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The terrestrial vertebrate fauna of the Montebello Islands, Western Australia

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ABSTRACT

The indigenous terrestrial vertebrate fauna of the Montebello Islands consists of five mammal, 70 bird and 21 reptile species. Three species of exotic mammals occur: Feral Cats and Black Rats were introduced in the 19th Century and the House Mouse was first recorded in 1983. Black Rats have probably been eradicated. Extinctions of the Spectacled Hare-wallaby (Hermite and Trimouille Islands) and the Golden Bandicoot (Hermite Island) are attributed to the exotic mammals. Extinctions of the Black-and-white Fairy-wren and Spinifexbird are attributed to exotic mammals on Hermite Island, but nuclear weapons testing in the 1950s may have been the cause if these species occurred on Trimouille Island in 1950.

INTRODUCTION

The Montebello (previously named Monte Bello) Islands (Fig. 1) lie in 20°21'30" to 20°31'55"S, 115°29'55" to 115°36'30"E and are off the Pilbara coast of Western Australia (WA), about 20 km north of the northern tip of Barrow Island and 80 km north-west of Cape Preston on the adjacent mainland. The closest port is Dampier, about 120 km to the east.

All islands are within Class A Reserve No. 42196, Conservation Park, while the land between high and low water is Class C Reserve 42197, Conservation Park. Both reserves are vested in the Western Australian National Parks and Nature Conservation Authority and managed by the Department of Conservation and Land Management (CALM). Faraday Pearls lease some of the bays under the Fish Resources Management Act and oyster lines are moored in many sheltered bays and inlets. Unofficial island names, currently under consideration as official names, are given in quotation marks.

The Montebellos is an archipelago of about 180 islands, islets and rocks varying in size from Hermite Island (1022 ha) and Trimouille Island (522 ha) to rocks of a few square metres (Fig. 1). Most of the western islands are composed of limestone with low coastal cliffs and occasional pale orange-brown alluvial sand plains and white sand beaches. There are moderately high cliffs on the west coast of Hermite Island, in the southern parts of Trimouille Island, the eastern parts of South East Island and surrounding Karangi Island. The northern islands (North West, Trimouille, South East) and the southernmost substantial island (Ah Chong) have extensive white sand plains and low dunes and beaches between limestone headlands. There are some areas of mangrove, mainly *Avicennia marina* with some *Rhizophora stylosa*, especially on Hermite Island. A fringing coral reef lies to the west and the waters adjacent to the islands have many reefs, shoals and sandbanks.

The islands have a tropical arid climate. The nearest weather station is on Barrow Island, where records have been kept since 1967. Barrow Island has a mean maximum daily temperature of 30.3°C and a mean minimum daily temperature of 21.4°C. The hottest months are February and March with mean maximum daily temperatures of 33.4°C, while the highest temperature recorded is 45.0°C. The coolest month is July with a mean maximum daily temperature of 16.9°C, while the lowest temperature recorded is 6.7°C. Most rain comes from summer tropical cyclones and thunderstorms and autumn and early winter middle level disturbances. The mean annual rainfall is 320.3 mm; the wettest months are June (mean 64.6 mm), March (60.8 mm), February (55.0 mm) and April (48.5 mm). The wettest month on record is 315.6 mm (February) and the highest daily rainfall was 210 mm (June). Drought is common, with all months having records of nil rainfall and 10 per cent of years having rainfall below 154.1 mm. Temperatures at the Montebellos would be slightly less extreme than on the larger Barrow Island, where the weather station is in the centre of the island. Rainfall from thunderstorms may be less than on Barrow, again because of the smaller area of land.

Hill (1955) and Burbidge (1971) have briefly described the vegetation of the islands. Limestone areas are dominated by *Triodia* hummock grassland with scattered low shrubs, while sandy areas have grasses and sedges

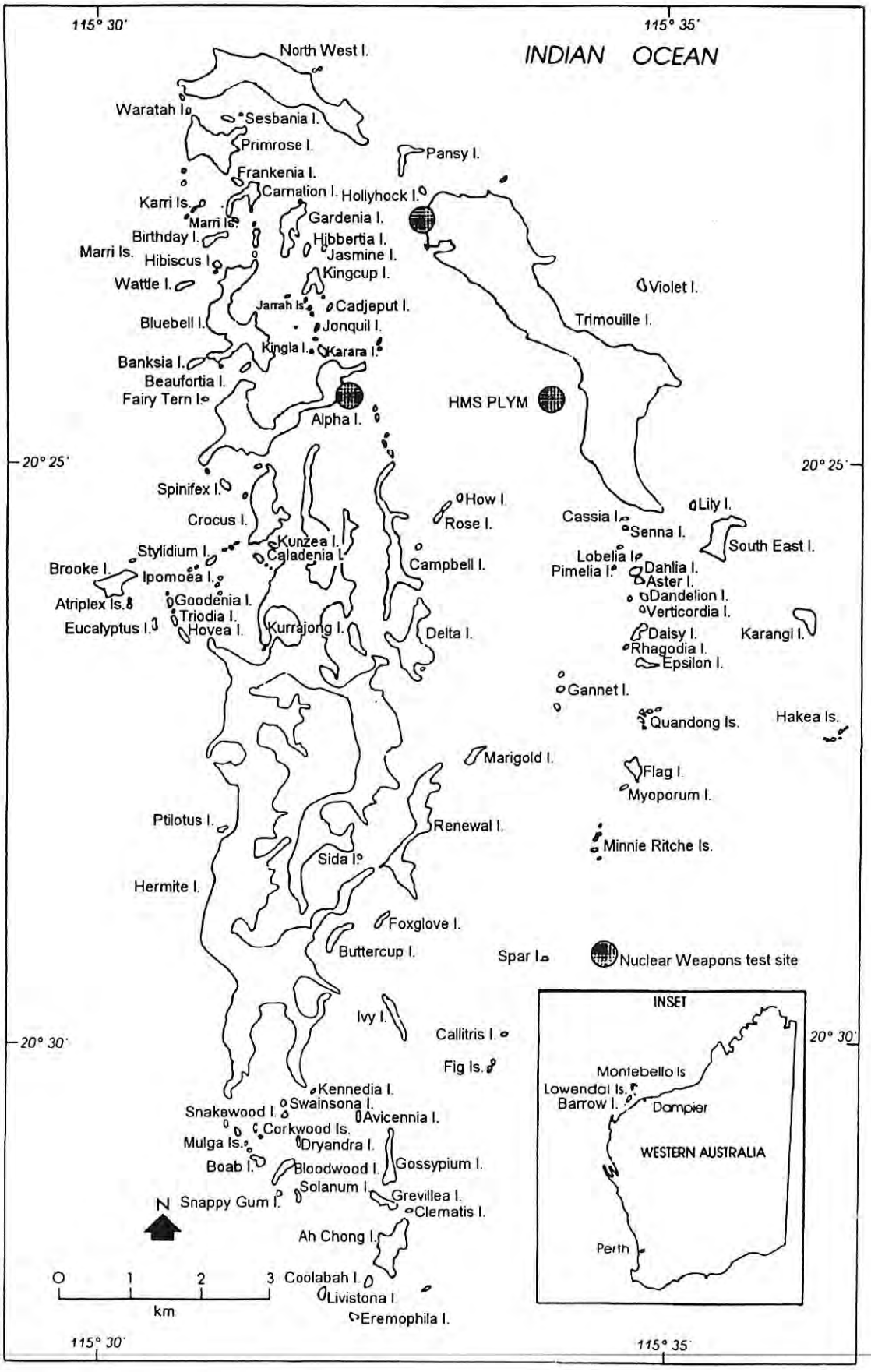

Figure 1. Montebello Islands, Western Australia.

with low shrubs (mainly *Acacia* spp.). Small patches of mangroves occur in sheltered bays, with larger areas in Stephenson Channel, Hermite Island.

In 1952 and 1956, the islands were used by the British as a site for testing atomic weapons (Cooper and Hartley 1979; Australian Ionising Radiation Safety Council (AIRSC) 1983; Cathcart 1994). Three nuclear devices were exploded. The first, in October 1952, was placed below the waterline in a corvette, HMS *Plym*, anchored off Main Beach, Trimouille Island, and resulted in considerable long term contamination of the northern two-thirds of Trimouille. The second and third weapons were exploded on 30 m towers, one at Point Gladstone, at the northern tip of Trimouille Island, and the other near Burgundy Bay on Alpha Island. The Alpha Island nuclear weapon, stated at the time to be 60 kilotons (Kt), was the largest tested anywhere in Australia (AIRSC 1983, Western Radiation Services 1993). However, the actual yield was 98 Kt. Since the test yield broke an assurance made personally by Prime Minister Anthony Eden of the United Kingdom to prime Minister Robert Menzies of Australia that the yield would not exceed 2.5 times that of the 1952 test (thus about 62 Kt), the true yield was concealed until 1984 ('British Nuclear Testing' at http://www.enviroweb.org/issues/nuketesting/hew/Uk/). During the tests the islands were occupied and many kilometres of temporary roads and other facilities were constructed. Structures and considerable amounts of rubbish from this period remain on the islands.

The islands were officially a prohibited area, controlled by the Commonwealth, until 1992, when they were returned to State control and declared a Conservation Park. There is residual, low level radiation from nuclear weapons tests on Trimouille and Alpha Islands. Landings on these islands should be restricted to one hour, there should be no soil disturbance and no metal objects should be handled or removed. Signs are erected providing information about radiation, but may be missing after cyclones. Further information on radiation hazards can be obtained from the Department of Conservation and Land Management, PO Box 835, Karratha, WA 6714, telephone + 8 9143 1488.

There was no Aboriginal occupation of the islands at the time of European exploration. The first European visitors were Thomas Bright and the survivors of the *Tryal*, wrecked on Tryal Rocks in May 1622. Nicholas Baudin named the outer islands in 1801. Phillip Parker King visited in HMS *Mermaid* in 1818 (King 1826) and J. Lort Stokes in HMS *Beagle* in 1840. At this time hydrographic surveys were carried out, and some natural history observations made (Stokes 1846). Thomas Haynes lived on the islands for some years from 1884, experimenting with pearl oyster cultivation, and in his spare time gathered samples of the flora and fauna, which were sent to the British Museum (Montague 1914).

In 1912, P.D. Montague (1914) carried out a biological survey, under the auspices of the Royal Society of London. His collections are in the British Museum. The next visitor who published natural history observations was Keith Sheard, who made a brief visit in August 1950 (Sheard 1950). Frank Hill (1955), who was part of the support party for the first nuclear weapon test, published natural history notes made in 1952. Dominic Serventy and Jock Marshall visited in 1958 to re-examine the natural history following the nuclear explosions (Serventy and Marshall 1964). Harry Butler made some observations in 1966 when an exploratory oil well was drilled on Trimouille Island (Butler 1967). Andrew Burbidge reported on biological survey work in 1970 and 1971, conducted by the then Department of Fisheries and Fauna, the 1971 trip being in association with Harry Butler and West Australian Petroleum (Burbidge 1971). Since then, there have been several visits by CALM staff and others, but little of this information is readily available. Morris (1991) summarized the values of the area and outlined management proposals, as required by the Commonwealth Government before the return to State control.

In 1996, Phase 1 of CALM's *Montebello Renewal* (a 'Western Shield' project) was carried out (Burbidge 1997). Phase 1 was the eradication of the Black Rats (*Rattus rattus*) from the archipelago. Biological survey work preceded this project, being carried out mainly in May-June 1994, and an experimental rat baiting project was conducted in August 1995. Follow up surveys in July 1997 and June 1998 resulted in the collection of more natural history data.

This paper summarizes current information on terrestrial vertebrate animals. Primary responsibility for the sections is Mammals – A.A. Burbidge; Birds – A.A. Burbidge, J.D. Blyth, P.J. Fuller and F.J. Stanley; Reptiles – P.G. Kendrick and L.A. Smith.

MAMMALS

Records of mammals commenced with the visit of HMS *Beagle* in 1840 (Stokes 1846). Montague (1914), Hill (1955), Serventy and Marshall (1964) and Burbidge (1971) also recorded mammal observations.

Isoodon auratus GOLDEN BANDICOOT

Hermite

Recorded on Hermite Island by Montague in 1912 (Montague 1914). Montague found recent remains, including shrivelled skins, and concluded that the species had become locally extinct only recently. He stated 'The cats have evidently been responsible for its extermination' (p. 631) and reported that the skulls corresponded with the Barrow Island subspecies *I. a. barrowensis*. Reported to be absent by Sheard (1950) and subsequent visitors.

[*Bettongia lesueur*] [BOODIE]

Serventy and Marshall (1964) found a lower jaw on Hermite Island in 1958. They postulated that, because of the condition of the bone, the species must have survived on the island until early in the 20th Century. Montague did not locate Boodies in 1912, nor did any other visitors, nor is there any sign of old warrens. Burbidge (1971) suggested that the presence of a single bone was insufficient evidence that the species occurred at the

Montebellos, as it could have been carried from Barrow Island by a Sea-Eagle. Serventy and Marshall were not aware that Boodies occurred on Barrow Island.

Lagorchestes conspicillatus SPECTACLED HARE-WALLABY

Hermite, Trimouille

Montague (1914) found this species on Hermite Island, stating that 'In its habits it is nocturnal, hiding by day amongst the thick *Spinifex*-tufts, and coming out just after sunset to feed upon the bark and young shoots and foliage of various herbs and bushes. It is unlikely that it will exist for many years longer, as it is one of the most defenceless animals that can well be imagined. It is easily dislodged from its hiding-place among the *Spinifex*, from which it often rises in an awkward fashion, tripping up and rolling over before getting away. Though it is able to hop swiftly for a short distance, it rapidly becomes exhausted, and is not difficult to obtain by simply running after it and catching it by the tail. ['*Spinifex*' is now *Triodia.*]

'The breeding-season appears to be during the summer and is possibly dependent upon the rains, for we saw no half-grown specimens, and as the rains the previous summer had failed, they may not have bred at all. It is possible, however, that the cats had accounted for all the young ones' (pp. 630–631) and 'The cats which have been introduced into Hermite Island appear to be breeding rapidly; wherever introduced they soon become exceedingly shy and wary, and grow to a large size. They will, no doubt, in a few years time have accounted for the wallabies, as they have for the bandicoots. If they cannot kill a full-grown wallaby—though I am inclined to believe they do—they make short work of the young ones' (p. 632). No hare-wallabies were seen by Sheard (1950), or by subsequent visitors.

Stokes (1846) stated that this species occurred on Trimouille Island at the time of his 1840 visit, reporting that 'Mr Fitzmaurice having seen plenty of wallaby on the larger islands, a party of us went ashore in the evening...' (p. 212). 'We found that Tremouille [sic] was as scantily supplied with vegetation as Barrow's Island; in one or two places was growing a stunted kind of wood, sufficient for fuel for a small sized ship; but there was no sign of water. The wallaby, which were very numerous, must have got their supply of moisture from the copious dews. They were found lying very close in the wiry prickly grass, allowing us to kick them out, when they went off at speed, affording excellent sport, quite equal to any rabbit shooting; among three guns we managed, in a couple of hours, to *bag* nearly twenty. It was a new kind of wallaby, and has been classed, from a specimen we brought away, as Lagorchester Conspicillata. It had a blunt nose, similar to those at Barrow's Island, and was about the same size, though its colour was lighter, and it had a back exactly like a European hare. The tail tapered away like a rat's, and the flesh was by no means good to eat, tasting very strong; this was the only instance in which we found wallaby at all unpalatable.' (p. 213)

Because Montague found Hare-wallabies only on Hermite Island, he suggested that this might also have been Stokes' locality, as old charts showed the Montebello group as a single island named Trimouille. However, a reading of Stokes shows that he realised this and that he left one of his officers, Fitzmaurice, in a boat to examine the Montebellos and to prepare new hydrographic charts of the area while the *Beagle* went to Barrow Island, so it is most unlikely that he would have made such a mistake. The Natural History Museum, London, has a skull of *L. conspicillatus* from Trimouille Island purchased from John Gould and registered in 1846 (specimen number 1846.4.4.26) (Jenkins[1] personal communication). Although there is no information on collector or date of collection, this is almost certainly the specimen 'brought away' by HMS *Beagle*.

[*Lagorchestes hirsutus*] [MALA, RUFOUS HARE-WALLABY]

Thirty Mala (20 females, 12 with pouch young, and 10 males) were introduced to Trimouille Island on 19 June 1998. These animals came from the 'Mala Paddock', a 1 km^2 fenced area in the Tanami Desert, Northern Territory and were translocated as part of an approved Translocation Proposal, developed as part of the Mala Recovery Plan. On 8 August 1998, radio-tracking showed that 28 were alive and one was dead; one transmitter was not located (Burbidge *et al.* 1999). Morris[2] (personal communication) located about 20 transmitters during the first week of January 1999; none of these was in mortality mode. In June 1999, radio-tracking and searching located 24 live and one dead Mala with transmitters, plus two additional adult Mala – one that had probably survived from the pouch young introduced in 1998 and one that had been conceived on the Island. The thick vegetation precluded searching for new animals over most of the Island.

Hydromys chrysogaster RAKALI OR WATER-RAT

Hermite, Trimouille, Alpha

Butler (1967, 1970) recorded tracks on Trimouille Island in 1966 and tracks identified as being from this species were found on Hermite Island in 1971 (Burbidge 1971). Morris (personal communication) recorded tracks on Alpha Island in 1983. It has not been reported since, despite extensive searches for it in 1994, and checks of beaches for tracks since.

Rattus rattus BLACK RAT

Most islands

Montague found this introduced species to be very common on many islands during his 1912 visit and attributed its presence to a pearling schooner wrecked about 20 years before his visit. Because of its extensive distribution in 1912, it is likely that this species established earlier than 1890, having escaped from careening and stranded pearling vessels, which were active in the archipelago from the 1840s.

[1] Paula Jenkins, Mammal Group, Department of Zoology, The Natural History Museum, Cromwell Road, London SW7, United Kingdom.

[2] Keith D. Morris, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065

Hill (1955) did not find evidence of rats on Hermite Island during his 1952 visit, although they were relatively common there in 1971 (Burbidge 1971). Between 1994 and 1996 we recorded rats on nearly every island and vegetated islet in the group, except South East and Karangi. They were common on islands as small as Ivy and 'Bloodwood'; but density was much lower on Hermite Island than on many other islands, possibly because of predation by cats. Hill recorded rats on South East Island, but Morris (personal communication) found none in May 1983, so local extinctions and re-invasions have apparently occurred.

Monitoring in 1997 and 1998 suggested that the 1996 rat eradication project, Phase 1 of *Montebello Renewal* (Burbidge 1997), had been successful, although further monitoring will be required before rats can be finally declared absent. Monitoring in 1999 showed evidence of rats on three islands: Hermite (1022 ha), Campbell (47 ha) and Delta (38 ha). The latter two islands were re-baited during winter 1999 and Hermite and adjacent islands were aerially baited in October 1999.

Mus domesticus HOUSE MOUSE
Hermite, Trimouille
Morris (personal communication) found a skull of this species in a Feral Cat scat on Hermite Island in June 1983. The identification of the skull was confirmed by the Western Australian Museum; however, the Museum did not retain the specimen. One volunteer saw an animal he thought was a mouse on Trimouille Island in 1996. In June 1998, P.J. Fuller saw a mouse on Trimouille and we subsequently observed mouse tracks at Cocoa Beach and near Balfour Point. It seems likely that mice numbers were previously kept very low because of predation by rats. Following the good seasons in 1998/1999, a mouse plague seems likely. Mice may occur on other islands in the group.

Vespadelus finlaysoni FINLAYSON'S CAVE-BAT
Hermite, Trimouille, Delta
Collected or observed by Montague (1914), Hill (1955), Butler (1967) and Burbidge (1971) on Hermite and Trimouille Islands. Observed in a cave on Delta Island in 1955 and 1994. A single larger bat, possibly a *Taphozous*, was observed in this cave in 1994, but was not captured.

Felis catus FERAL CAT
Hermite, Trimouille
Montague recorded cats on Hermite Island and he attributed the recent extinction of the Golden Bandicoot to their presence. Sheard (1950) and Hill (1955) also found cats on Hermite, but Burbidge (1971) reported them on Trimouille Island as well. During work between 1994 and 1998, we found cats only on Hermite. People working on the rat eradication project in 1996 repeatedly walked 50 m grids on all the larger islands, so it is most unlikely that we would have missed cat tracks or droppings.

Aerial baiting on Hermite Island in August 1996, using kangaroo meat sausage baits injected with '1080' poison, did not result in any reduction of cat tracks on monitored swept areas.

In June 1999, aerial baiting, using kangaroo meat baits further developed by Dr David Algar (CALMScience Division), eliminated all but four Feral Cats on Hermite island. These were trapped over the next six weeks.

Discussion

Two species of terrestrial, non-volant mammals were recorded at the Montebello Islands in the 19th and early 20th Centuries: *Isoodon auratus* (Hermite Island) and *Lagorchestes conspicillatus* (Hermite and Trimouille Islands); however, both are locally extinct. That the extinctions were caused by Feral Cats and Black Rats there can be little doubt: Burbidge, Williams and Abbott (1997) report a close correlation between the extinction of native mammals on Australian islands and the introduction of exotic mammals. Both species occur on Barrow Island and re-introduction to Hermite Island, once the Feral Cats have been eradicated, is planned.

Finlayson's Cave-bat is moderately common in the archipelago and other bat species may occur as well.

Of the exotic mammals, the Black Rat was most widespread, occurring on almost every island and vegetated islet in the group. Feral Cats, first reported on Hermite by Montague in 1912, are still present there. The only record on Trimouille Island (Burbidge 1971) was of a single animal and it is possible that one animal found its way there from Hermite or was introduced from a boat and has subsequently died. Cats may have found their way to Trimouille before: the local extinction of *Lagorchestes conspicillatus* on Trimouille sometime between 1840 and 1912 could have been caused by cats that subsequently died out, although extirpation owing to rats alone can not be ruled out.

BIRDS

Introduction

Records of birds at the Montebellos commenced with the work of Montague (1914), who visited the islands in 1912. Others to publish information on birds were Sheard (1950), Hill (1955), Serventy and Marshal (1964), Butler (1967), Burbidge (1971) and Abbott (1979, 1982).

We observed birds during our visits between 24 May and 8 June 1994, 14 August and 25 August 1995, 30 May to 2 September 1996, 14 July to 1 August 1997 and 9 June to 1 July 1998. Other records were obtained from CALM files.

Coturnix ypsilophora BROWN QUAIL
Moderately common on Hermite and Trimouille Islands. Occasional deserted clutches of eggs seen on both islands in 1994.

Puffinus pacificus WEDGE-TAILED SHEARWATER
Breeding on Ah Chong (*c.* 1000 pairs), 'Gossypium' (*c.* 100–150 pairs), Alpha (10 pairs), 'Birthday' (40–50 pairs), 'Beaufortia' (2–10 pairs), Brooke (*c.* 200 pairs), Flag (200–300 pairs), Gardenia (*c.* 300 pairs) and South East (*c.* 1700 pairs) Islands. Seen at sea near islands.

Puffinus huttoni HUTTON'S SHEARWATER
Eight mummified specimens were picked up on Trimouille and North West Islands in 1996.

Sula leucogaster BROWN BOOBY
Moderately common. Ones and twos seen in protected waters and adjacent seas.

Phalacrocorax carbo GREAT CORMORANT
Uncommon. Three birds seen in 1996.

Phalacrocorax varius PIED CORMORANT
Moderately common. A colony of 10 to 20 nests with eggs on one of the 'Karri Islands' on 26 June 1996.

Fregata ariel LEAST FRIGATEBIRD
Single female seen at Hermite Island on 17 June 1998.

Pelecanus conspicillatus AUSTRALIAN PELICAN
Moderately common. Small flocks occasionally present in protected bays.

Egretta novaehollandiae WHITE-FACED HERON
Uncommon. Several sightings in 1994 and 1998.

Egretta sacra EASTERN REEF EGRET
Common, mostly grey-phase birds. A single nest on 'Bloodwood' Island on 14 August 1996 had two eggs. On Buttercup Island three unused nests were located in August 1996. Montague (1914) also commented on the preponderance of grey-phase birds.

Ardea alba GREAT EGRET
Recorded by Burbidge (1971).

Butorides striatus STRIATED HERON
Two records. Buttercup Island, 1996 and Brandy Bay, Hermite Island, 1998.

Nycticorax caledonicus NANKEEN NIGHT HERON
Uncommon. Single bird seen in mangroves on Gardenia Island in 1994.

Pandion haliaetus OSPREY
Common. Breeding on numerous islands and islets. Eighteen nests were reported in use during 1996.

Elanus notatus BLACK-SHOULDERED KITE
Moderately common on all larger islands.

Hamirostra melanosterno BLACK-BREASTED BUZZARD
Single bird on Trimouille Island, 1997. Also recorded by Burbidge (1971).

Haliastur sphenurus WHISTLING KITE
Uncommon. Recorded by Burbidge (1971).

Haliastur indus BRAHMINY KITE
Moderately common. Breeding in mangroves on Crocus Island in 1994.

Haliaeetus leucogaster WHITE-BELLIED SEA-EAGLE
Three or four pairs seen in the archipelago each year from 1994 to 1998. Breeding recorded on Hermite (no date, Storr 1984), South East (1994), Trimouille (1985 and 1996), North West (1985), and Brooke (1996, 1997).

Circus assimilis SPOTTED HARRIER
Moderately common. Often seen hunting over larger islands.

Circus approximans SWAMP HARRIER
Uncommon. Recorded on Hermite, Bluebell and Ah Chong Islands. Two or three seen on every visit to Ah Chong in 1996. Both adults and juveniles present. This species is uncommon in the Pilbara and its presence at the Montebellos was unexpected.

Falco peregrinus PEREGRINE FALCON
Uncommon. Single bird on Ah Chong I, 1994.

Falco longipennis AUSTRALIAN HOBBY
Uncommon. Single bird on Ah Chong, 1996.

Falco cenchroides NANKEEN KESTREL
Common, all larger islands.

Limosa lapponica BAR-TAILED GODWIT
Common.

Numenius madagascariensis EASTERN CURLEW
Rare.

Numenius phaeopus WHIMBREL
Moderately common.

Tringa nebularia GREENSHANK
Moderately common.

Actitis hypoleucos COMMON SANDPIPER
Moderately common.

Heteroscelus brevipes GREY-TAILED TATTLER
Common.

Arenaria interpres RUDDY TURNSTONE
Moderately common.

Calidris canutus RED KNOT
Uncommon.

Calidris acuminata SHARP-TAILED SANDPIPER
Uncommon.

Calidris ruficollis RED-NECKED STINT
Moderately common.

Calidris ferruginea CURLEW SANDPIPER
Uncommon.

Esacus neglectus BEACH STONE-CURLEW
Common. About 12 to 15 pairs resident in archipelago between 1994 and 1998. Storr (1984) reported breeding on Trimouille Island but provided no details. We found a scrape ready for eggs on one of the 'Marri Islands' on 15 August 1996.

Haematopus ostralegus PIED OYSTERCATCHER
Common. Present on all beaches and mudflats. Breeding on Alpha 26 May 1983 and 'Renewal' (eggs) on 22 August 1995.

Haematopus fuliginosus SOOTY OYSTERCATCHER
Common; the Montebellos are a minor stronghold for this comparatively uncommon species. Breeding on Bluebell (single egg) on 15 August 1996. Nest was a scrape on beach.

Pluvialis squatarola GREY PLOVER
Uncommon.

Charadrius ruficapillus RED-CAPPED PLOVER
Moderately common

Charadrius leschenaultii GREATER SAND PLOVER
Uncommon.

Charadrius mongolus LESSER SAND PLOVER
Recorded by Montague (1914).

Larus novaehollandiae SILVER GULL
Common. A late summer and autumn breeder. Breeding on Brooke (recent nests, broken eggs on 25 May 1994 and *c.* 200 fledging chicks on 16 March 1997), 'Birthday' (4 old nests 25 May 1994), Gardenia (broken eggs on 31 May 1994), 'Renewal' (single fledgling, 4 June 1994), and South East (1000–1500 birds, three nests with eggs located, 28 May 1994).

Sterna caspia CASPIAN TERN
Common breeding resident. Breeding recorded on Ah Chong, Alpha, Bluebell, Dandelion, Flag, Foxglove, Islet to south of Hermite, Ivy, 'Kunzea', Marri Islands, Primrose and 'Renewal' and Trimouille. Breeding protracted with eggs between late April and August.

Sterna dougallii ROSEATE TERN
Common breeding resident with many thousands of birds present in 1994, 1995, 1996 and 1997. Not present in 1998. Autumn-winter breeder. Breeding recorded on Dahlia, Dandelion, 'Pimelia', 'Myoporum', Gannet, islet to the north of Gannet, 'Fig Islands', and 'Bloodwood'. Colonies from 6 pairs (Dandelion) to more than 2000 ('Bloodwood'). Eggs recorded in May. The colony on 'Bloodwood' Island in 1996 was abandoned by the adults and many dead chicks were found that had been eaten by rats. No breeding colonies located in 1997.

Sterna anaethetus BRIDLED TERN
No birds seen during our visits. Presumably a summer breeder. Evidence of breeding (broken eggs, dead runners, stunted non-flying fledged bird) found during winter trips on Dahlia, 'Gossypium', and South East. Juveniles present on rocky islets south of Hermite on 4 April 1971 (Burbidge 1971). Storr (1984) reported breeding but provided no additional information.

Sterna fuscata SOOTY TERN
Two mummified adults found on South East Island, 28 May 1994.

Sterna nereis FAIRY TERN
Breeding resident. A colony of 315 nests with eggs and six small chicks on 'Fairy Tern Island' on 15 August 1996 and a colony on the same island just commencing egg-laying on 28 June 1998. A colony of about 102 pairs (new scrapes, eggs, small chicks) on 'Hibbertia' Island on 27 July 1997.

Sterna bergii CRESTED TERN
Common. Breeds in some years. Breeding recorded on an islet to the north west of Bluebell (30 pairs, no date), 'Birthday' (70 pairs, 29 May 1994, addled eggs and broken shells), and on Daisy (5000–6000 pairs), Epsilon (*c.* 3500 pairs) on 28 May 1994. In August 1995 the remains of a large colony (estimated to have been about 1500 pairs) was located on Flag Island. Many mummified, partly buried, nearly fledged chicks were seen. This colony was presumably wiped out by Cyclone Bobby which passed near the Montebellos on 24 February 1995. As the eye of the cyclone was unusually slow moving, the severe winds persisted for a much longer period than normal (Bureau of Meteorology[3], Perth, personal communication). No breeding recorded in 1996 or 1997.

Sterna bengalensis LESSER CRESTED TERN
Uncommon. Several pairs observed among a large colony of Crested Terns on Daisy and Epsilon Islands in May 1994 may have been breeding. Because of the presence of large runners, this colony could not be examined closely.

[3] Regional Director, Bureau of Meteorology, PO Box 1370, West Perth, WA 6872.

Anous stolidus COMMON NODDY
Uncommon. Small roosting flocks occasionally seen on outer rocky islands.

Geopelia humeralis BAR-SHOULDERED DOVE
Common. Mainly around mangroves (where it roosts) and feeding among sand dunes. Old nest seen in mangroves at Brandy Bay, Hermite Island, in 1998.

Cuculus pallidus PALLID CUCKOO
Single bird on Hermite I in June 1994.

Cuculus basalis HORSFIELD'S BRONZE-CUCKOO
Recorded by Montague (1914).

Halcyon sancta SACRED KINGFISHER
Uncommon. Mangroves.

Halcyon chloris COLLARED KINGFISHER
Uncommon. Recorded by Montague (1914) and Hill (1955), but no recent reports.

Malurus leucopterus edouardi BLACK-AND-WHITE FAIRY-WREN
Extinct. Recorded on Trimouille Island by Sheard (1950). Not seen before or since.

Lichmera indistincta BROWN HONEYEATER
Common in mangroves.

Epthianura tricolor CRIMSON CHAT
Recorded by Montague (1914).

Pachycephala rufiventris RUFOUS WHISTLER
Recorded by Montague (1914).

Grallina cyanoleuca MAGPIE-LARK
A party of about six birds present for a short time in June 1996.

Rhipidura leucophrys WILLIE WAGTAIL
Uncommon. Three sightings in 1994.

Lalage sueurii WHITE-WINGED TRILLER
Uncommon. Two sightings in 1994.

Artamus leucorhynchus WHITE-BREASTED WOODSWALLOW
Common, especially around mangroves, but also hawking over larger islands.

Anthus novaezeelandiae RICHARD'S PIPIT
Common.

Taeniopygia guttata ZEBRA FINCH
Recorded by Montague (1914) on Trimouille and South East Islands. Geoff Kregor[4] (personal communication) saw 'hundreds' on Hermite Island between 26 and 30 August 1998.

Hirundo neoxena WELCOME SWALLOW
Common.

Cecropis nigricans TREE MARTIN
Common to uncommon in different years. Recorded over larger islands.

Eremiornis carteri SPINIFEXBIRD
Extinct. Recorded on Hermite Island by Montague (1914) and on Trimouille Island by Sheard (1950). Montague erected a new subspecies for the Hermite Island specimens based on 'its smaller size, proportionately larger bill, and in the colour of the head, which is a deeper and richer chestnut-brown.' Not seen by later observers.

Zosterops lutea YELLOW SILVEREYE
Common in mangroves.

Discussion

In all, some 70 species of birds have been recorded in the Montebellos. They comprise 42 sea and shore birds and 28 land birds. The breeding seabirds of the Montebellos have been summarized by Burbidge and Fuller (in press). Among the shorebirds, the relative abundance of Sooty Oystercatchers and Beach Stone-Curlews has been noted above.

Based on our observations between 1994 and 1998, some of the land birds are vagrants or passage migrants: Peregrine Falcon, Australian Hobby, Pallid Cuckoo, Horsefield's Bronze-Cuckoo, Crimson Chat, Rufous Whistler, Magpie-Lark, Willie Wagtail, White-winged Triller, Tree Martin and Zebra Finch. Resident land birds during this period were Brown Quail, Black-shouldered Kite, Spotted Harrier, Nankeen Kestrel, Bar-shouldered Dove, Brown Honeyeater, White-breasted Woodswallow, Richard's Pipit, Welcome Swallow and Yellow Silvereye.

Notable differences between the avifauna of the Montebellos and Barrow Island include the presence at the Montebellos of the Brown Quail and Marsh Harrier and the absence of the Singing Honeyeater, which is common at Barrow Island (Butler 1970; AAB personal observations). Both the Spinifexbird and the Black-and-white Fairy-wren are common breeding residents on Barrow.

Three species of land bird have apparently become locally extinct at the Montebellos. The Black-and-white Fairy-wren was recorded on Trimouille Island by Sheard (1950) but not by Montague in 1912, nor by Hill in 1952 or other later observers. Sheard (*op. cit.*) also recorded this species on Sholl Island, but recent surveys there have failed to locate it (FJS, unpublished). It seems strange that Montague did not record this distinctive species and a concern that Sheard misidentified it must remain.

The Spinifexbird was recorded by Montague in 1912 'principally upon the *Spinifex*-plains [i.e., *Triodia* hummock grassland] of Hermite, where it is common' (p. 634), and by Sheard on Trimouille in 1950. Montague

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visited Trimouille Island but did not record it. The species was not recorded by Hill in 1952, nor by later observers. It seems likely that, on Hermite Island, it was exterminated by the feral cats and/or rats and, on Trimouille Island, if it did occur there, by the atomic weapon test in 1952, which significantly affected most, if not all of the island (see Cathcart 1994).

Johnstone (1990), in commenting on the lack of records of the Mangrove Kingfisher from the Montebellos since 1952, suggested that atomic weapons testing may have destroyed much of their habitat. While the weapons testing did destroy mangroves on Trimouille Island, the larger stands in Stephenson Channel, Hermite Island, were not affected. Montague collected juvenile birds in 1912, so it was a breeding species in 1912. The reasons for its disappearance are unknown.

REPTILES

Montague (1914) was the first to describe the reptile fauna of the Montebello Islands, resulting from collections undertaken between May and August 1912. Hill (1955) made additional collections during the period of British nuclear weapons testing, between August and October 1952. These records, together with those of Butler (1967), collected in 1966 and lodged in the Western Australian Museum, were summarized by Burbidge (1971), who reported the results of collections made from Trimouille, Hermite, Campbell, Alpha, North West, Primrose and Bluebell Islands in 1970.

With the exception of opportunistic collections during brief visits by biologists and others, no further documentation of the reptile fauna of the Montebellos was undertaken until 1994, when CALM staff established 11 pit trap sites on nine islands. This trapping was undertaken prior to the eradication of black rats from the archipelago in 1996. This paper reports the results of those 1994 collections, and summarizes current knowledge of the reptile fauna of the Montebello Islands.

No systematic pit trapping had been undertaken on islands of the Montebello group prior to 1994. In that year, pit trap sites were established at three locations on Hermite, and on Ah Chong, Alpha, Bluebell, Brooke, Crocus, Delta, North West and Primrose Islands. These were open between 22 May and 7 June.

Pit traps were 20 litre ultraviolet-stabilized plastic buckets, with lids, and were placed in sandy habitats where soils were deep enough to sink the traps. Ten pits were placed at each location, in an array of five pairs, with pits from each pair located 5 m apart. Each pair of pits was separated by 15–20 m from adjacent pairs. Pairs of pits were traversed by a single 10 m aluminium fly-wire drift fence. Some pits were placed as close to rocky habitats as possible. When not in use, the pits were capped and buried.

Pit traps were run on two occasions for a minimum of four nights during each period. In addition to pit trapping, searching in litter, soil and under debris was also undertaken. Some night searching was also undertaken at sites on Hermite. Larger reptiles were sometimes captured in Elliott traps.

CHELONIIDAE

Caretta caretta	LOGGERHEAD TURTLE
Chelonia mydas	GREEN TURTLE
Eretmochelys imbracata	HAWKSBILL TURTLE
Natator depressus	FLATBACK TURTLE

Sea turtles are common in waters surrounding the Montebello Islands, and significant sea turtle nesting beaches occur on the Montebellos and nearby island groups. Green turtles (*Chelonia mydas japonica*), hawksbills (*Eretmochelys imbricata*) and flatbacks (*Natator depressa*) are known to nest on the Lowendal Group, while green and flatback turtles nest on Barrow Island. All three species above, and loggerhead turtles (*Caretta caretta*), are known from waters around and near to the Montebello Islands. However, while turtle nesting occurs on islands of the Montebello group, detailed information regarding species and locations is not available. Leatherback turtles (*Dermochelys coriacea*) may also occur in waters surrounding the Montebellos.

GEKKONIDAE

Diplodactylus jeanae
Hermite
Collected from sandplain habitat on Hermite Island, in May 1994.

Gehyra pilbara
Hermite
Known to inhabit the galleries of giant termite mounds throughout the Pilbara, the occurrence of this species on Hermite Island is probably linked to the presence of many large termite mounds. It was not detected on Alpha Island, where termite mounds also occur. Montague (1914) found this species to be common on Hermite. The five specimens identified as *Gehyra australis* in Burbidge (1971) have been re-identified as *G. pilbara*

Gehyra punctata
Trimouille
Collected from Trimouille in 1970 by Burbidge, but not recorded since. Generally an inhabitant of rocky habitats, it may still be present on Hermite and other smaller rocky islands.

Heteronotia binoei
Ah Chong, Alpha, Brooke, Crocus, Hermite, Primrose, Trimouille
A common species readily pit trapped, but also encountered under rocks, litter, logs and debris.

PYGOPODIDAE

Aprasia rostrata rostrata
Hermite
Known from a single specimen collected in 1952, the Hermite subspecies of *A. rostrata* has not been sighted since. Despite pit trapping and intensive hand searching in

soil under litter, rocks and debris, no specimens were caught. However, owing to the cryptic nature of the genus, it is possible that it still occurs on Hermite. Further survey effort will be required before any definitive statement regarding the present status of *A. r. rostrata* can be made. Storr *et al.* (1990) considered the Hermite specimen to be a full species (*A. rostrata*).

Delma borea
Hermite
Collected in 1970, and not seen since.

Delma nasuta
Hermite
Collected in 1970, and not seen since.

Lialis burtonis
Alpha, Hermite
Lialis was recorded in 1952 from the 'Montebello Islands', without a specific island locality. Pit trapped on Alpha and Hermite Islands in 1994.

AGAMIDAE
[*Ctenophorus c. caudicinctus*]
Listed by Hill (1955), with no additional information. No other records of this species have been made on the Montebello group, although it is very common on the adjacent Pilbara coasts and hinterlands. It is possible that this record is erroneous, or that a *C. caudicinctus* individual was inadvertently transported to the Montebellos on one of the vessels supplying the nuclear weapons program from Onslow, and subsequently observed or captured.

Gemmatophora gilberti gilberti
Ah Chong, Hermite
Very common on both Ah Chong and Hermite Islands, particularly behind mangrove areas on the latter, and sandy beaches with rocky cover nearby. Montague (1914) noted that this species was very abundant on Hermite (listed as *Physignathus gilberti*), and was present 'on nearly all the other islands'. The 1994 survey found this species only on Hermite and Ah Chong. This may indicate local extinctions from some of the islands in the group since Montague's visit in 1912, possibly owing to the presence of rats, or the episodic presence of cats.

VARANIDAE
Varanus acanthurus
Hermite
Recorded only from Hermite Island. Appeared to be common around rocky areas, particularly near mangrove or coastal areas.

Varanus gouldii
Alpha, Bluebell, Hermite, Trimouille, tracks on Campbell, Delta, North West, Primrose.
Very common on Trimouille, where black rats appeared to be a major diet item until their eradication in 1996. This species was also relatively common on Alpha and Bluebell Islands. *Varanus gouldii* is uncommon on Hermite, where a specimen was taken by Butler in 1984. Neither specimens nor tracks were recorded on Hermite during the 1994 survey.

Montague noted that *V. gouldii* was abundant 'over the whole Monte Bello Group', and Hill (1955) noted that they were common on Alpha, South East, North West and Trimouille. While the 1994 survey did not visit South East, tracks of *Varanus* sp. were observed on Campbell, Delta, North West and Primrose. While no specimens were secured, the location and nature of the tracks indicated that they were made by *V. gouldii*, or a similar species. Until confirmed otherwise, they are assumed to be *V. gouldii*. This large lizard is capable of swimming between islands of the archipelago.

SCINCIDAE
Ctenotus saxatilis
Ah Chong, Alpha, Bluebell, Brooke, Campbell, Crocus, Delta, Hermite, North West, Primrose, Trimouille
No other species of reptile was found on so many islands as *C. saxatilis*. It was very conspicuous, and was commonly caught in Elliott traps. It is probably present on all islands of reasonable size. Montague (1914) noted that they were common 'on all the larger islands' (listed as *Lygosoma leseurii*).

Glaphyromorphus isolepis
Ah Chong, Alpha, Bluebell, Campbell, Crocus, Delta, Hermite, North West, Trimouille
Almost as widespread as *Ctenotus saxatilis*; the more cryptic nature of this species may have meant that it was not detected in some instances. Montague noted that this species was common only on Hermite (listed as *Lygosoma isolepis*).

Morethia ruficauda exquisita
Hermite
Collected from Hermite Island in 1970 and 1993. This is a highly visible and unmistakable species, and if it were common it would have been recorded during the 1994 survey. It appears to be present at low density.

Lerista bipes
Ah Chong, Alpha, Bluebell, Brooke, Crocus, Delta, East Hermite, Hermite, North West, Trimouille
Common and conspicuous in sandy areas, particularly in beach dunes and near coastal sandplains. Large numbers of this species were pit trapped, and tracks were very common in some areas.

Lerista elegans
Bluebell, Hermite
Although apparently a common species on Hermite, where it was pit trapped on sandy substrates during the 1994 survey, only a single animal was trapped on Bluebell.

Lerista muelleri
Brooke, Hermite
Only two specimens were collected, indicating that this

species is probably uncommon on the Montebellos. This taxon is currently under review by one of the authors (LAS, in prep.). In WA, *L. muelleri* appears to be comprised of up to 15 species. The two specimens collected from the archipelago represent two undescribed species, both of which are widely distributed on the adjacent mainland.

TYPHLOPIDAE

Ramphotyphlops diversus ammodytes
Hermite
Recorded by Montague in 1912, in soil beneath a rock. This species has not been recorded from the Montebellos since.

BOIDAE

Antaresia stimsoni stimsoni STIMSON'S PYTHON
Hermite
Known only from Hermite. It was collected by Montague in 1912 and Butler in 1966, and reported by pearl farm operators in 1991. Observed on Hermite in 1996.

ELAPIDAE

Demansia rufescens
Hermite
Collected during the 1994 survey, and from the inter-tidal zone of Hermite in 1996.

Furina ornata
Hermite
Although the WA Museum collections have only one record of *F. ornata* from the Montebellos (collected in 1981), Hill recorded this species from Hermite in 1952 (listed as *Pseudelaps cristeanus*, and in Burbidge 1971 as *Brachysoma cristeanus*). No records have been obtained since.

HYDROPHIIDAE

Aipysurus laevis
Hydrophis major

Hydrophis ocellatus
A number of sea snake species are likely to occur in waters surrounding the Montebello group. The above three species in the collections of the WA Museum were taken near the Montebellos. Another seven are recorded from waters around Barrow Island: *Acalyptophis peronii, Aipysurus apraefrontalis, A. duboisii, Astrotis stokesii, Emydocephalus annulatus, Hydrophis elegans* and *Hydrophis kingii*. Examination of published distributions (Cogger 1996; Storr *et al.* 1986) indicated that a further three species may also occur in waters surrounding the Montebellos: *Aipysurus eydouxii, Hydrophis ornatus* and *Pelamis platura. Ephalophis greyi*, a mangrove specialist, may also occur in the archipelago.

Discussion

Twenty-one species of terrestrial reptile are known to occur on the Montebello Islands. It is immediately apparent that all but one species of reptile (*Gehyra punctata*) known from the Montebellos are present on Hermite Island. Hermite is the largest island in the group, and has by far the greatest shoreline. It has the full range of habitat types present on these islands, including large areas of sandplain, heavily eroded limestone uplands, and the largest areas of mangrove in the archipelago. However, the diversity of habitats alone is probably not sufficient to explain the apparent concentration of species onto this one island. During the 1994 survey, and possibly in the past also, collecting effort was greater on Hermite than elsewhere. Three pit trap sites were established on Hermite, while only one site was placed on other islands. No pit trapping at all was undertaken on Trimouille, despite its large size, owing to both logistical problems in accessing the sites by small boat and potential radioactive contamination of soil. In addition, field workers were accommodated on Hermite, meaning that opportunistic records made around camp contributed to Hermite's species tally.

The species detected are mostly those expected for islands of this size in this area. All but three species are known also from Barrow Island. Of these, one is endemic to the Montebellos (*Aprasia r. rostrata*), and one is a large varanid (Barrow supports *V. giganteus* instead of *V. gouldii*). The last, *Gehyra punctata,* is probably an example of a deletion or omission from the Barrow Island fauna at the time of or following its isolation. Given *G. punctata*'s known habitat preference for rocky areas, it is likely that this species is present but undetected on Hermite.

Aprasia rostrata is a poorly known species with a distribution restricted to the Exmouth Gulf area and Hermite Island. The Hermite subspecies, *A. r. rostrata,* is known only from a single specimen collected in 1952, and has not been recorded since. The presence of feral cats and black rats on the islands lead to fears that this population may have been adversely affected, possibly to extinction, by predation. However, while the recent failure to relocate this species on Hermite Island is discouraging, it is premature to suggest local extinction. *Aprasia* are highly cryptic animals, and further survey effort is required before the conservation status of this species can be determined.

It is certain that further visits to the Montebello group will yield additional records of reptiles. The presence of very large numbers of rats on Trimouille prior to the 1994 survey may have depressed numbers of native fauna to levels where they were not easily detected. The recent eradication of these rats may result in new records for Trimouille in the future. Likewise, more effort on the medium sized islands will undoubtedly result in additional records.

GENERAL DISCUSSION

Four species of native terrestrial mammals (two now extinct) and three species of exotic terrestrial mammals (one hopefully eradicated) have been recorded in the Montebello Islands in modern times. In addition, 21 species of terrestrial reptiles and 70 species of birds have

been recorded. Eight species of seabird have been recorded breeding. Only 10 of the 28 land bird species recorded are considered to be resident. One reptile subspecies (considered by Storr *et al.* 1990 to be a full species), *Aprasia rostrata rostrata*, is endemic to Hermite Island.

The terrestrial fauna of the Montebello Islands has been deleteriously affected by human activities, especially the introduction of Feral Cats and Black Rats in the 19th Century, and the testing of nuclear weapons in the 1950s. It is difficult to be precise about the effect of these disturbances as, although survey data are available from Montague's 1912 visit, there was little additional work until well after the weapons tests. It is clear that both native mammals disappeared before the tests, however, the evidence relating to the disappearance of the Black-and-white Fairy-wren and Spinifexbird is less clear. Both species existed on Hermite in 1912 and Hermite was little affected by the nuclear weapons tests, implicating rats and cats as a cause of local extinction. If either did occur on Trimouille Island, the weapons tests are the most plausible cause of extinction. The endemic legless lizard *Aprasia rostrata rostrata* has not been recorded since 1952, but this could be owing to its cryptic nature, as is probably the case for the lack of records of the blind snake *Ramphotyphlops diversus ammodytes* since 1912.

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