity 4 million years ago and continuing formation of coral reefs, have created a basaltic core capped with jagged limestone in a series of up to four tiered terraces [DNP 2002; Hoernle *et al.* 2011; see Figure 3 (p. S50)]. The coastline consists mostly of sheer limestone cliffs up to 20 m high with a few small rubble beaches. The inland plateau is gently undulating with occasional small hills rising 160–360 m above sea-level. The terraces between the coast and the plateau are generally narrow and separated by mostly sheer cliffs, which are often tilted or collapsed (Gray & Clark 1995; DNP 2002). Deep deposits of phosphate occur, especially on the plateau (Gray & Clark 1995; DNP 2002). Although it is unclear whether these originate from seabird guano or marine sedimentary deposits, the best evidence suggests that they are highly modified guano deposits (Weissberg & Singers 1982). A few small freshwater springs occur on the lower terraces, but there are no bodies of open water apart from ephemeral puddles.

The climate is equatorial with a wet season (north-westerly monsoons) from December to April and a dry season (south-easterly trade winds) prevailing for the rest of the year. The average annual rainfall is 2060 mm, ranging between a high of 3715 mm and low of 1067 mm (Australian Bureau of Meteorology data = BOM 2013). The hottest conditions are generally in March and April, and the coldest in August. The average maximum temperature is 27.3°C and the average minimum is 22.8°C, with extremes of 31.8°C and 14.1°C, respectively (BOM 2013). Local sea-surface temperatures are influenced by an upwelling south of Java, and follow a regular seasonal pattern of minima (<26°C) in August–October and maxima (>28°C) in February–April (Reville *et al.* 1990a). The higher productivity associated with cooler temperatures apparently dictates the highly seasonal breeding cycles of most seabird species on the Island (Reville & Stokes 1994).

Christmas Island's biogeography is influenced by both the Indomalayan and Australasian biota, but belongs to neither; it is biogeographically unique (James

& Milly 2006). The native vegetation consists of predominantly tall evergreen rainforests in the interior with semi-deciduous vine thickets on the coastal terraces [Australian Biological Resources Study 1993; see Figures 4–5 (pp. S50–51)]. The forests are floristically depauperate, but structurally complex. Approximately 25% of the Island has been cleared, and comprises open rocky ground and phosphate mine fields, weed fields, secondary growth and urban areas (Gray & Clark 1995; DNP 2002). There are at least 250 animals and plants (species and subspecies) endemic to the Island (James & Milly 2006). Endemic animals, apart from birds, include five mammals, five reptiles, four marine fish, 13 marine invertebrates and >200 described terrestrial and subterranean invertebrates. However, there are probably many more undescribed endemic invertebrates. The land crab fauna is world-famous for its unparellelled taxonomic and ecological diversities and its sheer biomass, and investigations continue to discover new endemic species (Orchard 2012). The endemic Red Crab *Gecarcoidea natalis* plays a significant role in determining the floristics and structure of the forests (Hicks *et al.* 1984; Orchard 2012), and thus probably the avifaunal composition. The subterranean invertebrate fauna is poorly known, but may be amongst the most significant in the world (Humphreys & Eberhard 2001). One endemic genus of small beetles, *Rhyncholobus*, has radiated into at least four species, each in a different habitat, as in Darwin's finches in the Galapagos Islands (James & Milly 2006). A recent review (Orchard 2012) suggests that autochthonous radiation may have occurred in terrestrial and subterranean crabs, but the land area, habitat diversity and perhaps isolation of Christmas Island are evidently insufficient to facilitate autochthonous radiation in vertebrate species.

A total of 16 species of birds bred on the Island at the time of human colonisation in 1888 (Sharpe 1900), although 23 species breed now (Johnstone & Darnell 2004a; James & Milly 2006; Valenzuela & James 2006). As recognised herein, 11 birds are endemic at either the species or subspecies level. Abbott's Booby *Papasula abbotti* is a palaeo-endemic species, so called because it once had a wider breeding range, but is now confined to the Island. The rest are neo-endemics: species that have evolved *in situ*. Six of these are endemic at the species level (Christmas Island Imperial-Pigeon *Ducula whartoni*, Christmas Island Swiftlet *Collocalia natalis*, Christmas Island Frigatebird *Fregata andrewsi*, Christmas Island Goshawk *Accipiter natalis*, Christmas Island Hawk-Owl *Ninox natalis* and Christmas Island White-eye *Zosterops natalis*), and four are endemic at the subspecies level (White-tailed Tropicbird *Phaethon lepturus fulvus*, Emerald Dove *Chalcophaps indica natalis*, Great Frigatebird *Fregata minor listeri* and Island Thrush *Turdus poliocephalus erythropleurus*). The swiftlet has been treated as a subspecies of either the Glossy Swiftlet *Collocalia esculenta* or Linchi Swiftlet *C. linchi*, but is treated here as an endemic species. Similarly, the goshawk has been treated as a subspecies of the Brown Goshawk (*Accipiter fasciatus natalis*) in the past and more recently as a subspecies of the Variable Goshawk (*A. hiogaster natalis*) (see Christidis & Boles 2008). No detailed taxonomic studies have been made of either the swiftlet or the goshawk (but see the Taxonomy and nomenclature section under Results). Five other species that were present at the time of settlement are wider-ranging taxa in the tropics and are not confined to the Island (Red-tailed Tropicbird *Phaethon rubricauda*, Red-footed Booby *Sula*

sula, Brown Booby *S. leucogaster*, Eastern Reef Egret *Egretta sacra* and Common Noddy *Anous stolidus*). Four species have colonised the Island of their own accord since settlement (Nankeen Kestrel *Falco cenchroides*, *c.* 1940s; White-faced Heron *Egretta novaehollandiae*, between 1965 and 1977; Lesser Frigatebird *Fregata ariel*, probably before 1980; and White-breasted Waterhen *Amaurornis phoenicurus*, *c.* 1992). A fifth species, the Asian Koel *Eudynamys scolopaceus*, has been present since *c.* 2002 and is possibly breeding. With the exception of the frigatebird, the new species are dependent on secondary habitats and their colonisation was facilitated by habitat clearance. Three introduced species have become established (Feral Chicken *Gallus gallus*, Java Sparrow *Lonchura oryzivora* and Eurasian Tree Sparrow *Passer montanus*). These are largely commensal with human disturbance and are rarely found in natural habitats. In addition, 18 species of migrants and 108 vagrants have been recorded on the Island (this paper). The avian biogeography of the Island is analysed in the Results.

Most conservation issues on the Island stem from a combination of inadequate quarantine (leading to the establishment of invasive plants and animals) and inappropriate land management (past land clearing, abandonment of phosphate mine fields, road verges etc.), which allows invasive species to prosper (James 2007). Wide-scale clearing for mining and municipal purposes, from colonisation until the early 1980s, removed ~25% of the Island's original forests. These areas currently vary from active mine sites, bare limestone pinnacle fields, abandoned weed fields, secondary-growth forests and revegetation fields to urban environments. A moratorium on forest clearing since 1988 is tenuously supported by law, but frequently challenged and seemingly vulnerable. A major threat in recent years comes from the invasive Yellow Crazy Ant *Anoplolepis gracilipes*, which reaches high densities, and alters the forest environment significantly (O'Dowd *et al.* 2003). Unfortunately, many other invasive species are present, including numerous other ant species, centipedes, bees, reptiles, rats, cats and plant weeds (James 2007). A focus on wide-scale control of Crazy Ants at the expense of targeted protection for vulnerable remnant populations may have had severe unintended consequences, such as the extinction of a bat and several reptiles in the last decade (James & McAllan 2010). In the past, hunting, poaching and persecution were significant threats (Stokes 1988). We are concerned that human over-population of the Island is emerging as a serious threat to the biota that apparently is not being monitored adequately; compare the situation on Lord Howe Island where the number of humans has a set limit (McAllan *et al.* 2004).

Methods

Sources of information

Literature was sourced for references to the birds of Christmas Island from several libraries (see Acknowledgements) and the files held at the office of Parks Australia North, Christmas Island (hereafter the Parks Office). Much of the recent information on non-breeding species is in the form of unpublished trip reports by visiting birders. We found some of this on the internet, but also corresponded with many observers known to have visited the Island. Records generally run to the end of December 2013 for vagrants and the end of December 2011 for regular and irregular visitors.

For birds that are vagrants to Australian territory, case summaries and reports of the Birds Australia Rarities Committee (BARC, now BirdLife Australia Rarities Committee) were sourced from *Wingspan*, the *Royal Australasian Ornithologists Union Report Series* and the BARC homepage (http://users.bigpond.net.au/palliser/barc/barc-home.html). The unvetted reports series in 'Twitchers corner' (*Wingspan*), 'Observations' (*Western Australian Bird Notes*), 'Bird notes series' (*The Bird Observer*) and 'Observations of seabirds' (*The Sea Swallow*) provided additional records. The equivalent series 'From the field' (*Oriental Bird Club Bulletin* and later *BirdingAsia*) and 'Indonesian bird reports' (*Kukila*) were searched for additional information on the status of many visitors and for extralimital records of Christmas Island seabirds.

A summary of Australian bird-banding data from the Island up to the end of 2011 was provided by D. Drynan of the Australian Bird and Bat Banding Schemes (ABBBS).

We have inspected the specimens held at the Australian Museum (Sydney), Raffles Museum of Biodiversity Research, National University of Singapore (Singapore), Museum Zoologicum Bogoriense, Bogor (Indonesia), Australian National Wildlife Collection (Canberra), Museum Victoria (Melbourne), and Western Australian Museum (Perth). The latter three museums and the Australian Museum have provided full listings of their holdings from Christmas Island.

DJJ spent ~44 months on the Island between 2002 and 2013, including a period of residency from December 2003 to April 2007. He undertook research into some of the resident species and systematically recorded the occurrences of non-breeding species. IAWM visited seven times between 2005 and 2013 (~2 months in total). All records made by DJJ & IAWM that are not attributed to a publication are considered previously unpublished.

Species status and biogeography

Species are given population codes based on estimates of the numbers of individuals, following McAllan *et al.* (2004), in a review of Lord Howe Island birds:

Rare	less than 100 individuals
Uncommon	100 to 1000
Common	1001 to 10 000
Abundant	more than 10 000 individuals.

These categories represent the maximum numbers of individuals on the Island during the year and are not an indication of the likelihood of observing a species. Non-resident species are either visitors or vagrants. Records of multiple individuals of a species at the same time (whether or not in a flock) or multiple sightings over an extended period are treated as a single 'set' of records (subject to the clarity of the data set). We have considered a species to be a regular visitor if it has had 15 or more sets of records, with records in most years since 1990. If a species has this number of records, but they are clumped in a few years, it is generally considered an irregular visitor. If there have been fewer than 15 sets of records, we have considered the species a vagrant.

The status of vagrant and visiting birds to Christmas Island is reviewed and assessed in both local and regional contexts. To analyse the avian biogeography of Christmas Island, we classify the breeding species according to the full distribution of their genus, species and/or subspecies group, depending on what is most appropriate. We classify the non-breeding species according to their regions of origin and migratory patterns. Those parts of taxon distributions in the New World are generally not discussed. We use bioregions that are defined to exclude trans-equatorial migrant birds, so that these species do not mask the

origins of resident avifauna and the source areas of potential colonisers. These and related terms are defined below.

1. Pelagic species = species that are predominantly marine except when breeding, and may have climatic or localised ranges, but whose ranges do not correspond with terrestrial bioregions. Palaearctic migrants are excluded.

2. Palaearctic migrants = species that breed in northern Eurasia and migrate annually to winter in the tropics or Southern Hemisphere, routinely crossing biogeographical boundaries in the process.

3. Indomalayan Region species = species from eastern Asia, from south-eastern Siberia through eastern and southern China to the Indian Subcontinent, Philippines, mainland South-East Asia, and Greater Sundas, but excluding Palaearctic migrants (the Oriental Region of some authors: see Clark *et al.* 1988).

4. Greater Sunda Islands species = species that are characteristic of the Greater Sunda Islands (Borneo, Sumatra, Java and Bali) in Indonesia, and uncharacteristic of both Wallacea and the rest of the Indomalayan Region.

5. Wallacean species = species that are characteristic of the islands of Eastern Indonesia (i.e. the Lesser Sundas, Moluccas and Sulawesi) that lie between Wallace's and Lydekker's Lines (White & Bruce 1986).

6. Australian species = species that are characteristic of areas on the Australian continental shelf, including Tasmania and New Guinea.

7. Equivocal origins refers to species and subspecies that either do not fit into one of the categories above, or for which more detailed information on the taxon is required.

8. Introduced by humans = introduced to Christmas Island directly or indirectly by humans or human activity.

Inskipp *et al.* (1996) defined an 'Oriental' Region that was an artefact: in the north, it is based on political rather than biogeographic boundaries and, in the south, including Wallacea on the basis that it was an area of faunal transition between the Indomalayan and Australian Regions. Inclusion of Wallacea in the Indomalayan Region is biogeographically incorrect. Wallacea is not only an area of transition, but it is also an area of local endemism, and therefore it is a region in its own right (Darlington 1957; Simpson 1977; White & Bruce 1986).

Vetting of records

Many bird records from Christmas Island are significant records not only for the Island itself, but also for Australian territory and/or the nearby Indomalayan Region. All cases reviewed by BARC are listed here, because BARC does not reject records outright, but either accepts or does not accept them. Unless otherwise stated, records citing BARC case numbers were accepted by that committee. We have had to investigate numerous unpublished and unvetted records and have a responsibility to vet records carefully. Generally, we have accepted records before 1990 that have been published by the original source (but not necessarily those that were published secondhand), and all records of species that are unquestionably regular visitors. With records of vagrants, we have had to weigh the probabilities and consequences of misidentifications from the details available to us. Some people might be upset that we have not accepted their records; however, many records of rare birds from Christmas Island have not been documented carefully or the information is not readily available. This said, we cannot always know the facts behind past events. We can emphasise only that future observers must note the local and regional status of the

species that they report, and take the trouble to thoroughly document significant records. We hope that this review provides observers with a greater understanding of the status of birds on Christmas Island. Observers often come from Australia not knowing whether to report a species. For example, the Grey-tailed Tattler *Tringa brevipes* is a common migrant species in mainland Australia, but is a rarer bird on the Island than the Malayan Night-Heron *Gorsachius melanolophus*.

Taxonomy and nomenclature

Generally, the taxonomy, nomenclature and sequence of birds in this review follow Christidis & Boles (2008). However, given that the Island is in close proximity to the Greater Sundas and the Indomalayan Region, we have also consulted relevant texts for these areas (e.g. Andrew 1992; Inskipp *et al.* 1996). Nevertheless, there are several instances where the broad scope of these checklists does not apply to Christmas Island. The few exceptions to the taxonomy of Christidis & Boles (2008) and other taxonomic issues are discussed in a separate Taxonomy and nomenclature section in the Results rather than in the species accounts. Common and scientific names for native plants follow Claussen (2005).

Species accounts

For breeding species, we give: the status and abundance according to the categories already defined and specific population estimates if they are available; the first report; the dates of the breeding season; preferred or recorded habitats; the extralimital range, if applicable; and the conservation status and threats. For breeding marine species, we provide an overview of marine distribution for endemic taxa or records at sea in local waters for non-endemic taxa. For vagrant species, we give: the status; number of records; details of known records; preferred or recorded habitats and locations; range of dates; and the usual distribution. Regular visitors are treated much the same as vagrants, except that records are summarised rather than listed in full.

Abbreviations used in the text:

ABBBS = Australian Bird and Bat Banding Schemes
AM = Australian Museum, Sydney
AMNH = American Museum of Natural History, New York
ANCA = Australian Nature Conservation Agency
ANPWS = Australian National Parks and Wildlife Service
ANWC = Australian National Wildlife Collection, Canberra
ARA = Australasian Raptor Association
BARC = BirdLife Australia Rarities Committee (formerly Birds Australia Rarities Committee)
BOCA = Bird Observers Club of Australia (now incorporated in BirdLife Australia)
BOM = Australian Bureau of Meteorology
CUMZ = Cambridge University Museum of Zoology, Cambridge, UK
EEZ = Economic Exclusion Zone in marine waters surrounding sovereign land
EPBC Act = Australian *Environment Protection and Biodiversity Conservation Act 1999*
IDC = Christmas Island Immigration Detention Centre, Toms Ridge, North West Point
IOSG = Indian Ocean Seabird Group inaugural Conference, 18–22 April 2008
IUCN = International Union for Conservation of Nature, Gland, Switzerland
NHM = The Natural History Museum, Tring, UK [formerly the British Museum (Natural History)]
nm = nautical miles
NMV = Museum Victoria, Melbourne
NSW = New South Wales

PANCI = Parks Australia North, Christmas Island
Parks Office = offices of PANCI (and formerly ANPWS and ANCA)
SSCSTE = Senate Standing Committee on Science, Technology and the Environment
TSSC = Threatened Species Scientific Committee
WA = Western Australia
WAM = Western Australian Museum, Perth
ZRC = Raffles Museum of Biodiversity Research, National University of Singapore (formerly the Raffles Museum and the Zoological Reference Collection).

All locations on Christmas Island that are mentioned in the text are listed with latitude and longitude in Appendix 3.

Results

A history of ornithology on Christmas Island

For convenience, the history of ornithology on Christmas Island can be divided into six different eras, reflecting changes in the emphasis and the sources of influence, although these eras are not entirely discrete.

The 'discovery era' – 1615 to 1885

The first known sighting of the Island was in early February 1615 when the East Indiaman, the *Thomas*, under the command of Richard Rowe, passed an island said to be 'length 4 or 5 leagues' at the latitude of 10°20′S and south-south-east of the Sunda Strait, though he did not give the Island a name (Rowe in Foster 1897, overlooked by Foster 1911). Gray (1981) said that the merchant John Milward, also aboard the *Thomas*, gave the date of the sighting as 3 February 1615, though we have found no earlier reference to Milward's account. The Island appeared as 'Monij' on a Dutch chart of discoveries in the Malay Archipelago and Australia (Gerritsz 1618–1630; copy viewed in the Mitchell Library, State Library of NSW, with other copies in Leiden, the Netherlands). It is unclear if 'Monij' was an annotation to the original chart because, although the chart is dated 1618, annotations indicate that the Australian coastline was mapped during voyages between 1616 and 1628. The Dutch continued to use Monij for the Island into the 18th century (e.g. de Vlamingh in March 1697), and it is found on subsequent maps (Schilder 1985, undated).

The Island received its present name from Captain William Mynors of the *Royal Mary* when he passed it on 25 December 1643 (Foster 1911; Gibson-Hill 1949a). The first recorded landing and the first mention of the avifauna were made by William Dampier aboard the *Cygnet* on 28 March 1688 (Gibson-Hill 1949a; Beken 1998). A landing party from the *Cygnet* obtained 'as many Boobies, and Men of War Birds [frigatebirds *Fregata* spp.] as sufficed all the Ship's Company' (Beken 1998, p. 224). Although it has been presumed that this party landed at the Dales because the *Cygnet* was lying off the south-western point (e.g. DNP 2002), it probably did not (Dampier in Gibson-Hill 1949a). At present, the nearest landing point for a canoe where nests of boobies and frigatebirds can be accessed on foot is West White Beach on the Island's north-west, although the landing may have been elsewhere. Landings by several later parties were usually poorly documented, but

the Island may have become well known to mariners as a source of food if not water (Gibson-Hill 1949a; DNP 2002). The first specimen of the endemic 'Golden Bosunbird' *Phaethon lepturus fulvus* was collected some time before 1760 as it was first described by Brisson (1760), but whether it was collected on the Island or at sea is unknown. An attempt was made to explore the Island in 1857 by the crew of the *Amethyst*, but the crew members could not get beyond the coastal terrace (Gibson-Hill 1949a). The Clunies-Ross family established a colony on the Cocos (Keeling) Islands in the 1820s and occasionally visited Christmas Island to harvest 'teak' (*Berrya cordifolia*) for building ships and houses, and apparently also to harvest seabirds for food (Gibson-Hill 1949a).

The 'exploration era' – 1886 to 1903

In 1886, George Clunies-Ross requested that the British Government annexe Christmas Island and grant him a lease to cut timber. Meanwhile, Sir John Murray, who was then writing up the reports from the *Challenger* Expedition (1872–1876), asked friends in the Admiralty to collect rock samples on islands not visited by the *Challenger* (Williams & Macdonald 1985). In January 1887, the HMS *Flying Fish* was returning to the United Kingdom from the Far East and moored in the cove that now bears her name. The crew could not penetrate beyond the shore terrace, but Captain Maclear (1887b) collected the first wildlife specimens, including two of the endemic landbird taxa later named by Sharpe (1887). Maclear also collected a phosphate specimen. This drove Murray to push for more exploration. In September 1887, the HMS *Egeria* visited for 10 days, and a party reached the plateau for the first time on record. The naturalist J.J. Lister collected wildlife specimens and named the remaining five endemic landbird taxa (Wharton 1888; Lister 1889). More phosphate specimens were collected, leading Murray to lobby for British possession. In June 1888, the British Government claimed sovereignty over Christmas Island, to be administered as part of the Colony of Straits Settlements (= Singapore). The Clunies-Ross family established the first small settlement in November 1888. J.N. Ridley, from the Singapore Botanic Gardens, visited the Island for a day in August 1890 and, although primarily collecting botanical specimens, provided a descriptive account of the Island's environment, including the birdlife. C.W. Andrews, of the British Museum of Natural History, was sponsored by Murray to spend 18 months on the Island to collect scientific specimens and study the natural history in 1897 and 1898. Murray's vision was to document the Island's environment before it was forever changed by the imminent mining that he proposed (Murray in Andrews 1900). This was perhaps the first baseline ecological study undertaken anywhere. The resulting *Monograph of Christmas Island* (Andrews 1900) made the Island perhaps the best-studied pristine oceanic island in history; it was a benchmark study in ecology for its day, and remains an immensely valuable insight into the Island's pre-development environment. Andrews collected all of the bird species then breeding, including the first Abbott's Boobies from the Island (Sharpe 1900). The specimens of frigatebirds that Andrews collected were a significant contribution to Gregory Mathews's (1914) global revision of the Fregatidae, including the scientific description of the Christmas Island Frigatebird and the recognition of the local Great Frigatebird as an endemic subspecies, the last of

the endemic birds to be described. In 1898, over 200 people moved to the Island in preparation for commercial mining. Hugh Ross also collected a few additional bird specimens, which he forwarded to Andrews. H.E. Durham visited the Island from December 1901 to February 1902 and collected a few birds now held at the CUMZ (Benson 1970).

The 'Singapore era' – 1904 to 1945

In 1904, the then director of the Raffles Museum, Dr R. Hanitsch, was commissioned by the Government of the Straits Settlement to assess the status of the Christmas Island Imperial-Pigeon and the impacts of hunting it. Between 26 September and 6 November, his expedition (which included J.N. Ridley, P.M. de Fontaine and their collectors) obtained 12 species of birds (Hanitsch 1904, 1905; Ridley 1905, Chasen & Kloss 1924; Morioka & Yang 1996). Apparently, Hanitsch (1904) produced an unpublished report on the status of the pigeon (cf. Hanitsch 1905), but no general account of the birds. Ridley (1905) described aspects of the expedition and gave a detailed account of the flora. In 1908, Andrews briefly returned to the Island to document changes in the environment after a decade of commercial mining activities, and observed most noticeably the sudden extinction of the two endemic and previously abundant rats, the Christmas Island Burrowing Rat *Rattus nativitatis* and Maclear's Rat *R. macleari* (Andrews 1909).

Two unnamed Dayak (indigenous Bornean) collectors were sent to the Island by the Raffles Museum in September and October 1923 and collected at least 20 species of birds (Chasen & Kloss 1924; cf. Morioka & Yang 1996). This collection included the first specimens of the introduced Java Sparrow. In August and September 1932, M.W.F. Tweedie from the Raffles Museum visited the Island for 36 days to reassess the conservation status of the Christmas Island Imperial-Pigeon. In an unpublished report, Tweedie (1932) concluded that, although the Imperial-Pigeon was less common than in 1904, it was not threatened (Chasen 1933b). Tweedie also collected probably close to 100 specimens of at least 18 bird species. These were reported on as the basis of Frederick N. Chasen's review of the Island's avifauna (Chasen 1933a; Morioka & Yang 1996). Carl A. Gibson-Hill was the resident medical officer on Christmas Island for 15 months between September 1939 and November 1940. Under Chasen's encouragement, Gibson-Hill made extensive observations on the natural history of the Island and collected ~200 specimens (of 30 bird species) for the Raffles Museum (Chasen 1940, undated; Gibson-Hill 1947; Wang & Hails 2007). After World War II, Gibson-Hill published extensively on the birds of the Island (Gibson-Hill 1947, 1949a,b, 1950) and many other aspects of its terrestrial zoology (see *Bulletin of the Raffles Museum*, Volume 18).

Several significant specimens collected for the Raffles Museum at both Christmas Island and the Cocos (Keeling) Islands are no longer present in the collection at its current home (Morioka & Yang 1996; DJJ; IAWM). One can only speculate on their whereabouts. Some Raffles Museum specimens, including most of the type-specimens, were routinely sent over many years to the NHM and other museums in Europe and the United States of America (Morioka & Yang 1996; Wang & Hails 2007), though there appear to be few records of this. From 1961, the

collection was in storage and moved at least four times before 1987, when it was moved to its present location at the National University of Singapore's Kent Ridge Campus (Morioka & Yang 1996; RMBR 2008). There is a possibility that some of the missing specimens from the Indian Ocean Islands are in other museums, but it is likely that many were lost, destroyed or discarded.

Japanese forces occupied Christmas Island from 31 March 1942 to August 1945, during which time a significant area of breeding habitat for Christmas Island Frigatebirds was cleared at the site of the present-day Golf Course (Williams 1971; DNP 2002).

The 'post-war era' – 1945 to 1976

Phosphate mining resumed in December 1945, and gradually became more mechanised and intense (Williams 1971). In 1948, the Australian and New Zealand Governments jointly bought the mining interests, but Christmas Island remained under British rule until 1 October 1958, when Australia gained sovereignty (Williams 1971; SATCI 1983; DNP 2002). There are no detailed ornithological records between the departure of Gibson-Hill in 1940 and the early 1960s. For 2.5 years between September 1960 and March 1964, A.J. Pearson spent periods of residence on the Island and recorded the birds that he observed (Pearson 1966). In June and July 1961, G.F. Mees and E.J. Car collected a few specimens for the WAM, but published little detail (WAM 1962; Voous 1964; Mees 1966). In 1961 and 1962, the Norwegian marine zoologist I. Vigeland and Captain Oftedal (master of the Norwegian vessel MS *Hoi Houw*) collected 46 bird specimens that were deposited in Oslo, Norway, and Amsterdam, the Netherlands (Voous 1964).

In the 1960s, a series of straight 'drill lines' was bulldozed over the Island on a 120-m grid to map phosphate reserves (DNP 2002). Though creating considerable environmental damage, the drill lines provided unprecedented access to much of the Island, and in particular facilitated the first detailed studies of Abbott's Booby. In June 1965, G.F. and P. van Tets visited the Island and undertook the first local bird banding (van Tets & van Tets 1966, 1967), and collected a few specimens. G.F. van Tets returned in the early 1970s to investigate potential bird-strike hazards at the new Airport (van Tets 1973, 1974b). In 1967, J.B. Nelson spent 8 months on the Island studying seabirds, particularly Abbott's Booby. He visited again briefly in 1974 and December 1976. His research into the seabirds led to several important scientific works (Nelson 1971, 1972) and allowed him to complete two seminal works, his review of the breeding biology of the frigatebirds (Nelson 1976) and his monograph of the Sulidae (gannets and boobies) (Nelson 1978). Nelson and van Tets both brought the plight of Abbott's Booby and the rest of Christmas Island's birds to international attention, and pressured the British Phosphate Commissioners and the Australian and New Zealand Governments to protect the Island's environment in general and Abbott's Booby in particular (Nelson 1974a, 1975, 1977; van Tets 1974a, 1975, 1983). Nelson's (1974a) address at the XVI World Conference of the International Council for Bird Preservation in Canberra brought the plight of the Booby to the world stage. A month later, in September 1974, at Nelson's recommendation, the British Phosphate Commissioners appointed D. Powell as the first Conservation Officer. Nelson (1972) also discovered large-

scale harvesting of seabirds for food that was recognised as a significant threat to the rarer species (Bell in ERTS 1976). In 1975, the private ownership of guns and sling-shots was banned to curb the hunting pressures on wildlife and, in 1977, the Christmas Island Imperial-Pigeon was given formal protection. In August 1975, an 'environmental survey team' led by Brian Bell (in ERTS 1976) visited the Island to assess environmental issues for the Australian Government (SATCI 1983). A flurry of commissioned investigations into the conservation of Christmas Island wildlife ensued from 1972 to the 1980s (Stokes 1988).

The 'ANPWS era' – 1977 to 1989

Australia remained slower to embrace responsibility for the environmental management of Christmas Island than to accept sovereignty and the profits of phosphate mining. In April 1977, D. Merton was appointed as the first Government Conservator (SATCI 1983), and there was a rapid reduction in poaching (Stokes 1988). F. Crome (1978) visited in 1977 to assess the conservation status of the Christmas Island Imperial-Pigeon, although the recommendations of his report were never implemented. Powell continued to study Abbott's Booby and fostered an interest in wildlife amongst local residents (Powell & Tranter 1981; Nelson & Powell 1986). In 1980, various ordinances were passed to increase protection of the wildlife (SATCI 1983). In April 1980, the Christmas Island National Park was declared, though at that time it covered only the south-western corner of the Island. The Park was expanded in 1986, and in 1989 to reach its current area of about two-thirds of the Island. The main purpose of the Park was to protect the breeding habitat of Abbott's Booby. In 1986, the Australian Department of Territories applied the WA *Environmental Protection Act 1986* to formally protect all wildlife. From 1968 to 1986, there were at least 27 articles and conference resolutions on conservation of Christmas Island birds (Appendix 1 in Stokes 1988).

The first three Government Conservators, D. Merton, J. Hicks and T. Stokes, and their colleagues, J. Tranter, H. Yorkston, B. Reville and J.N. Dunlop, studied the birds and wrote a host of scientific papers, research reports and popular articles. The Christmas Island Natural History Society was formed and published a series of books covering many aspects of the Island's environment, including a guide to the birds (Reville 1989). Breeding (colonisation) by the Lesser Frigatebird and White-faced Heron was suspected, Chickens were recorded as feral for the first time, and Eurasian Tree Sparrows breached the quarantine barrier, all in the early 1980s (Stokes 1988). During the 1980s, numerous studies of the seabirds and some landbirds were made (see references under species accounts). In 1987, the departure of Stokes signalled the end of an era and a more bureaucratic administration of environmental management on the Island. Stokes's final legacy was to consolidate over a decade of research and observations in his general review of the Island's birds (Stokes 1988), the first since 1949.

The 'birders era' – 1990 onwards

The first visit by birders (as distinct from professional ornithologists) was when K. Coate led a tour group to the Island in 1990. The next birding visit was by P. Snetzinger, B. King and H. Buck in August 1991 (Andrew 1997). Observations

Table 1. Bird species that have been recorded on Christmas Island. 1900 = Sharpe (1900), 1933 = Chasen (1933a), 1947 = Gibson-Hill (1947), 1988 = Stokes (1988), 2004 = Johnstone & Darnell (2004a), and 2013 = this paper.

Category	*1900*	*1933*	*1947*	*1988*	*2004*	*2013*
Landbirds, breeding and indigenous	8	8	8	10	11	11
Seabirds, breeding	8	8	8	8	9	9
Introduced species (extant only)	0	1	1	3	3	3
Visitors and vagrants	15	19	27	68	95	126
Unconfirmed species (supplementary list)	(0)	(3)	(2)	(~4)	(~11)	(~34)
Total number of confirmed species	**31**	**36**	**44**	**89**	**118**	**149**

from both these visits were not published. Christmas Island came into greater focus for Australian birders when M. Carter (1994) wrote an article about his trip in October–November 1993. His visit was prompted by his involvement with a list for the Island in the fourth edition of the *Field Guide to the Birds of Australia* (Simpson & Day 1993) and insider information that the forthcoming checklist of Australian birds (Christidis & Boles 1994) would, for the first time, include the Indian Ocean territories. This triggered a succession of birders spurred on by the sniff of rarities, and well-armed with a newly published field guide to the Greater Sunda Islands (MacKinnon & Phillipps 1993). Although it is impossible to be precise about numbers, we are aware of more than 70 visits by more than 400 birders since 1990, which took the bird list from 89 in 1988 to 149 at the end of 2013 (Table 1, Figure 6). The White-breasted Waterhen and Lesser Frigatebird were recorded breeding for the first time in 1992 and 2001, respectively (Carter 1994; DNP 2002), and the Asian Koel may have started breeding even more recently. In September 2006, the inaugural Christmas Island Birdweek had themes of Christmas Island endemics and seabird research, and was attended by ~40 participants. A small field guide to the resident birds was published in booklet form for the first Birdweek (Valenzuela & James 2006). Further Birdweeks have been held in subsequent years. The inaugural IOSG Conference was held on the Island in April 2008. Many of the otherwise unpublished observations by birders since 1990 were summarised by Johnstone & Darnell (2004a).

The creation of the Christmas Island National Park, environmental legislation, and the changing sentiment of the general public mean that the days of collecting birds are over. However, Parks Australia's rehabilitation program for injured and sick birds and the collection of road-kill carcasses have ensured a steady supply of bird specimens reaching Australian museums in the last decade. Meanwhile, the conservation status of all species was reviewed (Garnett & Crowley 2000; Garnett *et al.* 2011), and National Recovery Plans were prepared for several species.

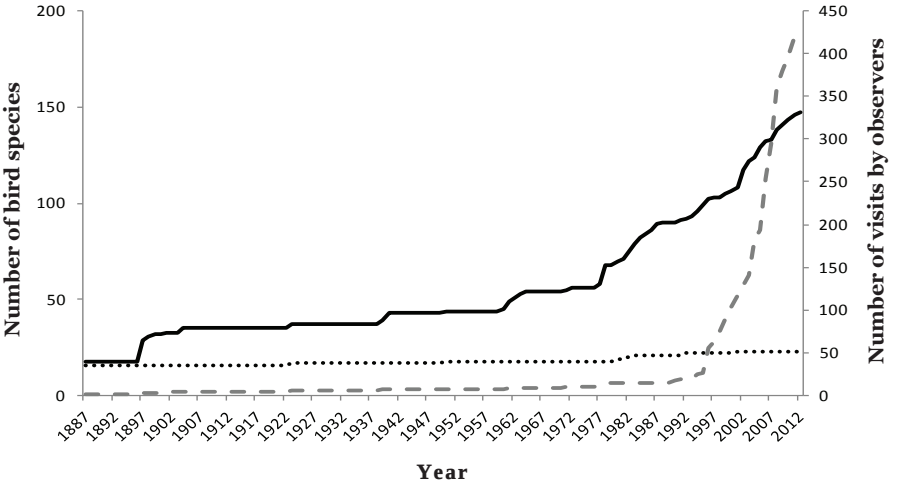

Figure 6. Graph of the total number of bird species recorded and total estimated number of visits by observers recording birds on Christmas Island between 1887 and 2012. Solid line = total number of species, breeding and non-breeding; dotted line = number of breeding species; dashed line = number of visits by bird observers.

Research continued into the birds during this era, funded by the Australian Government, industry, and independently. This included studies on the seabirds, the Christmas Island Goshawk and Christmas Island Hawk-Owl and landbirds in general (James 2007; James & McAllan 2010). Unfortunately, with few exceptions (see individual species accounts), most of this work remains unpublished and unconsolidated.

Future prospects

Modifications of habitats by human colonisation have brought about substantial environmental and ecological change. Christmas Island is in the midst of a biodiversity crisis, with many species declining rapidly towards extinction. Recently, the Christmas Island Pipistrelle *Pipistrellus murrayi*, an endemic microbat, was conceded by the Australian Government to have become extinct (Kamenev 2009; CIEWG 2010), all native reptile species have been reduced to tiny vestigial populations (James 2007) and as many as three may have become extinct in the wild in the last few years (K. Retallick pers. comm.; cf. CIEWG 2010). Many invertebrate species have apparently vanished (James & Milly 2006; James 2007). Although the causes (and extent) of this crisis have not been fully determined, it is clear that the interactions between habitat modification and invasive species are playing a major role. The invasive Yellow Crazy Ant has been the focus of much attention, research and management efforts (summarised in CIEWG 2010). So far the birds have not been badly affected, even though six now are listed as nationally threatened under the EPBC Act. Fortunately, it seems that the immediate threats to birds posed by the Yellow Crazy Ant and the predicted severe declines in bird populations (e.g. Garnett & Crowley 2000; Davis 2002; Davis *et al.* 2008) have

been greatly overestimated, at least in the short term (James & Retallick 2007; CIEWG 2010; James & McAllan 2010). 'New' habitats such as the Airport, Rubbish Tip, former slurry ponds, mine loading bays and other areas (particularly those with open rainwater pools), have provided habitat for numerous migrant and vagrant species that could not otherwise occupy the Island even temporarily. Habitat modification has paved the way for the colonisation of the Island by four self-introduced bird species and three species introduced by humans, and more will likely follow.

It remains to be seen whether the mass declines affecting other groups of the fauna will also affect the endemic birds. Insular bird faunas are renowned for their sensitivity and vulnerability to threats associated with human settlement, especially hunting, habitat modification and invasive species (Milberg & Tyrberg 1993; Hughes 2004). However, the most recent signs of declining bird populations on Christmas Island are emerging not in the endemics, but in three recently arrived species and a wide-ranging seabird (White-faced Heron, White-breasted Waterhen, Java Sparrow and Red-tailed Tropicbird—see respective species accounts). The signs indicate perilous times ahead for the fauna of Christmas Island. It is obvious that the threats to the Island's biodiversity are serious, multiple, complex and inadequately understood (James 2007; CIEWG 2010; James & McAllan 2010). Therefore, continuing to focus on a single issue such as one alien invasive ant species (e.g. Garnett & Crowley 2000; DNP 2002; Davis *et al*. 2008) will likely be counter-productive while there are many factors contributing to biodiversity declines.

Bird specimens held in museums

Specimens of birds from Christmas Island have been collected or retained on a fairly regular basis since the late 19th century. It is not possible to provide a complete inventory at present. In Australia, significant collections of most breeding species and some visitors and vagrants are held at the WAM (>350 specimens), ANWC (~140), AM (>100) and NMV (~100), dating from the 1960s or later. Overseas, significant collections are held at the NHM (from the late 19th and perhaps the mid 20th century: Sharpe 1900) and ZRC (>300 specimens from the early to mid 20th century: Chasen 1933a; Gibson-Hill 1947; Morioka & Yang 1996; DJJ; IAWM). Each contains most of the breeding species (except the recent colonists) and a few visitors and vagrants. Smaller collections are held at the AMNH (~50 specimens, mostly received by G.M. Mathews from C.W. Andrews, and the NHM), CUMZ (Benson 1970, 1999), Zoological Museum of the University of Oslo, Norway (38 specimens, of 14 species), and Zoological Museum of the University of Amsterdam, the Netherlands (nine specimens, of eight species: Voous 1964).

The type-specimens of most endemic landbird species and subspecies are held at the NHM (Warren 1966; Warren & Harrison 1971), with some at the CUMZ (Benson 1999). Those of both endemic frigatebirds are in the Mathews Collection at the AMNH (Greenway 1973) and that of Abbott's Booby (collected on Assumption Island) is in the United States National Museum (Deignan 1961). It is likely that some specimens collected for the Raffles Museum were traded with other museums. Christmas Island Frigatebirds collected away from the Island are

held at the AMNH, ZRC, Museum Zoologicum Bogoriense in Bogor, Indonesia (DJJ), and Turin, Italy (Elter 1986), at least. A specimen of Abbott's Booby from the southern coast of Java is held at the Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands (Becking 1976b). Combined, the collections total over 1400 specimens, of at least 67 species.

Taxonomy and nomenclature

The taxonomy of Christmas Island's breeding landbirds has long been influenced by the views of Frederick N. Chasen (1933a, 1935). Chasen felt that the Island's biogeographical affinities lay with Wallacea, despite its position being ~1140 km west of Wallace's Line. Also, the convention at that time was to lump species. Consequently, Chasen linked all of Christmas Island's endemic landbirds to species from Wallacea, and lumped most of them with their putative relatives. Chasen's views have influenced the species-limits of the avifauna from the time of publication to even the most recent checklists to cover the Island (Peters' Checklist series 1931–1986; Inskipp *et al.* 1996; Christidis & Boles 2008), as well as the conservation status of several taxa.

White-tailed Tropicbird

The pantropical White-tailed Tropicbird *Phaethon lepturus* was treated as monotypic by Marchant & Higgins (1990), but this was not substantiated. In the Plumages and related sections of that work, a 'golden morph' was described with the implication that it has no geographical restrictions different from the species as a whole (Marchant & Higgins 1990, pp. 950–951). In the introduction to the Family Phaethontidae, it was claimed that golden-plumaged forms are probably better regarded as morphs than as subspecies 'because they occur in different proportions in different colonies' (Marchant & Higgins 1990, p. 935). Most other authors to consider subspecies have recognised *fulvus* as a valid and endemic subspecies, based on the unique intensity and frequency of its golden-coloured plumage (e.g. Peters 1931; Chasen 1933a, 1935; Condon 1975; Dorst & Mougin 1979; Orta 1992a; Le Corre & Jouventin 1999; Clements 2000; Dickinson 2003; Gill & Donsker 2012).

Golden-plumaged White-tailed Tropicbirds dominate breeding populations of the species at only two locations: Christmas Island in the eastern Indian Ocean and Europa Island, >7000 km away in the western Indian Ocean. This latter form was recently named *P. l. europae*, based on its high frequency of golden plumage (70% of birds) and significantly smaller size than *fulvus* and nominate *lepturus* (Le Corre & Jouventin 1999). However, the strongly 'apricot' colour shown by 90% of Christmas Island *fulvus* individuals is not present in *europae*. While examining a live *fulvus* in the hand, Le Corre remarked to IAWM that subspecies *europae* never shows the same brilliant apricot-coloured plumage as *fulvus*. Throughout the rest of the range, only a slight golden tinge to the plumage on the body occurs, in no more than 15% of any population (Le Corre & Jouventin 1999). The presence of some white-plumaged birds on Christmas Island (<10%), their apparent increase in recent years, and apparent assortative pairing (judged by courtship displays) (Dunlop 1988; J.N. Dunlop pers. comm.; DJJ) indicate that the apricot

plumage is determined genetically. Therefore, *fulvus* deserves recognition as a valid subspecies.

Emerald Dove

This complex has two distinctive forms: the nominate *indica* group, which is found from South Asia east to the Lesser Sundas and Moluccas, where it is replaced by the *longirostris* group, continuing east to New Guinea, Australia and the Pacific. The groups are differentiated by distinct plumage forms: the silver-crowned western form and the brown-crowned eastern form. The boundary between the forms is sharp, being between islands <50 km apart in the centre of Wallacea (White & Bruce 1986). In addition, Rasmussen & Anderton (2005) cited differences in vocalisations between the two groupings, and suggested that they were separate species. Christidis & Boles (2008) did not come to a firm decision on this treatment and continued to follow the traditional arrangement, but noted that further work was under way. This split is gaining support (e.g. Gill & Donsker 2012), so we here point out that the endemic subspecies on Christmas Island, *natalis*, is allied with the putative western species 'Common Emerald Dove' *C. indica*. This would make it a separate species from all other forms of *Chalcophaps* in Australian territory, which would belong to 'Pacific Emerald Dove' *C. longirostris*. Note that the species-group name *chrysochlora* Wagler 1827 is not available for this eastern grouping, as it was based at least in part on birds from Java (Schodde & Mason 1997; *contra* Christidis & Boles 2008).

Christmas Island Swiftlet

The white-bellied swiftlets of the genus *Collocalia* (*sensu stricto*, i.e. excluding *Aerodramus*) comprise a complex of close to 40 taxa stretching from the Andaman Islands and the Malay Peninsula through the Indonesian and Philippine archipelagos to New Guinea, the Solomon Islands, Vanuatu and New Caledonia. Early on, Wallace (1863) recognised two species in the complex: *C. linchi*, with plain tails, from Java west to the Nicobar Islands; and *C. esculenta*, with spotted tails, from Sulawesi east to the Aru Islands. Lister (1889) described the white-bellied swiftlet with a spotted tail from Christmas Island as a distinct species, *C. natalis*. Oberholser (1906) recognised seven species: *C. linchi* (Greater Sundas and northern Philippines), *C. marginata* (central Philippines), *C. dodgei* (montane Borneo), *C. uropygialis* (Vanuatu), *C. neglecta* (Timor region), *C. esculenta* (Sulawesi to New Guinea) and *C. natalis* (Christmas Island). Stresemann (1925a) considered all the forms (including *natalis*) to be one species, *C. esculenta*, and Chasen (1933a, 1935) and Peters (1940) followed suit. Chasen (1933a) considered the nearest affiliates of *natalis* to be the distant, but spotted-tailed *neglecta* and *sumbawae* (Sumbawa, Sumba and Flores) and the proximal, but plain-tailed *linchi* (Java). Stresemann (1940) softened his view to recognise two 'natural' groups (*C. linchi* and *C. esculenta*), and placed *natalis* with *C. esculenta* based upon its spotted tail and despite its proximity to *C. linchi*. Salomonsen (1983) recognised the two groupings, *C. linchi* (Borneo westwards) and *C. esculenta* (Sumbawa and Sulawesi eastwards), but did not discuss forms from the Philippines or Christmas Island. He noted that the *esculenta* group consistently had tail-spots and naked

or nearly naked tarsi, but that there was considerable variation in the colour of plumage gloss between populations. He also found that tarsus feathering varied individually and not geographically. Somadikarta (1986) also recognised two species with the same names, but different compositions: *C. linchi* including subspecies *linchi* (Java and Nusa Penida), *dodgei*, *ripleyi* (montane Sumatra) and *dedii* (Bali and Lombok); and *C. esculenta*, including *cyanoptila* (Malaya, Sumatra and Borneo) and all forms to the east of Lombok, west of Sumatra and north of Borneo. This was triggered by evidence of sympatry in Borneo and Sumatra, but based on greenish versus bluish gloss in the plumage and the absence or presence of a feather tuft on the hind toe. Somadikarta (1986) did not refer to Salomonsen or analyse forms from the Philippines, or from east of Lombok, but kept *cyanoptila* in *esculenta* despite being aware of their differing tail patterns. By contrast and as an aside, he placed *natalis* in *esculenta* (following Stresemann) because of its spotted tail, and proposed a novel biogeographical boundary in support. He showed that there is more than one species in the Greater Sundas, but he split some forms from the Greater Sundas and Lombok into *C. linchi* and ignored the rest of the complex. This led to an unnatural grouping under the name *C. esculenta* of spotted-tailed forms (east of Lombok) with some plain-tailed forms (from Lombok westwards). Since then, some authorities have treated the complex as a single species, *C. esculenta* (e.g. Christidis & Boles 1994; Inskipp *et al*. 1996; Schodde & Mason 1997). Others have recognised *C. linchi* as a second species and kept *natalis* in *C. esculenta* (e.g. Andrew 1992; Chantler 1999; Chantler & Driessens 2000; Clements 2000; Dickinson 2003; Gill & Donsker 2012). Christidis & Boles (2008) moved *natalis* from *C. esculenta* to *C. linchi* and, although they emphasised uncertainty, they unjustly cited support from Somadikarta (1986) and Carter (1994), who suggested no such arrangement. In fact, Christidis & Boles (2008) moved *natalis* to a different species without examining any material, presenting any new data, or following any existing study.

Some recent genetic studies (Price *et al*. 2004, 2005; Thomassen *et al*. 2005; Moyle *et al*. 2008) have indicated greater speciation in the complex. For instance, eastern forms representing the *esculenta* group (*nitens* from New Guinea and *becki* from the Solomon Islands) appear distinct from both Bornean *cyanoptila* and *linchi*. This suggests that no forms in the Greater Sundas belong in *C. esculenta*. Birds from the central and southern Philippines form a separate grouping again, *marginata*. The Bornean *dodgei* is not only separate from the sympatric *cyanoptila*, but also apparently distinct from its more similar, but allopatric, relative *linchi* (*sensu stricto*), an arrangement implicitly followed by Myers (2009) and Phillipps & Phillipps (2009). The genetics of *natalis* has not been studied in this detail.

Although it is beyond the scope of this paper to revise the taxonomy of the genus, we have some additional data on *natalis*. All of ~40 freshly dead *natalis* examined on Christmas Island had white tail-spots like those described in the *esculenta* group, but lacked a feather tuft on the hind toe like the purported *linchi* group; plumage gloss was considered to be dull and oily, somewhat green and certainly not blue. Specimens of *natalis* examined at the ZRC and AM show this oily-green gloss on the top of the head, the upperwings and the uppertail (including the tail-

Table 2. The distribution of selected taxonomic characters amongst the major biogeographical groups in the broader white-bellied swiftlet complex. Shading shows matching of characters between *natalis* and other taxa.

Character	*natalis*	*esculenta* group	*marginata* group	*affinis* group	*linchi* group	*cyanoptila* group
Tail-spots	All	Most	None	None	None	None
Pale-fringed rump	All	Some	Some	Some	None	None
Reduced gloss on upperparts	All	Some	None	None	None	None
Green gloss on wings	All	Some	All	Some	All	None
Blue gloss on wings	None	Some	None	Some	None	All

coverts). However, the upper-body tracts (mantle, back, scapulars and rump) and hindneck lack the gloss, and the feathers there are dirty dark grey with narrow whitish margins that increase rearwards to form pale scaling on the rump and longest scapulars. This differs from *C.* (*esculenta*) *cyanoptila*, which has a dark metallic-blue gloss (similar to the Barn Swallow *Hirundo rustica*, though not as bright) to all of the upper-body, wing and tail tracts, with no pale margins to any dorsal feathers (specimens from Singapore, Peninsular Malaysia and Borneo at the ZRC and field observations in Singapore by DJJ). Specimens of *natalis* and *cyanoptila* are shown in Figure 7 (p. S51). *C.* (*e.*) *natalis* also differs from *linchi*, which has a uniform dark oily-green gloss to all of the upper-body, wing and tail tracts, with no pale margins to any dorsal feathers (field observations in Java by DJJ). The distinctive grey back and scaly rump of *natalis*, contrasting with the oily-green glossy wings and cap, are also readily visible in the field [DJJ; IAWM; Figures 8–9 (p. S52)].

According to Chantler & Driessens (2000) and Salomonsen (1983), numerous taxa in the complex have a palish rump caused by lack of gloss and pale shafts and/or pale fringes to the feathers: from the *marginata* group in the Philippines—*marginata* and *septentrionalis*; from the *affinis* group on islands in the Andaman Sea—*affinis* and *elachyptera*; and from the *esculenta* group east of New Guinea—*stresemanni*, *tametamele*, *desiderata*, *misimae*, *uropygialis* and *albidior*. Some taxa in the *esculenta* group also lack gloss or have reduced gloss to the upperparts, for example *neglecta*. However, no taxa in the *linchi* group show a pale rump or anything other than entirely green-glossed upperparts. In addition, white spots on the inner webs of the outer rectrices are found to varying degrees in most taxa east of Wallace's Line, but only one taxon to the west of that Line, *natalis*. The distributions of these taxonomic characters amongst the major biogeographical groups in the complex are presented in Table 2. This indicates that *natalis* shows the most similarity to taxa in the *esculenta* group and the least similarity with the two most proximal groups, *linchi* and *cyanoptila*.

It is highly significant that *natalis* is the only form in the complex to the west

of Wallace's Line that has a spotted tail. This might be an ancestral character that links *natalis* with the *esculenta* group, and certainly indicates considerable divergence from *linchi*, so placing *natalis* in *C. linchi* is unsatisfactory. Given the geographical distance and biogeographical separation between *natalis* and the other spotted-tailed forms and considering the apparent speciation elsewhere in the complex, *natalis* is likely to have diverged from the eastern birds as well. Under prevailing taxonomies, placing *natalis* in *esculenta* would also make *natalis* conspecific with the *cyanoptila* group, although these two seem the least similar (Table 2). Therefore, we consider it prudent to treat *C. natalis* as a separate species, the Christmas Island Swiftlet, unless compelling evidence is found linking it to another form in the broader white-bellied swiftlet complex.

Great Frigatebird

The Great Frigatebird *Fregata minor* was originally described as *Pelecanus minor* by Gmelin (1789) based on a colour illustration of a female bird in Edwards (1758–1764). Unfortunately, the provenance of Edwards's subject is unknown. Mathews (1914) described a form of Great Frigatebird as a new subspecies, *F. m. listeri*. Mathews intended to represent birds from the eastern Indian Ocean with *listeri*, and he based it on type-specimens from Christmas Island. In the same paper, he mistakenly fixed the type-locality of *minor* (from Edwards's illustration) to Jamaica. Since the species does not occur in the Caribbean, Rothschild (1915) moved the type-locality of *minor* to the Indian Ocean, and Lowe (1924) moved it again to Christmas Island. These actions made *F. m. listeri* a junior synonym of *F. m. minor*.

Females of the Christmas Island form always have a blue bill, whereas females of all other populations in the Indian Ocean have a pink bill, so Christmas Island birds are different from others in the Indian Ocean and are a subspecies endemic to the Island. The female specimen illustrated by Edwards had a pink bill, and thus Gmelin's *Pelecanus minor* did not come from Christmas Island. Therefore, Mathews's *listeri* is a valid name for the endemic subspecies on Christmas Island, which we hereby use. We intend to publish more on the taxonomy of *Fregata minor* elsewhere.

Christmas Island Goshawk

Lister (1889) originally described the Christmas Island Goshawk as a unique species, *Urospizias natalis*. In comparing specimens of related species, he noted that there were no similar taxa in the Indomalayan Region, though this goshawk was most closely allied to a complex of ~34 taxa ranging from Melanesia through Australia and New Guinea to Wallacea including *Accipiter fasciatus* (Brown Goshawk), *A. novaehollandiae* (Grey Goshawk), *A. hiogaster* (Variable Goshawk), and *A. griseogularis* (Grey-throated Goshawk) and their subspecies, and is particularly similar to *A. griseogularis* (*sensu stricto*) from Halmahera in the northern Moluccas.

Chasen (1933a, 1935) subsequently included *natalis* as a subspecies of *fasciatus* following Stresemann (1924, 1925b). Chasen did not have comparative material,

but noted that Stresemann compared *natalis* with three forms of *fasciatus* and one of *hiogaster*, all from Wallacea. The argument cited by Chasen (1933a) appears contrived, to confirm Chasen's preconceived notions that the fauna of Christmas Island is affiliated with that of Wallacea and that islands rarely give rise to endemic species. Our data disprove the former notion (see Avian biogeography p. S28), whereas advances in evolutionary biology and island biogeography leave the latter idea without any credence.

Wattel (1973) continued to keep *natalis* as a subspecies of *fasciatus*. However, he noted great morphological differences between *natalis* and the nominate subspecies, with adult *natalis* having a plain rufous breast, a generally darker dorsum and shorter more rounded wings. His measurements indicated that, although smaller than mainland Australian birds, *natalis* fits within the size range of the various subspecies of *fasciatus* from Wallacea. In addition, Wattel's measurements indicated that *natalis* is larger than all the subspecies of the *novaehollandiae–hiogaster* group from Wallacea, except for *griseogularis*. Often overlooked is that Wattel found the wing proportions of *natalis* most similar to those of *A. melanochlamys* (Black-mantled Goshawk), a high-altitude species from New Guinea. Stresemann & Amadon (1979) continued to place *natalis* in *fasciatus*, citing Wattel (1973) as the source for their treatment of the genus—even though Stresemann died in 1972 before Wattel was published. They did not accept Brown & Amadon's (1968) split of *griseogularis* from *novaehollandiae*.

D. Rogers (in Marchant & Higgins 1993) listed significant differences between *natalis* and mainland Australian subspecies of *fasciatus*: *natalis* had considerably smaller size (though note the variation of *fasciatus* found by Wattel); much more rounded wings; shorter plumage sequence to full maturation; and numerous, substantial plumage differences. Despite these differences, *natalis* was still kept in *fasciatus*. Based on observations and photographs, Carter (1994) suggested that *natalis* was more closely related to the *A. novaehollandiae–hiogaster* complex, noting the bright-yellow cere and different jizz. Debus (1994) agreed, and considered the short tarsus, short tail, heavy bill and bright-yellow cere to be inconsistent with the *fasciatus* group. Christidis & Boles (1994) and Inskipp *et al.* (1996) followed Chasen and others in maintaining *natalis* within *fasciatus*, largely because there were no other taxonomic studies to follow. Ferguson-Lees *et al.* (2001) separated the *novaehollandiae* group (*sensu lato*) into three species groups: *novaehollandiae*, *hiogaster* and *griseogularis*. They placed *natalis* in the species *A. hiogaster*, but (inadvertently?) included *natalis* in the distribution map of *fasciatus*. Separation of *griseogularis* from *novaehollandiae* was not new, as it had been done previously by Brown & Amadon (1968), though they had kept *natalis* in *fasciatus*. Similarly, the separation of *hiogaster* from *novaehollandiae* was advocated by Schodde (1977), though he did not circumscribe full species-limits for *hiogaster*. However, placement of *natalis* in *hiogaster* by Ferguson-Lees *et al.* (2001) was novel, and was supported only by supposed and superficial similarities in plumage between the forms, and without any serious consideration of phylogeny, convergence, biogeography, etc. This treatment, which puts *natalis* 1300 km away from its nearest sister taxon on Sumbawa, is similar to the untenable biogeographic arrangement of the Christmas Island Hawk-Owl (see p. S22; also

Debus 1994; Ferguson-Lees *et al.* 2001, under the *griseogularis* account).

Finally, Johnstone & Darnell (2004a) treated *natalis* as a distinct species based upon its considerable morphological differences from the *fasciatus* and *hiogaster* complexes. One aspect often overlooked is that the adult plumages of *natalis* are sexually dimorphic (Gibson-Hill 1947; DJJ). In addition, recent field studies (Hurley 2005; Holdsworth 2007; James 2007; DJJ) have revealed that the taxon's ecology differs vastly from *fasciatus*, particularly with regard to roaming behaviour, diminished territoriality and an absence of aerial displays. Yet, despite this, Christidis & Boles (2008) merely followed Ferguson-Lees *et al.* (2001).

Like the *fasciatus* complex, the *hiogaster* complex does not reach the Indomalayan Region, and its presence on Christmas Island is therefore not parsimonious. Moving a taxon from one species to another without substantive evidence is not satisfactory, so inclusion of *natalis* in *hiogaster* is not followed here. Leaving *natalis* as a subspecies of *fasciatus* is also unsatisfactory, as no substantive evidence has ever been presented for this equally biogeographically unlikely possibility. Therefore, in this work, *natalis* is recognised as a distinct species until proved otherwise. We concede that the issue will continue to be debated until a detailed taxonomic study is undertaken, but the treatment offered here is probably more biogeographically sound than any other proposition.

Christmas Island Hawk-Owl

As with the Christmas Island Goshawk, Lister (1889) originally described the Christmas Island Hawk-Owl as a distinct species, *Ninox natalis*. He aligned it with a group including four other forms from Wallacea that were considered species at the time (*forbesi*, *hypogramma*, *hantu*, and *squamipila*—from the most to the least closely allied). Chasen (1933a, 1935) readily accepted this analysis and also lumped *natalis* as a subspecies of *forbesi*. Peters (1940) combined *forbesi*, *hypogramma*, *hantu*, *squamipila* and *natalis* as a single species (*N. squamipila*) with five subspecies. Norman *et al.* (1998) studied mitochondrial DNA sequences in selected *Ninox* taxa, and concluded that *natalis*, *hypogramma* and *squamipila* (*sensu stricto*) should best be treated as three separate species. They had no data for *forbesi* and *hantu*, so recommended that these be left with *squamipila* for the interim. However, Lister and Chasen had originally allied *natalis* most closely with *forbesi*, and not with *squamipila* (*sensu stricto*), a fact apparently overlooked by Norman *et al.* (1998). Leaving *forbesi* in *squamipila* and removing *natalis* did not address the original lumping of *forbesi* and *natalis* by Chasen. Subsequently, Rheindt & Hutchinson (2007) suggested from a small sample of recordings of calls that the Moluccan forms might be separated at least as *forbesi*, *hypogramma* and *squamipila*—the latter including *hantu*. In any case, the treatment of *natalis* as a distinct species has since been widely adopted (e.g. Clements 2000; Dickinson 2003; Christidis & Boles 2008), and it makes biogeographical sense.

Number of species

At the end of 2013, a total of 149 species had been recorded definitely from Christmas Island. This includes 23 breeding species, 18 visitors and 108 vagrants.

In addition, 34 species or species groups are placed on the supplementary list (Appendix 1) because they were liberated, but are now locally extinct, were recorded in error, or have been reported, but not confirmed (Table 1). No visitors are seen in large numbers, although several occur regularly. There are rarely if ever more than 35 different species present on the Island at any point in time (DJJ; IAWM). No species of birds have gone extinct on Christmas Island in historical times. As no fossil or subfossil bones have been found, there are no data on prehistoric extinctions.

In their recent review, Johnstone & Darnell (2004a) listed 118 species definitely recorded, with six or seven unconfirmed species. The list in the present work differs by 22 species recorded for the first time since then, five species that were overlooked or omitted, four elevated to the confirmed list, and one elevated as a distinct species (Green-headed Yellow Wagtail *Motacilla taivana*), but two considered unconfirmed and thus relegated to the supplementary list. The list has increased by 57 from 92 (a 62% increase) in the 25 years since Stokes's (1988) review, including two new breeding species. In the 36 years since 1977 (the beginning of the 'ANPWS era'), the list increased by 89 from 60 (a 148% increase) at an average rate of about 2.5 (± standard deviation 2.2) additions per year. The numbers of visits by bird observers increased greatly after 1990. However, the rate of new bird species recorded on the Island remained the same between 1990 and 2012 as it had been between 1977 and 1990, and yet there is no sign of an asymptote approaching [Figure 6 (p. S14)].

We suspect that there are always some species of birds present on the Island that are normally considered vagrant to Australian territory. However, with a large area to cover and large populations of local birds to distract the observer, the odds of finding those vagrant birds are often small.

Population estimates of breeding species

Despite the research effort to date, there are few accurate and up-to-date population estimates for the breeding birds of Christmas Island. Gibson-Hill (1947) provided estimates that he considered to be of moderate accuracy for the seabirds and Eastern Reef Egret. It is not clear what survey effort was behind these estimates, but they were probably extrapolations from small samples. Pearson (1966) repeated Gibson-Hill's estimates with little change or new data. Following visits to Christmas Island in 1965, 1972 and 1974, van Tets (1975) gave population estimates for each of the species breeding at the time, expressed as numbers of breeding pairs. Given that he spent only 40 days on the Island, it is likely that the estimates were based on impressions rather than quantitative surveys, and they do not seem very accurate. Stokes (1988), in his Table 1, provided estimates of most seabird populations that were said to be from Stokes (1984), which is an unpublished reference that we have been unable to trace. Stokes (1985), however, stated that only three species (the two frigatebirds and Red-footed Booby) were surveyed by him at that time. An extensive combination of distribution surveys and density sampling in representative areas provided reasonably accurate estimates for those three at least.

Table 3. Summary of population estimates for birds breeding on Christmas Island. Sources of data: G-H = Gibson-Hill (1947), N = Nelson (1972), vT = van Tets (1975), S = Stokes (1988), G & C = Garnett & Crowley (2000), C = Corbett *et al*. (2003), J & R = James & Retallick (2007), BE = best estimate. Population estimates: i = individuals, p = breeding pairs, r = reporting rate (%), t = breeding territories. Sources of best estimates: a = DJJ (this work), i; b = DJJ (this work), p; c = Dunlop (1988), p; d = Corbett *et al*. (2003), i; e = James (2003), p; f = Yorkston & Green (1997), p; g = Stokes (1988), p; h = James (2007), i; and j = Hill & Lill (1998a), t. CI = Christmas Island.

Species	*G-H* (*p*)	*N* (*p*)	*vT* (*p*)	*S* (*p*)	*G & C* (*p*)	*C* (*i*)	*J & R* (*r*)	*BE*
Feral Chicken								>100 (a), i
Red-tailed Tropicbird	400–600	>1000	10–100	1380				>2000 (b), p
White-tailed Tropicbird	300–450	1000–3000	10–100	600	10 000		36	6000–12 000 (c), p
Emerald Dove			100–1000	>1000	2500	900–3500	38	900–3500 (d), i
CI Imperial-Pigeon			10–100		500	35 000–66 000	90	35 000–66 000 (d), i
CI Swiftlet			100 000–1 million		2500		57	5000–10 000 (b), p
Lesser Frigatebird								>10 (b), p
Great Frigatebird	2000–3000	500–1000	100–1000	3250				3500 (b), p
CI Frigatebird	1000–1500	<2000	100–1000	1620	2250			1200 (e), p
Abbott's Booby	500–750	2300–3000	100–1000		3000			2500 (f), p

Species	*G-H* (*p*)	*N* (*p*)	*vT* (*p*)	*S* (*p*)	*G & C* (*p*)	*C* (*i*)	*J & R* (*r*)	*BE*
Red-footed Booby	4500–6000	5000	10 000–100 000	12 050				12 000 (g), p
Brown Booby	5000–6500	2250	10 000–100 000	4910				5000 (g), p
White-faced Heron				100 (i)				<15 (a), i
Eastern Reef Egret	15–20		1–10					40 ± 20 (b), p
CI Goshawk			10–100	50–150	75		1	250 (h), i
Nankeen Kestrel			10–100				22	>300 (a), i
White-breasted Waterhen								<20 (a), i
Common Noddy	4000–5500	4000–5500	10 000–100 000	5390				5500 (g), p
CI Hawk-Owl			10–100	100	600			562 ± 105 (j), t
CI White-eye			100 000–1 million		10 000	80 000–170 000	99	80 000–170 000 (d), i
Island Thrush			100 000–1 million		2000	20 000–50 000	70	20 000–50 000 (d), i
Java Sparrow			10–100					<50 (a), i
Eurasian Tree Sparrow								>1000 (a), i

Garnett & Crowley (2000) provided population estimates for ten species and subspecies (all the endemic taxa except the Great Frigatebird). With some exceptions, it is not clear what their estimates were based on, but all of them were pessimistically low. All ten taxa were said to be declining and Critically Endangered, mostly from the perceived threats posed by the Yellow Crazy Ant. Fortunately, a decade later, these dire predictions of decline have not eventuated, and no significant impacts on birds from ants have been observed.

During an impact assessment of proposed phosphate-mine leases in 2002, Corbett *et al*. (2003) generated population estimates for four of the endemic forest birds. They used the distance sampling technique, which assumes that all birds present can be seen and counted and that birds do not move during the sampling period. These assumptions are not easily met, and the sample sizes were too small to provide accurate estimates, but they are the only quantitative survey estimates for the species involved.

James & Retallick (2007) established baseline data on the relative abundance of seven of the landbirds and the White-tailed Tropicbird. Their 511 presence–absence surveys did not provide population estimates, but produced reporting rates (i.e. percentage presence) with known statistical accuracies, so that repeat surveys in the future can determine population trends. The data also provided information on habitat preferences.

In this work, we have used the most recent published estimates available if they were based on quantitative survey data. Of course, that does not necessarily mean that the estimates are accurate. In cases where no quantitative data are available, we have made estimates based on whatever information was available, particularly our own field experiences.

The population estimates discussed here are summarised in Table 3. The figures in the 'best estimates' column are discussed in the Species accounts.

Bird banding

Bird banding was first undertaken on the Island in May and June 1965, when three species were banded by van Tets & van Tets (1967). Most seabird species were systematically banded in moderate numbers, and other species were banded opportunistically during the ANPWS era in the 1980s (Dunlop 1987; Stokes 1988). During the 1990s, a few Christmas Island Hawk-Owls were banded by R. Hill, and some other species were banded opportunistically. In 2004, a colour-banding project for the Christmas Island Goshawk commenced (Hurley 2005), and banding of Abbott's Booby began in association with tracking studies (Hennicke 2004, 2006). By 2006, increased research on birds saw the expansion of banding to include the Brown Booby, Red-tailed Tropicbird, Common Noddy and Island Thrush, as well as other seabirds in tracking studies and birds in rehabilitation (Table 4). Banding has been an integral focus of the annual Christmas Island Birdweek since its inception in 2006.

Banding data for Christmas Island (up to the end of 2011) are summarised in Table 4. Totals of 18 species and 1572 individuals were banded between May

Table 4. Summary of bird banding on Christmas Island. Banding data were provided by the ABBBS, current to the end of 2011. The longest recovery (i.e. time elapsed from banding to recovery: right column) is given in months. CI = Christmas Island.

Species	*No. banded*	*First banded*	*Last banded*	*No. recovered*	*First recovery*	*Last recovery*	*Longest recovery*
Red-tailed Tropicbird	365	25-Jun-83	10-Sep-10	5	19-Oct-88	27-Jul-07	69
White-tailed Tropicbird	81	11-Jul-83	15-May-10	1	17-Jun-85	17-Jun-85	<12
Emerald Dove	5	22-Jun-83	27-Jan-85	0			
CI Imperial-Pigeon	4	17-Dec-84	7-Sep-85	0			
Great Frigatebird	103	1-Mar-83	15-May-11	2	24-May-09	27-Apr-10	29
CI Frigatebird	40	2-Mar-83	25-May-10	0			
Abbott's Booby	134	5-Jul-77	2-Sep-10	2	6-Mar-89	6-Mar-89	<12
Red-footed Booby	46	30-May-65	29-Aug-07	1	26-Dec-06	26-Dec-06	<12
Brown Booby	414	20-Jul-74	9-Sep-10	16	22-Apr-85	10-May-09	284
Yellow Bittern	1	16-Dec-85	16-Dec-85	0			
Eastern Reef Egret	1	28-Jun-84	28-Jun-84	0			
CI Goshawk	145	11-Sep-83	29-Mar-07	179	15-Aug-04	30-Mar-07	31
Nankeen Kestrel	2	3-Mar-84	10-Sep-84	0			
Common Noddy	135	14-Sep-83	16-Apr-08	0			
CI Hawk-Owl	18	1-Feb-82	13-Nov-95	1	1-May-95	1-May-95	<12
Sacred Kingfisher	1	18-May-84	18-May-84	0			
CI White-eye	40	4-Jun-65	6-Feb-82	0			
Island Thrush	37	4-Jun-65	9-Sep-08	0			
Totals for 18 species	**1572**	**30-May-65**	**15-May-11**	**207**	**22-Apr-85**	**27-Apr-10**	

1965 and May 2011. There were 207 recoveries of banded birds between April 1985 and April 2010. Most of these were resightings of colour-banded Christmas Island Goshawks (James 2007), and other recoveries totalled only 28 individuals of seven species. There has been only one record of a bird banded on Christmas Island and recovered at another locality, a Brown Booby banded on 27 August 1974 and recovered exhausted at Nusakembangan on the southern coast of Java (466 km north-west) at an unspecified time. Only four species have been recovered >12 months after banding. The longest time between banding and recovery was for a Brown Booby, banded by T. Stokes in August 1985 and found dead >23 years later in May 2009 (Hennicke *et al.* 2012).

Significance of the avifauna

Eleven birds are endemic at either the species or subspecies level. In addition, the Island Thrush no longer breeds elsewhere in Australia (the Lord Howe and Norfolk Island subspecies are both extinct) and, within Australian territory, the White-breasted Waterhen breeds only here and in the Cocos (Keeling) Islands. Amongst the visitors and vagrants, many species have not been recorded elsewhere in Australian territory or they have been recorded only very rarely elsewhere in Australia. Christmas Island is the only breeding location known for the White-faced Heron and Nankeen Kestrel in the Indomalayan Region as defined by Inskipp *et al.* (1996), and several vagrant species have not been recorded elsewhere in the Indomalayan Region proper.

Christmas Island is listed by BirdLife International as an Important Bird Area in its own right (Birds Australia 2007). Seven marine bird species breed in internationally significant numbers that exceed the threshold of 1% of global populations, and the total number of seabirds easily exceeds the globally significant threshold of 10 000 breeding pairs. Three of the endemic bird species are listed as globally threatened by the IUCN (IUCN 2013), and all of these and an additional three endemic taxa are listed as nationally threatened under Australia's EPBC Act. Christmas Island is also one of only two islands in the world where eight species of 'Pelecaniformes' (in the broadest sense, i.e. including Phaethontidae) are found breeding, the other being San Benedicto off the coast of Mexico (Pitman & Balance 2002).

Avian biogeography

The biogeography of Christmas Island has received little attention and none recently. Andrews (1900, pp. 299–304) noted that the flora and fauna had strong affinities to the 'Indo-Malayan' biogeographic region (i.e. mainland South-East Asia and Greater Sundas). Nevertheless, he noted a high degree of endemism—at that time thought to be 45% of the land fauna, though he suggested that this figure would fall with further examination of the Greater Sundas fauna. In the late 19th century, the concept of Wallacea as an area of biogeographic transition was not fully developed, and Andrews was following the regions defined by Wallace (1876).

Chasen (1933a) seemed convinced that the birds of Christmas Island were affiliated with the Lesser Sundas, well to the east. However, his arguments,

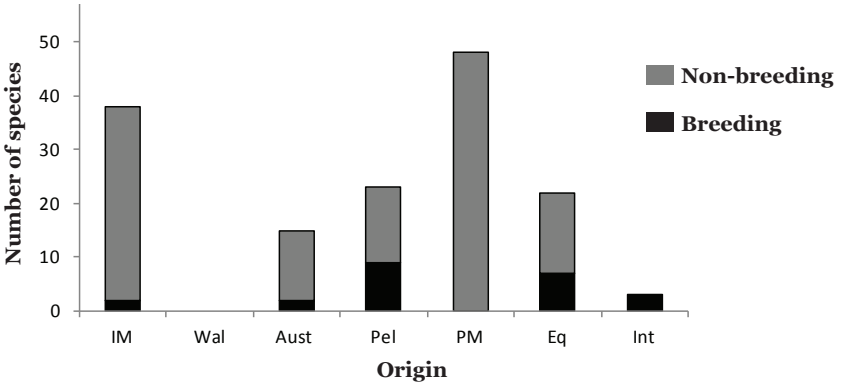

Figure 10. Origin of birds occurring on Christmas Island. IM = Indomalayan Region, W = Wallacea, Aust = Australia, Pel = pelagic species, PM = Palaearctic migrants, Eq = equivocal origins, and Int = introduced by humans.

geological, geographical and taxonomic, were flimsy. He did not recognise any affiliation between the resident landbirds of the Island and those of mainland South-East Asia and the Greater Sundas, and so supposed that the affiliations must lie with the 'Austro-Oriental' (= Wallacean) Region. He then lumped most of the landbirds with species from Wallacea, which consolidated his view of biogeography. Chasen's taxonomic decisions have largely been discredited (e.g. Mees 1957; Norman *et al*. 1998; see Taxonomy and nomenclature in Methods). In addition, Christmas Island is >1100 km west of Wallace's Line at its nearest point between Lombok and Bali, yet is only 350 km south of the Greater Sundas (Java) subregion of the Indomalayan Region. In the geological past, the Island lay farther to the south (Gray & Clark 1995) and so farther from Wallacea and the Greater Sundas. Currently, winds blow from the south-east (i.e. from continental Australia) and the north-west (i.e. the Indomalayan Region), but not from the east (i.e. Wallacea). Gray & Clark (1995) and Stokes (1988) both suggested that the Island's biodiversity in general was more closely affiliated with the 'Indonesian Archipelago' and 'Indo-Malay' regions, respectively, than with Australia.

We classified the birds recorded from Christmas Island according to categories of origin (pelagic species, Palaearctic migrants, Indomalayan, Greater Sunda Islands, Wallacean, Australian, equivocal, and introduced taxa: see Methods). The classifications are based on the analyses of distribution presented in the species accounts. Figure 10 shows the geographic origins of breeding and non-breeding species recorded on Christmas Island. Of the 23 breeding species, nine (39%) are pelagic seabirds. Amongst the 14 breeding landbirds, two (14%) are Indomalayan in origin, none are unequivocally Wallacean (*contra* Chasen 1933a), two (14%) are Australian, seven (50%) have equivocal origins and three (21%) are introduced. Of the 126 non-breeding species, 14 (11%) are pelagic, 48 (38%) are Palaearctic migrants, 36 (29%) are from the Indomalayan Region [one of these (<1%) being strictly from the Greater Sundas], none are strictly Wallacean, 13 (10%) are Australian, and 15 (12%) have equivocal origins.

These results fit logically with Christmas Island's origins and location. It is close to the boundary of two continental plates and has never been connected to another landmass. It is thus in neither the Australian nor Indomalayan biogeographic regions, though it receives migrants and strays from both. More species originate from the Indomalayan Region than Australia because of the former's proximity though, with strong south-easterly winds for much of the year, birds regularly arrive from Australia. Wallacea is far to the east and across the winds, so has little if any influence. The Island is south of the Palaearctic, and close to the East Asian–Australasian Flyway, so is therefore a minor stopover location or overshoot for Palaearctic migrants. Being oceanic, tropical pelagic species also occur. Although there is no direct evidence, we suspect that many migrants and vagrants from the north may reach the Island by moving southwards down the Malay Peninsula, continuing southwards down Sumatra and overshooting into the Indian Ocean.

Species accounts

All species positively recorded from the Island are documented here and listed in Appendix 2. An assessment of the status of the species is given at the start of each account. For vagrants and irregular visitors, the number of records is given, followed by details of these records. The usual range of the species is summarised at the end of each account. Unsuccessfully introduced species and species reported, but considered unconfirmed at this time, are treated similarly in Appendix 1.

Feral Chicken *Gallus gallus*

Uncommon breeding resident; introduced (>100 birds). Domestic fowl were first released from the HMS *Flying Fish* in January 1887 (Maclear 1887b), but there is no record that those birds survived. Domestic fowl were commonly kept from the earliest days of settlement, but there are no early reports of feral birds (e.g. Sharpe 1900; Ridley 1905; Chasen & Kloss 1924; Chasen 1933a; Gibson-Hill 1947; Pearson 1966; van Tets 1975, 1983). In the mid 1980s, T. Stokes noted a 'flock of 10 timid birds in secondary growth near the Airport on a number of occasions' (Stokes *et al.* 1987, p. 4) that had reportedly been there for many years. Reville (1989, 1993) implied that strays were present in settled areas in the mid 1980s. In 1993, Feral Chickens were noted only at the Golf Course and Chinese Cemetery (Carter 1994). At least four were seen by a Coate's Wildlife Tours group at Lily Beach in mid December 1995 (K. Coate *in litt.*). In 2002, DJJ recorded this species at these localities as well as the Resort and the Phosphate Dryers (DJJ). From 2002 to 2009, the species increased rapidly, with feral birds throughout the settled areas and at the Chinese Cemetery, Golf Course, Resort, Linkwater Road, Lily Beach Road, Lily Beach, the Phosphate Dryers, Rubbish Tip, Recreation Centre, Smith Point, Daniel Roux Cave, the Dales, Ross Hill Springs, South Point, scattered mine fields along the North South Baseline and near Egeria Point (K. Retallick pers. comm.; DJJ; IAWM). Based on this distribution and flock sizes of 5–10, the feral population would be >100 birds.

The name Feral Chicken is used here. There is no evidence that anything other than domestic birds has ever been brought to the Island (*contra* Carter 1994 and

Johnstone & Darnell 2004a). On Christmas Island, Feral Chickens only rarely resemble the wild Red Junglefowl (Smith 1996; DJJ; IAWM), and cocks never show the white ear-lappets (DJJ) that are typical of the subspecies *spadiceus* and *bankiva* in Peninsular Malaysia and the Greater Sundas (MacKinnon & Phillipps 1993; Wells 1999). It appears that domestic birds have been released by residents to various sites throughout the Island in recent years, especially near temples and natural water sources. These birds are considered noisy pests by many residents, and the Shire Council has attempted to cull them in settled areas. We recommend that feral birds be exterminated and domestic birds be regulated to prevent their straying. Elsewhere in Australia, feral populations of this Asian species are found on Norfolk Island, the Cocos (Keeling) Islands and North-west Island in the Capricorn Group, Queensland (Marchant & Higgins 1993).

Garganey *Anas querquedula*

Vagrant. One record. One female was seen by D. Merton at the South Point slurry ponds from 26 to 29 November 1978 (Stokes *et al.* 1987).

This species is a regular, but scarce Palaearctic migrant in mainland South-East Asia, the Greater Sundas and Wallacea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000). In Australia, it is a rare, but regular visitor in the north and a vagrant in the south (Marchant & Higgins 1990).

Sunda Teal *Anas gibberifrons*

Vagrant. One or two records, neither confirmed. A specimen was collected for the ZRC by R. Hanitsch in 1904 (Chasen & Kloss 1924). Chasen (1933a) later listed the record as *Anas gibberifrons gibberifrons*, indicating that it was not a Grey Teal *A.* [*gibberifrons*] *gracilis*, which was then treated as conspecific. The Grey Teal occurs commonly throughout Australia and New Zealand (Marchant & Higgins 1990), and is uncommon in the eastern Lesser Sundas west to Timor (Young 1996; Coates & Bishop 1997). Conversely, the Sunda Teal is widespread from Timor to Sumatra (Young 1996) and is the commonest duck in Java and Bali (MacKinnon & Phillipps 1993), so is much more likely to reach Christmas Island. This specimen is not presently in the ZRC (Morioka & Yang 1996; DJJ; IAWM). This lack of certainty has hindered the Sunda Teal's recognition on the Australian list (Christidis & Boles 2008); the record was not accepted by BARC (Case 791). A duck present at the Sewage Treatment Plant near Smith Point in July 2011 was found dead in early August 2011 (L. Preston pers. comm.). A photograph of the carcass (courtesy of L. Preston) shows a small teal with a rich-brown breast and bold white eye-rings, which is most likely a Sunda Teal (DJJ; IAWM); unfortunately, the specimen was not kept. Workers at the Sewage Treatment Plant said that this was not the first record of a duck at this locality (L. Preston pers. comm.).

These would be the only records of the Sunda Teal outside the Greater and Lesser Sunda Islands, the attributed records from Myanmar in Robson (2000) being of the Andaman Island Teal *A. albogularis* (cf. Marchant & Higgins 1990; Young 1996).

Hardhead *Aythya australis*

Vagrant. One record. A female-type bird was seen by P. Meek on 21 July 1997 (Eades 1997b).

This species breeds in Australia and is also a vagrant to Wallacea, Java, Bali and the Cocos (Keeling) Islands (Marchant & Higgins 1990; Andrew 1992; Coates & Bishop 1997; Herkenrath 2006; Hopton 2006).

Red-tailed Tropicbird *Phaethon rubricauda*

Common breeding species (>2000 pairs?). Known locally as the 'Silver Bosun'. The first record was of observations by J.J. Lister in October 1887 (Lister 1889). Historical population estimates are listed in Table 3. Stokes (1988, citing Stokes 1984) listed 1380 pairs, although Johnstone & Darnell (2004a, p. 443) cited that 'Stokes (1984)' listed 4000–6000 pairs. These are all likely to be underestimates, considering the inaccessibility of many breeding sites and the protracted breeding season. In 2005 and 2006, >200 nests were tagged and studied in two coastal subcolonies in the Settlement alone (Ishii 2006; James 2007). This area is only 1% of the coastline and, although the breeding distribution is very patchy, it suggests that the total breeding population is likely to be in excess of 2000 pairs (DJJ). Regardless, the Island is easily the largest breeding station of the Red-tailed Tropicbird in Australian territory (cf. Marchant & Higgins 1990; James 2001a).

It is possible that the population of Red-tailed Tropicbirds expanded considerably during the 20th century. Gibson-Hill (1947) recorded no nests on the coastal terrace in 1939–1940, though he was a meticulous observer. Stokes (1988) found 85 active nest-sites on the coastal terrace between Rocky and North East Points in 1985–1986. A study by DJJ and others found >200 active nests at Rocky Point alone in 2005–2006 (Ishii 2006; James 2007). Perhaps the extinct Christmas Island Burrowing Rat and Maclear's Rat previously placed a greater level of control on this tropicbird or, alternatively, human hunting placed pressure on the population in the mid 20th century.

T. Stokes (1988) banded 160 adult Red-tailed Tropicbirds on the coastal terrace between Rocky and North East Points in 1985–1986. N. Dunlop and others commenced an annual colour-banding program of adults at Rocky Point (as a Birdweek activty) in 2006 (James 2007). Few details have been reported from either study, but no long-term or long-distance recoveries have been reported.

The breeding season of Red-tailed Tropicbirds is protracted. Eggs are laid from November to August, peaking in February to May or June (Gibson-Hill 1949b; Stokes 1988). Very few Tropicbirds are present on the Island in December–January, indicating some post-breeding exodus and a lull in breeding (DJJ; IAWM). During incubation, foraging trips routinely last for >6 days and are >600 km in distance (Sommerfeld & Hennicke 2010).

Breeding sites are always on the ground, either along the coastal terrace near the edge of the sea-cliff, or in cavities high in the face of the inland cliff (Stokes 1988; Ishii 2006; DJJ). The distribution is very patchy in both habitats. Sea-cliff locations include the Margaret Beaches, Settlement to North East Point, Low Point,

Steep Point, Waterfall Cove and the northern half of the eastern coast. Inland cliff locations include the Golf Course cliffs, Steep Point, South Point, Middle Point and North West Point (Stokes 1988; DJJ). The number of sub-colonies or breeding clusters is unknown. The presence of displaying adults above the colonies indicates that there are more colonies or greater concentrations on the sea-cliffs than on the inland cliffs. In the Rocky Point sub-colonies, the nests tended to be shallow scrapes under vegetation (e.g. *Pemphis acidula*, Cabbage Tree *Scaevola taccada*, Pandanus *Pandanus christmatensis*, Pisonia *Pisonia grandis* and vine tangles), fallen fronds of Coconut Palm *Cocos nucifera*, or occasionally rocks (Ishii 2006). Nest-sites always had >70% shade cover, and nesting density was highest under *Pemphis*, presumably because of its consistent shade cover and clear understorey (Ishii 2006). Nests are often clustered in loose colonies, but also occur in isolated situations (DJJ). On the inland cliff, nest-sites appear to be in rock cavities, and are sparser than on the coastal cliffs (DJJ).

Marine records: Some Red-tailed Tropicbirds were seen from the RV *Franklin* in waters near Christmas Island in October 1987 (Dunlop *et al.* 1988a). N. Cheshire saw a single bird 200 nm south-south-east at 13°34′S, 106°59′E on 12 April 1995, and one outside the EEZ at 15°S, 107°E on 24 September 1995 (Bourne 1996; N. Cheshire *in litt.*).

The Island population of the Red-tailed Tropicbird is not listed as globally threatened by the IUCN (2013) or under the EPBC Act, as it is considered a population of a more widely distributed and secure species. Nelson (1972) recorded that the Tropicbird was shot occasionally for food. Stokes (1988) estimated that 1.6 km of coastline breeding habitat has been lost to municipal development, although Tropicbirds' nests still occur along this coast (DJJ; IAWM). A study in 2005–2006 found almost 100% losses of eggs or chicks in each season (Ishii 2006; James 2007). Late in 2006, remote cameras recorded two incidents of predation of chicks by feral Cats *Felis catus* and one by a Black Rat *Rattus rattus* (James 2007). Almost complete nesting failure in these sub-colonies continued until at least the 2010 season (Hennicke in Algar *et al.* 2011). A long-delayed program has finally commenced to remove cats from the Island (Algar *et al.* 2011), but it remains possible that this very important population of Tropicbirds could collapse. Predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000) have so far not eventuated. There is no information about the effects of *El Niño* Southern Oscillation events on nesting success. A study of breeding success of Settlement colonies of Tropicbirds found that there was a significant reduction in the number of active nests and eggs as a result of Cyclone Rosie in April 2008, though no adult Tropicbirds were found dead (Hennicke & Flachsbarth 2009). Cyclonic conditions are rare on the Island, but such events may become more frequent with climate change.

This species is found in tropical and subtropical waters of the Indian and Pacific Oceans, breeding at many localities (Nelson 2005). The nearest breeding localities to Christmas Island are the Cocos (Keeling) Group, eastern Indonesia, Ashmore Reef and islets off the WA coast, and the Chagos Group, though it is generally absent from the central Indian Ocean (de Korte & Silvius 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004b; Milton 2005; Clarke *et al.* 2011).

Of these localities, the only significant colonies are at Gunung Api and Manuk Island in eastern Indonesia.

Tarburton (1989) noted latitudinal clinal variation of the wing- and tarsus-lengths of Red-tailed Tropicbirds throughout the Pacific Ocean, and he considered the species monotypic. However, his paper found significant colour differences between the populations of the western (*rubricauda*—white birds) and eastern (*westralis*—pink-tinged birds) Indian Ocean, and between those in the Coral and Tasman seas (*roseotinctus*—pink-tinged birds) and those in the remainder of the Pacific (*melanorhynchos*—largely white birds). Some authors continue to recognise these four subspecies, evidently on this basis (e.g. Orta 1992a; Dickinson 2003; Johnstone & Darnell 2004a,b). However, Christmas Island birds are usually white, with a few showing a very faint tinge of pink flush to the underparts; the incidence of pink-tinged birds is less than expected for the population of the eastern Indian Ocean. Size differences between birds in the eastern Indian Ocean and Coral and Tasman Seas are not significant, and also show clinal variation from north to south. Birds in southern Tasman populations often have a pink tinge (IAWM), but Coral Sea populations rarely do (DJJ). Thus, it appears that the pink tinge also shows latitudinal variation, and is possibly related to the local diet.

Dispersal has been overlooked in the taxonomic discussion. Le Corre *et al.* (2003) noted movements across the Indian Ocean, based on single banding recoveries between Sumatra and Mauritius (Jenkins & Robertson 1969) and between Sugarloaf Rock, WA, and Réunion Island. This suggests intermixing between the western and eastern Indian Ocean populations, supposedly the most different in colour. It thus appears that subspecies are not warranted.

White-tailed Tropicbird *Phaethon lepturus fulvus* (Front cover)

Abundant endemic subspecies (6000–12000 breeding pairs). Known locally as the 'Golden Bosun'. The subspecies *fulvus* was first described by Brisson (1760) and again by Brandt (1839) without a type-locality. The first record definitely from Christmas Island is three specimens collected by J.J. Lister in October 1887 (Lister 1889; two specimens now in the CUMZ), but Grant (1898) was the first to recognise Christmas Island as the breeding locality of this subspecies. Historical population estimates are provided in Table 3. Early estimates were probably too low, because of the concealed rainforest nest-sites (Marchant & Higgins 1990). Dunlop (1988) undertook the only detailed assessment, to provide an estimate of 6000–12 000 breeding pairs. James & Retallick (2007) included this species in forest bird surveys, and recorded it flying over sites in 36.4% of 527 10-minute surveys. This is easily the largest population of the species in Australian territory, with all other populations being <100 pairs (Marchant & Higgins 1990). Golden Bosuns performing raucous communal display flights over the townships are a unique, striking and common sight that inspires local pride, and they have earned this bird a deserved iconic status on the Island.

Breeding is aseasonal, with laying in all months (Dunlop 1988; Stokes 1988), and juveniles grounded when making their sole exit flight from the nest to sea are recovered in all months (M. Orchard pers. comm.). Dunlop (1988) estimated the

breeding periodicity to be ~10 months apart. Nests are dispersed over much of the Island, but are more common on the upper terraces than on the shore terrace (Dunlop 1988). James & Retallick (2007) recorded the species less frequently at the western end of the Island than elsewhere. The choice of nest-sites is diverse. Most nests are in hollows in rainforest-canopy trees (Gibson-Hill 1947; Dunlop 1988; Stokes 1988). Some are in tree-hollows outside the rainforest (e.g. Territory Day Park: DJJ), and some are in epiphytic Bird's-nest Ferns *Asplenium nidus* in the rainforest canopy (DJJ). Nests are also common in limestone cavities in the sea- and inland cliffs (Sharpe 1900; Dunlop 1988; Stokes 1988; Reville & Stokes 1994), conspicuously so in the Settlement and the 'incline' between the Settlement and Silver City (DJJ; IAWM). One nest (on the ground in the base of a hollow tree) in Poon Saan was on the footpath outside an unoccupied block of flats and was used successfully for several years even after re-occupation of the flats (DJJ; IAWM). One nest was reported in a pipe in the moving phosphate-loading cantilevers at Flying Fish Cove (Stokes 1988). Nesting was reported in mined pinnacle fields in the 1980s (Stokes 1988), and it has since been incorrectly assumed that this occurrence is widespread (e.g. Marchant & Higgins 1990; Corbett *et al.* 2003; Johnstone & Darnell 2004a), but we found no evidence of this practice.

Marine records: The distinctive golden birds have been reported widely at sea, both within the Island EEZ and well outside it. Pearson (1966) saw golden-coloured tropicbirds 125 km south sometime in 1960–1964. They were reported at sea in or just outside the EEZ on over 15 other occasions between 1964 and 1999, in different months (Bourne 1970, 1985, 1989, 2000; Simpson 1970; Bourne & Dixon 1973; Slinn 1994; Cheshire 1995; N. Cheshire *in litt.*). Of note were 30 birds feeding with other seabirds between 45 and 60 nm east of Christmas Island on 20 June 1967 (Simpson 1970). Outside the EEZ, Gibson-Hill (1947) reported golden-coloured tropicbirds at sea off Java Head and the Cocos (Keeling) Islands. During four marine surveys between 1987 and 1996, golden birds (mostly solitary) were recorded around Christmas Island between 2°S and 21°S, as far afield as 1340 km east-south-east, 1540 km south-east and 1660 km north-west (Dunlop *et al.* 1988a, 2001). The Royal Navy Bird Watching Society database contains one record from the Bay of Bengal near Myanmar (~3200 km north-north-west of Christmas Island) and five records spread from the northern tip of Sumatra westwards about halfway to Sri Lanka (2200–2800 km north-north-west) (S. Howe *in litt.*). It also has >15 records of golden tropicbirds between southern Sumatra and Java and the Australian North West Shelf (an area which includes Christmas Island) and one in the Timor Sea between the northern Kimberley coast, WA, and Timor (~2200 km east of the Island); essentially, these records are concentrated along the deep waters of the Java Trench. Dunlop *et al.* (1988a, 2001) mapped golden-coloured tropicbirds in deep water with sea-surface temperatures of 24.4–29.6°C and salinities of 32.65–36.88‰.

The Island population of the White-tailed Tropicbird is not listed as globally threatened by the IUCN (2013) as it is considered a population of a more widely distributed and secure species. The subspecies is also not listed under the EPBC Act. It has been said that the population has been reduced since settlement (Marchant & Higgins 1990). This is presumably based on the assumption that clearing of 25% of

breeding habitat for mining and municipal purposes would reduce the population, as there are no data on population changes. There has been a moratorium on forest clearing since 1988. Historically, the White-tailed Tropicbird was considered uncommon on the Island, but it is presently conspicuous and usually considered common. Stokes (1988) reported that feral cats and Christmas Island Goshawks take nestlings, and its nests may be robbed by rats. Hill (2004a) noted an instance of an adult being taken by a Christmas Island Goshawk. Recently, Garnett *et al.* (2011) considered the subspecies Endangered on the basis of predation by rats and cats, the limited breeding area, and the suspected threat from hybridisation. The diverse nesting sites chosen suggest that the Tropicbird would be likely to adapt to nest-boxes of a suitable design if they ever should be needed. There is no information on effects of *El Niño* Southern Oscillation events on nesting success.

The White-tailed Tropicbird is pantropical in distribution, breeding at many localities, though usually in low numbers (Nelson 2005). The nearest breeding localities to Christmas Island are the Cocos (Keeling) Group, islets and cliffs on the southern coast of Java (though the species is evidently absent from most of Indonesia), the Chagos Group, and occasionally Ashmore Reef and Rowley Shoals north of the WA coast (de Korte & Silvius 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004b; Milton 2005; Clarke *et al.* 2011). However, all of these populations are small in number and consist entirely of white-morph birds, so are a different subspecies from *fulvus*. There has been a suggestion that there has been an increase in the number of white-morph birds on Christmas Island in recent decades, from none up to the 1960s, ~5% in the 1970s and 7% in the 1980s (Gibson-Hill 1947; Pearson 1966; Dunlop 1988). If this is the case, then it may be the result of recruitment of birds from Indonesia, where there has evidently been pressure on breeding sites, as White-tailed Tropicbirds there now breed only on inaccessible cliffs (de Korte & Silvius 1994).

Some taxonomic issues are discussed in Taxonomy (p. S16).

Red Collared Dove *Streptopelia tranquebarica*

Status uncertain. Five sets of records, but only four are confirmed. One was seen at the Plantation by S. & A. Keates and F. O'Connor on 30 December 2005 and 1 January 2006 (Anon. 2006a,d; Dooley 2006a; Palliser 2008; BARC Case 472), and by M. Schulz (pers. comm.) on 2 January 2006. The bird was first reported to DJJ by H'ng Kim Chey (pers. comm.) on 5 December 2005, and a bird fitting the general description was reported by J. Hueston (pers. comm.) at Field 19 (off the Blowholes Track) on 20 November 2005. One was seen and photographed at South Point Temple on 17–18 January 2008 (Anon. 2008a; Dooley 2008b; Ramsay 2008b; Roderick 2008; Palliser 2009; Tan S.J. & D. Mantle pers. comm.; BARC Case 564), where it had been present for 2 weeks. One was seen by a tour group at the LB3 ponds on 7 December 2009 (Baxter 2009; Anon. 2010a; Eaw & Dooley 2010; Ramsay 2010a). An adult male seen at the Rubbish Tip from 9 December 2010 to 11 February 2011 was observed by several visiting parties (James 2010; Anon. 2011a; Carter 2011b; Clarke 2011b; Dooley 2011a; Marsh 2011; Ramsay 2011a; IAWM; BARC Case 683). An adult male was photographed at the Settlement on 1–8 December 2011 (Baxter 2011b; BARC Case 739). These

are the only records for Australian territory, and probably all represent a single long-staying adult male.

Northern populations in India and China are migratory over short distances, but South-East Asian populations are resident (Robson 2000). This species is known as a vagrant in Thailand and Peninsular Malaysia (Grimmett *et al.* 1998; Wells 1999; Robson 2000). The sedentary Philippines subspecies *humilis* does not reach Borneo (Kennedy *et al.* 2000; cf. MacKinnon & Phillipps 1993). The population in Singapore, recorded only since 1940, is considered feral (Strange & Jeyarajasingam 1993; Wells 1999; Wang & Hails 2007). The only record for the Greater Sundas, a sight record in north-western Java in November 1995, was considered most likely a bird escaped or released from captivity (van Balen 1997). The only other known occurrences in Indonesia are feral populations in Sulawesi (Andrew 1992). In this context, the Christmas Island reports may refer to birds that escaped or were released from ships visiting from South-East Asia, and the species' status on the Australian list may be questionable.

Emerald Dove *Chalcophaps indica natalis* [Figure 11 (p. S53)]

Common endemic subspecies (900–3500 individuals). The first report from Christmas Island was the collection of the type-specimens of the subspecies by J.J. Lister in October 1887 (Lister 1889). Three syntypes are in the NHM (Warren 1966) and four are in the CUMZ (Benson 1999). Van Tets (1975) guessed the population size to be in the order of 100–1000 pairs (see Table 3). Stokes (1988) considered that there could be more than 1000 pairs. Garnett & Crowley (2000) gave the number of individuals as 5000, without explanation. Corbett *et al.* (2003) estimated the population by distance sampling to be 900–3500 birds, although the quiet and inconspicuous nature of the Emerald Dove should lead to under-sampling by this method. James & Retallick (2007) recorded it in 198 out of 527 10-minute surveys, a reporting rate of 38% that made it the fifth most frequently recorded of eight species in their forest bird survey.

The Emerald Dove occurs in evergreen and semi-deciduous rainforests, secondary growth, vegetated urban environments and shady clearings (Gibson-Hill 1947; Stokes 1988; Higgins & Davies 1996), and is largely absent from unvegetated mining wastelands (James & Retallick 2007). It feeds on the ground, mostly on fallen fruit, seeds, and perhaps invertebrates (Higgins & Davies 1996). Gibson-Hill (1947) listed Pawpaw *Carica papaya* and Rice *Oryza sativa* as favoured introduced foods. It walks and runs nimbly, feeding singly, in pairs or family groups of male, female and up to two juveniles, but never flocks (DJJ; IAWM). It is seen frequently on shady roadsides and in car parks, where it might seek food crushed by vehicle tyres (DJJ). It also frequently forages in the forest interior, even where the undergrowth is very dense (DJJ; IAWM). It usually calls from perches close to the ground (Reville 1989). Contrary to its reputation elsewhere (cf. Higgins & Davies 1996), it is far less tame and confiding than the other diurnal forest birds of Christmas Island (Gibson-Hill 1947; DJJ; IAWM).

The breeding season is October–February, with a peak in November–December (Gibson-Hill 1947). The nest is a loose platform of twigs with a lining of leaves,

placed in the fork of a thin, horizontal branch of a tree or shrub, 2–3 m above the ground (Gibson-Hill (1947). DJJ saw one nest in an outer branchlet of a Strangler Fig *Ficus microcarpa* 3 m above a road. The clutch-size is two (Gibson-Hill 1947).

The Christmas Island subspecies of the Emerald Dove *C. i. natalis* has been listed as Endangered (as a subspecies of Emerald Dove *C. indica, sensu lato*) under the EPBC Act since 2005. It is not listed as globally threatened by the IUCN (2013), as it is considered a subspecies of a more widely distributed and secure species. It was listed under the EPBC Act following predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000; Davis 2002). Garnett *et al.* (2011) considered it Near Threatened. Davis *et al.* (2008) reported a ninefold decrease in abundance in forest sites invaded by Crazy Ants in 2001. Fortunately, this has not resulted in an observed decline. James & Retallick (2007) found that the Emerald Dove remained widely distributed in forested habitats in 2006. The SSCSTE (1983) and Stokes (1988) listed poaching as a former threat, but there is no evidence of recent poaching (DJJ). Stokes (1988) listed predation by cats as definitely occurring and predation at nests by rats as probable, although Higgins & Davies (1996) mis-cited the latter as definite. However, nests appear to be built in outer branchlets beyond the reach of rats (Gibson-Hill 1947; DJJ). Emerald Doves are occasionally killed on the roads by vehicles, although this is unlikely to have a great impact on population levels (DJJ).

Some taxonomic issues are discussed in Taxonomy (p. S17).

Christmas Island Imperial-Pigeon *Ducula whartoni* [Figure 12 (p. S53)]

Abundant endemic species (35 000–66 000 individuals). The first record was the collection of the type-specimen, an adult male, by Captain J.P. Maclear in January 1887 (Maclear 1887a; Sharpe 1887; Warren 1966). Van Tets (1975) guessed the population to be ~10–100 pairs (Table 3). Garnett & Crowley (2000) gave an estimate of 1000 individuals, though the population is at least ten times greater than this (D. James in IUCN 2013). Corbett *et al.* (2003) estimated the population by distance sampling to be 35 000–66 000 birds. James & Retallick (2007) recorded it in 472 of 527 10-minute surveys, a reporting rate of 90%, making it the second most frequently recorded of eight species in their forest bird survey.

The Christmas Island Imperial-Pigeon is abundant in evergreen, semi-deciduous and secondary forests. A higher frequency in primary evergreen forests of the inland plateau has often been reported (e.g. Chasen 1933a; Gibson-Hill 1947; Stokes 1988; Higgins & Davies 1996), but this trend is probably much less marked in recent years (DJJ) through a reduction in poaching (see p. S39). The Imperial-Pigeon also occurs in regrowth, weed fields, urban areas and mine fields, avoiding only the most barren of cleared areas (James & Retallick 2007). It forages for fruit in the forest canopy, in isolated trees and in shrubs, rarely singly, usually in small groups to large flocks (Higgins & Davies 1996; DJJ). Recorded foods include the fruits of ~12 native and three introduced plants and the leaves of three native species (Higgins & Davies 1996). To that list we can add the young leaves of *Leucaena leucocephala* (locally known as Coffee Bush) and male flowers of Pawpaw (DJJ), as well as their leaves (Woinarski 2014; IAWM).

The introduced and widespread *Muntingia calabura* (locally known as Japanese Cherry) has become a very significant source of food, and flocks of several hundred birds sometimes occur where this plant is common and fruiting (DJJ; IAWM). The Imperial-Pigeon apparently sometimes forages on the ground for the berries of Belladonna *Atropa belladonna* (DJJ). It descends to the ground to drink at springs (e.g. the Dales) and puddles, sometimes in large congregations, most often during the dry season (Gibson-Hill 1947; Higgins & Davies 1996; DJJ).

The breeding biology is poorly known. The season is probably late August to February (Higgins & Davies 1996), but may be more spread, since woodcutters reported to Gibson-Hill (1947) that the species breeds year-round, peaking from January to April. Nests are usually in the crowns of tall rainforest trees, but have been recorded in saplings and vine tangles as low as 4 m above the ground (Hicks & Yorkston 1982; Higgins & Davies 1996). The nest of twigs is a loose-knit untidy platform ~20–40 cm in diameter (Gibson-Hill 1947; Hicks & Yorkston 1982). Detailed observations at a single nest were described by Hicks & Yorkston (1982).

The Christmas Island Imperial-Pigeon is listed by the IUCN (2013) as Near Threatened despite its having a single small population restricted to one location. In 2005, the Australian Government did not accept a nomination to list it as threatened under the EPBC Act on advice from the TSSC (TSSC 2005a). Garnett *et al.* (2011) considered it Near Threatened. Historically, the main threat has been heavy hunting, both legal and illegal (Chasen 1933a; Gibson-Hill 1947; Crome 1978; SSCSTE 1983; Stokes 1988), which largely ceased in 1977 (Stokes 1988), but hunting still occurs sporadically (DJJ). The Imperial-Pigeon has been considered to be threatened and declining on at least five separate occasions: 1904 (Chasen 1933a), 1932 (Chasen 1933a), 1940 (Gibson-Hill 1947), 1973 (HRCEC 1976) and 2000 (Garnett & Crowley 2000). On the first, second and fourth occasions, specific studies were commissioned to investigate, and they each determined that the Imperial-Pigeon had undergone declines caused by hunting, but could not quantify the decline (Hanitsch in Chasen 1933a; Tweedie in Chasen 1933a; Crome 1978). Fortunately, predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000) have so far not eventuated. Cats were reported to take some birds feeding low down in Japanese Cherry trees (Tidemann *et al.* 1994). Road-kills are scarce (James 2007). The species has recovered rapidly to very high population levels following the abatement of unsustainable hunting, but would be likely to be susceptible to future declines if protection were removed.

This species was introduced to the Cocos (Keeling) Islands (presumably Horsburgh Island) by the Clunies-Ross family, evidently between November 1888 and August 1890 (Ridley 1891; *contra* Wood-Jones 1909). The last confirmed record there was in 1906 (Wood-Jones 1909).

Pied Imperial-Pigeon *Ducula bicolor*

Vagrant. One record. An adult male was collected by Hugh Ross at Flying Fish Cove on 4 February 1899 (Andrews 1900). Several Pied Imperial-Pigeons were apparently observed on the Island at this time. Gibson-Hill (1947) listed the specimen as nominate *bicolor*, presumably on the basis of distribution.

Nominate *bicolor* occurs from the Andaman and Nicobar Islands through the Greater Sundas, Philippines, and Wallacea to western New Guinea; subspecies *spilorrhoa* occurs from northern Australia to southern New Guinea (MacKinnon & Phillipps 1993; Higgins & Davies 1996; Coates & Bishop 1997; Robson 2000). These two taxa are sometimes treated as separate species (e.g. Gill & Donsker 2012). This is the only record of nominate *bicolor* from Australian territory.

Savanna Nightjar *Caprimulgus affinis*

Vagrant. Eight sets of reports, but only one is confirmed. One was caught and photographed at the Airport by F.A.R. Hill on 30 May 1994 (Andrew & Eades 1994; Palliser 1999; BARC Case 187). Another was reported by Hill in October 1994 (Andrew 1994; Eades 1994; Higgins 1999). During a BOCA tour in October 1996, one was seen at the Airport on 29 October and two or three were seen on 31 October (Lester 1997; record cited as 'early Nov 1996' by Higgins 1999); apparently these birds were videotaped and were believed to be a male and a female or immature (Eades 1997a). Although Barkla's (1996) trip report for this tour did not list the species, he referred to these sightings in a report of a later trip (Barkla 2009). Johnstone & Darnell (2004a) reported that the same birds were still seen there up to mid 1997. A sighting of an unidentified nightjar at the Golf Course on 13 April 2005 had no supporting details (Brodie-Good 2005), and was possibly a Common Noddy, a species that flies around the Golf Course at night (DJJ; IAWM). M. Schulz (pers. comm.) reported an unidentified nightjar flushed from the side of the road at North West Point in December 2005. A bird was taped at the Airport and flew in to call-playback on 5 March 2007 (Anon. 2007b; Baxter 2007; Carter 2007; Dooley 2007b; Ramsay 2007a; R. Baxter *in litt.*). It was seen briefly and then called for some hours afterwards; it was also noted at this locality on 6 and 7 March 2007. A bird with the same call was heard at the northern end of the Airport by a tour group on 9 December 2009 (Baxter 2009; Eaw & Dooley 2010). One was seen at the Chalk Pits near the northern end of the Airport on 18 and 20 February 2012 (Anon. 2012a; Dooley 2012b; Faulkner 2012). One responded and came to a tape of the species' call at the Golf Course in early December 2013 (Baxter 2013).

This polytypic species is a widespread resident of southern Asia, from the Indian Subcontinent and southern China south to the Philippines, Greater Sundas and Wallacea; northern populations winter in the Greater Sundas (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Higgins 1999; Robson 2000). Higgins (1999) and Johnstone & Darnell (2004a) considered that the photographed bird from May 1994 resembled nominate *affinis* from Java and Sumatra. These are the only reports from Australian territory.

Grey Nightjar *Caprimulgus jotaka*

Vagrant. One record, unconfirmed. A bird, apparently a female, responded to playback of the male call at the northern end of the Airport on 10, 13 and 18 January 2012 (O'Connor 2012; IAWM). It flew by (not seen) and called on 10 January, and flew by (seen well) twice without calling on 13 January. On 18 January, it responded to playback by calling and coming in to be seen well.

It also responded to playback and was observed on 16, 18 and 20 February 2012 (Anon. 2012a; Dooley 2012b; Faulkner 2012).

The Grey Nightjar is polytypic. Separation into two species was advocated by Rasmussen & Anderton (2005) and several later authors, but this was overlooked by Christidis & Boles (2008). *C. jotaka* breeds widely in Asia from the Himalayas in the west to Japan in the east and from southern Siberia south to the Philippines and the Greater Sundas. Tropical populations are resident, but northern populations migrate to winter in mainland South-East Asia, the Philippines and Greater Sundas, with vagrants reaching Wallacea and New Guinea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000; Rasmussen & Anderton 2005). There are two prior reports from Australia: a photographic record from Ashmore Reef on 25 December 2003 (Dooley 2005b; Carter 2009; BARC Case 450) and a photographic record from onboard a ship in the Timor Sea on 23 August 2005 (Dooley 2006b; BARC Case 493; *contra* Carter 2009).

Christmas Island Swiftlet *Collocalia natalis* [Figures 7–9 (pp. S51–52)]

Abundant endemic species (~5000–10 000 breeding pairs?). The first record appears to be sightings of 'a small Swift' at Flying Fish Cove by Captain J.P. Maclear in January 1887 (Maclear 1887a,b). The species was described shortly afterwards from specimens collected in October 1887 (Lister 1889). Two syntypes are in the NHM (Warren 1966) and one in the CUMZ (Benson 1999). It is generally considered to be conspicuous and very common or abundant (Gibson-Hill 1947; Stokes 1988; Carter 1994; Johnstone & Darnell 2004a). There are no population estimates based on survey data. Van Tets (1975) guessed the population to be in the order of 100 000–1000 000 pairs (see Table 3), but this is too high an estimate for the size of the Island. Garnett & Crowley (2000) gave an estimate of 5000 individuals, but without any explanation. Based simply on the largest aggregations observed between 2002 and 2007 (of ~1000 individuals) and the small number of breeding caves known (see p. S42), it is likely that the population is in the vicinity of 5000–10 000 pairs (DJJ, this work). James & Retallick (2007) recorded the Swiftlet in 302 out of 527 10-minute surveys, a reporting rate of 57% that made it the fourth most frequently recorded of eight species in their forest bird survey.

This aerial species occurs in most habitats around the Island, including evergreen, semi-deciduous and secondary forests, weed fields, urban areas and cleared land, but it does not fly over the sea. It usually avoids the forest interior, but penetrates forest along tracks and other flyways, and sometimes drops down through gaps in the canopy (DJJ; IAWM). Gibson-Hill (1947) considered it more common on the inland plateau than on the coastal terraces, but most common on the western terraces of South Point and least common on the western coast. Large aggregations of up to 1000 birds congregate over North West Point, sometimes with vagrant swifts and swallows (DJJ). Stokes (1988) noted a preference for feeding in open, shady areas, such as along shady roads and forest edges. Carter (1994) noted a propensity for foraging in low air-space, and the Swiftlet often almost skims the ground (DJJ; IAWM). It is often seen amongst emergent trees above the forest canopy (Higgins 1999) and foraging round large Strangler Figs

along roadsides (DJJ; IAWM). There have been no dietary studies for the Swiftlet on the Island but, like its congeners, it feeds on small insects (Higgins 1999). It is generally diurnal, but sometimes forages around street-lights after dusk (DJJ). Several were once seen repeatedly drinking or bathing, while flying, at the pool above Hughs Dale Waterfall in 2004 (DJJ).

Nests are located in caves, but the Christmas Island Swiftlet has been reported breeding in only a few caves, all in the first inland cliff, and there have been no systematic attempts to locate and document colonies or count nests. Reported sites include Smiths Cave, (Upper) Daniel Roux Cave, Grimes Cave and other nearby caves on Smith Point, the Managers Alcove, Swiftlet Cave, and unnamed caves on the western side of South Point, near Hosnies Springs and at Smithsons Bight (Stokes 1988; Humphreys & Ebehard 2001; James & Milly 2006; M. Jeffery pers. comm.; DJJ). A. Graham (pers. comm.) found a few pairs breeding under a house on low pillars at Rocky Point (near the Managers Alcove) in 2004 (James & Milly 2006). DJJ found a few nesting in the roof of an abandoned building behind the Kampong in April 2012.

Gibson-Hill (1947) reported a protracted breeding season from September to March, with two peaks of laying, in October and January. This, coupled with a 40–45-day nestling period, and probably limited post-fledging dependence, led him to speculate that the Swiftlets might double-brood. The clutch-size is consistently two (Gibson-Hill 1947). Gibson-Hill (1947, p. 151) described the nest as being made from lichen and 'dried fibres of sago palm', clearly the endemic Christmas Island Palm *Arenga listeri*. Higgins (1999) later listed this as the Sago Palm *Metroxylon sago*, which does not occur on the Island.

The Christmas Island Swiftlet is not listed as globally threatened by the IUCN (2013), as it is considered a subspecies of a more widely distributed and secure species. Garnett *et al.* (2011) considered it Near Threatened. Stokes (1988) reported that the large colony at Daniel Roux Cave was abandoned in 1984, and suggested visits by people as a potential cause. Humphreys & Ebehard (2001) later recorded breeding there again. Another cave used near the oil terminal at Smith Point in 2005 was abandoned the following year after the construction of a pipeline adjacent to the cave entrance (IAWM). Stokes (1988) also considered that pesticide use might be an indirect threat. Fortunately, predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000) have so far not eventuated. Christmas Island Swiftlets are often killed by vehicles (van Tets & van Tets 1967), and this mortality shows spikes with increased traffic associated with development activities, but the levels are not likely to be a threat to the population (James 2007). James & Milly (2006) noted that the congeneric Linchi Swiftlet remains very common in Java, where pressures on bird populations are considerably greater than they are on Christmas Island.

Some taxonomic issues are discussed in the Taxonomy and nomenclature section (p. S17).

White-throated Needletail *Hirundapus caudacutus*

Vagrant. At least four sets of records. Johnstone & Darnell (2004a) listed two

unconfirmed records, from November–December 1984 and from November 1995. Several observers saw two at the Sports Ground on 14 November 2003, and up to three on 15 November 2003 (Anon. 2004a,b; Barrand 2005a). A bird seen at the Rubbish Tip on 23 April 2008 had originally been thought to be a Silver-backed Needletail *H. cochinchinensis*, but was probably a first-year White-throated Needletail (Ramsay 2008c; J. Davies pers. comm.; IOSG delegates pers. comm.; IAWM). Two White-throated Needletails were reported at the Rubbish Tip on 30 November 2008 (Baxter 2008b; Anon. 2009a), and two were reported at the Settlement on 2 December 2011 (Baxter 2011b).

Nominate *caudacutus* breeds in northern and central Asia and migrates to Australasia for the boreal winter; on passage, it is scarce in mainland South-East Asia, rare in the Greater Sundas and common in Wallacea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Higgins 1999; Chantler & Driessens 2000; Robson 2000).

Fork-tailed Swift *Apus pacificus*

Rare irregular visitor. At least 18 sets of records, 16 since 1990. The first occurrence was three seen by T. Stokes at North West Point on 9 November 1984 (Stokes *et al.* 1987). Another two were seen at Flying Fish Cove on 4 and 5 December 1985 (Stokes *et al.* 1987). Between 1995 and 2011, there were at least 16 reports (Bartram 1996; Smith 1996; Carter 2000a,b, 2001, 2011b; Anon. 2002b; Holmes 2002; Carter *et al.* 2008; Baxter 2010b, 2011b; James 2010; K. Coate *in litt.*; M. Holdsworth pers. comm.; IOSG delegates pers. comm.; C. Nixon pers. comm.; L. Preston pers. comm.; DJJ; IAWM). The Swift was reported in only nine of the 17 years, although annually from 2008 to 2011, which probably reflects the steadily increasing observer effort. Records are from late October to early May. It has mostly been seen singly or in small flocks of up to five birds, but 11 were recorded in April 2008 following Cyclone Rosie. Reported localities include the Settlement and Kampong, Poon Saan, the Rubbish Tip, Airport, North East Point, Ma Chor Nui Nui Temple, Margaret Knoll, South Point Temple, North West Point and Migrant Hill.

This polytypic species breeds widely throughout Asia, and nominate *pacificus* migrates to Australia for the boreal winter; on passage, it is locally common in mainland South-East Asia, the Greater Sundas and Wallacea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Higgins 1999; Chantler & Driessens 2000; Robson 2000).

House Swift *Apus affinis*

Vagrant. Three sets of records, two confirmed. One was seen by DJJ at the Rubbish Tip on 3 November 2005 (Dooley 2006a). A swift with a white rump seen at the Airport on 18 April 2008, several days before Cyclone Rosie, was possibly a House Swift (D. Stojanovic pers. comm.). At least seven House Swifts were observed from 23 to 28 April 2008 at the Rubbish Tip, North East Point, Poon Saan, near Ma Chor Nui Nui Temple and North West Point (Anon. 2008c; Dooley 2008c; Ramsay 2008c; M. Carter, F. O'Connor & T. Palliser pers. comm.; IOSG delegates

pers. comm.; IAWM; BARC Case 570). These reports followed Cyclone Rosie, and the birds were probably blown to the Island from near-coastal Sumatra. Singles were reported from North West Point on 29 November and 3 December 2011 (Baxter 2011b; Dooley 2012a; BARC Case 737).

The House Swift is a polytypic species that breeds widely in southern Asia and is a locally common resident in mainland South-East Asia and the Greater Sundas but it is subject to local movement; it appears to be colonising Wallacea. In mainland Australia, the subspecies *subfurcatus* has been recorded as a vagrant (Higgins 1999). However, *subfurcatus* is more southerly and largely sedentary, whereas the more northerly *nipalensis* is partly migratory (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Chantler & Driessens 2000; Robson 2000).

Matsudaira's Storm-Petrel *Hydrobates matsudairae*

Vagrant. Four records. One exhausted bird was found by J. Tranter at Flying Fish Cove on 15 August 1980 (WAM A.16946; Stokes *et al.* 1987). One bird attracted to the lights of the Settlement on 7 November 1980 was captured and released the following day (Stokes *et al.* 1987). One flew into a window at Flying Fish Cove in February 1983 (ANWC 37623). One damaged by oil near the Island was received at the Parks Office on 16 December 1984 and died the following day (ANWC 39154; note that the wrong registration number was given by Stokes *et al.* 1987). This species has not been reported at sea in Christmas Island waters.

This species breeds on islands south of Japan and migrates through western Micronesia and eastern Indonesia to winter in the Indian Ocean, from the coast of Kenya to the Timor Sea north of Australia, where it is reasonably common, and in the Pacific east to the Bismarck Archipelago (Marchant & Higgins 1990; Johnstone & Storr 1998; Cheshire 2010). It has been recorded from the Lombok Strait east of Bali (Johnstone *et al.* 1993; Grantham 2000; Mason 2011) as well as the Sunda Strait (van Balen in Grantham 2000).

White-faced Storm-Petrel *Pelagodroma marina*

Vagrant. Three records. Dunlop *et al.* (1996) and N. Cheshire (in Bourne 1996) recorded this species in ones and twos in April 1995 at five locations between the WA coast and Christmas Island, but only once in the EEZ, at 13°37′S, 107°06′E. One was found dead by DJJ and J. Goldberg in a Brown Booby's nest at Medwin Point in May 2002 (Johnstone & Darnell 2004a). The carcass was too damaged for preservation. One juvenile was found recently dead on the deck of a container ship arriving from the Cocos (Keeling) Group in May 2004 (AM O.71272; DJJ). It could be construed that this bird was ship-assisted. Regardless, the latitude of the Cocos (Keeling) Group is only 2° farther south.

This species breeds on islands off New Zealand, southern Australia and in the southern Atlantic Ocean (Marchant & Higgins 1990). Its winter range is imperfectly known, though it includes the north-western Indian Ocean. Dunlop *et al.* (1996) speculated that White-faced Storm-Petrels breeding in southern WA follow the Australian coast north to the region of North-west Cape, then branch off in a north-westerly direction to head for the Arabian Sea. If so, these birds would

pass the vicinity of Christmas and the Cocos (Keeling) Islands. This species has also been reported from Aceh and the Riau Archipelago in Sumatra (van Marle & Voous 1988; Rajathurai 1997). It may prove to be a rare passage migrant in seas surrounding Christmas Island.

Antarctic Prion *Pachyptila desolata*

Vagrant. One record. One was found washed ashore at Greta Beach on 23 June 2002. It was brought to the Parks Office, but died soon after (NMV B.24118).

This Southern Ocean species is known for the Indomalayan Region only from a specimen (now lost) collected from the coast of Java (Becking 1976a; Inskipp *et al.* 1996).

Bulwer's Petrel *Bulweria bulwerii*

Vagrant. Four sets of records. Dunlop *et al.* (1988a,b, 1996; also Bourne 1989) recorded the species widely over the eastern Indian Ocean south to 20°S in October 1987, including at least 12 occasions close to Christmas Island. Birds were recorded in the 1-degree blocks centred on 11°S, 103°E; 11°S, 104°E; 11°S, 106°E; 11°S, 107°E; and 12°S, 107°E, with further observations south-east almost halfway to the WA coast. N. Cheshire (*in litt.*) also noted one bird 134 nm south-south-east at 12°31′S, 106°49′E on 10 October 1987, and another 99 nm east-south-east at 11°04′S, 107°01′E on 17 October. Bulwer's Petrel was less common in the EEZ during surveys in April 1995, when it was reported only at 11°S, 106°E and 13°S, 106°E. Two birds were seen 135 nm south-east of the Island at 12°06′S, 107°10′E on 12 October 1999 (N. Cheshire *in litt.*).

Despite the paucity of records, the evidence suggests that Bulwer's Petrel is a regular visitor in low numbers to surrounding seas, though not near the Island itself, presumably through interference by frigatebirds. Elsewhere, Bulwer's Petrel breeds on islands in the subtropical and tropical Pacific and Atlantic Oceans. Recently, it has been discovered breeding in very low numbers at Round Island, Mauritius, in the western Indian Ocean (Merton & Bell 2003) and recorded in the Cocos (Keeling) Group (McAllan *et al.* in prep.). In the Pacific, the presumed source of birds recorded near Christmas Island, it breeds from the Ryukyu and Bonin Groups east to the Hawaiian, Phoenix and Marquesas Islands. Although there have been some sightings in the Coral Sea and Papua New Guinea (Cheshire 1989, 2010; Anon. 1998), this species is rare in the south-western Pacific, and birds apparently reach the eastern Indian Ocean through Indonesian waters, particularly Wallacea (Argeloo & Dekker 1996; Mason 2011).

Wedge-tailed Shearwater *Ardenna pacifica*

Rare regular visitor. Wedge-tailed Shearwaters are rarely recorded from land and inshore waters of Christmas Island, but apparently are regular in pelagic waters.

Land-based records: A Wedge-tailed Shearwater was captured and released by B. Reville at Tai Jin House on 6 October 1985 (Stokes *et al.* 1987; Marchant & Higgins 1990). One was seen over the sea from the Settlement some time between

25 December 1999 and 1 January 2000 (Hansboro 2000a). A bird with a broken wing was found by a resident in the Kampong on 29 September 2005 (AM O.71274). This species was reported by G. Roberts (*in litt.*) in May 2007 without details. A few individuals were seen by IOSG delegates (IOSG pers. comm.; IAWM) over the sea from the Settlement on 22 April 2008 during Cyclone Rosie. DJJ did not see this species from shore during >3 years in residence. The Shearwater seems to avoid the inshore waters of the Island, despite the strong upwellings present, perhaps to avoid intense competition from the breeding seabirds, or to avoid kleptoparasitism and harassment from frigatebirds.

Marine records: Wedge-tailed Shearwaters were recorded in EEZ waters in small to moderate numbers (up to 250+ birds) in January 1964 (Ozawa & Nakamura 1966), October 1987, April 1995, September–October 1995 and September–October 1999 (Bourne 1996; Dunlop *et al.* 1996; N. Cheshire *in litt.*).

This marine species is pantropical (Higgins & Davies 1990). The nearest breeding colonies are on North Keeling Island, Ashmore Reef, islands along the WA coast, and in the Chagos Group (Feare 1984; Burbidge *et al.* 1996; Symens 1999; Johnstone & Darnell 2004b; Milton 2005; Clarke *et al.* 2011). It is not known to breed in Indonesia (de Korte 1984, 1991).

Barau's Petrel *Pterodroma baraui*

Vagrant. Two sets of records. One bird was seen 50 nm east of the Island at 10°34′S, 106°35′E on 11 October 1987 and another 27 nm west-south-west at 10°39′S, 105°06′E on 13 October 1987 (Dunlop *et al.* 1988a,b; N. Cheshire *in litt.*). One was seen 75 nm north at 9°15′S, 105°39′E on 15 April 1995 (Bourne 1996; N. Cheshire *in litt.*).

Elsewhere in the Indian Ocean, van den Berg *et al.* (1991) recorded Barau's Petrel south of India and Sri Lanka east to near the coast of Sumatra in June–July 1984 and June 1985. P. Meeth saw it south of Java and Sumatra at 7°39′S, 102°45′E in August 1986, with other sightings south-west towards the Cocos (Keeling) Islands (Chapman & Cheshire 1987; Marchant & Higgins 1990). This little-known species breeds on Réunion and Rodriguez Islands in the south-western Indian Ocean (van den Berg *et al.* 1991). It may prove to be an uncommon regular visitor to surrounding seas of the South Equatorial Current (Dunlop *et al.* 1988a; Johnstone & Darnell 2004a).

Herald Petrel *Pterodroma heraldica*

Vagrant. One record. A single live, intermediate-morph bird was found at South Point on 29 August 2006 and brought to the Parks Office (Palliser & Carter 2012; BARC Case 640). It was identified by DJJ, held overnight, photographed by M. Holdsworth and released. This bird had white lores, characteristic of the Pacific Ocean population (i.e. nominate *heraldica*, not the subspecies *arminjoniana*). The presence of brood-patches on this bird suggests that it was breeding at the time, although as yet there are no confirmed breeding sites in the eastern Indian Ocean.

Most Herald Petrels breed on islands in the subtropical Pacific Ocean (Marchant & Higgins 1990). However, three birds identified as 'Herald Petrel *Pterodroma arminjoniana*' were seen apparently prospecting or breeding at North Keeling Island in the Cocos (Keeling) Islands in April 1986 (Stokes & Goh 1987; Marchant & Higgins 1990). Although these birds were later considered to be Round Island Petrels *P. arminjoniana* (DEH 2005), their pale lores definitely identify them as *P. heraldica* (J. Darnell pers. comm.; V. Tatayah pers. comm.). The species has not been recorded on North Keeling Island since, and is not known from the Indomalayan and Wallacean Regions (Andrew 1992; MacKinnon & Phillipps 1993; Inskipp *et al.* 1996; Coates & Bishop 1997). Elsewhere in the Indian Ocean, the species is now known to breed on Round Island off Mauritius, where there is a small population of ~20 pairs (V. Tatayah pers. comm.). One bird found on Round Island in April 2006 had been banded on Raine Island, Queensland, in July 1984 (V. Tatayah pers. comm.). Vagrants have been recorded from WA waters (Johnstone & Storr 1998; R. Johnstone pers. comm.).

Lesser Frigatebird *Fregata ariel ariel*

Rare breeding species (>10 pairs). A specimen in the ZRC was collected by Dr R. Hanitsch in 1904 and labelled as being from the Island (ZRC 3.00267; Morioka & Yang 1996). This record was not discussed by Chasen & Kloss (1924), Chasen (1933a) or Gibson-Hill (1947), and was overlooked by subsequent authors. The specimen has a label annotated in Chasen's hand (C. Yang pers. comm.) with '? *minor* FNC July 1933' (DJJ & IAWM). It is a juvenile in worn plumage with patterning of the underparts consistent with Lesser Frigatebird. The exposed culmen of 87.3 mm is consistent with female Lesser Frigatebird, and too small for either sex of the Great Frigatebird (James 2004). It is nonetheless improbable that Hanitsch, whose collection contained only one frigatebird, would collect a rarity amongst thousands of Great and Christmas Island Frigatebirds. The other specimens collected by Hanitsch during that expedition had specific dates (Morioka & Yang 1996), perhaps indicating that the frigatebird specimen was collected under different circumstances. It could be that it was collected at sea during the passage back to Singapore and presented along with the Christmas Island specimens, but without a label. Lowe (1924) referred to an immature specimen from 'Christmas Island'. He did not state which Christmas Island (there is another Christmas Island in the tropical Pacific, also called Kiritimati, where frigatebirds breed—Orta 1992b), and did not give the collection details, but this specimen was evidently in the NHM collection. Lowe (in Chasen 1933a) subsequently indicated that the locality was possibly in error. The collecting locality of the ZRC specimen is thus unclear.

The next report was by D. Merton in the late 1970s, although no localities or exact dates were given (Stokes 1988). Therefore, the first definite record was of four or five adult males carrying sticks seen by J. Hicks at North West Point on 31 March 1980 (Stokes *et al.* 1987). An adult male with an inflated gular sac was seen at the Golf Course on 16 March 1982 (Stokes *et al.* 1987). An adult female was seen at Douglas Point on 1 June 1984 (Stokes *et al.* 1987). An adult female and two adult males were seen at North West Point on 30 March 1985 (Stokes *et al.* 1987),

and one of the males was seen to strike at twigs in the canopy, which is a nest-building behaviour. Subsequently, the species was seen frequently in the western and northern parts of the Island over the next 2 years, leading to suspicion that it was breeding, or trying to breed. Two were seen in August 1990, though no locality was noted (K. Coate *in litt.*). Since 1990, the species has been recorded in low numbers by numerous observers on most visits (Carter 1994, 2000b, 2001, 2002, 2004, 2010b, 2011b; Harvey 1996; Hobcroft 1996, 2006; Farnes 1997; Lansley 1997; Maher 1997; Anon. 1999b; O'Connor 1999; Hansboro 2000a; Smith 2000; Clarke 2001; Barrand & Barrand 2003, 2007; Doughty 2003; Hunter 2004; Langfield 2004; Adams 2005; Barrand 2005b; Brodie-Good 2005; Carter *et al.* 2008; Roderick 2008; R. Baxter *in litt.*; K. Coate *in litt.*; B. King *in litt.*; N. Pamment *in litt.*; D. Helliar pers. comm.; C. Nixon pers. comm.; DJJ; IAWM). Between 2002 and 2007, DJJ observed many individuals and pairs, mostly adults, regularly at many locations around the Island. The frequency of observations is apparently increasing, though whether this is related to better observer ability or actual changes in numbers of Lesser Frigatebirds is unclear. However, DJJ noted unprecedented numbers for the Island in April 2012. There are no definite marine records from the EEZ, but N. Cheshire saw two possible females just to the south at 15°S, 107°E on 11 April 1995 (Bourne 1996).

Breeding records: A pair was observed on a nest behind West White Beach in mid 2001 (DNP 2002; Johnstone & Darnell 2004a; J. Middleton & J. Goldberg pers. comm.). In January 2004, DJJ and C. Surman saw a flock of ~10 juveniles in an apparent crèche with 100 juvenile Great Frigatebirds at the IDC. In April 2004, a dedicated survey of the shore terrace of North West Point found one nest near West White Beach (DJJ & C. Surman). In August–November 2004 and mid 2005, up to five nests were recorded scattered along the shore terrace of North West Point, mostly near the tip of the Point (DJJ). A chick found on the ground at Ethel Beach in mid 2005, and reared by M. Orchard at the Parks Office, was identified as a Lesser Frigatebird when juvenile (DJJ). During the IOSG Conference in April 2008, male Lesser Frigatebirds were seen carrying sticks at both the north-western and eastern coasts (IAWM). The size and distribution of the breeding population remains to be clarified, but is probably >10 breeding pairs.

The Island population of Lesser Frigatebirds is not listed as globally threatened by the IUCN (2013) or under the EPBC Act, as it is considered a population of a more widely distributed and secure species. There are no reports of any local threats to this species.

The Lesser Frigatebird is a pantropical seabird. The nearest breeding colonies are on North Keeling Island, Ashmore Reef, islands in the Banda Sea of eastern Indonesia, islands off the Kimberley coast, WA, and in the Chagos Group (de Korte & Silvius 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004b; Milton 2005; Clarke *et al.* 2011). There are several old records from western Indonesia, though it is unclear if the species bred there (de Korte & Silvius 1994). There have been recent apparent increases in populations of Lesser Frigatebirds in the Cocos (Keeling) Islands (McAllan *et al.* in prep.).

The subspecific taxonomy of the Lesser Frigatebird is poorly resolved. Four

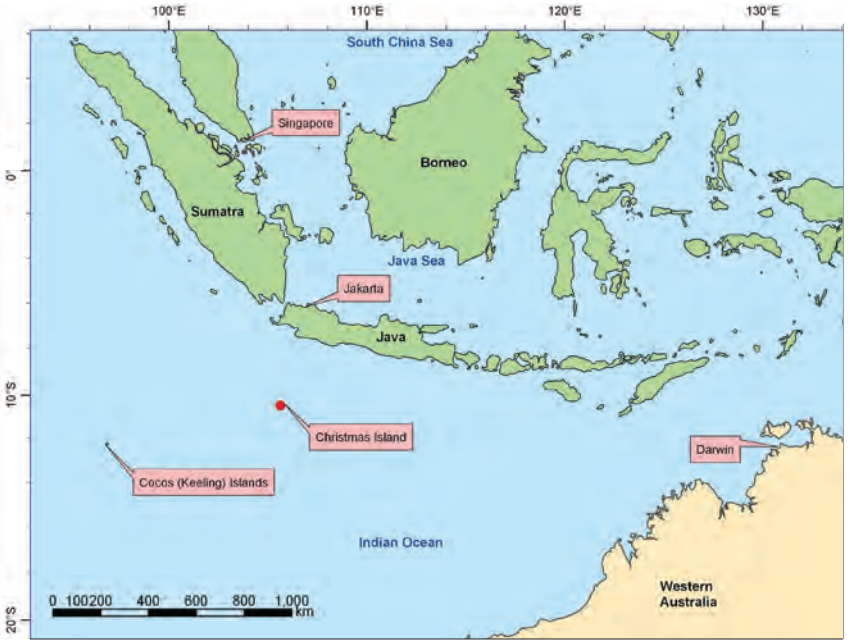

Figure 1. Location of Christmas Island

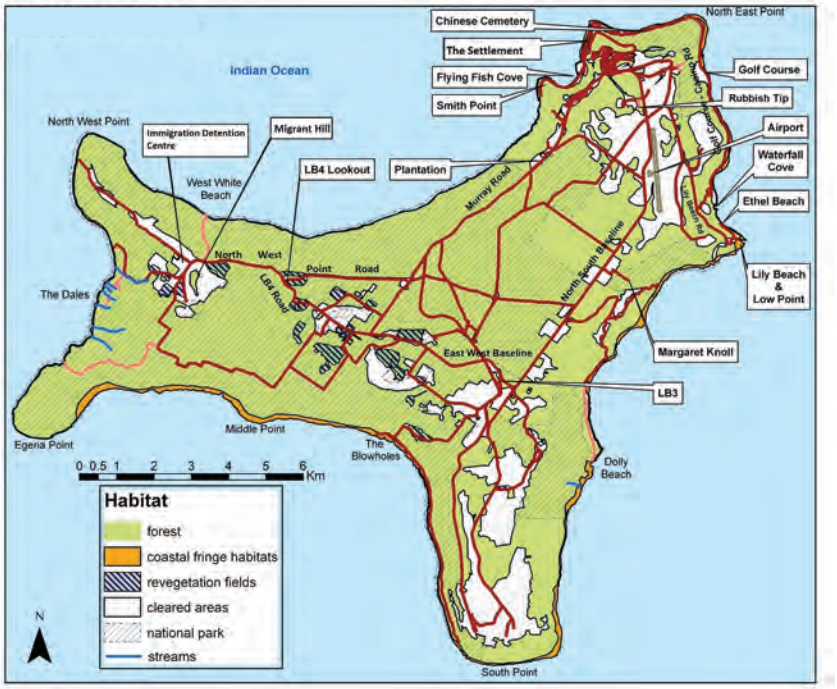

Figure 2. Map of Christmas Island

Figure 3. Terrace profile of Christmas Island. Photo: Ian A.W. McAllan

Figure 4. Evergreen rainforest on Christmas Island. Photo: Ian A.W. McAllan

Figure 5. Semideciduous rainforest on Christmas Island. Photo: Ian A.W. McAllan

Figure 7. Specimens of Christmas Island Swiftlet *Collocalia natalis* (left two) and *C.* (*esculenta*?) *cyanoptila*. Note the absence of gloss in the upper-body feather-tracts of *natalis*. Specimens are from the ZRC Collection. Photos: David J. James

Figure 8. Christmas Island Swiftlet in flight. Note the absence of gloss in the upper-body feather-tracts, white tips to rear scapulars and scaly rump; primaries are in moult. Photo: Tony Palliser

Figure 9. Christmas Island Swiftlet flying. Photo: Jenny Spry

Figure 11. Emerald Dove, adult male. Photo: Ian A.W. McAllan

Figure 12. Christmas Island Imperial-Pigeon. Photo: Ian A.W. McAllan

Figure 13. Great Frigatebird, female. Photo: Ian A.W. McAllan

Figure 14. Great Frigatebird, male. Photo: Max Orchard

Figure 15. Christmas Island Frigatebird, male. Photo: David J. James

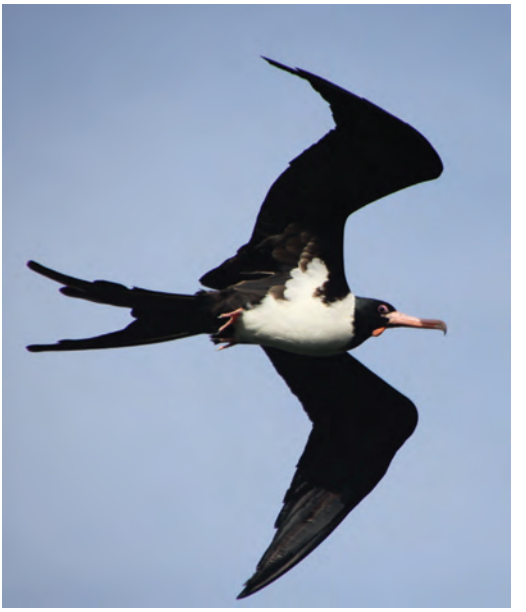

Figure 16. Christmas Island Frigatebird, female. Photo: Ian A.W. McAllan

Figure 17. Abbott's Booby, female. Photo: Tony Palliser

Figure 18. Abbott's Booby, juvenile. Photo: Ian A.W. McAllan

Figure 19. Red-footed Booby white-tailed brown and white morphs. Photo: Ian A.W. McAllan

Figure 20. Christmas Island Goshawk, immature female. Photo: Ian A.W. McAllan

Figure 21. Christmas Island Goshawk, adult. Photo: Mark Holdsworth

Figure 23. Christmas Island Hawk-Owl. Photo: Ian Montgomery

Figure 24. Christmas Island White-eye. Photo: Tony Palliser

Figure 25. Island Thrush, adult. Photo: Ian A.W. McAllan

Figure 26. Island Thrush, juvenile. Photo: Ian A.W. McAllan

Figure 27. Java Sparrows. Photo: Tony Palliser

subspecies have been described, of which three are usually recognised. Nominate *ariel* has a type-locality of Raine Island, Qld, and that name applies to all Pacific populations at least (Dorst & Mougin 1979). Matthews (1914) named the eastern Indian Ocean birds (Bedout Island, WA) as *F. a. tunnyi* for their larger size, and the western Indian Ocean ones (Aldabra Island, Mascarenes) as *F. a. iredalei* for their smaller size. Rothschild (1915) considered the size difference of *tunnyi* to be trivial and synonymised that subspecies under *ariel*, and subsequently Mathews (1927) agreed. Most subsequent authorities have recognised *ariel* from the Pacific and eastern Indian Oceans and *iredalei* from the western Indian Ocean, based on size differences (Peters 1931; Dorst & Mougin 1979; Marchant & Higgins 1990; Orta 1992b; Dickinson 2003; Nelson 2005). Marchant & Higgins (1990) noted reports of dimorphism in the colours of the bill (pink or blue-grey) and orbital-ring (red or blue) in females from Aldabra (Diamond 1971; Nelson 1976) and considered that this might be significant, but had no comparative data from elsewhere. At Herald Cay in the Coral Sea, on the Lacepede Islands in WA, and at Christmas Island, female Lesser Frigatebirds show this dimorphism in bill colour, but the orbital-ring is always red (James 2004). It also seems that blue orbital-ring colour does not occur in the North Keeling Island population (DJJ; IAWM). Meanwhile, more specific data on the supposed blue orbital-ring of Aldabra Island birds are required. In the interim, we recognise the Christmas Island population as nominate *ariel* and recognise *iredalei* from the western Indian Ocean as distinct, but consider *tunnyi* synonymous with *ariel*. Nevertheless, the boundary between *ariel* and *iredalei* in the Indian Ocean remains unclear. The southern Atlantic form is usually recognised as a separate subspecies, *trinitatis* (Peters 1931; Nelson 2005).

Great Frigatebird *Fregata minor listeri* [Figures 13–14 (p. S54)]

Common endemic subspecies (3500 breeding pairs). The earliest records of frigatebirds on Christmas Island, by Dampier's party (Dampier in Gibson-Hill 1949a), Captain J.P. Maclear in January 1887 (Sharpe 1887), Lister (1889) in September 1887, and Ridley (1891) in 1890, cannot be ascribed to species level. Specimens of this species collected by Andrews were initially listed as *Fregata ariel* by Sharpe (1900), although it is clear from Sharpe's descriptions that they were *F. minor*. G.M. Mathews's (1914) review of frigatebird taxonomy first clarified that the Great Frigatebird was the smaller of the two species then nesting on the Island. Mathews's (1914) description of the subspecies *listeri* was based on specimens collected by C.W. Andrews in 1897 (lectotype = AMNH 729553, collected at Flying Fish Cove in August 1897; Mathews 1914; Greenway 1973). Historical population estimates are listed in Table 3. Estimates by DJJ of the numbers of breeding pairs at known sub-colonies between 2002 and 2005 are presented in Table 5; these represent estimates of the numbers laying in a single year, not the total breeding population, which divides over 2 or more years (see p. S62). They are extrapolated from partial counts in some cases or from the distribution (area and density) of calling birds, especially at inaccessible colonies. The total estimate of 3500 pairs is 250 pairs higher than estimated by Stokes (1988), but is not sufficiently accurate to be taken as an indication of a change in abundance.

The Great Frigatebird has a protracted breeding cycle, averaging 16 months, to raise the single chick (Nelson 1976). Successful breeders from one year rarely if ever attempt to breed in the following year. Juveniles remain dependent until well into their second year, overlapping the subsequent nesting cycle. Courtship begins in mid to late January and peaks in April–May, the first signs being males calling and collecting sticks for nests. Eggs are laid from March to June, but early nests are generally ransacked or usurped by conspecifics (Marchant & Higgins 1990; DJJ). The first eggs hatch in about late April, and juveniles begin to fly by early September, but post-fledging dependence continues into the early months of the following year (DJJ). Known breeding locations are listed in Table 5. They are mostly on the shore terrace, with a few smaller colonies on the second terrace or the first inland cliff where it is gradual and vegetated (Stokes 1988; DJJ).

Marine records: Within the EEZ, N. Cheshire (*in litt.*; partially reported in Bourne 1996) recorded one female 48 nm east of the Island on 11 October 1987, one female 39 nm west-south-west on 13 October 1987, two males 100 nm south-south-east on 13 April 1995, five feeding 76 nm east-north-east on 1 October 1995, and 11 at 52 nm south-south-east on 7 September 1999. None were identified to subspecies, and the subspecies *listeri* has not been observed or collected away from the Island.

M. Orchard and others (pers. comm.) rehabilitated many frigatebirds (mostly Great) and raised orphan chicks at the Parks Office between 1993 and 2010; DJJ also observed these birds frequently in 2002–2007. Individual Great Frigatebirds regularly returned for many years to the feeding station after being reared there. The afternoon feeding time was clearly known to the birds, though some arrived in the morning and waited (apparently patiently) for just a small feed, displaying a very low energy requirement. One female reared from a very small size in 1995 was still returning in 2010. Some adult males regularly attempted to build nests in trees at the site and call to flying females, though not successfully. Individuals of the six breeding seabird species other than frigatebirds were also frequently reared at the Parks Office, but none returned or retained any bonds after their release. The fidelity of frigatebirds to return to their artificial rearing site and seek supplementary feeding into adulthood possibly stems from their long juvenile dependence and their propensity for kleptoparasitism (DJJ). The female that was still returning in 2010 (since 1995) had an individually recognisable voice, and evidently readily recognised M. Orchard. This, coupled with observations at the colonies, indicates that chicks can recognise their parents by call (DJJ; cf. Marchant & Higgins 1990).

The Island population of Great Frigatebirds is not listed as globally threatened by the IUCN (2013), as it is considered a population of a more widely distributed and secure species. The subspecies is also not listed under the EPBC Act. It was the only bird taxon endemic to the Island that was not assessed by Garnett & Crowley (2000) or Garnett *et al.* (2011). Mining and, to a lesser extent, municipal development have led to the loss of an estimated 48 ha of nesting habitat (Stokes 1988). Dunlop (1986) counted >200 pairs on the 2nd terrace on the western side of South Point (SWP 5) before the site was mined in the mid 1980s, and there were probably many more nests elsewhere on South Point before mining. Stokes (1988) recorded that 21 ha of low-density breeding habitat at Toms Ridge on North West

Table 5. Estimated number of breeding pairs of Great Frigatebirds at known sub-colonies on Christmas Island in 2002–2005. Estimates were made by DJJ: * = extrapolated from partial counts, # = based on distribution (area and density) of calling birds.

Sub-colony location	*No. of breeding pairs*
Golf Course*	400
Lily and Ethel Beaches*	300
Dolly Beach (McMicken Point)*	150
South Point (eastern shore terrace)*	150
South Point (eastern 2nd terrace)*	50
South Point (western shore terrace)*	750
Middle Point#	50
Egeria Point (southern shore terrace)#	50
Martin Point*	100
North West Point (Toms Ridge)#	50
West White Beach to North West Point*	1000
North West Point (2nd terrace)#	120
Margaret and Rhoda Beaches (2nd terrace)*	200
Drumsite (3rd terrace?)#*	100
Phosphate Hill (500 foot Quarry)*	30
Total breeding pairs	**3500**

Point (including the current site of the IDC) were cleared for mining in 1986–1987. Andrews (1900) recorded breeding at Flying Fish Cove where the species has not nested for many years (Stokes 1988; DJJ). Some other loss of breeding habitat has occurred at Lily Beach, Phosphate Hill and the Golf Course (Stokes 1988). Drowning during attempts to scoop up fresh water from artificial sources whilst on the wing is a recurring threat. During the 1980s, up to 100 birds per year drowned at the former mine slurry pond and water tanks at South Point (Stokes 1988; PANCI file archives). Smaller numbers drowned annually in the 1990s at the swimming pool and fountain at the Resort (PANCI file archives; M. Orchard pers. comm.), and a few drowned in the swimming pools at the Recreation Centre and the former construction camp on Phosphate Hill, when these were first constructed in the mid 2000s (DJJ). A few still drown in mud at rainwater ponds in mine loading bays at LB3, Toms Ridge and elsewhere (M. Orchard pers. comm.; DJJ). Poaching by flailing had a serious impact in the past, but ceased after the resettlement of the Cocos Malays in 1977 (Stokes 1988). There is occasional entanglement of Frigatebirds in discarded fishing line (Stokes 1988; DJJ), though this does not threaten at the population level (DJJ). Birds

rarely if ever hit electrical lines (DJJ; *contra* Marchant & Higgins 1990). There is no information about potential impacts from feral species such as the Yellow Crazy Ant, or threats in the marine range. There is no information about the effects of *El Niño* Southern Oscillation events on nesting success. However, it could be that a reduced nesting participation observed in 2010–2012 (DJJ; IAWM) was related to the significant *La Niña* event that took place at that time.

This species is pantropical, though the population in the Atlantic Ocean is small and restricted (Nelson 2005). The nearest breeding sites are at North Keeling Island, in the Banda Sea, in the Chagos Group, Ashmore Reef and Adele Island, WA (de Korte & Silvius 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004a; Milton 2005; Clarke *et al.* 2011). However, all of these populations belong to a different subspecies from the one on Christmas Island. Some taxonomic issues are discussed in the Taxonomy and nomenclature section (p. S20).

Christmas Island Frigatebird *Fregata andrewsi* [Figures 15–16 (p. S55)]

Common endemic species (1200 breeding pairs). The species was described by G.M. Mathews in 1914 based on specimens collected in the late 1890s (AMNH 729504, 20 November 1897, and AMNH 729505, 19 March 1899; Mathews 1914; Greenway 1973). AMNH 729504 was probably collected by Andrews, but AMNH 729505 was more likely collected by H. Ross, since Andrews was not present in 1899 (see Appendix in Andrews 1900). From the descriptions given, Sharpe (1900) listed *F. andrewsi* as *F. aquila*. Historical population estimates are listed in Table 3. Detailed ground surveys in 2003 provided an accurate estimate of 1200 breeding pairs (James 2003). However, the peculiar biennial breeding cycle of frigatebirds ensures that nest counts under-estimate the population size by perhaps 50–150%, depending on the season (Dunlop 1986; James 2003). Survey data from 2004 and 2005 that could correct for this are being analysed (DJJ).

Nesting of Christmas Island Frigatebirds is seasonally synchronous, but takes >1 year per cycle (Nelson 1976). Therefore, the population is divided into two or more stages of breeding at any point in time (James 2003). Courtship and nest-building activities begin by late January, peak in March, and continue into April. Laying begins in March and peaks in April, with hatching mostly in May–June. Juveniles begin to fly in September–October, but remain dependent and close to nest-trees often until April or May of their second calendar year. They later apparently depart from the Island with their parents and remain dependent for a further period, but details of this stage are poorly known.

Currently there are four significant nesting colonies of Christmas Island Frigatebirds: two on the eastern coast ('Golf Course' and 'southern outlier' south of the Golf Course) and two on the northern coast ('Chinese Cemetery' and 'Margaret Beaches'). All are on the shore terrace except the Chinese Cemetery colony, which is on the first inland terrace (James 2003). There are also small clusters of nests in the Settlement near Short Street, the inland cliff at the north-western end of Flying Fish Cove, and the footslopes of the inland cliff at Smith Point (DJJ; IAWM). There were formerly large colonies in Flying Fish Cove and on the northern coast below the Phosphate Dryers (Andrews 1900; Stokes 1988; James

Table 6. Known details (location, and number of Christmas Island Frigatebirds) of roost-islands used by non-breeding Christmas Island Frigatebirds. CI = Christmas Island, I = island, Is = islands. Sources: 1 = Chasen & Kloss (1928), 2 = DJJ & J. Hennicke unpubl. data, 3 = Medway (1966), 4 = Wells (1999), 5 = D. Bakewell & S. Rajathurai *in litt*., 6 = N. Brickle & F. Noni *in litt*., 7 = BirdLife International (2001), 8 = Q. Phillipps *in litt*., and 9 = Jensen & Tan (2010).

Roost-island	*Sea*	*No. of CI Frigatebirds*	*Source*
Ringi I, Anamba Is	South China	14 collected	1
Midai I, Natuna Is	South China	1 satellite-tracked to there	2
Renggis I, off Tioman I, Malaysia	South China	Accurate counts unavailable. ≤300, but mostly Lesser Frigatebird	3, 4, 5
Pulau Rambut, Jakarta Bay	Java	Count of 200, May 2012	6
Unknown I SE of Pulau Karimata, Kalimantan Barat, Indonesia	Java	1 satellite-tracked to there	2
Unknown I N of Pulau Bangka, Sumatra, Indonesia	Java	1 satellite-tracked to there	2
Ko Bida Sea stacks, Phi Phi, Thailand	Andaman	Frequently 300–500, possibly ≤800	7
Mantanai Is, Sabah	Sulu	≤130	8
Pulau Kalampunian Damit, near Kota Kinabalu, Sabah	Sulu	Regular many years ago, current status unknown	8
Bancauan I, Philippines	Sulu	≤100	9
Bancoran I, Philippines	Sulu	≤20	9
Tubbataha Reef, Philippines	Sulu	≤20	9
Cawili I, Philippines	Sulu	≤5	9

2003). The Margaret Beaches colony may represent a relocation of the former colonies. All colonies are or were in semi-deciduous vine thickets. The woven stick nests are typically placed high in the canopy or emergent trees, at sites with clear access and a strong bias to the leeward of the south-easterly trade winds (Stokes 1988; James 2003). Christmas Island Frigatebirds have been recorded nesting in 15 species of tree, of which Sea Almond *Terminalia catapa* is the most favoured (54%), followed by Stinking Wood *Celtis timorensis* (11%), Strangler Fig (8%), Propeller Tree *Gyrocarpus americanus* (8%) and Pongamia *Pongamia pinnata* (5%) (James 2003).

Marine records: Scattered sight records exist of single birds and of small flocks of Christmas Island Frigatebirds within the Island's EEZ (Bourne 1965;

Cheshire 1990; Dunlop *et al*. 2001; N. Cheshire *in litt*.), reflecting low observer effort. Telemetry studies have revealed that nesting Frigatebirds forage in all directions around the Island, with distance from the Island and duration of the trip increasing during the course of the nesting cycle (DJJ & J. Hennicke unpubl. data). Foraging trips lasting a week or more and extending >400 km from the Island in all directions are routinely undertaken by birds with large chicks.

When not breeding, a significant proportion of the population leaves Christmas Island to reside temporarily at roost-islands in South-East Asia. Adults depart from the Island after failed nesting attempts or along with their dependent juveniles after successful breeding (DJJ). The intervals that they spend away are unknown, but would obviously depend on the birds' recent history. Adults may return for the following nesting season or rest for ≥1 year. Some young birds may spend the majority of their 5 years of immaturity away from the Island, but some immatures of all ages can be found on the Island at all times (DJJ; IAWM). Christmas Island Frigatebirds typically vacate roost-islands daily before dawn and re-collect in soaring flocks over the islands around dusk, but do not land until after dark (A. Jensen, Q. Phillipps, N. Brickle, F. Noni, D. Bakewell, S. Rajathurai & K. Jordan *in litt*.; DJJ). At least 13 roost-islands regularly used by non-breeding Frigatebirds have been discovered through observation or by satellite-tracking studies (Table 6). These are all located in the Java, South China, Sulu and Andaman Seas, which are shallow, 'brown water' seas on the Sunda Shelf. Flocks of 100–≥500 Christmas Island Frigatebirds (often mixed with larger or smaller numbers of Lesser and sometimes Great Frigatebirds) have been reported at some roost-islands. Where counts have been made at roost-islands, females are more common than males (Phillipps & Phillipps 2009; Jensen & Tan 2010), but it has not been determined whether this reflects differences in behaviour, a skewed sex ratio or other factors. These roost-islands are evidently important in providing an opportunity for frigatebirds to remain at sea for extended periods, far from the breeding colonies, without the need to rest on the water or remain on the wing.

Hundreds of reliable reports of Christmas Island Frigatebirds come from locations on the Sunda Shelf seas and coastlines (DJJ). Records become sparser with increasing distance from the Sunda Shelf. Northwards, the Frigatebird has been recorded round the northern coast of the South China Sea as far as Hong Kong (Chalmers 2002). Eastwards, there are only four records from Wallacea (Trainor 2004), plus a report from Darwin, NT (McKean *et al*. 1975), one from the Gulf of Papua (Simpson 1990), and intriguing reports (with no supporting details) from Melanesia (Dutson 2001). Southwards, the only records outside Christmas Island waters are from the Cocos (Keeling) Islands (Stokes & Goh 1987). Westwards, the Frigatebird is reported rarely from the Andaman Islands, Sri Lanka and India (e.g. Dwarakanath 1981; Futehally 1981; Di Silva 1990, 1997; Saxena 1994; Warakagoda 1994) although many reports are unconvincing. The farthest and most unlikely record is of a juvenile in Kenya in 1969 (Mann 1989). It was identified from photographs by P. Harrison, but has frequently been considered unverified (C. Mann *in litt*.). The identification has recently been verified from the photographs by DJJ, using characters provided by James (2004). BirdLife International (2001) has the most detailed collation of records published.

This species breeds only on Christmas Island and is not known to have ever bred elsewhere. The rarest of the world's five species of frigatebirds, it is listed as Critically Endangered by the IUCN (BirdLife International 2000, 2001, 2004; IUCN 2013) and Vulnerable under the Australian EPBC Act. Garnett *et al.* (2011) considered it Critically Endangered because of its limited area of breeding colonies and continuing population decline, but listed mostly speculative threats. Historically, loss of breeding habitat has been the most severe cause of decline. There was probably a large colony in Flying Fish Cove before human settlement (Ridley 1891; Sharpe 1900). A large area of prime habitat was cleared at the Golf Course during World War II. The 'dryers colony' on the northern coast was large in 1967, affected by phosphate dust from *c.* 1971, sparsely populated by 1985, and abandoned by 2003 (Nelson 1972; Stokes 1985; James 2003). Harvesting Frigatebirds for food also had a severe impact, probably from the early days of settlement, but ceased from the late 1970s (Nelson 1972; Stokes 1985). James (2003) detected a decline of 3–16% between 1985 and 2003, but identified no threats on the Island that could account for this. He speculated that unknown threats in the marine range might be operating. Certainly, the reliance on seas and roost-islands over the Sunda Shelf presents a difficult conservation scenario: the area is highly populated, intensely fished, frequently polluted, and spread across numerous political jurisdictions where conservation has low priority.

Abbott's Booby *Papasula abbotti abbotti* [Figures 17–18 (p. S56)]

Common endemic breeding species (2500 breeding pairs). The species was described by Ridgway (1893) from a bird collected by Dr W.L. Abbott on Assumption Island north of Madagascar on 18 September 1892. The first record from Christmas Island was a specimen collected by Andrews on the eastern coast in October 1897 (Sharpe 1900).

Historical population estimates of Abbott's Booby are listed in Table 3. In addition, there have been six dedicated surveys of the breeding population and one re-interpretation (Table 7). The rugged terrain and density of forest in the nesting habitat make thorough surveys an arduous and difficult task. The biennial nesting cycle (see p. S68) means that only a proportion of the population is present in any season, so total population estimates must be derived by making assumptions about the number of absent birds. In addition, factors that might influence breeding numbers (e.g. habitat clearing, Yellow Crazy Ants and weather) have seemingly had different influences on all surveys (Table 7). Consequently, the results are complex and discordant. Building on four earlier surveys, and being particularly thorough, Yorkston & Green (1992, 1997) produced the best population estimate to date, of 2500 pairs, though this is now well out of date. That survey is no longer repeatable because of regrowth on the survey grid lines and forest thickening induced by Yellow Crazy Ants (P. Green pers. comm.; DJJ). A rapid and untidy aerial survey by PANCI in 2002 counted ~1500 breeding sites (actually 1444: James & Milly 2006), but was not checked on the ground for accuracy or analysed (Olsen 2004b). The claim that the raw count was comparable with previous surveys (Johnstone & Storr 1998; Olsen 2004a,b) is premature considering the complex population dynamics (Nelson & Powell 1986) and the

uncertain relationship between the different survey methods. The results from a second helicopter survey by PANCI in 2009 have not been published. Although the trend of the surveys appears to show decline followed by recovery (Table 7), the reality is probably decline followed by no recovery, with any apparent increase caused by increasingly thorough surveys (Yorkston & Green 1997).

Abbott's Booby has a protracted breeding cycle, averaging 16 months, to raise the single chick (Nelson 1971; Nelson & Powell 1986; Reville *et al*. 1990a). Reville *et al.* (1990a) reported that most (80%) successful breeders do not attempt to breed the following year: 70% wait until 2 years later, and 10% wait even longer; ~5% successfully raise nestlings by laying late (e.g. November) in the following season. Circumstantial evidence indicates high fidelity to mates and nest-sites (Nelson & Powell 1986). Numerous authorities have described the nesting season to include laying from April to July, with a clear peak in May that leads to a peak hatching period of July (Nelson 1971, 1978; Nelson & Powell 1986). Reville *et al*. (1990a) found a strong correlation between this peak hatching period and low sea-surface temperatures associated with high marine productivity. However, they also reported a wider spread of hatching dates, from July to October, and found that chicks hatching earlier and reaching a larger size by November (when food becomes scarcer) have higher survival rates. In 2004–2007, hatching peaked as late as August or September (Hennicke 2004, 2006; J. Hennicke pers. comm.). The magnitude and significance of this possible time-shift has yet to be explained. Dependent juveniles remain at their nest-sites and are fed by their parents until June or later of the next year (Reville *et al*. 1990a). Nests are located in tall evergreen rainforest trees on the upper terraces and central plateau, mostly 150–260 m asl (Nelson 1971; Reville *et al*. 1990a), although Yorkston & Green (1997) found some as low as 100 m asl on the northern coast. Successive surveys show a gradual expansion of the breeding area (Nelson & Powell 1986; Yorkston & Green 1997; Olsen 2004a,b). This may be a response to habitat loss and degradation, which reduces nesting density, forces birds to seek new nesting areas, and lowers breeding success in some instances (Reville *et al*. 1990a,b; Boland *et al*. 2012). Nests tend to be located in trees that are sheltered from the prevailing south-easterly trade winds, and on the north-western side of nest-trees. Over 60% of nests are in *Planchonella nitida* or *Syzygium nervosum*, and >95% are in just six species of tree (Powell & Tranter 1981; Nelson & Powell 1986; Yorkston & Green 1997).

Abbott's Booby has been listed as globally Endangered by the IUCN for 48 years (IUCN 1966, 2013), and is also listed as Endangered under the EPBC Act. Garnett *et al*. (2011) considered it Endangered. The species was extirpated at other breeding islands in the Indian Ocean by the early 20th century. Habitat clearance has been the main threat, and the first declaration of National Park on Christmas Island was specifically to protect Abbott's Booby habitat (DNP 2002). Between 1970 and 1974, it was estimated that 25% of the breeding habitat and 15% of the Booby population were destroyed (HRCEC 1976), and by 1987 one-third of the breeding habitat had been cleared for mining (Reville *et al*. 1990b). D. Powell (in Yorkston & Green 1997) witnessed the direct deaths of many chicks and adult birds, and Reville *et al*. (1990a) estimated that 400 breeding pairs were lost. Wind turbulence

Table 7. Population surveys of Abbott's Booby. Breeding sites = active nests and dependent juveniles at old nests (i.e. spanning 2 nesting seasons), though definitions varied slightly between studies; breeding pairs = entire breeding populations estimated using various assumptions regarding the proportion of birds absent from the Island at the time of the survey. Sources: 1 = Nelson (1971, 1972), 2 = Powell & Tranter (1981), 3 = Nelson & Powell (1986), 4 = Reville *et al*. (1990a,b), 5 = Yorkston & Green (1992, 1997), 6 = Olsen (2004a,b), and 7 = PANCI unpubl. data.

Year	*Timing*	*Survey*	*Breeding sites*	*Breeding pairs*	*Source*
1967	Before habitat clearing	Ground, + return counts	786	2300–3000	1
1979–80	During habitat clearing	Ground, + return counts	1351		2
1982	During habitat clearing	Ground, + return counts	1404–1518	1136	3
1983	During habitat clearing	Subsample modification of (2)		1900	4
1991	After habitat clearing and cyclone	Ground	1833	2500	5
2002	Height of Crazy Ant infestations	Helicopter	1444		6
2009	During La Niña event	Helicopter	?	?	7

downstream of these clearings led to an estimated decrease in nesting success of ~10% (Reville *et al*. 1990a,b). Given the species' low rate of reproduction, this extra burden is probably a considerable hindrance to recovery. Extensive revegetation intended to reduce this turbulence has been carried out and continues, but its effectiveness has not been assessed. Meanwhile, repeated proposals to reopen old mine sites (for further mining, the IDC, industry, etc.) or clear virgin forest for mining, present perennial threats (Olsen 2004a; James 2007; CIEWG 2010). Garnett & Crowley (2000) predicted that a decline in the population of 80% over three generations would occur with the spread of Yellow Crazy Ants. Fortunately, this prediction looks unlikely, but changes to forest structure induced by the Ants may yet cause further decline in the quality of breeding habitat (D. James in IUCN 2013). With a small population size, stochastic events such as storms can have considerable impacts (Olsen 2004a). For example, a cyclone in March 1988 (outside the peak of breeding) destroyed one-third of nest-sites, killed one-third of dependent juveniles, and apparently caused substantially reduced nesting effort in the following two seasons (Yorkston & Green 1997). Reville *et al*. (1990a) considered that nesting success would be higher in *El Niño* years when Indian Ocean sea-surface temperatures are lower. In keeping with this, we noted that there were unusually low numbers of juveniles and attendant adults in December 2010 to January 2011 during a severe *La Niña* event (BOM 2013).

Marine records: Within the EEZ, two Abbott's Boobies were seen 8 nm north-west of the Island on 16 October 1987, one was seen 63 nm north on 15 April 1995, and one was seen outside the EEZ, 225 nm east-south-east at 11°24′S, 109°22′E on 3 October 1995 (N. Cheshire *in litt.*). Birds sometimes feed within a few kilometres of the northern coast, while commuting (DJJ). Tracking studies have shown that birds brooding small chicks feed throughout a radius of 200–500 km from the Island, but especially to the north and north-west (Hennicke 2004, 2006). Reports within the potential range of breeding birds have come from the cold upwelling near the southern coast of Java (Becking 1976b), Java Head (J.B. Nelson in Becking 1976b) and the Sunda Strait (P. Andrew pers. comm.). Farther afield in the Indian Ocean, there are single records from Ashmore Reef, the Exmouth Plateau and a 'sub-adult' from Broome, WA (Hassell & Boyle 2000; Palliser 2005; BARC Cases 297, 432 & 541), near Scotts Reef (Graff 2013; Watson 2013) and the Banda Sea (van Balen 1996). Two early sight records from the Chagos Group (Bourne 1971; Hirons *et al.* 1976) are not supported by descriptive details (Bourne & Nelson 1976), but a 1996 record is more plausible (Symens 1999). A recent sight record from Rota in the Northern Marianas, Pacific Ocean (Pratt *et al.* 2009), is an exceptional and surprising record.

Currently, Abbott's Booby breeds only on Christmas Island, where it is a relict species. The collection of the first specimen on Assumption Island (north of Madagascar) followed by two more in 1908 (Fryer 1911) strongly suggests that it bred there in historical times (Abbott in Ridgway 1895; Bourne 1976), although Gibson-Hill (1950) and Nelson (1974b) argued that the habitat there was unsuitable. Formerly, it bred on Mauritius (pre-human subfossil material), and probably on Rodriguez Island, Mauritius (Nelson 1974b; Bourne 1976; Cheke 2001). Circumstantial evidence that it also nested on Glorieuses, Cosmoleda, the Seychelles and the Chagos Group is not compelling (Bourne 1971, 1976; Nelson 1974b). Subfossil remains of the nominate subspecies have also been found in the Pacific at Tikopia in the Solomon Islands and Efate in Vanuatu (Olson & Warheit 1988; Steadman 2006). A second subspecies, *P. a. costelloi*, has been described from subfossils recovered farther east in the Marquesas, central Pacific (Steadman *et al.* 1988). The suggestion that a large booby on Cocos Island (Costa Rica) in the eastern Pacific Ocean (Slud 1967) is, or was, a relict population of Abbott's Booby or very similar (Nelson 1974b) was thought improbable by Bourne (1976). Note however that this was before the description of *costelloi*. In any case, Abbott's Booby bred widely in the tropical Indo-Pacific before the arrival of, and persecution by, humans.

Red-footed Booby *Sula sula* [Figure 19 (p. S57)]

Abundant breeding species (12 000 breeding pairs). The first record of the species from the Island was an adult female specimen collected by Captain J.P. Maclear in January 1887 (Sharpe 1887). Historical population estimates are listed in Table 3. The estimate of 12 050 pairs by Stokes (1988, citing Stokes 1984) was based on a combination of distribution surveys and density sampling (Stokes 1985), and is the only quantitative estimate. Nelson (1972) guessed that there were 3000 pairs along the northern coast alone. Stokes (1985, 1988) recorded

1058 nesting pairs in 16.4 ha of forest (65 nests per ha) at South Point in 1984 and 1985, before the site was mined.

Breeding is highly seasonal, with nest-building in April and laying concentrated in May–June (Gibson-Hill 1947; Nelson 1972). Colonies are located primarily in semi-deciduous forests on the shore terraces and footslopes of the inland cliff, and in some places on the upper terrace up to ~150 m asl (Gibson-Hill 1947; Stokes 1988). Nests are always in trees, and usually high above the ground. Formerly, Red-footed Boobies may have nested close to the ground near Lily Beach before abandoning the practice under hunting pressure (Nelson 1972). In the early 2000s, >50 nests were counted in each of three giant trees (a Strangler Fig and two Propeller Trees) behind the Golf Course, but two of those fell over, in 2002 and 2005 (DJJ). When a Propeller Tree fell in April 2005, DJJ was nearby and inspected within 20 minutes of the crash; adult Boobies had been building nests, but none was killed or injured (DJJ). Red-footed Boobies frequently nest alongside both Great and Christmas Island Frigatebirds, sometimes within a few metres. Nest-sites are generally separated from those of Abbott's Booby, except possibly on the second terrace above Middle Point, where the two species come very close (DJJ).

Marine records: Red-footed Boobies are often observed from shore in large flocks feeding on bait fish driven to the surface by pelagic predatory fish, particularly Yellowfin Tuna *Thunnus albacares* (DJJ). Many were seen close to the Island on 21 February 1964 (Slinn 1994). N. Cheshire (*in litt.*) made many observations from the RV *Franklin* over several cruises in October 1987, April and September 1995 and September–October 1999, which included: 11 birds 55 nm north, 32 feeding 75 nm north, 34 feeding 20 nm east-north-east, 60 birds 76 nm east-north-east, 65 feeding 20 nm east, 500 birds 22 nm east flying towards the Island, 15 birds 48 nm east, 30+ feeding 27 nm west-south-west, one bird 83 nm east-south-east, three adults 90 nm south-east, 100+ adult and 20+ immature birds 52 nm south-south-east, four birds 97 nm south-south-east, six birds 198 nm south-south-east, and 400+ birds feeding 8 nm north-west of the Island. During four marine surveys between 1987 and 1996, Dunlop *et al.* (2001) recorded Red-footed Boobies on 57 occasions between 9°S and 17°S, over waters with sea-surface temperatures of 26.2–29.9°C and salinities of 32.65–34.77‰. Records away from the Island might include birds from other breeding stations. Breeding birds with small chicks tend to make 1-day (returning at night) or 2-day foraging trips, ranging from near-shore up to 200 km offshore, with most trips being ≥100 km offshore (Taylor 2010; J. Hennicke pers. comm.).

The Island population of Red-footed Boobies is not listed as globally threatened by the IUCN (2013) or under the EPBC Act, as it is considered a secure population of a more widely distributed and secure species. Stokes (1988) estimated that 220 ha of breeding habitat had been cleared up to December 1987, including areas with densities of up to 65 nests per ha, but a moratorium on forest clearing has been in place since 1988. Many, possibly 2000 birds per year, were taken for food up to the late 1970s (Nelson 1972; Stokes 1988). Strong winds sometimes cause many chicks to fall to the forest floor. There is little information about the effects of *El Niño* Southern Oscillation events on nesting success, but *La Niña* events seem

to reduce nesting success. J. Hennicke (in Taylor 2010) reported low breeding participation and success in 2010, and suggested that these were related to high rainfall and high sea-surface temperatures.

Colour morphs and taxonomy: This is a pantropical and monotypic species. It has been said to have three subspecies (e.g. Dorst & Mougin 1979; Dickinson 2003). However, as noted by Murphy (1936) and Nelson (1978, 2005), these are based on colour morphs. Colour morphs include largely white birds, white-tailed brown birds (the brown being of varying intensities), and all-brown birds. The colour morphs often cluster geographically within island groups. Nevertheless, the three morphs co-exist, with many island groups having more than one colour morph freely interbreeding. This confounds the broader geographical boundaries suggested for subspecies. For example, all the populations of Red-footed Boobies of the Indian Ocean east to the central Pacific were included in one subspecies, yet just within the Indian Ocean there is considerable variation. Most populations in the Indian Ocean are all-white morphs, yet white-tailed brown-morph birds are (or were) dominant in the western Indian Ocean populations on Europa, Tromelin, the Glorieuses and Rodrigues Islands, and were also present at Agalega and possibly St Brandon (Le Corre 1999; Cheke 2001).

The Island population of Red-footed Boobies consists almost entirely of white-morph birds. The orange-buff wash to the head and underparts in the breeding plumage is particularly strong in the Island population, suggesting some degree of genetic separation. The first record of a white-tailed brown-morph bird was in early June 1967, though no further details were given (van Tets & van Tets 1967; *contra* Hennicke 2009). Since then, white-tailed brown-morph Boobies (with brown scapulars—*sensu* Nelson 1978; *contra* Marchant & Higgins 1990) have been seen on several occasions, including single adults at sea off Lily Beach in July 2005 (DJJ), flying over the Settlement in August 2005 (DJJ), and at Flying Fish Cove in December 2005 (IAWM). An adult was seen collecting sticks on several occasions near Ethel Beach in August and September 2007 (Hennicke 2009). An adult with a damaged wing was being rehabilitated at the Parks Office in April 2008 and was still present in May 2009 (IAWM). At least two Boobies were seen collecting sticks in May 2009, one at the Chinese Cemetery on 2 May and one near Ethel Beach on 6–7 May (IAWM). Two were seen returning from the sea in April 2012 (DJJ). Clear sexual dimorphism in bare-part coloration was documented in breeding colonies in the Coral Sea (James 2001b), but is barely discernible on Christmas Island (DJJ). Gibson-Hill (1947) described changes in the coloration of bare parts associated with progressive stages of breeding.

The breeding colonies of Red-footed Boobies nearest to Christmas Island are on North Keeling Island, Ashmore Reef, islands in the Flores and Banda Seas in Eastern Indonesia, on the Spratly and Paracel (Xisha) Islands in the South China Sea, and in the Chagos Group (de Korte & Silvius 1994; Hsu & Melville 1994; Poole 1994; Symens 1999; Johnstone & Darnell 2004b; Clarke *et al*. 2011). In Indonesia, Red-footed Booby colonies include both white morphs and white-tailed brown morphs (de Korte 1984; de Jong 2011), with the colony on Suanggi Island in the Banda Sea having 5–15% white-tailed brown-morph birds. Indonesian populations of the Boobies are under threat from human activity, including hunting and

habitat loss, and the Red-footed Booby has long been extinct as a breeding species in western Indonesia (de Korte & Silvius 1994; de Jong 2011). Continued pressure on the eastern Indonesian populations may have encouraged movement of birds, including white-tailed brown-morph birds, into Christmas Island waters.

Brown Booby *Sula leucogaster plotus*

Abundant breeding species (5000 breeding pairs). The first record appears to be four specimens collected by C.W. Andrews at Flying Fish Cove in August and November 1897 (Sharpe 1900). Historical population estimates are listed in Table 3. Gibson-Hill (1947) and Stokes (1988, citing Stokes 1984) both listed the population at ~5000 pairs, though neither provided any supporting data. Nelson (1972) estimated 2250 pairs along the eastern coast alone.

Breeding is probably partly aseasonal (Gibson-Hill 1947; Marchant & Higgins 1990). Laying has been recorded in all months, but there is a strong peak in March–May (Gibson-Hill 1947; Nelson 1972). There is considerable synchronisation within sub-colonies, moderate synchronisation between them, and possibly wide variation in timing between years (DJJ), but the patterns remain to be fully documented. Nest-sites are mostly along the outer edge of the shore terrace or on the top edge of the first inland cliff. Where the shore terrace is wide and the pinnacle terrain is not excessively rugged (such as Middle Point and the eastern shore terrace of South Point), Brown Boobies nest in loose colonies with spacing between nests as close as ~2 m. Where the pinnacles are more rugged (e.g. the western shore terrace of South Point and the Dales coast), the nesting density is lower, with spacing often dictated by flat spaces in the terrain. On the top of the inland cliff, spacing is lower again, and often linear, and depends on available outcrops and high ledges. In some locations, scattered nests occur up to 10 m inside the forest, both on the shore terrace (e.g. above Margaret Beaches) and on top of the inland cliff (e.g. east of Egeria Point). Nest-sites are always on the ground, either under cover of vegetation or in the open (Gibson-Hill 1947; DJJ).

Marine records: Occasional Brown Boobies were seen close to the Island on 21 February 1964 (Slinn 1994). Around 20 birds were seen 45–60 nm east of the Island on 20 June 1967 (Simpson 1970). N. Cheshire (*in litt.*) saw this species within the EEZ in October 1987, April 1995 and September 1999. Locations included: 75 nm north, 20 nm east-north-east, 20 nm east, 48 nm south-east, 52 nm and 100 nm south-south-east, 27 nm west-south-west and 8 nm north-west. Brown Boobies were seen singly and in flocks of ≤40, and often feeding. One was seen just outside the EEZ by D. Balance, at 10°36′S, 105°30′E, on 28 December 1999 (Bourne 2000). Records from farther afield might include birds from other breeding stations. However, sight records from the cold upwelling near the southern coast of Java (Becking 1976b) were likely to be of birds from Christmas Island, since it is the nearest breeding station, and one bird banded on the Island was recovered on that shore (ABBBS unpubl. data). Dunlop *et al.* (2001) commented on the lack of records distant from the Island, and suggested that the birds forage comparatively close to breeding stations. They mapped Brown Boobies over deep water with sea-surface temperatures of 24.0–29.9°C and salinities of 32.65–35.35‰.

The Island population of Brown Boobies is not listed as globally threatened by the IUCN (2013) or under the EPBC Act, as it is considered a secure population of a more widely distributed and secure species. Storm swells occasionally cause extensive destruction of nests in exposed sub-colonies, especially on the western coast of South Point (DJJ). Some nesting habitat has been lost to clearing, mostly for municipal purposes rather than mining (Stokes 1988). Minor poaching occurred historically (Stokes 1988). A small sub-colony on the shore terrace at Low Point declined from >40 nests in 2002 to ~20 in 2004–2006 and through to 2012 (DJJ; IAWM), presumably from disturbance by tourists after the 2003 construction of stairs and a boardwalk made the colony easily accessible. Cat scats are frequent in Booby colonies, suggesting that cats may take small chicks (Stokes 1988; DJJ). The invasive Tropical Fire Ant *Solenopsis geminata* occurs amongst nests on the eastern shore terrace of South Point, swarming on dead chicks and dropped fish (DJJ). Ticks (Acari) (rare on the Island) were found in several Booby nests on the inland cliff above Douglas Point in 2006 (DJJ). There is no information on the effects of *El Niño* Southern Oscillation events on nesting success.

This is a pantropical and polytypic species. Nominate *leucogaster* occurs in the Atlantic Ocean and Caribbean, subspecies *brewsteri* and *etesiaca* in the eastern tropical Pacific, and subspecies *plotus* in the Indian and western Pacific Oceans, including Christmas Island. The nearest breeding colonies are on the Cocos (Keeling) Islands, Ashmore Reef, islands in the Banda Sea in eastern Indonesia, and the Spratly Islands in the South China Sea, with larger numbers on islands off the northern coast of WA and the Chagos Group (de Korte & Silvius 1994; Poole 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004b; Clarke *et al.* 2011).

Great Cormorant *Phalacrocorax carbo*

Vagrant. About six reports, but only two confirmed records. Three Great Cormorants were noted by D. Merton and D. Powell in October and November 1977, including two at Flying Fish Cove on 18 October 1977 (van Tets 1978a; Stokes *et al.* 1987). A third individual recorded at the same time was said to have perched for 2 days on a yacht that arrived from the coast of Java, until it was in sight of the Island (Stokes *et al.* 1987; ANPWS file, Parks Office). It was probably one of these birds that was found dead by D. Powell at West White Beach on 6 November 1977 (ANWC 19872), and another from 1977 was donated by D. Merton to the ANWC (spirit specimen 30438, head only). Both of these individuals have white throats, and are thus the Australian subspecies *carboides* (IAWM). One was seen by D. Merton at Greta Beach, on 8 January 1978, being attacked by frigatebirds, and another as it flew over Flying Fish Cove on 2 August 1978 (Stokes *et al.* 1987). One was recorded by J. Hicks at the Dales on 5 July 1980 (ANPWS file, Parks Office). A cormorant seen flying past the Settlement by C. Surman (pers. comm.) on 3 July 2004 was said to be too large for a Little Black Cormorant *P. sulcirostris* and was probably a Great Cormorant. A Great Cormorant was seen at Flying Fish Cove in March 2006 (J.N. Dunlop pers. comm.).

This species is widespread in Europe, Asia, Africa, Australia and eastern North America (Marchant & Higgins 1990). Subspecies *carboides* breeds in Australia,

where it is widespread and highly nomadic (Marchant & Higgins 1990). The Eurasian subspecies *sinensis* is resident in northern South-East Asia and a scarce visitor to the Malay Peninsula (Robson 2000). This species is extremely rare in the Greater Sundas: it is not recorded from Java or Bali, is possibly extinct in Sumatra and rare in Borneo (MacKinnon & Phillipps 1993; Holmes 1997). In Wallacea, it has been recorded only from the Kai Islands, where it is likely to have been subspecies *carboides*, given the proximity to New Guinea (White & Bruce 1986; Coates & Bishop 1997; Clements 2000). In this context, the Great Cormorant that supposedly rode from Java to Christmas Island on a yacht seems implausible.

Little Black Cormorant *Phalacrocorax sulcirostris*

Vagrant. At least four sets of records. One was seen at the cantilevers at Flying Fish Cove over 2 weeks in September–October 1986 (Stokes 1988). One was seen at Flying Fish Cove in August 1990 (Johnstone & Darnell 2004a; K. Coate *in litt.*). One was seen by M. Carter at the Settlement in mid November 2001 (Anon. 2002b). One was seen at Flying Fish Cove on 14 March 2002 (Anon. 2002c; Holmes 2002). An adult female in care at the Parks Office (noted by DJJ on 8 September 2002) subsequently died (NMV B.24012). One was seen at Flying Fish Cove on 5 December 2002 (Doughty 2003); Johnstone & Darnell (2004a) listed this record erroneously as January 2003. Single birds were seen by DJJ in Flying Fish Cove on 19 and 26 April and 25 August 2003. A juvenile was seen at Dolly Beach on 10 November 2003 (Barrand & Barrand 2003). A single bird seen by DJJ at Ethel Beach on 8 February 2004 had been present since mid December 2003 (M. Orchard pers. comm.). One was seen by DJJ at Flying Fish Cove on 14 June 2004. One was seen twice at Ethel Beach in late November 2004 (Carter 2004). Many of the records between 2001 and 2004 probably represent multiple sightings of one or a few individuals.

This species is widespread and common in Australia, New Guinea, and Wallacea (Marchant & Higgins 1990; Coates & Bishop 1997). It is rare to scarce in the Greater Sundas except in Java, where it was first recorded in the 1940s but is now a common breeding species (MacKinnon & Phillipps 1993; DJJ). Christmas Island birds could originate from Australia or Indonesia.

Australian Pelican *Pelecanus conspicillatus*

Vagrant. Two records. One was seen by D. Powell in October 1978 (Stokes *et al.* 1987). An emaciated bird was found by J. Hicks at Flying Fish Cove on 23 July 1981 and later released (Stokes *et al.* 1987).

This species breeds only in Australia, where it is widespread and highly nomadic (Marchant & Higgins 1990). It is a vagrant to Java and probably Sumatra (MacKinnon & Phillipps 1993) and a vagrant or irregular visitor to Wallacea (Coates & Bishop 1997). It has not been recorded in mainland South-East Asia (Robson 2000). In 1978, an irruption from Australia saw it become widespread and locally numerous in Wallacea, and vagrants reached New Zealand, the Greater Sundas, Fiji, Palau and Christmas Island (van Tets 1978b; Marchant & Higgins 1990; MacKinnon & Phillipps 1993; Coates & Bishop 1997).

Yellow Bittern *Ixobrychus sinensis*

Vagrant. Eight sets of records. One was captured by D. Powell at Waterfall Cove on 17 February 1978 and released the next day (Stokes *et al.* 1987). One immature was captured, measured, photographed, banded and released near the Post Office Padang on 16 December 1985 (Stokes *et al.* 1987). Two photographs, measurements and a summary of field characters were provided by Stokes (1990). One was photographed by L. Preston and L. Cash at the LB3 ponds on 17 February 2009 (Anon. 2009b; Dooley 2009a; Ramsay 2009a; L. Preston pers. comm.; BARC Case 596). A 'juvenile' (presumably immature) bird was taken into care on 15 November 2010, though it subsequently died (L. Preston in Anon. 2011a; Ramsay 2011a; Palliser & Carter 2013; BARC Case 733). At least seven birds were present on the Island from late December 2010 to early March 2011 (Anon. 2011a,b; Baxter 2011a; Carter 2011b; Clarke 2011b; Dooley 2011a,b; Marsh 2011; L. Preston pers. comm.; BARC Case 734). This included up to six birds seen at the entrance to the Resort and one bird at the LB3 ponds, all on 5 January (Carter 2011b). One was found by L. Preston at the LB3 ponds stalking and eating grasshoppers in the second week of December 2011 (Barrand *c.* 2011). One was seen at the Resort entrance on 17 February 2012 (Anon. 2012a; Dooley 2012b; Faulkner 2012). One was seen in the Settlement in early December 2013 (Baxter 2013).

This monotypic species is a scarce to locally common resident and winter visitor in mainland South-East Asia, the Greater Sundas, Wallacea, the Philippines and New Guinea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). It has been recorded on several islands in the Indian and Pacific Oceans and is a vagrant to mainland Australia and the Cocos (Keeling) Islands (Marchant & Higgins 1990; Baxter 2010b; James 2010; Anon. 2012c; Dooley 2012a; Watson 2012; BARC Case 678).

Schrenck's Bittern *Ixobrychus eurhythmus*

Vagrant. Two records. A single bird was rescued from a cat by S. Kowi in the Settlement on 18 November 2003, but died shortly afterwards (NMV B.30627; Barrand *et al.* 2006; BARC Case 419). A single bird was photographed along the Dolly Beach Track near Ross Hill Springs on 30 November 2010 (Baxter 2010b; Anon. 2011a; Dooley 2011a; Ramsay 2011a; Palliser & Carter 2012; BARC Case 677).

Schrenck's Bittern breeds in northern Asia and is a scarce winter visitor to mainland South-East Asia, the Greater Sundas, Sulawesi in Wallacea, and the Philippines (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). The two records above are the only records from Australian territory.

Cinnamon Bittern *Ixobrychus cinnamomeus*

Vagrant. Four records. One was captured by P. Green and A. Yon on 22 February 2002 on a track near the Pink House and taken into care, but subsequently died (NMV B.24113; Carter 2003; BARC Case 332). One was seen by L. Preston at Gaze Road in the Settlement on 29 February 2008 and the following day by several

observers (Anon. 2008b; Baxter 2008a; Carter & Carter 2008; Dooley 2008b; Ramsay 2008c; Palliser 2009; BARC Case 555). It was captured, photographed and released at Waterfall Cove on 1 March, but was not seen again. A bird of either this species or Schrenck's Bittern was seen to land on the phosphate loader in Flying Fish Cove on 7 December 2009 (Baxter 2009; Ramsay 2010a). A male was photographed near Ma Chor Nui Nui Temple on 27–28 February 2010 (Anon. 2010b; Baxter 2010a; Dooley 2010a; Ramsay 2010b; R. Baxter & L. Preston pers. comm.). One was photographed near the entrance to the Resort on 10 February 2011 (Anon. 2011b; Clarke 2011b; Dooley 2011b; Ramsay 2011b).

This monotypic species is common to abundant in mainland South-East Asia, the Greater Sundas, western Wallacea and the Philippines, with some passage migration recorded in Malaya (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). It has recently been reported from the Vogelkop of western New Guinea (Tindige 2003), though its status there is clouded by the presence of a cinnamon morph of the Black Bittern *I. flavicollis* (P. Gregory *in litt.*). These were the only records from Australian territory until two records from the Cocos (Keeling) Islands in early 2011 (Carter 2011a; IAWM) and one from south of Broome, WA, in December 2011 (BARC Case 730).

Black Bittern *Ixobrychus flavicollis*

Vagrant. Seven records. One was seen by G. van Tets (1974a) at Ross Hill Springs on 25 September 1972. One was seen by D. Merton at Ross Hill Springs on 25 November 1978 (Stokes *et al.* 1987). One was seen on the road verge south of the Golf Course on 7 March 2002 (Holmes 2002; DJJ), and at the same location by M. Carter and S. Dooley on 12 March 2002 (Anon. 2002c). M. Orchard captured and relocated a bird from a pond in a suburban yard in Silver City on 25 December 2005; it was identified as nominate *flavicollis* by DJJ. One was seen along the Blowholes Road on 4 December 2009 (Barrand *c.* 2009), not the Golf Course Road (*contra* Ramsay 2010a). One was seen and photographed along the road to the Resort near Ma Chor Nui Nui Temple from 5 January 2011 to late in that month (Anon. 2011a; Carter 2011b; Marsh 2011; Ramsay 2011b; DJJ; IAWM). One bird in the Settlement in late November 2011 was taken into care, but later died (L. Preston pers. comm.; specimen seen in PANCI freezer on 17 January 2012 by IAWM).

Nominate *flavicollis* is a scarce to uncommon resident and winter visitor in mainland South-East Asia, the Greater Sundas, Wallacea and the Philippines (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). Black Bitterns in mainland Australia are the subspecies *australis* and make only local movements (Marchant & Higgins 1990), so it is likely that all Christmas Island records refer to nominate *flavicollis*.

Eastern Great Egret *Ardea modesta*

Rare irregular visitor. No seasonal pattern to occurrence. Two were present on Phosphate Hill in June and July 1961 (Mees 1966). One was seen near the Golf Course from 7 April to 5 June 1962 (Pearson 1966). One was seen at the Golf

Course on 24 January 1963, where it was found dead on 29 January 1963 (Pearson 1966). Another was seen on 2 October 1963 (Pearson 1966). It was listed by van Tets (1974a, 1983) as a rare visitor. Occasional individuals were seen between mid 1983 and early 1987 (Stokes 1988). Johnstone & Darnell (2004a) listed it as a rare or casual visitor. Since 1990, it has been recorded on numerous occasions by many observers, particularly from 2002 onwards (e.g. Barkla 1996; Hobcroft 1996; Carter 2001, 2010b; Barrand & Barrand 2003; Barrand 2005b, *c.* 2009; K. Coate *in litt.*; N. Hamilton *in litt.*; L. Preston pers. comm.; DJJ; IAWM). No Eastern Great Egrets were present in early 2004, but from May 2004 to early 2006 a bold individual was resident in the north-east of the Island (DJJ). This individual or another was seen occasionally at South Point and the Rubbish Tip during the same period (DJJ). It patrolled yards in Poon Saan, Silver City and the Settlement; it hunted grasshoppers in gardens; it hunted Eurasian Tree Sparrows at chicken-coops and waited on roof-tops for Sparrows flushed from yards by people; it lay in wait to hunt Christmas Island White-eyes at bird-baths; it hunted exotic fish in garden ponds; and it visited Flying Fish Cove to hunt in the tidal pools. Several residents reported that it cleaned all the fish out of their ponds, and eventually it was dispatched by locals who had lost their fish. Eastern Great Egrets have also been noted eating Red-footed Booby chicks in the latter's nests behind the Kampong (L. Preston pers. comm.). From June 2005 to early 2006 at least, another two Egrets were present in the north-east of the Island (DJJ). As a pair, they also hunted at garden ponds, in grassy clearings and were often at Waterfall Cove. They sometimes walked across the crowns of trees as if they were on floating water-plants, waiting for flocks of foraging White-eyes. They moved with the White-eye flocks, seemingly trying to stay ahead of them and anticipate which way the flock was headed. The Egret has been recorded in all months of the calendar year since 2002. Locations where it has been recorded include the Airport, Phosphate Hill, Rubbish Tip, Poon Saan, Drumsite, Flying Fish Cove, Smith Point, the Settlement, North East Point, Golf Course, Resort, Waterfall Cove, near Stronach Hill, LB3 ponds and South Point.

As delineated, the species is widely distributed from India to Japan and south through South-East Asia to Australia and New Zealand, with no subspecies (Christidis & Boles 2008; Marchant & Higgins 1990). The origins of Christmas Island birds are unknown.

Intermediate Egret *Ardea intermedia*

Vagrant. Seven to ten records. Sharpe (1897) exhibited a specimen of this species collected by C.W. Andrews at a meeting of the British Ornithologists' Club on 15 December 1897. However, this specimen was not referred to again by Sharpe (1898, 1900), so cannot be considered a valid record. Subsequent workers listed the species as a rare visitor (e.g. van Tets 1974a). The first acceptable record was a bird seen by a BOCA tour group from 25 to 29 October 1996 (Barkla 1996). One was seen with an Eastern Great Egret by DJJ at the Golf Course on 14 September 2002. Two were seen at the Golf Course in early December 2002 (Doughty 2003). One was seen by DJJ at the Rubbish Tip on 11 April 2004. One, possibly the same

individual, was seen at the Golf Course on numerous occasions from 9 July to 26 November 2004 by DJJ and by two tour groups between 22 November and 6 December 2004 (Carter 2004; Anon. 2005b). One was seen in March 2008 (R. Baxter *in litt.*) and, presumably the same bird, near the Chinese Cemetery from 11 to 18 April 2008 (J.N. Dunlop pers. comm.). One was seen at the LB3 ponds on 29 November and 3 December 2009 (Barrand *c.* 2009) and (probably the same bird) on several days in January 2010 (Carter 2010b). One was seen by a tour group at the Golf Course on 25–26 November 2012 (James 2012).

This species is widely, but patchily distributed, in the Old World, mostly south of the Himalayas in Asia and south of 23°N in Africa. Geographical variation is subtle and poorly understood, with opinions differing substantially about the number of subspecies (Sharpe 1898; Kuroda 1936; Deignan 1947; Hancock & Elliott 1978; Mees 1982; Wild Bird Society of Japan 1982; Hancock & Kushlan 1984; White & Bruce 1986; Marchant & Higgins 1990; MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000; Kushlan & Hancock 2005). Differentiation of subspecies is based mostly on coloration of bare parts during the courtship period, so the origins of Christmas Island birds are unresolved.

Purple Heron *Ardea purpurea*

Vagrant. One record. A juvenile was seen by P. Snetzinger, B. King and H. Buck on 23 August 1991 (Andrew 1997; Johnstone & Darnell 2004a; Gentile 2009; B. King *in litt.*). Although no description or specific locality was given, this record of a distinctive species came independently from very experienced observers and so we believe that it is valid.

This species has a patchy distribution in Europe, Africa and southern and eastern Asia (Kushlan & Hancock 2005). The northernmost populations of the Asian subspecies *manillensis* migrate south to join residents in South-East Asia, the Philippines, Greater Sundas and Wallacea. It is common in the Greater Sundas (MacKinnon & Phillips 1993). It was placed on Christidis & Boles's (2008) supplementary list on the basis of this record. The only other record from Australian territory was at Herdsman Lake, WA, on 22 February 2013 (BARC Case 784).

Cattle Egret *Ardea ibis*

Vagrant. Five records. Two were seen by T. Stokes at the Airport from 19 to 26 June 1985 (Stokes *et al.* 1987). One was seen by DJJ at the Airport on 10 March 2002. Two were seen by G. Holmes, M. Carter and S. Dooley at the Airport on 12 March 2002 (Anon. 2002c; Holmes 2002). One was seen by DJJ at the Airport on 11–12 December 2004. An 'adult' was seen at the Settlement on 15 April 2005 (Brodie-Good 2005). One was seen at the cantilevers on 28 April 2008 (Anon. 2008c; Carter *et al.* 2008).

Subspecies *coromanda* is widespread and common in Australasia, Wallacea and southern Asia, including the Greater Sundas (Marchant & Higgins 1990; MacKinnon & Phillipps 1993; Coates & Bishop 1997). Christmas Island birds could originate from any of these localities, and can only be the subspecies *coromanda*.

Striated Heron *Butorides striata*

Rare irregular visitor. A specimen of the Asian subspecies *amurensis* was collected by two Dayak collectors for the ZRC on 8 November 1923 (ZRC 3.00466; Chasen & Kloss 1924; Morioka & Yang 1996). Van Tets (1974a) listed it as a rare visitor from Asia. One was seen at Ross Hill Springs on 17 January 1984 (Stokes *et al.* 1987). One immature female donated to the NMV around 2002 (NMV B.24114) is listed as *javanicus* on geographical grounds (N.W. Longmore *in litt.*), but also fits on measurements (wing-length 174 mm—see Wells 1999). This bird was presumably the one seen in the Parks Australia freezer in December 2001 by Rohan Clarke (pers. comm.).

Since 2001, there have been at least 28 records and at least one each year. Most reports were from the north-eastern coast at Flying Fish Cove, Ma Chor Nui Nui Temple, the Resort, Waterfall Cove, Ethel Beach and Lily Beach. One was at Andersons Dale, one at the Rubbish Tip, one at the LB3 ponds and one at the Plantation. The earliest record in this period was 18 November and the latest was 18 May (Robson 2001; Anon. 2002c, 2003, 2004b, 2005b; Holmes 2002; Carter 2004, 2007, 2010b, 2011b; Johnstone & Darnell 2004a; Barrand 2005b; Carter & Carter 2008; Baxter 2010b, 2011b; James 2010; Clarke 2011b; Marsh 2011; J. Adams *in litt.*; R. Baxter *in litt.*; K. Coate *in litt.*; C. Doughty *in litt.*; D. Mantle *in litt.*; L. Preston *in litt.*; M. Roderick *in litt.*; D. Torr *in litt.*; C. Nixon pers. comm.; DJJ; IAWM). All sightings have been of single birds, but in early 2011 there may have been up to three birds at different sites in the north-east. There have been three reports of adults (D. Mantle *in litt.*; DJJ) and one of an immature (D. Mantle *in litt.*). On three occasions, DJJ considered the birds to be an Asian subspecies.

This pantropical species has 23–30 subspecies, including about five in South-East Asia, three in Wallacea and five to eight in Australasia (Payne 1979; Hancock & Kushlan 1984; Marchant & Higgins 1990; Clements 2000; Kushlan & Hancock 2005). Birds recorded on Christmas Island apparently all originate from South-East Asia. Resident birds in the Greater Sundas are of subspecies *javanicus*, whereas in the western Sumatran Islands the resident subspecies is *spodiogaster* (Payne 1979; Hancock & Kushlan 1984; van Marle & Voous 1988; Kushlan & Hancock 2005); Morioka & Yang (1996) used the synonym *sipora* for this population. There are also two migratory subspecies that could reach Christmas Island. One, *amurensis*, breeds in north-eastern China, the Korean Peninsula and Japan, and migrates to southern China, northern Indochina, Taiwan, the Philippines and northern Borneo (Payne 1979; Hancock & Kushlan 1984; Kushlan & Hancock 2005). The other, *actophilus*, breeds in southern China south to northern Myanmar, Thailand and Indochina, and is said to migrate south to the Nicobar Islands, mainland South-East Asia, western Sumatran islands and western Borneo (Payne 1979). The ZRC holds specimens said to be *amurensis* from Thailand, Singapore and Sumatra collected from September to March (Morioka & Yang 1996), indicating that this subspecies is a migrant to South-East Asia including the Greater Sundas. Van Marle & Voous (1988) also used *amurensis* for those Striated Herons that migrate to Sumatra. Thus, the status of the subspecies wintering in South-East Asia and the Greater Sundas is not resolved. The frequency of records since 2001, and their clustering on the eastern coast of the Island, may indicate that a small

number of resident individuals was involved, and breeding is even possible. In this scenario, they could be either *javanicus* or *spodiogaster* (*sipora*). Conversely, the narrow range of dates (November–May) could indicate a regular wintering pattern by individuals of a longer-distance migrant, either *amurensis* or *actophilus*.

Chinese Pond Heron *Ardeola bacchus*

Vagrant. Four confirmed records. A bird at the Rubbish Tip was viewed daily by M. Carter, R. Baxter and others on 1–16 March 2008 (Baxter 2008a; Carter & Carter 2008; Moorhead 2008; Ramsay 2008c; Palliser 2009; BARC Case 567). Early references to this as a Javan Pond Heron *A. speciosa* were in error (Anon. 2008b; Dooley 2008b; M. Carter pers. comm.). A bird in breeding plumage was seen at the LB3 ponds from 1 to 6 May 2009 (Ramsay 2009b; L. Preston & P. Kelly pers. comm.; IAWM; BARC Case 626). Another was seen at the corner of Phosphate Hill Road and the Lily Beach turnoff in March 2010 (L. Preston pers. comm.). One (presumably the same bird) was still present there on 2–7 May 2010 when seen by R. Baxter (Dooley 2010b; Ramsay 2010c; L. Preston pers. comm.). One (possibly the same again) was seen in front of a house in Silver City on 7 May 2010 (Ramsay 2010c). One was photographed near the entrance to the Resort on 1–2 June 2011 (Anon. 2011c; Dooley 2011c; Ramsay 2011c; M. Rogers *in litt.*). In addition, a single pond heron of unknown species was photographed by a Coate's Wildlife Tours group, between Flying Fish Cove and Tai Jin House on 9–16 December 1995 (Andrew 1996a; Anon. 1996b; Harvey 1996; Mitchell 1996a; K. Coate *in litt.*). A photograph of this bird appeared in Andrew (1996a). Another pond heron, thought to be a Chinese Pond Heron, was seen by P. & R. Barrand and P. & D. Agnew near the Phosphate Dryers stockpile on 17 November 2003, and distant photographs were obtained (Anon. 2004a,b; Palliser 2006; BARC Case 452—not accepted to species level). An unidentified pond heron in non-breeding plumage was seen by DJJ at the LB3 ponds on 8 April 2012.

The Chinese Pond Heron breeds in the boreal summer from north-eastern India through eastern China and northern South-East Asia (Hancock & Kushlan 1984; Kushlan & Hancock 2005). Northern populations winter in South-East Asia and the Greater Sundas (Hancock & Kushlan 1984; MacKinnon & Phillipps 1993; Robson 2000). Elsewhere in Australian territory, this species has been recorded from the Cocos (Keeling) Islands in May 2006 (Carter & Baxter 2007; BARC Case 488) and January–March 2011 (Baxter 2011a; Clarke 2011a; Marsh 2011; T. Palliser pers. comm.) and the Tanami Desert, NT, in March 2009 (BARC Case 589). It was reported near Broome, WA, in March 2008 (Birding-Aus archives), and photographed at Scott Reef in March 2009 (BARC Case 611).

Javan Pond Heron *Ardeola speciosa*

Vagrant. One record. A bird was seen and photographed at the Golf Course by L. Preston (pers. comm.) on 12 and 13 June 2010 (Ramsay 2010d). It was in partial breeding plumage, though lacking the crest plumes. As this species breeds from December to May (Kushlan & Hancock 2005), it is likely that this bird was dispersing following breeding.

The Javan Pond Heron breeds in southern Sumatra, Java, southern Borneo, Sulawesi, and the Lesser Sundas east to Sumbawa, and southern central Myanmar, central Thailand, Cambodia and southern Vietnam. This species has been recorded also from Malaya, Sarawak, Sabah and Mindanao, where breeding is suspected (Kushlan & Hancock 2005). Elsewhere in Australia, this species has been recorded in Darwin in March 2007, and in the Cocos (Keeling) Islands from February to December 2009 and again in 2012 (Anon. 2009b; Baxter 2009; Palliser & Carter 2012; P. Jones pers. comm.; IAWM), and Kununurra, WA, on 13 January 2011 (Palliser & Carter 2012; BARC Case 661).

Pied Heron *Egretta picata*

Vagrant. One set of records. One was seen by a Kevin Coate Tours group at Waterfall Cove on 1 December 1994 (Anon. 1995; Smith 2000; K. Coate *in litt.*). This bird evidently remained for >4 years, with further sightings in December 1995; January, April, and October–December 1996; March 1997; and April 1999 (Anon. 1996a, 1999b; Barkla 1996; Craig 1996; Hobcroft 1996; Maher 1997; K. Coate *in litt.*; F. O'Connor pers. comm.).

This species is found in northern Australia and New Guinea, but is uncommon and patchy in the southern Moluccas and eastern Lesser Sundas west to Timor and Sulawesi (Coates & Bishop 1997). It has not been recorded from the Indomalayan Region proper (MacKinnon & Phillipps 1993; Robson 2000).

White-faced Heron *Egretta novaehollandiae*

Rare resident, apparently breeding. Two specimens were collected by C.A. Gibson-Hill on the north-eastern coast in November 1940 (ZRC 3.00679 and 3.00680; Gibson-Hill 1947; Morioka & Yang 1996). Voous (1964), Mees (1966) and Pearson (1966) did not record this species, and van Tets (1974a) considered it rare. By late 1986, it was thought by Stokes *et al.* (1987) to be common and probably a breeding resident. The species was reported by all visiting parties since 1990 from whom we have trip reports, usually without comment. It was noted as common on several trips by birders and tour groups between August 1990 and December 1999 (e.g. Carter 1994; O'Connor 1999; K. Coate *in litt.*). Numbers counted by birders at the Airport in this period were typically around five or six, though 12 were seen in November–December 1999 (O'Connor 1999; K. Coate *in litt.*). K. Coate (*in litt.*) was told that up to 40 had been counted by Airport staff and, as a consequence, many had been culled (see also Smith 2000; Carter 2004). On a following trip in April 2000, the only White-faced Herons seen were three at Phosphate Hill and one at the Airport (K. Coate *in litt.*). In November 2001, eight were seen at the Airport and two at South Point (K. Coate *in litt.*). The species was recorded regularly by DJJ between February 2002 and April 2007. The highest count was a flock of 15 (including three juveniles) at the Airport on 3 April 2005. Single, newly fledged juveniles were observed at the Golf Course (24 September 2002 and 17 September 2005) and Silver City (30 October 2004). Other locations where adults were seen included the Rubbish Tip, Chalk Pits at the northern end of the Airport, Quarry Road industrial area, Irvine Hill, mine fields along the North

South Baseline, South Point, LB3 ponds, Field 22, the IDC, Drumsite, Smith Point, Flying Fish Cove, Chinese Cemetery, Norris Point, Ma Chor Nui Nui Temple, the Resort, and Waterfall Cove. Small numbers were also reported regularly to DJJ by numerous visiting birders during this period.

M. Orchard (pers. comm.) noticed a decline in numbers between 1993 and the mid 2000s. This is consistent with Stokes's (1988) estimate of 100 individuals versus DJJ's highest count of 15 over 5 years (with no higher counts by visiting birders since then), and reports of culling. DJJ noted the species to be very wary of humans and vehicles, which is consistent with persecution. Direct observation of nesting on the Island has not been reported. However, the observations of courtship behaviour (Stokes 1988), and newly fledged juveniles (DJJ), and the year-round presence and persistence of the species despite reported culling leave little doubt that it nests on the Island.

This species was originally widespread and partially nomadic in Australia, New Guinea, New Caledonia and the Lesser Sundas (White & Bruce 1986; Marchant & Higgins 1990). Although currently thought of as monotypic, birds from New Caledonia have sometimes been separated as the subspecies *nana* (Amadon 1942). The subspecies has colonised several island groups: Norfolk Island and Lord Howe Island *c.* 1938, though it has been seen on these islands since at least 1907 (Hull 1910; McAllan *et al.* 2004); New Zealand in the 1940s, where it continues to increase in number (Robertson *et al.* 2007); the Kermadec Group since the 1950s (Turbott 1990); the Chatham Group since the 1970s (Turbott 1990); and Fiji since 1997 (Dutson & Watling 2007). It has been recorded as a vagrant in Vanuatu, the Louisiade Archipelago, Bougainville, Guadalcanal, Tonga, the Snares Islands, Auckland, Campbell and Macquarie Islands, the Cocos (Keeling) Islands, Bali and, intriguingly, Xiamen Island in China (Stokes *et al.* 1984; Coates 1985; Gill 1988; Turbott 1990; Bregulla 1992; MacKinnon & Phillipps 1993; Heather & Robertson 1997; Dutson 2001; Kushlan & Hancock 2005). It is believed that birds recorded from the Moluccas may be wintering birds from farther south (White & Bruce 1986). Apart from vagrants in Bali and China, it has not been recorded in the Indomalayan Region proper (MacKinnon & Phillipps 1993; cf. Robson 2000).

Little Egret *Egretta garzetta*

Vagrant. At least eight reports, but only four confirmed records. Two birds were observed and one collected at Norris Point in April 1940 (Gibson-Hill 1947). The bird collected had completely black feet and soles, making it the subspecies *nigripes* (ZRC 3.00610; Morioka & Yang 1996; IAWM). 'Occasional individuals' were seen by T. Stokes (1988) between 1983 and 1987. One was seen near the Airport in August 1990 (Johnstone & Darnell 2004a; K. Coate *in litt.*). One bird, which had entirely yellow feet and lower 20–30 cm of its legs, was seen at the Golf Course on 2 November 1993 (Carter 1994). This bird was undoubtedly nominate *garzetta* from South-East Asia. One was seen at the Airport on 15 November 2001 (Carter 2001) and (presumably the same bird) at this locality on 18–25 November 2001 (K. Coate *in litt.*). One was seen at the Dales on 8 and 11 December 2001

(Clarke 2001; Anon. 2002b). One, of the Australian subspecies *immaculata*, was seen and photographed at the LB3 ponds on 27–28 April 2008 (Carter *et al.* 2008; T. Palliser pers. comm.). Another of the subspecies *immaculata* was seen by a tour group at the northern end of the runway on 1 December 2012 (James 2012).

Little Egrets on Christmas Island should be identified with caution: juvenile white-morph Eastern Reef Egrets *E. sacra* frequently show yellow soles or yellow feet and lower legs, unusual bill colours, and a more gracile shape than adults (N. Moores *in litt.*; DJJ). Subspecies *immaculata* is widely distributed in northern and eastern Australia, and undertakes long-distance movements on occasion; it has yellow soles to black feet (Hancock & Kushlan 1984; Marchant & Higgins 1990; Kushlan & Hancock 2005). Subspecies *nigripes* has black feet, but occasional individuals have yellowish soles (Kushlan & Hancock 2005). It breeds in Java, though the limits of its range are unclear. It is known from the southern Malay Peninsula, and is said to disperse to Sumatra, Borneo and Wallacea, where visitors from Australia (*immaculata*) may also occur (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Wells 1999; Wang & Hails 2007). These two subspecies are sometimes synonymised under *nigripes* (e.g. Marchant & Higgins 1990). Nominate *garzetta* has yellow feet and lower legs; it breeds throughout much of Eurasia, and is a scarce to common resident and winter visitor to mainland South-East Asia, Sumatra, Borneo, Sulawesi and Ambon (White & Bruce 1986; MacKinnon & Phillipps 1993; Robson 2000). It has been recorded at least twice in mainland Australia (Carter & Menkhorst 2006). Observations on Christmas Island of the subspecies *garzetta* can only be of birds originating from South-East Asia, but, without a description, a '*nigripes*' could be from Australia, Java or Wallacea. Christmas Island Little Egrets clearly have multiple origins.

Eastern Reef Egret *Egretta sacra*

Rare breeding species (40 ± 20 pairs). A white female was collected by Captain J.P. Maclear in January 1887 (Sharpe 1887). Two specimens were collected in October 1887, when 'several' birds were seen (Lister 1889). Sharpe (1898) erroneously listed one of Lister's specimens as a Chinese Egret *Egretta eulophotes* (see Appendix 1). At least one bird was either seen or collected in August 1890 (Ridley 1891). Ridley (1905) saw a white egret near North East Point on 29 September 1904 that he thought might have been this species. A specimen was collected for the ZRC by Dayak collectors on 5 November 1923 (ZRC 3.00546; Morioka & Yang 1996), which was listed without comment by Chasen & Kloss (1924). Chasen (1933a) categorised the species as a vagrant, but conceded that it could be resident. Gibson-Hill (1947) considered it the least numerous of the resident species, with 15–20 pairs, and grey morphs predominating slightly. He reported the first breeding record: a nest on the sea-cliff near Dolly Beach in August 1940. Two birds were collected by G.F. Mees in June–July 1961 (WAM A.9279 and A.9280). Van Tets (1975) estimated the population at 1–10 pairs. Stokes (1988) implied that the estimates of Gibson-Hill and van Tets were accurate. He also recorded the presence of the species away from the shore at streams, pools and grassy areas on the shore terrace. Reville (1989, 1993) stated that it could be found in any open area and on roads in the rainforest, and reported breeding

at Dolly and Ethel Beaches. Most birdwatching tours from 1990 to the present have noted this species. Between February 2002 and April 2007, DJJ recorded it regularly at all beaches, the Golf Course and the lower reaches of the Dales. There appeared to be a communal roost-tree near Ethel Beach, used by perhaps ten birds at times. The species was also occasionally seen at the Chinese Cemetery and other locations along the road between the Settlement and Resort, and once at Smith Point. More significantly, it was regularly recorded in accessible areas where extensive areas of bare pinnacles extend inland from the sea-cliff (e.g. on the western coast of South Point). During cruises along the northern, eastern and western coasts by boat, it was seen at irregular intervals, foraging in tidal pools at the base of the sea-cliff, perching on top of the cliffs or flying along the cliff-faces. It was never seen above the shore terrace, in mine fields or on rainforest tracks. Based on this, the population may be in the order of 40 ± 20 pairs (DJJ), though this does not imply any increase from earlier estimates. The ratio of white to grey morphs seemed about even or slightly favouring the grey morph.

This polytypic species is widely distributed along the coasts of the Indomalayan Region, Wallacea, Australasia and Polynesia (Hancock & Kushlan 1984; Marchant & Higgins 1990; MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000; Dickinson 2003). Subspecies *albolineata* is said to occur in New Caledonia and the Loyalty Islands, with nominate *sacra* occupying the remainder of the range, including Christmas Island.

Nankeen Night-Heron *Nycticorax caledonicus*

Rare irregular visitor. No seasonal pattern of occurrence. A male of subspecies *hilli* was collected on the north-eastern coast in August 1939 (Gibson-Hill 1947), but the specimen is not currently in the ZRC (Morioka & Yang 1996; IAWM). Van Tets (1974a) considered it a rare visitor from Australia. One was seen by D. Merton at the South Point slurry ponds on 10 June 1977 (Stokes *et al.* 1987). A night-heron with rufous plumage seen at Middle Point on 1 October 1984 may have been this species (Stokes *et al.* 1987). Since 1995, there have been seven sets of records involving either one or two birds, including adults and immatures (Maher 1997; Carter 2001, 2004; Clarke 2001; Anon. 2002b, 2005b,d; Johnstone & Darnell 2004a; Adams 2005; Brodie-Good 2005; R. Baxter *in litt.*; K. Coate *in litt.*; D. Mantle *in litt.*; G. Roberts *in litt.*; T. Low pers. comm.; M. Orchard pers. comm.; DJJ). One or two adults were seen irregularly at Hughs Dale from 14 June 2004 to May 2007, with over 20 reports in that period. Other reported localities include the shoreline west of Flying Fish Cove, the Grotto, Waterfall Cove, Ethel Beach and Ross Hill Springs. There have been no reports since January 2008.

Subspecies *hilli* occurs in Australia, New Guinea and Wallacea (Marchant & Higgins 1990; Coates & Bishop 1997), and the Cocos (Keeling) Islands, and is the form that reaches Christmas Island (Gibson-Hill 1947; Morioka & Yang 1996). Apparently, the Philippines subspecies *manillensis* reaches Borneo, and formerly bred in small numbers in north-western Java (Marchant & Higgins 1990; MacKinnon & Phillipps 1993). Other subspecies occur in Micronesia, Melanesia, New Caledonia, and formerly occurred in the Bonin Islands (Marchant & Higgins 1990).

Malayan Night-Heron *Gorsachius melanolophus*

Vagrant. At least 12 reports, but only two confirmed records. An immature bird was flushed by H. Yorkston, M. Stokes and T. Stokes from the shore terrace below Ross Hill Springs on 29 January 1982 (Stokes *et al.* 1987). One bird was trapped at Tai Jin House on 13 December 1982, and identified as immature from measurements and photographs (J. Hicks and N.W. Longmore in Stokes *et al.* 1987). Another immature bird was seen at the Christian Cemetery near the Settlement on 21 January 1986 (Stokes *et al.* 1987). One subadult was seen on tracks near Jedda Cave on 7–8 March 2002 (Holmes 2002; Palliser 2004; DJJ; BARC Case 345). A *Gorsachius*-type night-heron was seen on the road near Dolly Beach on 2 March 2008 (Anon. 2008b; Baxter 2008a; Carter & Carter 2008; Dooley 2008b; Ramsay 2008c). One was seen on the Winifred Beach Track on 9 March 2008 (Baxter 2008a; Moorhead 2008), but was not accepted by BARC (Case 569). One was seen on the Winifred Beach Track by C. Boland and M. Gant on 15 January 2009 (C. Boland *in litt.*). Additional possible sightings were made on this track in early February 2009 (Barkla 2009) and by Parks Australia staff at Egeria Point in late February 2010 (Baxter 2010a). At least three Malayan Night-Herons were present from early December 2010 to early March 2011: one near Ross Hill Springs in December and early February (Clarke 2011b; Ramsay 2011b; L. Preston pers. comm.); one 50 m from the start of the Dolly Beach Track near the North South Baseline in late December until it was found dead (evidently a road-kill) on 19 January (Anon. 2011a; Carter 2011b; Marsh 2011; Ramsay 2011b; L. Preston pers. comm.; DJJ; IAWM); and one on a track near the Jedda Cave from mid February to 6 March (Anon. 2011b; Baxter 2011a; Clarke 2011b; Dooley 2011b). The carcass was forwarded to the AM. One live Night-Heron was observed along the track to Margaret Knoll between mid December 2011 and 17 February 2012 (Anon. 2012a; Dooley 2012b; Faulkner 2012; L. Preston pers. comm.; IAWM; BARC Case 735).

This monotypic species is a scarce resident and winter visitor in mainland South-East Asia, the Greater Sundas, Wallacea and the Philippines (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). Elsewhere in Australian territory, it was seen and photographed in the Cocos (Keeling) Islands in May 2011 (R. Baxter, M. Carter & J. Davies *in litt.*), but the record has not yet been vetted.

Japanese Night-Heron *Gorsachius goisagi*

Vagrant. One record. A tour group led by P. Barrand saw and photographed an adult on the Blowholes Track over several days from 29 November 2007 (Palliser 2009; P. Barrand *in litt.*; BARC Case 548). It was originally identified as a Malayan Night-Heron (Anon. 2008a; Dooley 2008a; Ramsay 2008a).

This rare monotypic species breeds in Japan and winters in the Ryukyu Islands, Taiwan, and southern China, with records south to the Philippines, Brunei, Sulawesi and Halmahera, and once on Belitung, Sumatra (Kushlan & Hancock 2005; Iqbal & Takari 2006). This is the only record of this species from Australian territory.

Glossy Ibis *Plegadis falcinellus*

Vagrant. Four sets of records. One, possibly a juvenile, was seen by G. Holmes at the southern end of Quarry Road on 26–28 March 2002 (Holmes 2002). One was seen at South Point from late January until at least 8 March 2007 (Anon. 2007b; Carter 2007; Ramsay 2007a; R. Baxter *in litt.*; L. Preston pers. comm.). Four were seen at the LB3 ponds on 23 April 2011 and one at the same locality 2 days later (R. Baxter & L. Preston pers. comm.). One was photographed near the Phosphate Dryers on 29 April 2011 (R. Baxter pers. comm.; C. Nixon & IAWM). Probably one of the same individuals was seen on the Blowholes Track on 10 July 2011 (J. Woinarski *in litt.*), with additional sightings at the Central Area Workshop on 3 September 2011 and LB3 ponds on 18 September 2011 (Anon. 2011d; Low 2011; N. Hamilton *in litt.*; D. Binns per L. Preston pers. comm.). One was photographed by a tour group at a minefield along the North South Baseline, south of the junction with the East West Baseline on 24 November 2012 (James 2012).

This monotypic species has a large, but patchy, range in the Old and New Worlds. It is widespread, but highly nomadic in the Malay Peninsula and the Greater and Lesser Sundas (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000). A small population breeds in north-western Java (MacKinnon & Phillipps 1993), possibly the origin of the Christmas Island birds. However, the species is also widespread and highly nomadic in Australia (Marchant & Higgins 1990).

Oriental Honey-buzzard *Pernis ptilorhynchus*

Vagrant. Six reports, but only one confirmed record. One was photographed by Rohan Clarke near the Airport on 10 December 2001 (Clarke 2001, 2003; Palliser 2004; BARC Case 335). It was initially reported as a Short-toed Eagle *Circaetus gallicus* (Anon. 2002b; Stafford 2002a). A large, dark hawk with broad, fingered wings, a shortish tail and a small head, which was flushed off the Blowholes Track by DJJ and J. Goldberg on 13 May 2002, was probably this species. A large, pale hawk with broad, fingered wings, a broad pale band through the shortish tail and a small head, which was briefly seen flying over the Plantation by DJJ and M. Schulz on 1 January 2006, was also probably this species. A bird seen at Silver City on 31 January 2011 was initially thought to be possibly a harrier (Marsh 2011), but was subsequently claimed as an Oriental Honey-buzzard, after subsequent reports of this species in 2011 (BARC Case 696), but was not accepted. One was present at the Settlement from late February to at least mid April 2011 (Anon. 2011b; Baxter 2011a; Dooley 2011b; Ramsay 2011b; L. Preston pers. comm.). One was reported from Margaret Knoll on 19 July 2011 (Anon. 2011c; L. Preston pers. comm.).

In the austral spring, large numbers of this species migrate south down the Malay Peninsula and Sumatra, and then east through Java and Bali to Wallacea (Ash 1993; Nijman 2001; Germi 2005), so it is not surprising that stragglers reach Christmas Island. This species has also been recorded once from Kakadu in the Northern Territory (Dooley 2005c; Gregory 2007; BARC Case 477). Note that the spellings *ptilorhyncus* and *ptilorynchus* are unjustified emendations of the original *ptilorhynchus* (Dickinson 2003; *contra* Christidis & Boles 2008).

White-bellied Sea-Eagle *Haliaeetus leucogaster*

Vagrant. One set of records. An immature was present on the Island in 1971 and 1972 (van Tets 1974a). It was first seen by D. Powell in October 1971 and was also seen by G. van Tets on 29 September 1972.

This monotypic species occurs from India through southern Asia to Wallacea, New Guinea and Australia (Marchant & Higgins 1993).

Christmas Island Goshawk *Accipiter natalis* [Figures 20–21 (pp. S57–58)]

Uncommon breeding endemic species (~250 individuals). This is the rarest endemic bird on the Island (James & Retallick 2007) and one of the most poorly known birds in Australian territory. The first record was the collection of the type-specimens by J.J. Lister from 30 September to 9 October 1887 (Lister 1889). Five syntypes are in the NHM (Warren 1966) and five are in the CUMZ (Benson 1999). Stokes (1988) extrapolated the population to be 50–150 breeding pairs, based on a habitat extent of 106 km^2. Hill (2004a) extrapolated the population to be 50–100 breeding pairs, based on 101 km^2 of available habitat and a possible density of 0.89–0.96 adult per km^2. A colour-banding and resighting study was commenced in 2004 by the ARA and PANCI (James *et al.* 2004; Hurley 2005; Holdsworth 2007; James 2007; James & McAllan 2010). By October 2006, 103 birds were banded and there were 99 resightings of banded birds and 238 sightings of unbanded birds in the study period. From these data, James (2007) estimated the total population size to be ~250 birds (99/238 = 103/248). This approximate calculation did not take into account parameters such as natality and mortality rates, study biases etc. Initial results also showed a nearly 2:1 ratio of males to females, although this may be because females are less mobile, rather than less common, than males (Hurley 2005; Holdsworth 2007). A sample of 73 birds banded in 2006–2007 showed an age structure of 37% first-year birds, 14% second-year birds and 49% adult (3+ years) birds (Holdsworth 2007), which might also be influenced by differential mobility. The project has been ongoing, but further population data are not yet available. James & Retallick (2007) recorded the species in only six of 527 10-minute surveys, a reporting rate of 1.1% that made it the least frequently recorded of eight species in their forest bird survey.

This species may have relaxed territoriality, as some individual adult and independent immature birds were resighted at opposite ends of the Island, and were sometimes recorded within a few hundred metres of active nests of other Christmas Island Goshawks, yet no territorial disputes were observed (DJJ). It apparently has no aerial displays, such as threat displays and triumph ceremonies (DJJ), typical of many accipiters (Ferguson-Lees *et al.* 2001). Its hunting techniques include capturing prey on the ground, snatching off foliage, and seizing in the air. Christmas Island Goshawks chase small flying birds through the forest, pounce on birds and other prey on the ground, and snatch insects from foliage using 'short-stay perch-hunting' (Hill 2004a). The species is attracted to sources of disturbance, and waits on roadsides apparently for vehicles to flush prey; it also readily follows people walking or working in the forest (Stokes 1988; DJJ).

Lister (1889) reported the remains of Christmas Island White-eyes, lizards

and large grasshoppers in the stomachs of Christmas Island Goshawks that he collected. Gibson-Hill (1947) reported on the stomach contents of six Goshawks: three collected in forest contained remains of Asian Giant Centipedes *Scolopendra morsitans*, beetles, Emerald Dove, Island Thrush and rats; three collected near poultry-runs contained locusts *Locusta migratoides*, mantids *Hierodula dispar*, domestic chicken, Christmas Island White-eye and Java Sparrow. Analysis of nine pellets from Goshawks captured in June 2004 (James *et al.* 2004) found insects (82%—mostly the grasshopper *Valanga irregularis*), birds (16%) and reptiles (2%—probably the small, fossorial and introduced Grass Skink *Lygosoma bowringii*). Hill (2004a) reported cases of predation on nestling Red-footed Boobies and an adult White-tailed Tropicbird. DJJ saw Goshawks carrying a nearly fledged Christmas Island Imperial-Pigeon chick and a half-grown Red-footed Booby chick, and saw a Goshawk snatch a Giant Forest Gecko *Cyrtodactylus saddleiri* from a tree-trunk inside the forest after the Gecko was disturbed by researchers. A nest found in 2004 contained the remains of an Emerald Dove chick (M. Holdsworth pers. comm.). Reville *et al.* (1990a) reported that Goshawks will take unguarded Abbott's Booby chicks. Hennicke (2012) observed a Goshawk disturb an Abbott's Booby chick from its perch; the chick fell and died, and the Goshawk fed on the corpse until displaced by a Robber Crab *Birgus latro*. The high incidence of nestlings in prey items of the Goshawk indicates that nest-robbing of birds is frequent.

The Christmas Island Goshawk occurs in evergreen and semi-deciduous rainforests, secondary growth, edges, roadsides, clearings and urban habitats; it appears to be absent only from bare pinnacle fields. Reports that it is more a bird of edges and clearings (e.g. Gibson-Hill 1947; Johnstone & Darnell 2004a) probably reflect observer bias towards open habitats and easier detection there, because systematic surveys show that it is commoner inside rainforest (Hill 2004a; DJJ).

Gibson-Hill (1947) listed the breeding season as probably October to the end of February, based on four nests recorded in November–January. These nests were untidy platforms of twigs placed in horizontal forks, 8–18 m above the ground. Hill (2004a) observed four nests, two in *Syzygium nervosum* in evergreen rainforest and two in Sea Almonds in semi-deciduous rainforest. These nests were 30–80 cm in diameter and placed in the forks of two or more branches 25–35 m above the ground. The ARA found two nests in August 2004, with laying deduced to be in July, indicating a wider spread of nesting dates (Hurley 2005). Both nests were within 10 m of a vehicle track in evergreen forest in the crowns of Macarangas *Macaranga tanarius*, 15 and 20 m above the ground, respectively (Hurley 2005). DJJ found one nest in December 2004 >30 m above the ground in a horizontal fork of a large rainforest-canopy tree above a vehicle track. There have been four counts of one chick and one count of two chicks from five nests, apparently indicating a low reproductive rate (Gibson-Hill 1947; Hurley 2005).

The Christmas Island Goshawk is listed as Endangered (as a subspecies of the Brown Goshawk *A. fasciatus natalis*) under the EPBC Act. It is not listed as globally threatened by the IUCN (2013), as it is considered a subspecies of a more widely distributed and secure species. Garnett *et al.* (2011) considered it Endangered. With 25% of the Island cleared for mining and municipal purposes,

habitat loss is a severe threat to any species with such an intrinsically small range and low population size. Although Gibson-Hill (1947, p. 146) considered it 'fairly common over the whole island', Pearson (1966) saw <10 birds in 2.5 years. Perhaps this difference was caused by a significant decline between 1940 and 1961, or perhaps it was a difference in perception. Nelson (1977) asserted that Goshawk numbers decreased between 1938 and the early 1970s and increased again by 1977, but provided no supporting data. Others have assumed ≥25% reduction in the population size proportional with habitat loss (e.g. Stokes 1988; Hill 2004a; Hurley 2005). However, secondary forest and other disturbed habitats, although not breeding habitat, still provide foraging habitat for breeding adults and probably a refuge supporting elevated populations of pre-breeding birds (DJJ). This species was formerly heavily persecuted for attacking domestic poultry, and was trapped and shot with guns and sling-shots (Gibson-Hill 1947; SSCSTE 1983; Stokes 1988), though this abated after 1977 (Stokes 1988) and is apparently rare or absent now (DJJ). Fortunately, predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000; Hill 2004a) have so far not eventuated. Hill (2004a) also listed potential threats as confinement to an island, disease, natural catastrophes, small population size, inbreeding depression, predation by cats, road-kill and weed invasion. There are few data to assess the reality of any of these, though the road-kill levels are low (James 2007) and inbreeding depression is not a high risk for species with naturally low population levels. Potential competition with the self-introduced Nankeen Kestrel (Hurley 2005) has received little consideration, although the two species largely occupy different habitats.

Some taxonomic issues are discussed in Taxonomy (p. S20).

Chinese Sparrowhawk *Accipiter soloensis*

Vagrant. One record. One was seen at the Rubbish Tip on 8 and 9 February 2011 (Anon. 2011b; Clarke 2011b; Dooley 2011b; Ramsay 2011b). This record is tentatively accepted because photographs confirm the identification, although formal vetting by BARC is still required. A small immature *Accipiter* hawk, thought to be a Chinese Sparrowhawk, was seen to fly past the lookout at Territory Day Park on 4 December 2002 (Anon. 2003; Doughty 2003).

In the austral spring, thousands of both Japanese *A. gularis* and Chinese Sparrowhawks migrate south down the Malay Peninsula and Sumatra, then west through Java and Bali to Wallacea (Ash 1993; Nijman 2001; Germi 2005), so it is not surprising that stragglers may reach Christmas Island. Elsewhere in Australian territory, this species has been seen and photographed in the Cocos (Keeling) Islands in 2010 and 2011 (Baxter 2010b; Carter 2011a; Clarke 2011a; Dooley 2012a; Graff 2013; Watson 2013; DJJ; IAWM; BARC Cases 754 & 757) and on Ashmore Reef on 14 November 2013 (BARC Case 803—under review).

Japanese Sparrowhawk *Accipiter gularis*

Vagrant. One record. A rufous-breasted adult male was seen well east of LB4 at the Field 23 rehabilitation site over several days, on 10–12 March 2011 and

later that month (Anon. 2011b; Baxter 2011a; L. Preston pers. comm.). This record is tentatively accepted because photographs confirm the identification, although vetting by BARC is still required. A bird thought to be a male Japanese Sparrowhawk was seen on 1 December 1996 (Hobcroft 1996; Eades 1997a). A small accipiter, possibly this species, was seen on the walking track to West White Beach in December 2001 (Clarke 2001; R.H. Clarke *in litt.*). A small accipiter, thought to be a juvenile male Japanese Sparrowhawk, was seen by DJJ at the Rubbish Tip on 17 January 2004 (Palliser 2006; BARC Case 418—not accepted). A small accipiter seen by DJJ and IAWM below Margaret Knoll on 14 December 2005 was too distant to identify, but was smaller than a Nankeen Kestrel.

In the austral spring, thousands of Japanese Sparrowhawks migrate through the Malay Peninsula, Sumatra and Java to Wallacea (Ash 1993; Nijman 2001; Germi 2005). Elsewhere in Australian territory, this species was recorded on Ashmore Reef (Anon. 2012b; BARC Case 747). Recent reports and photographs of birds considered to be this species from the Cocos (Keeling) Islands (e.g. Baxter 2010b; Carter 2011a; Clarke 2011a; Dooley 2012a; DJJ; IAWM; BARC Case 802—under review) have not yet been vetted.

Nankeen Kestrel *Falco cenchroides*

Uncommon breeding resident. There are probably >300 pairs plus immature birds, although no accurate estimates have ever been made. The Nankeen Kestrel currently occurs in much higher densities on Christmas Island than it does on the Australian mainland. The first record for the Island appears to be observations made by A.J. Pearson in 1960 when it was already 'present in large numbers' (Pearson 1966, p. 69). It was recorded as common in June and July 1961 (Mees 1966), when it was already widespread and breeding. Mees (1966, p. [10]) estimated the population at 'not far below a hundred individuals' and collected three specimens: at Toms Ridge, North West Point; on the South Point Road; and at the Golf Course (WAM A.9272–A.9274). A Mr Forrester told Mees (1966) that Kestrels were present when he had arrived on the Island 10 years earlier, though they were less common then. Since they were not reported by Gibson-Hill (1947), Mees deduced that they arrived between 1940 and 1950. Five specimens were collected by O. Oftedal and I. Vigeland in 1961 and 1962 (Voous 1964). Van Tets (1975) gave a population estimate of 10–100 pairs, which Stokes (1988) listed without updating. James & Retallick (2007) recorded the Kestrel in 117 of 527 10-minute surveys, a reporting rate of 22% that made it the second least frequently recorded of eight species in their forest bird survey. Since 1990, it has been reported by numerous observers; visitors frequently refer to it as abundant, perhaps because of very high densities at the Airport, Rubbish Tip and Settlement. K. Coate was told by Airport staff (November 2001) of culling because of aircraft safety concerns (K. Coate *in litt.*). However, any culling has had little effect, as it is still possible to count >20 Kestrels around the Airport on most days (DJJ; IAWM).

Nankeen Kestrel nests have been recorded in introduced palms, on power-pylons, radio-masts, and ledges of buildings (Reville 1989; DJJ), but the breeding biology has not been documented in any detail. The Kestrel is most abundant

in open country, and also occurs along roads and cliffs, but is absent in forest and rare over the forest canopy (James & Retallick 2007; DJJ). Reville (1989) reported a diet of grasshoppers and lizards. In December 2005 and May 2006, Schulz & Lumsden (2009) examined pellets from 115 regular feeding sites. The large grasshopper *Valanga irregularis* accounted for ~97% of food items, but other insects (beetles, moths and butterflies) and the introduced Grass Skink were occasionally present. Remains of the Christmas Island Swiftlet were found at 12% of sites, and these authors speculated that Swiftlets were caught on the wing. However, given the number of road-killed Swiftlets on the Island, it seems more likely that Kestrels scavenge these carcasses rather than catch Swiftlets in flight.

Christmas Island White-eyes frequently give alarm calls when Nankeen Kestrels appear, but there are no records of predation. Although technically indigenous, the Kestrel probably acts as an invasive predator. It has been suggested (though not proved) that its predation contributed to the declines of the endemic Christmas Island Blue-tailed Skink *Cryptoblepharus egeriae* and Christmas Island Pipistrelle (Rumpff 1992; James 2005, 2007).

The nominate subspecies breeds on the Australian mainland, Tasmania and Christmas Island, some birds migrate to Wallacea, and strays occasionally reach Bali, Java, the Cocos (Keeling) Islands and New Zealand (MacKinnon & Phillipps 1993; Marchant & Higgins 1993; Johnstone & Darnell 2004b). Subspecies *baru* is resident in New Guinea.

Peregrine Falcon *Falco peregrinus*

Vagrant. Five sets of records. A juvenile was seen by A.J. Pearson (1966) between 27 February and 1 April 1962. At least one bird with heavily streaked underparts was seen on most days from 28 December 1996 to 3 January 1997 (Anon. 1997b; Farnes 1997; Lansley 1997); it was at VQ3 Lodge in the Settlement, Drumsite, the Golf Course and the LB4 Lookout. Lansley (1997) considered that it resembled Australian birds. One bird was seen at Margaret Knoll on 13 January 2008 by D. Mantle (pers. comm.). One was seen at the Golf Course on 5 January 2010 by M. Carter and A. Silcocks (Carter 2010b; Ramsay 2010b). This bird was claimed as subspecies *calidus* (which breeds in the Eurasian tundra and is a long-distance migrant) on the basis of a slender moustachial streak and pale underparts (Carter & Silcocks 2010). One was seen by B. Blewett at Martin Point in late February 2010 and may have been the same bird seen in January (Baxter 2010a; Dooley 2010a). One was seen at the Airport on 28 November 2010 (Baxter 2010b). One (possibly the same bird) was seen at Steep Point on 9 December 2010, the Settlement on 10 December 2010 and 5 January 2011, and the northern end of the Airport on 6 January 2011 (James 2010; Carter 2011b; Ramsay 2011a; DJJ; IAWM).

This cosmopolitan species has many subspecies. Johnstone & Darnell (2004a) thought that the source of the Christmas Island Peregrine Falcons was probably one of the migratory subspecies from northern Asia or possibly the subspecies in the Greater Sundas, *ernesti*, which is small, dark and sedentary. Dooley (2011a) reported that both the subspecies *calidus* and *japonensis* had been claimed for the birds observed in late 2010–early 2011.

Baillon's Crake *Porzana pusilla*

Vagrant. Two reports, but only one confirmed record. One was caught during mowing operations at the Airport by Z. Hassan on 31 March 1999 (Carter 2000b). It was photographed, but subsequently died, and the specimen was apparently discarded (photographs identified by M. Carter). One was seen at the Parks Nursery at Drumsite on 3 December 2002 (Anon. 2003; Doughty 2003).

Nominate *pusilla* (with underparts buff-brown) breeds in northern Eurasia and southern Africa, and winters in southern Asia, whereas the Australian subspecies *palustris* (with underparts blue-grey) is highly nomadic or migratory within Australia, but apparently does not reach South-East Asia (Marchant & Higgins 1993; Coates & Bishop 1997; Robson 2000). The Christmas Island records lack descriptions, but possibly could be *pusilla*.

Ruddy-breasted Crake *Porzana fusca*

Vagrant. Two records. An adult female was collected by C.W. Andrews on 29 August 1897 (Sharpe 1900). A male was collected by C.A. Gibson-Hill in September 1940 (Gibson-Hill 1947), although the specimen is not presently in the ZRC (Morioka & Yang 1996; DJJ; IAWM; BARC Case 798—under review).

This polytypic species is found from India to Japan and south to the Greater Sundas and Wallacea (Marchant & Higgins 1993). These are the only records of this Indomalayan species from Australian territory.

White-breasted Waterhen *Amaurornis phoenicurus*

Rare breeding resident (<20 adults). It was first reported on the Island in 1992 (R. Hart in Carter 1994) from the Parks Nursery at Territory Day Park, Drumsite (M. Orchard pers. comm.). A pair raised two chicks at the Parks Office in April 1993 (M. Orchard in Carter 1994), and this group was also seen from 27 October to 3 November 1993 (Andrew & Eades 1993; Carter 1994; BARC Case 178). A pair (presumably the same one) bred successfully at the Parks Office for several years until one bird was killed on the road; the other bird remained for several more years, but did not find another mate before disappearing in *c.* January 2004 (M. Orchard pers. comm.; DJJ). By late 1993, Parks staff had also observed White-breasted Waterhens at the Power Station, Airport and Golf Course. Between 1993 and 2012, this species was reported by >60 visiting parties (e.g. Anon. 1996a, 1997b, 1999b; Barkla 1996; Craig 1996; Harvey 1996; Hobcroft 1996, 2005, 2006, 2007; Farnes 1997; Lansley 1997; Lester 1997; Maher 1997; O'Connor 1999; Carter 2000b, 2001, 2002, 2004, 2007, 2011b; Hansboro 2000a; Smith 2000; Clarke 2001, 2011b; Holmes 2002; Stafford 2002a; Barrand & Barrand 2003, 2007; Hunter 2004; Langfield 2004; Barrand 2005b; Morris 2005; Rogers 2006; Baxter 2010a,b; Marsh 2011; K. Coate *in litt.*; N. Hamilton *in litt.*; IAWM; BARC Case 291). DJJ made numerous sightings between 2002 and 2007. During ~60 days on the Island in 2002, Waterhens were seen about every second day on average at ten locations, totalling a minimum of 21 individuals and two breeding records (summarised in BARC Case 361). A pair at the Resort raised two chicks to independent juveniles between March and September 2002, in the presence of

two other independent juveniles apparently from an earlier brood. Another pair at the Rubbish Tip had three chicks in March 2002. DJJ made a similar number of sightings in 2004, but during >300 days on the Island, and no chicks were seen. From 2005 to April 2007, DJJ's sightings steadily decreased in terms of frequency and the number of sites. This trend continues, with very few records since 2007, despite numerous visiting birders to the end of 2011 (Carter *et al.* 2008; Baxter 2009, 2010a,b, 2011b; Carter 2010b, 2011b; James 2010; Clarke 2011b; Marsh 2011; N. Pamment *in litt.*; D. Helliar pers. comm.; IOSG delegates pers. comm.; L. Preston pers. comm.; DJJ; IAWM). Carter (2010b) even presumed it to be extinct on the Island. However, some birds were still present in low numbers in early 2012 (IAWM). The Island population briefly reached >20 adults in 2002–2004, but has declined since then (Figure 22). The cause of this apparent decline is probably attributable to feral cats, although there is no direct evidence. There have been more records from November and December than other months, but this probably just reflects visits by birders, as the species has been reported year-round and there were no seasonal patterns to DJJ's records.

Apart from a pair at North West Point from January 2004 until at least early 2007 (DJJ) and a bird seen at the Central Area Workshop on 6 September 2011 (N. Hamilton *in litt.*), the White-breasted Waterhen has been recorded only in the 'dogs-head' area north-east of a line from Lily Beach to the Plantation, which includes the Airport, Phosphate Hill, Rubbish Tip, Irvine Hill, Phosphate Dryers, Drumsite, Territory Day Park (Parks Nursery), Poon Saan, Silver City, Chinese Cemetery, North East Point, Golf Course, Norris Point, and the Resort. It favours disturbed habitats, including grassy clearings and weed thickets. It is fairly shy and rarely frequents suburban areas. Breeding has been reported in January, March, April and October, possibly indicating a lack of seasonality.

This species has an extensive range in southern Asia south of the Himalayas, from India to southern China, mainland South-East Asia, the Greater Sundas, Sulawesi and the Philippines (Mackinnon & Phillipps 1993; Wells 1999; Robson 2000; Rasmussen & Anderton 2005; Brazil 2009). It colonised the Cocos (Keeling) Islands in *c.* 1998 (McAllan *et al.* in prep.). It is now a common resident there (e.g. James 2010; Carter 2011a; IAWM). There is also one record from Ashmore Reef on 25–27 January 2003 (BARC Case 431).

There are differing views on the number of identifiable subspecies for the White-breasted Waterhen. Named subspecies include nominate *phoenicurus* (Sri Lanka and Travancore); *chinensis* (the remainder of India, where all populations are resident, east to southern Thailand and China); three resident taxa on the Andaman and Nicobar Islands (*insularis*, *leucocephala* and *midnicobaricus*), with another (*maldivicus*) in the Maldives; *javanicus* (resident in the Greater Sundas, Malay Peninsula, Philippines, and Talaud and Sangihe in the North Moluccas); and *leucomelana* in the remainder of Wallacea (Peters 1934; Taylor & van Perlo 1998; Wells 1999; Rasmussen & Anderton 2005). These are often reduced to as few as three taxa (e.g. Ripley 1977; Dickinson 2003). The recent consensus is that at least Indian birds are the same as Sri Lankan birds, and that resident *leucomelana* is recognisable. The resident birds in Malaya and the Greater Sundas (*javanicus*)

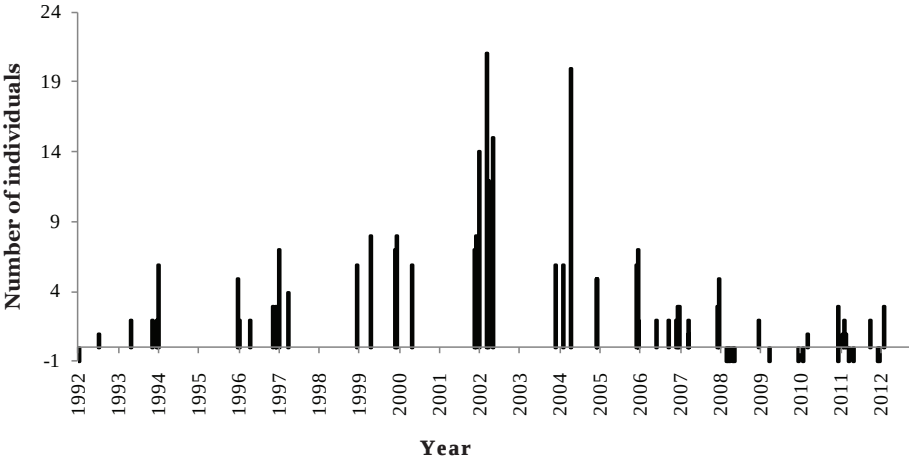

Figure 22. *Ad hoc* count data for the White-breasted Waterhen on Christmas Island from 1992 to 2012 (n = 62). Counts exclude chicks; counts of zero are displayed as '–1' to distinguish from missing values. See text for data sources and interpretation.

are smaller than migratory birds from the north and should be recognised (e.g. Mees 1986; Wells 1999). Consequently, the birds that colonised Christmas Island [and the Cocos (Keeling) Group] might be *javanicus* or the migratory population, which is either *chinensis* (if it is valid) or else *phoenicurus*. Since the Waterhen is resident on Christmas Island, it is most likely *javanicus*.

There are three specimens of the White-breasted Waterhen from the Island. A WAM specimen (WAM A. 26879) is unsexed but, from its wing-length of 144 mm (Johnstone & Darnell 2004a), it is either a male *javanicus* or a very large female, bordering on the size of a small migratory bird. An adult female in NMV has a wing-length of only 143 mm (NMV B.24008; N.W. Longmore pers. comm.), fitting into the size range of *javanicus*. However, an adult female in the AM has a wing-length of 160 mm (right wing of AM O.71277, measured by IAWM), placing this bird firmly in the size range of migratory birds. It is therefore possible that more than one subspecies is involved, but it is clear that more work is needed on the taxonomy of the species. The subspecies found in China has expanded into Japan in recent decades (Taylor & van Perlo 1998).

Watercock *Gallicrex cinerea*

Vagrant. Five to seven sets of reports, but only three confirmed records. An unknown number was reported by locals in December 1972 and January 1973 (van Tets 1974a, 1983; Marchant & Higgins 1993 erroneously listed the end-date as January 1983). One was seen by Stokes (1988) at the Golf Course in January 1982. One immature or female-type bird was seen at the spring north of the Resort on 30 December 1999 (Hansboro 2000a; BARC Case 283). One immature or female-type bird was seen by DJJ and J. Middleton near the Pink House on 8 March

2002 (Palliser 2004; BARC Case 346). One juvenile male was regularly seen and photographed at the Golf Course from 6 January to 11 February 2011 (Anon. 2011a; Carter 2011b; Clarke 2011b; Dooley 2011b; Ramsay 2011b; DJJ; IAWM; BARC Case 695). Up to three birds were observed near North East Point in early March 2011 (Baxter 2011a). One male in breeding plumage was seen at the entrance to the Resort on 30 April 2011 (C. Nixon pers. comm.; IAWM).

This monotypic species occurs in southern Asia from India east to Japan and south to the Philippines, the Greater Sundas and occasionally Wallacea (MacKinnon & Phillipps 1993; Marchant & Higgins 1993; Coates & Bishop 1997; Robson 2000). These are the only records from Australian territory (Marchant & Higgins 1993), apart from recent records from the Cocos (Keeling) Islands (e.g. Chongkin *et al.* 2009; James 2010; Carter 2011a; Clarke 2011a; Dooley 2012a; BARC Cases 566, 681 & 740) and Ashmore Reef (Graff 2013; Watson 2013; BARC Case 773).

Black-tailed Native-hen *Tribonyx ventralis*

Vagrant. One record. One was seen by F. O'Connor and S. & A. Keates on Irvine Hill Road and near the Rubbish Tip on 3 and 5 January 2006 (Anon. 2006a,d; F. O'Connor pers. comm.) and photographs were shown to DJJ.

This Australian species is prone to large irruptions, and vagrants have reached Tasmania and New Zealand (Marchant & Higgins 1993), though it is unknown from Wallacea and the Indomalayan Region proper (cf. Andrew 1992; Inskipp *et al.* 1996).

Eurasian Coot *Fulica atra*

Vagrant. One record. One was seen by J. Hueston and DJJ at the LB3 ponds from 6 to 17 April 2005 (Adams 2005; DJJ). The subspecies was not determined.

Nominate *atra* ranges widely in Eurasia, and is a rare visitor to Borneo, Java and Bali, but has not been recorded from Sumatra or Australian territory (MacKinnon & Phillipps 1993; Marchant & Higgins 1993). Subspecies *australis* is widespread in Australia (Marchant & Higgins 1993). The Eurasian Coot colonised New Zealand in the 1950s and is spreading there (Robertson *et al.* 2007), and may have colonised lowland New Guinea in the 1970s (Coates 1985). Vagrants have been reported from Norfolk Island, Lord Howe Island, and Wallacea (Coates & Bishop 1987; Marchant & Higgins 1993).

Sooty Oystercatcher *Haematopus fuliginosus*

Vagrant. One record. One was reported by W.H. Butler at Smith Point on 2 October 1983 (Stokes *et al.* 1987).

Though not usually considered a long-distance vagrant, there are two other records of this species outside continental Australia. A single sight record from Lord Howe Island in March 1987 was probably this species (McAllan *et al.* 2004) and a single bird of subspecies *opthalmicus* was well documented in south-eastern

Bali in April 1997 (Mason 1997). Apart from the Bali record, this species is unknown from the Indomalayan Region proper (Andrew 1992; Inskipp *et al.* 1996).

Black-winged Stilt *Himantopus himantopus*

Vagrant. At least 13 sets of records, ten since 1990. Five birds were seen by J. Lattin at the Airport in April 1983 (Stokes 1988). Three immature birds were seen at temporary ponds in mining areas on the western end of the Island on 23 May 1985, where two remained for a week and the third until 6 June 1985 (Stokes *et al.* 1987). One was caught by two boys at Flying Fish Cove on 20 November 1988 and handed to Parks staff (D. Philips, ANPWS file). It is now a spirit specimen in the WAM (WAM A.26482). Johnstone & Darnell (2004a) listed two birds photographed by Airport staff and other sightings since the 1990s without specific details. An adult male *leucocephalus* was seen by DJJ at the Chalk Pits near the Airport on 5, 12 and 19 September 2004. An adult *leucocephalus* was seen by DJJ at the LB3 ponds from 28 March to early May 2005 (also Anon. 2005d; Brodie-Good 2005), and a juvenile *leucocephalus* was seen by DJJ at Flying Fish Cove on 1–3 May 2005. A first-year immature *leucocephalus* was photographed at the Pink House in early May 2005 by A. Gorge (photographs identified by DJJ). An adult *leucocephalus* at the Airport from mid August to at least early December 2006 was seen by many observers (Anon. 2007c; DJJ & IAWM). One was reported by G. Roberts (*in litt.*) in May 2007. An immature was seen at Waterfall Cove in mid December 2007 (Hobcroft 2007; H.H. Tan pers. comm.). One (presumably the same bird) was seen at Ethel Beach on 13 January 2008 (D. Mantle pers. comm.). An immature *leucocephalus* was photographed by P. Harlow and J. Hall in front of the Kampong on 14 August 2010 (P. Harlow pers. comm.). An adult and an immature *leucocephalus* were found at Flying Fish Cove from 29 May to 2 June 2011 (Ramsay 2011c; N. Hamilton *in litt.;* M. Rogers pers. comm.) and (presumably the same birds) again on 22–23 July 2011 and at Isabel Beach on 22 July (Low 2011; J. Woinarski *in litt.;* M. Holdsworth pers. comm.). Records are thus from almost every month. So far, only subspecies *leucocephalus* has been identified on Christmas Island.

Subspecies *leucocephalus* breeds in Australia, New Zealand, New Guinea, probably Wallacea and sparsely in Java, Bali and Sumatra; it is an uncommon visitor to the western Sumatran islands and Borneo, and vagrants have reached Norfolk and Lord Howe Islands, several subantarctic islands, Ashmore Reef and the Cocos (Keeling) Group (MacKinnon & Phillipps 1993; Marchant & Higgins 1993; Coates & Bishop 1997; Kemp 2000; Iqbal *et al.* 2009; McAllan *et al.* in prep.). Nominate *himantopus* is widespread though patchy in Eurasia and scarce in mainland South-East Asia. Vagrants reach the Philippines and Borneo (MacKinnon & Phillipps 1993; Marchant & Higgins 1993; Robson 2000) and could reach the Island.

Pacific Golden Plover *Pluvialis fulva*

Rare regular visitor between September and mid March. An immature male was collected by C.W. Andrews at Flying Fish Cove on 14 November 1897 (Sharpe

1900). Gibson-Hill (1947) collected a specimen at Rocky Point on 12 November 1939 (ZRC 3.02669; Morioka & Yang 1996; IAWM). One was collected by J. Hicks at the Airport on 20 January 1981 (AM O.56513). This species was considered to be a regular visitor between September and April by Gibson-Hill (1947) and Stokes (1988), but in only November and December by Johnstone & Darnell (2004a). Since 1990, it has been reported in singles and small flocks by at least 25 visiting parties in most years (Carter 1994, 2000b, 2004; Barkla 1996; Hobcroft 1996, 2005, 2006; O'Connor 1999; Clarke 2001; Holmes 2002; Doughty 2003; Morris 2005; K. Coate *in litt.*; IAWM). Most records since 1990 were between October and mid March. DJJ recorded a small flock on every one of many visits to Low Point between the months of October and February in 2002–2006. The earliest arrival date was 9 September (in 2004) and the latest date was 13 March (also in 2004) (DJJ). The largest flock was 31 at the Airport on 1 December 2010, with similar numbers reported through to January 2011 (Baxter 2010b; James 2010; Carter 2011b; DJJ; IAWM). Most records have been from Low Point. One bird was seen at the Sports Ground on 17 November 1999 (Carter 2000b).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Grey Plover *Pluvialis squatarola*

Vagrant. Six records. A flock of up to 17 birds was seen by D. Merton at the Airport in September 1978, and a few were seen in November 1978 (Stokes *et al.* 1987). One was seen at Flying Fish Cove from 30 November to 7 December 1994 (K. Coate *in litt.*). One was seen by DJJ at Low Point in company with 11 Pacific Golden Plovers on 31 October 2005. One was seen by M. Holdsworth (pers. comm.) at Low Point during Birdweek on 2–6 September 2006. One was seen at an unspecified location on 28 November 2008 (Baxter 2008b). One was seen at ponds near South Point in late November 2010 (L. Preston pers. comm.).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Little Ringed Plover *Charadrius dubius*

Vagrant. Two records, but neither is confirmed. One to two birds were seen by D. Merton and J. Tranter at the South Point slurry ponds on several days from 23 September to 26 October 1978 (Stokes *et al.* 1987). This record was considered unverified by Marchant & Higgins (1993). One was seen well (as close as 4 m) and photographed at temporary ponds on Phosphate Hill from 21 to 23 April 2009 (Dooley 2009b; D. Helliar pers. comm.; cf. Anon. 2009c).

This Palaearctic migrant reaches the Greater Sundas regularly and Australia in very small numbers (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Kentish Plover *Charadrius alexandrinus*

Vagrant. Two records, but only one confirmed. In February 1994 F.A.R. Hill saw 'a Red-capped or Kentish-type Plover', but the views 'were less than ideal' (Andrew

& Eades 1994). One female in non-breeding plumage was seen by DJJ at Flying Fish Cove on most days from 17 April to 15 May 2005 (Anon. 2005c; Palliser & Carter 2012; BARC Case 641).

This Palaearctic migrant reaches the Greater Sundas regularly, though it is a vagrant to Australia (MacKinnon & Phillipps 1993; Marchant & Higgins 1993). The 2005 record was the third for Australian territory.

Lesser Sand Plover *Charadrius mongolus*

Vagrant. At least five records. It was listed by van Tets (1974a) as a regular visitor, but no records were given. Likewise, Stokes (1988) listed it as a regular visitor, and indicated that he had seen the species, but no records were mentioned. One was seen at Ethel Beach in late November 2001 (K. Coate *in litt.*). Single individuals were seen by DJJ at Flying Fish Cove on 13–15 September 2002, 23 October 2004, and 27 March 2005. One was seen at the Airport from late November to 9 December 2010 (Baxter 2010b; James 2010).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Greater Sand Plover *Charadrius leschenaultii*

Vagrant. Twelve sets of records ranging from September to December, six since 1990. Two females were collected by J.J. Lister in October 1887 (Lister 1889). An adult female was collected by C.W. Andrews at Flying Fish Cove on 14 November 1897 (Sharpe 1900). A male was collected for the Raffles Museum by their Dayak collectors on 5 November 1923 (ZRC 3.02372; Chasen & Kloss 1924; Morioka & Yang 1996). A female was collected for the Raffles Museum by M.W.F. Tweedie on 16 September 1932 (ZRC 3.02373; Morioka & Yang 1996). The species was considered to be a regular visitor by Gibson-Hill (1947), van Tets (1974a, 1983) and Stokes (1988). One juvenile was found dead by G.F. van Tets at the Golf Course on 19 September 1972 (ANWC skeletal specimen 23127). One was seen by a BOCA tour group at the Airport on 28–29 October 1996 (Barkla 1996). One was seen at Ethel Beach in late November 2001 (Johnstone & Darnell 2004a; K. Coate *in litt.*; J. Adams pers. comm.). Two were seen at Ethel Beach on 13 December 2001 (Clarke 2001; Anon. 2002b). Two were seen by DJJ at Flying Fish Cove on 11, 13 and 21 September 2002, and one was there on 14 September 2002. One was seen by DJJ at the Airport on 28 September 2005. Two were seen at South Point from 31 October to 1 November 2008 (N. Pamment *in litt.*). One was seen at the Settlement on 19 September 2010 (L. Preston pers. comm.).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Oriental Plover *Charadrius veredus*

Vagrant. Eight sets of records. One female was collected by O. Oftedal on 1 October 1961 (Voous 1964). Van Tets (1974a) described this species as a rare migrant. Up to five were seen by D. Merton and J. Tranter at the Airport and South Point slurry

ponds on several days between 21 September and 26 November 1978 (Stokes *et al.* 1987). Two were seen at the Airport on 8 November 1984 (Stokes *et al.* 1987). One was seen at the Airport on 9 December 1995 (Harvey 1996; Anon. 2006e; K. Coate *in litt.*). The species was seen by a BOCA tour group on 28–31 October 1996 (Barkla 1996). One was seen at the Airport on 5 December 1996 (Hobcroft 1996). Two were seen at the Airport between 30 November and 5 December 1998 (Johnstone & Darnell 2004a; K. Coate *in litt.*). One was seen at the Airport on 15 November 2001 (Carter 2001). One was seen at Ethel Beach in late November 2001 (K. Coate *in litt.*).

This Palaearctic migrant reaches the Greater Sundas rarely and northern Australia regularly (MacKinnon & Phillipps 1993; Marchant & Higgins 1993).

Masked Lapwing *Vanellus miles*

Vagrant. Four sets of records. An unknown number was seen by G.F. Mees and E.J Carr between 14 June and 15 July 1961 (WAM 1962; Pearson 1966; G.F. Mees pers. comm.). Two were observed by J. Lattin at the Golf Course in September and October 1982 (Stokes 1988). A female specimen dating from 1982 at the ANWC (37620) must be one of these. Three birds were seen at the Airport over several days in June 2008 (Anon. 2008c; D. Hobcroft pers. comm.). These birds then moved to the Golf Course by September, and were present until at least late October 2008 (N. Pamment *in litt.*; L. Preston pers. comm.). Two were seen at the Settlement in August 2011 (L. Preston pers. comm.). The specimen from 1982 and the birds seen in 2008 were of the nominate subspecies found in northern Australia and southern New Guinea.

The southern subspecies *novaehollandiae* of this Australasian species has expanded its range to include Lord Howe Island, New Zealand, the Chatham Islands, Kermadec Islands and New Caledonia, with recent records from Norfolk Island and Fiji (Marchant & Higgins 1993; Dutson & Watling 2007). Nominate *miles* is an irregular visitor to the southern Moluccas and eastern Lesser Sundas, and a vagrant to the Solomon Islands (White & Bruce 1986; Coates & Bishop 1997; Trainor *et al.* 2009). This species is unknown from the Indomalayan Region proper (cf. Andrew 1992; MacKinnon & Phillipps 1993; Robson 2000).

Pin-tailed Snipe *Gallinago stenura*

Status uncertain, though probably a rare regular visitor. At least 18 reports, but only the four specimen records can be considered confirmed as there are identification difficulties with live birds. Only one record has been submitted to BARC (BARC Case 304), but was not accepted. Nevertheless, Pin-tailed Snipe from Christmas Island has been removed from the BARC review list, which suggests that BARC considers the Pin-tailed Snipe to be sufficiently regular on the Island that records do not need vetting. An adult male was collected by C.W. Andrews on 1 December 1897 (Sharpe 1900). Two specimens in the AM (AM O.56461 and O.56462) were collected on 8 December 1981, by H'ng Kim Chey and J. Hicks, respectively. These specimens were overlooked by Stokes *et al.* (1987), Stokes (1988) and Johnstone & Darnell (2004a). One bird was seen well

on the roadside verge near Poon Saan during heavy rain on 12 December 1995 (Andrew 1996a; Harvey 1996; K. Coate *in litt.*). One unidentified snipe seen near North West Point in early January 1996 was possibly this species (Anon. 1996a; Craig 1996). One was found dead under a power-line near the Sports Ground on 10 January 1996 (Anon. 1996a; K. Coate *in litt.*). The specimen had 27 tail-feathers and was undoubtedly this species (K. Coate *in litt.*). It was handed to the Parks Office, but apparently the specimen was not kept. Two were photographed at the Airport on 5 December 1996 (Hobcroft 1996). One was seen at the Rubbish Tip on 28 December 1996 and others were heard at the Airport (Farnes 1997; Lansley 1997). A possible snipe was heard calling at night near the Airport in mid March 1997 (Maher 1997). One was flushed several times from long grass near the Golf Course from 30 November 1998 to 5 December 1998 (K. Coate *in litt.*). Two were seen at Poon Saan on 30 December 1999 (Hansboro 2000a,b; Palliser 2004; BARC Case 304—not accepted). One was seen on the Golf Course on 16 November 2001 (Carter 2001; Anon. 2002a; Stafford 2002a). One was seen at the Resort entrance on 13 December 2001 (Clarke 2001; Stafford 2002a). One was seen at Low Point on 8 March 2002 and another was seen near Migrant Hill on 30 March 2002 (Holmes 2002). Four were seen at the former go-kart track near the Sports Ground on 15 March 2002 (Anon. 2002c). Three were seen by DJJ at Phosphate Hill airport beacon on 16 March 2002. One was photographed by DJJ and C. Surman at the Pink House on 17 December 2003. Up to 10 snipe were scattered around the Airport apron at night on 29 March 2007 (M. Holdsworth, N. Mooney, P. Menkhorst & M. Webb pers. comm.; DJJ). Two were seen at the LB3 ponds by M. O'Connell on 4 January 2010 and one at the same place by M. Carter on 6 January 2010 (Carter 2010b; Ramsay 2010b). Three or more birds at the LB3 ponds in January 2012 could have been Swinhoe's Snipe *G. megala* rather than Pin-tailed Snipe (L. Preston pers. comm.; IAWM). The earliest date that a snipe was seen was 16 November and the latest was 29 March.

The Pin-tailed Snipe is a Palaearctic migrant and reaches the Greater Sundas regularly, the Cocos (Keeling) Group in most years, and northern Australia irregularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996; IAWM).

Swinhoe's Snipe *Gallinago megala*

Vagrant. One definite record. One bird photographed at the Pink House on 17 December 2003 (DJJ) was previously considered to be this species, and accounts for the listing by Valenzuela & James (2006); it is now thought that this was a Pin-tailed Snipe (D. Hobcroft pers. comm.; DJJ). A bird found injured (believed to have hit overhead wires) at the Pink House on 9 December 2009 by E. Johari, F. Fadli and S. Sharif was taken into care, but subsequently died (Anon. 2010a; Ramsay 2010b; M. Orchard pers. comm.). The frozen specimen was identified by M. Carter (Carter 2010a, pers. comm.).

This Palaearctic migrant reaches the Greater Sundas regularly and northern Australia irregularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996). However, in Sumatra, the Malay Peninsula and Singapore, it is a rare winter visitor, and Pin-tailed Snipe outnumber Swinhoe's Snipe by more than ten to one (van Marle & Voous 1988; Wells 1999; Wang & Hails 2007).

Bar-tailed Godwit *Limosa lapponica*

Vagrant. Four records. One was caught and identified by A.J. Pearson on 26 October 1963 (Pearson 1966). One was seen at the Airport in late November 2001 (K. Coate *in litt.*; J. Adams pers. comm.). One was seen at the Airport on 8 and 10 December 2001 (Clarke 2001; Anon. 2002b). One was seen at the Airport from 5 November to 9 December 2010 (Baxter 2010b; James 2010; L. Preston pers. comm.).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Little Curlew *Numenius minutus*

Vagrant. Four records. One of several birds was collected by J. Hicks on 20 January 1981 (AM O.56481; Stokes *et al.* 1987); the birds were in the company of a flock of Pacific Golden Plovers. One was seen at the Airport on 19 November 2005 (Barrand 2005b; Anon. 2006c), and (presumably this same bird) was found injured there on 23 November 2005, and died the same day (AM O.71279). One was seen and heard in flight by DJJ at the Golf Course on 2 September 2006. One was photographed at the Airport on 5 November 2010 (L. Preston pers. comm.).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Whimbrel *Numenius phaeopus*

Vagrant. Eight to nine records. Adult male and female Whimbrels of subspecies *variegatus* were collected at Flying Fish Cove by C.W. Andrews on 17 November 1897 (Sharpe 1900). Another adult female was collected at the same place by Andrews on 26 December 1897 (Sharpe 1900). Although there were no further records, it was described as a regular visitor by Gibson-Hill (1947) and van Tets (1974a). An immature male found by D. Merton at Drumsite on 8 September 1977 was injured and subsequently died (ANWC 19873). One Whimbrel was seen on the road-side verge near Poon Saan during heavy rain on 12 December 1995 and (presumably the same bird) at Flying Fish Cove and the Settlement over the next few days (Andrew 1996a; Harvey 1996; K. Coate *in litt.*). One was seen by a BOCA tour group on 25 and 29 October 1996 (Barkla 1996). One found by C. Davies was seen by DJJ at the Chinese Cemetery on 20–24 September 2004. One was seen near the Golf Course on 10 December 2010 (James 2010). One was present at Flying Fish Cove from late December 2011 to at least 17 January 2012 (L. Preston pers. comm.; IAWM). One was seen by a tour group at the Golf Course on 26–27 November 2012 (James 2012).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Eastern Curlew *Numenius madagascariensis*

Vagrant. One record. One was seen by a Coate's Wildlife Tours group at the Airport on 7 December 1994 (Anon. 1995; Smith 2000; K. Coate *in litt.*).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Terek Sandpiper *Xenus cinereus*

Vagrant. One record. A single bird was seen by D. Merton and J. Tranter at the South Point slurry ponds over 6 days from 6 November 1978 (Stokes *et al.* 1987).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Common Sandpiper *Actitis hypoleucos*

Rare regular visitor between August and April. A pair was collected in Flying Fish Cove by J.J. Lister in October 1887 (Lister 1889). Gibson-Hill collected one near Rocky Point in November 1939 and three in November 1940, at Flying Fish Cove, Isabel Beach and Waterfall Cove (Morioka & Yang 1996). This species was considered to be a regular visitor in the austral summer by Gibson-Hill (1947), van Tets (1974a, 1983), Stokes (1988) and Johnstone & Darnell (2004a). One (possibly a male) found dead by G.F. van Tets at the Golf Course on 19 September 1972 was preserved as a skeleton (ANWC 23160). The Common Sandpiper has been reported by numerous visiting parties in most years since 1990 (Carter 1994, 2001, 2002, 2004, 2011b; Barkla 1996; Craig 1996; Harvey 1996; Hobcroft 1996, 2005, 2006, 2007; Farnes 1997; Maher 1997; O'Connor 1999; Smith 2000; Clarke 2001, 2011b; Holmes 2002; Barrand & Barrand 2003; Doughty 2003; Langfield 2004; Barrand 2005b, *c.* 2009, *c.* 2011; Morris 2005; Rogers 2006; James 2010; K. Coate *in litt.*; B. King *in litt.*; D. Mantle *in litt.*; N. Pamment *in litt.*; D. Helliar pers. comm.; IAWM). All records were of singles, pairs or flocks of three. Some observers reported sightings from different parts of the Island, leading to cumulative totals of five to eight. Most records since 1990 were between late October and early April. DJJ recorded the earliest arrivals by late August in every year between 2003 and 2006 except for 2004 (when the earliest arrival was 1 August). One or two birds were almost invariably present (if not always visible) at Flying Fish Cove from September through to March in 2003–2006. Most birds leave by the end of March, and the latest record appears to be 27 April (D. Helliar pers. comm.). Most localities where this species has been recorded are on the coast, and include Flying Fish Cove, Isabel Beach, Rocky Point, Waterfall Cove, Ethel Beach, Low Point, Lily Beach, Greta Beach, Dolly Beach, Medwin Point, the Blowholes, Middle Point, Winifred Beach, the Dales coast, Margaret Beaches and Smith Point. A record from the Chalk Pits near the Airport on 2–3 April 2002 (Holmes 2002) is exceptional for its distance from the coast.

This species is a Palaearctic migrant that reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Grey-tailed Tattler *Tringa brevipes*

Vagrant. Seven records. A female was collected at Flying Fish Cove by Hugh Ross on 22 September 1898 (Andrews 1900). One was seen by D. Merton at Flying Fish

Cove on 9 December 1977 (Stokes *et al.* 1987). One seen by D. Merton at Ross Hill Springs on 30 September 1978 (Stokes *et al.* 1987) seems an unlikely record on the basis of habitat. One was seen at Waterfall Cove on 7 December 1996 (Hobcroft 1996). One was seen at Dolly Beach in April 2000 (Smith 2000; K. Coate *in litt.*). One was photographed at Flying Fish Cove on 3 October 2010 (L. Preston *in litt.*), where two were seen on 25 September 2011 (N. Hamilton *in litt.*).

This Palaearctic migrant is rare in Sumatra and uncommon in Java and Borneo, but regularly visits Australia (MacKinnon & Phillipps 1993; Higgins & Davies 1996; Grantham & Kemp 2000).

Common Greenshank *Tringa nebularia*

Vagrant. Nine sets of records. One was collected by Dr R. Hanitsch in 1904 and deposited at the ZRC (Chasen & Kloss 1924), although this specimen can no longer be located (Morioka & Yang 1996; IAWM). Van Tets (1974a, 1983) considered this species to be a regular visitor. Two were seen by a Coate's Wildlife Tours group at South Point on 12 December 1995 (Andrew 1996a; Harvey 1996; K. Coate *in litt.*). One was seen at Waterfall Cove in mid January 1996 (K. Coate *in litt.*). One was seen at the Airport on 30 April 1996 (T. Palliser pers. comm.). Two *Tringa* individuals were reported at ponds near Drumsite between 19 November and 5 December 1998 by two independent parties (K. Coate *in litt.*; A. Richards *in litt.*), but were identified as a Common Greenshank and a Marsh Sandpiper *T. stagnatilis* by one and as two Common Greenshanks by the other. One Common Greenshank was heard by DJJ at the IDC site on 22 October 2004. One was seen at Waterfall Cove from 25 to 27 November 2004 (Carter 2004; DJJ). It was also seen by a Coate's Wildlife Tours group sometime between 28 November and 1 December 2004 (Langfield 2004). At least one was seen at the LB3 ponds on 28 November 2010 (Baxter 2010b; L. Preston pers. comm.). One was seen at the Rubbish Tip on 9 December 2010 (James 2010).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Marsh Sandpiper *Tringa stagnatilis*

Vagrant. Probably only one record. One was reported by D. Merton at the Airport on 6 November 1978, though there are no verifying details (Stokes *et al.* 1987). A Marsh Sandpiper in company with a Common Greenshank was reported at ponds near Drumsite between 19 November and 5 December 1998 (A. Richards *in litt.*), but later observers at this site saw only two Common Greenshanks (K. Coate *in litt.*). A report of this species from Waterfall Cove on 23 November 2004 was later withdrawn (R. Baxter *in litt.*).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Common Redshank *Tringa totanus*

Vagrant. One record. A male specimen was collected by C.A. Gibson-Hill at

Flying Fish Cove in September 1939 and deposited at the ZRC (Gibson-Hill 1947), although it can no longer be located (Morioka & Yang 1996; DJJ; IAWM). It was said to be a regular visitor by van Tets (1974a, 1983).

This Palaearctic migrant reaches the Greater Sundas regularly and Australia and the Cocos (Keeling) Islands rarely (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Wood Sandpiper *Tringa glareola*

Vagrant. Fourteen sets of records, nine since 1990. A female was collected by Gibson-Hill (1947) at Flying Fish Cove on 7 November 1940 (ZRC 3.03139; Morioka & Yang 1996). Five were seen by B. Bell at the South Point slurry ponds in mid August 1975 (Stokes *et al.* 1987). Several were seen by D. Merton and J. Tranter at the same spot in late January 1978 and from 20 September to 25 November 1978 (Stokes *et al.* 1987). Two were seen at the Airport on 25 September 1984 (Stokes *et al.* 1987). Stokes *et al.* (1987) considered that this species may be a frequent visitor. 'Several' were noted at a 'pool in an old mine site' in August 1990 (K. Coate *in litt.*). One juvenile was seen by DJJ at the Blowholes Road on 10 September 2002. One was seen by DJJ at the Golf Course on 11, 12 and 14 September 2002. One was photographed by J. Pilgrim and seen by DJJ at the corner of Murray and Research Station Roads in September 2005. Two were seen by DJJ at the Phosphate Dryers on two consecutive days in late October 2006. One was seen at pools by the road near Grants Well on 12 January 2008 (D. Mantle pers. comm.). One was seen at the LB3 ponds from 19 to 27 April 2008 (Carter *et al.* 2008; Y. Cherel, C. Feare & D. Stojanovic pers. comm.), with another there from 26 to 30 November 2008 (Baxter 2008b). One was at the Rubbish Tip on 28 November and 9 December 2010 (Baxter 2010b; James 2010).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996). Most records are from August to November, presumably on southern passage. It might prove to be a regular passage migrant.

Ruddy Turnstone *Arenaria interpres*

Rare irregular visitor. This species was considered to be a regular visitor by van Tets (1974a) and Stokes (1988), although there appear to be no documented records before 1993. However, there have been few reports since 2006. Three were seen at Low Point on 31 October 1993 by M. Carter (1994). It has since been seen by at least ten visiting parties in some, but not all, years since 1993 (Carter 1994, 2000; Barkla 1996; O'Connor 1999; Smith 2000; Clarke 2001; Barrand & Barrand 2003; Hobcroft 2005; Morris 2005; K. Coate *in litt.*; L. Preston *in litt.*). In addition, DJJ saw this species six times at Low Point between 2002 and 2006. The earliest date recorded by DJJ was 9 September (in 2002) and the latest was 23 January (in 2004). Smith (2000) reported four birds in late April 2000, presumably northward migrants. This was one of the largest recorded flocks. Most sightings were between October and January and involved single birds, but groups of two to five have been reported. The Ruddy Turnstone has been recorded only at

Low Point, Ethel Beach, and once each at Waterfall and Flying Fish Coves. At Low Point, it is usually in mixed flocks with the more common Pacific Golden Plover (DJJ).

This Palaearctic migrant reaches the Greater Sundas, Australia and the Cocos (Keeling) Group regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Great Knot *Calidris tenuirostris*

Vagrant. One record. A dead bird was 'handed to Parks' on 23 November 1988 (WAM A.26543; D. Phillips in ANPWS files).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Red Knot *Calidris canutus*

Vagrant. One record. A single bird was seen in a yard in Silver City on 22 September 2011 (J. Woinarski *in litt.*).

This Palaearctic migrant is a rare passage migrant and very rare boreal winter visitor in the Greater Sundas (MacKinnon & Phillipps 1993), but a common and regular winter visitor in Australia (Higgins & Davies 1996).

Sanderling *Calidris alba*

Vagrant. Five records. An adult was collected by C.W. Andrews in 1897 or 1898, though no details were given (Sharpe 1900). Up to five were seen by D. Merton and J. Tranter at Greta Beach, Flying Fish Cove, the Airport and the South Point slurry ponds on 6 days between 12 October and 26 November 1978 (Stokes *et al.* 1987). A specimen was collected in December 1988 (WAM A.26880). One was seen by DJJ at Flying Fish Cove on 7 May 2005. One was seen at Flying Fish Cove by a tour group on 30 November 2009 (Barrand *c.* 2009).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Red-necked Stint *Calidris ruficollis*

Vagrant. At least nine records, eight since 1990. A juvenile male and juvenile female were collected by C.W. Andrews at Flying Fish Cove on 20 September 1897 (Sharpe 1900). This species was considered by Gibson-Hill (1947) as probably a regular visitor in small numbers, though he gave no records. It was seen by a BOCA tour group on 28–29 October 1996 (Barkla 1996). A road-killed bird was found by P. Crabtree at the Resort on 17 November 1999 (Carter 2000b). One was seen at Waterfall Cove on 24 November 2001 (Johnstone & Darnell 2004a; K. Coate *in litt.*; J. Adams pers. comm.). Fifteen were seen at the Chalk Pits near the Airport on 7 April 2002 (Holmes 2002). A juvenile was photographed at Ethel Beach by R. Stephenson on 1 November 2007 (photographs identified by DJJ). One was seen at a puddle near Lily Beach on 23 April 2008, after Cyclone Rosie (Anon. 2008c; J.N. Dunlop pers. comm.). Two birds were seen near South Point

on 1–2 November 2008 (N. Pamment *in litt.*). One in breeding plumage was seen at the LB3 ponds on 1 May 2009 (L. Preston pers. comm.; IAWM).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Long-toed Stint *Calidris subminuta*

Vagrant. Three records. Two males were collected from a flock of three Long-toed Stints at Dolly Beach in September 1940 and deposited at the ZRC (Gibson-Hill 1947), although these specimens can no longer be located there (Morioka & Yang 1996; DJJ; IAWM). One Stint was seen by D. Merton at the South Point slurry ponds on 21–22 September 1978 (Stokes *et al.* 1987), and two at this locality by J. Tranter on 3 November 1978 (Stokes *et al.* 1987).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Pectoral Sandpiper *Calidris melanotos*

Vagrant. One record. One was photographed by L. Preston on the shoreline at Flying Fish Cove on 6 September 2013 (L. Preston *in litt.*; photographs identified by DJJ & IAWM).

This species breeds largely in the Nearctic, from Alaska east to Hudson Bay, with smaller numbers breeding on the northern Siberian coast, west to the Taimyr Peninsula. Most birds winter in South America, though small numbers are reported in most years in southern Australia and New Zealand (Higgins & Davies 1996). It is a vagrant to Peninsular Malaysia, Singapore, Papua New Guinea and the Solomons, but is so far unknown from Indonesia and Malaysian Borneo (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000; Mann 2008; Myers 2009; Phillips & Phillips 2009; Dutson 2011). There is a recent record from the Cocos (Keeling) Group (P. Jones *in litt.*).

Sharp-tailed Sandpiper *Calidris acuminata*

Vagrant. Four sets of records. Up to five were seen by D. Merton at the South Point slurry ponds and the Airport on 4 days between 15 October and 26 November 1978 (Stokes *et al.* 1987). One was seen at the quarry near the Airport between 19 and 26 November 1998 (A. Richards pers. comm.). One was seen at the Airport on three occasions in mid November 1999, and six were at this locality on 18 November 1999 (Carter 2000b). At least one was found at the LB3 ponds on 28 November 2010 (Baxter 2010b). One was seen at the Airport on 10 December 2010 (James 2010).

This Palaearctic migrant reaches the Greater Sundas rarely and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Curlew Sandpiper *Calidris ferruginea*

Vagrant. Six sets of records. Up to five were seen by D. Merton and J. Tranter at the

Airport and the South Point slurry ponds on 10 days between 23 September and 12 November 1978 (Stokes *et al.* 1987). A specimen in the WAM (WAM A.26543) is dated as 1 December 1988. Five Curlew Sandpipers were photographed by Z. Hassan at the Airport on 18 November 1999 (Carter 2000b). One adult in non-breeding plumage was seen by DJJ at the LB3 ponds on 30–31 March 2005 (Anon. 2005c). Two were seen at South Point on 14 October 2010 (L. Preston *in litt.*). One was found dead by J. Woinarski at Flying Fish Cove on 2 October 2011 (specimen seen in PANCI freezer by IAWM).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Red-necked Phalarope *Phalaropus lobatus*

Vagrant. One record. One was seen swimming off Smith Point by a Peregrine Tours group on 8 December 2002, and later being chased by Christmas Island Frigatebirds (Anon. 2003; Doughty 2003).

This Palaearctic migrant migrates and winters mainly at sea, and reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Oriental Pratincole *Glareola maldivarum*

Rare irregular passage migrant. Four sets of records before 1990. An immature female was collected by C.W. Andrews on 3 October 1897 (Sharpe 1900). A female was collected for the Raffles Museum by their Dayak collectors on 8 November 1923 (ZRC 3.03494; Chasen & Kloss 1924; Morioka & Yang 1996). D. Merton saw two at the South Point slurry ponds on 31 October 1978 and 53 at the Airport on 6 November 1978 (Stokes *et al.* 1987). A flock of 37 was seen by D. Phillips at the Airport on 19–20 November 1988 (ANPWS file, Parks Office). Since 1990, the species has been recorded on at least 27 occasions, though some of these may have been sightings of the same individuals (Andrew 1996a; Barkla 1996; Harvey 1996; Hobcroft 1996, 2007; Carter 2001, 2007; Holmes 2002; Barrand & Barrand 2003, 2007; Johnstone & Darnell 2004a; Anon. 2007b; Ramsay 2007a; Baxter 2008b, 2009, 2010b, 2011b, 2013; Barrand *c.* 2009, *c.* 2011; K. Coate *in litt.*; J. Adams pers. comm.; R. Baxter pers. comm.; DJJ). It is recorded in most, though not all, years. Records are from two distinct periods of the year, 3 October to 9 December and 9 March to 23 April, coinciding with the southward and northward migrations, respectively. Most reports are from mid November to early December. Small flocks are often seen, usually ranging from 5 to 25 birds, though singles are also reported. On 9 March 2007, an exceptional flock of 500 was noted in flight at the Airport, and 310 were counted on the ground shortly afterwards; these sightings followed Cyclone Jacob, which came within 250 km to the south of the Island on 8 March (see Anon. 2007b; Carter 2007; Ramsay 2007a; BOM 2013). Sightings have been made near cleared areas, including the Airport, Sports Ground, Rubbish Tip, Settlement, quarries and car parks. On 1 December 2009, a flock of nine was observed approaching South Point over the ocean (Barrand *c.* 2009).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Australian Pratincole *Stiltia isabella*

Vagrant. About nine sets of records. Around 30 birds were recorded by G.F. Mees at cleared land near South Point sometime between 5 June and 14 July 1961 (Voous 1964; Mees 1966). Two of these were collected in June for the WAM (WAM A.9271 and A.9272). One male and two females were collected by O. Oftedal on 1 October 1961 (Voous 1964). Three were seen by B. Bell at the Airport in mid August 1975 (Stokes *et al.* 1987). An immature was seen at the Blowholes on 25 May 1984 (Stokes *et al.* 1987). About 50 birds (immatures and adults) were seen at the Airport from 25 September to December 1984 (Stokes *et al.* 1987). Another 10 were seen there on 5 July 1985 (Stokes *et al.* 1987), and one in August 1990 (Johnstone & Darnell 2004a; K. Coate *in litt.*). One in the Settlement was photographed by P. Maberly and seen on several days by DJJ in mid May 2005. At the IDC site in 2005, DJJ saw five on 5 June, three on 6 July and six on 18 July. At the Airport in 2005, DJJ saw six on 9 August, four on 13 August, five on 4 September, three on 11 September and two on 18 September. At least four were present at the Airport from 19 July until at least early September 2011 (Anon. 2011d; Low 2011).

This short-distance migrant breeds in Australia, and is a regular winter visitor to New Guinea and Wallacea and an erratic visitor to the Greater Sundas (MacKinnon & Phillipps 1993; Higgins & Davies 1996; Coates & Bishop 1997).

Brown Skua *Stercorarius antarcticus*

Vagrant. One record. One of the subspecies *lonnbergi* was seen by N. Cheshire 52 nm south-south-east of Christmas Island at 11°22′S, 105°47′E on 7 September 1999 [N. Cheshire *in litt.*; an incorrect date was provided by Eades (1999) and Johnstone & Darnell (2004a)].

This species breeds on subantarctic islands and disperses north to around 25°N (Olsen & Larsson 1997). Vagrant birds have been recorded throughout the northern Indian Ocean.

Pomarine Jaeger *Stercorarius pomarinus*

Vagrant. One set of records. N. Cheshire saw a single bird in the EEZ at 13°39′S, 107°01′E on 12 April 1995, another just outside the EEZ at 16°S, 107°E on 17 April 1995, and one outside the EEZ at 11°40′S, 109°40′E on 18 October 1987 (Bourne 1996; N. Cheshire *in litt.*).

This Palaearctic migrant reaches the Greater Sundas and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Arctic Jaeger *Stercorarius parasiticus*

Vagrant. Two reports, but only one confirmed record. An immature was found on

Lily Beach Road on 5 January 1983, and died later that day (Stokes *et al.* 1987). It was measured and a written description taken, but was not preserved. Another small jaeger was found dead in mid 1979 (Stokes *et al.* 1987). Photographs were sent to several seabird experts, who thought that it was either an Arctic Jaeger or a Long-tailed Jaeger *S. longicaudus*.

This Palaearctic migrant reaches the Greater Sundas rarely and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Common Noddy *Anous stolidus pileatus*

Abundant breeding species (5500 breeding pairs). C.W. Andrews collected an adult male at Rocky Point on 15 November 1897 and an adult female at Flying Fish Cove the following day (Sharpe 1900). Andrews (1900) noted that this species bred on the sea-cliffs around the Island. Historical population estimates are listed in Table 3. Gibson-Hill (1947), Nelson (1972) and Stokes (1988, citing Stokes 1984) all estimated the population size at up to 5500 breeding pairs, though none provided any data.

Gibson-Hill (1947) described the Common Noddy as a breeding visitor, being plentiful during the breeding season from April to November, with a general exodus from December to March. Dunlop (1987) estimated the laying period to be concentrated between May and July, but also recorded a brooding bird on 1 April and considered the breeding cycle to finish in September. Reville (1989, 1993) considered that most members of the population are migratory and breed between April and September, but small numbers are sedentary and breed on the northern coast in November–March. At least the extent of the exodus apparently varies between years: often some birds are present year-round (Pearson 1966; Stokes 1988; DJJ), but birds were almost completely absent from January to April in 2011 (Carter 2011b; Clarke 2011b; IAWM), which was a *La Niña* year. Gibson-Hill (1947) recorded nest-sites only on ledges on the sea-cliffs, except for one nest found in a Pandan (probably *Pandanus christmatensis*) crown projecting over a sheltered beach. Pearson (1966, p. 68) reported nesting in trees at 'one or two places' on the shore terrace. Stokes (1988) recorded that there were few nests along the exposed coasts, such as Smithsons Bight and the north-eastern coast, but noted more nesting in forest trees on the terraces (for example, behind the Golf Course, at Ethel Beach and South Point) than on the cliffs. Pointing out the difference from Gibson-Hill's (1947) account, Stokes (1988) speculated that nesting in trees might be a recent habit for the Noddy on Christmas Island. During DJJ's time on the Island, Noddies nested in all these habitats, as well as in the crowns of Coconut Palms at the Golf Course. The latter habitat resource was not present during Gibson-Hill's time and apparently not exploited during Stokes's time. There are no data to indicate if this apparent expansion of nesting habitats within 70 years is associated with an increase in the population size or is merely a shift away from cliff sites.

Marine records: Two possible Common Noddies were seen at 9°36′S, 107°06′E by A.R. Louch on 7 February 1988 (Bourne 1989). In surveys in April 1995, N. Cheshire (*in litt.*) saw 100 feeding 20 nm east of the Island on 14 April and 100

feeding 20 nm east-north-east on 15 April. In surveys near the Island in September and October 1995, the only Noddies seen were 50+ noted at Flying Fish Cove on 29 September (N. Cheshire *in litt.*).

The Common Noddy is not listed as threatened under the EPBC Act or by the IUCN (2013), and there is no evidence of any decline in the Island population. The SSCSTE (1983) recorded that hunting was heavy and could wipe out the species, although hunting abated from 1977 (Stokes 1988) and has not occurred to any significant extent recently (DJJ). Stokes (1988) listed rats, cats, hunting and clearing of habitat as impacting on the species' numbers, but considered it to be still common. Few nests would be accessible to cats (DJJ). Black Rats are abundant in the cavities of some sections of the sea-cliffs (DJJ), so it is plausible that they have caused Noddies to favour nesting in trees and/or have reduced nesting success on cliffs, but there are no data available to assess this. There is no information about the effects of *El Niño* Southern Oscillation events on nesting success.

This polytypic species is pantropical, but only subspecies *pileatus* occurs in the Indian and western Pacific Oceans (Higgins & Davies 1996). However, Higgins & Davies (1996) stated that birds breeding from WA north to the Savu Sea, Indonesia, perhaps warrant subspecific separation, although the variation is very slight. The nearest breeding colonies are in the Cocos (Keeling) Group, Lari Larian off the south-eastern coast of Kalimantan, Gunung Api and Manuk in Eastern Indonesia, Layang-Layang in the Spratly Islands in the South China Sea, the Chagos Group, Ashmore Reef and islands off the WA coast (de Korte 1991; de Korte & Silvius 1994; Poole 1994; Johnstone & Storr 1998; Symens 1999; Johnstone & Darnell 2004b; Milton 2005; Clarke *et al.* 2011).

Lesser Noddy *Anous tenuirostris*

Vagrant. One set of records. Up to nine were found roosting on the phosphate-loading cantilevers in Flying Fish Cove by M. Carter and R. Baxter from 29 February to 8 March 2008 (Anon. 2008b; Baxter 2008a; Carter & Carter 2008; Dooley 2008b; Ramsay 2008c). Up to ten were noted there from 11 to 24 April 2008 (J.N. Dunlop pers. comm.; IOSG delegates pers. comm.; IAWM), with smaller numbers recorded through to 28 April 2008 (Carter *et al.* 2008).

This species breeds only in the tropical and subtropical Indian Ocean, the nearest locations being the Cocos (Keeling) Islands, Ashmore Reef (in small, irregular numbers), the Houtman Abrolhos Islands and the Chagos Group (Johnstone & Storr 1998; Symens 1999; Clarke *et al.* 2011; McAllan *et al.* in prep.). Records from the Java Sea in de Korte (1984, 1991) reverted to Black Noddy *A. minutus* without explanation in de Korte & Silvius (1994), and the Lesser Noddy was not recorded for Indonesia by Andrew (1992). The nominate subspecies breeds in the western Indian Ocean, and subspecies *melanops* breeds in the Houtman Abrolhos Islands (Higgins & Davies 1996; Bourne 1997). However, the validity of these subspecies has not been tested, and the subspecific identities of birds breeding closest to the west (Cocos) and the east (Ashmore) likewise have not been determined, so the identity of birds reaching Christmas Island is uncertain.

White Tern *Gygis alba*

Vagrant. Two records. An immature bird was observed by J.N. Dunlop over the ocean at Rocky Point on 10 January 1985 (Stokes *et al.* 1987). A White Tern was reported on a buoy in Flying Fish Cove *c.* 9–12 December 1995 (Andrew 1996a).

The breeding location nearest to Christmas Island is the Cocos (Keeling) Islands, where at least 2000 individuals nest on North Keeling Island and smaller numbers on the Southern Atoll (Stokes *et al.* 1984; Hopton 2006). This species is very rare in South-East Asia, including the Greater Sundas and Wallacea (MacKinnon & Phillipps 1993; Coates & Bishop 1997; Robson 2000), and also rare in northern Australia (Higgins & Davies 1996). MacKinnon & Phillipps (1993) erroneously stated that this species breeds on Christmas Island.

Bridled Tern *Onychoprion anaethetus*

Vagrant. One set of records. At least six birds were noted by IOSG delegates on a boat trip along the northern coast from Flying Fish Cove to North West Point on 19 April 2008 (Anon. 2008c; J.N. Dunlop, M. Le Corre & M. Orchard pers. comm.). Up to four were seen on mooring buoys off Smith Point, Flying Fish Cove and the Settlement from 20 to 24 April 2008 (IOSG delegates pers. comm.; IAWM).

This pantropical seabird has gaps in its distribution in the Atlantic, central Indian and eastern Pacific Oceans (Higgins & Davies 1996). The breeding locations nearest to the Island are islets off the southern coast of Java (de Korte 1991). There are large colonies in Indonesian waters and on Ashmore Reef and on islands off the WA coast (de Korte 1991; Johnstone & Storr 1998; Milton 2005; Clarke *et al.* 2011).

Sooty Tern *Onychoprion fuscata*

Rare visitor. Sooty Terns are rarely recorded from land and inshore waters, but apparently are regular in pelagic waters. One specimen collected by D. Powell (no recorded details) was registered at the AM on 14 November 1984 (AM O.58478; Stokes *et al.* 1987). One specimen in the WAM was collected on 21 December 1987 (WAM A.26479). One bird was seen in flight near the Settlement on 15 November 1999 (Carter 2000b). One was found by S. Comport at Silver City on 12 March 2004 but died overnight (bird sent to WAM). One seen by DJJ was perched on the coastal cliff near the Golf Course on 11 July 2004. One was seen by DJJ at Flying Fish Cove on 29 July 2005. One was found at the Airport on 2 February 2006, but later died (AM O.71276). More than three, including immature birds, were seen from shore by IOSG delegates at the Settlement on 22 April 2008 at the height of Cyclone Rosie (Anon. 2008c; C. Feare pers. comm.; IAWM). One immature bird hit a building at the IDC on 22 April 2008 and later died (J.N. Dunlop & M. Orchard pers. comm.). One was seen offshore from the Settlement on 10 February 2011 (Clarke 2011b).

Marine records: Large numbers were reported by the crew of the *Umitaka-maru* to the north-west of the Island in January 1963 (Ozawa *et al.* 1966), although Ozawa & Nakamura (1966) acknowledged that the crew had difficulties distinguishing

Sooty Terns from Common Noddies, and never recorded Common Noddies near Christmas Island. Sooty Terns were seen near Christmas Island on at least four occasions in October 1987 by observers aboard the RV *Franklin* (Dunlop *et al.* 1988a); N. Cheshire (*in litt.*) recorded Sooty Terns in the one-degree blocks centred on 10°S, 104°E and 12°S, 106°E in April 1995, and saw ~50 Sooty Terns south-south-east of the Island on 7 September 1999.

This marine species is pantropical (Higgins & Davies 1996). The breeding locations nearest to Christmas Island are the Cocos (Keeling) Islands, Ashmore and Cartier Reefs, the Houtman Abrolhos Islands, Lari Larian off the south-eastern coast of Kalimantan, Layang-Layang in the South China Sea, Gunung Api in the Banda Sea and the Chagos Group (Feare 1984; de Korte 1991; de Korte & Silvius 1994; Poole 1994; Burbidge *et al.* 1996; Symens 1999; Clarke *et al.* 2011).

Little Tern *Sternula albifrons*

Vagrant. One set of records. One was reported at Flying Fish Cove by T. Smith (1996) between 27 October and 1 November 1995, on 3–12 January 1996 by M. and J. Craig (Anon. 1996a; Craig 1996), and in mid January 1996 by K. Coate (*in litt.*). Two were recorded at Flying Fish Cove in mid April 1996 (K. Coate *in litt.*).

The Little Tern breeds from Europe east to the Middle East, eastern Asia and Australia (Olsen & Larsson 1995). There was a resident population breeding on Java and Bali in Indonesia, and there is a migrant population from eastern Asia (MacKinnon & Phillipps 1993; Wells 1999), suggesting that more than one subspecies is involved, as in Australia. However, de Korte (1991) noted that there have been no recent breeding records of this species from Indonesia. The origin of the birds reported from Christmas Island is unknown.

Gull-billed Tern *Gelochelidon nilotica*

Vagrant. Two sets of records. N. Cheshire photographed one perched on a mooring buoy in Flying Fish Cove on 29 September 1995 (Eades 1995; Andrew 1996a; Bourne 1996; Johnstone & Darnell 2004a). One was seen by DJJ in 2004 at the Airport on 19 and 25 September and 16 October and then at Drumsite on 18 and 23 October. This was an adult of the Asian subspecies *affinis* in non-breeding plumage.

Subspecies *affinis* breeds widely in Asia south to eastern India and southern China, and moderate numbers regularly winter in western and northern Australia (Robson 2000; Rogers *et al.* 2005). Nominate *nilotica* breeds in northern Eurasia and migrates at least as far south as northern mainland South-East Asia (Robson 2000).

Whiskered Tern *Chlidonias hybrida*

Rare irregular visitor. About 17 sets of records. D. Powell collected a specimen, without recording a date or locality. Stokes *et al.* (1987) stated that this was sent to the AM and registered as AM O.58479. However, that number refers to another

species from a different locality. Presumably Powell's specimen is AM O.67055, which is a Whiskered Tern that was presented by T. Stokes. This juvenile female was registered in 1996, but was freeze-dried, a method used at the AM only during the mid 1980s. Seven birds were seen by D. Merton at the Airport on 23 September 1978 (Stokes *et al.* 1987). Since 1990, there have been at least 15 records scattered through the year, without seasonal pattern (Harvey 1996; Hobcroft 1996; Holmes 2002; Johnstone & Darnell 2004a; Dooley 2009b; Ramsay 2009b; Anon. 2011c; K. Coate *in litt.*; M. Rogers *in litt.*; J. Wieneke *in litt.*; P. Kelly pers. comm.; L. Preston pers. comm.; DJJ; IAWM), mostly at Flying Fish Cove and Smith Point, with single sets of records at Isabel Beach, the Airport, LB3 ponds and near Stronach Hill. They were mostly single birds, but occasionally two or three. Most of the few birds that were aged were adults (DJJ), but an immature barely out of juvenile plumage and an adult in moult were photographed at a temporary pond near Stronach Hill on 26 May 2011 (N. Hamilton *in litt.*).

This is an Old World species, found in Africa, southern Europe, and east to eastern Asia and Australia (Olsen & Larsson 1995). The nominate subspecies breeds in Africa, Europe and Asia, whereas subspecies *javanicus* breeds in Australia and New Guinea. Records from the Greater Sundas and western Wallacea are of wintering birds of both subspecies (Mees 1977; White & Bruce 1986). The breeding locations nearest to Christmas Island are in north-eastern India, southern China, and Australia. Christmas Island records could be of either or both subspecies.

White-winged Black Tern *Chlidonias leucopterus*

Vagrant. Six records. One was seen by DJJ at Flying Fish Cove on 19 April 2003. One was seen during Birdweek in September 2007 (J.N. Dunlop pers. comm.). One was seen by IAWM at the Airport on 11 April 2008, and one was seen on a mooring buoy by J.N. Dunlop, M. Le Corre and M. Orchard (pers. comm.) in Flying Fish Cove on 19 April 2008 (Anon. 2008c). One was seen by a tour group at Flying Fish Cove on 5 December 2009 (Baxter 2009), and one was seen there on 8–9 January 2010 (Carter 2010b).

This monotypic species is a Palaearctic migrant that winters south to Africa, southern Asia and Australasia (Higgins & Davies 1996). The birds recorded on Christmas Island appear to be passage migrants.

Common Tern *Sterna hirundo*

Vagrant. Six records. One was seen at Flying Fish Cove on 9 January 1996 (Anon. 1996a; Craig 1996). Two were seen at Flying Fish Cove on 2 May 1996 (T. Palliser pers. comm.). One was seen at the cantilevers in Flying Fish Cove on 14 and 19 November 1999 (Carter 2000b). One was seen in the Settlement on 26 April 2000 (Smith 2000; K. Coate *in litt.*). One was reported in December 2000 by a Coate's Wildlife Tours group (Johnstone & Darnell 2004a). One was seen at Flying Fish Cove on 7 December 2001 (Clarke 2001).

This Palaearctic migrant reaches the Greater Sundas irregularly and Australia regularly (MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Lesser Crested Tern *Thalasseus bengalensis*

Vagrant. Five records. One was seen by R. Downes at Flying Fish Cove on 22 November 2000 (Downes 2001); a barely adequate description was given. One was found by P. Whittington and IAWM at Flying Fish Cove on 23–24 April 2008, following Cyclone Rosie. It was observed and photographed on 26–27 April by T. Palliser, M. Carter and F. O'Connor (pers. comm.). It was extremely pale and was at one point suggested to be an Elegant Tern *T. elegans* (Anon. 2008c; Dooley 2008c; M. Carter *in litt.*). However, the plumage patterns and coloration fit the nominate subspecies of Lesser Crested Tern endemic to South Asia and found east to Singapore (specimens examined at the ZRC: IAWM). R. Baxter (*in litt.*) photographed one in non-breeding plumage at Waterfall Cove in late November or early December 2010. One was photographed at buoys off Smith Point in late December 2011 (L. Preston pers. comm.). Two were reported without any details being noted in early December 2013 (Baxter 2013). The nominate subspecies is considerably paler than the Crested Tern *T. bergii*, whereas the Australasian subspecies *T. bengalensis torresii* is only slightly paler.

This marine and mostly tropical species breeds widely from the Mediterranean to Africa and India, with a large break in breeding distribution to the Australasian subspecies (see Higgins & Davies 1996). The nominate subspecies is a common winter visitor to the Greater Sundas (MacKinnon & Phillipps 1993) and is abundant in the Java Sea during the austral summer (DJJ), but there are no other reports from Australian territory, though it is likely that birds observed at the Cocos (Keeling) Group in December 2011 are also this subspecies (M. Roderick pers. comm.).

Crested Tern *Thalasseus bergii*

Vagrant. Three records. A specimen in the WAM was collected supposedly by B. Reville on 9 July 1987 (WAM A.21490). A single immature Crested Tern was photographed in August 1990 (Johnstone & Darnell 2004a; K. Coate *in litt.*). One was seen by DJJ at Flying Fish Cove on 7 May 2005.

This marine species breeds over a large area along the coasts and offshore islands of the Indo-Pacific and is common in Australia and Indonesia (de Korte 1991; MacKinnon & Phillipps 1993; Higgins & Davies 1996).

Mew Gull *Larus canus*

Vagrant. One record. One was seen and photographed by K. Shurcliff and D. Houghton near the Airport from 25 to 29 March 2001 (BARC Case 315). It was in either second-year or adult plumage, and was most likely the subspecies *kamchatchensis* (Eades 2001b; Palliser 2003; Johnstone & Darnell 2004a).

There are no records of this Holarctic species from South-East Asia, including the Greater Sundas, Wallacea and the Philippines (Andrew 1992; MacKinnon & Phillipps 1993; Coates & Bishop 1997; Kennedy *et al.* 2000; Robson 2000). The Mew Gull has not been recorded elsewhere in Australian territory (Christidis & Boles 2008).

Asian Koel *Eudynamys scolopaceus*

Rare regular visitor or resident. More than 35 records, four confirmed by BARC; all records are since 2002. A 'koel' was heard calling by P. Green (pers. comm.) in one of the settled areas in about September 2002. A single male 'koel' was recorded at Territory Day Park and the Parks Office by S. Pell and B. Bucholtz between 27 November and 4 December 2003, and was heard by M. Orchard in this area over a slightly longer period (Anon. 2004a,b; M. Orchard pers. comm.). A first-winter male photographed by DJJ at the Parks Office on 14–15 July 2004 was the first record identified as Asian Koel (Palliser 2007; BARC Case 436). A pair was seen by DJJ at Rocky Point on 10, 22 and 31 August 2004, after reports by locals of calling birds (BARC Case 635). Another pair was recorded regularly (16 observations) by DJJ in Silver City from 18 August to 20 December 2004 (Palliser & Carter 2012; BARC Case 635). From late 2004 to 2012, pairs and single birds were reported regularly in the Settlement and Silver City (and once in Poon Saan) by numerous observers, tour parties and local residents (Carter 2004, 2010b, 2011b; Anon. 2005a,b, 2011a; Barrand 2005b, *c*. 2011; Hobcroft 2005, 2007; Barrand & Barrand 2007; Dooley 2008a, 2010a,c; Baxter 2009, 2010b, 2011a,b, 2013, *in litt.*; Eaw & Dooley 2010; James 2010; Ramsay 2010a,b, 2011a; Low 2011; Palliser & Carter 2012; N. Hamilton *in litt.*; L. Preston pers. comm.; DJJ; IAWM; BARC Cases 637 & 643). In December 2010, the simultaneous presence of different pairs at Rocky Point and Silver City was confirmed (James 2010). Records are from all months of the year, but are more frequent from August to January, when pairs are calling in the Settlement and Silver City. Away from the urban areas, koels have been reported near the Dales on 23 September 2006 (heard only—M. Holdsworth pers. comm.), the Rubbish Tip twice (Barrand 2005b; Anon. 2006c; Dooley 2007c; Ramsay 2007b; G. Roberts *in litt.*; DJJ), Waterfall Cove on 29 February 2008 (heard only—Carter & Carter 2008), and the Chinese Cemetery three times (Barrand *c*. 2011; Baxter 2011a; IAWM). Many sightings of Asian Koels are made in or near the figs *Ficus saxophila* and Pawpaw (L. Preston pers. comm.; DJJ; IAWM).

At least four first-winter males (with some retained juvenile plumage) have been recorded several times (Hobcroft 2007; cf. Dooley 2008a; DJJ; IAWM). One seemed to be paired with an adult female at Rocky Point in December 2010 (DJJ). There have been two records of juveniles: one seen by DJJ at the Parks Office in October 2006, and one seen by DJJ & IAWM at Silver City in December 2010 and January 2011 (see also photograph in Baxter 2010b). On 6 January 2011, this last juvenile was associating with a pair of adults that seemed to be maintaining a territory there, as they had done for several years. It is unlikely that this juvenile migrated to the Island and was accepted by the calling pair in Silver City. Given this, and the apparent influx of the species, its regularity, pairing, calling and territoriality, it seems highly probable that the Asian Koel now breeds on Christmas Island. The only potential host of this obligate brood-parasite would be the Island Thrush.

This polytypic species is widespread in southern Asia, from India and southern China south to the Greater Sundas and Wallacea. It is generally considered that the northern subspecies *chinensis* is a winter visitor to southern mainland South-

East Asia and the Greater Sundas, and that subspecies *malayanus* is resident in the same areas (Wells 1999; Robson 2000; Dickinson 2003). To the contrary, apparently only *malayanus* is represented in the ZRC collection from mainland South-East Asia (DJJ). However, the Christmas Island koels appear more likely to be *chinensis* than *malayanus*. Firstly, Wells (1999) and Payne (2005) differentiated *malayanus* by its warm rufous tones in adult female plumage from *chinensis* with its colder dark and white tones. Females on Christmas Island are consistently cold-toned and lack rufous tones to the feathers (DJJ). Secondly, juvenile specimens of *malayanus* from Singapore, Malaysia and Vietnam (ZRC) have predominantly brown plumage (including remiges and rectrices) and a blackish head (DJJ). Conversely, two juveniles seen on the Island were black with fine white spots dorsally and white scaling on the vent, and four first-winter males had retained juvenile remiges and rectrices that were predominantly black (DJJ; IAWM). The only other records of this species from Australian territory are from the Cocos (Keeling) Islands, largely since 2007 (Palliser & Carter 2012) except for a possible sighting in November 1999 (McAllan *et al.* in prep.).

Horsfield's Bronze-Cuckoo *Chalcites basalis*

Vagrant. Two sets of records. An immature female was collected by C.W. Andrews in 1897 or 1898 (Sharpe 1900). An adult was seen at North East Point on 21 April 2008 (IAWM; see also Anon. 2008c). An immature bird was photographed at South Point on 26 April 2008 (T. Palliser pers. comm.).

This species breeds in Australia, and part of the population moves north in the austral winter to Wallacea and the Greater Sundas, rarely reaching Singapore (MacKinnon & Phillipps 1993; Higgins 1999; Wang & Hails 2007).

Pallid Cuckoo *Cacomantis pallidus*

Vagrant. Two records. One was observed by D. Powell and D. Merton near Migrant Hill on 20 October 1977 (Stokes *et al.* 1987). An immature that had been struck by a vehicle was found by H'ng Kim Chey on 28 December 1980 (WAM A.16947; Stokes *et al.* 1987).

This species breeds in Australia and is a vagrant to the Lesser Sundas and southern New Guinea (White & Bruce 1986; Coates & Bishop 1997; Higgins 1999). It is unknown from the Indomalayan Region proper (cf. Andrew 1992; MacKinnon & Phillipps 1993; Inskipp *et al.* 1996; Robson 2000).

Himalayan Cuckoo *Cuculus saturatus*

Rare regular passage migrant. Only one record before 1990. Previously considered to be the Oriental Cuckoo *C. optatus*, but see p. S118. Southward passage migrants from Asia reach the Island most years between mid October and mid December. Johnstone & Darnell (2004a) described it as a rare or casual visitor in October–January. One was seen by J. Lattin at the Settlement on 7 November 1982 (Stokes 1988). One was seen at the Airport on 29 October 1996 (Lester 1997). It was reported in singles and small flocks by at

least 12 visiting parties in most years since 2001 (Clarke 2001; Anon. 2002b, 2003, 2004b, 2005b, 2006c,d, 2007a; Barrand & Barrand 2003; Doughty 2003; Carter 2004; Barrand 2005b; Hobcroft 2005, 2006; Baxter 2010a,b; C. Surman pers. comm.; IAWM). DJJ saw five different (recognised by plumage and location) birds in November 2004, five in October–November 2005, and four in November 2006. The earliest date recorded was 17 October (in 2005) (DJJ) and, apart from a few in January and February 2010 (Baxter 2010a; Carter 2010b), the latest was 18 December (in 2006) (Hobcroft 2006), indicating that most records are from the southward passage migration. Most birds have been hepatic-morph females or juveniles, but a few grey-morph adults have been identified. Himalayan Cuckoos were mostly seen on the margins of secondary forests along roads and tracks, or at the Rubbish Tip. Other localities include Phosphate Hill, Irvine Hill, North West Point, the Dales Track, Winifred Beach Track, South Point, Pink House, Grants Well and Margaret Knoll. Several were noted eating the caterpillars of nymphalid butterflies (DJJ).

Payne (2005) and King (2005) recommended that the traditional Oriental Cuckoo *C. saturatus* (*sensu lato*) be treated as three separate species, the Oriental Cuckoo *C. optatus*, the Himalayan Cuckoo *C. saturatus* (*sensu stricto*) and the Sunda Cuckoo *C. lepidus*, mainly because of differences in vocalisations. Christidis & Boles (2008) accepted this taxonomy although Erritzoe *et al*. (2012) continued to consider *saturatus* and *optatus* the one species. Mainland Australian records are all of *optatus*, with the exception of two specimens whose measurements indicate they might be *saturatus* (Rogers in Higgins 1999). The proportion of *saturatus* versus *optatus* increases from east to west across Indonesia (Cramp 1985); *optatus* is virtually the only form in Micronesia and the most common form in Wallacea; the two are equally common in Borneo, Java and perhaps the Philippines; and *saturatus* is common in Sumatra where *optatus* is almost unknown (Cramp 1985; van Marle & Voous 1988; Higgins 1999; Kennedy *et al*. 2000; Payne 2005; Phillipps & Phillipps 2009). *C. optatus* also migrates earlier than *C. saturatus*, moving through the Philippines, Wallacea and New Guinea from early September onwards (Higgins 1999); and large numbers of (evidently) *optatus* move past Ashmore Reef in September and October (M. Carter pers. comm.; DJJ). Conversely, *C. saturatus* migrates through the Malay Peninsula in October and November, to winter in Sumatra and Java from November to February (van Marle & Voous 1988; Higgins 1999; Wells 1999). We consider the Christmas Island records likely to be *saturatus* (cf. Johnstone & Darnell 2004a) that have overshot their wintering destination in Sumatra, based on the location of the Island south of Sumatra and the late timing of their appearance. Since the birds do not call on Christmas Island, measurements or specimens would be desirable. *C. saturatus* has not been confirmed elsewhere in Australian territory, but vagrant 'Oriental Cuckoos' in the Cocos (Keeling) Islands are also likely to be *saturatus*.

Large Hawk-Cuckoo *Hierococcyx sparverioides*

Vagrant. One record. A first-year bird was seen by DJJ and IAWM at the Rubbish Tip on 15 December 2005 (McAllan & James 2008; see also Anon. 2006c; Dooley 2006a; Palliser 2008; BARC Case 494).

This species breeds from the Himalayas to eastern China, and south to northern Myanmar, Thailand and Indochina (Payne 2005). It winters south to the Greater and Lesser Sunda Islands and is an uncommon winter (i.e. austral summer) visitor to Java (MacKinnon & Phillipps 1993; Payne 2005). The only other records from Australian territory are several sightings from the Cocos (Keeling) Islands since December 2010 (Baxter 2010b, 2011a,b; Barrand *c.* 2011; Carter 2011a; Clarke 2011a; Anon. 2012a; Dooley 2012a; P. Jones pers. comm.).

Christmas Island Hawk-Owl *Ninox natalis* [Figure 23 (p. S58)]

Common endemic species (562 ± 105 breeding pairs). The first record of the Christmas Island Hawk-Owl was the collection of the holotype, an adult male, by J.J. Lister in October 1887 (Lister 1889; Warren 1966). Van Tets (1975) guessed the population to be in the order of 10–100 pairs, and Stokes (1988) and Olsen & Stokes (1989) guessed it to be ~100 pairs. Using data from radio-tracking, territory mapping and census by playback of calls, Hill & Lill (1998a) found that Hawk-Owls were uniformly distributed through primary evergreen and semi-deciduous rainforests at a density of 5.5 ± 1.0 territories per km^2, and a much lower density in secondary vegetation, which translated to a population estimate of 562 ± 105 breeding pairs. Low & Hamilton (2013) undertook a playback census limited to roads over 20 nights in mid 2011. They recorded 32 individuals at 22 sites although it is not clear how many sites they surveyed in total. They suggested that the total population was within the range estimated by van Tets (1975) and Stokes (1988) of 10–100 pairs. While acknowledging certain survey limitations, Low & Hamilton (2013) recommended urgent, more extensive surveys. PANCI conducted nocturnal listening surveys using a methodology similar to that of James & Retallick (2007) except that they were nocturnal. These were repeated four times each year at ~105 sites in 2006, 2012 and 2013, and had reporting rates that indicated that the population was stable (DNP 2014; J. Woinarski pers. comm.; DJJ). Although 20 years old, the population estimate of Hill & Lill (1998a) still appears to be the most accurate available.

The Christmas Island Hawk-Owl occurs in all evergreen and semi-deciduous forests on the coastal and inland terraces and the plateau, suburban gardens and some secondary forests (Hill & Lill 1998a; Hill 2000; DJJ). Hill & Lill (1998a) assumed that densities are lower in modified and disturbed habitats. Only four nests have been located, three by J. Young (Hill & Lill 1998a) and one by DJJ in 2004. All were in hollows in large emergent *Syzygium nervosum*, three on the inland plateau and one on the coastal terrace. However, the Hawk-Owl maintains territories in locations without this tree species, so presumably nests in the hollows of other tree species (Hill 2000), and the possibility that the availability of this tree limits the population (Hill 2000, 2004b) seems unlikely (DJJ). The breeding season has not been determined accurately as only a few nests have been recorded, but signs of breeding have been recorded in all seasons of the year (Higgins 1999). Hill & Lill (1998b) analysed the characteristics of roost-sites in some detail.

The diet consists primarily of large arthropods (crickets, grasshoppers, mantids, cockroaches, cicadas, moths and spiders), supplemented with small vertebrates [geckoes, skinks, rats and small birds (Christmas Island White-eyes)] (Gibson-

Hill 1947; Kent & Boles 1984; Phillips *et al*. 1991; Hill & Lill 1998b). This includes introduced and indigenous species (Kent & Boles 1984). Higgins (1999) listed the endemic Christmas Island Pipistrelle in the diet, but this was only speculative (cf. Olsen & Stokes 1989). Observed foraging strategies include snatching prey from foliage in the understorey, perch-hunting around clearings, and sallying for moths at street-lights (Olsen & Stokes 1989; Hill & Lill 1998a; DJJ).

This species is listed as globally Vulnerable, as it has a single small population restricted to one location (IUCN 2013). It is also listed as Vulnerable under the EPBC Act and by Garnett *et al*. (2011). Hill & Lill (1998a) and Hill (2000, 2004b) listed the main threat as introduced diseases, but this is speculative. Hill (2000) listed predation by feral cats and death from vehicle collisions as potential threats, but concluded that neither was significant in the mid 1990s. Fortunately, predictions that Yellow Crazy Ants could cause a severe population decline (in this case by swarming nest-sites and killing chicks: Garnett & Crowley 2000; Hill 2004b) have so far not eventuated. Impacts of habitat modification by weeds and Yellow Crazy Ants have been flagged (Hill 2004b), but not assessed. Other potential threats, such as attacks by feral bees or centipedes and the recent loss of prey such as endemic geckoes and skinks have not been considered. It has been deduced that the clearing of 25% of the Island led to a population reduction of 25% and proportionately increased the species' vulnerability to extinction (Hill 2000). However, some breeding pairs have large parts of their territory in secondary growth and urban habitats (Hill & Lill 1998a; DJJ). It is also likely that secondary growth unsuitable for breeding provides refuge for fledged juveniles, increasing their survival, which in turn provides some resilience in the population dynamics.

Some taxonomic issues are discussed in Taxonomy (p. S22).

Common Kingfisher *Alcedo atthis*

Vagrant. Five records, four confirmed. A single bird was reported on at least four occasions at Andersons Dale by J. Barkla and C. Lester from 30 October to 1 November 1996 (Barkla 1996; Eades 1997a; Lester 1997). Although it was seen well, no description has been published or submitted to BARC. One was seen by DJJ at Flying Fish Cove on 11 September 2002, and observed at close range for 25 minutes (Stafford 2002b; Palliser 2004; BARC Case 364). It was probably a juvenile female of the subspecies *bengalensis*. One was seen at Waterfall Cove on 5–7 May 2006 (Anon. 2006b,e; Baxter 2006; Dooley 2006c; Palliser 2008; BARC Case 486). One, probably an adult female, was photographed on a rock on the eastern side of Flying Fish Cove on 7 December 2006 (Rogers 2006; Anon. 2007a,c; Dooley 2007a; Palliser 2009; BARC Case 523). A juvenile was seen and photographed as it fed at an ornamental pond at Drumsite on 13–14 September 2008 (Dooley 2008d; R. Stephenson, K. Retallick, M. Orchard & L. Preston pers. comm.; Anon. 2008d; Ramsay 2008e). Widely circulated photographs confirmed the identification. These are the only records from Australian territory.

This species is widespread in Eurasia and its geographical variation is subtle, with many subspecies recognised (Cramp 1985; Fry & Fry 1992). The Common Kingfishers seen in 2002 and 2008 were possibly the subspecies *bengalensis*,

which breeds in southern and eastern Asia and winters south to the Greater Sundas and Wallacea (Fry & Fry 1992). This subspecies lays as early as January, and this is consistent with the worn juvenile plumage noted in September; the more northern subspecies lays from April onwards.

Sacred Kingfisher *Todiramphus sanctus*

Vagrant. About nine records. A live bird was found on the road at night at Smith Point on 14 May 1984 (Stokes *et al.* 1987). It was photographed, banded and released. An unidentified kingfisher seen in front of Tai Jin House on 12 and 16 April 1984 may have been this species (Stokes *et al.* 1987). A pair was seen in front of the (mine) General Manager's Residence at Rocky Point on 9 June 1985 (Stokes *et al.* 1987). One was seen by DJJ at Norris Point on 7 February 2002. One bird was seen in the Settlement in about March or April 2004 (C. Surman pers. comm.). One was picked up off a driveway and released by J. Hueston (pers. comm.) in the Settlement in mid 2004. One was seen by numerous observers, including two tour groups, at the eastern end of the Settlement and at the Chinese Cemetery in late November and early December 2004 (Carter 2004; Anon. 2005b; R. Baxter *in litt.*; DJJ). One was photographed by P. Maberly at the Settlement in mid April 2005 (identity confirmed by DJJ & IAWM). One was seen at Ethel Beach on 17 December 2006 (Hobcroft 2006; Anon. 2007a,c). One was reported by a tour group near the Resort entrance in November 2008 (R. Baxter *in litt.*).

This species breeds in Australia, New Zealand and several south-western Pacific Islands. Nominate *sanctus* from Australia is a widespread non-breeding visitor to the Greater Sundas, Wallacea, New Guinea and the Bismarck and Solomon Islands (Higgins 1999).

Collared Kingfisher *Todiramphus chloris*

Vagrant. Up to seven reports, but only two confirmed records. Single birds were seen by A.J. Pearson on 8 May, 6 June and 20 September 1962 and on 26 September 1963 (Pearson 1966). Van Tets (1974a) listed it as a rare visitor. Johnstone & Darnell (2004a) listed a record for 22 October 1977 that we have been unable to trace. One was seen by D. Merton at Lily Beach on 7 September 1978 (Stokes *et al.* 1987). Higgins (1999), followed by Johnstone & Darnell (2004a), erroneously listed this record as April 1978. One bird seen by a tour group and photographed in the Settlement on 7 May 2006 (Baxter 2006; R. Baxter *in litt.*) looked like an Asian form of Collared Kingfisher, but responded to call-playback with a call sounding like that of a Sacred Kingfisher, so its identification has been questioned. However, Collared Kingfishers in Singapore (subspecies *humii*) have one call that is virtually identical to the common *kek kek kek*... call of the Sacred Kingfisher and readily respond to playback of Sacred Kingfisher calls (DJJ; IAWM), so this record can be accepted as Collared Kingfisher. One bird, photographed by L. Preston (pers. comm.) at the Settlement on 24 May 2009, was not identified to subspecies level, but was not one of the Australian subspecies (Anon. 2009c; details confirmed by J. Davies & M. Carter). One was supposedly photographed by a local observer at Flying Fish Cove in the period June–September 2011 (N. Hamilton *in litt.*). As

several of the records lack details, they may have been of the Sacred Kingfisher, which may not have been adequately considered (Johnstone & Darnell 2004a).

The Collared Kingfisher is widespread, with numerous subspecies scattered from the Red Sea through South and South-East Asia to Australia and the Pacific east to Samoa (Fry & Fry 1992). Christmas Island birds are likely to be from South-East Asia and most likely subspecies *humii*, but possibly the inland *armstrongi* (Fry & Fry 1992; Robson 2000; cf. Wells 1999). The taxonomy of this complex is in disarray, with widely differing opinions, but few data in the literature, and there could be several species included under this name. The relationships between *T. sanctus, T. c. humii* and Australian subspecies of *T. chloris* require inspection.

Dollarbird *Eurystomus orientalis*

Vagrant. Five sets of records. One was seen by A.J. Pearson on the north-eastern coast from 28 January to 2 February 1963 (Pearson 1966). One was seen on three occasions south-east of the LB4 Lookout from 28 December 1996 to 3 January 1997 (Anon. 1997b; Farnes 1997; Higgins 1999). One was seen near the corner of Murray Road and the East West Baseline on several days in March 2007 (Anon. 2007b; Baxter 2007; M. Holdsworth pers. comm.). One was seen 1.5 km west of LB3 along the East West Baseline in early December 2011 (M. Roderick pers. comm.). One, considered to be the 'Asian race *abundus*' and possibly the same bird, was seen in Poon Saan on 7 December 2011 (Barrand *c.* 2011). One (of an Asian subspecies) was found in the Airport car park by P. Kyne and M. Jackson at dusk on 24 November 2012, but could not be relocated the next day (James 2012).

This polytypic and highly migratory species is widespread from southern and eastern Asia to New Guinea and Australia. Fry & Fry (1992) recognised nine subspecies, of which three are widespread migrants and six are insular endemics. Subspecies *pacificus* breeds in Australia and the Lesser Sundas and migrates north to New Guinea and Wallacea for the austral winter; nominate *orientalis* breeds in eastern Asia to mainland South-East Asia, with migratory and sedentary populations; subspecies *calonyx* (of which *abundus* is a synonym—see Fry 2001) breeds in north-eastern Asia and migrates to mainland South-East Asia and the Greater Sundas in the boreal winter. The insular subspecies are generally sedentary (Fry & Fry 1992; MacKinnon & Phillipps 1993; Coates & Bishop 1997; Higgins 1999; Wells 1999; Robson 2000). The exact distributions are confused and the situation is not helped by apparent intergradations of *orientalis* with both *pacificus* and *calonyx*. Any of *orientalis*, *calonyx* or *pacificus* may reach Christmas Island, but birds consistently appear different from Australian *pacificus*. Only *pacificus* has been confirmed in Australian territory (Higgins 1999), but several of the numerous records from the Cocos (Keeling) Islands (e.g. Moorhead 2008; D. Hadden *in litt.*; D. Hobcroft *in litt.*; DJJ; IAWM) were not *pacificus* and resembled *calonyx*. The subspecies *calonyx* is more common than *orientalis* as a migrant crossing from the Malay Peninsula to Sumatra (Wells 1999), and is perhaps more likely to reach Christmas Island. Species boundaries in the complex deserve more attention. A pair of nominate *orientalis* courtship-feeding in Singapore in January 2012 had quite different calls from *pacificus* from Australia, and did not respond to playback of *pacificus* calls (DJJ).

Fairy Pitta *Pitta nympha*

Vagrant. One record. One foraging 50 m before the end of Winifred Beach Track was videotaped on 11 November 2012 (Graff 2013; Watson 2013; B. Moloney & T. Detto *in litt*.; BARC Case 769). This is the second Australian record, the first being at Derby, WA, in December 2007 (BARC Case 748).

This species breeds in eastern China, Taiwan, South Korea, and southern Japan. It winters in southern China, Laos, Vietnam and Borneo, where it is nevertheless rare (MacKinnon & Phillipps 1993; Robson 2000; Dickinson 2003; Brazil 2009).

Blue-winged Pitta *Pitta moluccensis*

Vagrant. Two records. A specimen in the CUMZ was collected by H.E. Durham on 14 December 1901 (specimen 27/Pit/1/r/1; Benson 1970); Benson identified the subspecies as nominate *moluccensis*. A Blue-winged Pitta was found dead floating on the ocean near Thundercliff Cave on the north-western coast on 25 February 2010 (Anon. 2010b; R. Baxter 2010a; Dooley 2010a; Ramsay 2010b; specimen now in AM, W. Boles pers. comm.). There are four other records of vagrants to Australia, all in WA (Johnstone & Hamilton 1995; also BARC Case 219).

This species is not known from Java immediately to the north, though it is considered a regular visitor in the boreal winter to southern mainland South-East Asia and Sumatra, and is occasionally reported from Borneo (van Marle & Voous 1988; Wilkinson *et al.* 1991; Andrew 1992; Holmes 1997; Robson 2000).

White-bellied Cuckoo-shrike *Coracina papuensis*

Vagrant. One record. One was seen by DJJ near the Old Chinese Cemetery on Quarry Road at Phosphate Hill on 8 June 2005.

This species is found in Australia, New Guinea, the Bismarck and Solomon Islands and the Moluccas, but is unknown in the Indomalayan Region proper (Andrew 1992; Higgins *et al.* 2006). White-bellied Cuckoo-shrikes recorded sporadically in the Lesser Sunda Islands west to near Timor appear to be vagrants of the northern Australian subspecies *hypoleuca* (cf. White & Bruce 1986).

Brown Shrike *Lanius cristatus*

Vagrant. Seven reports, but only three confirmed records. One was seen by A.J. Pearson on 7 April 1962 (Pearson 1966). No details were provided, and the record is not usually considered to be substantiated (e.g. Christidis & Boles 1994) though, given the later records, it was probably valid. One was seen by J. & B. Watson, R. Farnes, P. Lansley and P. Milburn in thick vegetation opposite the Golf Course from 28 December 1996 to 3 January 1997 (Anon. 1997b; Eades 1997a; Lansley 1997; Lansley *et al.* 2003; BARC Case 299). One adult, believed to be the same bird, was seen at the same location on 16 March 1997 (Anon. 1997c; Maher 1997; Lansley *et al.* 2003). One was seen by A. Richards and Reg Clark on 20 and 22 November 1998 near 'phosphate mining buildings' (Anon. 1999a; Palliser 2000; BARC Case 260). This record was erroneously listed as December 1998 by Johnstone & Darnell (2004a). One was seen in Silver City on 24–27 April

2000 (Anon. 2000b; Coate 2000; Smith 2000; K. Coate *in litt.*). It was thought to be either subspecies *confusus* or *lucionensis* (Smith 2000), but no substantiating details were provided. One was reported by E. Ervasti and G. Lindstrom at the High School in Drumsite on 4 March 2001 (Robson 2001). One was seen by Rohan Clarke at Poon Saan on 12–13 December 2001 (Anon. 2002b; Stafford 2002a; Palliser 2003; BARC Case 329). The rufous coloration on the back and rump and a large pale area on the forehead suggest that it was most likely the subspecies *superciliosus*, which winters south to Sumatra, Java and the Lesser Sundas (Lefranc & Worfolk 1997; BARC Case 329).

This polytypic species breeds in North-East Asia, south to southern China, and winters in India, Sri Lanka, southern and coastal China, and South-East Asia (Lefranc & Worfolk 1997). All four subspecies reach the Greater Sundas. These were the only records from Australian territory until a sight record of subspecies *lucionensis* from Ashmore Reef in November 2011 (Dooley 2012a; R. Clarke pers. comm.).

Tiger Shrike *Lanius tigrinus*

Vagrant. One record. A female Tiger Shrike was found by J. Pridham (pers. comm.) at North East Point on 23 April 2008 and seen by numerous others on the same day and through to 28 April (Anon. 2008c; Carter *et al.* 2008; Dooley 2008c; Ramsay 2008c; Palliser 2009; IOSG delegates pers. comm.; IAWM; BARC Case 562). Another shrike with a reddish-brown back, possibly this species, was briefly seen at the Rubbish Tip on 23 April 2008 (P. Whittington pers. comm.). These observations followed Cyclone Rosie, so the birds were probably blown to the Island from near-coastal Sumatra.

This species breeds in eastern China, south-eastern Siberia, Korea and Japan, and winters in southern China and South-East Asia (Coates & Bishop 1997; Lefranc & Worfolk 1997). This was the first live record for Australia; one found road-killed near Fremantle, WA, may have been ship-assisted (Christidis & Boles 2008). Since the 2008 observations, there has been a report in April 2010 of the same individual at Browse Island in the Kimberley, and at Ashmore Reef (Anon. 2010c; BARC Case 792), and several reports from the Cocos (Keeling) Islands from November 2012 to February 2013 (Graff 2013; Watson 2013; G. Christie, P. Jones, J. Weigel & B. Moorehead *in litt.*).

Oriental Reed-Warbler *Acrocephalus orientalis*

Vagrant. Two records. One was seen and heard at close range by a tour group led by C. Doughty at the Settlement on 4, 8 and 9 December 2002 (Anon. 2003; Doughty 2003). A single bird was found by L. Preston (pers. comm.) at the entrance to the Resort in early January 2011. It was photographed and its call taped by several birders through to early March 2011 (Baxter 2011a; Carter 2011b; Marsh 2011; L. Preston pers. comm.; DJJ; IAWM).

This Palaearctic migrant breeds in south-eastern Siberia, northern and central China, Korea and Japan, and migrates south to winter in eastern India and South-

East Asia, with lower numbers in New Guinea (MacKinnon & Phillipps 1993; Baker 1997; Coates & Bishop 1997). It has been reported from northern Australia and Ashmore Reef on numerous occasions. BARC has accepted nine records, and Higgins *et al.* (2006) accepted several more.

Pallas's Grasshopper Warbler *Locustella certhiola*

Vagrant. One record. A single bird found by IAWM at North East Point on 21 April 2008 was later heard and sometimes glimpsed by others (R. Crawford, J. Pridham, D. Stojanovic, E. Wagner, P. Whittington, M. Carter, T. Palliser & F. O'Connor pers. comm.) until 28 April. Sound-recordings by IAWM were identified by P. Holt and K. Bishop (Anon. 2008c; Dooley 2008c; BARC Case 576).

This Palaearctic migrant breeds in south-eastern Siberia and central Asia east to northern China. It winters in central and southern India, mainland South-East Asia, the Philippines (Palawan) and the Greater Sundas (MacKinnon & Phillipps 1993; Baker 1997; Robson 2000; Wells 2007). This is the first record from Australian territory, though it has since been recorded at Ashmore Reef on 8 April 2011 (BARC Case 731). It was mistakenly listed as the Manchurian Reed-Warbler *Acrocephalus tangorum* by Ramsay (2008c) and Pallas's Leaf Warbler *Phylloscopus proregulus* in early printings of Slater *et al.* (2009).

Dusky Warbler *Phylloscopus fuscatus*

Vagrant. One record. One was seen and heard at the Settlement on 3–4 May 2009 (Ramsay 2009b; Palliser & Carter 2012; IAWM; BARC Case 620); identity was confirmed by P. Holt and P. Morris from sound-recordings by IAWM.

This Palaearctic migrant breeds in south-eastern Siberia and central Asia east to central China. It winters in central eastern India, South-East Asia south to Malaysia and Singapore (Baker 1997; Rasmussen & Anderton 2005; Wang & Hails 2007; Wells 2007), but has not been reported from the Greater Sundas. This is the first record from Australian territory.

Christmas Island White-eye *Zosterops natalis* [Figure 24 (p. S59)]

Abundant endemic breeding resident (80 000–170 000 individuals). The first record may have been sightings of 'a little flycatcher of the same sombre colour' by Captain J.P. Maclear in January 1887 (Maclear 1887a, p. 13; 1887b, p. 510). However, the species was described from specimens collected by J.J. Lister from 30 September to 7 October 1887 (Lister 1889). Three syntypes are in the NHM (Warren & Harrison 1971) and another three are in the CUMZ (Benson 1999). Another early specimen was said to be in the collection of Canon Tristram, but was destroyed with damage to the Liverpool Museum, UK, in World War II (see Benson 1999). Visitors generally consider the White-eye to be abundant. The only survey-based population estimate is 80 000–170 000 individuals, derived from distance-sampling surveys (Table 3; see Corbett *et al.* 2003). This equates to 8–17 birds per hectare (assuming 100 km^2 of suitable habitat), which might be an overestimate, but is reasonable. James & Retallick (2007) recorded it in 506 of

527 10-minute surveys, a reporting rate of 99% that made it the most frequently reported forest bird in their study, and found no significant difference in habitat preferences or distribution across the Island. It is abundant in all habitats except where there are no trees or shrubs (DJJ; IAWM).

Despite the abundance and conspicuous nature of this species, it is very poorly known. It is very gregarious, forming flocks of up to ~100, but usually 10–30 birds. It forages from the top of the canopy to the ground, with no competitors. Food includes nectar, fruit, seeds and insects (caught by gleaning), but few specific details have been published (Higgins *et al.* 2006). Introduced plants are important in the diet in disturbed habitats (Gibson-Hill 1947), especially the Japanese Cherry (DJJ). The White-eye is abundant deep inside evergreen and semi-deciduous forests (James & Retallick 2007), where the fruits and/or flowers of Strangler Fig, Macaranga, Stinking Wood and *Tristiropsis acutangula* seem important (DJJ). Davis *et al.* (2008) observed 44 instances of White-eyes 'attacking' the introduced scale insects.

Breeding is thought to be from September to January (Gibson-Hill 1947), but otherwise breeding biology is very poorly known (Higgins *et al.* 2006).

This abundant species seems secure at present. It is listed as globally Near Threatened (IUCN 2013), although BirdLife International (2004) considered it Vulnerable because it has a small population restricted to two localities. Garnett *et al.* (2011) considered it Near Threatened. It was previously listed as globally Critically Endangered but, fortunately, predictions that Yellow Crazy Ants could cause a severe population decline (Garnett & Crowley 2000) have so far not eventuated. In 2005, a nomination for listing as Endangered under the EPBC Act was not accepted on advice from the TSSC (TSSC 2005b). Davis (2002) found no evidence of impacts from Yellow Crazy Ants. Re-analysing the same data, Davis *et al.* (2008) claimed that the White-eye actually benefitted from ant invasion, presumably related to an increase in honeydew-secreting scale insect prey because of the mutualism between the ants and the scale. Stokes (1988) listed cats and probably rats as occasional predators. Small numbers of White-eyes are taken by Christmas Island Goshawks (Lister 1889; Gibson-Hill 1947) and visiting Eastern Great Egrets (DJJ), and the White-eye gives alarm calls in the presence of Christmas Island Hawk-Owls (Hill & Lill 1998b), Nankeen Kestrels (DJJ) and larger vagrant species (e.g. Horsfield's Bronze-Cuckoo: IAWM). It is only rarely killed by cars (James 2007).

This species is endemic to Christmas Island. It was introduced to Horsburgh Island in the Cocos (Keeling) Group supposedly between 1890 and 1895 (Wood-Jones 1909), but more likely by the Clunies-Ross family between November 1888 and August 1890 (Ridley 1891), and remains extant there today (IAWM; DJJ). Mees (1957, p. 200) considered it 'a distinct species without close relatives'.

Barn Swallow *Hirundo rustica*

Rare regular visitor and passage migrant between August and April. A juvenile female of subspecies *gutturalis* was collected by C.W. Andrews at Flying Fish Cove on 16 October 1897 (Sharpe 1900). This species was considered a regular visitor

by Gibson-Hill (1947), although he did not document any records. This species was listed as a regular visitor between September and November by van Tets (1974a, 1983) and between September and January by Stokes (1988). Johnstone & Darnell (2004a) described it as a moderately common visitor mainly between October and January, with odd records in April. They claimed that all records are referrable to *H. r. gutturalis*, which is likely to be correct on geographical grounds, but supported only by the 1897 specimen. It was reported in singles and small flocks by at least 36 visiting parties in most years since 1990 (Carter 1994, 2000b, 2001, 2002, 2010b, 2011b; Barkla 1996; Craig 1996; Hobcroft 1996, 2005, 2007; Smith 1996; Anon. 1997a, 2002c; Farnes 1997; Lester 1997; Maher 1997; O'Connor 1999; Coate 2000; Hansboro 2000a; Smith 2000; Clarke 2001, 2011b; Holmes 2002; Stafford 2002a; Barrand & Barrand 2003; Doughty 2003; Hunter 2004; Barrand 2005b, *c.* 2009; Morris 2005; Rogers 2006; Baxter 2008a, 2011b; Carter & Carter 2008; Carter *et al.* 2008; Low 2011; R. Baxter *in litt.*; K. Coate *in litt.*; N. Hamilton *in litt.*; N. Pamment *in litt.*; D. Helliar pers. comm.; IAWM). The number of birds seen in any one season can vary considerably (DJJ). This species has been recorded from all months except May–June, but most records are from late October to mid April. The spread of dates has grown in recent years as a result of increasing observer effort. A single record for the month of July (30 July 2004: DJJ) is the earliest arrival date and 27 April (in 2008) is the latest date (Carter *et al.* 2008). The pattern of records suggests that some birds winter on the Island for up to 3 months, but many are passage migrants. Larger flocks included ≥20 in December 1996 and January 1997 (Farnes 1997), 14 in March 1997 (Maher 1997), ~12 in April 2000 (Smith 2000), 20 in April 2002 (Holmes 2002), and 15 in March 2004 (DJJ). Localities where it has been recorded are mostly in the north-east, and include the Rubbish Tip, Phosphate Hill, Airport, Phosphate Dryers, Drumsite, Poon Saan, Flying Fish Cove, the Settlement, Chinese Cemetery, North East Point and the Golf Course, as well as North West and South Points.

This Palaearctic and New World migrant reaches the Greater Sundas and northern Australia regularly (MacKinnon & Phillipps 1993; Higgins *et al.* 2006).

Tree Martin *Petrochelidon nigricans*

Vagrant. Between two and seven records. One possible Tree Martin seen at the Rubbish Tip on 2–3 November 1993 (Carter 1994) was later submitted as an Asian House Martin *Delicon dasypus* to BARC, but not accepted, leaving the bird's identity in doubt (Palliser 2004; BARC Case 320—not accepted as Asian House Martin). It was listed as an Asian House Martin by Johnstone & Darnell (2004a). N. Cheshire saw one bird on board the RV *Franklin* at 12°00′S, 106°30′E, 97 nm south-south-east of Christmas Island on 13 April 1995 (Casement 1996; N. Cheshire *in litt.*). One was seen by DJJ at the Rubbish Tip on 11 April 2004, at the Parks Office on 31 May 2004, and at the Rubbish Tip from 30 October to 19 December 2004 (seven sightings), and was also seen by two tour groups between 22 November and 3 December 2004 (Carter 2004; Langfield 2004). One was seen by DJJ at the Rubbish Tip from 27 March to 8 May 2005 (six sightings), and again on 7 August 2005. The records from 2004–2005 probably represent a single, long-staying individual.

This Australian species is a regular visitor to the Moluccas and Lesser Sunda Islands, and has been observed to breed on Alor in the Lesser Sundas (White & Bruce 1986; Holmes 1995). It is unknown from the Indomalayan Region proper (cf. Andrew 1992; MacKinnon & Phillipps 1993; Inskipp *et al.* 1996).

Red-rumped Swallow *Cecropis daurica*

Vagrant. Eight reports, but only one confirmed record. Eight were seen by T. Stokes, P. Goh and B. Reville at the LB4 Lookout on 17 January 1986 (Stokes *et al.* 1987). Two were seen at Migrant Hill between 28 October and 1 November 1995 (Eades 1995; Smith 1996; T. Smith pers. comm.). Two were seen on 1–2 December 1996 (Hobcroft 1996). Three were seen at the Golf Course on 18 November 1999 (Carter 2000b; BARC Case 289). Four Swallows were seen by DJJ on the Dales Road near the IDC on 7–8 November 2005 (Anon. 2006a,c; Dooley 2006a), and one was seen here by DJJ and a tour group led by P. Barrand on 12 November 2005 (Barrand 2005b; Anon. 2006c). A single Swallow was seen by T. Low and DJJ at the Plantation in early January 2006. One was reported at Migrant Hill by a visiting British tourist in November 2011 (L. Preston pers. comm.). Two were photographed by a tour group at the Golf Course on 28 November 2012 (James 2012).

This species breeds from northern Africa and southern Europe east across Asia to eastern China and Japan. It is very scarce in Sumatra, Borneo and Bali, but unknown from Java and Wallacea (van Marle & Voous 1988; Andrew 1992; Coates & Bishop 1997; Holmes 1997; Mason 2011). It has been reported on several occasions in northern Australia. Higgins *et al.* (2006) suggested that it may be a regular visitor there, though Christidis & Boles (2008) listed it as a vagrant.

Asian House Martin *Delichon dasypus*

Rare regular visitor. Sixteen or more sets of reports, all since 1990, six confirmed by BARC. One was seen by P. Milberg and K. Coate at the LB4 Lookout on 25 November 1996 (Anon. 1997a; Coate 1997; Eades 1997a; K. Coate *in litt.*). The first confirmed record was of up to 20 seen on 1–6 December 1996 at the Airport and Drumsite by D. Hobcroft (Hobcroft 1996; Eades 1997a; BARC Case 313). The five other confirmed records are two at the Rubbish Tip on 15–16 April 2003 (BARC Case 384), two at the Airport on 4 March 2007 (BARC Case 531), 5–8 at Margaret Knoll on 13 January 2008 (BARC Case 565), at least five on 23–28 April 2008 at North East Point, near Ma Chor Nui Nui Temple and North West Point (BARC Case 573), and one at North West Point on 28 November 2009 (BARC Case 681). Since 1997, this species has been reported by numerous observers and parties (Anon. 1997c, 2002b, 2006a,c, 2007b, 2011a; Maher 1997; Carter 2001, 2007; Stafford 2003; Palliser 2004, 2009; Barrand 2005b, *c.* 2009; Hobcroft 2005; Baxter 2007, 2009, 2010b, 2011b; Dooley 2007b, 2008b,c, 2012a; Ramsay 2007a, 2008b,c, 2010a, 2011a; Carter *et al.* 2008; Roderick 2008; Eaw & Dooley 2010; James 2010; L. Living & E. Fothergill *in litt.* to M. Carter 2003; N. Pamment *in litt.* 2008; IOSG delegates pers. comm. 2008; J.C. Taylor pers. comm. 2005; DJJ; IAWM). Most records have been at North West Point, but other locations include the Settlement, Quarry Road (Phosphate Hill) and South Point. The

earliest report was on 31 October (in 2008), and the latest was on 28 April (in 2008). Flock sizes have varied from one to 30 (Baxter 2011b). On Christmas Island, the Asian House Martin has not been seen to perch; perching is rarely recorded in this species (Robson 2000; Wells 2007).

Nominate *dasypus* is a long-distance migrant and is the only form recorded from the Malay Peninsula southwards. It is fairly common in southern mainland South-East Asia and sporadic in the Greater Sundas (MacKinnon & Phillipps 1993; Robson 2000). The species has not been reported in Wallacea (Coates & Bishop 1997) and is rare in the Philippines (Kennedy *et al.* 2000). Elsewhere in Australian territory, there is one confirmed record of a single bird on the Cocos (Keeling) Islands in March 2007 (Baxter 2007; BARC Case 530).

Blue-and-white Flycatcher *Cyanoptila cyanomelana*

Vagrant. Two sets of records and up to seven reports, three of which are confirmed. One first-winter male with turquoise-blue wings was seen at Silver City on 7–8 December 2003 by DJJ (BARC Case 408). In late 2006, there was an unprecedented series of reports by multiple observers involving between four and seven birds (Anon. 2007a). In November 2006, a small, bright, blue, black and white bird was seen by L. Preston (pers. comm.) in Kampong; this description fits an adult male Blue-and-white Flycatcher. A week later, a brightly coloured, blue, black and white flycatcher was seen by M. Bramson and L. Barrow at North West Point near the IDC; it was reported to DJJ and identified as an adult male Blue-and-white Flycatcher from the plates in Robson (2000). A first-winter male was photographed on a track 1.7 km north of Grants Well on 2 December 2006 (Rogers 2006; Anon. 2007a; Dooley 2007a,c; Palliser 2009; BARC Case 515). A different-plumaged first-winter male was photographed at the Sports Ground on multiple occasions on 3–8 December 2006 (Palliser 2009; BARC Case 516). A first-winter female was photographed at the Winifred Beach Track turnoff on 16 December 2006, and a first-winter male was seen at the same place on 18 and 20 December 2006 (Hobcroft 2006; Anon. 2007c; DJJ).

This species breeds in eastern Asia, migrates through South-East Asia, and winters in the Greater Sundas and the Philippines (Robson 2000). It is a regular visitor in Borneo, but is uncommon in Java and Sumatra (MacKinnon & Phillipps 1993). There are three records from elsewhere in Australia: an adult male found dead near Cossack, WA, on 5 December 1995 (BARC Case 242); an adult male at Broome Bird Observatory, WA, on 15–19 November 2002 (Hassell *et al.* 2003; BARC Case 370); and a male seen at the Cocos (Keeling) Islands in March 2011 (Baxter 2011a).

Island Thrush *Turdus poliocephalus erythropleurus*

[Figures 25–26 (pp. S59–60)]

Abundant endemic breeding resident (20 000–50 000 individuals). The first record was the collection of the holotype of the subspecies by Captain J.P. Maclear in January 1887 (NHM 1887.5.1.21; Maclear 1887a; Sharpe 1887; Warren & Harrison 1971). Visitors generally consider this species common or abundant. The

only survey-based population estimate is 20 000–50 000 individuals, derived from distance-sampling surveys (Corbett *et al.* 2003). This equates to 2–5 birds per hectare (assuming 100 km^2 of suitable habitat), which seems reasonable. James & Retallick (2007) recorded it in 356 of 527 10-minute surveys, a reporting rate of 70% that made it the third most frequently reported forest bird in their study. It is more frequent in evergreen forest than in disturbed habitats (James & Retallick 2007). However, it is still common in regrowth and suburban yards (DJJ), but tends to shun areas with dense undergrowth, especially thickets of pandans *Pandanus christmatensis* and *P. elatus* (Stokes 1988; James 2007; L. Olsen & J. Murakami pers. comm.), although it does forage on open ground in and around pandan thickets (DJJ). It is absent from natural and mined pinnacle fields (James & Retallick 2007; DJJ). It is tame and confiding, and particularly active at dawn and dusk, though it can be active throughout the day. Adults vigorously defend fairly small breeding territories. It usually occurs singly, in pairs or family groups and rarely flocks of up to five birds (James 2007; James & Retallick 2007; L. Olsen & J. Murakami pers. comm.; DJJ; IAWM).

The Island Thrush mostly forages on the ground, using perches as lookout posts and for roosting. However, it occasionally forages on tree-trunks (Gibson-Hill 1947) and the walls of buildings and window sills, but not in foliage or aerially (DJJ). The most common item in the diet is probably millipedes (Diplopoda), but beetles (Coleoptera) are taken frequently (James 2007; L. Olsen & J. Murakami pers. comm.; DJJ). The Thrush also eats earthworms (Annelida) (Carter 2000b) and probably a wide range of other invertebrates (Clement & Hathway 2000). One hand-reared juvenile captured and ate Daddy-long-legs spiders *Pholcus* sp. (though they were not favoured) and an Asian House Gecko *Hemidactylus frenatus* (DJJ). Terrestrial slaters (Isopoda) are avoided (DJJ). Strangely, Davis (2002) considered the Thrush a frugivore.

Breeding peaks between October and March, but may occur throughout the year (Higgins *et al.* 2006; DJJ). Nests have been reported in Bird's-nest Ferns, in creepers (especially *Hoya aldrichi*), tree-hollows and nooks in the aerial roots of Strangler Figs, in forks of trees (including at 1 m in a Coffee Bush), in a dense exotic palm, in a tin can on a pole leaning against a Poinciana *Delonyx regia*, on ledges in buildings, and on a step-ladder in a carport (Higgins *et al.* 2006; James 2007; L. Olsen & J. Murakami pers. comm.; DJJ). The breeding cycle from courtship to independence of juveniles takes *c.* 1 month, and the raising of two, three or four broods in succession is probably common (Reville 1993; James 2007; L. Olsen & J. Murakami pers. comm.; DJJ). At one nest, the adult pair had a dependent juvenile while incubating another clutch of two eggs, and once these eggs had hatched the adults ignored the juvenile, which stopped begging, but continued to forage in the territory (James 2007; L. Olsen & J. Murakami pers. comm.). Independent birds form flocks of 5–20, often with a mix of older and younger juveniles (James 2007; L. Olsen & J. Murakami pers. comm.; DJJ).

The Island Thrush is not listed as globally threatened by the IUCN (2013), as it is considered a subspecies of a more widely distributed and secure species. The Christmas Island subspecies was listed as Endangered under the EPBC Act in April 2005, because of a perceived threat from the Yellow Crazy Ant (Garnett & Crowley

2000). Davis (2002) and Davis *et al.* (2008) found variations in abundance and nesting success of the Thrush associated with different levels of infestation by Yellow Crazy Ants, and feared a population decline of the Thrush. Yet, over a decade later, the Thrush remains abundant throughout the forests of Christmas Island (James & Retallick 2007; DJJ; IAWM). Stokes (1988) listed bird trapping, cats and rats as threats, but considered the population of the Island Thrush to be very abundant and in no danger of extinction; trapping no longer occurs (DJJ). Occasional Thrushes are killed by cars (DJJ). Garnett *et al.* (2011) considered the Christmas Island subspecies of the Island Thrush to be Near Threatened.

This species has ~50 subspecies spread widely from Taiwan through the Philippines, Greater Sundas, Wallacea, Melanesia south to New Caledonia and east to Samoa (Clement & Hathway 2000; Clements 2000). Two other subspecies from the Australian territories of Norfolk and Lord Howe Islands are both extinct (Higgins *et al.* 2006). The localised and insular subspecies are largely confined to mountain peaks above 2000 m or small oceanic islands (MacKinnon & Phillipps 1993; Clement & Hathway 2000). *T. p. erythropleurus* was introduced to several of the Cocos (Keeling) Islands, supposedly between 1890 and 1895 (Wood-Jones 1909), but more likely by the Clunies-Ross family between November 1888 and August 1890 (Ridley 1891). It was last reported there in 1941 (Gibson-Hill 1949b).

Purple-backed Starling *Sturnus sturninus*

Vagrant. Two records. One was observed by G. & G. Goodreid in their garden in Poon Saan and verified by F.A.R. Hill on 4 June 1996 (Andrew 1996b; Goodreid & Goodreid 1996; Palliser 1999; BARC Case 213). A female or juvenile was photographed at the Settlement on 28 November 2011 (Baxter 2011b; Dooley 2012a; L. Preston pers. comm.; BARC Case 736).

This species breeds in northern China, Mongolia, south-eastern Siberia and Korea, and winters to South-East Asia and the Greater Sundas (Feare & Craig 1998; Wells 2007). Apart from a bird found in the Cocos (Keeling) Islands in December 2010–January 2011 (Baxter 2010b; Marsh 2011), these are the only confirmed records from Australian territory.

Java Sparrow *Lonchura oryzivora* [Figure 27 (p. S60)]

Rare resident; introduced (<50 birds in 2012–2013). The first recorded birds were collected by two Dayak collectors in October–November 1923 (Chasen & Kloss 1924); this would include an unregistered ZRC specimen, which is moulting from immature to adult plumage, and was collected on the Island on 17 November 1923 (IAWM). Since this species was not recorded in 1908 by Andrews (1909), Stokes (1988) deduced that it had been introduced between 1908 and 1923.

Gibson-Hill (1947) recorded the Java Sparrow's range in 1940 as including the 6-mile (10-km) length of the North Coast Road (i.e. from Settlement to Waterfall Cove where there was a string of huts, vegetable gardens and chicken-runs along the water-pipeline, but no Golf Course; cf. Adams & Neale 1993) and south along the railway line for 2 miles to near the present location of the Plantation. The same

range was also reported in 1961 (Mees 1966). Mees collected two specimens at the Grotto near the Golf Course in June and July 1961 (WAM A.9273 and A.9421; IAWM). According to Forshaw & Shephard (2012), the Sparrow was present at the Golf Course, the Chinese Cemetery and throughout the settled areas in the 1980s. Higgins *et al*. (2006) wrote that it occurred at the Airport, but this was an incorrect interpretation of van Tets (1983), who merely speculated that it could colonise there. Since 1990, it has been recorded by numerous visiting parties, in all months, from Settlement (Flying Fish Cove, Kampong, Post Office Padang, and the Cocos Padang east to Rocky Point), Chinese Cemetery, Silver City (all suburban areas), Poon Saan (all suburban areas including Taman Sweetland), Drumsite (all suburban areas, Parks Office, Territory Day Park and Nursery) and the Phosphate Dryers.

The range appears to be contracting gradually. The last sightings east of the Settlement were at the Chinese Cemetery in February and March 2002 (DJJ); this coincided with the closure in about 2001 of the chicken-battery that was located between the Christian and Chinese Cemeteries, which had supported large flocks of Java Sparrows (M. & B. Orchard pers. comm.). The Sparrow has rarely been reported in the Kampong since 1994. From 2002 to 2007, DJJ found it to be scarce at Drumsite. The only recent sighting beyond Drumsite was a report at the Phosphate Dryers in November 2003 (Barrand & Barrand 2003). In November 2012, it was found only in Poon Saan despite a concerted search over several days at the Settlement and Drumsite (DJJ).

Reported numbers vary widely, and appear to fluctuate. Gibson-Hill (1947) considered the species to be very plentiful in 1939–1940. Van Tets & van Tets (1967, p. 316) reported 'large numbers' and 'flocks of 50 or more'. In the late 1980s, Reville (1993) considered the population level to be ~200–300 birds, and it was probably ~300 birds in the period 2002–2007 (DJJ). The highest counts since 1990 were ~100–140 birds in Poon Saan in March 2002 (Carter 2002; Holmes 2002; DJJ), though obviously this was only part of the population. Available counts of Java Sparrows between 1995 and 2012 are plotted in Figure 28. The data are from a wide variety of sources (Anon. 1996a, 2002c; Farnes 1997; Maher 1997; Carter 2000b, 2004, 2010b, 2011b; Hansboro 2000a; Clarke 2001, 2011b; Holmes 2002; Barrand & Barrand 2003; Langfield 2004; Morris 2005; Hobcroft 2006, 2007; Rogers 2006; Carter & Carter 2008; Carter *et al.* 2008; Barrand *c*. 2009, *c*. 2011; Baxter 2010a, 2011a,b; James 2010; Marsh 2011; R. Baxter *in litt.*; K. Coate *in litt.*; B. King *in litt.*; N. Pamment *in litt.*; DJJ; IAWM), so it should be noted that they were not collected systematically and they are counts of birds in one or more flocks and are not population estimates. Nevertheless, the data show that the counts peaked around 2002 and then declined substantially through to 2010, with the suggestion of some recovery in 2011. This might indicate that (1) the population level fluctuates over periods of years or decades (e.g. according to environmental conditions such as rainfall), (2) the population is in rapid decline (in which case it might not persist longer than a few more years), (3) mobile flocks follow fluctuating resources and therefore their visibility changes or (4) there are too many biases in the data set. Perhaps all are partly true, but the long-term pattern

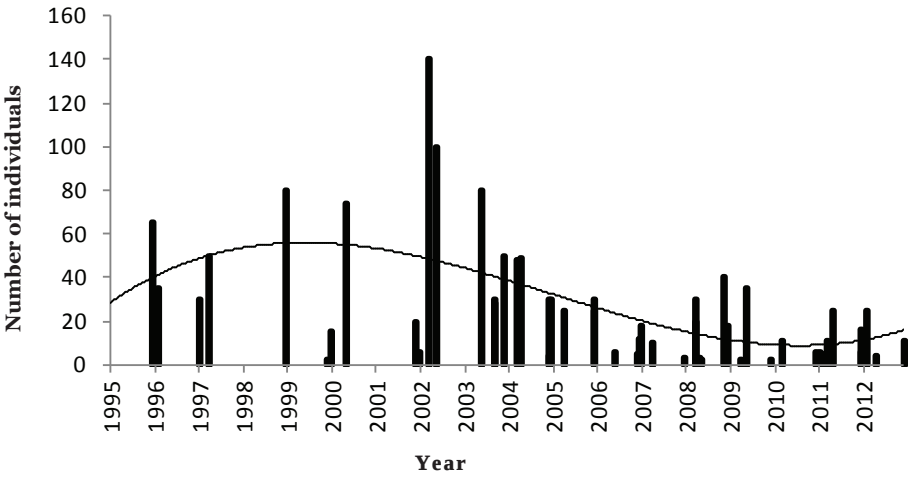

Figure 28. *Ad hoc* count data for the Java Sparrow on Christmas Island from 1995 to 2013 (n = 51; see text for data sources and interpretation).

and the concurrent decline in range best support explanations (1) or (2). The population was apparently <50 birds at the end of 2012, although this number may change rapidly.

The Java Sparrow population is heavily dependent on anthropogenic food sources, such as rice grain, bread and chicken food (accessed at chicken-runs), on lawns, and occasionally at feeding tables (Gibson-Hill 1947; DJJ). Gibson-Hill (1947) also reported that Sparrows feed on the seeds of grasses and Stinking Passion Flower *Passiflora foetida* along the edge of clearings. Barrand & Barrand (2003) reported them feeding on seeding grass on the road edge. DJJ recorded a flock of 48 on the road verge in Poon Saan in March 2004 and a pair at the Parks Office several times in 2005 feeding on the seeds of Gomphrena Weed *Gomphrena celosioides*. In a yard in Silver City in 2004, DJJ frequently observed Sparrows climbing the seed stalks of Golden Beard Grass *Chrysopogon aciculatus* (a common lawn grass on the Island) to bend them over and access the ripening seeds. In April 2011, IAWM observed nine feeding at length on a limestone cliff behind houses in the Settlement, where there was no obvious seed—possibly they were feeding on the soil for minerals. A flock at Poon Saan in April 2011 may have been feeding on fallen seeds from she-oaks *Allocasuarina* sp. (IAWM). Artificial water sources (especially bird-baths) appear to be very important (M. Carter in Forshaw & Shephard 2012; DJJ).

Gibson-Hill (1947) found six Java Sparrow nests between May and August, and Reville (1993) reported a nest in May. DJJ recorded adults carrying nesting material in July, newly fledged juveniles in June, older (but still dependent) juveniles in August, and flocking, newly independent juveniles in July. Perhaps exceptionally, K. Coate (*in litt.*) reported several pairs with juveniles at Poon Saan

in November 2001. Four of Gibson-Hill's (1947) nests found in cavities were not completely closed over at the top, whereas two in bushes were globular. Reville (1993) reported a nest in a hollow branch of a Coral Tree *Erythrina variegata*. M. Orchard (pers. comm.) reported Java Sparrows nesting in the axillary cavities of Date Palms *Phoenix dactylifera* along Murray Road opposite the Parks Office in the late 1990s, and DJJ suspected similar activity at the Cocos Padang in the mid 2000s.

This species is gregarious and sometimes forms large flocks at food sources (Higgins *et al.* 2006). Independent juveniles sometimes form separate flocks from adults (DJJ). At feeding sites, the Java Sparrow sometimes forms mixed flocks with Christmas Island White-eyes (Gibson-Hill 1947) and Eurasian Tree Sparrows (DJJ; IAWM).

It has been claimed that the Java Sparrow could pose a threat to native species by carrying or harbouring disease (Hill 1997a, 2004a). Based on this speculation, Bomford & Sinclair (2002, p. 34) even categorised it as a 'serious threat to the environment ... as a possible vector of disease to the endangered Christmas Island Hawk Owl'. We agree with Forshaw & Shephard (2012) that this accusation is unjustified. The Java Sparrow on Christmas Island is now just as insular as the Hawk-Owl after at least 87 years of quarantine, no avian diseases have ever been identified on Christmas Island, and there is no evidence that the Hawk-Owl is facing decline. This population of Java Sparrows is more likely to have conservation value as a disease-free population of a globally threatened species. Individuals are occasionally killed by cats (Higgins *et al.* 2006; K. Coate *in litt.*), cars (K. Coate *in litt.*; DJJ), Christmas Island Goshawks (Gibson-Hill 1947; Hill 2004a; DJJ) and by entanglement in chicken-coops (S. Comport pers. comm.; A. Graham pers. comm.; DJJ). Circumstantial evidence indicates that the Island's population of Java Sparrows is likely being displaced by the other introduced granivorous passerine, the Eurasian Tree Sparrow (Higgins *et al.* 2006; Forshaw & Shephard 2012; DJJ). The shift of people away from a village lifestyle, such as occurred along the water-pipeline and railway before World War II (Adams & Neale 1993), probably led to a reduced distribution and population level of Java Sparrows (DJJ).

This monotypic species is indigenous to Java, Bali and Kangean, though it has been widely introduced elsewhere (MacKinnon & Phillipps 1993; Higgins *et al.* 2006; Wells 2007). Elsewhere in Australian territory, it was introduced to the Cocos (Keeling) Islands in the 19th century, but is no longer extant there (Higgins *et al.* 2006). Given the previous movement of shipping, the Christmas Island birds could have originated directly from Java or from the Cocos (Keeling) Islands.

Eurasian Tree Sparrow *Passer montanus*

Common resident; introduced (>1000 individuals). The first report was of several birds observed by D. Powell in the Flying Fish Cove area from March 1983, although this species was possibly present up to 2 years beforehand (Stokes *et al.* 1987). In late 1986, ANPWS staff attempted to eradicate the small flock in the Wharf area by capturing them, but none could be captured (Stokes 1986a,b).

When Stokes left the Island in 1987, numbers had grown (but were still <20), and it was probable that the Sparrow had bred (Stokes 1988; Reville 1989, 1993). K. Coate (*in litt*.) considered it to be common around the Settlement in August 1990, and in December 1998 he noted flocks of 30–50, and estimated that there were 250–300 birds in the settled areas of the Island. Carter (2000b) noted a great increase in numbers between his visits in 1993 and 1999. There were likely to be >1000 individuals by 2005 (DJJ).

Between 2002 and 2007, DJJ noted that the species was common throughout the residential areas of the Settlement (from the boat ramp in western Flying Fish Cove to Rocky Point and up Gaze Road to the George Fam Centre), Silver City and Poon Saan. Higher estimates of birds observed in the Settlement alone include 150–200 (and a flock of 120) in November 1999 (Carter 2000b), 50 in mid December 2007 (Hobcroft 2007) and several hundred in May 2009 (IAWM). In April 2012, DJJ recorded multiple flocks (at least five) of ~100 birds at the Settlement alone. It is less common at Drumsite. DJJ recorded it commonly at the High School, but rarely elsewhere. Sightings increased gradually in eastern Drumsite (from the Parks Office to the shops) from *c*. 2005 to 2007, but it was much less common there than in the lower residential areas. The situation was little changed at Drumsite in April 2012 (DJJ). This suggests that at the time the Eurasian Tree Sparrow was still colonising Drumsite. By 2012, it was not found outside residential areas. Subject to anthropogenic food supplies, this highly commensal species could potentially colonise Phosphate Hill (e.g. the Hospital, light industrial area, Recreation Centre, Rubbish Tip and Airport), along the incline and conveyor between the Phosphate Dryers and the Wharf, the Resort, and the IDC at North West Point. It is unlikely to colonise undisturbed sites. It is probably heavily reliant on anthropogenic food sources, but also feeds on lawns (DJJ; IAWM). It frequents chicken-pens and yards where free-range or 'stray' chickens are fed. Many congregated daily at the Noodle House in the Settlement to feed on food scraps, especially cooked rice, that are deliberately left for them (M. Carter in Johnstone & Darnell 2004a; DJJ; IAWM).

Newly fledged juveniles were observed by DJJ at Silver City in July 2004. Most nests are probably located in cavities in buildings. However, DJJ observed apparent nest building in cavities in the inland cliff behind the Cocos Padang and Temple Court in the Settlement. Suitable nesting sites in the limestone cliffs are likely to be abundant.

It has been claimed that the Eurasian Tree Sparrow could pose a threat to native species by carrying or harbouring disease (Hill 1997a,b, 2004a,b). It could potentially displace the other introduced granivorous passerine, the Java Sparrow, through competition (Higgins *et al*. 2006). Individuals are occasionally killed by Eastern Great Egrets and possibly by Christmas Island Goshawks and feral cats (DJJ).

This species is found throughout the Palaearctic south to India, South-East Asia, the Greater Sundas, Philippines and Wallacea (Wells 2007). The subspecies on the Island is unknown. The initial appearance of small numbers in the Wharf area indicates that the original colonists reached the Island by ship (Stokes *et al*. 1987;

Higgins *et al.* 2006). The nearest subspecies to Christmas Island is *malaccensis*, which occurs throughout South-East Asia, Sumatra, Java and Bali (Clements 2000; Robson 2000; Johnstone & Darnell 2004a). According to Filewood (1996, p. 28), 'the subspecies is Oriental, supposedly from a vessel from Hong Kong (where *P. m. saturatus* is native), but the birds could have joined the ship elsewhere'. We have found no other account suggesting that the Eurasian Tree Sparrow came from Hong Kong. Phosphate has been exported from Christmas Island to many Oriental nations, but rarely if ever to Hong Kong, although many ships are registered there. However, many ships go to Indonesia, Singapore and Malaysia. These ports are only a few days away, and there is a good chance that individuals or a small flock of Sparrows from these similar climates could survive such a journey. Circumstantially, we think it more likely that the subspecies introduced is *malaccensis*.

['Yellow Wagtail' complex *Motacilla aff. flava*]

'Yellow Wagtails' *M. flava* (in the widest sense) are rare regular migrants on Christmas Island between late September and May. Up to 22 subspecies have been recognised in the complex, but Alström & Mild (2003) recognised only 13. 'Yellow Wagtails' have complex plumage variation with moderate sexual dimorphism, strong seasonal variation, different adult and first-year plumages and complex geographical variation. Field characters for separating the various forms are subtle and are still being investigated, especially for first-year birds (Alström & Mild 2003).

Three taxa (subspecies) have been reported from the Island. The recognition of several species within this complex by Christidis & Boles (2008) means that at least two species occur on Christmas Island: the Eastern Yellow Wagtail *M. tschutschensis* and Green-headed Yellow Wagtail *M. taivana*. Many Island records that lack sufficient detail for identification to species level as currently delineated are now summarised. Individuals were reported in December 1977, October 1978 and January and March 1985 (Stokes *et al.* 1987). 'Yellow Wagtails' have been reported at least 12 times by visiting parties since 1990 [Andrew & Eades 1993 (photographed); Carter 1994, 2000b, 2004; Barkla 1996; Harvey 1996; Smith 1996; Lester 1997; O'Connor 1999; Coate 2000; Smith 2000; Barrand & Barrand 2003; Doughty 2003; Langfield 2004; Baxter 2006; K. Coate *in litt.* (photographed)]. These records were all of singles or pairs, except for a flock of four at the Rubbish Tip on 16 November 2003 and six at the same place on 5 December 2003 (Barrand & Barrand 2003; Doughty 2003). DJJ saw five individual juveniles of unknown type between 2003 and 2005. The earliest date in any year, for 30 records (whether identified to species or not), was a juvenile Eastern Yellow Wagtail *M. tschutschensis* on 18 September (in 2003) (DJJ), and the latest date in any year was a Green-headed Yellow Wagtail *M. taivana macronyx* on 6 May (in 2004) (DJJ). Most records were from October to December, with only two in September, one in January, two each in April and May, and none in February and March. Individuals and flocks were rarely present for more than a week, indicating that 'Yellow Wagtails' are passage migrants (mainly on southern migration) rather than visitors. The largest

numbers recorded were flocks of 12 (all juvenile Eastern Yellow Wagtails) on 24 October 2005 and nine (eight juvenile and one adult Eastern Yellow Wagtail on 31 October 2004 (DJJ). Locations where unspecified 'Yellow Wagtails' have been recorded include the Rubbish Tip, Plantation, Phosphate Dryers, Central Area Workshop, Winifred Gate, Flying Fish Cove, Rocky Point, North East Point, Resort, LB3 ponds and the Blowholes Track.

As a group, the 'Yellow Wagtails' breed in northern Eurasia and migrate south to Africa and southern Asia.

Eastern Yellow Wagtail *Motacilla tschutschensis*

Rare regular passage migrant. Up to 20 reports. Three immature birds were collected by C.W. Andrews at Flying Fish Cove in 1897 and 1898 (one in October 1897) (Sharpe 1900). The specimens were said to be *simillima* (= *tschutschensis*) by Gibson-Hill (1947); however, this could be confirmed if the specimens were still at the NHM. Adults in breeding plumage or traces of it were seen by DJJ on 16 April 2003, 11 December 2003, 31 October 2004 and two on 23 October 2005; and by IAWM on 22–23 April 2008. DJJ closely inspected juveniles on several occasions, and tentatively identified many as *tschutschensis*: one at the Rubbish Tip on 18–30 September 2002; one at the Phosphate Dryers on 16 April 2003; one at the Plantation on 30 October 2004; 5–9 at the Rubbish Tip on 8 days between 30 October and 15 November 2004 (accompanied by an adult with traces of breeding plumage on 31 October); five at the Rubbish Tip on 23 October 2005 (accompanied by an adult in breeding plumage); 12 at the Rubbish Tip on 24 October 2005; seven at the Rubbish Tip on 31 October 2005; one at the Winifred Gate on 24 October 2005; and 1–5 at the Rubbish Tip on 3–5 November 2005. These were identified as *tschutschensis* based on the following combination of characters: pale, broad supercilium extending well posterior to the eye; broad dark eye-stripe broadening into a distinctly triangular patch on the ear-coverts that is darker around the edges and paler in the centre, and is therefore paler than the nape; distinct, pale moustachial stripe separated from the pale throat by a thin, dark and broken malar stripe; and at least two bold, pale bars on the wing-coverts. One was photographed at South Point on 1 November 2008 (N. Pamment *in litt.*). A bird at the Chinese Cemetery on 4–5 December 2009 was identified as an Eastern Yellow Wagtail (Barrand *c.* 2009; Baxter 2009; Ramsay 2010a), as were others seen in September 2010 (Ramsay 2010d), one at the Rubbish Tip on 28 November 2010 (Baxter 2010b; Ramsay 2011a) and one in the Settlement on 29 November 2011 (Baxter 2011b). One was seen at the Golf Course in early December 2013 (Baxter 2013). The recorded dates range from 18 September to 23 April. Most records are from September to early December, with a few records from April of birds on the return migration, a pattern that matches records of the unidentified forms.

M. tschutschensis (formerly known as *M. flava simillima*) apparently is the most common form of 'Yellow Wagtail' in Australia (Schodde & Mason 1999), and it is a widespread wintering species in South-East Asia, including most of Indonesia (MacKinnon & Phillipps 1993; Robson 2000; Alström & Mild 2003).

Green-headed Yellow Wagtail *Motacilla taivana*

Vagrant. At least three records.

Nominate *taivana*. Two adults in mostly breeding plumage were seen by DJJ at the Rubbish Tip on 7 and 11 December 2003. One juvenile seen by DJJ and IAWM at the Rubbish Tip on 18 November 2006 was tentatively identified as *M. t. taivana*. It showed a dark eye-stripe that, although broadening posterior to the eye, did not form a distinctly triangular patch, was not pale in the centre, and was concolorous with the nape; and it lacked a dark malar stripe and hence a pale moustachial stripe. The status of *M. t. taivana* in Australia is uncertain (Schodde & Mason 1999), but it is widespread in South-East Asia, including Java and Wallacea (White & Bruce 1986; MacKinnon & Phillipps 1993; Robson 2000; Alström & Mild 2003).

Subspecies *macronyx*. One adult male in fresh breeding plumage was seen by DJJ at North East Point on 6 May 2004. An adult male was photographed at the Settlement on 3 May 2009 (Anon. 2009c; Ramsay 2009b; IAWM). *M. t. macronyx* (or perhaps *M. flava thunbergi*?) has been reported once in NSW (Schodde & Mason 1999), and there are reports from the Cocos (Keeling) Islands (Baxter 2006), and Broome, WA (T. Palliser *in litt.*). This subspecies is widespread wintering in mainland South-East Asia (Robson 2000) and, although not noted by MacKinnon & Phillipps (1993), it was listed for Sumatra by van Marle & Voous (1988).

Citrine Wagtail *Motacilla citreola*

Vagrant. One record. A single female was seen and photographed by L. Preston at the LB3 ponds on 5 May 2009 (L. Preston pers. comm.; Anon. 2009c; Ramsay 2009b; BARC Case 597).

This species breeds from central Europe east through central Asia to central China and south to the Himalayas and south-western China (Alström & Mild 2003; Tyler 2004; Wells 2007). It winters in Iran, Pakistan, India, Sri Lanka and South-East Asia, though may not yet have been recorded from the Greater Sundas (MacKinnon & Phillipps 1993). This is the third record for Australian territory.

Grey Wagtail *Motacilla cinerea*

Rare regular visitor between August and January, with very rare passage migrants recorded in April and May. An adult male was collected by C.W. Andrews at Flying Fish Cove on 7 October 1897, and identified as subspecies *melanope* (Sharpe 1900). It was listed as a rare visitor by van Tets (1974a, 1983). Several were seen at various locations by D. Merton in November 1977 and September–October 1978 (Stokes *et al.* 1987). Several were seen at various locations between August and December in 1983 and 1984 (Stokes *et al.* 1987). Stokes (1988) listed it as a regular visitor between September and January. Johnstone & Darnell (2004a) described it as a moderately common and fairly regular visitor between October and April, and suggested that *robusta* is the most likely subspecies. It was reported in singles and small flocks by at least 37 visiting parties in most years since 1990

(Eades 1995; Andrew 1996a; Anon. 1996a, 2000a, 2002b, 2004a, 2005b, 2006d; Craig 1996; Harvey 1996; Mitchell 1996a,b; Smith 1996; Farnes 1997; O'Connor 1999; Carter 2000b,c, 2001, 2004, 2011b; Coate 2000; Hansboro 2000a; Clarke 2001, 2011b; Stafford 2002a; Barrand & Barrand 2003; Barrand 2005b, *c.* 2009; Hobcroft 2005; Morris 2005; Dooley 2006a; Rogers 2006; Baxter 2009, 2010a,b, 2011b, 2013; Ramsay 2009c, 2010a,b,d, 2011a; James 2010; Low 2011; Marsh 2011; K. Coate *in litt.*; N. Hamilton *in litt.*; B. King *in litt.*; N. Pamment *in litt.*; IAWM). DJJ also recorded the species >70 times between 2002 and 2006. In the period 2003–2006, the earliest arrivals were in mid to late August each year, the earliest date being 12 August (in 2003). Numbers accumulated gradually so that by September or October there were usually several individuals or small flocks spread over the Island, amounting to up to 10 birds. By December, they tended to congregate in slightly larger flocks, often at the Plantation or Rubbish Tip. By mid January each year, most had left the Island, and the latest date for wintering birds was 23 January (in 2003) (DJJ). A straggler was noted in late February (in 2010) (Baxter 2010a). Later in the year, passage migrants have been recorded on 11 April in 1996 (Mitchell 1996b); 6 May in 2004 (DJJ) and 7 May in 2010 (Baxter in Ramsay 2010c). From August to November, many Grey Wagtails observed by DJJ were in first non-breeding plumage (which is similar to adult non-breeding plumage, but with a pale base to the lower mandible, faint pale fringes on feathers on the crown, mantle and wing-coverts, and a buff wash to the supercilia and breast), but by December immature birds were rarely distinguished (DJJ). Larger flocks of Grey Wagtails reported include seven in January 1996 (Anon. 1996a; Mitchell 1996a), five in December 2001 (Clarke 2001), eight in November–December 2004 (Anon. 2005b, 2006e), six in December 2005 (DJJ & IAWM), nine in December 2009 (Ramsay 2010a), and up to 11 in December 2009–January 2010 (Carter 2010b; R. Baxter pers. comm.). Field guides generally suggest that Grey Wagtails prefer habitats near water, particularly forest streams. However, in the absence of fresh water on Christmas Island they often occur on roads and tracks, particularly in the shade of large trees such as figs. Localities where the species has been recorded are spread across the Island and include the Rubbish Tip, Phosphate Hill, Irvine Hill, Plantation, Phosphate Dryers, Drumsite, Poon Saan, Flying Fish Cove, the Settlement, North East Point, Golf Course, Resort, Waterfall Cove, Ross Hill Springs, South Point, LB3 ponds, Pink House, Grants Well, Central Area Workshop, LB4, North West Point, almost the entire lengths of Murray and North West Point Roads, and numerous other roads and tracks on the central plateau and coastal terraces.

This species breeds in the Palaearctic south to southern Europe, Iran, the Himalayas and central China, and winters in Africa, South and South-East Asia, the Greater Sundas and Wallacea (Alström & Mild 2003; Tyler 2004). Elsewhere in Australian territory, it is known only as a vagrant.

White Wagtail *Motacilla alba*

Vagrant. Seven sets of reports, of up to 12 separate sightings, but only five confirmed records. A 'pied' wagtail was seen by M. Orchard (pers. comm. to M. Carter) at South Point in October or November 1993. Two adult males of

subspecies *leucopsis* were seen by P. Maher at the quarry near the Airport on 17 March 1997 (Anon. 1997c; Maher 1997), but without details this record is unconfirmed. A bird described as a cross between a Willie Wagtail *Rhipidura leucophrys* and a Magpie-lark *Grallina cyanoleuca* was seen by J. McDonald (pers. comm.) at South Point in late February 2002. An adult male of subspecies *leucopsis* was seen by DJJ and G. Holmes (2002) at the Rubbish Tip on 4–5 March 2002 (BARC Case 350). A first-year individual (probably female) of subspecies *ocularis* was seen by M. Carter and S. Dooley at the LB3 ponds on 11 March 2002, and a different first-year individual (probably a male) also of subspecies *ocularis* was seen at the Rubbish Tip on 11–12 March 2002 (Carter 2002; Holmes 2002; Dooley 2005a; DJJ; BARC Cases 339 & 340). A further two different males in non-breeding plumage of subspecies *leucopsis* were photographed on 17 March 2002 at the Rubbish Tip and South Point (Carter 2002; Dooley 2005a). To summarise, there were at least five individuals recorded between 4 and 17 March 2002, three *leucopsis* and two *ocularis*; both *ocularis* and one *leucopsis* records were submitted to BARC and accepted. One bird was seen flying over the Poon Saan shops by DJJ on 10 March 2005, but the subspecies was not determined. A male *leucopsis*, probably in first-summer plumage, was observed by DJJ at close quarters for >1 hour in the Settlement on 4 April 2006 (Palliser & Carter 2012; BARC Case 639). One bird of subspecies *leucopsis* was seen by R. Baxter, S. Pell and DJJ at the Rubbish Tip on 10–14 March 2007 (Ramsay 2007a; BARC Case 568). One bird of subspecies *leucopsis* was photographed at Ma Chor Nui Nui Temple in early March 2010 (Dooley 2010a; Ramsay 2010b; L. Preston *in litt.*). One bird was seen and heard flying over Phosphate Hill by DJJ on 4 April 2012, but the subspecies was not determined.

This species breeds in the northern Palaearctic and Alaska south to southern Europe, northern India and northern South-East Asia (Alström & Mild 2003). Northern and high-altitude populations winter south to Africa, South and South-East Asia and Borneo. There are no records of this species for Sumatra, Java or the Wallacean region (Andrew 1992; Coates & Bishop 1997), though it is common in northern Borneo (MacKinnon & Phillipps 1993).

Forest Wagtail *Dendronanthus indicus*

Vagrant. One record. A single bird was photographed by L. Preston on the Blowholes Track on 17 May 2009, and photographs were widely circulated to confirm the identification (Anon. 2009c; Ramsay 2009b; Palliser & Carter 2012; L. Preston pers. comm.; BARC Case 662).

The Forest Wagtail breeds in south-eastern Siberia, Japan, Korea and south to central China, and winters south to India, Sri Lanka, southern China, South-East Asia and the Greater Sundas (MacKinnon & Phillipps 1993; Alström & Mild 2003; Wells 2007). The only other record for Australian territory is of a long-staying individual in a suburban yard in Alice Spriings, NT, in April–September 2013 (BARC Case 811).

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In this list of references there are numerous unpublished reports. It should be noted that although the account of the birds in Andrews's monograph on Christmas Island (Andrews 1900) was said to have been written by R.B. Sharpe, the vast bulk of the information in this account was actually verbatim text supplied by Andrews himself.

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Appendix 1. Supplementary list of birds on Christmas Island

Species liberated, but now locally extinct, recorded in error, or reported, but not confirmed, are listed and discussed. The treatment is similar to the main species accounts.

Rock Dove *Columba livia*

A racing pigeon was found in the Settlement in October 1986 and taken into care (Stokes 1986a,b). It had bands that indicated that it had been released in Taiwan about one month earlier. It was released on Christmas Island after 3 weeks. Shortly afterwards, another racing pigeon, also from Taiwan, was discovered at Drumsite. One immature male found near the wharf at Flying Fish Cove in *c.* 2002 was killed by quarantine officers (NMV B.24123). One racing pigeon found in the Settlement on 1 September 2004 was captured and euthanased (WAM 36146). This bird had a band number (PRT 03 949401697 2135) that we have not yet traced. A 'confused' bird with green and purple leg bands was seen in forest near the IDC on 3 July 2011 (J. Woinarski *in litt.*).

Although the identity of these birds is not in doubt, they were not released on the Island by humans so are not introduced, nor were they wild birds. It is worth recording further records of this species for Christmas Island as self-introduced Rock Doves have become a management issue on Lord Howe Island, where they displace Grey Ternlets *Procelsterna cerulea* from nest-sites on cliffs (McAllan *et al.* 2004).

Collared Dove *Streptopelia* sp.

A dove said to be a 'Collared Dove *Streptopelia decaocto*', was noted by a Coate's Wildlife Tours group at Flying Fish Cove in early December 1993 (Johnstone & Darnell 2004a, p. 476; K. Coate *in litt.*). The locals who fed it said that it arrived on the Island on a phosphate ship. It is possible that this bird was one of several collared dove species *Streptopelia* spp.

Nicobar Pigeon *Caloenas nicobarica*

Chasen (1933a) reported that a resident of the Island visited the Raffles Museum to identify a bird that he had seen. The description led Chasen to suspect that it was a Nicobar Pigeon. Johnstone & Storr (1998) listed this species for WA from a report by R. Nojek of an immature bird that landed on a ship in the Timor Sea in February 1989. Otherwise, this species has not been recorded from Australian territory.

Swiftlets: Himalayan *Aerodramus brevirostris*, Edible-nest *A. fuciphagus*, Black-nest *A. maximus* and Mossy-nest Swiftlets *A. salanganus*

There have been many records of unidentified and/or unconfirmed *Aerodramus* swiftlets from Christmas Island recently:

A. A large unidentified swiftlet with a white rump seen by T. Stokes on 8 April 1984 near the Central Area Workshop (Stokes *et al.* 1987) might have been a very-pale-rumped *Aerodramus* swiftlet or a House Swift.

B. A dark swiftlet photographed by D. Hobcroft near the Phosphate Dryers on 2 December 1996 (Hobcroft 1996; see photograph in Eades 2001a) was first thought probably to be a Black-nest Swiftlet *A. maximus*, but is now thought more likely to be a Himalayan Swiftlet *A. brevirostris* (D. Hobcroft *in litt.*; B. van Balen *in litt.*).

C. A bird seen near the IDC by DJJ on 7 and 8 November 2005 (Anon. 2006a,c; Dooley 2006a) was thought probably to be an Edible-nest Swiftlet *A. fuciphagus*, but has now been claimed as a Himalayan Swiftlet, based upon its large size, deeply forked tail and pale rump with faint dark streaks (DJJ; BARC Case 697—not accepted).

D. Up to 20 swiftlets were seen after Cyclone Rosie at various sites (the Rubbish Tip, North East Point, near Ma Chor Nui Nui Temple and North West Point) on 23–28 April 2008 by many observers (Anon. 2008c; Dooley 2008c; Ramsay 2008c; M. Carter, F. O'Connor & T. Palliser pers. comm.; IOSG delegates pers. comm.; IAWM). They appeared to be of two species: the more common and paler types have been claimed as Edible-nest Swiftlet (BARC Case 577—not accepted) and some all-dark types with slightly forked tails have been claimed as the Mossy-nest Swiftlet *A. salanganus* (BARC Case 578—not accepted).

E. A bird considered as either a Black-nest or an Edible-nest Swiftlet was seen briefly on 10–11 December 2009 by a tour group near the entrance to the IDC (Baxter 2009; Ramsay 2010a).

F. A bird considered to be a Mossy-nest Swiftlet was seen at the Airport on 30 November 2010 (Baxter 2010b; Dooley 2011a; Ramsay 2011a). This was also reported as a possible Black-nest Swiftlet in early December 2010 (Dooley 2011a).

G. A dark swiftlet with a slightly notched tail seen near the Resort on 29 January 2011 was considered to be a Mossy-nest Swiftlet (Marsh 2011).

H. A tour group reported a single unidentified 'nest swiftlet' at South Point, and four Edible-nest Swiftlets and a Himalayan Swiftlet at North West Point, all on 29 November 2011 (Baxter 2011b; Dooley 2012a). These were followed by reports of four Edible-nest Swiftlets on 30 November and a Mossy-nest Swiftlet on 2 December 2011 at North West Point (Baxter 2011b; Dooley 2012a).

I. A single bird, believed to be an Edible-nest Swiftlet, was observed along the North South Baseline on 9 December 2011 (Barrand c. 2011).

The Himalayan Swiftlet breeds in southern Asia (north-western and north-eastern India, southern China, Nepal, Bhutan south to Bangladesh, Laos, Myanmar and Thailand), and is a passage migrant through Peninsular Malaysia, apparently Sumatra and probably Singapore. The Black-nest Swiftlet is widespread in South-East Asia from Myanmar to Peninsular Malaysia and the Greater Sunda Islands, and is thought to be sedentary. The Mossy-nest Swiftlet is endemic to the Greater Sundas and is largely sedentary. Traditionally, the Edible-nest Swiftlet has been considered a widespread resident of southern Asia, from the Andaman and Nicobar Islands through mainland South-East Asia, the Greater Sundas, and east to Timor in the Lesser Sundas and Palawan in the Philippines, with several subspecies that are not all adequately described (Chantler & Driessens 2000). This broad species definition includes only swiftlets with 'white' or 'edible' nests, but it includes dark forms and forms that are paler with pale rumps. Separation of dark-rumped forms (*A. fuciphagus* with *vestitus, micans* and *dammermani*) from paler forms (*A. inexpectatus* with *germani* and *perplexus*) creates two allopatric species with consistent and different appearances instead of one that is extremely variable (Robson 2000; Cranbrook *et al.* 2013; Earl of Cranbrook *in litt.*). Of these two, only the dark *A. fuciphagus* (*sensu stricto*) occurs naturally in the Greater Sundas and Lesser Sundas (Chantler & Driessens 2000; Lim & Cranbrook 2002), whereas the paler *A. inexpectatus* occurs in coastal mainland South-East Asia and the Andaman Islands. The 'farming' of swiftlets in South-East Asia for their nests has complicated this situation greatly. Genetic and morphological evidence indicates that various hybrids from *A. fuciphagus* × *A. i. germani* dominate semi-domesticated populations in swift farm houses throughout South-East Asia (Cranbrook *et al.* 2013). These hybrids are frequently sympatric with their pure parental forms still nesting in natural situations (i.e. caves). Many of the claims of Edible-nest Swiftlets from Christmas Island seem to be pale swiftlets that could be farm swiftlets or a natural population of *A. inexpectatus* or *A. brevirostris*. The darker birds could be *A. fuciphagus* (*sensu stricto*), *A. salanganus* or *A. maximus*,

which are extremely difficult species to identify in the field. Other reports of *Aerodramus* swiftlets from Australian territory include at least five from Broome, WA, two from the Cocos (Keeling) Islands, and three from Ashmore Reef (Hopton 2006; A. Boyle, M. Carter, J. Darnell, J. Reid & G. Swann pers. comm.). An individual photographed near Broome, WA, on 15 February 2001 was accepted by BARC as either an Edible-nest or a Black-nest Swiftlet (Palliser 2004; BARC Case 342), and the other reports are unconfirmed.

Silver-backed Needletail *Hirundapus cochinchinensis*/Brown-backed Needletail *H. giganteus*

Three birds provisionally identified as Brown-backed Needletails were seen at the Rubbish Tip by M. Carter *et al.* on 14 November 2001 and on the road leading to the Airport the following day (Carter 2001; Anon. 2002a,b; Stafford 2002a). However, the identity of the species was not considered confirmed by BARC (Palliser 2004; BARC Case 344—not accepted). An individual of one of these two species was seen by DJJ at the corner of Murray Road and Jedda Cave Track on 11 February 2002. DJJ considered it more likely to be a Silver-backed Needletail, but the case submitted to BARC argued that it was either Silver-backed or Brown-backed Needletail, and it was accepted as such (Palliser 2004; BARC Case 385). A bird seen at the Rubbish Tip on 23 April 2008, initially thought to be a Silver-backed Needletail, was probably a first-year White-throated Needletail (see White-throated Needletail in species accounts). A bird claimed as a Silver-backed Needletail was seen at the Rubbish Tip on 26 November 2008, but has not been vetted (Baxter 2008b; R. Baxter *in litt.*). Otherwise, these species have not been reported from Australian territory.

Dark-rumped Swift *Apus acuticauda*

One bird, possibly of this species, was seen by M. Carter, P. Crabtree, K. Harris and G. Walker at the Ma Chor Nui Nui Temple on 18 November 1999 (Carter 2000a,b), but the record was considered unconfirmed (BARC Case 288—not accepted). BARC noted that it could possibly have been a Common Swift *A. apus* or an aberrantly plumaged Fork-tailed Swift. Otherwise, this species has not been recorded from Australian territory.

Jouanin's Petrel *Bulweria fallax*

This species was possibly seen at sea off Christmas Island by D. Mantle (*in litt.*) in 2008. Elsewhere in Australian territory, it has been recorded only from near Ashmore Reef, although there is an unconfirmed claim from the Cocos (Keeling) Islands (Baxter 2010b).

Tahiti Petrel *Pseudobulweria rostrata*

One was said to be recorded by F.T.H. Smith in 1994 (Barkla 1996). This species breeds on islands in the Pacific Ocean and is regularly found west to the Moluccas, and Lesser Sundas near Timor (Coates & Bishop 1997) and near Scott and Ashmore Reefs in the Timor Sea (M. Carter pers. comm.; DJJ). It is unknown from the Indomalayan Region proper (Andrew 1992; Inskipp *et al.* 1996).

Masked Booby *Sula dactylatra*

D.M. Simpson reported '100 Blue-faced Boobies' 45–60 nm east of the Island on 20 June 1967 (Simpson 1970; also Bourne & Dixon 1973). It is unclear what species was being referred to here. Blue-faced Booby is an alternative common name for Masked Booby, which is not definitely known from Christmas Island and nearby waters. It may have been a reference to Red-footed Boobies, which have blue faces, or perhaps Abbott's Boobies, though the number reported is large for this last species. R. Baxter (*in litt.*) listed two during a trip from 28 February to 3 March 2008. Occasionally, Masked Boobies are reported by

visiting tourists, but none have been confirmed with detailed descriptions or photographs. The nearest breeding stations for Masked Boobies are the Cocos (Keeling) Group and islands off the WA coast (Johnstone & Storr 1998; Johnstone & Darnell 2004a). Dickinson (2003) erroneously listed the Masked Booby as breeding on Christmas Island, but not the Cocos (Keeling) Group.

Chinese Egret *Egretta eulophotes*

Stokes (1988) and Marchant & Higgins (1990) discredited an old record of the Chinese Egret from the Island, as a misidentified Eastern Reef Egret, but introduced additional confusion in the process. They referred to a specimen said to be collected by Captain J.P. Maclear in January 1887 that was identified by Sharpe (1887) as *E. eulophotes*. Maclear did collect a white egret, but Sharpe (1887) identified it as *Ardea jugularis* (= Eastern Reef Egret *Egretta sacra*), not *eulophotes*. In fact, Sharpe never identified Maclear's specimen as *eulophotes* in any publication. In his *Catalogue of the Birds of the British Museum*, Sharpe (1898) treated *eulophotes* as a synonym of *sacra*, but commented that he did so with 'great hesitation' (p. 141) and he was evidently unsure of any differences between the two taxa. In two minds, he then went on to state that some of the specimens including 'Mr Lister's bird from Christmas Island are undoubtedly *eulophotes*' (p. 142). J.J. Lister (1889) had collected two egrets in October 1887 and identified them himself as *Ardea jugularis*. They were a white-morph male and a grey-morph female (Lister 1889). Subsequently, Sharpe (1900) listed all the specimens of small egrets collected by Maclear, Lister and Andrews (in 1897–1898) as *Demiegretta sacra* (= Eastern Reef Egret *E. sacra*). This reflected his continuing synonymy of *eulophotes* under *sacra* rather than a reidentification of Lister's specimen. Chasen (1933a, 1935), Gibson-Hill (1947) and van Tets (1974a, 1983) listed both *sacra* and *eulophotes* for Christmas Island. Chasen and Gibson-Hill cited Sharpe (1898) to justify the inclusion of *eulophotes*, but treated it as a full species. According to Stokes (1988) and Marchant & Higgins (1990), P. Colston of the British Museum (*in litt.* to P. Higgins) confirmed that 'Maclear's' specimen was in fact *sacra*, although this was never the specimen in doubt. We cannot confirm whether or not Colston examined Lister's specimens as well, but in any case these are most unlikely to be *eulophotes*.

Spoonbill *Platalea* sp.

A spoonbill of an unknown species was seen independently by A. Yon (pers. comm.) and G. Foo (pers. comm.) as it walked around the streets of Poon Saan over several days in January 2005.

Harrier *Circus* sp.

A Swamp Harrier *C. approximans* was reported by G. Robertson in the mid 1980s (ANPWS file). The file was compiled by T. Stokes, but neither Stokes *et al.* (1987) nor Stokes (1988) listed harriers of any species. Barkla (1996) expressed the opinion that a Western Marsh Harrier *C. aeruginosus* 'listed by Stokes' was more likely to be an Eastern Marsh Harrier *C. spilonotus*. Stokes listed no harriers at all for Christmas Island, and it is likely that Barkla was erroneously referring to a harrier specimen collected from the Cocos (Keeling) Islands in 1941 (Gibson-Hill 1949c; Stokes *et al.* 1984; Morioka & Yang 1996). This last specimen is still in the ZRC, and is apparently a Swamp Harrier (IAWM). A harrier of unknown species was photographed (distantly) at the Airport on 18 January 2008 (M. Roderick pers. comm.). Another possible harrier seen at Silver City on 31 January 2011 (Marsh 2011) was subsequently claimed as an Oriental Honey-buzzard (BARC Case 696), but was not accepted.

Eurasian Hobby *Falco subbuteo*

There was a possible sighting of this species by J. Reid in November 1997 (Johnstone & Darnell 2004a). One was reported by two tour groups in March 2007 (Anon. 2007b; Baxter 2007; Dooley 2007b; Ramsay 2007a; M. Carter *in litt.*). It was initially identified as an Oriental Hobby *F. severus*, but photographs, though poor, showed the bird to be most probably a Eurasian Hobby (Baxter 2007; M. Carter *in litt.*; W. Clarke *in litt.* to D. Hobcroft; BARC Case 533—not accepted). The species has since been reported from the Cocos (Keeling) Islands on 5 December 2010 (James 2010; BARC Case 682).

Buff-banded Rail *Gallirallus philippensis*

One was reported by D. Merton in Silver City on 18 January 1978 (ANPWS file). However, the record was not presented in Stokes *et al.* (1987), and therefore is questionable.

'Eastern Golden Plover' *Pluvialis apricaria*

Pearson (1966, p. 70) carelessly listed Pacific Golden Plover as '*Charadrius apricarius* Gmelin. Eastern Golden Plover'.

Caspian Plover *Charadrius asiaticus*

Records of the Caspian Plover from Christmas and the Cocos (Keeling) Islands are derived from earlier treatment of the Oriental Plover *C. veredus* as a subspecies of Caspian Plover *C. asiaticus* (e.g. Gibson-Hill 1949c; Pearson 1966).

Grey Phalarope *Phalaropus fulicarius*

An adult in non-breeding plumage was seen by DJJ at sea off Hospital Point on 31 October 2004, but the record was not accepted (BARC Case 638).

Roseate Tern *Sterna dougallii*

A possible Roseate Tern was noted by J. Barkla and C. Lester in Flying Fish Cove on 27–29 October 1996 (Barkla 1996; Lester 1997). The bird was in very heavy moult. 'From the field notes, we have now concluded it was a probable Roseate Tern, although the condition of the bird's plumage makes it impossible to be certain' (Lester 1997, p. 12).

Elegant Tern *Thalasseus elegans*

A Lesser Crested Tern seen at Flying Fish Cove on 23–27 April 2008 was at one point suggested to be an Elegant Tern (e.g. Ramsay 2008d), and has erroneously entered the field-guide literature (Slater *et al.* 2009).

Rose-ringed Parakeet *Psittacula krameri*

A pair was present from the mid 1970s until about early 1987 (Stokes *et al.* 1987; Stokes 1988). A single male was noted by several observers from early August 1990 until July 2004 (Farnes 1997; Barrand & Barrand 2003; K. Coate *in litt.*; DJJ). It was recorded at the Settlement, near the Chinese Cemetery and at Silver City. From December 2003 to July 2004, DJJ saw it in his yard in Silver City on a weekly basis, and sometimes in the eastern end of the Settlement, but it was not recorded subsequently. At this time, several residents were aware of the parrot, and common rumours on the Island were that a pair was released from a visiting ship or by a former harbour-master many years earlier. Evidently one of the original birds survived for almost 30 years. However, no breeding population ever established.

Parrot Psittacidae sp.

A 30-cm-long parrot with dark plumage and an erect crest was seen in flight by D. Merton near Lily Beach on 7 May 1977 (Stokes *et al.* 1987). It was not listed by Stokes (1988).

Asian Drongo-Cuckoo *Surniculus lugubris*

An immature was reported without details by E. Ervasti and G. Lindstrom at the Settlement on 6 March 2001 (Robson 2001). Otherwise, this species has not been recorded from Australian territory.

Indian Cuckoo *Cuculus micropterus*

A possible Indian Cuckoo seen in early November 1995 was not positively identified (Andrew 1995).

Bee-eater *Merops* sp.

P. Green (pers. comm. to DJJ) reported a secondhand observation of an unidentified bee-eater at the Settlement in May 2002 (Anon. 2002d).

Wheatear *Oenanthe* sp.

An unidentified wheatear was photographed opposite the Golf Course on 14 January 1996 (Andrew 1996a; Anon. 1996a,b; Beruldsen 1996; Mitchell 1996a). Although the Northern Wheatear *O. oenanthe* appeared the most likely contender (Beruldsen 1996; Johnstone & Darnell 2004a), the bird could not be definitively identified (Palliser 1999; BARC Case 214—not accepted). Another bird seen on 30 November 1998 may have been an Isabelline Wheatear *O. isabellina* (Johnstone & Darnell 2004a; K. Coate *in litt.*).

Javan Myna *Acridotheres javanicus*

A specimen was collected by Dr R. Hanitsch in 1904 for the ZRC, though it is missing now (Chasen & Kloss 1924; IAWM). Gibson-Hill (1947) reported that an escaped bird was seen for about a week in June 1939. This species was not recorded in 1923 (Chasen & Kloss 1924) or 1932 (Chasen 1933a). There is no evidence of deliberate introduction or of breeding in the wild, and the two were evidently cage birds that escaped on separate occasions.

Hill Myna *Gracula religiosa*

A specimen was collected by the Dayak collectors for the ZRC in October–November 1923 (Chasen & Kloss 1924). Presumably this is the same unregistered female specimen presently in the ZRC that was collected on 7 November 1923 (IAWM). This species was absent in 1932 (Chasen 1933a). There is no evidence of deliberate introduction, or of breeding. This record has usually been regarded as an escaped captive bird.

Flowerpecker *Dicaeum* sp.

One female was reported in May 1996 (Andrew 1996b), but the record has since been withdrawn (T. Palliser pers. comm.).

Red-throated Pipit *Anthus cervinus*

A single pipit seen by F.A.R. Hill in February 1994 was described as a 'pipit with a rufous throat – presumably a Red-throated Pipit', although the views were 'less than ideal' (Andrew & Eades 1994).

Pipit *Anthus* sp.

There has been much speculation on the identity of a pipit collected by two Dayak collectors for the ZRC in October or November 1923 (Chasen & Kloss 1924). The situation is made complicated by changing species boundaries, complex nomenclature, and the disappearance of the specimen. This specimen was originally identified as Richard's Pipit *A. richardi malayensis* (Chasen & Kloss 1924). Chasen (1933a) subsequently expressed doubt that the bird was *malayensis* because it was too large, but he still listed it as *A. novaeseelandiae malayensis*. This reflected only a taxonomic change at a higher level. In his *Handlist of Malaysian Birds*, Chasen (1935) listed the specimen as Tawny Pipit *Anthus campestris striolatus* Blyth 1847 (described from Darjiling [= Darjeeling], India), and the only record for the Malaysian region as he defined it. In a footnote, he admitted that there was 'One specimen only, a puzzling bird and identification not absolutely certain' (Chasen 1935, p. 287). Gibson-Hill (1947) listed the specimen as *Anthus campestris striolatus* without comment, but subsequently considered the identification 'doubtful' (Gibson-Hill 1949d, p. 225). However, *striolatus* is a subspecific name that was used in association with more than one species. *A. striolatus* was treated as a full species by Sharpe (1895), but was synonymised without mention within the monotypic Blyth's Pipit *A. godlewskii* in *Peters' Checklist* (Mayr & Greenway 1960). Without re-examining the specimen, Stokes (1988) considered that the measurements more likely fitted *A. novaeseelandiae* (in the broadest sense). Johnstone & Darnell (2004a) believed it might have been either a form of Richard's Pipit *A. richardi sinensis* or *A. r. urensis*, or a Blyth's Pipit, because both the Paddyfield Pipit *A. rufulus* (in which *malayensis* is now placed) and Tawny Pipit do not fit the wing measurement quoted by Chasen (1933a). These arguments are less than compelling, however. Chasen (1935) had specimens of *sinensis* from Sumatra, but saw no association between them and this troublesome specimen, whereas Blyth's Pipit breeds in Siberia, Mongolia and China, and winters no closer to Christmas Island than the Indian Subcontinent and occasionally northern Myanmar (Robson 2000). The Christmas Island specimen could not be located at the ZRC by DJJ in 2003 and 2004 and IAWM in 2008 and 2009.

A report of 'Richard's Pipit *A. novaeseelandiae*' by D. Merton in Silver City on 22 October 1977 (Stokes *et al.* 1987) lacks sufficient detail to determine its specific status (Johnstone & Darnell 2004a).

Appendix 2. Species list and status of birds on Christmas Island

This listing is of all the bird species known from Christmas Island and surrounding waters, excluding those escapee species known to be extinct (see Appendix 1). Status codes: A = abundant, C = common, U = uncommon, R = rare, V = vagrant; B = breeding species, vis = regular visitor, pas = passage migrant, irr = irregular visitor, I = introduced breeding species; ? = status indeterminate.

Species	*Status*	*Species*	*Status*
Feral Chicken	U I	Intermediate Egret	V
Garganey	V	Purple Heron	V
Sunda Teal	V	Cattle Egret	V
Hardhead	V	Striated Heron	R irr
Red-tailed Tropicbird	C B	Chinese Pond Heron	V
White-tailed Tropicbird	A B	Javan Pond Heron	V
Red Collared Dove	?	Pied Heron	V
Emerald Dove	C B	White-faced Heron	R B
Christmas Island Imperial-Pigeon	A B	Little Egret	V
Pied Imperial-Pigeon	V	Eastern Reef Egret	R B
Savannah Nightjar	V	Nankeen Night-Heron	R irr
Grey Nightjar	V	Malayan Night-Heron	V
Christmas Island Swiftlet	A B	Japanese Night-Heron	V
White-throated Needletail	V	Glossy Ibis	V
Fork-tailed Swift	R irr	Oriental Honey-buzzard	V
House Swift	V	White-bellied Sea-Eagle	V
Matsudaira's Storm-Petrel	V	Christmas Island Goshawk	U B
White-faced Storm-Petrel	V	Chinese Sparrowhawk	V
Antarctic Prion	V	Japanese Sparrowhawk	V
Bulwer's Petrel	V	Nankeen Kestrel	U B
Wedge-tailed Shearwater	R vis	Peregrine Falcon	V
Barau's Petrel	V	Baillon's Crake	V
Herald Petrel	V	Ruddy-breasted Crake	V
Lesser Frigatebird	R B	White-breasted Waterhen	R B
Great Frigatebird	C B	Watercock	V
Christmas Island Frigatebird	C B	Black-tailed Native-hen	V
Abbott's Booby	C B	Eurasian Coot	V
Red-footed Booby	A B	Sooty Oystercatcher	V
Brown Booby	A B	Black-winged Stilt	V
Great Cormorant	V	Pacific Golden Plover	R vis
Little Black Cormorant	V	Grey Plover	V
Australian Pelican	V	Little Ringed Plover	V
Yellow Bittern	V	Kentish Plover	V
Schrenck's Bittern	V	Lesser Sand Plover	V
Cinnamon Bittern	V	Greater Sand Plover	V
Black Bittern	V	Oriental Plover	V
Eastern Great Egret	R irr	Masked Lapwing	V

Appendix 2 continued

Species	*Status*	*Species*	*Status*
Pin-tailed Snipe	R vis?	Lesser Crested Tern	V
Swinhoe's Snipe	V	Crested Tern	V
Bar-tailed Godwit	V	Mew Gull	V
Little Curlew	V	Asian Koel	R vis?/B?
Whimbrel	V	Horsfield's Bronze-Cuckoo	V
Eastern Curlew	V	Pallid Cuckoo	V
Terek Sandpiper	V	Himalayan Cuckoo	R pas
Common Sandpiper	R vis	Large Hawk-Cuckoo	V
Grey-tailed Tattler	V	Christmas Island Hawk-Owl	C B
Common Greenshank	V	Common Kingfisher	V
Marsh Sandpiper	V	Sacred Kingfisher	V
Common Redshank	V	Collared Kingfisher	V
Wood Sandpiper	V	Dollarbird	V
Ruddy Turnstone	R irr	Fairy Pitta	V
Great Knot	V	Blue-winged Pitta	V
Red Knot	V	White-bellied Cuckoo-shrike	V
Sanderling	V	Brown Shrike	V
Red-necked Stint	V	Tiger Shrike	V
Long-toed Stint	V	Oriental Reed-Warbler	V
Pectoral Sandpiper	V	Pallas's Grasshopper Warbler	V
Sharp-tailed Sandpiper	V	Dusky Warbler	V
Curlew Sandpiper	V	Christmas Island White-eye	A B
Red-necked Phalarope	V	Barn Swallow	R vis/pas
Oriental Pratincole	R irr pas	Tree Martin	V
Australian Pratincole	V	Red-rumped Swallow	V
Brown Skua	V	Asian House Martin	R vis
Pomarine Jaeger	V	Blue-and-white Flycatcher	V
Arctic Jaeger	V	Island Thrush	A B
Common Noddy	A B	Purple-backed Starling	V
Lesser Noddy	V	Java Sparrow	R I
White Tern	V	Eurasian Tree Sparrow	C I
Bridled Tern	V	Eastern Yellow Wagtail	R pas
Sooty Tern	R vis	Green-headed Yellow Wagtail	V
Little Tern	V	Citrine Wagtail	V
Gull-billed Tern	V	Grey Wagtail	R vis/pas
Whiskered Tern	R irr	White Wagtail	V
White-winged Black Tern	V	Forest Wagtail	V
Common Tern	V		

Appendix 3. Gazetteer of locations on Christmas Island used in the text

Locations are listed alphabetically. Not all locations are proper names. 'The' has been omitted in all cases, even when it is part of a proper name. Roads and tracks are mostly listed beginning with 'corner of'. Geographical co-ordinates are degrees, minutes and seconds South and East, and are mostly accurate to within 100 m. This gazetteer does not include locations away from Christmas Island.

Location	*Latitude and longitude*	*Location*	*Latitude and longitude*
Airport	10°27′04″, 105°41′19″	Dales	10°28′45″, 105°33′28″
Andersons Dale	10°28′57″, 105°33′18″	Daniel Roux Cave	10°26′20″, 105°39′46″
Blowholes	10°30′53″, 105°37′21″	Dolly Beach	10°31′12″, 105°40′37″
Central Area Workshop	10°28′39″, 105°37′48″	Douglas Point	10°30′16″, 105°34′10″
Chalk Pits at northern end of Airport	10°26′33″, 105°41′20″	Drumsite	10°25′55″, 105°40′24″
		Egeria Point	10°30′51″, 105°32′13″
Chinese Cemetery	10°25′00″, 105°41′15″	Ethel Beach	10°27′50″, 105°42′28″
Christian Cemetery near Settlement	10°25′01″, 105°40′59″	Field 19	10°30′05″, 105°37′58″
Cocos Padang	10°25′04″, 105°40′29″	Field 22	10°29′10″, 105°36′44″
Corner of Blowholes Track & East West Baseline	10°30′03″, 105°39′12″	Field 23	10°28′38″, 105°36′48″
		Flying Fish Cove	10°25′46″, 105°40′13″
Corner of Dales Track & Winifred Beach Track	10°28′36″, 105°34′27″	Fuel buoys off Smith Point	10°25′55″, 105°39′40″
Corner of Murray Road & East West Baseline	10°29′23″, 105°37′16″	General Manager's Residence at Rocky Point	10°25′02″, 105°40′56″
Corner of Murray Road & Jedda Cave Track	10°28′02″, 105°38′19″	George Fam Centre	10°25′17″, 105°40′27″
Corner of North South Baseline & Dolly Beach Track	10°29′10″, 105°40′09″	Golf Course	10°25′34″, 105°42′05″
		Grants Well	10°28′53″, 105°39′07″
Corner of North South & East West Baselines	10°30′13″, 105°39′24″	Greta Beach	10°30′08″, 105°40′29″
		Grimes Cave	10°26′25″, 105°39′44″
Corner of Research Station Road ('Pink House Track') & East West Baseline	10°29′47″, 105°38′57″	Grotto	10°25′20″, 105°42′06″
		High School in Drumsite	10°26′08″, 105°40′07″
Corner of Research Station Road ('Pink House Track') & Murray Road	10°28′15″, 105°38′06″	Hosnies Springs	10°28′34″, 105°41′31″
		Hospital	10°25′31″, 105°41′00″
		Hospital Point	10°24′58″, 105°40′26″

Appendix 3 continued

Location	*Latitude and longitude*	*Location*	*Latitude and longitude*
Hughs Dale	10°28′45″, 105°39′11″	Parks Office at Drumsite	10°25′58″, 105°40′12″
IDC	10°28′19″, 105°34′36″	Parks Nursery at Drumsite	10°25′57″, 105°40′09″
Irvine Hill	10°26′29″, 105°40′29″	Phosphate Dryers	10°26′32″, 105°40′02″
Isabel Beach	10°25′26″, 105°40′20″	Phosphate Hill	10°25′57″, 105°41′24″
Jedda Cave	10°29′14″, 105°38′42″	Pink House Research Station	10°29′31″, 105°38′50″
Kampong	10°25′42″, 105°40′18″	Plantation	10°26′59″, 105°39′39″
LB3	10°29′56″, 105°39′11″	Poon Saan	10°25′21″, 105°40′56″
LB4 Lookout	10°28′41″, 105°36′07″	Poon Saan Shops	10°25′22″, 105°40′52″
Lily Beach	10°28′01″, 105°42′40″	Post Office Padang	10°25′36″, 105°40′22″
Lily Beach Road	10°27′52″, 105°42′18″	Power Station	10°26′28″, 105°40′05″
Linkwater Road	10°27′29″, 105°42′09″	Quarry Road Industrial Area	10°25′26″, 105°41′28″
Low Point	10°28′01″, 105°42′46″	Recreation Centre	10°26′05″, 105°40′58″
Ma Chor Nui Nui Temple	10°26′47″, 105°42′30″	Resort	10°27′20″, 105°42′17″
Margaret Beaches	10°26′56″, 105°39′06″	Rhoda Beaches	10°27′41″, 105°37′37″
Margaret Knoll	10°28′38″, 105°41′03″	Rocky Point	10°24′53″, 105°40′32″
Martin Point	10°27′46″, 105°33′07″	Ross Hill Springs	10°29′19″, 105°40′34″
McMicken Point	10°31′22″, 105°40′37″	Rubbish Tip	10°26′10″, 105°41′11″
Medwin Point	10°33′54″, 105°40′03″	Rumah Tinggi	10°24′56″, 105°40′52″
Middle Point	10°30′41″, 105°35′42″	Settlement (at the Barracks)	10°25′06″, 105°40′27″
Migrant Hill*	10°28′30″, 105°34′47″	Sewage Treatment Plant at Smith Point	10°25′53″, 105°39′45″
Mooring buoys off Smith Point	10°25′55″, 105°39′40″	Silver City	10°25′20″, 105°40′35″
Noodle House in Settlement	10°25′17″, 105°40′23″	Smith Point	10°25′41″, 105°39′47″
Norris Point	10°26′35″, 105°42′32″	Smithsons Bight	10°31′25″, 105°37′34″
North East Point	10°24′50″, 105°42′06″	South Point (eastern shore terrace)	10°33′20″, 105°39′58″
North West Point (tip)	10°26′30″, 105°33′08″		
Old Chinese Cemetery on Phosphate Hill	10°25′31″, 105°41′48″		

Appendix 3 continued

Location	*Latitude and longitude*	*Location*	*Latitude and longitude*
South Point (tip)	10°33′56″, 105°39′15″	Territory Day Park	10°25′56″, 105°40′06″
South Point (western shore terrace)	10°33′07″, 105°38′19″	Toms Ridge	10°28′27″, 105°34′40″
South Point Temple	10°33′28″, 105°38′45″	VQ3 Lodge in Settlement	10°25′01″, 105°40′30″
Sports Ground	10°26′02″, 105°40′56″	Waterfall Cove	10°27′34″, 105°42′19″
Steep Point	10°28′13″, 105°42′37″	West White Beach	10°27′44″, 105°34′53″
Stronach Hill	10°29′36″, 105°40′03″	Wharf	10°25′33″, 105°40′17″
Tai Jin House	10°25′43″, 105°39′54″	Winifred Beach	10°29′49″, 105°32′47″
Taman Sweetland	10°25′24″, 105°40′57″	Winifred Gate	10°28′45″, 105°34′24″
Temple Court in Settlement	10°25′15″, 105°40′25″		

* We use the coined name ‘Migrant Hill’ for the crest of the cliff overlooking North West Point and the IDC. This feature has no official name. Confusingly, it has been called Murray Hill, Powells Hill and Jacks Hill in birding reports in recent years. It was nicknamed ‘Helicopter Hill’ by Parks Australia staff in 2002 and ‘Media Hill’ more recently by journalists filming the IDC. It appears as an inland cliff on the north-western edge of a massif formed by Murray, Powells, Jacks and other hills.

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Front cover: Golden White-tailed Tropicbird. Photo: Ian A.W. McAllan

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